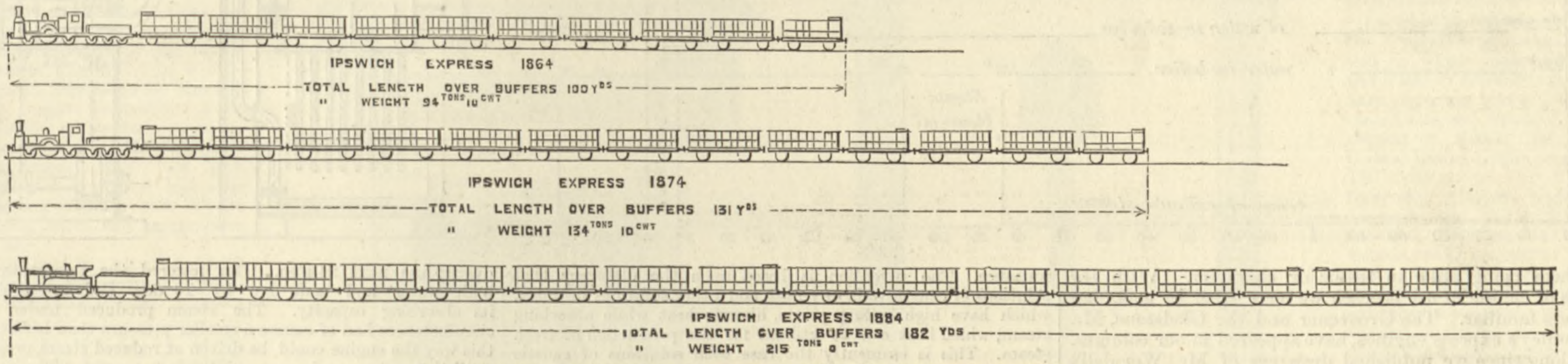
THE CONSUMPTION OF COAL ON RAILWAYS.

SINCE the very earliest days of railway locomotion by steam, earnest endeavours have been made to improve the locomotive engine. Most men will be disposed to say that the result of this search after ultimate mechanical perfection is to be seen on our railways in the greater dimensions, improved form, and superior finish of the modern engine, as compared with its ancestors. But great dimensions, elegance of design, and splendid workmanship are in themselves and by themselves of no practical value. The work to be done by a locomotive is comparatively simple, and the only test of its merits is the way in which its work is done and the cost of doing it; and all the admirable features which we have enumerated above are only valuable as well as admirable in so far as they reduce the cost of transport and promote its certainty and celerity. A very handsome engine may be unable to haul a heavy train in adverse weather, or it may consume a great deal of coal. On the other hand, an ugly machine may endear itself to everyone who has to do with it by its great capacity for hard work, small consumption of fuel, and few demands for repairs. Nothing, indeed, may, in a general sense, be regarded as more deceptive than a locomotive. Nothing, in short, but the possession of detailed information of a very comprehensive kind can enable anyone to pronounce an opinion of much value concerning the merits and demerits of any particular type of engine. Such knowledge is in many respects limited, and it is our purpose in writing this article to endeavour to throw a little light into a very dark place, and so enable our readers to form some idea of the results actually obtained in practice.

The expense of working a locomotive may be classified under two principal heads, namely, cost of fuel and cost of repairs. To the latter we do not intend to refer further at present. We shall confine what we have to say to the fuel question. Concerning this there is much ignorance. A paper is read now and then, or an authoritative statement is made; or an experiment is carried out, from which the world learns that a particular engine burns 26 lb. of coal per train mile, let us say; but next to nothing is known outside a limited circle concerning the real consumption of fuel, taken all round, on a great railway. Some time since we applied to the locomotive superintendents of a number of the principal railways in Great Britain for information concerning the quantities of fuel burned in conducting the operations of their railways. Some locomotive superintendents have not as yet seen fit to make any reply to our application; others courteously declined to give information, but the others, we are happy to say, responded cheerfully to our request, and furnished us with figures of very wide interest, and we believe now for the first time made public in an accessible form.

Our inquiry was intended to find out what was the gross consumption of coal per train mile in 1873 and 1883, in order that some idea may be formed concerning the amount of success which has attended the various improvements effected during the period in the locomotive engine. It will be understood that "gross consumption" is a different matter from the consumption per engine mile, and is not comparable with statements concerning the consumption per train mile on a given trip or group of trips. The results given below are obtained by dividing the whole quantity of coal burned in any given year by the number of train miles—goods, mineral, passenger and all—run in the same period. It may be said that this is a very crude kind of statistical information. As a matter of fact, however, it is nothing of the kind; it is an important species of balance-sheet. Shareholders care nothing whether they have to pay for coal for goods traffic or passenger traffic, so long as they have to pay it; and it may be stated without fear of contradiction that that line is best managed by its engineers which has, other things being equal, the smallest coal bill to pay. Now it will be seen from the figures which we are about to put before our readers that substantial improvements have been effected in the working of the great lines to which our figures refer; and the fact reflects very great credit on the engineers by whom the improvement has been wrought.

