THE NAVIES OF BRITAIN AND FRANCE.

A portion of the French Press has latterly adopted a threatening tone towards England. Our occupation of Egypt has lasted too long, and has excited the jealousy of our neighbours. Hence we are told a war with England would be popular, seeing that "no general mobilisation would be necessary"—we quote from the *Standard*—"as an invasion of France was not to be apprehended, and any landing of a French army in England need not be contemplated. The object of the war should be to vindicate the rights and position of France as a Mediterranean Power, and to effect this only the navy, and perhaps a *corps d'armée*, certainly not more, would be needed. The landing of twenty or thirty thousand men in Egypt would not be a work of insuperable difficulty, and this would entail the capitulation of the small British force engaged there. That once effected, England would probably be glad to sue for peace, especially as her navy was not now in a position to cope with that of France." Taking this as a sample, it is interesting to examine the data on which the soundness of this statement can be tested; that is to say, to look briefly at the relative strength of the French and British navies, and at our general position in the Mediterranean. Lord Brassey's "Naval Annual," which is on the eve of making its appearance, deals with the relative strength of the fleets of Britain and those of other Powers, and puts a quantity of statistics in a compact form. Until this appears we must make the best of such information as we pick out and shape to our purpose.

The first part of the statement we quote we may pass over. We think with the writer that the British are not likely to invade France, and that the French are not likely to invade England. The matter to consider seriously is whether France could so easily dislodge us from Egypt by landing thirty thousand men in that country. There are three main elements in this question. (1) The relative strength of our fleets as to fighting power. (2) Power of organisation of transport. (3) The geographical position of our possessions and ports on the Mediterranean. These questions are too large to deal with except in the merest outline within the space at our command; but perhaps it may be useful to furnish this so far as means admit of it. We will commence with the fleets.

The statistics of the British and French fleets are singularly elastic. Experience has shown that with a purpose in view and a robust conscience a writer can classify the ships so as to show almost any result he likes. Sir Edward Reed, by reckoning only the citadels of our ships, and ignoring the whole tonnage outside the citadel, and by selecting a limit of 15in. thickness to the armour, which just took in the French Devastation and Foudroyant, and excluded our Devastation, Thunderer, and Dreadnought, was able to show in his first class 126,288 tons of French shipping against 51,570 British. On the other hand, we have seen the line drawn at such a point as to tonnage that the proportion may be reversed. Then the reckoning of coast defenders tells, and whether these should be taken into account depends on the operations contemplated. Again, in a short time the French wood built ships may be all out of the service; whether these should be reckoned or not depends on the date assumed in the argument. Any list of ships, then, is liable to objection on one or another ground. We submit lists of British armour-clad ships, which may, we think, be as fairly representative of their strength at the present moment as any we have seen. From this the British coast defenders of the Glatton class are omitted. The French are included as being available for European war generally. All ships launched since 1884, including five British and three French armour-clad vessels, are struck out, because they would not be completed in time for any war coming on us shortly. England had two ships launched in 1884, and one in 1883. France had four ships launched in 1883—France therefore gains by drawing the line at the end of 1884 rather than 1882. Drawing it at the end of 1883 would suit her best of all, so far as armour-clad ships are concerned. The list annexed shows thirty-two English and twenty-one French ships; the English tonnage being 250,640 tons and the French 163,790 tons. These lists may be modified more or less according to the view taken by any writer. We are inclined, however, to believe that no fairly drawn estimate *at the present moment* would represent the power of the French armoured fleet within 20 per cent. of the British. The proportion of our unarmoured cruisers is very nearly the same. The relative strength of the fleets varies slightly from year to year. On September 12th, 1884, we published a list showing these to be equal. This represented a probable condition at a certain future time, when vessels now building are completed, but not at the present moment; and it is a condition that will be soon affected by the additional ships laid down by our Government if they are pushed on. In fact, it was in the hope of a change of this kind that the impending state of matters was put forward by the press and afterwards by Sir E. Reed at the United Service Institution and in Parliament.

Assuming then that the British fleet of regular fighting ships is about 20 per cent. stronger than that of France, we may pass on to torpedo boats and lastly transport and troop ships. In the former we fear the French are considerably in advance of us, though we know of no recent statistics published on the subject, and progress is rapid in this branch of building. In transports, on the other hand, France is very weak; and, we think, depends a good deal on her Navy for carrying her troops, and as to supply of stores she is under difficulties. In Sir Nathaniel Barnaby's paper read at the United Service Institution, in 1883, the French steam merchantmen were shown as less than one-eighth of our own.

To place troops in Egypt the Frency Navy would have to force its way past our Mediterranean fleet, and make good a landing, which would constitute a serious operation of war. It seems to be thought in France that because their troops muster in hundreds of thousands, where our thousands are reckoned in tens and twenties, that they would compare with us equally well in sending an expedition consisting of thirty thousand men across the seas. This is a great error. We believe that our blows would be found far-reaching and quick, if not very heavy; and that no Power could carry out this class of undertaking with the ease and speed of England. Abyssinia, Ashanti, Egypt, and the Zula War have all called into play the necessary machinery for this class of operation, while such machinery is habitually working in India. At the present moment we have about thirty thousand men in Burmah. The state of the country, no doubt, has been the object of a considerable measure of public attention; but who has heard of any trouble or effort in sending the troops there, or supplying them? The French, who come next to ourselves, make more fuss about the transport of ten thousand men from Marseilles to Algiers than we do if we send double the number to the remotest habitable quarter of the globe.

It may be argued, however, that France lies between us and Egypt. To this we should promptly reply that practically we are between France and Egypt. It is only necessary to take a step forward to prove it. France, to send an army to Egypt, must get them past Malta and our Mediterranean Fleet, then land them. French writers appear to think that they could defeat our ships, a thought which we regard as only admissible on the supposition that they caught us at a disadvantage, and used torpedo boats with all the success that their advocates anticipate. It is necessary, however, to dispose of our fleet completely and beat us very badly to get their force landed. Whoever turns to a list of naval stations—say in the "Illustrated Naval and Military Magazine"—or picks it out of the "Navy List," will find in the Mediterranean at this moment the Dreadnought, the Agamemnon, Alexandra, Orion, Superb, Temeraire, and Polyphemus, with the Thunderer at Malta. These constitute a very awkward force to dispose of so completely that the whole expedition and its supplies can quietly go on and force a landing. The Polyphemus has 17 knots speed; if torpedo ships are to prove so good as to give the French a great advantage, what a very unpleasant adversary this vessel would be to a large and necessarily slow expedition. It is to be borne in mind that any delay either before or after war is declared, greatly increases the difficulty. India is a few days more distant from Egypt than France, but practically it is very much closer, seeing that forces and supplies could be poured in with the ease and security of peace operations before war was declared, and without much trouble after it. To land thirty thousand men in Egypt, then, France would have to muster her fleet unperceived in the Mediterranean, to make war without a week's notice, and then, without any delay, to destroy the British Mediterranean fleet entirely. Otherwise, she would be cut up at sea, and also have a force overmatching hers waiting for her in Egypt. It may be objected that part of such a force must consist of native troops, who would not face Europeans. The French have not found their own "Chasseurs Indigènes" much inferior to their own men when well officered and led, and they would be quite deceived if they reckoned on a moral advantage of this kind. In fact, if truth must be told, our Indian troops in China were anything but impressed with their French allies, and remarked that if these were Europeans, they would undertake to fight that kind of European at any time. This doubtless was the hasty impression produced on them by the small stature of the Frenchmen. Nevertheless, moral effect depends sometimes on positive error, and we are inclined to think that the most likely advantage the French might gain morally, would be in any idea that they might impress on their own men that they were going to engage only our native Indian troops. If it came to landing, undoubtedly moral effect has its weight. Marmont said that a battle was won not by the actual number of men killed but by the number of men frightened. It is said that when the French were falling back before Wellington, the "Rifles" were ordered to occupy a village held by the French. It was not in any way a strong or important post, and the Rifles were consequently amazed at the desperate resistance they encountered, and still more when the French re-formed, and most gallantly returned again and again in the endeavour to recapture the village. Eventually a wounded man explained that the new dark uniform of the Rifles had not been known, and that the French refused to be dislodged from a village by Portuguese, as they supposed. This incident, if accurately related, shows how very much harder Portuguese must have fought than English to gain a victory at that time.

To return to the general features of the question, we think that if our power of supplying Egypt from India, without disturbance or trouble, be compared with the project of the French crushing our fleet and landing and supplying an expedition from the Mediterranean it will be concluded that France could hardly devise an operation more calculated to fail than this attempt to drive us out of Egypt. Can it be that she reckons on the help of Italy? If so she has not gone the right way to get it. Does it not appear probable, on the other hand, that Italy would be more likely to go the other way? Sooner or later Italy fears the necessity of a war with France. Might she not hail this as a favourable opportunity? Italy has some splendid ships. It may be questioned if she could provide them with coal, for such a ship as the Italia devours monstrous quantities; but allied with us this difficulty would be met. We do not, however, wish seriously to press the consideration of Italy going to war, because the land fighting, where we could help her but little, would be too dangerous. Probably whenever Italy has to fight France she hopes it will be with continental allies.

We must, however, look at war with France in a general aspect. It does not at all follow because Egypt is the provoking cause, that the fighting need take place in Egypt. What if France declares war, and at once strikes us, where she of all Powers can hit hardest, in our soft place, our commerce? This we confess is a much more serious matter. This is the danger to which we and many in this country have long called attention. It is to meet this that we have latterly been so much more in earnest in building swift cruisers. Undoubtedly this is the question of the day as to England's defence, and in the case of France as the enemy, raised in its most serious shape. Suffering and loss would be entailed on England, but nothing decisive could be effected at once, and it is hard to say what would follow. It might be that gradually the French vessels would be captured. This is the more likely, as in order to stop our trade from the West they would have to act further from their base of operations than our own. Then again other nations would suffer as well as ourselves. When we find that seven-eighths of the carrying trade of the world is in British vessels, it exposes a very vulnerable object to attack undoubtedly, but at the same time an object that concerns the world generally, and not England only. Would the world put up with this? The world in the abstract is a useless element; but would the world remain in this abstract condition? We can well believe that some Powers are jealous of us, and would bear a good deal; but this is hardly true of all. America, for example, would suffer much, and apart from the Irish element, America would probably wish us well. At all events, the stoppage of the cotton trade to England would cause a serious pinch, and this might soon lead to sympathy, which would be the more valuable as it might take the shape at first of assistance by telegraph information and irregular means, and then possibly it might swell into something much more definite. The consideration of this, however, would draw us on into the discussion of a large question unconnected with the immediate subject of our article. A war in this shape with France would be serious enough. France herself would feel the stoppage of her trade sufficiently to prevent such a war being popular for long, in spite of the light-hearted way in which some French writers speak of it. We can only compare this language with the suggestion of some of our own officers that we have not sufficient ships, and that on that account we ought to have war with France, seeing that in times past our navy was largely strengthened by sources of supply found at the Nile and Trafalgar, adding that it is a fact that before these events it appeared as if our fleet was decidedly inferior to that of France both in number and quality. All this sort of language being put aside, war with France would be a grim and terrible thing. We have little doubt that there is too much good feeling and good sense in France to provoke such a catastrophe; but the bare possibility ought to spur us on to the construction of the classes of vessels specially suited to protect our commerce.

British Armour-clads available in the Immediate Future.

Name.	Date of launch.	Displacement.	Speed.	Maximum armour.	Armament. Primary guns.
		tons.	knots.	in.	
Hercules	1868	8,680	14·0	9	8—18-ton M.L.
Monarch	1868	8,320	14·9	10	2—24 ,,
Audacious	1869	6,010	12·8	8	10—12 ,,
Invincible	1869	6,010	14·1	8	10—12 ,,
Sultan	1870	9,200	14·1	9	8—18 ,,
Iron Duke	1870	6,010	13·6	8	10—12 ,,
Hotspur	1870	4,010	12·7	11	2—25 ,,
Swiftsure	1870	6,910	13·8	8	10—12 ,,
Triumph	1870	6,640	12·0	8	10—12 ,,
Devastation	1871	9,330	13·8	14	4—35 ,,
Thunderer	1872	9,330	13·4	14	2—38 ,, / 2—35 ,,
Rupert	1872	5,440	13·6	14	2—18 ,,
Alexandra	1875	9,490	15·0	12	2—25 ,,
Dreadnought	1875	10,820	14·2	14	4—38 ,,
Shannon	1875	5,390	12·4	9	2—18 ,,
Inflexible	1876	11,880	13·8	24	4—80 ,,
Téméraire	1876	8,540	14·5	11	4—25 ,,
Belleisle	1876	4,870	12·2	12	4—25 ,,
Nelson	1876	7,630	14·4	9	4—18 ,,
Northampton	1876	7,630	13·2	9	4—18 ,,
Neptune	1878	9,310	14·2	13	4—38 ,,
Superb	1878	9,170	13·8	12	16—18 ,,
Agamemnon	1879	8,510	13·3	18	4—38 ,,
Orion	1879	4,870	13·0	12	4—25 ,,
Ajax	1880	8,510	13·3	18	4—38 ,,
Conqueror	1881	6,200	15·5	12	2—43-ton B.L.
Collingwood	1882	9,150	16·4	18	4—43 ,,
Colossus	1882	9,150	15·5	18	4—43 ,,
Edinburgh	1882	9,150	15·5	18	4—43 ,,
Imperieuse	1883	7,390	17·0	10	4—18 ,,
Rodney	1884	9,700	17·0	18	4—68 ,,
Warspite	1884	7,390	17·0	10	4—18 ,,
	—	250,640	—	—	—

French Armour-clads available in the Immediate Future.

Name.	Date of launch.	Displacement.	Speed.	Maximum armour.	Armament. Primary guns.
		tons.	knots.	in.	
Océan	1868	7,500	13·7	8½	4—23-ton
Marengo	1869	7,187	12·0	8½	4—23 ,,
Suffren	1870	7,600	14·3	8½	4—23 ,,
Richlieu	1873	9,100	14·0	8½	6—23 ,,
Friedland	1873	8,540	13·4	8½	8—23 ,,
Colbert	1875	8,457	14·4	8½	8—23 ,,
Tonnerre	1875	5,574	12·3	13	2—28 ,,
Redoutable	1876	9,200	14·7	14	4—28 ,,
Trident	1876	8,800	14·3	8½	8—23 ,,
Fulminant	1877	5,574	12·0	13	2—28 ,,
Amiral Duperré	1879	11,100	14·5	21½	4—48 ,,
Dévastation	1879	10,100	15·2	15	4—48 ,,
Turenne	1879	6,400	14·1	10	4—15½ ,,
Bayard	1880	5,881	14·5	10	4—15½ ,,
Terrible	1881	7,200	14·5	19¾	2—75 ,,
Courbet	1882	9,700	15·0	15	4—49 ,,
Vauban	1882	5,900	14·0	10	4—18½ ,,
Amiral Baudin	1883	11,380	15·0	21½	3—75 ,,
Furieux	1883	5,560	12·0	17¾	2—47 ,,
Indomptable	1883	7,168	14·5	19¾	2—75 ,,
Duguesclin	1883	5,869	14·0	10	4—18½ ,,
	—	163,790	—	—	—

Note.—French ships are generally better furnished with secondary armaments of guns than the British.

THE TRIANGULATION AND MEASUREMENT OF THE FORTH BRIDGE.

By Reginald E. Middleton, M.I.C.E.

No. III.

Instruments and tools: Standard rods.—The 12ft. standard rods used in setting out the greater part of the foundation and steel work were of white pine 12ft. in length and 3in. square; the ends were of brass 6in. long by 3in. square, with steel faces cast in, one face, the vertical one, being segmental in plan with a radius of 5in., the

other, which was horizontal, made an obtuse angle. The segmental end was fixed with four screws; the other, though also fixed with four screws, could on slackening the screws be adjusted by means of a hard wood wedge, a motion of $\frac{1}{8}$in. in each wedge of the three rods producing an alteration of $\frac{1}{8}$in. in a length of 540ft., the length of the fixed standard. The wedges were held in place by split pins. The wood of which these rods were made became somewhat warped after three years' use, and this caused an error in the perpendicular of the faces; therefore three new rods were made to replace them while they were being corrected. These rods were made of similar wood supplied at the same time as that for the old rods, and were otherwise similar except that they were 10ft. long instead of 12ft., and the adjustment was made by means of a screw and nut between two collars working in the centre of the rod. The rods supplied to Mr. Meik as being standard at 68 deg. were 10ft. long of pitch pine, about $2\frac{3}{4}$in. by $1\frac{1}{2}$in.; the ends were of brass, without any means of adjustment, and were struck to a radius of 5ft. in every direction.

The following is a table showing the alterations in length of these rods at different dates:—

1883.					12ft. rods.	1885.					12ft. rods.
Nov.	9	..	..	..	$+\frac{1}{4}$ = ·0208	May	7‡	..	..	..	$+\frac{3}{32}$ = ·0078
Dec.	12	..	..	..	$+\frac{11}{16}$ = ·0573	,,	7‡	..	..	..	$+\frac{5}{32}$ = ·0130
1884.						,,	7‡	..	..	..	0 = ·0000
Aug.	5	..	..	..	$+\frac{9}{19}$ = ·0469	,,	22	..	..	..	0 = ·0000
,,	29	..	..	..	$+\frac{11}{32}$ = ·0286	June	4	..	..	..	$+\frac{1}{8}$ = ·0208
Oct.	10	..	..	..	$-\frac{5}{32}$ = ·0521	,,	22	..	..	..	$+\frac{5}{32}$ = ·0630
Nov.	11	..	..	..	$+\frac{27}{32}$ = ·0703	,,	26	..	..	..	$+\frac{1}{16}$ = ·0052
,,	15	..	..	..	$+\frac{1}{16}$ = ·0625	July	1	..	..	..	$-\frac{1}{16}$ = ·0156
,,	27*	..	..	..	$-\frac{5}{32}$ = ·0521	,,	2	..	..	..	$-\frac{1}{16}$ = ·0156
Dec.	3†	..	..	..	$+\frac{3}{16}$ = ·0156	,,	17	..	..	..	$-\frac{3}{32}$ = ·0312
1885.						,,	17	..	..	..	$-\frac{1}{32}$ = ·0365
Jan.	20	..	..	..	$+\frac{21}{32}$ = ·0547	,,	21	..	..	..	$-\frac{3}{16}$ = ·0156
March	11	..	..	..	$+1\frac{1}{32}$ = ·0859	Aug.	21	..	..	..	0 = ·0000
,,	24	..	..	..	$+\frac{1}{8}$ = ·0781	Sept.	28	..	..	..	$-\frac{1}{32}$ = ·0026
May	6	..	..	..	$+\frac{3}{16}$ = ·0156	Oct.	16	..	..	..	$+\frac{1}{16}$ = ·0052
,,	7‡	..	..	..	$+\frac{9}{32}$ = ·0234	Nov.	16	..	..	..	$+\frac{1}{16}$ = ·0052

The 10ft. rods gave $+\frac{1}{8}$ = ·0104 on November 16th, 1885, and Mr. Meik's rods, which were correct to standard on November 1st, 1883, gave $+\frac{33}{32}$ = ·0599 on September 8th, 1885 The 10ft. rods gave $+\frac{9}{16}$ = ·0469 on January 15th, 1886, and $+\frac{3}{4}$ = ·0625 on March 11th, 1886.

The writer hoped to have been able to obtain such information as would enable him to follow the rods through their several changes and formulate the variations, but he has not found it possible to do this. It is believed that the arrangement of the second set of rods is superior to the first, and that the shape of the ends is satisfactory; perhaps the radius of the segmental end might be increased with advantage, but this is the only alteration suggested. In working up hill the segmental end should go first, as it is more easy to plumb to the square edge of this face than to the obtuse angle of the other face. In going down hill the position should be reversed.

Steel standard.—Soon after his arrival at Queensferry the writer called attention to the errors likely to arise by the use of wooden standards of length in the setting out of the steel work, and advised that steel standards should be used for this purpose, standardised by the fixed standard at a received mean temperature, as steel rods when in contact with the manufactured steel would follow its temperature pretty closely, and thus the steel work when constructed would have a uniform ratio of length at all emperatures. To meet this purpose a steel standard about 400ft. long, made of bridge rails 68 lb. per yard, rivetted together at the joints, and firmly bolted to a mass of concrete at the centre of its length, was laid down in the centre of one of the roads in a timber box with a movable cover; the 12ft. standard rods were corrected for length to the temperature of the steel rail on a particular day, the correction being $\frac{5}{8}$in. short in 540ft.; the rail was marked at the end of each rod, and the 12ft. divisions so marked were divided up by means of a pair of compasses. The difference between a distance of 200ft., as measured by Mr. Meik's rods, corrected for their known error, and the steel standard corrected for temperature, was ·000137ft., or $\frac{1}{6\,\frac{1}{2}\,0}$in., and between the mean of two measurements of 433ft., made with the 12ft. rods, and the steel standard, was ·0019 = $\frac{3}{1\,\frac{5}{8}\,8}$.

Steel rods.—From this steel standard, two sets of three steel rods were constructed of $\frac{5}{8}$in. square steel, each 10ft. long, the ends being shaped as for the ordinary rods. One of the 10ft. standard rods was put between specially prepared centres in a lathe, and the steel rods were brought to the same length; each set was then tried separately on the steel standard over a length of 200ft. and corrected until the error was not more than $\frac{1}{0\,4}$in. in 200ft.; the rods were also interchanged between themselves, the distance being measured first by rods Nos. 1 and 2, then by Nos. 1 and 3, and lastly by Nos. 2 and 3, to make sure that each rod was correct; finally one set was kept in the office for reference, the other being sent into the works.

Plumb bobs.—The writer after using plumb bobs of all shapes, does not think that one sort is superior to another; it is of more importance that the cord should fit the hole and that it should be thin and strong, and he believes plaited cotton cord to be the best for the purpose; silk braid is not satisfactory, and any twisted material fails. The points of plumb bobs should be of steel and hardened, which, however, is seldom if ever done. In plumbing the ends of rods it is necessary to use cords of uniform thickness, and to remember that these must be allowed for; it is natural to try to plumb the exact edge of the rod, which is incorrect, and as the correction must be estimated, the use of different thicknesses of cord is sure to lead to error. The square for bringing the ends of the rods into a vertical plane is shown at Fig. 3, see page 281, in The Engineer, October 8th; it is a useful tool, but requires care in using as its accuracy depends upon the absolute straightness and level of the rods both longitudinally and transversely, and it is difficult to make quite sure of the first and last conditions.

Steel bands.—Three steel bands were used at different times, their lengths being 200ft., 150ft., and 100ft.; they are exceedingly useful for checking purposes, but must not be relied on otherwise without great care being taken in checking the results, as their changes of length—except in grey, still weather—are sudden and great. When used in contact with large masses of the same material they take up the temperature of that material, and the thermometer should be put between them and it, and the results obtained will be satisfactory if the sun does not strike the steel and there is no change in the force or direction of the wind; but these conditions cannot easily be secured. The variation of the steel bands from standard was equal to about $1\frac{1}{2}$ degrees of temperature.

Steel tapes.—The same remarks apply to the use of steel tapes; which, however, are quite indispensable for the measurement of short lengths. One great fault is to be found both with steel bands and steel tapes, and that is the inaccuracy of the ends, which, if even right to begin with, very soon become incorrect. The author suggests that, instead of using the ordinary ring or handle, a brass end with a square face accurately cut to length and rivetted to the tape or band should be used; a hole might be drilled in the brass for holding by or hooking on to anything. It was found necessary, in all cases where accuracy was required, to hold the tape or band a foot up, and this practice is apt to lead to error in booking the lengths.

Theodolites.—The theodolites used were a 12in. transit made by Messrs. Cooke and Sons, of York, divided to 10 sec., and fitted with a central plug for supporting the plumb bob, which when removed gave place to a centreing telescope fitted with cross hairs, by means of which the instrument could be centred without the use of the plumb bob. The author is not aware if this arrangement has been used before; he suggested it to the makers, and found it to be of the greatest value, as he was able to be quite certain of the accurate setting of the instrument in all weathers. This instrument was provided with a traversing table actuated by three horizontal screws, which allowed of a motion of about 1in.; the legs were constructed of angle iron, with a cast iron top plate filled with grooves, in which rested the three quick pitch screws of the traversing table, which again received the finely pitched levelling screws of the instrument itself. A table of errors is given in the appendix, but the following is a condensed statement of them.

Verniers A			B			C			D		
deg.	min.	sec.	deg	min.	sec.	deg.	min.	sec.	deg.	min.	sec.
0			90	0	18·3	180	0	1·4	270	0	3·1
269	59	43·5	0			89	59	53·1	179	59	4·3
179	89	52·7	270	0	6·8	0			90	0	4·7
89	59	57·	180	0	5·5	269	59	55·4		0	

Differences between Corrected and Observed Angles.

	sec.
All observations—	
Average error per angle	3·81
Average + error per angle	+3·08
,, − ,,	−4·24
Best observations—	
Average error per ang'e	0·78
Average + error per angle	+1·14
,, − ,,	−0·43

Errors in Triangles.

Average error	1·27
,, reading	−0·10
Greatest + error	+2·48
,, − ,,	−3·23
Average + ,,	+1·17
,, − ,,	−1·36

Triangulation of 1885.

Average error	0·74
,, reading	+0·19
Highest + error	+2·00
,, − ,,	−0·44
Average + ,,	+0·82
,, − ,,	−0·44

A 7in. transit theodolite, by Cook and Son, divided to 10 sec. with three verniers to each circle, specially designed for the work, the vertical circle being $8\frac{3}{4}$in. diameter, the telescope sighted to read an object as near as 6ft. distant, extra strong Y's, centreing telescope, and all the tangent screws provided with reaction springs, which are a great help in accurate work. Where screws without springs are used, there is always a certain amount of play, and it is much more difficult to sight exactly on an object, and if the instrument be touched there is an error. A 7in. transit theodolite divided to 10 sec. with two verniers; with this instrument much of the setting out was done. It was not, however, very well adapted for the purpose, as it would not read anything nearer than 22ft. distant; the verniers also were not well designed or fitted, they were not sufficiently firmly attached to the instrument, and it was nearly impossible to get them to cover the right length on the circle, and when they were correctly adjusted the adjustment was not maintained. The legs sent with this instrument were of the ordinary type in use in England, and did not give satisfaction, as they were not sufficiently stiff; they were therefore replaced by others of the same type as supplied with the other instruments, namely, where the points of support are directly under the three screws. With these legs, if the bolts be kept moderately tight, no shake is possible. A 5in. theodolite of ordinary type was used more particularly for centreing the tubes on the drilling roads.

Levels.—A 20in. reversible level, tripod type, was used for levelling from station XVIII. to XIX. and XV.—a distance of 1700ft. in one direction, and of 2125ft. in the other, and at this distance a broad pencil line could be read; and when the instrument was reversed it would read on it again. The error in levels between the north and south sides and Inch Garvie Island was with this levelling between $\frac{1}{2}$in. and $\frac{1}{4}$in. A great advantage in this instrument is that it can be adjusted with one staff. There is a description of the adjustments required in vol. lix., page 278, of the "Proceedings" Inst. C.E. The other levels need not be described. The 12in. and 7in. theodolites and the 20in. level supplied by Messrs. Cook and Sons were fitted with glass diaphragms, on which the cross lines were scored. These were very clear and fine, and were practically indestructible.

Instrumental errors.—The readings of the 12in. theodolite were all taken one way; that is to say, the A vernier was brought to zero and the instrument sighted; all the readings of the four verniers were taken; the instrument was moved to the required point, and all the four readings booked; it was then brought back to bear on the original point, and these four readings repeated. It was next moved through 90 deg., so that the A vernier read 270 deg. and the same process repeated, and the same again with the A vernier at 180 deg. and 90 deg.; then the telescope was reversed and the C vernier brought to zero, and so on. The total number of vernier readings for one observation is, with the 12in. theodolite, ninety-six, and with the 7in. theodolite, which has three verniers, fifty-four. In the following tables[5] of errors, those in Table I. refer to the divergence of the different verniers from accuracy, or, perhaps, it would be more true to say that they refer to inaccuracy in dividing the circle. The differences between the different blocks of readings and the means must not be taken necessarily to be errors, as there is a tendency to read high or low according to the light; and the second table shows how much of these differences may be considered to be error. This is again exemplified in the third and fourth tables, where the errors in the three angles which form any triangle are given, and also the difference between the observed and the corrected angles is given. By Table II. the error in reading zero is found to be in the 12in. theodolite − ·653 sec., and in the 7in. theodolite + ·03 sec. By Table III. the maximum and minimum errors in reading are found to be − 0·27 sec. and − 0·10 sec. respectively. By Table IV. the maximum and minimum average errors are respectively per angle 3·81 sec. and 0 90 sec.

Setting out lines.—In setting out long straight lines which have to be observed from one station, a plumb bob line is better to sight on than a pole, but it must be thoroughly protected from the wind. A moderately thick line, chalked, and with a suitable background, say a black board, can be easily seen at a distance of half a mile. The writer has found considerable difficulty in setting out straight lines with the 12in. instrument when the focus has to be much altered, as the movement of the rack on one side of the telescope has a tendency to deflect the instrument to one hand or the other; and he is of opinion that where large telescopes are used a tangent screw arrangement should be provided for altering focus which will not tend to deflect the instrument out of line, or if this be not attainable, then it is better to use a small instrument than a large one. In observing angles the focus should be adjusted before the instrument is clamped, in order to avoid any error from the cause above mentioned. When triangulating from successive points on a supposed straight line, it is not sufficient to assume that these stations are in the straight, each one should be observed separately.

Bench marks.—Bench marks cut in stone or wood are not to be relied on thoroughly for very accurate work; it is better in the case of stone or concrete to insert a copper bolt and mark down with a centre punch, and for marks on timber a copper tack scored across with a knife gives the same results; a broad arrow may be cut in alongside to call attention to the mark if necessary. The writer has to thank Mr. W. N. Bakewell for this information.

Poles.—Fixed poles should be of the same diameter throughout, and securely fixed plumb, and must at the same time be easily movable; if they are not made of one diameter it is probable that some part of the pole may be out of centre. The writer has found white poles with three or four black rings painted on them, each ring being some 2in. deep, the best for sighting in; if there be a larger amount of black they become dim and are not easily distinguished. The writer has to thank Mr. W. R. Martin, of the Forth Bridge Works, for his kindness in supplying him with information which his notes failed to afford.

* Corrected for setting steel standard. † Reset. ‡ Frequent snow squalls.

VISITS IN THE PROVINCES.

HENRY POOLEY AND SON'S WEIGHING MACHINE WORKS, LIVERPOOL.

These works, in Manchester-street, Liverpool, were started at a very remote period, as a general millwrights' shop for doing all kinds of what is now called engine work, the lease having been renewed by the Corporation in 1786, and the foundry having been added in 1803 or 1804. Until that period weighing machines were made by the old millwrights singly as ordered; but the father of the present head of the firm began to systematise the manufacture, and, as his machines became more and more appreciated, gradually restricted his business to their production, so that for many years this firm has stood pre-eminent in this branch, as it certainly is the originator of the trade. The works, employing from 450 to 600 men, have been added to from time to time as occasion required, to keep pace with the ever-increasing demand for the accurate balances of all kinds, which have made the firm's reputation.

The great bulk of the parts, even the steelyards, are cast, a suitable mixture of pig, arrived at after long experience, being used, with more or less cast scrap, according to circumstances. Strange to say, this latter is just now obtained largely from old sugar mills sent over from the West Indies, one of the draughtsmen having recognised therein some of his old designs. The charge is lifted to the melting stage by a hoist raised by admitting steam on the top of the piston of a long-stroke steam lift. This was made at the works, as also were the engines which have converted three hand cranes into steam cranes in the foundry. As many parts constantly recur, plate moulding is largely resorted to; and there is a home-made moulding machine for various parts, in which the simple pattern is raised above the plate by a lever and again lowered after ramming. Green sand is used exclusively for the moulds with baked loam cores; and an emery grinder greatly assists in the work of trimming the castings. Though malleable iron is not much used, steel castings are coming more generally into use. The knives, or "centres," of certain descriptions of levers are made of steel, or steeled iron in those of large size. They are inserted in the sand moulds, so as to be enveloped by the metal when poured. After the lever is removed from the foundry, it is dealt with in the fitting shops; and the knife edges are there tempered and hardened, when properly "gauged" or positioned.

For the quantity of work turned out the proportion of machining is not great compared with that of an engine; but it must evidently be of the most accurate character.

[5] These will appear in another impression.

All parts of the smaller weighing machines are made interchangeable, so that any required part may be supplied and is sure to fit. Platform weighing machines are made for stock; but orders only are executed for large weighing machines and weighbridges, some of which latter have been made up to 100 tons. There is one now in the shop for a London tramway; but the position was so awkward that it was found necessary to curve the platform to the radius of the road. The side thrust is counteracted by links, arranged so as to cause as little friction as possible. The firm considers, however, that no weighbridge should be placed upon a curve, as such a position sets up an amount of vicious action in the suspended parts as to interfere with the accuracy of results, and also the life of the apparatus. In times of slackness, rather than discharge old hands accustomed to the work, the firm puts them to making machine tools and special appliances, which are thus designed and carried out expressly for the work they have to do. Jigs are largely used, especially some in the form of a cradle, mounted on centres like those of a lathe, for holding parts to be planed or otherwise machined on more than one face. With their aid, a single setting suffices for all the machining, and the faces are absolutely true one with another.

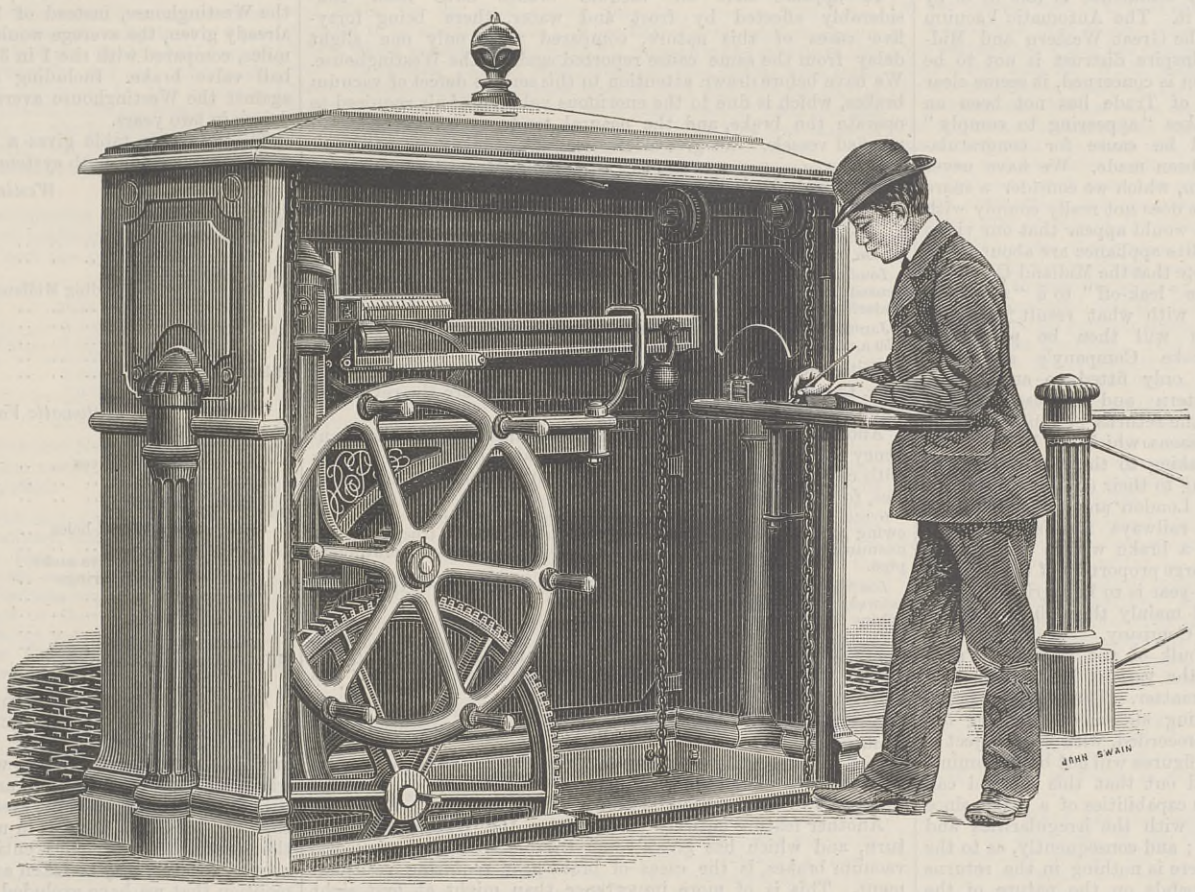
There are two dividing machines for graduating steelyards; and they are kept in almost constant use. They have a series of change wheels like those of a screw-cutting lathe; and an endless screw, set at an acute angle horizontally with the bed, gives some divisions that cannot be obtained with the change wheels. The actual dividing is performed by a fine tool set in a box at the end of a horizontal reciprocating bar like that of a shaping machine, the figures being stamped with punches by hand. In the larger machines, the steelyards are not merely marked with the divisions for the various increments of weight; they have an actual nick or recess cut in, to receive a corresponding projection on the underside of the poise. It is found more expeditious to set the sliding poise roughly at tens of pounds, for instance, and then get the exact weight with the small slider. For sliding the large poise along the beam, a bent lever brings a pair of small rollers down upon the face with a sweep, raising the poise clear of it. In machines for two denominations, such as pounds and kilogrammes, for instance, the rollers above mentioned work in a groove between two horizontal faces marked with the respective scales; and the locking bolt, which engages in the nicks, is drawn transversely to the side of the beam over that scale which it is required to use for a given weighing.

Messrs. Pooley are making a simple and efficient machine that prints its own weight on a ticket. The slider is provided with a rack which rotates vertical discs, mounted on horizontal and transverse spindles, and carrying figures like those of a numbering stamp, being so adjusted that the figures at the lowest points in their circumference shall always correspond with the weight indicated. When the exact weight is ascertained, a ticket is inserted in a holder below the discs, and brought against them by a cam with handle, thus receiving an impression of the figures. A novelty this year is a platform weighing machine, fitted with what the firm denominates a disappearing pillar. The pillar, which carries the indicating arrangements, has one of its sides made flat and of the same pattern as the flooring. When not in use it is turned down on a hinge joint, so as to be flush with the floor, thus presenting no projection whatever.

The firm is going largely into machines for weighing grain continuously and automatically. So far back as 1854-5, the father of the present head of the firm saw room for such a machine. The mode of handling grain in England, however, forbade the use of automatic grain-weighing in stores; but now grain merchants have taken a leaf out of the book of their American cousins, while improving upon transatlantic models, and are erecting storehouses for grain with vertical binns instead of the former flat floors. This new departure has given an impulse to the design of grain stowing machinery, such as that for lifting it from the holds of vessels, disposing of it over floors, and so forth. Under the altered circumstances, apparatus for weighing automatically becomes a matter of necessity, not only on account of economical working, but also on the ground of accuracy. It thus happens that the thirty-four or thirty-five years' experience which Messrs. Pooley have had in this matter is now likely to at length bear fruit. There are at present in the shop several new machines for this purpose to be used in one of the large granaries in Liverpool. An equal-armed beam carries the weight plate at one end and a hopper, divided longitudinally and vertically, at the other. The quantity of grain it is desired to weigh at each operation is represented by loose weights on the plate; but a slight deduction is made therefrom by a slider on the weight side of the centre, though exerting its influence on the grain side. The grain falls into one compartment of the hopper, being directed by a swing and reversible shoot, and, as soon as the quantity received in the hopper overbalances the loose weights on the plate minus the deduction made by the slider, it raises the weight plate clear of its support. This action removes the beam from the influence of the deducting slider, and at the same time reduces, by a cut-off, the orifice through which the grain flows. The reduced stream flowing into the hopper now causes it to overbalance the total weight on the plate; and a trip on the falling hopper, striking a stop, releases a catch which has hitherto held up the cover at the under side of the compartment being filled, allows the grain to fall out, thus shifting over the swing cover so as to close the other compartment, and also shifts over the shoot for directing the grain into this other compartment. At the same time an index is moved forward one division on the recording dial; the cut-off is raised so as to lay open the whole orifice to the grain; the beam is again brought, by a link, under the influence of the deducting slider; and the weighing goes on continuously, without any attention.

The present extensive importation of frozen meat, and the transference of the carcases from the vessel to the cold store, along an overhead track, like those used in rolling mills, have brought into being a new form of weighing machine, to ascertain the weight of each carcase as it passes along, without handling or loss of time. A short length of the bar is hung on a beam, so as to permit of the weight passing over it being taken by a checker.

Messrs. Henry Pooley and Son maintain by contract nearly the whole of the railway weighing apparatus in the United Kingdom; and probably nine-tenths of the goods and mineral traffic of the kingdom is weighed over their machines.



POOLEY'S WEIGHBRIDGE AND COVER AT BRIGHTON.

The above illustrates the ornamental cover by means of which Messrs. Pooley have covered the steelyard of a weighbridge which they erected between Brighton and Hove, and by which coal entering from Hove is weighed for toll.

BEYER, PEACOCK, AND CO.'S LOCOMOTIVE WORKS, MANCHESTER.

These famous works, which are now capable of turning out four locomotives a week, were started about thirty-three years ago by Charles Beyer, manager to Sharp, Stewart, and Co., and Richard Peacock, locomotive superintendent on the Manchester, Sheffield, and Lincolnshire Railway. In addition to some ground on which a way with sharp curves is laid down for testing tramway engines, the works cover nine acres of ground at Gorton, near Manchester, adjoining the M.S.L. line, with which they are connected by a siding. Besides lines of way to three gauges, an 18in. tramway is now being laid throughout the works, the portions where points and crossings occur consisting of cast iron plates. The full complement of men is over 2000; and nearly 1500 are now employed. One of the latest engines, for Buenos Ayres, with motion bars boxed in for excluding dust, bears the number 2791, corresponding to the total number of locomotives constructed by this firm up to the present time.

Nearly everything is made "at home;" and all materials are subjected to severe tests, for which purpose a hydraulic testing machine has been supplied by Buckton, of Leeds. The foundry is light, spacious, and lofty, and is provided with an overhead traveller. The horizontal engine which drives the fan for blowing the cupolas runs at 240 a minute with 75 lb. steam, which is admitted through a $\frac{3}{4}$in. hole in a $\frac{1}{8}$in. plate inserted between the flanges of the stop valve and the pipe. The very tenacious moulding sand is formed by grinding red sandstone and mixing it with coal dust, the mixture being afterwards sifted very fine in a mechanical riddle. Brass nuts are made by casting hexagonal bars and then cutting them off to length in the same lathe which drills and taps the holes.

Tube plates are flanged bodily in a hydraulic press; and all rings, such as angle iron rings and the strengthening rings for dome seatings, are welded up, raised to a moderate heat uniformly all over, and then placed over a form consisting of four separate segments, which are expanded by driving a conical plug into a conical hole in the middle. In this way the exact diameter required, and the exact degree of tension in the case of shrinking on, are secured.

All forgings that are not of steel are made from wrought iron scrap, carefully picked over to exclude pieces of steel, for which the pilers receive a premium. There are several steam hammers of various sizes by Massey and by Rigby; but that most approved of is one made at the works with a single-side standard, divided in the middle to permit of getting all round a forging. A great deal of stamping is now done under the hammer, as, for instance, the crank boss and counterweight of driving wheels. Wheels are built up from the separate parts previously forged under the steam hammer. The spokes, after being forged, with their wedge-shaped ends, which meet in the centre, having V-shaped grooves on both inclined sides of the wedge, are placed with the wedge downwards and enclosed between two clamps, on the anvil of a steam hammer, the other end having been raised to a welding heat; a bar—also brought to welding heat—is then "dabbed on," and beaten down to form part of the rim. Such a joint has been slotted through and tested in every way without showing a sign of unsoundness. When the spokes are all put together in a hoop, the two V-grooves in the inclined sides of the wedge-shaped ends form square, or rather, diamond-shaped holes, to receive corresponding keys. The centre is raised to welding heat, when a washer is welded, first on one side and then on the other, to form the boss. Tires are bored by being made to revolve horizontally on a table while being acted upon simultaneously by three tools set in boxes, self acted in both directions, on fixed arms. Tires, for being shrunk on the wheels, are laid on a face plate, and heated uniformly by a ring of gas jets, when the wheel is dropped in, and the tire cooled by a stream of cold water applied by hose.

All wearing parts not made of steel are case-hardened, for which operation there are six furnaces, and also six cast iron crucibles for receiving such parts as the journals of axles. Where necessary, case-hardened parts are finished in special emery-grinding machines, the spindle of the emery wheel in all cases being made to shift slightly while revolving, so as to secure uniform work. There is a machine of this kind for finishing the inside of slot links, the small vertical emery grinder rising and falling slightly while revolving, and the link being made to follow its arc by being tied by a radius bar.

All plate edges are planed; and rivetting is done as far as possible by Tweddell's hydraulic machines. All holes are drilled through templates; in fact, everything is machined to template, so that corresponding parts are interchangeable. A machine has been made by the company for boring cylinders, turning and facing their flanges, and planing the valve face at the same time. Coupling rods are finished by cylindrical milling tools, the radius of which is equal to that of the curve. In the event of a curve with gradually increasing radius, such as that always stipulated for by the late Mr. Beyer, being adopted by the designer of a locomotive, the machine can still be used with a "former," as in copying lathes. Of course so celebrated a locomotive company as that of Beyer and Peacock may be supposed to know their own business best; but we should have thought they might save time and labour in setting coupling rods for machining by mounting them on centres once for the four sides, and then simply present each side in succession to the milling cutters.

A great many of the machine tools, including some capstan lathes, are by Smith and Coventry; but a great many have also been made at the works. Indeed, the company makes special tools to order. The large drawing office is lighted on both sides, and has two desks on each side for forty boards in all, besides the chief draughtsman's office with a few more. Messrs. Beyer, Peacock, and Co. employ girls regularly for tracing in a separate office, giving them 15s. a week. In the case of new drawings, where the lines are perfectly distinct, they are found to get through more work than men, while the tracing leaves nothing to be desired. This company has made for itself a great reputation, so that its tenders are often accepted even when far from being the lowest; and no precaution is neglected, in selecting materials, in careful supervision of work, which must be of the best, and in testing finished engines and machines, to maintain this high reputation.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—James B. E. Warrington, engineer, to the Mistletoe; William T. Allen, engineer, to the Humber; William F. Hinchcliff, assistant-engineer, to the Humber; Robert Ford, acting boatswain, to the Firefly.

THE BRAKE RETURNS TO THE BOARD OF TRADE.

There can be no question as to the interest in the subject of continuous brakes disappearing so long as the half-yearly returns to the Board of Trade continue to be issued, though that they are not necessary for this purpose is occasionally made clear by the recurrence of those railway accidents which such appliances were specially designed to prevent. The return for the half-year ending June 30th is one of considerable interest, not only as showing the progress of brakes adopted by those companies which have accepted the Board of Trade conditions, as well as by certain others which obstinately refuse to do so, but also as pointing out the weakness of the various systems.

The total carriage stock in the United Kingdom amounted at the end of June last to 51,790 vehicles, thus showing an increase of 543, or rather more than 1 per cent. on the last return. Omitting vehicles fitted only with connecting pipes, 22,230 of the total stock, or 43 per cent., were fitted with brakes, which as it is called, "appear" to comply with the Board of Trade conditions; 13,111, or 25 per cent., with brakes which there is no doubt, even to the official mind, do not do so; and 16,449, or 32 per cent., are not yet fitted with any brakes at all.

As to the progress made, it can hardly be considered that the proportion of automatic brakes—43 per cent.—is anything like an adequate amount to have resulted from the pressure of the Board of Trade for the last nine years. This amount is made up practically of three systems, as follows:—Carriages with brakes: Westinghouse, 11,558; Automatic "Leak-off," 6690; Vacuum Brake Company's Automatic, 3374.

The Westinghouse brake is in use, it appears, on some fifteen railways in England and Scotland: it is common to the joint stock of the three great routes—viz., the East Coast, the West Coast, and the Midland—and every confidence is felt in it by those who have to depend upon it. The Automatic Vacuum Leak-off brake is used entirely on the Great Western and Midland railways, and that it should inspire distrust is not to be wondered at. So far as this system is concerned, it seems clear that the pressure of the Board of Trade has not been an unmixed good, and if all the brakes "appearing to comply" were of this type, there would be cause for congratulation that such poor progress had been made. We have never concealed our dislike to this system, which we consider a snare and delusion, or our opinion that it does not really comply with the Board of Trade conditions. It would appear that our views on the subject of this hermaphrodite appliance are about to be confirmed in another way, for we note that the Midland Company has changed 466 vehicles from the "leak-off" to a "non-leak-off" brake during the half-year, with what result we shall examine later on. The system will then be practically the same as the Vacuum Brake Company's automatic brake with ball valve, which is only fitted to any extent on the London and South-Western and Lancashire and Yorkshire railways; and so far as the returns of faults go, it is clear that however strong the reasons which the Midland and Great Western may have had for taking to the leak-hole, there is nothing to justify their reverting to their old system, just as there was nothing to justify the London and South-Western and Lancashire and Yorkshire railways forming a fourth party on the brake question when a brake was in the market which had never been beaten. A large proportion of the increase of fitted vehicles during the half-year is to be ascribed to the non-automatic vacuum system, and mainly through the action of the London and North-Western Company.

Proceeding now to examine the bulk of the Board of Trade returns—viz., the report against the various brakes—we find some interesting and instructive matter. The Vacuum Brake Company is in the habit of issuing statements showing the miles run per fault of every kind recorded, with what object it is not difficult to see, though their figures will not bear examination. We have frequently pointed out that this method can never be a test of the merits or the capabilities of a brake, since the returns only profess to deal with the irregularities and failures, and not with the successes; and consequently, as to the main point—that of efficiency—there is nothing in the returns to guide us. Everything, too, depends on the nature of the cases, as to how far they are to be attributed to defects of men or material, or in the principle of the apparatus. It is clear, moreover, that nearly every company selects a different basis, and that each has its own idea of what incidents should be reported. Taking the returns as they stand, however, if the method alluded to is applicable at all, it can only be used to compare brakes which profess to fulfil the same conditions and are constructed on similar principles. In the following table this has been done, and we think the absurdity will strike everybody.

Brake Returns for the Half-year ending June, 1886.—Comparison between the Brakes on various Systems.

Name of brake.	Carriage stock fitted with brakes.	Miles run.	Reports.	Miles per report.
Continuous Non-automatic.				
Westinghouse non-auto	350	729,081	Nil.	729,081
All non-auto vacuum ..	9,207	17,696,654	135	1 in 131,086
Automatic Vacuum "Leak-off."				
Great Western system.	3,586	5,952,005	102	1 in 58,352
Midland system	2,475	5,129,897	20	1 in 170,996
Continuous Automatic.				
Westinghouse auto ..	11,558	18,882,152	454	1 in 41,590
Vacuum Co.'s auto (including L. and Y. miles and reports) ..	3,374	4,746,106	149	1 in 31,853
Midland non-leak-off..	466	555,801	15	1 in 37,053
Sectional Brake.				
Clark-Webb chain ..	1,843	2,730,642	8	1 in 341,330
All Vacuum Brakes Compared.				
All auto vacuum	10,064	16,395,017	296	1 in 55,388
All non-auto vacuum..	9,207	17,696,654	135	1 in 131·086

Although the Westinghouse non-automatic brake has run nearly three-quarters of a million miles without a single report, no one suggests its extension. The chain brake, the simple vacuum, and the automatic vacuum leak-off, which are the next highest, as everyone knows have been condemned, and therefore such a system of comparing brakes must also be condemned. The Westinghouse and the Vacuum Company's automatic are the only brakes which can be held to comply in any sense with the Board of Trade requirements; and, such as it is, the result is all in favour of the Westinghouse. The Lancashire and Yorkshire Company again distinguishes itself by its professed inability to give the mileage of its engines, and we are therefore compelled—as on previous occasions—to credit them with the average miles of all the other engines fitted with the same brake, amounting to about one and three-quarter millions. They have further included in the Westinghouse return fourteen cases which evidently refer to the vacuum brake, and these we have transferred to their proper quarter. Turning to the nature of the reports, we find that the non-automatic vacuum has distinguished itself by one collision with the buffer stops at Kirkstead, on the Great Northern Railway, one on the London and North-Western at Sutton Coldfield, and another at Birmingham station on the same line; making, along with sixty-eight cases of overrunning, no less than seventy-one "failures to act" during the six months. No great encouragement, ordinary minds would think, for the extension of such a system. The report on the Birmingham case is too good to omit.

May 5th: The 1.35 p.m. passenger train, Wolverhampton to London, was travelling near Monument Lane station, when the engine coupling broke, causing the engine to part from the train, and the brake apparatus on the train did not bring the vehicles to a stand clear of the engine. This appears to have been partly owing to the guard in the rear brake van having taken off the automatic brake with which his van was provided.

The value of the automatic tell-tale in use on the London and North-Western Railway is further apparent from the fact of trains having eight times overshot platforms through the brake "failing to act."

It appears that all vacuum brakes have been considerably affected by frost and water, there being forty-five cases of this nature, compared with only one slight delay from the same cause reported against the Westinghouse. We have before drawn attention to this serious defect of vacuum brakes, which is due to the enormous volumes of air required to operate the brake, and the natural tendency to create ice in rarefied vessels. We give a few cases out of many recorded.

Great Western Railway.—January 20th: Nine minutes' delay at Melksham. The brake could not be released, owing to the air-pipe of engine 2209 being partially choked with ice.

Lancashire and Yorkshire Railway.—March 1st: Delay of fifteen minutes between Victoria and Rochdale, and seven minutes at Rochdale. Brake piston frozen fast on engine No. 681.

London and South-Western Railway.—January 9th: Freezing of condensed steam in cylinder, No. 654 third-class carriage, 11.15 a.m. train, Waterloo to Southampton. Fourteen minutes' delay.

January 21st: Ice in miniature sack, No. 683 third-class carriage, 8.50 a.m. up Portsmouth train. Fourteen minutes' delay.

With the winter almost upon us, and its prospect of frost and fogs, the reflections induced by these extracts are the reverse of comforting.

Another peculiarity in vacuum brakes appears to be their tendency to absorb a good deal besides air, and to gorge themselves with cotton-waste, sponge-cloth, and other indigestible delicacies, for instance:—

Great Western Railway.—June 13th: Five minutes' delay at Oxford, owing to brake blocks binding on the wheels of milk truck 441. On examination a large piece of waste was found in T-piece of continuous pipe.

Lancashire and Yorkshire Railway.—February 3rd: Delay of six minutes between Hellifield and Manchester, piece of lead getting into ejector of engine No. 372.

London and North-Western Railway.—May 28th: The 8.50 p.m. train from Euston had a late start, owing to something being wrong with the vacuum brake, and on subsequent examination a piece of "waste" was found to have got into the vacuum pipe.

London and South-Western Railway.—April 1st: Sponge cloth in vacuum pipe, No. 11 guard's van, 11.30 a.m. train, Waterloo to Richmond. Two minutes' delay.

April 9th: Sponge cloth found in clapper valve of ejector, No. 424 engine, 10.30 p.m. up Windsor train. One minute delay.

The last two cases caused "failures to act."

Another feature entirely absent from the Westinghouse return, and which has given some trouble with the automatic vacuum brakes, is the cases of brake-gear requiring readjustment. This is of more importance than might at first sight appear. The stroke of the piston must be kept as short as possible on account of the necessity for maintaining a large reservoir space, and as a high proportion of leverage is required, owing to the low pressures available, the blocks must be kept very close to the wheels, and consequently require frequent readjustment to compensate for wear. This operation would appear to have been sometimes overdone, as may be seen from the following sample out of twelve given in the London and South-Western Company's return:—

March 9th: Required readjusting, 12.45 p.m. special train, Salisbury to Waterloo. Fifteen minutes' delay.

It is found in practice that the blocks of the vacuum system require readjusting three times to once of the Westinghouse, the practically unlimited pressure of the latter enabling the blocks always to hang quite free.

Carrying our investigation further, we are struck with the serious length of the delays in the vacuum compared with the Westinghouse returns. Even the "leak-off" system on the Great Western is subject to delays of 20, 17, 13 minutes, the average all round being four minutes per case, which is certainly better than the ball valve brake on the Lancashire and Yorkshire and London and South-Western railways. Amongst the returns of the former we find the following:—

June 1st: Delay of forty-five minutes at Midge Hall. Rolling ring twisted and jammed in brake cylinder, engine No. 58. Failure of material.

Nearly three hours delay were caused by five cases!

The average of the Lancashire and Yorkshire is 6·6 minutes. The London and South Western also experience the same sort of thing, such as the following amongst others:—

February 9th: Cross shafts stiff and primed in miniature sacks, Nos. 507 first and 145 second-class carriages, 6.37 p.m. down Reading train. Twenty-eight minutes' delay.

The average for this line is 6·2 minutes per fault. These two railways therefore using the ball-valve brake average nearly six and a-half minutes per case, and they run nearly four million miles at the cost of 904 minutes, or an average of 4352 miles per minute. The London and Brighton and Caledonian Companies having the Westinghouse system, run nearly five and a-half million miles with an average delay of 3·3 minutes per report, or a total cost of 198 minutes, which gives an average of 27,404 miles per minute, or a proportion of six to one compared with the vacuum. The disadvantages of stuffing boxes, or their equivalent, is also strikingly apparent. By the use of the triple valve in the Westinghouse system, the necessity for having the pressure on both sides of the brake pistons is avoided, and consequently the piston-rods do not require packing. Other systems of automatic brakes, having power stored upon both sides of the piston, require such packing, and there are no less than forty-eight cases reported against the automatic vacuum brakes on this account.

For instance, on the Great Western:—

April 30th: Seventeen minutes lost running between Newton and Bristol, owing to the brake blocks binding on wheels of composites 294 and 307. Cylinder gland leaking.

London and South-Western Railway.—February 9th: Cross shafts stiff and primed in miniature sacks, Nos. 507 first and 145 second-class carriages, 6.37 p.m. down Reading train. Twenty-eight minutes' delay.

Midland Railway.—January 25th: 4.55 p.m. train from Bradford. Thirty-four minutes' delay at Hunslet and Heeley, where train was stopped by leakage at improperly packed piston-rods.

Further, it would appear that the Westinghouse system may be congratulated on not requiring auxiliary valves in the guard's vans, such as are rendered necessary in the vacuum systems for accelerating the action of the brakes; since we find a number of cases in which the presence of these additions have been the means of causing delay. There are also thirty cases of release valves against only one on the part of the Westinghouse. The Westinghouse system certainly possesses brake cylinders and piston packing, but whereas these have only caused two delays, and those through carelessness, there are no less than fifty-three cases in the automatic vacuum returns referring to cylinders and pistons and rolling rings, in addition to the forty-eight cases already mentioned of glands, &c. There are four cases where the rolling rubber packing-rings alone caused 127 minutes' delay.

Having now shown of what the Westinghouse reports do not, let us examine of what they do, consist. This is a very simple matter, first, because the whole of the apparatus in use is uniform in character, and because the special parts peculiar to this brake are practically conspicuous by their absence. Burst hose alone is responsible for 61 per cent. of the reports, and these with broken copper pipes make about 70 per cent. of the total; of the remainder, about 20 per cent. are due to leaks and carelessness or inexperience, and the special parts form only about 10 per cent., compared with 76 per cent. against the special parts of the automatic vacuum brakes. There are very few cases of damaged pipes reported against the vacuum systems, and if we eliminate the 70 per cent. alluded to on the part of the Westinghouse, instead of 1 in 41,000 miles per report, as already given, the average would be increased to 1 in 132,000 miles, compared with the 1 in 31,000 for the Vacuum Company's ball valve brake. Including all cases, however, the reports against the Westinghouse average only one incident for every driver in two years.

The following table gives a summary of the reports against the special parts of both systems:—

Westinghouse.

		Numbers in use.
On engines:		
Pumps	21	1,902
Drivers' valves	6	1,902
On carriages:		
Triple valves (excluding Midland) ..	8	14,700
Cylinders	2	14,700
Couplings	5	35,218
Cocks	5	35,218
Release valves	1	14 700
Miles run	—	18,882,152
	48	

Automatic Vacuum Systems.

		Numbers in use.
On engines:		
Ejectors and air valves	34	2,200
Drivers' valves	1	2,200
Drip valves..	12	2,200
On carriages:		
Ball valves and leak-holes	16	10,500
Cylinders	22	10,500
Glands and miniature sacks..	48	10,500
Pistons and rolling rings	31	10,509
Guards' valves	11	—
Release valves	30	—
Couplings	18	23,500
Dummies	3	23,500
Miles run	—	16,395,017
	226	

It is not easy from the returns to get at the number of parts in use in the automatic vacuum systems owing to the want of uniformity, and there being three kinds employed. Many engines and tenders are fitted with only steam brakes—against which we may mention there are no reports, since they form no part of the continuous brake system—and there is evidently more than one kind of apparatus in use on the same railway, whereas the Westinghouse system is entirely uniform. The figures given above, however, may be taken as being about correct. We should mention that we have excluded from the above list twenty-three reports of "triple valves sticking" on the Midland Railway. This company continue to persist in reporting three or four times as many cases against triple valves as all the other lines put together, and during this half year has run only half a million miles with the Westinghouse brake out of nearly nineteen millions in all. The delays referred to are due to entirely different causes, as every other company has discovered; and this persistent attempt to injure the reputation of such an admirable device is little to the credit of such a corporation as the Midland Railway. This company enjoys a decided advantage in making the returns of its own appliance as well as of that of its rival, and we think it quite possible that if the Westinghouse Company are allowed the privilege of reporting all cases against the Midland brake, the returns from this line would bear a different aspect. If the triple valves were subject to sticking, they could never perform the work they do on the 120,000 engines, tenders, carriages, and wagons for which fittings have been sold. What this work amounts to is evident from another of the interesting returns made by the London and Brighton Company, which is to be found in the appendix. On a certain day in June, it seems the Westinghouse brake was applied 20,167 times—that is, 8302 times for ordinary booked stoppages, and 11,865 times for signals, &c. The movements of the triple valves, in fact, number close on 200,000,000 in the course of the half-year in the United Kingdom alone, and out of this number only eight have once resulted in delay.

That the want of uniformity in the vacuum system is a serious hindrance to traffic is clear from the extracts already given. It was thought at one time apparently that the adoption of a so-called "universal" coupling was all that was necessary to harmonise conflicting systems—a ludicrous idea enough. The returns show that "leak-off" carriages do not work well with the "non-leak-off;" and further, that the non-automatic vacuum when run in automatic trains give occasion for trouble. Various cases are reported of the brakes being applied on North-Western vehicles under these circumstances, although fitted with a special cut-off valve to prevent such mishaps; and, of course, the latter would do the same if run in trains worked on the former system. We make no apology for speaking strongly in favour of the Westinghouse brake. It is a duty we owe to ourselves and the public, and the matter is too serious a one not to be in earnest. There is no other brake which has stood the same test as the Westinghouse, or with which there has been anything like the same experience in all climates. It is practically the same now as it was years ago, it has proved victorious in all contests, and we have ourselves no doubt that ultimately it, or something very like it, will be universally in use in this and other countries.

RAILWAY MATTERS.

The Board of the Brighton Railway Company has appointed Mr. Allen Sarle as general manager, to succeed the late Mr. J. P. Knight. Mr. Sarle also retains his former position of secretary.

A new central railway station, said to be the largest in the world, is nearing completion at Frankfort-on-the-Main. It has taken six years to construct, and will cost about £150,000, of which the Government has contributed about £100,000 and the Ludwig Railway Company the balance.

The London Commission appointed to invite the co-operation of English companies and corporate bodies in the Railway Jubilee Celebration to be held at Paris next year is, it is stated, making good progress. Some joint action in the matter will be discussed shortly by the different managers, and several subjects have already been suggested to be brought before the projected Congress. The Chatham and Dover Company offers transport facilities to and from Paris on the occasion on the same basis as those accorded by the Northern of France.

Electric lights have been used for three months past in a dining car running between Paris and Brussels. The electricity is supplied from the constant batteries of Desruelles. Forty-five of these in fifteen boxes, weighing nearly 1400 lb., are attached under the car. They are said to afford light for seventy hours to twenty-one lamps with 100 aggregate candle-power. The light is very steady for the first twenty hours, and then begins to grow weaker. It is remarked that to supply the same light from an accumulator nearly twice the weight would have to be carried.

An examination of the steel sleepers made by the Barrow Hematite Steel and Iron Co., and laid on the North-Eastern Railway Company's 1330 yards of Train Valley Railway in March, 1885, has been made, and the result is said to have been in every way satisfactory. The inspector is of opinion that the sleepers will keep good for twenty or twenty-five years, whereas the old-fashioned wooden ones only lasted from twelve to fourteen years. The cost of the wooden sleepers is certainly but half that of the steel ones, and are not so troublesome to lay in; but when once in, the steel sleepers give less trouble.

The directors of the South Staffordshire and Birmingham District Steam Tramways Company have just paid a dividend of 6 per cent. per annum upon the preference shares for the half-year to the 31st July last. The wagons on order for rail and road goods traffic will, the directors state, be delivered to the company shortly, and negotiations for a considerable traffic are now pending. The alteration of the line belonging to the Birmingham Central Tramways Company from Handsworth will probably, the report adds, be completed in a year, when arrangements will be made for running powers into Birmingham.

According to a recent report, the following are the numbers of vehicles fitted with each description of continuous brakes, the percentage so fitted to the total in use, and the percentage of miles run by trains so fitted:—

	Fitted.	p.c.	Miles run p.c.
Clark's chain and Clark and Webb's	2,516	5	4
Fay's, Newall's, and Fay and Newall's	1,609	3	1
Smith's vacuum	5,923	11	17
Vacuum	3,609	7	10
Automatic vacuum	6,690	13	17
Vacuum automatic	3,318	6	4
Westinghouse automatic	11,203	22	28

The percentage of miles run by the Fay and Newall is exclusive of the Lancashire and Yorkshire and some minor railway companies' train mileage, which could not be supplied.