We shall begin with the east coast, taking the Great Eastern Railway as a type of line with a very heavy mixed traffic—with, indeed, fast passenger service, fast fish and milk trains, coal and heavy goods, and a severe metropolitan traffic—while the trains of the company have to traverse very steep and long inclines, and many sharp curves. It is evident, therefore, that the conditions under which the line is worked make exceptional demands on locomotives. Mr. T. W. Worsdell, locomotive superintendent of the line, has supplied us with the following statement, Table I.



COMPARATIVE DIMENSIONS OF GREAT EASTERN RAILWAY EXPRESS TRAINS.

In order that an idea of the increase in the passenger traffic may be formed, Mr. Worsdell has kindly placed at our disposal a diagram, a reduced copy of which will be found above. This diagram shows the Ipswich express train out of London at the different periods named, giving the exact style of the vehicles and the length of the trains. There is, it will be seen, an increase in the total coal burned per train mile in the ten years; but this is entirely due to the increased work done by the engines. Thus reducing the coal to a uniform load, the consumption has decreased 1·39 lb. per mile, although the speed has augmented 15 per cent. It must not be forgotten that we are not now dealing with coal per horse-power per hour, but with coal per mile, which is a different thing.

TABLE I.
GREAT EASTERN RAILWAY.
Statistics of Locomotive Work for the Years 1883 *and* 1873.

	1883.	1873.	1883. Increase.	1883. Decrease.
Passenger miles..	8,834,468	5,217,810	3,616,658	—
Goods miles..	4,844,935	3,714,672	1,130,263	—
Total train miles	13,679,403	8,932,482	4,746,921	—
Piloting, shunting, ballasting, &c.	3,397,205	1,886,697	1,510,508	—
Total engine miles	17,076,608	10,819,179	6,257,429	—
Total consumption of coal	tons 280,645	tons 166,100	tons 114,545	—
Coal per train mile	lb. 45·96	lb. 41·65	lb. 4·31	—
,, engine mile ..	36·81	34·39	2·42	—
First-class goods engine:				
Diam. of driving wheels	ft. in. 4 10	ft. in. 5 3	—	in. 5
Cylinders..	in. in. 17½ × 24	in. in 16½ × 24	in. 1	—
Total working weight..	tons cwt. 37 10	tons cwt. 31 13	tons cwt 5 17	—
Working pressure.. ..	lb. 140	lb. 140	—	—
Coal train:				
Consumption per mile..	lb. 46·68	lb. 43·75	lb. °/。 2·93 or 6¾	—
Speed per hour	miles 20	miles 17·4	miles °/。 2·6 or 15	—
Average load	tons 438½	tons 398	tons °/。 40½ or 10	—
Consumption per mile with average load, 400 tons	lb. 42·58	lb. 43·97	—	lb. °/。 1·39 or 3¼

The consumption of coal per train mile is absolutely independent of the speed and entirely dependent on the resistance. This truth is, we know, usually overlooked; its accuracy may be demonstrated in a moment. Thus, let the resistance remain the same and the speed be doubled, then the quantity of fuel burned in a given time must also be doubled. But inasmuch as the time expended in traversing a mile is halved, although the rate of consumption is doubled, the consumption per mile remains unaltered. To make this quite clear, let us take the case of two trains, the one running at double the speed of the other, the resistance being constant. If it were in one case 3000 lb. and the speed thirty miles an hour, or 44ft. second, we should have $\frac{44 \times 60 \times 3000}{33,000} = 240$-horse power, while in the second case, at sixty miles an hour, we should have $\frac{88 \times 60 \times 3000}{33,000} = 480$ indicated horse-power. The consumption of coal per hour would be doubled, but it would remain the same per mile as explained above. It may be taken as mathematically certain that speed as speed has no influence whatever on the consumption per mile, and this being the case, we may say that the consumption will only vary in some ratio with the resistance, the resistance again varying with the speed. When we speak of reducing the coal to a uniform load as above, we mean a uniform weight of train, not a uniform resistance. Resistance augments in a rather rapid ratio with the speed, and it is under the mark to assume that it may increase 15 per cent., while the speed augments in like proportion; but the resistance is the direct measure of the consumption per mile, which consumption, as we have seen, is independent of the speed. Therefore, if the resistance has augmented 15 per cent., while the coal bill remains unchanged, it follows that the locomotive engines of 1883 are 15 per cent. better than those of 1873; and the high-speed engines will come out still better when tested in this way, for not only are the trains heavier, but the speeds are faster, and therefore the resistance is much augmented, and with it the demand for steam.

The next railway on our list is the London, Brighton, and South Coast, on which the mineral traffic is comparatively small. It may be called a first-class passenger railway, with a heavy metropolitan traffic, quick speeds, heavy trains, and crooked and hilly roads. We are indebted to Mr. W. Stroudley, locomotive superintendent of the line, for Table II.