The Scotch express from the North had a narrow escape near Masbro' station, on the Midland Railway, last Sunday morning. A goods train from London had been detaching trucks for Masbro', and had passed to the down main line of the Masbro' and Chesterfield branch until the Northern express had gone by. Two trucks, however, remained foul of the Sheffield line, and these being caught by the express engine were smashed to atoms. A portion of the wagons struck the Pullman sleeping car, and carried away the footboard and steps, while a coupling of the express also gave way. On reaching the next station, Holmes, the driver, found that several of the back carriages had been left behind. The express was brought to a stand, and the train thoroughly examined. Nobody was hurt, many of the passengers being scarcely conscious that anything unusual had occurred. Breakdown gangs from Sheffield and Masbro' were soon on the spot, but the Chesterfield line was blocked for three hours.

A Board of Trade report has been published on the collision which occurred on the 1st ult. at Penistone Station, on the Manchester, Sheffield, and Lincolnshire Railway, when a portion of the 5.30 p.m. down passenger train from London, while standing at the platform at Penistone Station, was put into backward motion by the engine, and ran into a siding at the back of the ticket platform, where it came into collision with a wagon which was standing against the buffer stops at the end of the siding. Twenty-three passengers and the rear guard complained of injury. The portion of the train which ran back consisted of a third-class carriage, a dining car, a composite carriage, a third-class carriage, a third-class saloon, a third-class carriage, a composite carriage, and a brake van, all fitted with the non-automatic vacuum brake. The report is to the effect that "this collision occurred from the want of sufficient brake-power to hold the eight rear vehicles upon their receiving a blow from the engine and front van when these latter were setting back to rejoin the eight vehicles."

In reporting upon a collision at Berry Brow, near Huddersfield, on the Lancashire and Yorkshire Railway, Major-General Hutchinson says:—"This collision was the result of a dangerous mode of working at Brockholes Station, which is situate on a gradient falling towards Huddersfield at 1 in 100," and he describes what he considers the proper mode of proceeding would have been under the circumstances which led to the collision, but he concludes by saying:—"Nor would the collision have occurred had the runaway vehicles, like the rest of the train to which they had been attached, been provided with automatic brake appliances, as the brakes could then have been applied before they had been uncoupled from the train. The Lancashire and Yorkshire Company have, however, been making good progress in fitting their rolling stock with automatic brake appliances. During the six months ending 30th June, 1886, they had so fitted 44 engines and 331 vehicles, making the total thus fitted at that date 309 engines and 1328 vehicles. In addition to this they have a large number of vehicles still fitted with Fay's or Newall's continuous—mechanical—brakes."

A project is on foot for tunnelling the "Great Divide"—that is, the Rocky Mountains—and the point proposed to be tunnelled is under Gray's Peak, which rises no less than 14,441ft. above the level of the sea, but is the narrowest in the great backbone. At 4441ft. below the peak, by tunnelling from east to west for 25,000ft. direct, communication would be opened between the valleys on the Atlantic slope and those of the Pacific side. This would be sixty miles west of Denver, and would shorten the distance between Denver, in Colorado, and Salt Lake City, in Utah, and consequently the distance between the Missouri river, say at St. Louis, and San Francisco, nearly 300 miles; and there would be little more required in the way of ascending or descending or tunnelling mountains. Part of the work has already been accomplished. The country from the Missouri to the foot of the Rockies rises gradually in rolling prairie till an elevation is reached to 5200ft. above the sea level. The Rockies themselves rise at various places to a height exceeding 11,000ft. Of the twenty most famous passes only seven are below 10,000ft., while five are upwards of 12,000ft., and one, the Argentine, is 13,000ft. Of the seventy-three important towns in Colorado, only twelve are below 5000ft.; ten are over 10,000ft., and one is 14,000ft.

NOTES AND MEMORANDA.

Attention has recently been recalled to the use, long practised in India, of sugar or molasses in mixture with mortar, by which its strength is much increased.

The deaths registered in twenty-eight great towns of England and Wales during the week ending 23rd of October corresponded to an annual rate of 19·3 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year. In Greater London 3446 births and 1712 deaths were registered, corresponding to annual rates of 33·9 and 16·8 per 1000 of the population.

A new process for making steel pipes or tubes is thus described as in use in Germany. Steel is cast into a round mould, a core is thrust into it, so that a short tube is formed between it and the walls of the mould. The short tube or cup thus obtained is then rolled or drawn in an ordinary train. This seems to be a modification of the system of Mr. James Robertson, of Birmingham, which we shall describe fully.

At the meeting of the Paris Academy of Sciences, October 11th, a paper was read on a principle in rational mechanics, and on a demonstration used by Daniel Bernoulli in 1757, by M. de Jonquières. The reference is to the author's recently-explained theory of the hydro-extractor, the fundamental principle of which he now finds was already known to Bernoulli. His demonstration, analogous to that of M. de Jonquières, is contained in his memoir entitled, "Principes hydrostatiques et méchaniques, &c." which obtained the prize of the Royal Academy of Sciences.

The number of miles of streets at present containing mains constantly charged, from which constant supply could be given, and upon which hydrants for fire purposes could be fixed, in each district of London, is as follows:—Kent, about 85 miles; New River, about 251; East London, 180; Southwark and Vauxhall, 160; West Middlesex, 107; Grand Junction, 82; Lambeth, 217¼; Chelsea, 74; making a total length of about 1156¼ miles. The companies are ready to give constant supply and to affix hydrants whenever legally required to do so.

The deaths registered in twenty-eight great towns of England and Wales for the week ending Saturday, October 16th, corresponded to an annual rate of 18·9 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year. In Greater London 3229 births and 1604 deaths were registered, corresponding to annual rates of 31·8 and 15·8 per 1000 of the population. In the outer ring 18 fatal cases of diarrhœa and five of "fever" were registered; five of diarrhœa and three of "fever" occurred in the registration district of Tottenham.

From one ton of ordinary gas coal may be produced 1500 lb. of coke, 20 gallons of ammonia water, and 140 lbs. of coal tar. By destructive distillation the coal tar will yield 69·6 lb. of pitch, 17 lb. of creosote, 14 lb. heavy oils, 9·5 lb. of naphtha yellow, 6·3 lb. naphthaline, 4·75 lb. naphthol, 2·25 lb. alizarin, 2·4 lb. solvent naphtha, 1·5 lb. phenol, 1·2 lb. aurine, 1·1 lb. benzine, 1·1 lb. aniline, 0·77 lb. toluidine, 0·46 lb. anthracine, and 0·9 lb. toluene. From the latter is obtained the new substance known as saccharine, which, *Science* says, is 230 times as sweet as the best cane sugar.

A paper was recently read before the Paris Academy of Sciences, on the temperature of the bed of oceanic basins compared with that of the continents at the same depth, by M. Faye. In connection with the reference made to this subject in the opening address of the President of the British Association at Birmingham, the author takes the opportunity of generalising the law already established by him respecting the more rapid and deeper cooling of the earth's crust under the seas than under the continents. Not only is this law applicable to the Polar seas, whose lowest depths have a temperature very near zero, but also to those which do not freely communicate with the poles. In these waters also the temperature decreases with the depth, the difference between them and the continents at the same depths being, within about 15 deg., as great as for the oceans.

In writing on the intensity of powder pressures in guns, Mr. W. Mattieu Williams calls attention to the enormous discrepancy between the results obtained in the testing of the pressure exerted by the explosion of gunpowder by the Government Committee on Explosives and those of Count Rumford made in 1793, and described in his essay on "The Force of Fired Gunpowder" (published in London, 1802, and recently reprinted, with his other essays, in America). Our Government official experiments give a pressure per square inch varying from 15·4 to 28·1 tons per square inch, the latter obtained in the 81-ton gun. Rumford's maximum was 277 tons, as shown by overcoming the tested tenacity of metal that the powder tore asunder; or 73 tons, as indicated by the lifting of a weight by the explosive energy. His reasons for believing Rumford's experiments to be more reliable than those of the Committee are:—"(1) The resistance to be overcome, and by which the force was measured, viz., the gravitation of a known weight, was by far more definite and measurable than the degree of indentation or compression of a cylinder of copper, which serves as the measure of force in the Rodman and Crusher gauges. (2) In Rumford's arrangement the force of the explosion was more directly applied to the resistance by which it was measured than in the official experiments, where the shock of the explosion was first communicated to a solid piston 1in. in length, and by this transferred to the copper cylinder of the Crusher gauge or the knife of the Rodman gauge. By this arrangement much of the force is expended upon internal work in the intervening piston, producing mechanical vibration of its substance, and a returning wave of elastic compression, which would have no measurable effect on the gauge. Besides this, another portion of the force compressing the piston must be converted from mechanical motion into heat motion." Mr. Williams' contention is thus, that instrumental inertia and its effects are not sufficiently considered in the Woolwich calculations.

At a meeting of the Royal Society of New South Wales in August, the Society's medal and prize of £25 was presented to Mr. S. Herbert Cox, F.C.S., F.G.S., for his prize essay on "The Tin Deposits of New South Wales." The principal deposits occur in New England as impregnations, segregation veins, and lodes in granite, also as gash veins in Silurian slates, and as a network of veins or stockwork in haplite. The granitic eruption occurred not later than carboniferous times, and no sedimentary strata appear to have been deposited until the tertiary period, when the leads of alluvial tin were formed, together with their associated gravels. Denudation on an enormous scale has gone on, and the silurian slates which rest on the granites have only been preserved as outlying patches included in folds in the granite. Dykes of feldspar and quartz porphyry traverse both the granite and the slates, but the date of this eruption is probably tertiary, although evidence appears to point out that this acidic only preceded the ensuing basaltic eruption by a short time. The more fluid basalt flowed for considerable distances, frequently burying the gravels of the river beds with the tin they contained, and preserving these "deep leads" from subsequent denudation. True lodes appear to be rare, but some remarkable impregnated areas exist in greisen; "segregation" veins of small size are found in the granite, and in the slate "gash" veins up to 4in. in width occur, but these are certainly not true lodes. Fortunately, wolfram occurs in separate veins from the tin; copper and iron pyrites, fluor-spar, tourmaline, white mica, and topaz are common; beryl forms a rock with quartz, through which tinstone is impregnated. In the alluvial deposits, tinstone is found associated with diamonds, sapphires, zircon, &c. The greater quantity of the tinstone hitherto raised has been from the alluvial, and the "deep leads" which are still being worked, and will probably be greatly developed in the future, closely correspond in their course with the shallow ones. They are worked to depths of 140 to 180ft., and are frequently found below solid floes of basalt. A yield of 5 per cent. tin in lodes, and from ½ to 1 cwt. per cubic yard in deep alluvial deposits, pays for extraction. The total output of tin between 1872 and 1883 is 64,794 tons of ingots, and 13,268 tons of black tin.

MISCELLANEA.

For their steam steering gear in the Liverpool Exhibition Messrs. Amos and Smith, of Hull, have received the highest award.

At the Liverpool Exhibition the gold medal for planing and other wood-working machines has been awarded to Messrs. Thomas Robinson and Son.

Messrs. Charles Burrell and Sons, of Thetford, Norfolk, have been awarded a gold medal at the Liverpool Exhibition for traction and portable engines.

It is stated that Mr. J. A. Longridge has signed an agreement that he is to get a "wire" gun made at the expense of the Government; but he is to receive no assistance whatever from any Government department.

It is stated that his Excellency Liu-ming Chuen has contracted with Messrs. Telge and Co. for the construction of a telegraph line from Tai-nan to Tai-pei. Messrs. Jardine, Matheson, and Co. have obtained a contract for laying a cable from Amoy to Hoo-mee—Formosa—the cost of which is estimated at 210,000 dols. It is expected that both of these lines will be completed before the end of this year.

A good deal of stir is being heard just now concerning the signalling arrangement on board our men-of-war for communication between the officers on the upper deck and the engine room. The speaking tube is in use as an auxiliary to the mechanical and electric systems, but complaint is made of all these as unsatisfactory, and a committee has been appointed at Portsmouth, consisting of Captains Tracey and Long, and Messrs. Alton, Sennett, Durston, and Deadman, to consider the question.

Mr. Philip Jenkins was entertained to dinner on Tuesday night by the members of Lloyd's Register Cricket Club, at the Holborn Restaurant, on the occasion of his leaving the service of Lloyd's Register of British and Foreign Shipping to enter upon his duties as Professor of Naval Architecture and Marine Engineering in the John Elder chair at the University of Glasgow, to which he has recently been appointed. Mr. Benjamin Martell, the society's chief surveyor, presided, and was supported by a large gathering of the London staff of the association.

A circular from Messrs. Easton and Anderson announces that the partnership which has existed for the past eight years between themselves and Mr. W. E. Rich, M. Inst. C.E., having expired by the effluxion of time, Mr. Rich retires from the firm, and intends "to commence business as a consulting engineer, in which career the experience he has gained during the nineteen years he has been associated with our firm will, we think, be found very advantageous, and he carries with him our best wishes for his success." Mr. Rich is so well known in connection with the best practice in steam engineering, waterworks, and special machinery, that his partners may be sure of his success.

The Gloucester Corporation has under its consideration a great financial scheme involving an outlay of over a million sterling, with a view to restoring some of the lost prosperity of the city and port. It is proposed that the Corporation should buy up the docks and canal with all existing rights. The nominal value is placed at something over a million. It is estimated that the whole might be purchased for about £900,000. In addition to this it would be necessary to expend £100,000 on external improvements, including a new dock at Shepperdine or elsewhere down Channel, and £60,000 on internal improvements, including the widening and deepening of the canal between Gloucester and Sharpness—sixteen miles in length—and the provision of extra dock accommodation. The realisation of the scheme would necessitate, it is thought, an outlay of about £1,060,000.

The Duke of Sutherland has, we are informed, after testing Kirkaldy's live steam feed-water heater on his steam yacht Sans Peur, and finding a saving as between 5 tons 2 cwt. as against 6 tons per 24 hours, given instructions that a similar heater be fitted in his yacht Catarina. The saving ascertained by the Duke of Sutherland is confirmed by the very large saving made by the Bridge Cement Company, and although it seems impossible to explain the origin of the gain, a considerable number of users have entirely satisfied themselves respecting it. Indirectly it can easily be imagined that a boiler may have its efficiency enhanced by better circulation resulting from the use of very hot feed, but nevertheless the demands of theory are not satisfied. The object, however, of the maker is not so much to make a saving in fuel as to prolong the life of boilers by supplying them with hot-feed at all times.

A 100-ton crane has just been completed by Messrs. Higginbottom and Mannock, of the Crown Ironworks, West Gorton, Manchester, for Messrs. Sir W. G. Armstrong, Mitchell, and Co., Newcastle-on-Tyne. The crane is of the Goliath type, having a lift of 50ft., and is intended for dealing with the heaviest class of castings. The crab has two barrels, both hoisting at once, and by an ingenious arrangement the weight of crab and load is equally distributed over eight wheels. The crane is rope driven, and the reversing is effected by means of friction clutches, which drive steel worms working into gun-metal worm wheels. All wheels and axles are of steel. The weight of the crab and chain is about 25 tons; the length of the chain is about 220ft. The snatch block is of Lowmoor iron, and is so arranged that the heaviest loads can easily be turned by the hand when suspended. Altogether the crane is of massive proportions, and of good design in general and in detail, and highly creditable to Messrs. Higginbottom and Mannock.

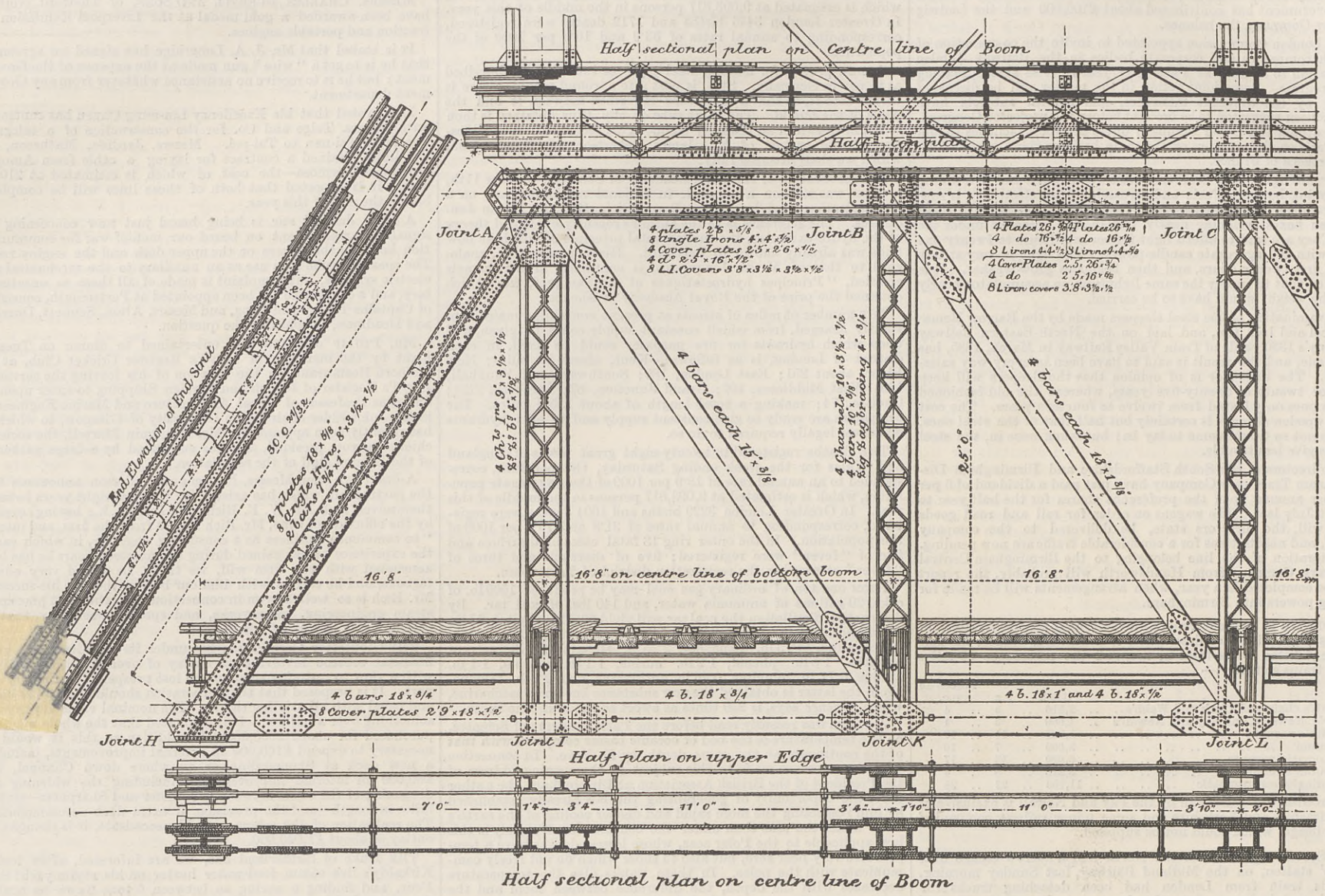
Sir Charles Mark Palmer, M.P., has been telling the people of Jarrow what he thinks of the signs of the times. The occasion was a banquet given by the mayor of that not very ancient borough, though by the way, it possesses a church dating from the time of the Venerable Bede. An address was presented to the honourable baronet congratulating him on the honour recently conferred upon him by her Majesty the Queen. Of course he had to reply, and in doing so did his best to make his audience pleased with themselves, and with the past, present, and future of Jarrow. He reminded them of the John Bowes, the first iron screw collier built in 1851 by his firm, and which is still afloat, an abiding witness to the enduring qualities of iron as a shipbuilding material. The venture was not only a successful one from the point of view of an engineer and a naval architect, but also from that of a commercial man seeking only profit. The pioneer steam collier was followed by many others, and gradually the Tyne, and subsequently the Wear, the Tees, and the Hartlepool became famous throughout the world for the fine cargo boats built, equipped, and sent to sea from those localities, until all the oceans of the world are now teeming with them.

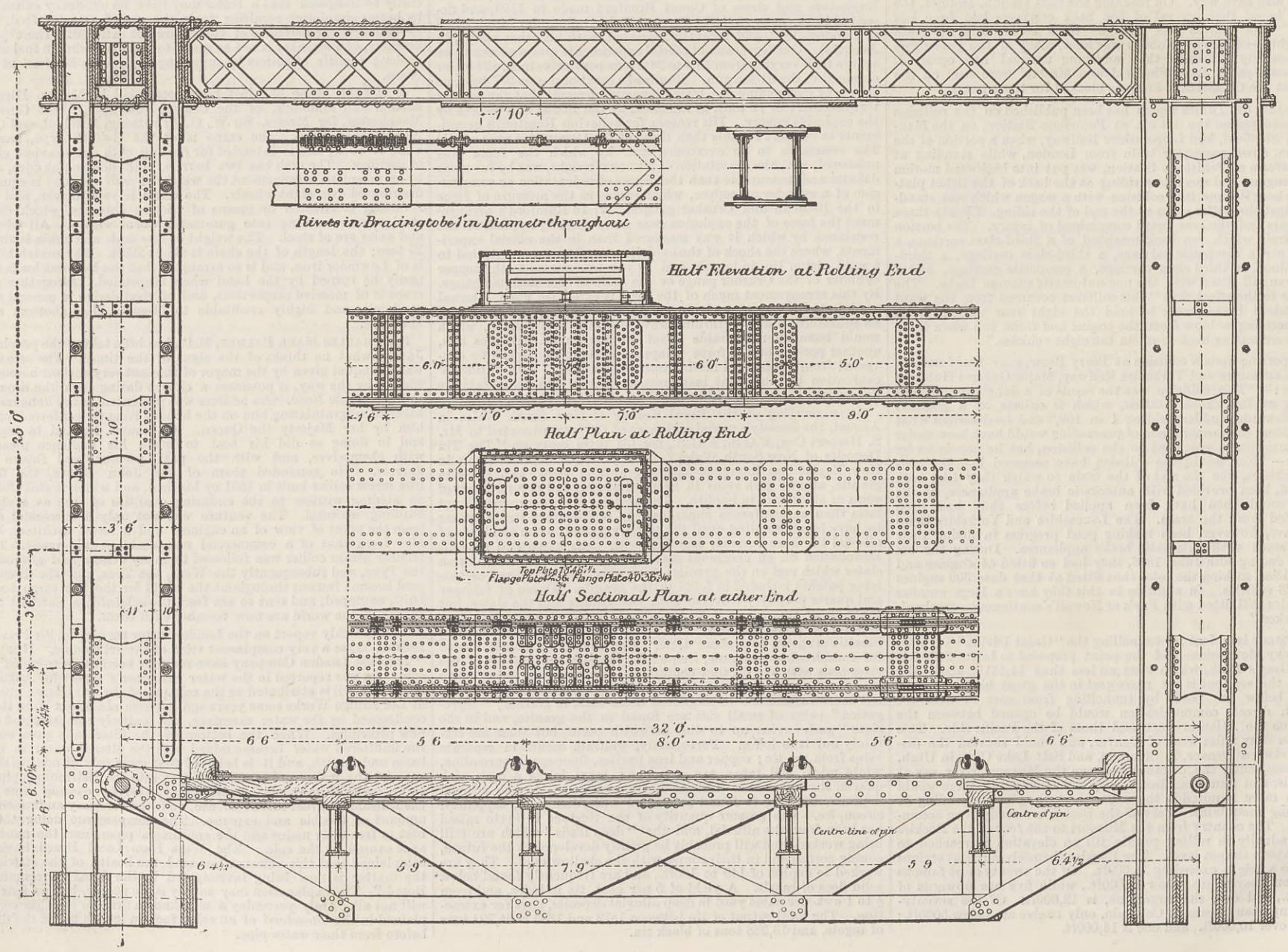
The monthly report on the London water supply, by Sir Francis Bolton, takes a very complacent view of the eel trouble. It says: "The East London Company have recently been again troubled by eels. As was reported in the water examiner's report for August, 1884, this evil is attributed to the collapse of the Middlesex filters at Lee Bridge Works some years ago. These old filters were then condemned by the water examiner, and entirely reconstructed on new principles. When the bottom of the filter beds gave way, the unfiltered water became mixed with the filtered water in the basin underneath, and it is believed that some eels of minute size entered the mains and found their way into the distributory pipes and have since multiplied considerably, thereby causing some of the consumers great inconvenience, and the company an immense amount of trouble and expense. The company are doing their best to free their mains and the consumers' pipes from the annoyance caused by the eels. The West Ham Local Board having complained that this nuisance menaced the health of the district, the matter is now being investigated by the Local Government Board." The explanation may satisfy some people, but we fear it will not all. Only yesterday a well-known firm in the City complained in the *Standard* of an eel a foot in length taken the day before from their water pipe.

RAILWAY BRIDGE OVER THE RIVER RIACHUELO.

MR. EDWARD WOODS, PRES. INST. C.E., ENGINEER.

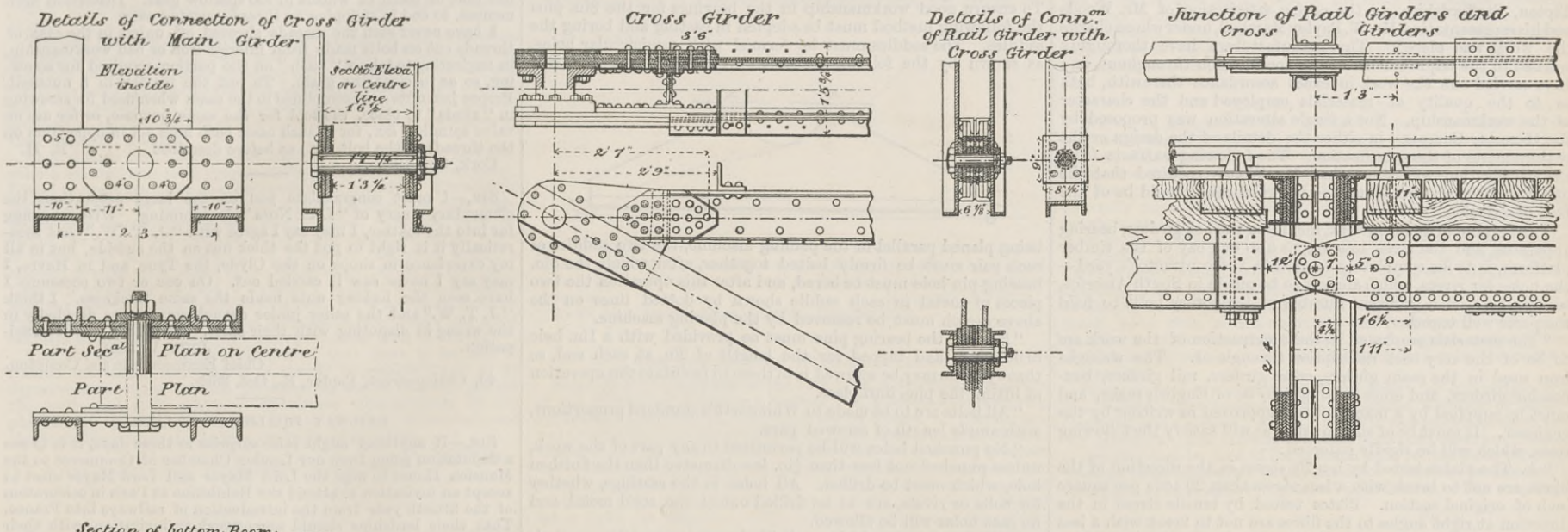
(*For description see page 345.*)

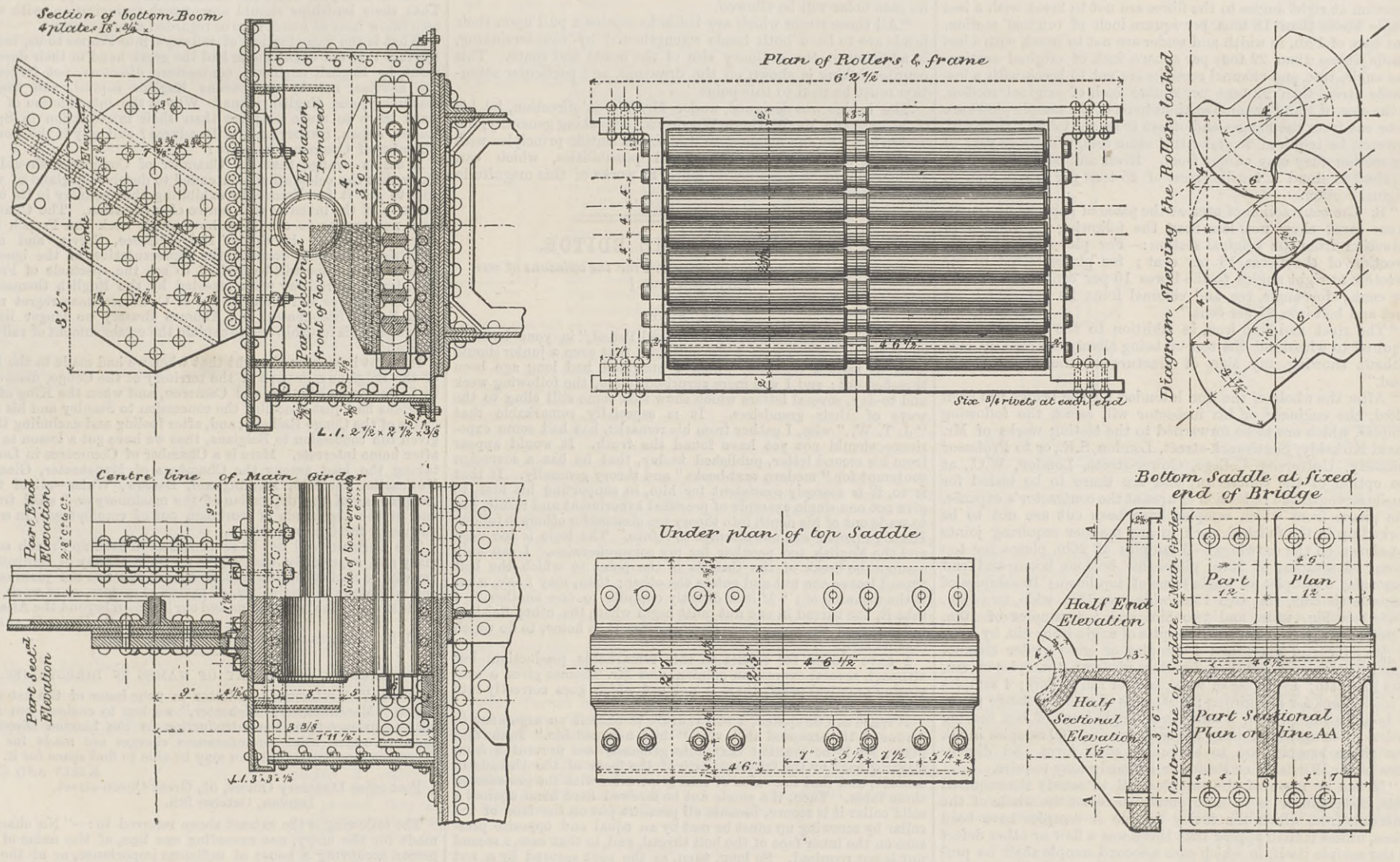




RAILWAY BRIDGE OVER THE RIVER RIACHUELO.

MR. EDWARD WOODS, PRES. INST. C.E., ENGINEER.





RAILWAY BRIDGE OVER THE RIACHUELO.

IN THE ENGINEER of the 8th inst. was published a page of engravings illustrative of a fine bridge for South America, the engravings including a general elevation to a small scale, a part elevation to a larger scale, plans, plan and sections of counter bracing, and the arrangement of the bolts and distance pieces for the booms and counter bracing. Through the courtesy of Mr. Woods we are now enabled to give on page 344 and above further engravings of details, and on page 325 was given a perspective view. This bridge is to carry the Buenos Ayres and Ensenada Port Railway over the Riachuelo, near Buenos Ayres. It has been constructed, and is now being erected under the direction of Mr. Edward Woods, President Inst. C.E., who is engineer-in-chief to the railway, the design and the whole of the drawings having been prepared in Mr. Woods' office.

The bridge is particularly interesting as a recent example of English construction, and on account of the care which has been taken with the design and all the details. Amongst the special points of interest in the design is the adoption and arrangement of articulated joints between rail girders and cross girders and between cross girders and main girders. In each of these the axis of the connecting pin is placed in the vertical axis of gravity of the girder to which the connection is made, thus avoiding all twisting stresses in the structure. This alone is of much importance and interest. In designing the main girders particular care has been taken to secure to each element its due, and only its due, proportion of the total stress. This is only possible where the pin form of connection previously mentioned is adopted, and it is easier in this case, as the girders may be taken as composed of four equal elements. The connections of the various members forming the main and cross girders respectively have been designed to fulfil the requirements of "uniform stress," the importance of which was first pointed out by Professor Callcott Reilly in a paper read before the Institution of Civil Engineers in 1865. These requirements may be shortly defined in the following terms:—(1) That the deflections of the rail girders, cross girders, and main girders, shall not cause deviations in the positions of the lines of action of the several supporting forces. (2) That the mean fibres respectively of the members meeting at any joint shall intersect at one point, and that this point shall also be the centre of gravity of the group of rivets or pins constituting the joint. (3) That the centre of the leading rivet hole in any joint or bar subject to tension be placed in the mean fibre of the bar.

An ingenious detail in the design is the form given to the expansion rollers, the peculiarity of which is that it allows of the use of rollers of practically 6in. in diameter, but placed so that they are only 4in. apart centre to centre. This is shown by the engravings above.

The bridge is constructed to carry a double line of railway of 5ft. 6in. gauge, with a space of 8ft. between the lines of track. In consequence of the requirements of the Argentine Government, namely, that the intensity of the stress upon the metal shall in no case exceed 3·81 tons per square inch, or 6 kilog. per square millimetre of section both in tension and compression, when the bridge is loaded throughout its length with a rolling load of 1·064 tons per foot, or 3·5 metric tons per metre run of span on each line of railway, the bridge is necessarily a very heavy one.

In the design a rolling load has been provided for, of 18 tons per bay, or 1·08 tons per foot run of span on each road, which is slightly heavier than the Government requirements. The stresses upon the cross girders, rail girders, and their connections have also been computed with reference to the distribution of weight in the heaviest engines in use on the railway. The dead weight of the superstructure with rails, chairs, and platform complete, is estimated to be 637½ tons. The units of load per bay per girder therefore become—

Dead load	21¼ tons.
Live load	18 ,,
Total load	39¼ ,,

The following are the principal dimensions of the bridge:—

Length, centre to centre, of bearings	250ft. 0in.
Depth of main girders, centre to centre of booms, one-tenth of span, or	25ft. 0in.
Main girders, distance apart centre to centre	32ft. 0in.
Cross girders are placed at a distance apart centre to centre which divides the main girder into fifteen equal bays, viz.	16ft. 8in.
Depth of cross girders, centre to centre of booms	3ft. 6in.
Depth of rail girders, back to back of angle irons	1ft. 4in.

The main girders were set out in the workshop to a camber of 6in. in the centre measured from the horizontal line. The cross girder fastenings being set out to give a camber of 2·5in. in the centre from the horizontal line, it is calculated that the dead load of the bridge will reduce the camber by about 1·5in., so that when erected and unloaded there will be a camber of 4·5in. in the main girder and 1·0in. in the permanent way.

Stresses and sections.—It will be interesting to refer to some of the leading stresses in the structure. The bending moment at the centre of each of the main girders, when the bridge is completely loaded, is 18,300 foot-tons, and as the mean depth of the girder is 25ft., the stress on the booms at centre is 732 tons; this, with a limit of stress intensity of 3·81 tons per square inch, requires a sectional area of 192·1 square inches. The actual sections provided are—

Top boom.—Four plates 26in. by 1in. = 104 square inches; four plates 16in. by ¾in. = 48 square inches; eight L^3 4in. by 4in. by ¾in. = 43·5 square inches; total section provided, 195·5 square inches.

Bottom boom.—Twelve plates 18in. by 1in., deducting two 1in. rivet holes from each, the effective sectional area becomes 12in. by 16in. by 1in. = 192 square inches.

Stresses in web.—The following cases serve to illustrate the web stresses:—The vertical strut between the joints as in the one that has to resist the heaviest stress, which stress may be stated as follows:—78 × unit of moving load, plus 75 × unit of dead-load, all divided by 15 $= \frac{78 \times 18 + 75 \times 21{\cdot}25}{15} = 199{\cdot}85$ tons, which requires 52·45 square inches of section. The sectional area provided is: Four channel irons 10in. by 3½in. by ½in. = 32 square inches; four bars 10in. by ⅝in. = 25 square inches; total section provided, 57 square inches.

The maximum stress upon the end diagonal ties, namely, those between joints H and K, is $= \frac{91 \times 18 + 90 \times 21{\cdot}25}{15}$ × cosecant $\theta = 236{\cdot}7 \times 1{\cdot}2 = 284$ tons, requiring 74·55 square inches of section. The section provided is, four bars 15in. by 1⅜in. Deducting one 1in. rivet hole from each, the effective sectional area becomes 4 by 14in. by 1⅜in. = 77 square inches. The maximum stress upon the end inclined strut, namely, that between joints A and H, is equal to seven units of total load multiplied by cosecant of $\theta = 39{\cdot}25 \times 7 \times 1{\cdot}2 = 329{\cdot}7$ tons, requiring 86·5 square inches of section. The sectional area provided is: Four plates 18in. by ⅝in. = 45 square inches; two bars 7¾in. by 1in. = 15·5 square inches; eight L^5 8in. by 3½in. by ½in. = 44·0 square inches; total sectional area, 104·5 square inches. It may be mentioned that in the perspective view which

we published last week, the diagonal wind bracing was not shown as indicated in the plan given in our impression of the 8th inst. This was simply because this wind bracing was not in place when the photograph was taken in the builder's yard.

The work has been executed by the Horseley Company, Tipton, Staffordshire, to the entire satisfaction of Mr. Woods and his representative, Mr. W. Bayley Marshall, under whose charge the work was placed. The manufacturers have thoroughly worked to the requirements of the specification throughout, and have carried out the work in exact accordance therewith, both as to the quality of materials employed and the character of the workmanship. Not a single alteration was proposed by the Horseley Company in either the details of the design or the requirements of the specification. The following extracts from the specification will show that Mr. Woods required that the quality of the materials and the workmanship should be of the best description.

"The whole of the ironwork, including the box girders, bearing apparatus, and the cross bracing, as also one bay of the timber platform, is to be completely erected in the contractor's yard—the holes for rivets, which are left to be put in in South America, being filled with a sufficient number of temporary bolts to hold the parts well together."

"The materials employed in the construction of the work are to be of the very best description throughout. The wrought iron used in the main girders, cross girders, rail girders, box-bearing girders, and cross bracing is to be of English make, and must be supplied by a manufacturer approved in writing by the engineer. It must be of such quality as will satisfy the following tests, which will be rigidly enforced:—

"A. The plates tested by tensile stress in the direction of the fibres are not to break with a less stress than 20 tons per square inch of original section. Plates tested by tensile stress in the direction at right angles to the fibres are not to break with a less tensile stress than 18 tons per square inch of original section. Flat bars of 12in. in width and under are not to break with a less tensile stress than 22 tons per square inch of original section. The angle, tree, and channel sections are not to break with a less tensile stress than 22 tons per square inch of original section. In the case of T and channel sections some of the sample pieces are to be cut from the flanges and others from the tables; they will, however, be required to stand the same test, whichever part of the section they may be cut from. Rivet and bolt iron will be required to stand a tensile stress of 25 tons per square inch of original section.

"B. The contraction of area at the place of rupture by tensile stress must show not less than the following percentage of reduction from the original section:—For plates tested in the direction of the fibres 15 per cent; for plates tested in the direction at right angles to the fibres 10 per cent.; for bars 20 per cent.; for angle, tee, and channel irons 20 per cent.; for rivet and bolt iron 25 per cent."

"The rivet and bolt iron, in addition to the above will be required to withstand the test of being closely doubled up cold without showing any sign of fracture of the fibres at the bend."

"After the whole of the iron intended for the bridge has been rolled, the engineer or his inspector will select the following samples, which are to be forwarded to the testing works of Mr. David Kirkaldy, Southwark-street, London, S.E., or to Professor Kennedy, University College, Gower-street, London, W.C., at the option of the contractor, and are there to be tested for tensile strength and reduction of area at the contractor's expense. The pieces from which samples have been cut are not to be worked up in the finished work in any manner requiring joints not shown on the drawings:—6 samples of 26in. plates for top boom; 6 samples of 18in. plates for bottom boom and end diagonals; 6 samples of angle irons of top boom; 10 samples of diagonal tie-bars, viz., two 15in. wide, two 13in. wide, two 12in. wide, two 9in. wide, and two 8in. wide; 8 samples of 10in. channel irons for verticals; 2 samples of angle irons 8in. by 3½in. by ½in., for end diagonals; 4 samples of cross girder channel irons; 2 samples of 9in. bars for cross girders; 2 samples of 8in. bars for ditto; 4 samples of web plates of rail girders; 4 samples of angle irons for rail girders; 2 samples of web and flange plates of box bearing girders; 2 samples of angle irons of box bearing girders; 2 samples of T-irons for cross bracing; 60 samples in all. The above samples are to be cut to such form and dimensions as Mr. Kirkaldy or Professor Kennedy may require.

"If one or more of the samples fail to satisfy the required tests, the engineer is to have power to reject the whole of the materials from which the faulty sample or samples have been taken, unless it shall appear that there was a flaw or other defect in the sample itself, in which case a second sample shall be provided and tested in the same way as the first or faulty sample.

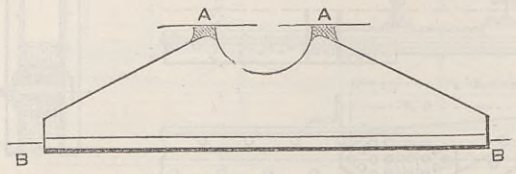
"The twenty-eight cross girder connection pins, the fifty-six rail girder pins, the four 8in. pins for the rocking saddles, and the sixteen expansion rollers are to be of the very best cast steel. The four top saddles, and the four lower saddles, and the two roller paths are all to be of the best description of cast steel, of quality specially suited for the requirements of these castings. The bars forming the two expansion roller frames must be of the best quality of Bessemer or Siemens steel. The contractor must submit the name of the firm from whom he proposes to obtain the steel to the engineer, and must receive his—the engineer's—approval of the said firm in writing before placing the order.

"The rivets and bolts throughout must be of the best quality of Lowmoor iron, or of Messrs. Kirk Brothers' West Cumberland iron.

"The workmanship throughout is to be of the very best possible description. All holes, without exception, are to be drilled, and wherever possible the holes are to be drilled at one and the same operation through the various thicknesses of metal which have to be connected by the rivets. The positions of all rivets are shown on the drawings, and the said positions must be rigidly adhered to. If any holes should be drilled in the wrong places the bar or plate in which such mistake has occurred must be condemned. No plugging to be allowed. The holes for the pin connections of cross girders with main girders and of rail girders with cross girders are to be accurately bored to gauges, so as to be a close fit without being at all loose upon the pins.

"The cast steel pins connecting the cross girders to main girders, and rail girders to cross girders, must be carefully turned to gauges, so that they will be a tight driving fit in the bored holes above referred to. The nuts and thread on these pins must be machined, and split pins must be provided to prevent the nuts slackening back.

"The cast steel rollers must be accurately machined to the forms shown on drawing No. 10, particular care being taken in shaping the rollers and pitching the holes in roller frames to ensure the interlocking of the rollers before the edge of the bearing surface has passed the perpendicular in either direction. This is to be tested by placing the complete roller frame upon a true surface plate and rolling it in either direction until the rollers lock. The top and bottom saddles must be carefully planed on their bearing surfaces. The holes for the 8in. rocking pins must be accurately bored, the holes to be perfectly cylindrical and their axes in each case to be exactly parallel with the bearing surfaces of the saddle and at right angles to the longitudinal centre line of the bridge. To ensure good workmanship in the bearings for the 8in. pins the following method must be adopted in casting and boring the saddles. The saddles must be formed with semicircular holes, as shown by the following sketch:—The faces A A and B B



being planed parallel in the planing machine, the two saddles of each pair must be firmly bolted together, after which the 8in. bearing pin hole must be bored, and after this operation the two pieces of metal in each saddle shown by dotted lines on the above sketch must be removed by the planing machine.

"Each of the bearing pins must be provided with a 1in. hole drilled into and tapped for the length of 2in. at each end, so that eyebolts may be screwed into these to facilitate the operation of lifting the pins into place.

"All bolts are to be made to Whitworth's standard proportions, with ample length of screwed part.

"No punched holes will be permitted in any part of the work, unless punched not less than ¼in. less diameter than the finished hole, which must be drilled. All holes in the castings, whether for bolts or rivets, are to be drilled out of the solid metal, and no cast holes will be allowed.

"All those rivets which are liable to receive a pull upon their heads are to have both heads strengthened by countersinking, in addition to the ordinary size of the heads and snaps. This countersinking is shown on the drawings, and particular attention must be paid to this point."

The bridge was designed, under Mr. Woods' direction, by his chief assistant, Mr. W. Hugh Woodcock. Speaking generally, the design is a genuine attempt to combine scientific principles with practical workshop expediency and possibilities, which can without doubt be more nearly allied in works of this magnitude than in those of smaller scale.

LETTERS TO THE EDITOR.

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

LOCK NUTS.

Sir,—On reading the query of "Lead Pencil," in your issue of the 1st inst., *re* lock nuts, I was surprised that even a junior should wish to raise a question which I imagined had long ago been threshed out; and I was more surprised to see, the following week and to-day, several letters which show that some still cling to the ways of their grandsires. It is especially remarkable that "J. T. W.," who, I gather from his remarks, has had some experience, should not yet have found the truth. It would appear from his second letter, published to-day, that he has a sovereign contempt for "modern text-books" and theory generally. If that is so, it is scarcely consistent for him, in supporting his idea, to give not one single example of practical experiment and result, but to wade out of his depth into theory too obscure for others to follow. His argument I will not attempt to refute. The logic is too deep and the English too peculiar for my comprehension. I can only assume the break of the threads is the point at which the bolt thread leaves one nut and enters the other; then, may I ask, what is the meaning of: "If it is directly opposite to one another." I take it, the thread in one nut must begin where the other finishes, unless one of them can turn further after it is home, to do which it must strip.

I have looked for replies to this remarkable production, but although several express an opinion, and Mr. Thomas gives a convincing practical proof, there is not one which goes correctly into the theory of the matter.

If space can be spared, I will venture to submit an argument in favour of the accepted idea, viz., "thick nuts outside." In the first place, let it be granted that nuts generally are prevented from slacking back by the frictional grip of the faces of the threads in contact, and that the value of that grip varies with the pressure on those faces. Then, if a single nut be screwed hard home against a solid collar it is secure, because all pressure put on the face of the collar by screwing up must be met by an equal and opposite pressure on the inner face of the bolt thread, and, in that case, a second nut is not required. So long, then, as the part secured by a nut on a bolt is free from vibration and offers a steady resistance to the nut, it is equivalent to the collar referred to, and a second nut is unnecessary; but, as soon as it begins to vibrate, it will in effect alternately strike and leave the nut to a greater or less degree, and, during those minute intervals of time when it does not bear on the nut, it must of necessity leave it free to turn. This brings us to the conclusion that what is required is something equivalent to the collar on the bolt, against which the main nut may always bear, and which will be independent of the vibration of the part secured; and, I take it, this is the purpose the lock nut is designed to serve.

It is then evident: First, that the lock nut must be the inner one; secondly, that to be of service as a lock nut, it must have no share in supporting the vibrating piece, but must bear on the outer face of the bolt thread, so as, at all times, to resist the main nut, which of necessity bears on the inner face; thirdly, that if the first nut is jammed up and left bearing on the inner face with the second jammed on top of it, there can be no security. For, since both bear on one side of the thread, directly the inner nut is relieved of pressure it will in turn relieve the outer, and both will be loose. If it is required to fix lock nuts, where the work must be screwed up tight as, instanced by some correspondents, the first nut may be screwed right home, the second screwed home on top, and then the first turned back against it, just enough to transfer its bearing from the inner to the outer face of the bolt thread, which will be done without withdrawing it from its work in the least.

If these conclusions be accepted, I think it will be seen that the strain on the outer nut is in an outward direction, and is that due to the work plus that due to the pressure of the inner nut on the thread; while that on the inner nut is in an inward direction, and is equal to that on the outer nut minus that due to the work. Therefore, thick nuts outside. Springbows.

October 15th.

Sir,—I would not again seek to encroach on your valuable space, only I find some of your correspondents seem to be a little mixed in their ideas as regards the action of lock nuts. *Sine quâ non*, both nuts must be a good fit on bolt. It is a gross mistake to think slack nuts can be jam nuts proper. Nuts to lock must act in opposition—*i.e.*, the outer one causing tension on the bolt; the inside one causing compression on the bolt, because the inside nut must creep the thickness of the "shake" after being tightened up, before it becomes a jam nut proper of the system. Stripping will not occur, because the strength of a very few tight-fitting threads are equal to that of the section of the bolt. Take the case of a tight nut on an inch bolt—eight threads to the inch—and supposing shearing resistance to equal cohesive resistance, two threads will have equal area with bolt; nut of eight threads will have a factor of four; nut half thickness will have factor of two. But in the case, the nuts being slack fit for the bolt, the conditions are vitiated, for threads are exposed to leverage, resulting in bending action like that of teeth of wheels in too shallow gear. Distortion commences, to end in stripping by threads turning over.

I have never seen the threads sheared off unless in the case of threads cut on bolts made from inferior iron or bad workmanship, in neglecting to take a "wash" on the portion required for screwing, so as to close the grain. To put the matter in a nutshell. Proper jam nuts are exemplified in the cases when used for screwing in "studs" to place, the tool for the same purpose, or for use on valve spindles, &c., for in such cases both nuts act in opposition on the threads of the bolt, &c., as before described. R. H.

Cork, Oct. 19th.

Sir,—I must congratulate you on the large proportions the elementary query of "Lock Nuts" is assuming. Without going far into the matter, I may say I agree with "J. T. W." that theoretically it is right to put the thick nut on the outside, but in all my experience in shops on the Clyde, the Tyne, and in Havre, I may say I never saw it carried out. On one or two occasions I have seen the locking nuts made the same thickness. I think "J. T. W." and the other junior draughtsman were decidedly in the wrong in disputing with their chief. Thanking you in anticipation.

John Wilson,
Chief Engineer late s.s. Compton.

40, Chrisp-street, Poplar, E., Oct. 26th.

RAILWAY JUBILEE IN FRANCE.

Sir,—If anything might raise surprise in these days, it is to see a deputation going from our London Chamber of Commerce to the Mansion House to urge the Lord Mayor and Lord Mayor elect to accept an invitation to attend the Exhibition at Paris in celebration of the fiftieth year from the introduction of railways into France. That their lordships should accept such an invitation, with their own Show near at hand, is to be regarded as surprising.

What is the introduction of railways into France to us, besides the fact that our countrymen had the great hand in their development, by English engineers, contractors, directors, not forgetting the navvies, nor by any means English capital, and English machinery, and English plans? Why is the introduction of railways there to move us more than their introduction in Spain, Russia, Japan, Switzerland, or Honduras? and why is the London Chamber of Commerce to move?

It seems strange that our Chamber of Commerce should not know that the celebration is intended to deprive England of work and to get it for France, by exhibiting that country in its usual attitude of the inventor and centre of civilisation. The Chamber does not appear to count up how much work the French have driven us out of in Spain, Italy, Greece, Servia, and other countries. On this occasion the representatives of the ignorant nations in Europe will be invited to see the spectacle of French superiority in railway work attested by the English themselves. The Lord Mayor and the Chamber of Commerce may regret much that Robert Stephenson and Thomas Brassey no longer live to accompany his lordship and to explain the establishment of railways in France.

It might have been thought that when we had made to the King of the Belgians a present of the territory of the Congo, discovered by Livingstone, Stanley, and Cameron, and when the King of the Belgians had just cancelled the concession to Stanley and his associates of the Congo Railway, and, after fooling and excluding them, given the concession to Belgians, that we have got a lesson to look after home interests. Here is a Chamber of Commerce in London taking the lead among the Chambers of Manchester, Glasgow, Newcastle, Sheffield, Birmingham, Barrow, Wales—all of them complaining of the depression of the machinery and steel trades, and of the thousands of workmen out of employment, in consequence of foreign competition.

The Germans will not be so unwise as to back up French supremacy and superiority, and to give up their chance of competition among the nations of the earth. France has not the justification and advantage of originality, of extent of system, or of work, that she is to claim the lead over us and our kinsmen beyond the Atlantic.

Hyde Clarke.

32, St. George's-square, S.W., October 25th.

CHARGING FOR ENTRY OF NAMES IN DIRECTORIES.

Sir,—With reference to a letter in your issue of the 1st inst., signed "Manufacturer, Colchester," we beg to enclose you herewith an extract from the introduction to the London Directory, showing under what circumstances charges are made for that Directory, and trust that you may be able to find space for it.

Kelly and Co.

Post-office Directory Offices, 51, Great Queen-street, London, October 9th.

The following is the extract above referred to:—"No charge is made for the entry, not exceeding one line, of the name of any person occupying a house of sufficient importance, or of the sole occupant of any office or chambers; but if the entry exceeds one line, the excess not arising from the length of the name of the firm, or of the address, a charge will be made for the excess above one line. A fashion has recently sprung up for one or more individuals, not being registered companies, to trade under some fanciful title, as when 'William Smith,' instead of having his name entered as 'boot and shoe maker,' requires to be entered as the 'Brixton Benevolent Boot and Shoe Supply Association,' or 'John Brown,' instead of calling himself 'dealer in wines and spirits,' wishes to be entered as 'The West End Wholesale and Retail Association for the Supply of Genuine Wines and Spirits.' These entries not only unnecessarily occupy space, but cause much trouble in preventing mistakes between two of similar name. In all such cases the whole entry is charged for, but the person always has the option of having his real name entered free."

GROYNES ON SHIFTING BEACHES.

Sir,—Will you allow me to supplement my letter in your issue of August 27th by a few remarks on the effect of the recent heavy seas on the groynes at Brighton, as I think, if carefully examined, an instructive lesson may be learned?

The wind was south-westerly, and therefore, after the storm had passed, more shingle was to be found on the west side of the groynes, but not one single groyne from the east to the west of Brighton and Hove but had lost shingle from both sides. Each groyne, without exception, had produced a considerable scour on the east side. Where they had to be fixed opposite to a sea wall, the effect was to drive seawards a large portion of the shingle; but where the groynes were placed opposite unprotected land, both the shingle and a portion of the land behind it were washed away. The parts of the frontage where most damage has been caused are (1) between the Hove eastern boundary and the West Pier, (2) the Aquarium and the Chain Pier, and (3) eastward of Paston-place, Kemp Town. In each of these cases the damage done was immediately to the eastward of some extra large groynes.

In the first case there is a large concrete groyne at the Hove boundary, and the entire roadway eastward, opposite the ornamental enclosures, has been washed away, the enclosure wall being left exposed 8ft. or 9ft. below where the surface of the road was. The sewer and manhole alluded to in my letter have now been completely exposed, the face of the cliff being many feet shorewards of them, and varying in height from 4ft. to 6ft. The second instance is eastward of the two large concrete groynes recently completed near the Aquarium. The electric railway was here supported on timber piles and trestles. These have been washed away, as well as large masses of shingle, as far as the Chain Pier. The

third instance is to the east of the Paston-place concrete groyne. Here a similar occurrence to the one I have before described has taken place. The edge of the cliff is now exposed for a height of from 4ft. to 7ft. to the edge of the roadway. Should by chance another storm arise before sufficient earth has again been carted to satisfy the raging waves, the roadway will again fall a prey to them.

The case has now become sufficiently serious for the authorities to decide how they will deal with their foe. If they continue their old policy of directly opposing it, they should, in face of the foregoing evidence connecting the large groynes with the damage done, be prepared to do so by a heavy wall, as well as massive groynes, so as, irrespective of cost, to offer a constant resistance to their persevering enemy.

As a shingle beach is the most natural protection, and as I consider a sea wall and solid groynes drive the shingle into deep water, I wish to draw attention to other methods of security. The shingle is driven along by the waves, and would be deposited near high-water mark were it not for the water, which, after the wave has struck the wall or solid groyne, is forced to return seawards, when it carries the shingle with it. If therefore the wave could be allowed to pass with little or no obstruction, whilst at the same time it is robbed of its load of shingle, I think it will be admitted that the desired object would be attained. It is to attain this end that I advocate the use of open groynes, as they retain the good features of the solid groynes without producing their ill-effects.

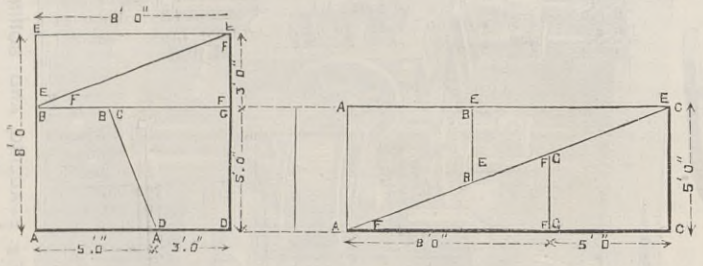
The late storm has abundantly proved that there is no lack of shingle travelling, but that it is simply impossible for it to be deposited amidst the turmoil produced by waves dashing against the walls and solid groynes. Substitute open gratings for the planking of the solid groynes, as I have so often advocated, and the desirable change would soon make itself apparent.

A. Dowson.

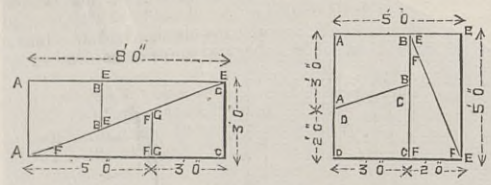
3, Great Queen-street, Westminster, October 27th.

SUPERFICIAL AREAS.

Sir,—Would any of your readers kindly explain the annexed problems in superficial areas? Suppose I had a sheet of iron 8ft. square, the area of which is 64 square feet, and I had to cut it in any form so that I would have a rectangle 13ft. by 5ft. The area of the sheet, to start with, is 64ft., but when cut and placed



according to sketch it is 65 square feet. As will be seen, it is easily done. Now reverse the rule, and take a rectangle sheet 3ft. by 8ft., the area of which is 24 square feet, but by cutting it in a like manner we can make it 5ft. square—nearly—which is an area of 25 square feet. In both cases there is a gain of 1ft., as it were, out



of the impossible. I have tried to calculate it all ends up, but to no purpose. I trust that you will publish the above, and that some of your readers will solve the mystery.

Jas. MacDonald.

Hartlepool, October 25th.

THE PROELL ENGINE.

Sir,—In your issue of the 22nd inst. I noticed a description and illustration of the Proell high-speed engine, and should be glad if you could find space for some corrections and additions which are likely to remove an erroneous impression about the construction and performance of this engine. It was only in an experimental engine of this kind that Dr. Proell employed a valve of conical construction. At present they are made quite cylindrical, nearly perfectly balanced, and by a simple gearing the valve receives a lateral motion at a different ratio to the rocking one, whereby the friction on the face is reduced, and at the same time the face is enabled to grind itself tighter by long use. Although the setting of the eccentric by a governor in the fly-wheel has been attempted before, I think that the governor is entirely novel in construction, and, as you will see from the diagrams which I enclose, Figs. 1 and 3, it solves the question of automatic expansion in a high-speed engine in a most perfect manner. The two principal features which contribute to this success are:—(1) The application of only one single spring, the axis of which goes through the centre of the shaft, and in consequence the great disturbing influence due to the centrifugal force of laterally-arranged springs is entirely obviated. The spring is further in a state of compression, and its considerable length—which is unattainable in other constructions—allows the coils of the same to be wound so closely that the breaking of the spring does not make any appreciable difference in the running of the engine, as only the elasticity of one coil is thereby lost, the broken ends settling on one another. (2) The application of the auxiliary weights q, which, during the first part of the opening of the governor arms assist the opening, while when they have passed their middle position they counteract the opening tendency, thereby attaining an approach to accuracy not reached before.

Fig. 1

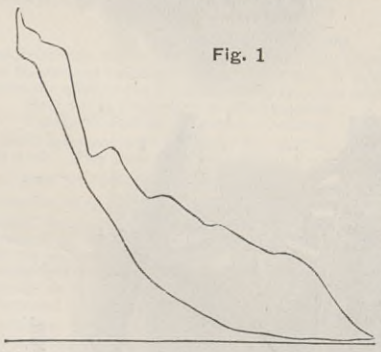
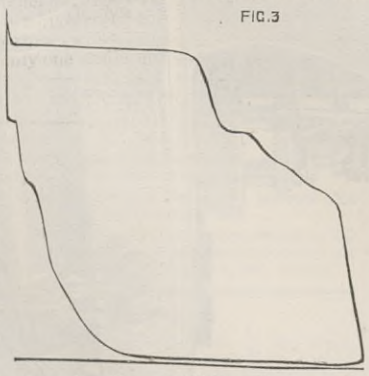
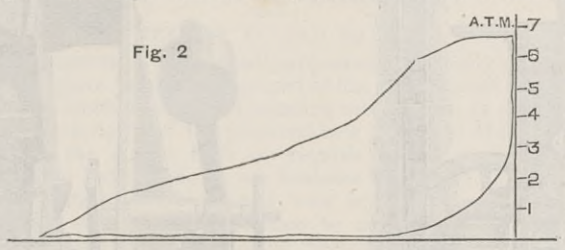


FIG.3



The speed of 180 revolutions per minute, to which your contemporary refers, was one used at a trial, when, owing to deficient arrangements of the indicator gear, it was found impossible to indicate the engine at a higher speed than 180. Enclosed I beg to hand you copies from an engine of this kind, Fig. 2, with cylinders of 14in. by 20in., indicating about 100-horse power, running at 242 revolutions, or a piston speed of about 800ft., which, with another of the same kind, drives the electric lighting installation of the National Theatre at Buda Pesth. At Adamsthal, in Bohemia, one of these engines has been at work for many months with 350 revolutions

Fig. 2



per minute, which I think will prove that the system may be classed among the successful ones, attaining a modern high speed under the perfect control of a reliable automatic expansion governor.

Hermann Kuhne.

25-35, New Broad-street, London, October 25th.

THE FRICTION OF HYDRAULIC RAMS.

Sir,—In The Engineer of the 17th prox. a description is given in the column of "Railway Matters" of a locomotive weighing apparatus, which is being manufactured by Messrs. R. Stephenson and Co. On the 14th July, 1858, when in the employment of Messrs. Neilson and Co., Glasgow, I was instructed to have put in below the wheels of locomotive 450, which was about completed, six short hydraulic rams which had just been got into store, together with the pressure gauges for them, to weigh this engine, before taken down for shipment. The cylinders of these rams were 7in. in diameter by 4½in. deep, while the rams were 5in. deep, and, of course, mounted with cup leathers on the lower ends. These leathers presented a ring to the cylinders of about ⅛in. deep all round. They were new, and quite a good job. This locomotive was one of ten then being constructed for the Bombay and Baroda Railway, had 16in. by 22in. cylinders, and the four hind wheels coupled. I had all ready and coupled to the water service, and tried before noon the next day, as desired, so as not to disappoint the inspecting party, who were to arrive at the works at that hour. I showed them the engine raised and lowered on the rams, and when up for the third time they took the pressures indicated on the gauges, and retired to the office to make up the quantities. I did not hear a word drop from either of the gentlemen as to what the probable friction would be of the six rams, or if taken into account by them at all. I had noticed that when the engine with the rams was being lowered that the gauges indicated considerably less pressure than when being raised. My object was not so much to know the weight of engine as to gain a little knowledge of the ram friction; and to ascertain, as near as possible, what this friction was, I set about making out. I placed a man at each of the six rams, while the pumps raised the engine up nearly 2in.; when each of them took the indications on his gauge, and placed his finger on the ram on top of cylinder, so that he might feel and call out the moment he felt the ram move downward. The indications on the gauges were seen to have fallen from 10 lb. to 11 lb. at the point of movement; and although the engine was lowered over an inch farther, the gauges remained practically the same. But to prove that no error had crept in, the experiment was gone over again and the pumps set to work. The pressure gauges were observed to gradually regain the lost 10 lb. or 11 lb., and took their stand there, however far the rams were pumped up. The return water tap was again turned, to let the water finally off the rams, when the gauges again gradually lost the 10 lb. or 11 lb. before the rams made a move downward; so I concluded, whether right or wrong, that full 5 lb. per square inch was the friction on the united area of the six rams. I very much regret that I cannot now give the figures indicated on the different gauges, as I have lost the little vest pocket note-book in which I then jotted them down.

W. Robertson, Engineer.

Dublin, Oct. 26th.

THE LATE MR. ALLIBON.

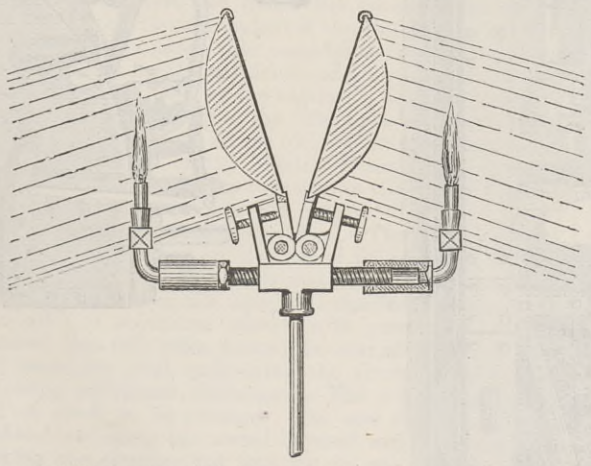
Sir,—Permit me to correct two slight mistakes in your last week's issue. They occur in a short article on the career of my father, the late Mr. George Allibon. The first is that the name of his partner at Gravesend was Noyes not Noyds; and the second, that he left Messrs. Leyland in 1883 and went as superintendent engineer to the Inman Steamship Company, in whose service he was at the time of his death.

George H. Allibon.

Sea View, Litherland Park, October 25th.

STREET LIGHTING.

Sir,—Not until each street lamp is turned into a miniature lighthouse, distributing the rays of light from the gas by reflection or refraction, can we say that gas has been fully utilised. We have many lamps burning a great quantity of gas, giving off a powerful light, and reflected in bright patches immediately under the lamps, while between the lamps is in comparative darkness. Amongst many plans we have devised for the all-round system of lighting by reflection or refraction, we consider, for narrow streets, throwing the beams of light right and left along the pavement to be preferred, allowing the gas of itself to light across the street, and which is aided by the spreading of the rays from the double lenses, as per engraving, which we have practically tested in one of the lamps at the municipal buildings here, which we have been kindly



granted the free use of by the authorities. There are two convex lenses placed closely together at the bottom, with the convex surfaces inclined downwards, and which can be set at any angle that may be determined on with the small set screws as shown; likewise, the jets can be adjusted as shown, but this may be entirely dispensed with on ordinary occasions, the lenses and jets being quite rigid and immovable. The gas jets are placed in front of the lenses and are always visible. The rays from the one are refracted through the convex surface, and, being caught up by the other lens, are refracted downwards on the pavement at any angle that may be desired. It will thus be seen that the rays from the one light are refracted through the other light, and *vice versâ*. With this plan there are no shadows as with reflectors. A stream of soft light is thrown right and left along the pavement, and partially distributed across the street, and is by no means hurtful to the eye, while the gas of itself lights up the foot of the lamp and across the street. The gas remaining always visible is the main feature in this arrangement. We may mention that the lenses are 4in. in diameter, but would recommend 6in. lenses as preferable.

Portobello, N.B., October 20th.

John G. Winton.

RAILWAY COUPLINGS.

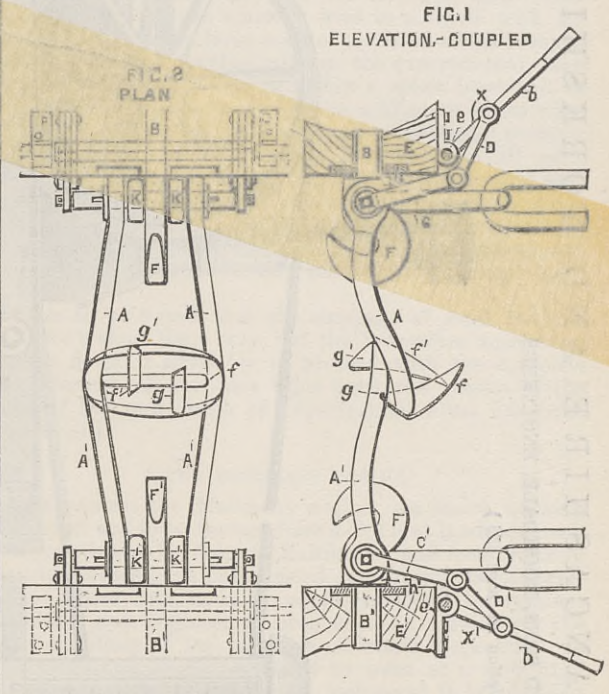
Sir,—The abstract of Mr. Heinke's paper, contained in your last issue, suggests the following remarks; the insertion of which, I trust, will be justified by the importance of the subject to railway companies, their servants, and the general public.

Passing over Mr. Heinke's introductory remarks as being generally admissible, we come to his statement of the requirements of an ideal coupling, the various propositions being such as may be generally admitted so far as they refer to cost, applicability and facility for coupling with stock not so fitted; also to varying lengths and levels of buffers. But it will not suffice for a coupling to be capable of being worked by hand from the side only. It should be an efficient automatic coupling, and need not cost much more than a non-automatic one; and there can be no question as to the fact that it would effect a great saving in time and labour, as well as being an increased factor in the means of saving life.

In support of my arguments I will select for comparison with Mr. Heinke's non-automatic the automatic coupling of Messrs. Copeland and Gilmour; which I think is not more expensive than Mr. Heinke's. The existing drawbar, hook, and chain are retained, it can therefore be used in conjunction with rolling stock otherwise fitted; a large immediate outlay need not therefore be incurred by its adoption, as it allows of gradual introduction. The coupling is

FIG.1
ELEVATION.-COUPLED

FIG.2
PLAN

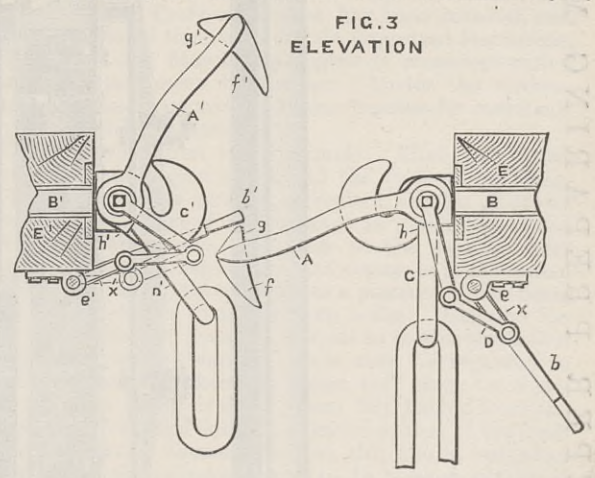


effected at two points, and being formed in one piece, without springs, it appears to me to be unlikely to get out of order. It does not interfere with end flaps of timber wagons, &c.; is certain in action on curves or otherwise, and can be readily uncoupled from either side, and fixed securely out of action by a slight continuation of the lifting movement of the hand lever, can be worked readily, even on the darkest night, without the aid of a lantern, and can also be uncoupled in ordinary tension without backing, &c. Moreover, when fixed out of action, it is quite clear of dead stops, it being within the line of the dead buffers, and as the length of the coupling is proportioned to the length of the stroke of the springs of the trucks to which it is fitted, there is no risk of the fouling upon which Mr. Heinke lays so much stress.

It will be seen from the above remarks that it is possible for an automatic coupling to fulfil all the requirements, and others which Mr. Heinke does not suggest.

Now for a comparison of the two systems. Against the instantaneous, certain, and unaided action of the automatic coupling,

FIG.3
ELEVATION



when being coupled, even on the darkest night, we have the tedious process of connecting the Heinke coupling, which requires to be operated upon by a man from the side of the wagon, who has to fish about with a heavy weight and seize an opportunity for coupling. This performance requires much time and judgment, and is entirely a matter of feeling, particularly on a dark night. It is needless to say that in practice the shunters would frequently act with the Heinke coupling, as he states that they do with the pole, give up the use of the coupler, rush in between the trucks, and couple by hand. Another defect in this coupling is that it cannot be uncoupled in ordinary tension, which alone means a great loss of time, compared with a good automatic one. Thus the advantages derived from the use of an automatic coupling in rapidly disposing of the trucks in a crowded goods yard are clearly self-evident.

Finally, Mr. Heinke, a servant of an important company, asks, "What return shall we get for our outlay? &c." Surely, being in such a position and looking at the question in that light, he admits that his employers should obtain some return for their outlay! What would they obtain by the adoption of a non-automatic coupling? I contend, nothing. Even the gain in saving the lives of their servants would be doubtful. But by adopting a good automatic coupling the companies would gain an appreciable amount of time—which means interest on outlay—and the risk of their servants' lives would be reduced to a minimum.

London, E.C., October 7th.

Common Sense.

SLEEPER PREPARING MACHINERY, LANCASHIRE AND YORKSHIRE RAILWAY.

MESSRS. T. ROBINSON AND SONS, ROCHDALE, ENGINEERS.

(*For description see page 353*)

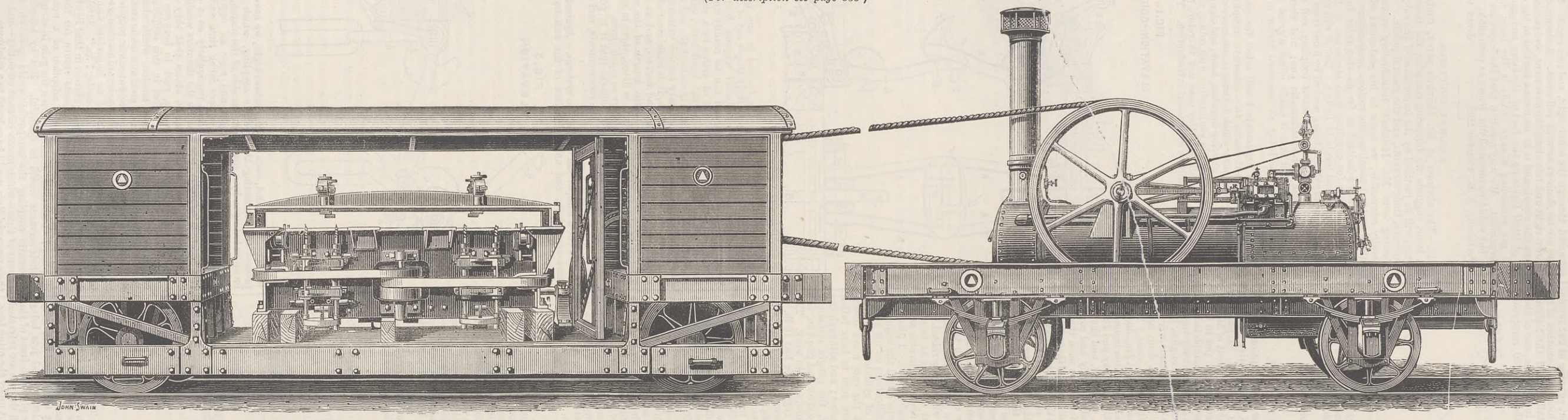


Fig. 1—PORTABLE SLEEPER ADZING AND BORING MACHINE AND ENGINE.

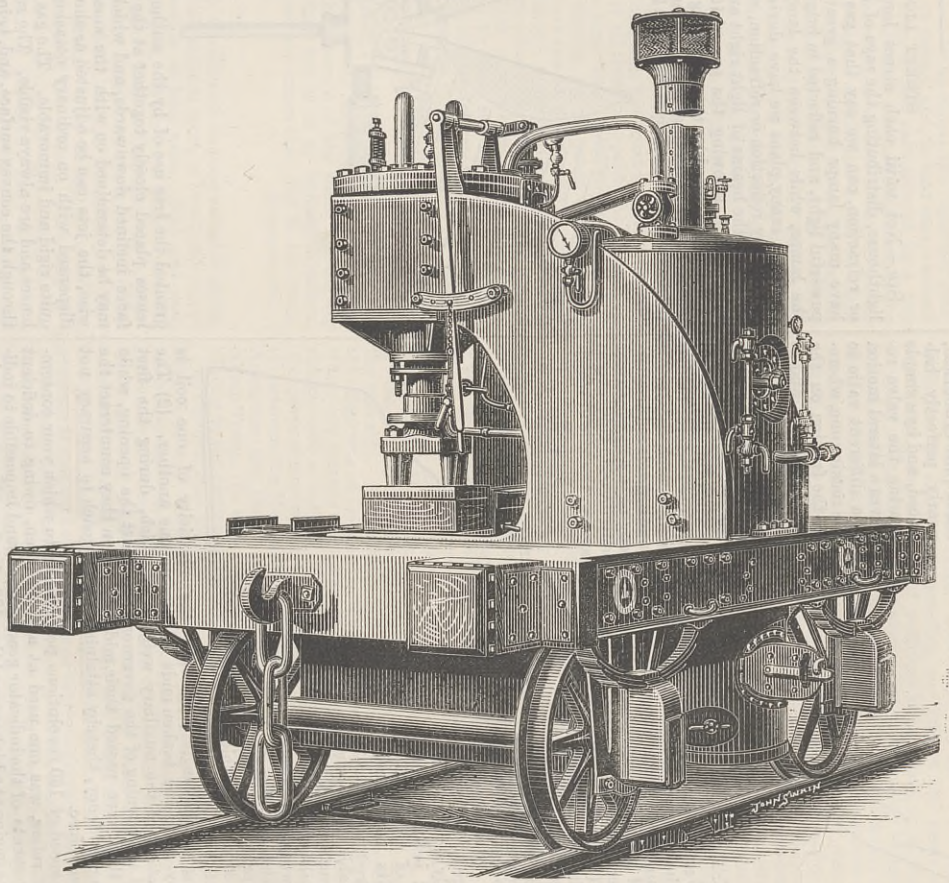


Fig. 4—STEAM SPIKE AND TREENAIL DRIVER.

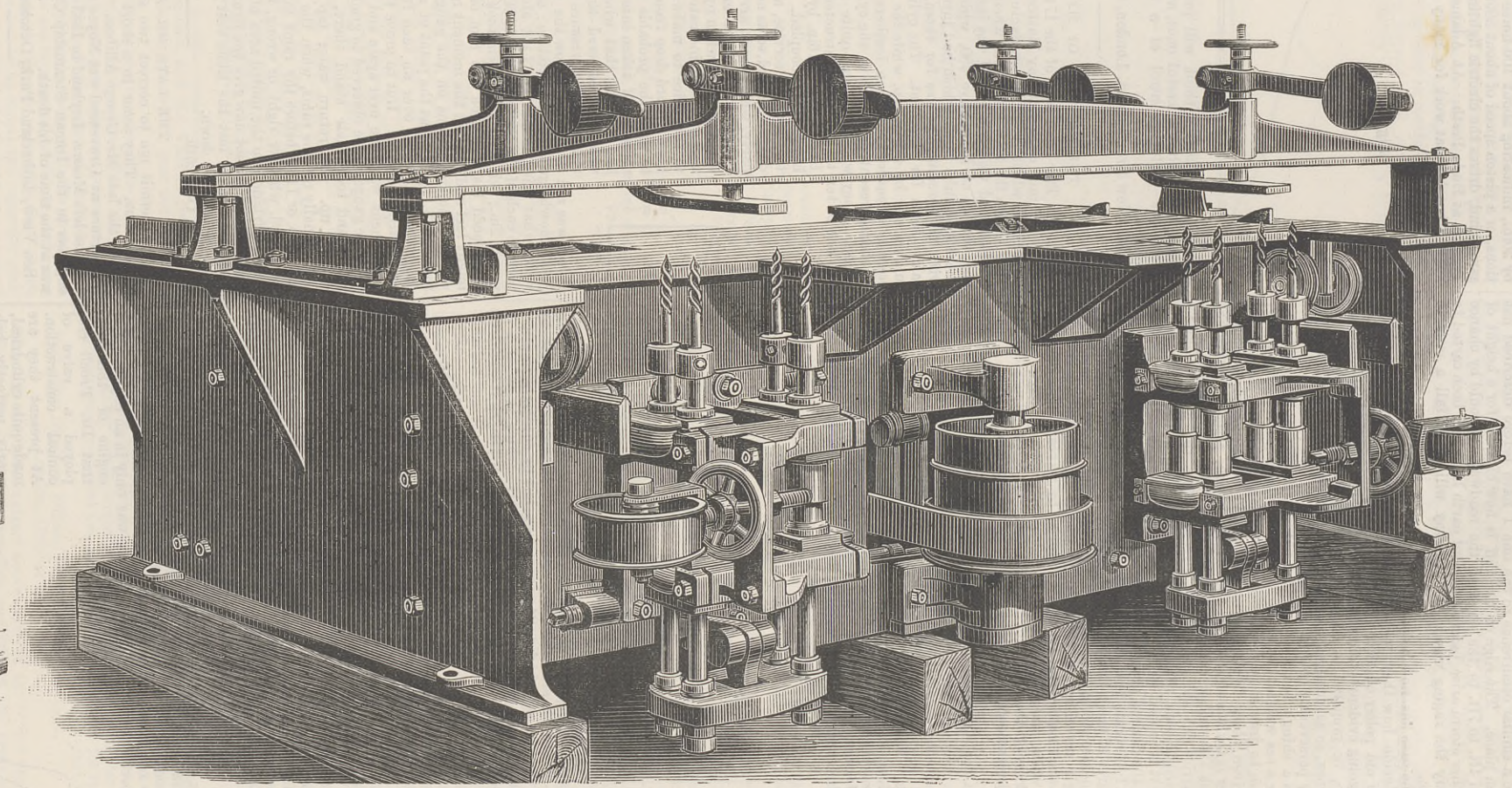


Fig. 2—ADZING AND BORING MACHINE

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TO CORRESPONDENTS.

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P. B. (Broken Crank Shafts).—*The article did not appear in* The Engineer.

H. D. (Clough Hall).—*The boiler is too small for the cylinder. A cylinder 9in. by 9in. would be large enough. The engine will, of course, drive your boat, but at a slow speed; probably about 5½ to 6 knots.*

Cantab.—*Your engines are too small to give you any advantage worth having by compounding, and the proportions of your cylinders are all wrong. A 3in. high-pressure cylinder should have a 5in. low-pressure.*

S. S.—*We presume that the proceedings for compensation are under Sec.* 308 *of the Public Health Act,* 1875. *We are not aware that any subsequent Act has affected these provisions. But apart from statute, is not the "damage" the difference between the injury and the benefit, and nothing more—that is, the amount of injury left after deducting the benefit?*

WHITE LINES ON BLUE.

(*To the Editor of The Engineer.*)

Sir,—In reply to your correspondent, particulars of the above process can be found in the "Minutes" of the Institution of Civil Engineers, 1886, Part IV., in a paper "On Heliography" by Mr. Thwaite. The prepared sun copy paper can be obtained of the Victoria Drawing-office, 15, Ashcroft-buildings, Victoria-street, Liverpool. J. V.

Liverpool, October 20th.

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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.

Society of Engineers.—On Monday, November 1st, at the Westminster Town Hall, at 7.30 p.m., a paper will be read "On Liquid Fuel," by Mr. Percy Tarbutt, A.M.I.C.E., of which the following is a synopsis:—Sources of supply of liquid fuel; petroleum, tar, shale oil. Means of conveyance. Theoretical evaporative value; practical advantages. Various descriptions of oil burners and furnaces. The author's system described; details of results obtained at various works where it is employed.

Royal Institution.—Monday, Nov. 1st, at 5 p.m.: General monthly meeting.

DEATH.

On the 26th Sept., at Bhagalpore, Bengal, India, of heart disease, Edward le Lievre, Executive Engineer D.P.W., in his 43rd year.

THE ENGINEER.

OCTOBER 29, 1886.

THE NEW ENFIELD RIFLE.

Statements having recently appeared in the daily papers that a grave crisis has occurred at the Royal Small Arms Factory, Enfield Lock, and pointing more or less to a complete break-down of the proposed new "Enfield-Martini" rifle for the Army, both as regards breech-action and barrel, we have made it our business to enquire into the actual facts of the case, and now lay them before our readers—with special reference to our article of 20th August last, upon the Enfield Factory and the present military rifles of Europe. After very extensive departmental trials of various modifications—more especially with reference to the diameter of the bore and the details of rifling—and when the design of the new weapon had been approved by the Ordnance Committee, one thousand rifles were ordered to be manufactured and distributed among different regiments, in order to undergo severe practical trial for a length of time. The detailed reports of the results of this test have lately been received and laid before a "Special Committee," of which Major-General P. Smith—late Grenadier Guards—is President; the members being Colonel Arbuthnot, Superintendent Royal Small-Arms Factory, Colonel Tongue, Commandant of the School of Musketry at Hythe, Commander Meryon, R.N., as representative of the Navy, with Sir Henry Halford for the Volunteers; Lieutenant-Colonel Oldham, Cameron Highlanders, acts as Secretary.

The following is a brief *résume* of the objections made to various portions of the rifle in the reports above alluded to, which have been carefully tabulated by the Committee; the objections are here taken roughly in the order of comparative unanimity:—First, to the wooden handguard as being too much of a handful, and especially as bottling up the breech end of the barrel and keeping in any moisture which runs down the barrel. Secondly, to the flat fore-end of the stock as affording little or no support to the barrel. Thirdly, as to the quick-loader. The chief objection is the difficulty of carrying it when not in use, for which it is considered that the increased facility of loading does not compensate. In some instances, cartridges are reported as jamming in using the quick-loader, but this would seem to be chiefly due to the ammunition supplied for the trials. Fourthly, to the sighting. The standing back-sight, which was fixed on the fore-end of the body, was found to be too near the eye; this condemnation is unanimous. Several objections are made to the top of the barleycorn of foresight being rather too broad, and to the wind gauge attached to the slide. It will be seen, on reference to our former article, that the details of sighting were expressly arranged to be subject to modification from the results of the experimental trials. Fifthly, to the locking-bolt. There were several objections to this arrangement, the most serious being that it was sometimes found not to act properly, but to give the effect of a hair trigger, owing to its not quite freeing the trigger-nose, but causing it to just catch on the extreme edge of the tumbler-bent. Also it is considered that the soldier is very liable to omit locking the bolt, when he would have no guarantee of safety, nor anything to tell whether the rifle was loaded or not; hence the old Martini-Henry "indicator" is generally prefered. In a moment of peril the bolt, if locked, would prevent him loading without an extra motion, and if—forgetting that it was locked—he might force the lever over the bolt and break it. Sixthly, to the mode of attachment of the sword bayonet. That if the top of the cleaning-rod—which passed through a small hole in the cross-bar of the bayonet—gets a little bent, the sword-bayonet cannot be fixed. Seventhly, to the position of the sword-bayonet on the barrel. Some of the reports were against and some in favour of the new point of attachment underneath the barrel; it was generally found to cause the rifle to shoot high, contrary to the expectation that it would tend to correct this very general fault of rifles. Careful trials seem to prove that the exact effect is to throw about 18in. above the bull's-eye at 100 yards range. Eighthly, to the action of the extractor. Great difference of opinion exists on this question; some of the reports condemn the extractor altogether, while others praised it highly.

While giving the defects in full, it is most satisfactory to know that all the reports are tolerably unanimous as to the good shooting powers of the arm. While the experimental reports were yet under the consideration of the Committee, the Superintendent of the Enfield Factory prepared a fresh specimen rifle remedying the chief defects. He substituted for the wooden hand-guard one of leather, such as had been used by the regiments in Egypt and the Soudan, attached firmly to the rifle by a lace; the quick-loader was abolished, and the locking bolt also done away with, the indicator of the Martini-Henry being restored. To do this it was necessary to return to the square tumbler axis. A shorter cleaning rod was used, with a longer "jag" to screw on to it when used. The standing back sight was put forward on the barrel so as to be close to the elevating leaf. This improved weapon has not, however, been tried, as the Special Committee—having gone into all the objections raised with great care—recommended that fifty rifles should be manufactured at once and issued for trial, embodying the above, as well as the following additional alterations:—The old grooved fore-end of stock to be restored. The sole objection to the mode of attaching the sword-bayonet will be removed by making the cleaning rod and jag in one, and having a deeper pipe in the stock to receive the jag end of the rod; this will cause the top of the cleaning rod to be quite clear of the cross-bar of the bayonet. The sword-bayonet to be fixed to the right side of the barrel, as in the Martini-Henry rifle. With regard to the sighting, not only is the position of the standing sight to be altered, but it is only to be up to 150 yards range; up to 300 yards the necessary elevation will be obtained by sliding the bar along the leaf, without raising the latter to the perpendicular position. Further, a finer "barley corn" is to be used for the foresight, and an inclined plane placed at the back of the sight, so as better to lead the eye up to it. The wind gauge will be omitted. A very important alteration will be an improved form of extractor; the tail or lower arm will be lengthened, which will greatly increase the power of the first action of the block upon it, and also bring it sooner into play. By this means it is hoped that the extraction of the empty cartridge-case will be made easier. The case is slightly coned near the base, so that the chief point is to give it the first start out of the chamber. The length of the lever will also be increased, which will further augment the power exerted for extraction.

On reviewing the foregoing defects, and the alterations proposed for removing them, it is evident that the Enfield barrel, the really novel feature in the new rifle, has satisfactorily stood the test of practical experience; the improved shooting resulting from its adoption will be evident from an inspection of the comparative tables given in our previous article. As regards the breech mechanism, the last proposed alterations only restore it more to the exact form of the Martini-Henry action, except so far as the improved extractor is concerned; the principle remains unchanged. It is therefore difficult to see where the "breakdown" of the rifle takes place. Meanwhile the crisis is sufficiently grave to the 700 unfortunate workmen who have been temporarily thrown out of employment by the suspension of work upon certain portions of the new arm, and the reflection forces itself upon us that it was scarcely wise to proceed with the manufacture upon a large scale of a rifle of which many of the details were emphatically in the experimental stage. It may be added that probably a spirit level will be added to the fittings, to enable the soldier to know when he is actually holding his weapon in a horizontal position. The other portions of the Enfield Factory are in full operation, and experiments are being actively prosecuted with magazine rifles, which many good authorities are of opinion must soon be adopted. The patterns being prepared for trial are the "Enfield-Jones," on the "block" system, and the "Lee" and "Lee-Burton," the two latter being "bolt" rifles.

It is to be hoped that the stoppage of work referred to is for a short time only, but the War-office authorities do not deem it advisable to proceed with the complete manufacture of the new rifles until the results of the trial of the new batch of experimental arms has been ascertained.

THE MARCHANT ENGINE.

Concerning the Marchant engine, we know nothing save what was to be learned from looking at it when shown last year in the Inventions Exhibition, and from reading circulars which have been issued concerning its performance. These data, however, supply sufficient information to enable any engineer to pronounce an opinion on the truth or fallacy of the principle on which it operates. It is a compound engine, intended to work at a very high pressure—500 lb. on the square inch—and it is provided with a set of four stage pumps, by which two-thirds of all the steam passing through it are returned to the boiler; the remaining one-third is disposed of in a surface condenser in the usual way. It is, we understand, claimed that by the use of the stage pumps about two-thirds of all the steam which would otherwise be consumed is returned to the boiler to be used over again, with the result that the consumption of fuel is reduced to three-fourths of a pound per horse-power per hour, or about one-third of that used by ordinary compound engines. A statement of this kind involves, in our opinion, a fallacy which ought to be hardly worth refuting. We find, however, that certain engineers of some standing are disposed to admit that Mr. Marchant is right; and one or two technical journals have accepted his figures as correct at least in the main; furthermore, the authority of Professor Zeuner has been invoked, and it has been stated that, with certain important limitations, the theory of Mr. Marchant's engine is consistent with a proposition laid down by Zeuner. Under the circumstances, we make no apology to our readers for commenting on the whole question.

Zeuner's proposition is very simple. After the exhaust port in a steam engine opens, and the bulk of the steam in the cylinder has escaped, a certain weight of steam remains behind, part of which has to be pushed out of the cylinder by the piston. As soon as the exhaust port closes, compression begins, and the steam is finally raised at the end of the return stroke to a pressure which bears some close relation to that in the boiler. Rankine has shown that the best pressure is equal to that in the boiler, so that the whole clearance space may be regarded as eliminated, because when the steam port opens the clearance space is already full of steam left behind from the preceding stroke, and equal in pressure to that of the fresh incoming steam. Zeuner says that this steam, instead of being left in the cylinder, ought to be pushed out of it into a compressing pump, and by compression converted into water and forced into the boiler. His words are:—"At the position *b*"—that is to say, the best point theoretically for compression to begin—"of the piston the communication between condenser and steam cylinder would be closed, while in the place of it communication between the steam cylinder and the cylinder of the feed pump would be established. During the further motion of the feed pump piston the remainder of the steam in the cylinder would be pushed into the feed pump cylinder, and there at the next stroke converted by compression into water, and this, with the water previously drawn in, would be pressed back into the boiler. Hence, according to my idea, the whole alteration to our steam engines would consist in this, that the feed pump mould be made double-acting and its cylinder larger than hitherto, as in this case the pump has to draw in not merely water, but in the second half of its stroke, steam also. In engines without condensation, the water drawn in by the feed pump should, where possible, be heated to 100 deg. C. by the waste fire gases. To me the idea appears quite

practicable, and worth closer consideration and following up." We may leave out of consideration the proposal to use waste heat to raise the temperature, because that is outside the main proposition, which is that economy can be effected without extraneous aid. "The fundamental idea to be grasped in this case is to heat the feed-water by compression of steam to nearly the boiler temperature, and not to effect this heating by the communication of the corresponding quantity of heat in the boiler itself." There is some discrepancy between this passage and that quoted above, but passing by this, it will be seen from what we have stated, that to a certain extent Mr. Marchant does what Zeuner says first, only he pumps back a much larger quantity of steam than Zeuner proposes to use, and so far as we are aware he does not carry compression to anything like the same extent.

It requires some little courage to dispute the accuracy of a proposition made by a German professor, and above all by a man of Zeuner's reputation. Nevertheless, we do not hesitate to say that if we understand the Professor aright, he is distinctly wrong; and no heretofore unknown economy is to be gained by treating the residual steam in a cylinder in the way he proposes. His words appear to us to bear only one construction; but our readers have these words before them, so that they are in as good a position as we are to know what they mean. We may divide the proposition into two. Let us suppose, first, that compression is carried to such an extent in the cylinder alone, that the boiler pressure is reached some fraction of the stroke before the stroke is completed, and that the lead is such that the moment this point is reached the slide valve opens. Then as the piston continues to advance, the whole of the residual steam, less clearance—which, however, we may for the moment neglect—will be returned into the boiler without the aid of any separate pump. Now it is very easy to see that no saving of fuel can result from this process. The work done in forcing the residual steam back into the boiler will be greater by the amount lost through the friction of the apparatus than that given out by the same steam, or an equivalent volume, during the next stroke of the piston. To make this quite clear, let us suppose that we have a vertical cylinder containing a loaded piston, and that we introduce a certain quantity of steam below the piston. Let the cylinder be 8ft. long, and that 1 lb. of steam of 100 lb. pressure is supplied, and this lifts the piston 1ft. No more steam is introduced, and the piston continues to rise by the expansion of the steam. The conditions are analogous to those of an engine cutting off at one-fifteenth of the stroke, and with a clearance of 7 per cent. Then the whole work done will be in round numbers 158,000 foot-pounds, and in the performance of this work about one-fifth of the whole heat will be used up. At the end of the operation then we should have four-fifths of a pound of steam and one-fifth of a pound of water. It must be added here, to avoid misapprehension, that these figures are not precise, but sufficiently close approximations. If now sufficient power be applied, the piston can be forced down again to its original position. The steam will be compressed, its temperature will rise, the water will be re-evaporated, and at the end of the operation things will be precisely as they were before; and leaving friction, radiation, &c., out of the account, the work done *by* the steam during expansion will exactly equal that done *on* the steam during compression. But what is true of the whole stroke is true of part of it, and no economy of any kind can be gained by compressing steam, save in the sense and in the way well understood and already referred to, namely, that it is better to use the residual steam to fill clearance space than to employ fresh steam for that purpose. Rankine says—page 420 of "The Steam Engine and other Prime Movers"—"the most advantageous adjustment of the compression takes place when the quantity of steam confined or cushioned is just sufficient to fill the clearance at the initial pressure."

Next let us consider what happens if the residual steam is conveyed into the feed-water and forced back with it into the boiler. Let us assume that one-sixth of all the steam is returned in the cylinder. It is clear that in this case the back pressure would be very high, unless some means were taken to get rid of it. This may be effected by the feed-water, which, if properly mixed with it, and of sufficiently low temperature to begin, would suffice to condense it. The feed-water would thereby be raised to boiling point—212 deg., and the vapour from it would represent a back pressure equal to that of the atmosphere. In a non-condensing engine it would amount to this in any case, so that there would be no loss in this way, and there would be a considerable gain, probably 14 or 15 per cent., derived from heating the feed-water as compared with not heating it. But this is not, as we understand him, what Zeuner means. He proposes that compression should be carried to such an extent that the residual steam would be liquefied and then mixed with the feed-water, and that this constitutes a previously unconsidered means of saving fuel. No economy could result from it. Zeuner has overlooked the fact that the work done in compressing and liquefying the steam cannot be less than the work which it is competent to return when it again becomes steam in the boiler. In fact, to return it at all to the boiler is a work of supererogation. The liquefied steam cannot take heat from the boiler; on the contrary, it will return heat to it—heat derived from the conversion into heat of the energy expended in compressing it. Theoretically, all that can be done in this way might be done in the cylinder without ever transmitting the compressed fluid into the boiler at all. At the beginning of the stroke the clearance space would then contain a small quantity of water at a very high temperature. As soon as the piston commenced to move away from the end of the cylinder this water would begin to be converted into steam, and it would not be necessary to open the steam port until the pressure had fallen in the cylinder to that in the boiler; but all the work done by the steam nominally saved during one stroke, which we may call *a*, would have to be deducted from the total work done during the preceding stroke, which we may call *b*. The only construction to put on Professor Zeuner's proposition which is consistent with its soundness is that the gain he supposes to be obtainable is due to heating feed-water which would otherwise be cold. But there are much better methods of doing this than employing the feed pump to draw steam out of the cylinder. In non-condensing engines the whole of the exhaust steam may be used for the purpose, and will supply five to six times as much as is necessary. Even in the case of condensing engines, the same result may be secured by permitting a portion of the waste steam just at the moment the exhaust port opens to flow into a heater, as has been done in the United States; for it is evident that nothing like the whole of the steam in an engine exhausting at a point above atmospheric pressure is needed to maintain a vacuum in the condenser; and by the aid of very simple mechanism one part of the steam may be blown into the atmosphere, and the remainder condensed, with a great saving of cooling water—a point of considerable importance. If, therefore, Professor Zeuner suggests a new theory, the proposition is not sound. If, on the other hand, his proposition is sound, then it suggests nothing new. If Zeuner's proposition is unsound, then in so far as the theory of the Marchant engine is based on it, that theory is also unsound. Mr. Marchant gains nothing whatever by pumping part of his steam back into the boiler, save in so far as he raises the temperature of the feed-water at the same time. It is, we may add, by no means improbable that he is quite aware of this truth, and pins his faith on the mode of action of his stage pumps. It is well known that when elastic fluids such as air, have to be compressed to great densities, stage pumps are always employed. A set of stage pumps is simply a compound engine reversed; that is to say, we have first a low-pressure pump, which takes air at atmospheric pressure; increases this pressure to, say, 30 lb. on the square inch, and delivers to a second and smaller pump, in which the pressure is raised to 60 lb. on the square inch. This pump delivers into a third and still smaller pump, which forces it into the receiver, say at 120 lb. This is found to be a much more convenient system than employing one pump to do the whole; of course there is no power gained. Mr. Marchant some twenty years ago held that stage pumps actually economised power, or, in other words, created energy—although he did not put it this latter way—and it seems to be very probable that he is of the same opinion still. On no other assumption that we can imagine is it possible to explain the circumstance that there is a Marchant engine in existence, unless, indeed, we adopt the other horn of the dilemma and say that he has made a wonderful discovery in thermo-dynamics quite undreamed of hitherto, and flatly opposed to the conclusions of such men as Rankine and Clerk-Maxwell. Our readers may take their choice.

In conclusion, we beg to assure the gentlemen who have signed the circulars to which we have already referred, that if they think they possess arguments in favour of the principle of the Marchant engine which we have overlooked, we shall be very happy to afford them space in our correspondence columns to set forth their views. Mr. Marchant has as yet given us no opportunity of carrying out a practical test of his engine, which would set questions concerning its merits at rest.

LOCK NUTS.

The correspondence concerning lock nuts which has appeared in our columns supplies an admirable illustration of the ease with which different deductions can be drawn from the same facts by varying the point of view from which they are regarded. If our correspondents did but know it, they are very nearly unanimous. The whole question turns on the proper position for the thin nut, or "lock nut," as it is called with a certain amount of irony. One man holds that the thin nut ought to be over the thick nut; another that it ought to be under it. It seems to us at first sight not a little remarkable that concerning such an apparently trivial detail we should have received a host of letters from all parts of the kingdom. Those we have selected for publication are fair examples of the whole. We shall not attempt to explain why feeling should run so high, and it is noteworthy that almost without exception the disputants have entirely overlooked the query put by "Lead Pencil," which began the discussion. He asked, it will be remembered, for some information concerning the *practice*, not the opinions, in different shops; and he has got in return little or nothing but opinions, scarcely a word being said as to practice. We may supply the omission, and say that, so far as our own not very limited experience extends, the thin nut when used at all is put outside the thick nut. So much for practice.

The arguments advanced in favour of putting the thin nut inside are that when the thick nut is screwed down on it the thin nut is driven back, so to speak, on the screw, no longer takes hold of it and acts as a washer, the whole strain then coming on the outside or thicker nut. If the arrangement of the nuts be reversed, then the whole strain will come on the thin nut, which would obviously be bad practice. This argument may or may not be sound, according to circumstances. Let us suppose, for example, that we are dealing with a holding-down bolt. The large nut is first put on and screwed down, until it exerts a pull of, say, seven tons on the bolt. The small or lock nut is now screwed down with force enough to put a pull of a ton on the bolt. It is obvious that in this case the thin nut has not pushed the thick one away from the under side of the threads in the nuts, and it is quite clear that it does not take any strain transmitted through the lower or thick nut. If the top nut were screwed down until it pulled with a force of seven tons, then it might begin to push the lower one down, or, more accurately, to draw the bolt up through it, but not before; but the thinness of the nut puts this out of the question. Therefore under such conditions, the thin nut may go outside. Take next the case, say, of a stuffing-box gland. Here the pressure exerted on the nut is very moderate, and consequently, when the thin nut is screwed down, it will force the threads of the thick nut away from those in the stud bolt in a way easily understood, and the whole strain will be taken by the thin or lock nut. But, under the circumstances, the strength of the thin nut is much more than great enough to sustain the strain put upon it, and consequently the thin nut may be put on outside or on the top of the thick, where it not only looks better, but is much more easy to get at. In fact, the thin nut should never be put under the thick when the nuts have often to be turned, because it is extremely inconvenient to get at a thin nut under another nut with a thick spanner; but it is not at all inconvenient with the thin nut outside. There is, therefore, really no ground for the righteous indignation displayed by some of our correspondents against the man who proposes to put the thin nut outside the thick nut. When there is a heavy strain on the bolt the thin nut must be outside, in order that the proper stress may be put on; and when there is not a heavy stress on the bolt, it is of no practical consequence where the thin nut is put, as far as strength is concerned, and it is a matter of practical convenience to put it outside. For ourselves, our own practice would be identical with that of the London and Brighton Railway, for example, and we should use two nuts of precisely the same thickness.

It does not appear to be generally known that the ordinary rule which makes the nut of a thickness equal to the diameter of the bolt gives a great excess of strength. The thin nut employed for locking is usually quite half a diameter thick. Thus a $\frac{3}{4}$in. bolt will have a $\frac{3}{8}$in. lock nut. This thickness of nut, if properly fitted, is nearly sufficient to equilibrate the breaking strain of the bolt. The thread will probably strip when the thickness of the nut is about three-fifths of the diameter, but this is not certain, for the bolt is often broken first. One of our correspondents asked very pertinently if a case could be cited in which the thin nut being outside, either it or the bolt had stripped. The question remains unanswered. No doubt nothing of the kind has ever occurred under legitimate strain, provided the threads were a good fit. When a nut is too loose, there is, of course, no saying what may happen.

It is not a little remarkable that all our correspondents have accepted without question the theory or assumption that it is possible to securely lock a nut on a bolt with another nut. Nothing can be much further from the truth; a lock nut does give a certain measure of security, and may prevent a nut which is loose from working off. But under any conditions of vibration the ordinary lock nut system is quite untrustworthy. It has a certain field of utility, but the field is limited, and some other and safer expedient should be employed. In large marine work set screws are used, a collar being turned on the lower end of the nut, or that next the work, into which collar a small set pin is tapped. The system works perfectly. We need hardly add that hundreds of devices have been patented for locking nuts, especially in the United States, where the number of them runs that of the car couplers close, and this is saying a good deal. We have no intention of pronouncing an opinion concerning their merits. As to the lock nut controversy, most of our readers will, we think, agree with us that enough has now been said on the subject. "Lead Pencil" and his fellow students may show lock nuts on their drawings wherever they like. They will be certain to please some one whichever locality they select, and it is really, within the conditions we have tried to define, a matter of no importance whether they are put inside or outside the thick nut.

RUNAWAY TRAINS.

Two reports on recent accidents have been issued by the Board of Trade which are of more than usual interest, both being of that class called runaway accidents. The first occurred on September 1st at Penistone station, on the Manchester, Sheffield and Lincolnshire Railway, near the scene of the notorious calamity on July 16th, 1884. A portion of the 5.30 down passenger dining car train from London for Manchester, while standing on a gradient of 1 in 106, was put into backward motion by the engine and front van—which had been detached to put off a carriage—setting back too sharply on it. The eight vehicles ran back, and entering a siding through some catch points, came into collision with a wagon standing against the buffer stops at the end of the siding, after running nearly 300 yards, and twenty-four people were injured. The hand brake had been applied, but was of course no use on falling gradients of 1 in 120 and 1 in 91. As General Hutchinson remarks, in his report, "The collision would no doubt have been prevented had the train been fitted with a good automatic continuous brake instead of only with the non-automatic vacuum brake, as in the former case, when the engine and two front vehicles had been detached from the train, the brakes would have been left applied throughout the remaining portion, which it would then have been almost impossible to set in motion on the falling gradient. Instead of this, on the engine and two front vehicles leaving the train, the continuous brake ceased to be available, and the eight rear vehicles were prevented from running back only by the brake—probably not fully applied—of a van weighing not quite a tenth of the weight of the vehicles in front of it, and liable, therefore, to be put into backward motion by a slight blow in front. It is very unsatisfactory to find from the return of the half-year ending June 30th, 1886, that this company has done nothing towards supplying its rolling-stock with automatic brakes, notwithstanding the warning it received from the very serious accident which occurred near Penistone in July, 1884, when there is every reason to believe that had the train been fitted with a good automatic brake the consequences of that accident might have been considerably mitigated." Such a state of things is worse than unsatisfactory, but if Sir Edward Watkin and others were not to be taught a lesson by the previous disaster, where eighty-eight people were killed or injured, they are hardly likely to be less cynically indifferent to the injury only of twenty-four people. Who are the victims they are waiting for we cannot say. Sir Edward Watkin, however, is by no means the only sinner, for, according to the last return, there are now some 10,000 vehicles actually fitted with the non-automatic vacuum brake, and 3000 with connecting pipes; and it is to be noted that a large proportion of the increase of fitted vehicles during the half-year is to be ascribed to this system, mainly, of course, owing to the action of the London and North-Western Company. When, more than two years ago, we commented on the awful carnage resulting from the calamity at Penistone—towards mitigating or entirely preventing which this brake was utterly powerless—we said this accident was "the deathblow to the

new venture is as much as £150,000; but such an estimate must be largely excessive. The new works will be almost the pioneer steel works in North Staffordshire, and the competition of the steelmasters from the North of England is one of the main reasons which has induced the noble owner to lay down the new establishment.

Business in the iron trade of North Staffordshire is participating in the general revival. Orders are coming to hand with increased freedom, and some makers can now see work ahead for several weeks. The specifications arriving warrant the mills being run about five hours per week. Common and ordinary bars have advanced in quotation 2s. 6d. per ton.

On Wednesday there was an adjourned meeting in Wolverhampton of the South Staffordshire Mining Accident Fund, when it was resolved to proceed with the scheme for establishing a new Miners' Permanent Relief Fund for South Staffordshire and East Worcestershire.

The Indian railways are still expressing large requirements, which will prove an acceptable addition to current trade. The State Railways require steelwork for a bridge of 250ft. span, and the Nizam's Guaranteed State Railways are inviting tenders for large quantities of railway material. This includes heavy supplies of transverse steel sleepers and keys and 2500 tons of steel rails—66½ lb. Other railways, including the Bombay, Baroda, and Central, and the Oude and Rohilkund, will shortly prove good customers.

Some satisfactory orders will shortly be given out by the Bridgtown Tramways Company. They include steel rails, steel sleepers, bolts and nuts, and fish-plates.

There are rumours of dissatisfaction among the Cradley Heath chainmakers. They are considering whether the whole trade should turn out again, and a decision will probably be arrived at next week. The Walsall chainmakers show no inclination to resume work, and are appealing for support from the various districts.

The Bromsgrove nail makers have at length secured the desired advance in wages of 10 per cent. As the result of their recent interview with the masters at Birmingham the question has been seriously considered, and the employers have determined to concede the advance from Saturday week.

The horse nail makers of Lye, Old Hill, and Netherton will send a deputation to the principal employers to ask for a return to the 2s. 6d. list. This concession the men are hopeful of obtaining.

The Council of the Birmingham Chamber of Commerce will shortly convene a general meeting of the Chamber to receive a deputation from the National Fair-Trade League. The purpose of the deputation is to lay before the Chamber their views, especially in connection with the evidence given before the Royal Commission.

The Exhibition at Birmingham closes this week, after a period of great success. It is really a remarkable demonstration of the industrial capacities of the district. The whole of the exhibits, as various in their purposes as admirable in their workmanship, are the product of *bonâ fide* manufacturers living within fifteen miles of the great Midland centre. The largest attendance was reached on Monday, when there were more than 12,000 visitors.

The Birmingham master builders have issued notices for a general reduction in wages of 1d. per hour; unless a mutual arrangement is come to the matter will go to arbitration. The severe competition in local contracts of builders from other parts of the country is the main reason for the demand. A meeting of 2000 brassworkers, held in the Birmingham Town Hall on Wednesday, determined to resist any further wages reductions.

NOTES FROM LANCASHIRE.

(From our own Correspondent.)

Manchester.—There is still a good deal of buying going on in the iron trade of this district, but as the actual requirements of the users of iron have not shown any very appreciable enlargement, the business now being done must to a large extent be more or less of a speculative character. There is, however, no doubt a considerable weight of iron passing into the hands of consumers who have for a long time been working simply from hand-to-mouth, and have consequently allowed their stocks to run abnormally low, and who have now been induced to buy extra quantities as a matter of precaution against any further advance in prices; this, although not for actual wants, may be regarded as a legitimate enlargement of buying for trade requirements, but for the present it is no more than a simple transference of iron from the heavy stocks held by makers into the hands of consumers, and it is just as much in existence as ever to meet the wants of consumption when they arise, whilst the large quantity of iron which has recently been sold to speculators, in many cases altogether outside of the trade, will of necessity have to find its way into the market again. Taking these facts into consideration, it would be hazardous to pronounce any definite opinion as to the permanence of the upward movement which has recently been so strongly developed throughout the iron trade, and it can scarcely be said that the feeling all through the market is one of very great confidence in the future. The prime mover in the advance has been, and still is, to a very large extent, restriction of the output; and until there is a really substantial enlargement of requirements for actual consumption, the improvement in the market can scarcely be regarded as established on a thoroughly legitimate footing. For the present, however, the upward movement is being well maintained, and prices still show a tendency to harden; but apart from what are more or less speculative transactions, the weight of business doing shows some falling off.

The Manchester iron market on Tuesday brought together a full average attendance, and a fairly animated tone characterised business generally, with a strong tone throughout prices. Lancashire makers of pig iron are still booking a considerable weight of orders, and are very firm at 37s. to 38s., less 2½, as their minimum prices for forge and foundry qualities delivered equal to Manchester, with a disinclination to sell for anything like forward delivery at these figures. Sellers of district brands in some instances report a lessened weight of business offering, whilst others still report large sales being made; quoted prices are firm at 36s. 6d. for forge and 37s. 6d. to 38s. for foundry Lincolnshire, and 39s. 6d. to 40s. 6d. for Derbyshire iron, less 2½, delivered equal to Manchester. In outside brands, although perhaps there has been some little wavering on the top figures, prices have shown a general upward tendency during the week, and for good-named brands of foundry Middlesbrough sellers are asking 42s. 4d. net cash for prompt, and 1s. per ton above this for forward delivery equal to Manchester.

In hematites there has been a considerable business doing during the week, with a steady upward movement in prices, No. 3 foundry qualities delivered into this district being now quoted at about 53s. 6d. to 54s. per ton, less 2½ per cent.

There is a moderate business doing in manufactured iron, and makers are in a better position as regards orders than they have been for some time past, with the result that they are now holding out for some advance upon late rates. They now decline to accept offers at under £5 per ton for bars delivered into the Manchester district; hoops are quoted at £5 7s. 6d., and sheets at about £6 10s. per ton, but for the last-named class of goods the demand is still only slow, and no very material advance in prices is being got.

Engineers and machinists throughout this district are still generally only indifferently employed, and no real improvement can as yet be reported in the above branches of trade. A few leading tool-makers are kept busy, and some of the principal boiler makers are better off for orders, but the general run of trade in these branches is only very slow. Locomotives builders are still very badly off for work, and general engineers and cotton machinists are but poorly supplied with orders.

The important subject of boiler explosions was under discussion at a numerously attended meeting of the Manchester Association of Engineers on Saturday. Mr. S. Boswell read a paper in which he dealt at considerable length with the causes of boiler explosions, the different types of boilers, the remedies for explosions, and the results of inquiries by the Board of Trade and coroners' juries. The three principal causes from which boilers exploded were defective construction, malconstruction, and mismanagement. Defective construction embraced corrosion in various forms, due to chemical action, fractures, due to mechanical action, and channelling, due to a combination of mechanical and chemical action. Malconstruction, to which some of the most disastrous explosions of recent years had been due, embraced faulty design and imperfect workmanship, and consisted in making one part stronger than another, imperfect staying of ends, faulty equipment and construction of fittings, imperfect setting, indifferent and occasionally dangerous repairs. In designing a boiler, three points must be kept well in view—safety, efficiency, and economy, of which safety was the most important, and probably no boiler answered these conditions so completely as the well-constructed standard make of Lancashire or Galloway boiler. There was no doubt that most boiler explosions were preventible, and what was wanted to ensure freedom from explosions was to place the boiler under the care of those who had made boiler keeping a speciality; in short, to get a good boiler and then have it well loooked after. Mr. Boswell deprecated further Government interference in the shape of compulsory inspection or certificated engine tenters, but thought there was room for very great improvement in the system on which the Board of Trade inquiries were carried out, which were often the means of a complete miscarriage of justice, and he urged that the guilty should be punished by occasionally being dropped upon for the cost of the inquiry. In the discussion which followed, the chairman—Alderman W. H. Bailey—quite agreed that it was only right the cost of an inquiry into an explosion should go against the proprietor of a boiler who had been found guilty of negligence. Mr. Lavington Fletcher, chief engineer of the Manchester Steam Users' Association, remarked that nearly every explosion was attributed to the neglect of the attendant, but nine times out of ten this was quite a mistake; it was not the attendant, but the weakness of the boiler, that was the cause of the explosion. With regard to the Bill proposed by Mr. Broadhurst for compelling engine tenters to hold a certificate, he looked upon the object of this Bill as simply to raise wages. It was not the men who were to blame, but the boiler that was wrong, and if the object of the Bill had been to save life, it would have sought to ensure an inspection of the boiler. Mr. Longridge strongly urged that the owner of a boiler should be made responsible if an explosion occurred, and this would give the boiler insurance companies just the influence they required to ensure a regular and thorough inspection of boilers without any recourse to compulsory inspection, which was not desirable. During the course of further discussion, other members also expressed their objection to any Government interference, either in the shape of a Board of Trade code of rules, compulsory inspection, or certificated engine tenters. Mr. Joseph Adamson considered that all boiler explosions were preventible, and the cause of them all were either selfishness, carelessness, or ignorance. With regard to corrosion, of which so much had been said, as one cause of boiler explosions, he urged that with the present numerous appliances for filtration there was no difficulty in supplying pure water to a boiler, and this was infinitely better than attempting to doctor impure water after it had been put into the boiler. With regard to boiler inspection, whether it was under Government control or made compulsory through the medium of insurance companies, he was afraid it tended to the construction of boilers simply that would pass and to remove the responsibility from the maker of the boiler to the authority by whom it was passed.

A new method of illuminating large workshops or open spaces by means of what is termed the "Lucigen" light which has been recently introduced, I had an opportunity of seeing in experimental operation at the works of Messrs. Musgrave, of Bolton. The light is produced by burning creosote, tar oil, or other heavy hydrocarbons in a special form of burner by means of compressed air; the oil is thus consumed in the form of an extremely fine spray, and yields an intensely bright light, giving off no smoke or smell, and effectually lighting up a large radius. The results obtained from three lights temporarily fixed, two in the foundry and one in the open yard, were very satisfactory, and I understand that Sir Joseph Whitworth and Co., after a trial of several of the lights, have ordered a large number of them for their works at Openshaw, whilst they are also being fixed on a number of the pit banks in the district. The light is not only very effective, but it has a further important recommendation, that it is very economical, the patentees claiming that it will yield a light of 2500-candle power at a cost of about 2d. to 3d. per hour. During the past week there has also been a further successful exhibition of the light in Manchester, and they are at present being employed for lighting up the ground where the Manchester Exhibition buildings are being erected.

In the coal trade there is a fairly good demand for house fire classes of fuel, and in these there is a tendency towards some slight advance at the close of the month; but all other descriptions of fuel for iron making, steam, and general trade purposes, are still bad to sell, plentiful in the market, and as low in price as ever.

Barrow.—The business in the hematite pig iron trade of this district continues steady and active, and the demand remains large from all sources. Home orders are numerous, and the inquiries from America, the Continent, and the Colonies are as brisk as they have been during the past few weeks; and the probabilities are that a very large bulk of iron will change hands before the winter season fairly sets in, with the view of securing deliveries in the early part of the new year. The inquiry is more especially marked from America and from the Colonies; but there is a steady demand from all quarters, and larger are more frequent than smaller orders. The output of pig iron has been increased in North Lancashire and Cumberland, and at present it represents something like an aggregate of 30,000 tons per week, all of which is going directly into consumption, and a great majority of which is of Bessemer descriptions. The output of forge and foundry iron is fairly maintained, and the demand for these qualities of metal is good when it is considered that they are now largely used in cases where inferior classes of iron were formerly chiefly and only used. The value of pig iron is steadily maintained at 44s. 6d. per ton net for Bessemer mixed descriptions, and 43s. 6d. for forge and foundry iron. It speaks well for the high quality of forge and foundry iron, when the variance in price between these qualities and Bessemer is so small. Stocks of iron have been further reduced, and they are now within a narrow area. Steel rails are in steady and brisk request from all sources, and the orders which have been placed with makers will maintain activity at works for some months. Further contracts are offering which are likely to be accepted at improved prices. Quotations still show a tendency in the direction of an advance. £3 17s. 6d. per ton is the value of heavy sections of steel rails, but in some cases as high as £4 and £4 2s. 6d. is quoted. Plates and slabs are in fuller inquiry. Forge steel is in fair demand, as also are tires. Merchant steel, however, is quiet; but there is an improving business in wire, hoops, &c. The shipbuilding trade is still very dull. More inquiries are, however, to hand, and new orders are expected. Marine engineers are busy, but ironfounders and boilermakers have not much to do. Finished iron is in better demand at fuller prices. Iron ore is brisk at from 9s. to 10s. 6d. at mines. Coal and coke steady. Shipping busy.

THE SHEFFIELD DISTRICT.

(From our own Correspondent.)

THE improvement noted last week is fully maintained. Hematites are sold freely at the advanced values, and a further rise is looked for, causing consumers to order for forward delivery. Common irons are also feeling the wave of revival. In some quarters a tendency is perceptible to regard the present movement as a mere "spurt" which will only be of temporary duration. I am bound to say that my information leads me to think there is a genuine and steady swelling of business. A hopeful sign is the universality of brisker trade. Not in one branch of industry, but all round, in the light as well as the heavy trades, the report is the same. In establishments where the principals are far from sanguine as a rule, it is admitted that the world's markets show recuperative indications which are exceedingly welcome. The head of a very important concern said to me this week:—"Business is undoubtedly better in the different markets you ask about; but if we were to make it public that our books are again getting filled with orders, we should have trouble with our men, who would probably demand more wages. And now the margin of profit is so small we cannot pay more; if we pay more, up goes the price of the goods, and the foreigners step in."

A very gratifying feature of the business now being done is the trade with Ireland. In the South, as well as in the North, and also in the Western districts, the merchants and dealers seem to be gradually recovering from the paralysis which overtook trade during outrage and agitation. Orders are coming in more freely, and, what is equally important, payments are being regularly made. In the Cork quarter the signs of revival are particularly marked. Our English and Scotch markets are also better. The Scotch spring journeys next year are certain to be productive of good orders, as a good grain harvest has been well secured, and the green crops—particularly the turnips, which are the backbone of Scotch farming—have never been excelled.

South American merchants are now ordering pretty freely. The constant wars in that quarter never seem to greatly affect business. The cutlery sent there is of a high quality, and the trade, in spite of competition, keeps good, even better than it was at the corresponding period of last year. Australia is also sending good orders, and trade is well maintained in India, particularly amongst the European residents. The Chinese and Japanese requirements are disappointingly small, but they are gradually getting larger; and once the Burmah disturbances are quelled, there are hopes of extensive dealings with the great populations in that empire.

"False marking," as applied to cutlery and other goods, is being made a "cry" in the municipal elections this season. It is always unfortunate when matters of trade are mixed up with politics, and the present is no exception to the general rule. The Town Council declined to accept the report of the majority of the Committee, as not being borne out by the evidence submitted to them, and by a large majority accepted the report of the minority, which was far less strong in its character. The practical result would have been to support Mr. Mundella's Bill, which was the outcome of the work of the Cutler's Company, who have done excellent service in preventing fraudulent trading. The trade unionists, headed by their leaders, are now calling for a Royal Commission, and declarin they could produce evidence which would establish the charges made against Sheffield manufacturers. It is not denied that several factors, probably a few manufacturers, have bought German goods and resold them, sometimes with a Sheffield label; but that these things have been done generally by Sheffield firms is indignantly repudiated. Yet the allegation is to that effect. The first paragraph of the rejected report cleared up this point, stating that no firm of position or respectability had been guilty of any such practices. It is to be feared that a good deal of class hatred is entering into this controversy. At the first meeting of the trade unionists on the question, it was freely indicated that the masters, in the Royal Commission on the Broadhead outrages, had their turn, and now it was for the unionists to have theirs.

At the Liverpool Exhibition Messrs. John Brown and Co., of the Atlas Steel and Ironworks, Sheffield, have obtained two gold medals. One has been awarded for their marine engineering exhibit, the new patent ribbed furnace flue, flanged boiler-end plates, and propeller blades being specially mentioned. In the submarine section a gold medal has been awarded for steel hemispheres pressed in dies out of flat plates without weld.

The Sheffield School of Art has originated a novel and important movement. The council offer ten free scholarship competitions among the male students of Board and other public elementary schools in the parish of Sheffield between the ages of twelve and fourteen years, who intend to be apprenticed to some of the staple trades of the town. These scholarships are tenable at the School of Art, or the branch art classes at Attercliffe or Lowfields, from January, 1887, to July, 1888, entitling the holders to receive instruction in the subjects taught at the school without payment of any fees.

THE NORTH OF ENGLAND.

(From our own Correspondent.)

THE Cleveland pig iron trade has been very steady during the last few days. No further advance has taken place, but a fair amount of business has been done at the rates which ruled a week ago.

The market held at Middlesbrough on Tuesday last was well attended, several merchants being present from Glasgow and elsewhere. For prompt delivery of No. 3 g.m.b. the price was firmly maintained at 33s. per ton. That figure is freely offered by buyers for delivery to the end of this year. They are willing to give 9d. per ton more for the first quarter of next year, and 1s. more for delivery to the end of June. Makers, however, have sufficient orders on their books to last for a considerable time; and as the tendency of prices is undoubtedly upwards they decline to commit themselves far ahead. The demand for forge iron is not so strong as for No. 3; any quantity being obtainable at 31s. 6d. per ton.

Warrants are offered at 33s. 6d. per ton, but there are few sellers at Middlesbrough. Considerable business has of late been done in them at Glasgow at the price named.

On Monday last Messrs. Connal and Co. had in their Middlesbrough store 300,828 tons of pig iron, which represents an increase of 200 tons for the week.

Pig iron shipments from Teesside wharves reached, between the 1st and 25th of the month, a total of 70,628 tons, being about 7000 tons more than during the corresponding portion of September, and about 8000 more than in October last year.

The demand for finished iron is better than it has been for a long time, and makers are getting about 5s. per ton advance on minimum prices. Ship plates are now quoted £4 10s. to £4 12s. 6d. per ton; common bars £4 10s., and angles £4 7s. 6d., all free on trucks at makers' works, less 2½ per cent. discount.

Messrs. Jones Bros. have this week re-started their light sheet mills and nail works.

Sir C. M. Palmer has strong faith in the "good time that's coming." There are, he says, far more inquires for new ships; several orders have been booked, and more are likely to follow. The steel trade is better, and to some extent the iron trade; and he has for long noticed that when iron improves coal is sure to follow. He does not believe in the doctrine that a large and complex business like that of his firm is beyond the capacity of any staff of officials to manage. He is sure that there is sufficient intelligence within the several departments controlled by his general manager to overcome any difficulty which may arise. All that is wanted to spread universal satisfaction throughout Jarrow is that the long-looked for good times should come quickly, and endure sufficiently to enable them to get some benefit from them.

Mr. W. T. Doxford's presidential address, delivered on the 13th inst. before the N.E. Coast Inst. of Engineers and Shipbuilders, has attracted some attention. The portion which deals with the statistics of shipbuilding, though interesting, is not novel to those who are familiar with that industry. But when the author gives his ideas as to the future, what he says is worthy of every consideration. Steamship owners must reconcile themselves to the fact that a large proportion of their property is at present prac-

tically valueless. Many vessels still afloat are really obsolete, and can never be worked profitably unless refitted with triple-expansion engines and otherwise altered. Mr. Doxford estimates the number of such inefficient steamers at 2573, and thinks nearly £10,000,000 will have to be spent upon them during the next ten years, to place them in a position to compete. The larger the vessel is the better she will pay her owners, provided only she is able to find sufficient cargo and suitable dock and harbour accommodation at her ports of destination.

These considerations naturally suggest others of equal importance. If the ensuing ten years have the effect of covering the sea with larger and more efficient vessels, that will mean permanently cheaper ocean transit for goods of all kinds, as well as for passengers. The different ports of the world will, in fact, be brought gradually closer together. Agricultural landowners in particular must look out. They have suffered severely for some time, and are by no means happy now. But if by cheaper ocean transit the agricultural produce of other countries is made still cheaper here, that means that British land must fall still further in value, and with it land rents. Recent improvements in the marine engine, and in refrigerating machinery, are, in fact, completely upsetting all kinds of hitherto sacred arrangements connected with entail, primogeniture, glebe lands, tithes, endowments, and other remnants of feudal times. And, strange to say, few landowners recognise that it is the mechanical engineer, and not the farmer nor the labourer, who is hitting them so hard.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

There has been rather less doing in the Glasgow pig iron market this week. Business was very strong at about the highest point at the opening, but afterwards the quotations were somewhat irregular, with considerable hesitation on the part of operators. This state of the market is ascribed to the difficulty of forecasting what effect the further restriction of the output of coals is likely to have upon the state of business generally. Hitherto it must be admitted that, so far as Scotch pig iron is concerned, the upward movement is largely speculative. Purchases for future shipment cannot be ascertained to have been made on any extended scale, and on this account it seems now to occur to operators that they ought to proceed with caution. The shipments of the past week were 8651 tons, as compared with 6531 in the preceding week, and 7210 in the corresponding week of 1885. The quantities sent to Canada and the United States are good, but from other countries the demand is comparatively light. Three furnaces put out in Ayrshire by Messrs. William Baird and Co. reduce the total blowing to sixty-six, as against ninety-one at this date last year, but several of the furnaces are to be lighted up by other firms presently. The week's addition to stocks in Messrs. Connal and Co.'s stores is 1759 tons.

Business was done in the warrant market on Friday at 42s. 11½d. to 42s. 10½d. cash. On Monday the market was steady at 43s. 10½d. to 42s. 10d. cash. Tuesday's market was less strong, with cash quotations at 42s. 11d. to 42s. 8d. Wednesday's market was dull at 42s. 5d. to 42s. 4½d. and 42s. 6d. cash. To-day—Thursday forenoon—business took place at 42s. 6d. to 42s. 3½d. cash. The market was closed in the afternoon.

The current values of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 48s. 6d.; No. 3, 44s. 6d.; Coltness, 51s. 6d. and 45s.; Langloan, 48s. and 44s. 6d.; Summerlee, 49s. 6d. and 44s.; Calder, 48s. and 43s. 6d.; Carnbroe, 44s. 6d. and 41s. 6d.; Clyde, 44s. 6d. and 40s. 6d.; Monkland, 44s. and 39s. 6d.; Govan, at Broomielaw, 44s. and 39s. 6d.; Shotts, at Leith, 47s. and 45s.; Carron, at Grangemouth, 46s. 6d. and 43s. 6d.; Glengarnock, at Ardrossan, 44s. 6d. and 41s. 6d.; Eglinton, 43s. 6d. and 39s. 6d.; Dalmellington, 44s. and 40s.

The past week's arrivals of Cleveland pigs in Scotland were 5465 tons, being 2805 tons less than in the same week last year.

The steel trade is fairly active, although one important work is doing very little in shipbuilding steel—except forgings—in consequence of the low prices. The latter would have to advance 7s. to 10s. a ton before they are considered distinctly remunerative; but most of this advance has been made within the past few days. After lasting for about eight weeks, the strike at the Motherwell Steel Works is now at an end.

Malleable iron is reported to be in rather better demand at the improved rate.

In the past week two locomotives valued at £4500 were shipped from Glasgow to Bombay; machinery to the value of £6500 was despatched to different places; sewing machines in parts, £1400; steel goods, £6400; and general iron manufactures, £31,300; including pipes and bars to the value of £12,760 for Bombay.

There has been a good business in the coal trade. The shipments of the past week from Scotch ports were 86,038 tons, compared with 79,231 in the same week of last year. At Glasgow 22,610 tons were despatched; Greenock, 2529; Ayr, 8174; Irvine, 2291; Troon, 4972; Burntisland, 21,951; Leith, 4433; Grangemouth, 16,828; and Bo'ness, 2050 tons.

Towards the end of last week the principal ironmasters, who had been resisting the movement of the miners for an advance of wages, made a concession to all the workmen in their employment, bringing their wages back to the point from which they had been reduced earlier in the year. No sooner had this been done than the colliers in the West, acting on the advice of a meeting of national delegates held in Glasgow, resolved to demand another 6d. a day, and to reduce their working time from five to four days a week until the concession was made. A considerable number of the collieries were therefore deserted by the men on Monday, which they resolved to keep as a holiday as well as Thursday.

About the judiciousness of the action of the miners in standing for the second 6d. at present there are differences of opinion. Some hold that the advance is fully justified by the upward movement in the price of pig iron, while others are apprehensive that another increase, entailing a further rise in prices, might drive away a large proportion of the trade from Scotland to Wales and the North of England. In the Mediteranean Scotch coals are already being supplanted by Welsh which are of better quality, the difference in price not now being such as to recommend purchases from Scotland. From the figures given above, it will be seen that as yet the total Scotch shipments are comparing well with those of this time last year; but it is possible that further restriction of output and higher prices may curtail the exports in the course of the next few weeks. Everything depends upon whether the impetus given to trade by the generally confident tone prevailing all round will be strong enough to keep up the demand in spite of higher quotations.

In the meantime, the coalmasters of Lanarkshire and the Slamannan and Bathgate districts have unanimously refused to give the second 6d. of advance.

Messrs. Merry and Cuninghame have commenced to sink two new coal pits in the vicinity of Irvine.

Sheriff Gillespie, of Dunfernline, has given his decision in a most important test case affecting the relations of the Fife miners with their employers. The Cowdenheath Coal Company sued Peter Drylie, miner, for 13s. for alleged loss and damage by his working only five days a week instead of eleven days a fortnight, as provided by the colliery rules. The defence was that the regulations had never been agreed to by the colliers. But the Sheriff has held that their constant exposure at prominent places at the collieries gave the rules the nature of a contract of service, and he has accordingly given decision in favour of the company for 10s. and expenses. The miners have long believed that they are entitled to disregard the rules, for this amongst other reasons—that in slack times the masters do not guarantee them eleven full days work a fortnight, and that therefore it is unfair that they should be compelled to obey rules that are not always adhered to by their employers. There is a probability of the case being appealed to a superior court.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The stormy weather still continues to affect, more or less, the coal shipments at the Welsh ports. Cardiff showed a falling off of 50,000 tons, compared with the preceding week, and Newport, as well as Swansea, exhibited a decrease. The Newport coasting total was only 19,000 tons, in round numbers. This may, however, be soon expected to alter, as the house coal business is getting active. This is noticeable in the Rhymney Valley, where, during the last six weeks, there has not been an idle day. The same cannot be said for steam collieries in the Rhondda; scarcely a colliery there turns out the output it is capable of doing. In this, as in the tin-plate trade, I quite agree with local critics, the trade suffers from over-production. We have too many collieries for the straitened demand. Hence, though the coal trade is beginning to look up, the competition is so great that the benefit, so far, is but a slight one.

Prices remain low. A capital house coal, "through," is being sold in trucks at Cardiff for 7s. This would amount to 8s. delivered into the house. The very best steam coal is quoted f.o.b. Cardiff 8s. 6d. to 8s. 9d., and secondary sorts have been sold as low as 7s.

It is not to be wondered at that the audit of coalowners' books shows against the collier, and that a reduction in accordance with the sliding scale is imperative. The Ferndale scale and that of the Associated Coalowners of South Wales and Monmouthshire justify, therefore, a reduction of 2½ in the pound in colliers' wages, which will forthwith be carried out. The Ocean scale warrants the continuance of present wages.

The colliers at Wrexham appear to have thought that in wage questions they could comport themselves as in political movements—elections to wit—and have found their mistake.

In Monmouthshire one colliery is still on strike, Mr. Stone's, North Blaina. The manager has made the most ample offers, but the men want arbitration, though no one but the colliers can see anything to arbitrate about after the manager's concession.

I have just gone through the voluminous report of the Commission on Mines, and a "pertinent query" suggests itself to me,—Why should it remain a sealed book to the mass of the colliers? As a Blue-book it is seen only by the most intelligent of the coalowners and a few managers; but for its most valuable suggestions, made by the experienced members of the Commission, its forcible and exhaustive examinations into all points, a copy should be with every collier.

I find that a full *résumé* is to be given in the "History of the Welsh Coal Trade," but that work, unless a cheap edition be published, will be out of the colliers' reach.

There is little of interest to record in connection with the iron and steel trades. Some few home and colonial rail orders and a moderate sleeper trade keep the works going.

Steel sleepers, as I have contended, are to form a good part of future trade. A steel sleeper, tried on one of the railways near, stood all tests perfectly. The price of steel is just double that of wood, but judges say that they will last three or even four times those of wood.

I note a new feature in our steel exports—an increase in the matter of "blooms." Important consignments went off this week to America and San Francisco, and a substantial cargo of rails for Costa Rica.

An important colliery case has just been decided in the Rhondda Valley. A collier sued his company for a substantial amount due, he alleged, for working the clod above the coal at 2d. per ton. The company would only give 1d. per ton, and for the difference was sued. But the plaintiff produced an agreement to pay 2d., signed by the underground manager. The contention was that the underground manager had no power to sign, that this was the manager's duty, and the Court decided accordingly.

Tin-plate affairs continue to afford a good deal of discussion. Prices became unsteady last weck, and dropped sensibly, then they recovered, and the tone of the trade may be regarded as good.

For a few days prices declined for ordinary cokes to 13s. after being at 13s. 6d., then a stand was made. Sales were effected at 13s. 1½d., 13s. 3d., and now I hear of business done at 13s. 6d. Good orders are in hand for Bessemer steels.

In the Swansea district the impression is that the falling off in price was due to the re-opening of some of the old works which had been stopped. Cargoes from that port were large, nearly 38,000 boxes having been shipped, and as 30,000 only came into stock, stocks have been reduced accordingly, and prospects of better prices are tolerably good.

The harbour trustees at Swansea have decided to deepen the lock of the North Dock.

One engineering outcome of the late storm is a harbour of refuge at the Mumbles. There should be many along the coast. A bay near Fishguard, when I saw it last, was dotted with the masts of wrecks.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

A commission, which has been sitting in Russia to inquire into, among other matters concerning the iron industry, the expediency of again increasing the duties on iron, has concluded its labours with a recommendation for raising them 25 p.c., which in all probability will come into force on the 1st of January, 1887. At the same time the principal blast furnace proprietors in Silesia have undertaken not to blow in more furnaces than are now at work for the next six months. These two circumstances have given a decided fillip to the pig iron market of the district; indeed, so much so, that in anticipation of the above increase of duties coming into force, the whole of the accumulated stocks have been contracted for up to April next year, a great part of which is for export over the border into Poland and Russia. This, coupled to the fact of the rolling mills being still at full work, necessarily makes the market more animated than it was, and prices are expected to rise accordingly. Also there is a little more vitality in the steel trade, caused by demands for permanent way materials for the State Railways. The orders for ship plates, angles, and other kinds of iron for the building yards on the Baltic are also plentiful, and the same may be said for constructive iron of various sorts; in fact, many works are fully engaged for the best part of the current quarter on such orders. Common plates are more neglected, while thin sheets are still in good request.

In Rhineland-Westphalia it is agreed that there are signs of improvement in most branches of the iron and steel industry, with the single exception of rails, and that prices have reached the lowest point. As they have not receded, in these times they may be looked upon almost as having advanced, though no actual rise has taken place. In pigs the tendency is hopeful, in sympathy with the Silesian market, and in Austria the quotations are also firmer; orders are coming more regularly to hand, and prices are a shade better than they have been there of late. Native ores in Westphalia are about the same as for some time reported, and Spanish are firmer with somewhat advanced freights. Up to 16th inst. inclusive 2,538,107 tons have been exported from Spain against 2,758,904 tons in 1885 and 2,117,129 tons in 1884. In pigs there is more demand, but this has made no impression on prices as yet, unless it be a trifle in favour of forge qualities. Next month higher prices are looked forward to in the Siegerland. Foundry pig remains in the same condition that it was, and if it has been more called for all that has been accomplished is, to keep prices from going back. The rolling mills generally are fully employed, but as yet this spurt has only kept the old low prices from falling deeper, but an increase of them seems shortly to be in prospect. In plates there is a healthy tendency without any special changes to note. The same may be said of the thin sheet trade. Only steel wire rods are in good request, and the prices are somewhat better, whilst iron rods and drawn wire are neglected and stocks increasing, with only a poor outlook for the winter months. In railway material nothing much is doing, but the wagon works have recently secured a good deal of work, and tenders are out for still more rolling stock and some rails. The foundries and constructive works are still poorly off both as to new orders and prices. The metal founders are equally complaining of late, as the orders are diminishing in volume and prices are shrinking, whilst, on the other hand, the raw material is rising, so that the finished article is double afflicted. Only with a good deal of trouble can the following prices be obtained—red brass, 1·60; bronze, 1·60; phosphor bronze, 1·70 p. ko.

In Belgium the market is firm, partly on account of the more favourable reports from abroad, partly because a good export business is expected—India being looked upon as a favourable field—and partly because the iron combination has at last become an accomplished fact. Each of the covenanted works deposits 5000f. security, and the Government mining engineers are deputed to supervise the proper carrying out of the stipulations of the convention. The John Cockerill Company stood, and perhaps still stands, in imminent danger of losing the services of its eminent General Director, Baron Sadoine, who has for twenty years conducted these large works and 14,000 men with so much ability and skill, for during the late riots and destruction at Seraing and the neighbouring works all remained quiet at the Cockerill Works. It has transpired that a misunderstanding with regard to the negotiations concerning the projected new works at Nikolajew and Batum, between the board of directors and Baron Sadoine, caused the latter to tender his resignation, but one of the most influential shareholders took the matter up, and in consequence now a general meeting of shareholders is to be convened to, if possible, arrange the matter and so avoid a calamity, which it really would be for the company, by losing the services of such a manager.

There is a slight weakening of prices in France, as far as rolled girders are affected, which are at present quoted 125 to 127·50, but merchant iron being 130 to 135, and plates 155 to 160f. p.t. As a reconstruction in infantry, artillery, and marine material is expected, hopes are entertained of large orders for iron being soon placed. A new railway sleeper on the plan of Reynoul and Ponsard, which is being introduced on the State Railways, is causing some sensation. An armoured fort is being constructed at Creusot, from which are to be fired projectiles reaching a distance of 14 km. So it is reported at least.

The great girder rolling firms of the Saar—West Germany—and Lorraine, Dillinger, and Burbach Companies, Messrs. Stamm, Kraemer, and de Wendel have formed a combination with the intent of stiffening, if not of raising, the present depressed prices of this article.

The prices tendered at Bromberg, Prussia, a few days ago for 8438 tons steel rails were: Dortmund Union Co., 104·75 at Dortmund; Hoesch and Co., 104·80; Krupp, 104, the last two at the respective works; and the Darlington Iron and Steel Co., 112·50 M. p.t. delivered at their destination, Neufahrwasser, Baltic; therefore the latter price was the lowest.

On the 18th inst. the second large Bremen liner for the East route was launched from the Vulcan Yard at Stettin, and received the name Bayern.

The completion of the canalisation of the Main from the Rhine to Frankfurt and the opening of the new docks at the latter town were celebrated on the 20th inst. The docks are well appointed with the necessary appliances for discharging and loading vessels, and now the large boats which load coal in the Rhur basin can proceed direct to Frankfurt to discharge their cargoes, thus enabling the Westphalian coals to penetrate more directly and cheaply into the heart of South Germany.

LAUNCHES AND TRIAL TRIPS.

The R.M.S. Spartan, built and engined in 1881 by Messrs. J. and G. Thomson, of Glasgow, for the Union Steamship Company's Cape of Good Hope Mail Service, has had her engines converted from the compound to the triple expansion type by Messrs. T. Richardson and Sons, of Hartlepool, and has been supplied with new boilers working at a pressure of 160 lb. per square inch. The diameters of the new cylinders are 34in., 54in., and 89in. respectively, and the length of stroke 60in. The Spartan went out for her trial trip in Stokes Bay on Monday, the 18th inst., and the result was most satisfactory to all concerned. In order to make the comparison between the results of this trial trip and those obtained by the Spartan with her compound engines as complete as possible, the vessel was loaded down to the same mean draught of water as on the occasion of her original trial. With the compound engines and boilers working at a steam pressure of 75 lb. to the square inch, vacuum 27in., and 66 mean revolutions per minute, the Spartan indicated 3684-horse power, and the mean of four runs on the measured mile showed a speed of 14·78 knots. With the new triple expansion engines and boilers, with steam pressure 160 lb. to the square inch, 26in. vacuum, and mean revolutions 67 per minute, she indicated 4088-horse power, and her mean speed on the measured mile was 15·2 knots. This shows an increase of over 400 indicated horse-power and of half a knot in the ship's speed on a decreased consumption of coal. The adoption of the triple expansion engines will add greatly to the comfort of passengers through the decreased vibration, while the economised consumption of coal will be of advantage to the proprietors. The Union Company's R.M.S. Athenian is now having her engines converted in a similar manner to those of the Spartan, and the extension of the principle to other steamers of the company will probably follow. In addition to the Ocean Mail steamers, two other steamers, belonging to the Union Company's Intercolonial Service, namely, the Anglian and the African, are fitted with triple expansion engines.

Messrs. Ed. Finch and Co., of Chepstow, are about to build a powerful twin-screw tug and salvage steamer for service on the Bute Dock Estate. The vessel will be fitted with compound surface-condensing engines capable of developing about 500-horse power effective, and driving the vessel some 12 knots per hour. She will be fitted with powerful salvage pumps and equipment for the raising of sunken ships and steamers, and other purposes; also with one of the most powerful steam fire pumps extant, capable of throwing some 70,000 gallons of water per hour to a distance of 250ft. Competition plans and specifications for this vessel were submitted by the principal shipbuilders of this country; that of Messrs. Finch and Co. has been accepted.

H.M.S. Forth, a twin-screw corvette, was successfully launched from Pembroke Dockyard last Saturday. The ship is built of steel, and was commenced in December, 1884. Her principal dimensions are—Length, 300ft.; breadth, 46ft. Her armament consists of twenty 8in. guns, one Gardner and one Nordenfelt gun, and eighteen Whitehead torpedoes. Her indicated horse-power is 3800, and she has a crew of 250 men.

Manchester Sewage Scheme.—At a meeting of the Manchester City Council, held on the 27th inst., Mr. Bailey Denton, of the firm of Bailey Denton, Son, and North, Palace-chambers, Westminster, was selected as consulting engineer to advise upon the scheme about to be carried out for the sewerage and sewage disposal of that city.

South Kensington Museum.—Visitors during the week ending Oct. 23rd, 1886:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 10,294; mercantile marine, Indian section, and other collections, 3793. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1638; mercantile marine, Indian section, and other collections, 212. Total, 15,937. Average of corresponding week in former years, 16,653. Total from the opening of the Museum, 25,224,359.

NEW COMPANIES.

THE following companies have just been registered:—

Nobel Dynamite Trust Company, Limited.

This company was registered on the 18th inst. with a capital of £2,000,000, in £10 shares (of which 153,700 will be issued as fully-paid), to acquire shares, stock, debentures, or other interest in companies, associations, or firms engaged in manufacturing or trading in explosives, fuses, detonators, glycerine, chemicals, &c., but more particularly in the Nobel and other dynamite and explosive companies with limited liability, which at present exist, or hereafter may exist, in Europe or elsewhere. The company will adopt two agreements, the first dated 15th inst., between Thomas Reid, of Glasgow, a shareholder in Nobel's Explosive Company, Limited, and J. D. Taylor; and the second dated 14th inst., and made between Francois Barbe, of 8, Rue d'Aumale, Paris, and J. D. Taylor. The subscribers are:—

	Shares.
*Thomas Reid, 92, West George-street, Glasgow, merchant	500
*Sir C. Tennant, Bart., The Glen, Peebles, merchant	500
*H. Beckett, 16, St. Vincent-place, Glasgow, merchant	500
*M. A. Phillipp, Hamburg, merchant	500
*C. Wickmann, Hamburg, merchant	500
*J. D. Taylor, 9, Mincing-lane, merchant	250
*E. Kraftmeier, 6, Great Winchester-street, managing director Chilworth Gunpowder Company, Limited	250
*John Taylor, C.E., 6, Queen-street-place	250
*J. Thorne, 85, Gracechurch-street, merchant	250
Thos. Johnston, 149, West George-street, Glasgow, merchant	250
*J. Menz, Dresden, banker	250
Alfred Nobel, 53, Avenue Malakoff, Paris	5000
*J. N. Heidemann, Cologne	250

The number of directors is not to be less than ten nor more than fourteen; the first are the subscribers denoted by an asterisk; qualification, 250 fully-paid shares; remuneration, £4000 per annum. Mr. Alfred Nobel is appointed honorary president of the company.

George Forrest and Son, Limited.

This company proposes to trade as brass founders and finishers; gas, water, electric light, mechanical, lighthouse, and sanitary engineers; contractors, lamp manufacturers, and gas-fitters, and for such purposes will acquire the business now carried on under the name of George Forrest and Son. It was registered on the 18th inst. with a capital of £50,000, in £5 shares. The subscribers are:—

	Shares.
Walter McNeil, 28, Devonshire-street, N., clerk	1
Henry George, 1, Nevill's House, New-street-square, E.C., manager	1
H. L. Lilley, Ware, Herts, solicitor	1
W. H. Hardy, 5, Great Winchester-street, chartered accountant	1
Louis Hardy, 5, Great Winchester-street, chartered accountant	1
A. W. Kerly, 14, Great Winchester-street solicitor	1
Henry Verden, 14, Great Winchester-street, solicitor	1

The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first and act *ad interim*; qualification, 20 shares; remuneration, £50 per annum to each director, and such further sum as may be voted by the company in general meeting.

Henry Wilson and Co, Limited.

This is the conversion to a company of the business of iron and brass founders and general ship furnishers, carried on at Cornhill, Liverpool. It was registered on the 14th inst. with a capital of £20,000, in £1 shares. The subscribers are:—

	Shares.
T. Wilson, 31, Wapping, Liverpool, oil merchant	2
D. Fernie, 7, Rumford-street, Liverpool, shipowner	2
H. F. Fernie, 7, Rumford-street, Liverpool, shipowner	1
G. A. Wilson, 31, Wapping, Liverpool, paint manufacturer	2
T. M. Lynch, Seaforth, commercial traveller	2
G. E. Fairbairn, 185, Fountain-road, Liverpool, ironfounders' assistant	2
E. W. West, 8, Cornhill, Liverpool, iron and brass founder	1

Mr. E. W. West is appointed manager at a salary of £364 per annum. A board of directors will be dispensed with unless otherwise decided by a resolution passed at a special meeting by two-thirds of the members present personally or by proxy.

Sugar Filtration Company, Limited.

This company proposes to acquire the benefit of an agreement of 1st May between Mr. George Schoetensack, of 70 and 71, Bishopsgate-street, Mr. A. Domeier, 13, St. Mary-at-hill, and Mr. Rudolf Englert and Dr. Franz Becker, of Prague, for the purchase of certain patents and inventions relating to the manufacture of sugar and allied substances. The company was registered on the 18th inst. with a capital of £10,000, in £1 shares. The subscribers are:—

	Shares.
Harold Evans, 5, Holly Villas, Leytonstone, clerk	1
Leopol Courtiss, 19, Talfourd place, Peckham, clerk	1
P. Fanhänel, The Gables, East Acton, merchant	1
W. Mauritz, 179, Prince of Wales-road, Kentish Town, clerk	1
Thos. G. Wood, 37, Marquis-road, Stroud-green, merchant	1
A. Willcox, 311, Southwark Park-road, clerk	1
A. E. E. L. de Lavigerie, 6, Dayton-grove, Peckham, clerk	1

The number of directors is not to be less than three nor more than five. Most of the regulations contained in Table A of the Companies' Act, 1862, apply to the company.

Australian Mutual Shipping Company, Limited.

This company was registered on the 19th inst. with a capital of £100,000, in £100 shares, to carry on the business of a shipping company in all branches, and in particular the loading of ships for Australia; power is also taken to buy, sell, and prepare for market, and deal in coal, iron, metals, timber, live stock, meat, and other merchandise or produce, and freight of every kind. The subscriptions are:—

	Shares.
W. Gardiner, 12, Redcross-street, E.C., merchant	1
*D. E. Ellis, 31, Lombard-street, merchant	1
*H. H. Chapman, 8, Leadenhall-street, merchant	1
F. S. Roberts, 18, Finch-lane, merchant	1
G. Wade Share, 72, King William-street, merchant	1
W. Purkiss Wincott, 3, Brabant-court, merchant	1
W. MacNish Porter, 77, Pancras-road, beer exporter	1

The number of directors is not to be less than three nor more than nine; qualification, five shares; remuneration, £2 2s. each for every board or committee meeting attended. The first three subscribers are appointed directors.

Tesselated Floor Covering Company, Limited.

This company was registered on the 15th inst. with a capital of £50,000, in £5 shares, to acquire, upon terms of an unregistered agreement of the 30th ult., the business carried on by Messrs. Hands and Bonny, under the name of the Patent Noiseless Plain and Inlaid Tile Company. The subscribers are:—

	Shares.
S. Spence, Bulpton, Essex, land agent	1
C. W. Jarvis, 52, Brixton-road, engineer	1
T. Pott, 12a, Old Cavendish-street	1
H. Clark Lewis, Tynemouth-road, Tottenham	1
R. W. Wilson, 41, Rowan-road, W., merchant	1
W. McLachlan, M.E., 6a, Austinfriars	1
J. E. Leyland, 39, Epirus-road, Fulham, actuary	1

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100 in shares or stock; remuneration, £600 per annum.

Consolidated Gold Mines of Mulatos, Limited.

This company was registered on the 19th inst. with a capital of £660,000, in £1 shares, to enter into an agreement with Messrs. Elborough and Co. for the purchase of a concession and right to the Consolidated Gold Mines of Mulatos, in the State of Sonora, Mexico, consisting of about 24,000 acres, together with the mill, houses, stores, machinery, working materials, tools, &c. The subscribers are:—

	Shares.
J. H. Hayward, 78, Queen's-road, Bayswater	1
S. T. Galloway, 7, Perch-street, Shakelwell-road, N.	1
C. E. Eden, West Norwood, corn merchant	1
G. T. Born, Port Hall, Brighton	1
G. H. Humphries, Thanet Lodge, Norbiton, bank manager	1
E. N. Dawe, 23, Bucklersbury	1
C. Gladstone Eames, 16, Peak-hill, Sydenham	1

The number of directors is not to be less than three nor more than thirteen; the subscribers are to appoint the first and act *ad interim*; qualification, 200 shares; remuneration, £3000 per annum. Each director will be entitled to receive all reasonable expenses incurred by him in connection with the company, with the assent of the board.

London Flock Company, Limited.

Registered on the 16th inst. with a capital of £5000, in £1 shares, to take over and carry on the flock manufacturing business of Mr. Joseph Fraser Oates, of 53, Glengall-road, Old Kent-road. The subscribers are:—

	Shares.
*J. F. Oates, 53, Glengall-road, flock manufacturer	1
*R. H. Blatchford, 40, Bankside, contractor	1
J. Preston Oates, 12, Anlay-street, Old Kent-road, flock manufacturer	1
J. Hopwood, 36, Coborn-road, Bow, chemist	1
W. F. Edwards, 251, Upper-street, Islington, corn merchant	1
G. A. Summers, 63, Oakdale-road, Leytonstone, book-keeper	1
J. Capson, Morning-lane, Hackney	1

The number of directors is not to exceed four; the first two subscribers are appointed directors.

ENGINEERING SOCIETY, KING'S COLLEGE, LONDON.—At a general meeting held on October 12th, Mr. Long read a paper "On Petroleum." He gave a brief sketch of the process through which it has to pass before it is fit for use, and how it might be advantageously used for fuel. The method of distillation was pointed out, the object being to remove the lighter hydrocarbons and all tarry matter. After describing the stills, the author referred to the carriage of petroleum by sea, pointing out the advantages of transportation in bulk over that in casks, and also the necessary precautions to ensure safety and stability. The question of petroleum as a fuel was next dealt with, it being stated that practically the ratio of the heating value of that substance to that of coal was as 3:1. Where it can be obtained at a low rate it may be used with great advantage, as, for instance, in America and Southern Russia, but in England its heavy price prohibits its use. The chief advantages in its use are (1) that one stoker can attend to all the furnaces; (2) that it is smokeless; (3) that its intensity can be regulated to any extent. After a short discussion the meeting adjourned. At the meeting held on October 19th, a discussion took place on blasting agents. It was opened by a paper "On Dynamite," from Mr. Gask, giving an account of its composition and relative cost as regards gunpowder. The method of charging and tamping the holes, and fixing the detonator, was fully explained, and also the advantage of dynamite over gunpowder in wet ground. Great care has to be taken with dynamite when frozen, numerous accidents having happened from explosions when in that state. It is a very convenient explosive in the case of sunken rocks, &c. Mr. Heathcote then explained some forms of safety cartridges, including (1) the lime cartridge, where the expansion of lime on the addition of water is utilised; (2) where strontia is brought into contact with ammonia; (3) by breaking a vessel containing nitric acid, and thus letting it combine with picric acid. Mr. Preece next gave the advantages of firing charges by electricity, and the way it is done, giving as an instance the blowing up of the Hell-gate, and explaining the arrangement of the batteries. The American substance, rackrock, was mentioned by Mr. Moore as being 56 per cent. more explosive than gunpowder, but inferior to dynamite. After the recent quarry accident in Scotland had been discussed, the meeting adjourned.

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.

19th October, 1886.

13,287. BALZARINE FABRICS, W. Ecroyd, Bradford.
13,288. STOPPERS for BOTTLES, &c., W. H. R. Kelly, Yorkshire.
13,289. FIRE EXTINGUISHER, H. A. Mansfield and H. M. Harrington, London.
13,290. ATTACHMENTS for BOXES for the RECEPTION of TICKETS, &c., J. R. Wherry, H. H. Rottaken, and E. N. Wiegel, Arkansas, U.S.
13,291. TAPS or VALVES for WATER or other FLUIDS, J. Fagan, Yorkshire.
13,292. SOLITAIRES, &c., H. Owen, Birmingham.
13,293. TRANSMITTING ROTARY MOTION from MOTORS to DYNAMO-ELECTRIC MACHINES, S. Alley and A. G. Brown, Glasgow.
13,294. STRUCTURAL APPLIANCES and other FITTINGS, H. H. S. Pearse, London.
13,295. ARTIFICIAL METAL DENTURE or PLATE, J. S. Tayler, Grimsby.
13,296. STRENGTHENING METALLIC BOXES, H. H. Chilton, Wolverhampton.
13,297. HOT AIR PIPES for FIREPLACES, R. Greene, Northampton.
13,298. RAILWAY BOGIE CAR, W. Smith, Idlewild.
13,299 ARTIFICIAL LIGHT, F. W. Hayward, Norwich.
13,300. FASTENERS for FOLDING DOORS of CUPBOARDS, &c., W. Bagshaw, Dudley.
13,301. SEWING MACHINES, J. Pittuck and J. A. E. Vosper, Stonehouse.
13,302. LOOMS for WEAVING CARPETS, &c., J. Hollingworth, Huddersfield.
13,303. SPOOL WINDING MACHINERY, J. Heal, Halifax.
13,304. SHIPS' BERTHS, W. P. Hoskins, Birmingham.
13,305. PROPELLING VELOCIPEDES, J. A. Stephan, Birmingham.
13,306. BRICK and TILE FACING, R. G. Scrivener, Newcastle.
13,307. LIGHTING PIPES and CIGARS, J. G. Stormont Erdington.
13,308. BOXES and CASES for WINES and SPIRITS, J. Saddler, Glasgow.
13,309. APPLYING a WEB of PAPER to PRINT from a LITHOGRAPHIC and TYPE PRINTING PRESS, C. Waddie, Edinburgh.
13,310. BOILERS for GENERATING STEAM, &c., J. Murrie, Glasgow.
13,311. TRAVELLING DRESSING BAGS or CASES, W. Thornhill and Co. and A. Watson, London.
13,312. PRINTING TELEGRAPHS, J. H. Linville, London.
13,313. VENTILATING DRAINS or SEWERS, R. H. Reeves, London.
13,314. FRENCH POLISH REVIVER, P. Wright, London.
13,315. VENTILATORS for RAILWAY CARRIAGES, &c., E. Beswick, London.
13,316. GAS REGULATORS, F. Bosshardt.—(*A. L. J. Ladous, France.*)
13,317. LEVER NUTS, F. Pickford, Birmingham.
13,318. TREATMENT of NEURALGIA, D. F. Hamlink, London.
13,319. STOPPERS for BOTTLES, R. B. Macnaughtan, London.
13,320. AUTOMATIC SPRING BOX COVER, F. Griffin, London.
13,321. MAKING, &c., AERATED DRINKS, G. W. and L. G. Chinnery, London.
13,322. GRINDING, &c., RAZORS, &c., W. J. Jordan, London.
13,323. CORSET BUSKS, L. Phillott and J. G. Smith, London, and J. C. Morrell, Ealing.
13,324. FUNERAL WHEELED BIER and GRAVE BARRIER, S. Stretton, London.
13,325. TWIST LACE CURTAIN MACHINES, J. Carver and J. Newton, London.
13,326. COMBINED COPYING PRESS, PEN, and PENCIL-HOLDER, S. H. Crocker, London.
13,327. LOCKING STOP-COCKS or TAPS, J. Saxby, London.
13,328. REVOLVING SMALL-ARMS, T. Bayley and J. Reeves, London.
13,329. FLOWER HOLDER, W. Spurrier, London.
13,330. FASTENER for BUTTONS, &c., J. McDonnell, London.
13,331. MIXING FLOUR, &c., H. A. Weber and J. G. Zeidler, London.
13,332. AUTOMATIC CUT-OFF for WATER PIPES, W. G. Browne, J. Keely, W. A. Hemphill, and T. P. Westmoreland, London.
13,333. LAWN TENNIS BATS, L. K. and T. A. Deverell, London.
13,334. CLOTH, W. Murgatroyd, Leeds.
13,335. SAFETY or RELIEF VALVES, A. J. Boult.—(*W. A. O. Hegeman, United States*)
13,336. FLUID PRESSURE REGULATORS, A. J. Boult.—(*W. A. O. Hegeman, United States.*)
13,337. RYDER'S SILICATED RUBBER COMPOSITION, W. Ryder, London.
13,338. SCALES for WEIGHING, E. Edwards.—(*L. Martane, France.*)
13,339. METAL SCREW MACHINES, W. W. Popplewell.—(*J. Stehli and the Hartford Machine Screw Company, United States.*)
13,340. TUBES for ELECTRIC CONDUCTORS, H. E. Newton.—(*E. D. McCracken, United States.*)
13,341. COVERING, &c., ELECTRIC WIRES, H. E. Newton.—(*E. D. McCracken, United States.*)
13,342. PIANOFORTE MUSIC DESK, J. H. Abbott, London.
13,343. MUSICAL INSTRUMENTS, F. E. P. Ehrlich, London.
13,344. CENTR FUGAL PUMPS, W. Anderson, London.
13,345. FIRE-LIGHTER, J. Childs, London.
13,346. BOOKBINDING MACHINES, J. Y. Johnson.—(*J. S. Jones, United States.*)
13,347. CORSETS, &c., H. H. Lake.—(*J. Stone and M. Gardner, United States.*)
13,348 LOCKS and LATCHES, H. H. Lake.—(*S. J. and J. W. Hicks, United States.*)
13,349. PRINTING PATTERNS upon FABRICS, J. Bauer, London.

20th October, 1886.

13,350. SEWING MACHINES, J. Poyser, London.
13,351. HEALDS for LOOMS, W. and G. W. Ellis, Huddersfield.
13,352. FAN APPLIANCE for SMITHS' FORGES, J. O'Connor and A. Spencer, Manchester.
13,353. WEIGHT REGULATOR for LOOMS, J. Belicard, Manchester.
13,354. RECORDING MUSIC, C. H. Wall and O. Oström, Glasgow.
13,355. DOMESTIC FIRE-GRATES, R. W. Garland, Glasgow.
13,356. BELT FASTENERS, J. Foit, East Stockwith.
13,357. DECKLE APPARATUS for PAPER-MAKING MACHINES, J. Wood, Glasgow.
13,358. BOLTS and BARS for GATES, &c., E. Murgatroyd, Bradford.
13,359. BUFFERS for RAILWAY CARRIAGES, E. C. Ibbotson, Sheffield.
13,360. SMOKING PIPES, W. Booth, Sheffield.
13,361. BURNER for GASSING YARNS, W. Hartcliffe and W. H. Malkin, Manchester.
13,362. DYEING COTTON, &c., F. A. Gatty, Manchester.
13,363. VELOCIPEDE SADDLES, J. B. Brooks, Birmingham.
13,364. SPINDLELESS REVOLVING CHIMNEY COWL, R. Pardoe, Aberdare.
13,365. KITCHEN RANGES, H. Thompson, London.
13,366. TRANSMITTING MOTION, J. R. H. Williamson, Manchester.
13,367. OSCILLATING SHUTTLES, &c., for SEWING MACHINES, J. and W. U. Morton, Glasgow.
13,368. RATTLE BELLS, E. B. Lowe, Birmingham.
13,369. GALLEYS for LETTER-PRESS PRINTERS, J. Donaldson, Edinburgh.
13,370. TIES, BOWS, CRAVATS, &c., J. Ferguson, Bowdon.
13,371. MOLE and VERMIN TRAPS, J. Roberts, Wednesfield.
13,372. VELOCIPEDES, W. W. Ford, London.
13,373. VELOCIPEDES, M. D. Rucker, London.
13,374. BOXES, &c., E. A. Sharp, London.
13,375. EXPLOSIVES for USE in FIRE-ARMS, T. G. Hart, Bath.
13,376. EXTRACTING TIN from IRON in TIN SCRAPS, R. H. W. Biggs.—(*C. Malin, Paris.*)
13,377. KEYLESS LOCK, E. G. Rolland, London.
13,378. TOASTING FORKS, J. F. Scott, Wednesfield.
13,379. TILL, J. Mair and Troughton and Co., London.
13,380. PLATES or CLICHES with INTAGLIO or CAMEO SURFACES for PRINTING, J. Brunner and C. Klary, London.
13,381. FILLING SACKS with GRAIN, &c., W. P. English, London.
13,382. COMBINED PENHOLDER and PENKNIFE, C. E. Hodges, London.
13,383. PULLEYS USED with ROPES, Right Hon. Viscount Bury and M. Immisch, London.
13,384. MONEY RECKONING MACHINE for FIXING on PURSES, &c., A. J. Willis, London.
13,385. REMOVING FUSEL OIL, &c., from CRUDE SPIRITS, H. Grote, London.
13,386. GAS ENGINE, J. Roots and A. Ashby, Crofton.
13,387. REFINING MINERAL, &c., OIL, R. B. Tennent, Glasgow.
13,388. STOPPERING JARS, &c., for PRESERVES, A. Horenburger and H. Benger, Glasgow.
13,389. CONTINUOUS FURNACE for PRODUCING CHLORINE, E. Solvay, London.
13,390. KNAPSACKS, W. A. F. Blakeney, Glasgow.
13,391. FRAMES for CUTTING FUSTIANS, &c., J. F. Smith, Manchester.
13,392. MARKING WRAPPERS for PACKING TOBACCO, &c., H. H. Wills, London.
13,393. MEASURING APPARATUS for HATS, C. Bergmann, London.
13,394. SINGLE CHAIN GRAB DREDGERS, J. R. Bell, London.
13,395. PROTECTORS for SHOP WINDOWS, &c., F. G. Sage, London.
13,396. SPRING LEVER APPARATUS for STRAIGHTENING the INVERTED GREAT TOE, C. Krohne and H. Seemann, London.
13,397. MANUFACTURE of BOXES, &c., L. Gunn, London.
13,398. PROPELLING TRICYCLES, &c., F. D. Bumstead, London.
13,399. BLOWERS, W. R. Mansell, Birmingham.
13,400. FIRE-ARMS, W. H. Beck.—(*J. Rochatte, France.*)
13,401. CARPETS, W. Taylor and W. Youngjohns, London.
13,402. SOAP, G. Linget and J. Viaudey, London.
13,403. TENNIS SHOES, F. B. Martin, London.
13,404. GUNS, O. Imray.—(*A. de Brynk, Russia.*)
13,405. SAFETY TIPPING WAGON, R. Bolton, London.
13,406. SAFETY ASHPAN for LOCOMOTIVES, E. F. Vaughan, London.
13,407. CONTROLLING the POTENTIAL or CIRCUITS where ALTERNATING CURRENTS are USED, J. M. V. Kent and W. H. Snell, London.
13,408. BORING or PIERCING the BACKS, &c., of BRUSHES, J. Raper, M. Pearson, and F. Gill, London

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13,409. ANGLE COUPLING, H. J. Clark.—(*C. J. Clark United States.*)
13,410. ADJUSTABLE BICYCLE BEARINGS, C. T. Linford, Aston.
13,411. MEASURING INSTRUMENTS or GAUGES, J. Buckley, Manchester.
13,412. HYDROCARBON and other LAMPS, F. R. Baker, Birmingham.
13,413. RAILWAY CARRIAGE, &c., WINDOWS, L. A. Parrock, Birmingham.
13,414. DISENGAGING HOOK for BOAT LOWERING PURPOSES, R. Hill, Liverpool.
13,415. ROTARY MOTORS, J. Hannay and J. H. Walker, Glasgow.
13,416. TREATMENT of LEAD PIGMENTS, J. B. Hannay, Glasgow.
13,417. COMPOUND BOILERS for HEATING WATER, &c., E. Kemp, Glasgow.
13,418. SPIRIT MEASURING TAPS, D. Ogg, jun., Glasgow.
13,419. CEMENTING TOGETHER THICKNESSES of WOOD, &c., W. H. Carmont, Manchester.
13,420. SEALING AIR-TIGHT CANISTER, &c., LIDS, J. Burtinshaw, Manchester.
13,421. BOOTS, F. G. Draycott, Leicester.
13,422. APPLYING DYE to the HAIR, &c., W. B. Hinde, Birmingham.
13,423. PORTABLE TELEPHONE, H. Binko, London.
13,424. SUPPLY of FEED-WATER for BOILERS, L. Mills, South Preston.
13,425. BALLS for BILLIARDS, &c., T. B. Sharp, Smethwick.
13,426. CHANDELIERS and GASALIERS, F. R. Baker, Birmingham.
13,427. STEERING HEAD for VELOCIPEDES, T. E. Bolton, Manchester.
13,428. BREAKING, &c., FIBROUS MATERIALS, E. Brasier, London.
13,429. WINDOW BLIND FURNITURE, R. K. Jones, Liverpool.
13,430. JACK STANDS for LOOMS, G. A. Shiers and A. Wright, Manchester.
13,431. SLIDES for DOOR CHAINS, C. T. Smith, Birmingham.
13,432. STOVES and FIRE GRATES, G. L. Shorland, London.
13,433. UMBRELLAS, &c., J. B. Seel, Manchester.
13,434. BOX from which CONTENTS can be ABSTRACTED WITHOUT OPENING IT, S. Harris, London.
13,435. CONVERTIBLE CHAIR and HAMMOCK, J. E. Hooper, London.
13,436. SPIRIT LEVELS, J. W. Harrington, Sheffield.
13,437. PARASOLS, &c., T. Widdowson, Sheffield.
13,438. LAMP BOWLS, T. C. J. Thomas, London.
13,439. TRIMMING SOLES of BOOTS, &c., R. A. Slater. London.
13,440. FASTENINGS for WINDOWS, J. E. Parr and T Kendrick, London.
13,441. MECHANISM for EFFECTING ROTARY MOTION, &c., T. Williams, London.
12,442. MAGAZINES of REPEATING FIRE-ARMS, T. P. Wood and W. Clifford, London.
13,443. ASBESTOS, G. G. M. Hardingham.—(*R. N. Pratt, United States.*)
13,444. FILTERING and COOLING, W. P. Thompson.—(*A. J. McBride, United States.*)
13,445. FLUSHING APPARATUS, D. Anderson, Liverpool.
13,446. CHECKING, COUNTING, &c., the NUMBER of PERSONS ENTERING and LEAVING TRAM CARS, &c., W. H. Gittins, Liverpool.
13,447. DRESS IMPROVERS, A. J. Boult.—(*G. Guglielmi, Spain.*)
13,448. CYLINDRICAL BRUSHES, F. J. and C. F. Page.—(*J. V. Gane, France.*)
13,449. CONDUCTORS for ARMATURES, W. H. Scott and E. A. Paris, London.
13,450. COATS, J. H. Hamilton, London.
13,451. DOOR FASTENERS, J. H. Clark, London.
13,452. FITTING, &c., SHOPS, STORES, &c., J. Hont, London.
13,453. EMBOSSED FABRICS, G. Marchetti, London.
13,454. CAP for the ENDS of REVOLVING ARMATURES, J. Roper, Bradford.
13,455. FIRE-ARMS, J. G. Howard, London.
13,456. CARPETS, H. Fawcett, London.
13,457. HALTER MOUNTINGS, V. A. Coleman, Bromley.
13,458. MUSIC-HOLDER for VIOLINS, W. H. Wingate, London.
13,459. REGULATING the CURRENTS in DYNAMO-ELECTRIC MACHINES, H. J. Haddan.—(*F. V. y Graells, Spain.*)
13,460. COATING SHEETS of IRON and STEEL, R. Heathfield, London.
13,461. RAILWAY COUPLINGS, H. E. Newton.—(*La Compagnie des Appareils automatiques pour accrocher et decrocher les wagons de chemins de fer, France.*)

13,462. Slate Pencil Sharpener and Holder, J. L. Hancock, London.
13,463. Hygienic Dress Improver, W. Percy, London.
13,464. Securing Rails to their Sleepers, L. P. Goffin and E. Vanriet, London.
13,465. Sinking Shafts, &c., F. H. Poetsch, London.
13,466. Colouring Compounds, C. A. Bennert, London.
13,467. Taking Photographic Pictures, N. E. Boyd, London.
13,468. Syphon Cisterns, G. C. Wickham, Lynn.
13,469. Scoring Cardbord, &c., for Boxes, J. Perry, London.
13,470. Treatment of Fœcal Matter, C. D. Abel.—(*P. Coupry, sen., France.*)
13,471. Electrical Machines, A. Bellingham and M. Justin, London.
13,472. Propeller, A. M. Clark.—(*M. H. Borgfeldt and A. C. Schutz, United States.*)
13,473. Treatment of Colouring Compounds, C. A. Bennert, London.
13,474. Safety Extinguishing Apparatus, E. W. Cleversley, London.

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13,475. Arc Lamps, W. Rowbotham and F. S. Worsley, London.
13,476. Shirt Cuff Retainer, T. Kissack, London.
13,477. Catch or Fastener, T. Cheverton, London.
13,478. Corset, L. G. Crowle, London.
13,479. Sifting Frame, T. Shore, Hanley.
13,480. Printing Photographic Vignettes, W. Brookes, Manchester.
13,481. Iron from Phosphatic Slags and Minerals, W. Galbraith, Glasgow.
13,482. Heads employed in Looms for Weaving, J. Yeadon, Bradford.
13,483. Pneumatic Process of Manufacturing Steel Ingots, B. H. Thwaite, Liverpool.
13,484. Reception of Coin and Supply of Postage and other Stamps, W. H. Fogg, Leeds.
13,485. Connecting Broken Shafts of Screw Steamers, W. W. Heron, Blyth.
13,486. Attaching Cams to Screws of Gill Boxes, W. Walton, Skipton-in-Craven.
13,487. Projectiles or Shot, J. T. Fenwick, Gateshead.
13,488. Portable Advertising Street Vans, H. Scott, Liverpool.
13,489. Flexible Metallic Capsules for Bottles, C. Cheswright, London.
13,490. Automatic Vent Peg for Casks, &c., T. Varley and J. B. Moorhouse, Skipton-in-Craven.
13,491. Stopper for Bottles, W. Meeks, Ashton-under-Lyne.
13,492. Machines for Rendering Laths and Cutting Veneers, W. Ellis, London.
13,493. Springs, E. Rusden, Manchester.
13,494. Indicating the Level of Water, &c., J. Dugdill, jun., Manchester.
13,495. Fastening of Brooches, &c., J. Long, Birmingham.
13,496. Double Valve, A. Miller, Glasgow.
13,497. Machine for Carbonising Wool, &c., G. Tolson and J. Illingworth, Batley.
13,498. Machine for Carbonising Wool, &c., G. Tolson and J. Illingworth, Batley.
13,499. Liquor Frames, &c., W. H. Ireland, Birmingham.
13,500. Knitted Under Shirts, &c., J. Fortune and Renwick and Reyburn, Glasgow.
13,501. Candles, A. E. Scott, London.
13,502. Compound Ingots, E. Wheeler, London.
13,503. Metal Bodies or Ingots, E. Wheeler, London.
13,504. Winding, &c., Yarn or Thread, J. Boyd, Glasgow.
13,505. Lamps, A. K. Irvine, Glasgow.
13,506. Bearings for Suspending Lamps from Axles of Velocipedes, &c., H. W. Holloway, Banbury.
13,507. Suspension Conductor for Incandescent Electric Lamp, A. L. Fyfe, London.
13,508. Registering Money Tills, S. J. Bobbett, London.
13,509. Enabling Gas Jets to be Raised or Lowered, A. W. Bevis, London.
13,510. Cart, J. Smith, London.
13,511. Kilns for Burning Limestone, R., J., S., T. and R. W. Briggs, London.
13,512. Turning Drugs, &c., for Drying, F. C. C. Hewett, E. P. Keevil, and W. P. Davis, London.
13,513. Brushes, C. A. Watkins, London.
13,514. Combined Automatic Weighing and Height-measuring Machine, J. Gozney, London.
13,515. Charging Accumulators, E. J. Houghton, London.
13,516. Ventilator for Haystacks, &c., D. and W. Taylor, London.
13,517. Propulsion of Navigable Vessels, P. F. Maccallum, Glasgow.
13,518. Stretching Metallic Springs in Pianos, &c., G. F. Redfern.—(*A. Theyskens, Belgium.*)
13,519. Telegraph Cables, G. F. Redfern.—(*E. Gelerat, France.*)
13,520. Gas Burner, A. Michaux, London.
13,521. Carriage Brake, A. Bruel, London.
13,522. Vent Pegs, &c., H. F. Dale and J. P. Kendall, London.
13,523. Wick of Lamps of Petroleum, &c., J. de Bondoni and A. Seefelder, Constantinople.
13,524. Gas Pumps, W. J. Ferguson, London.
13,525. Lamp Burners, W. Snelgrove, London.
13,526. Animal Traps, W. T. Norris, London.
13,527. Pipes for Smoking, A. E. Harston, London.
13,528. Delivering Prepaid Goods after the Reception of Coin, W. S. Oliver, London.
13,529. Filling and Emptying the Cells of Batteries, R. Oakley, London.
13,530. Box-irons for Laundry Purposes, G. Woollisoroft, Liverpool.
13,531. Iron and Steel, A. G. Greenway, Liverpool.
13,532. Safety and Saving Apparatus, J. B. Fondu, London.
13,533. Fancy Paper, A. Schmidt, London.
13,534. Cartridges, &c., H. S. Maxim, London.

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13,535. Inducing, &c., the Draught in Marine, &c., Furnaces, J. Kinnear and J. Ewing, London.
13,536. Hygienic Combination Dust and Housemaid's Box, B. D. Dove, London.
13,537. Water-waste Preventer for Water-closets, &c., D. Lyon, Liverpool.
13,538. Hollow-ware Vessel Handles, J. W. Sankey, Birmingham.
13,539. Safety of Miners after an Explosion, S. Morley, Horsforth.
13,540. Lessening the Jolting of Railway Trains on Lines, J. B. Bell, Grantham.
13,541. Bottle Stoppers, A. C. Farrington, Shelfanger Spa, Diss.
13,542. Machine Street Sweepers, H. Whiley, Manchester.
13,543. Utilising Waste Ashes, D. Caddick and J. Wake, Middlesbrough.
13,544. Applying Electricity to the Actions of Pianofortes, C. W. Siddle, Halifax.
13,545. Knitting Machines, J. Smith, Bradford.
13,546. Oilers or Oil Cans, T. Furnival, Liverpool.
13,547. Coppers for Washing Clothes, H. Short and W. Houghton, Liverpool.
13,548. Packing Earthenware or China, C. R. Clark, Staffordshire.
13,549. Photographic Camera, W. Brooks, Manchester.
13,550. Footballs, W. Hawcridge, Bradford.
13,551. Transparent Revolving Lamp Motion from Heated Air, W. Strain and Sons, Belfast.
13,552. Velocipede Lamps, H. Lucas, Birmingham.
13,553. Taps and Valves, H. Waters, Birmingham.
13,554. Automatic Water-closet Apparatus, S. Johnson, London.
13,555. Ventilating Buildings, &c., J. Horrocks, Southport.
13,556. Registering Facsimile Copies of Receipts, W. N. Ashton, London.
13,557. Rotary Printing Machines for Polychromatic Impression, G. A. Bédart, Paris.
13,558. Gas Burner, J. Buckland, Taunton.
13,559. Protecting Back Quarters of Boots, &c., by Leather, M. J. and B. Martin, Norwich.
13,560. Hand Parcel Holder, F. A. Barraclough, Manchester.
13,561. Fishing Fly Cases, P. D. Malloch, London.
13,562. Coating of Metal Sheets with Metal, P. M. Justice.—(*W. B. Spear, United States.*)
13,563. Electrical Measuring Instruments, E. W. Lancaster, Birmingham.
13,564. Manufacture of Malleable Iron, W. Martin, Glasgow.
13,565. Admission of Air to Furnaces, J. and R. B. Bonthrone, Glasgow.
13,566. Governors for Steam Engines, E. Jones, London.
13,567. Friction Gear for Driving Machinery, E. Jones, London.
13,568. Candlesticks, &c., W. Carter, London.
13,569. Telephonic Apparatus, J. S. Ross, London.
13,570. Boxes for Bottled Liquids, F. Foster, London.
13,571. Meters for Measuring Water, &c., J. Davies, Birmingham.
13,572. Miner's Safety Lamp, W. Banks and S. Brierly, London.
13,573. Spinning and Twisting Rings, H. Ashworth, London.
13,574. Composition for Preventing Incrustation in Steam Boilers, J. L. Honnart, London.
13,575. Saving Ships in Distress, F. Bosshardt.—(*A. E. M. du Bourblanc, France.*)
13,576. Pumping, &c., Gaseous Waters, T. Cockcroft, Liverpool.
13,577. Indicating Escape of Gas, J. Stott, London.
13,578. Preparation of Fuel, H. H. Lake.—(*G. Godeffroy, Germany.*)
13,579. Paper Folding Machines, E. Konig, London.
13,580. Process of Producing, &c., Photographs, A. M. Clark.—(*C. T. Cain. United States.*)
13,581. Draughtsman's Instruments for Ruling Section, &c., Lines, A. M. Clark.—(*D. W. Briggs, United States.*)
13,582. Manufacture of Boots, J. Hughes, London.
13,583. Construction of Artificial Bombs, &c., of Confectioned Material, W. A. Barlow.—(*S. Julien, France.*)
13,584. Hydraulic Apparatus for Utilising the Force of the Waves of the Sea, W. A. Barlow.—(*E. J. Delaurier, France.*)
13,585. Buffers for Ships, &c., R. H. Hughes and R. A. Lee, London.
13,586. Locking and Unlocking the Doors of Railway Trains, J. Kendall and F. G. G. Lines, London.
13,587. Electric Measuring and Regulating Apparatus, F. W. Lawson and C. W. S. Crawley, London.
13,588. Steam Boilers, S. P. Wilding.—(*T. Lammine, Mülheim.*)
13,589. Paper or Cardboard Boxes, A. F. Bird, London.
13,590. Safety Lamps for Miners, &c., J. Macnab, London.
13,591. Preventing the Escape of Noxious Fumes from Batteries, M. Bailey and J. Warner, London.
13,592. Primary Batteries, M. Bailey and J. Warner, London.
13,593. Small-arms, L. F. Banks, London.
13,594. Metallic Tubing, E. I. Levavasseur and H. Witzenmann, London.
13,595. Breech-loading Fire-arms, O. Jones, London.

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13,596. Water Tap or Valve, J. Mitchell, Glasgow.
13,597. Fall Pipes, J. Parsons, Nottingham.
13,598. Dyeing Papers, J. Fletcher, Manchester.
13,599. Toilet Fixtures for Holding Rolls of Paper, &c., J. S. Downing, Birmingham.
13,600. Belt Purses or Pouches, D. B. Harris and E. R. Richards, Birmingham.
13,601. Umbrellas, &c., J. R. Shearer, London.
13,602. Ships' and other Lamps, J. Rea, jun., Birmingham.
13,603. Screw or Twist Augers, &c., C. Whitehouse, Birmingham.
13,604. Mixing Fuller's Earth used in the Milling of Woven Fabrics, W. Fenton, Halifax.
13,605. Composition for Preventing and Removing Incrustation and Corrosion of Boilers, J. Cooke, Halifax.
13,606. Carbonising Fabrics composed of Animal and Vegetable Fibres, J. Walker, Halifax.
13,607. Regulating the Position of Sheet Music, &c., R. A. Cruickshank, Glasgow.
13,608. Washing Machines, R. A. Gartside and W. H. Tiplady, Manchester.
13,609. Distance Keeper for Hansom Carriages, &c., H. P. B. Celli, London.
13,610. Metallic Brake Block for Vehicles, C. Buckley, Moston.
13,611. Sockets for the Handles of Tools, A. E. Stayner, Millhouses, near Sheffield.
13,612. Branding or Stamping on Cigars, E. Gunter and W. H. Somers, Lower Clapton.
13,613. Movable Screw-button, J. Amberny, Paris.
13,614. Prevention of Accidents in Steep Mines, W. Scott, Newcastle-under-Lyme.
13,615. Folding Umbrellas, W. P. Thompson.—(*J. D. Nesbitt, United States*)
13,616. Manufacture of Bricks, &c., R. Scholefield, London.
13,617. Rolling Mills, A. Marklin, London.
13,618. Saturating Wood, R. G. Burstenbinder, London.
13,619. Fuel Economiser, &c., W. Abbott, London.
13,620. Tripod Camera Stands, A. W. Dollond, London.
13,621. Platting Tin for Ventilating, &c., Purposes, E. Hancock, Landport.
13,622. Collapsible Tubes, E. F. Lucy, London.
13,623. Novel Method of Draining the Permanent Way of Railways, A. Haarmann, London.
13,624. Fastening the Ends of Flat Driving, &c., Belts, A. W. Death, London.
13,625. Chronograph Watches, A. L. Piguet, London
13,626. Steering Gear, W. Clarke and J. B. Furneaux, London.
13,627. Hauling, &c., Machinery, W. Clarke and J. B. Furneaux, London.
13,628. Pads for the Protection of Collar, &c., Wounds, in Horses, &c., E. S. Probyn, Pontypool.
13,629. Combined Brush and Brake, W. Carter, London.
13,630. Basting Meat, T. S. Archer, London.
13,631. Igniting Gas by Electricity, H. J. Coates E. W. J. Macdonald, London.
13,632. Wood-boring Tools, H. Walker, London.
13,633. Shuttle Mechanism for Oscillating Shuttle Sewing Machines, A. Riese and F. Quenstedt, London.
13,634. Cloth-feeding Mechanism, A. Riesi and F. Quenstedt, London.
13,635. Pianofortes, J. Delerue, London.
13,636. Purifying and Graining Hides, T. Palmer, London.
13,637. Blocks of Artificial Fuel, R. Combret, London.
13,638. Spinning Machinery, W. Mair.—(*Partly communicated by James Robertson, India.*)
13,639. Holder for Cigars, &c., G. H. Hill, London.
13,640. Railroad Cross Ties, J. W. Flynn, London.
13,641. Indicating the Electrical Potential in Systems of Electrical Distribution, B. J. B. Mills.—(*J. W. Howell, United States.*)
13,642. Roller Bearings, G. and E. Smith, London.
13,643. Self-lighting Gas Burners, G. A. Sweetser, London.
13,644. Draught of Furnaces, &c., E. W. Collier, London.
13,645. Travelling Bags, O. Seefels, London.
13,646. Band Wheels, A. Goodwin and A. Goodwin, jun., London.
13,647. Automatic Window Catch, &c., A. E. Stove, London.
13,648. Carbons for Electrical Purposes, W. R. Johnston, London.
13,649. Drill Brace, C. Davy, London.
13,650. Railway Couplings, W. H. Kaltenback, London.
13,651. Running Gear of Vehicles, C. Dinsmoor, London.
13,652. Operating Railway Signals, G. Edwards, London.
13,653. Leads and Rules, H. H. Lake.—(*E. O. Chase, United States.*)
13,654. Fluoride of Aluminium, &c., L. Grabau, London.
13,655. Fly-wheel Guards, &c., J. G. Rockhill, London.
13,656. Automatically Closing Tap Valve, J. and J. F. Gilmore, and W. R. Clark, London.

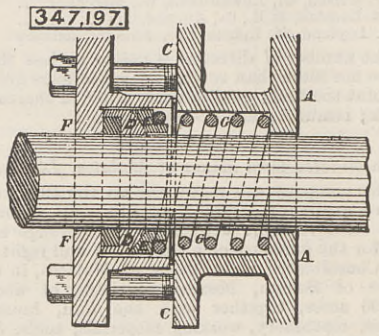
SELECTED AMERICAN PATENTS.

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

347,197. Adjustable Packing for Piston-rods, *William Pohlman, Middletown, N.Y.—Filed May 5th*, 1886.

Claim.—(1) The combination of the cylinder head A, casing C, spring G, solid ring E, and sectional rings D F, the ring D having the dowels *d*, all arranged substantially as set forth. (2) The combination of the cylinder head A, casing C, packing *e*, spring G, solid

347,197.

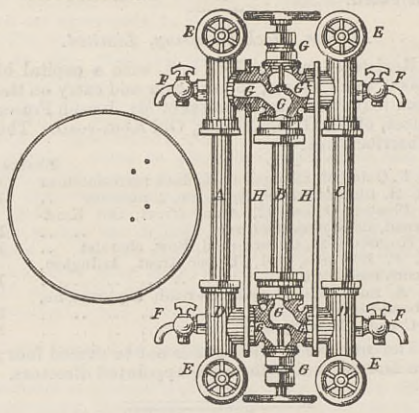


ring E, and sectional rings D F, the ring D having the dowels *d*, all arranged substantially as set forth. (3) In a piston-rod packing, the cylinder head A, casing C, and packing *e*, combined with the spring G, solid ring E, and sectional rings D F, substantially as set forth.

347,303. Compound Water Gauge for Steam Boilers, *David Pyke, Philadelphia, Pa.—Filed November 27th*, 1885.

Claim.—(1) A compound water gauge for steam boilers, constructed substantially as herein shown and described, and consisting of the three parallel glass tubes A B C, the elbow couplings D, attached to the ends of the said tubes A C, having offsets in their inner arms, and provided with valves E and cocks F, and the three-way globe valve G, connected with the

347,303.

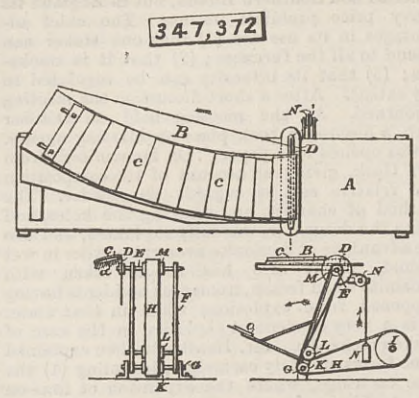


ends of the centre tube B, and with the elbow couplings of the side tubes, as set forth. (2) In a compound water gauge for steam boilers, the combination, with the three glass tubes A B C, the elbow couplings D, attached to the side tubes A C, and the three-way globe valves G, connected with the centre tube B, and the elbow couplings of the side tubes, of the connecting bars H, substantially as herein shown and described, whereby greater firmness and strength are given to the gauge, and the glass tubes are prevented from being accidentally broken, as set forth.

347,372. Barrel Making Machine, *George W. Packer, Rock Falls, Ill.—Filed February 15th*, 1886.

Claim—(1) In a barrel making machine, a curved guideway having an adjustable gauge at one extremity, which way receives and supports a series of staves in such position with respect to the line of movement of a travelling saw that the last stave and the blade of the saw shall have the same convergence as the edges of the staves, in combination with such travelling saw, whereby the series of staves may be exactly gauged for a required size of barrel, substantially as set

347,372

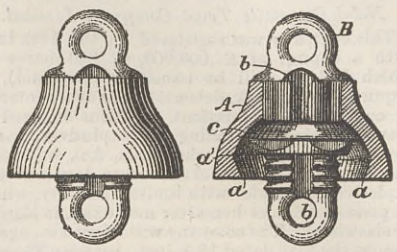


forth. (2) In a barrel making machine, a curved guideway having an adjustable gauge at one extremity, which way receives and supports a series of staves in such position with respect to the cut of a saw that the last stave and the blade of the saw shall have the same convergence as the edges of the staves, in combination with such saw, whereby the series of staves may be exactly gauged for a required size of barrel, substantially as set forth.

347,342. Expansion Rubber Buckets for Chain Pumps, *Sanford A. Goss, Chicago, Ill.—Filed October 13th*, 1885.

Claim.—(1) The rubber bucket A, having its largest inward diameter at a^1 thickened at its lower end to form the inward incline *a*, whereby it is adapted to be

347,342

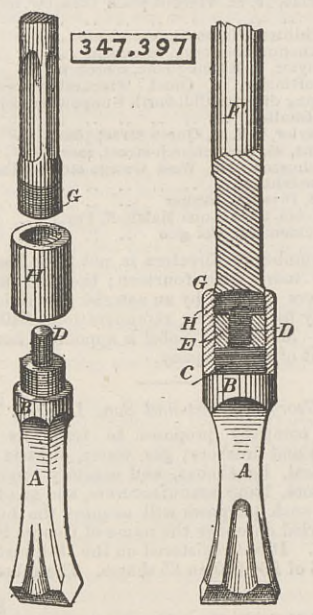


expanded by moving an interior nut in either direction along the supporting link, substantially as described.

347,397. Chuck for Rock Drills, *James Throckmorton and Joseph G. Throckmorton, Harvey's, Pa.—Filed April 19th*, 1886.

Claim.—The combination, with the bit A, provided with the shoulder B and the extension C, formed with the left-hand thread and neck D, of less diameter than said extension, and formed with right-hand thread, of the stem F, having externally threaded

347.397

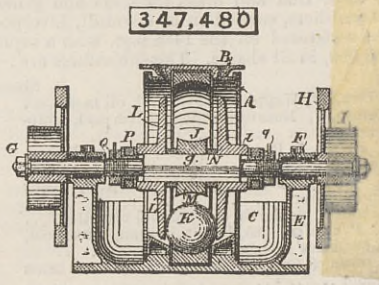


end G and interiorly threaded opening E, to engage said stem D, and the collar H, provided with an interior left-hand screw thread throughout its entire length, and adapted to engage the thread of the end G of the stem and that of the extension C of the bit, and its lower end abutting against said shoulder, substantially as and for the purpose specified.

347,480. Pulverising Machine, *Hermann B. Feldmann, Philadelphia, Pa.—Filed April 23rd*, 1886.

Claim—(1) In a pulverising machine, the following elements in combination: a casing, a driving shaft, a sphere or roller, and two discs mounted upon the shaft and capable of an end-for-end motion thereon, substantially as set forth. (2) In a pulverising machine the following elements in combination: a casing, a driving shaft, a sphere or roller, two discs mounted upon the shaft and capable of an end-for-end motion thereon, and means for compressing said discs against the ball or roller, substantially as set forth. (3) In a pulverising machine of the class herein recited, the combination of a casing, a driving shaft, a sphere or

347,480

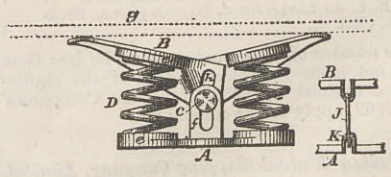


roller, two discs mounted upon the shaft and capable of an end-for-end motion thereon, and a collar upon the shafts between the discs, which is adapted to receive and thereby protect the shaft against the inward thrust of the ball, substantially as set forth. (4) In a machine of the class recited, in combination with a casing, a driving shaft, a ball adapted to travel upon a track within said casing, and a pair of discs, the opposing faces of which are flat, so that the ball can travel in toward the shaft without occasioning a movement of the discs, substantially as set forth. (5) In a machine of the class above recited, the combination of a casing containing a ball track, a ball upon said track, a shaft journalled with respect to said casing, two discs capable of a movement endwise upon said shaft, springs exterior to the discs for forcing the latter discs together, and abutments to resist the outward thrust of the springs, substantially as set forth. (6) In a machine of the class recited, the combination of a shaft, discs upon the shaft, a collar upon the shaft between the discs, and elastic packings between the said collar and the opposing faces of said discs, substantially as set forth.

347,647. Car Spring, *Chas. D. Schoen, Philadelphia, Pa.—Filed March 30th*, 1886.

Claim.—(1) A car spring, in combination with top and bottom plate or plates, the top plate or plates

347,647



being fulcrumed to the bottom plate, and the ends of the plate or plates being free so that they can move freely as their angles change by compression of the springs. (2) In a car spring, a lever or levers, in combination with a bottom plate, the lever or levers being applied substantially as set forth, whereby the spiral or other spring shall be self-graduating relatively to the varying load or pressure.