This table is more complete in some respects than Mr. Worsdell's. It is evident that, on the whole, Mr. Stroudley has effected a steady, continuous reduction; the exceptions being due either to severe weather, or possibly to some difference in the quality of the coal. It will be seen that as Mr. Stroudley has been able to substitute new engines working with heated feed-water for the old engines of miscellaneous types, the consumption of coal has decreased; and this notwithstanding that the trains have increased in weight 40 per cent. during the ten years. All the passenger trains have continuous brakes, and these require some steam to work them.

TABLE II.
LONDON, BRIGHTON, AND SOUTH COAST RAILWAY.
Statement of Miles Run and Fuel Consumed.

Year.	Train miles.	Engine miles.	Fuel consumed.	Consumption per mile. Train.	Consumption per mile. Engine.
			tons cwt.		
1873	5,300,022¼	6,207,807	102,517 13	43·33	36·99
1874	5,462,940¾	6,472,341¾	105,959 8	43·45	36·67
1875	5,773,860¾	6,876,576¼	107,083 4	41·54	34·88
1876	6,054,458¼	7,369,112	106,928 1	39·56	32·53
1877	6,597,102	7,758,745½	109,787 5	38·44	31·70
1878	6,799,961¼	8,267,602¾	111,316 3	36·67	30·16
1879	6,814.564½	8,306,707¾	113,023 9	37·15	30·48
1880	7,222,729¾	8,973,816	123,298 9	38·24	30·78
1881	7,598,954¼	9,401,119	134,569 7	39·67	32·06
1882	7,861,557¼	9,570,205¾	130,804 5	37·27	30·62
1883	7,985,783¼	9,630,406	132,159 7	37·07	30·74
1884	8,099,963	9,693,285	127,819	35·35	29·54

TABLE III.
GREAT WESTERN RAILWAY.
Statistics of Locomotive Work, 1873 *and* 1883.

Year, &c.	Miles open.	Total mileage. Train.	per c'nt	Total mileage. Engine.	per c'nt	Coal consumed by engines.	Average lbs. per mile. Train.	Average lbs. per mile. Engine.
						tons.		
Engines: Passenger		8,531,879	43·3	9,310,493	40·9	110,606	29·03	26·61
Goods ..		11,185,108	56·7	13,467,989	59·1	256,722	51·41	42·69
Total, 1873.	1502	19,716,987		22,778,482		367,328	41·73	36·12
Engines: Passenger		13,162,620	42·3	14,068,543	38·6	161,567	27·49	25·72
Goods ..		17,965,142	57·7	22,396,129	61·4	362,264	45·17	36·23
Total, 1883.	2268	31,127,762		36,464,672		523,831	37·69	32·17

The proportion of goods to the total mileage was 17·8 per cent. in 1873, and 18·2 per cent. in 1883. The difference between 43 lb. per train mile in 1873 and 35 lb. in 1884 speaks for itself, and needs no comment.

We now turn to the Great Western Railway, a line with heavy mixed traffic, but for a great portion of its length extremely level. Mr. Dean, the locomotive superintendent of the line, has kindly supplied us with the preceding table, No. III. The conditions here are somewhat peculiar, because the weights of the trains and the speeds are very nearly now what they were ten years ago. It must be remarked that the Great Western trains ran at higher speeds than those on any other line even long before 1873, and the other railways have only been doing recently that which the older line had already done. The saving effected in fuel therefore can be estimated without any complication, and it amounts to about 4 lb. per train mile—a very important item. The total train mileage in 1883 was 31,127,762; at one pound per mile, the total coal consumption would be 13,892 tons, so that a saving of 4 lb. per mile means 55,568 tons, or, say, something like £20,000 available for dividend.

We have already published the following:—

TABLE IV.
MIDLAND RAILWAY.
Statistics of Locomotive Work, 1873 *to* 1883.

Year.	Train miles.	Increase.	Consumption of coal per mile.
			lbs.
1873	19,811,396	—	57·18
1874	20,834,042	1,022,646	54·68
1875	22,515,234	1,681,192	53·40
1876	23,651,546	1,136,312	52·67
1877	24,738,317	1,086,771	50·76
1878	25,621,576	883,259	48·70
1879	27,097,735	1,476,159	49·17
1880	29,558,458	2,460,723	46·51
1881	31,583,760	2,025,302	47·39
1882	32,062,736	478,976	47·41
1883	33,087,255	1,024,519	49·00

The Midland Railway is a line combining all manner of adverse conditions. The traffic is conducted at an exceptionally high speed; and much of it over the heaviest roads in England, as, for example, the line from Derby to Buxton. The coaches, too, are of a very heavy and luxurious description. In a word, all the conditions indicate great locomotive power, and a large consumption of fuel. That Mr. Johnson has succeeded in making the important reductions stated above is the most satisfactory evidence of the wisdom of the policy he has adopted in the design of his engines.

We have in these four tables a comprehensive statement of the actual coal paid for by four of the great English railway companies, and the lines are each typical, no two

THE HONIGMANN FIRELESS LOCOMOTIVE ENGINE.

Fig. 6.

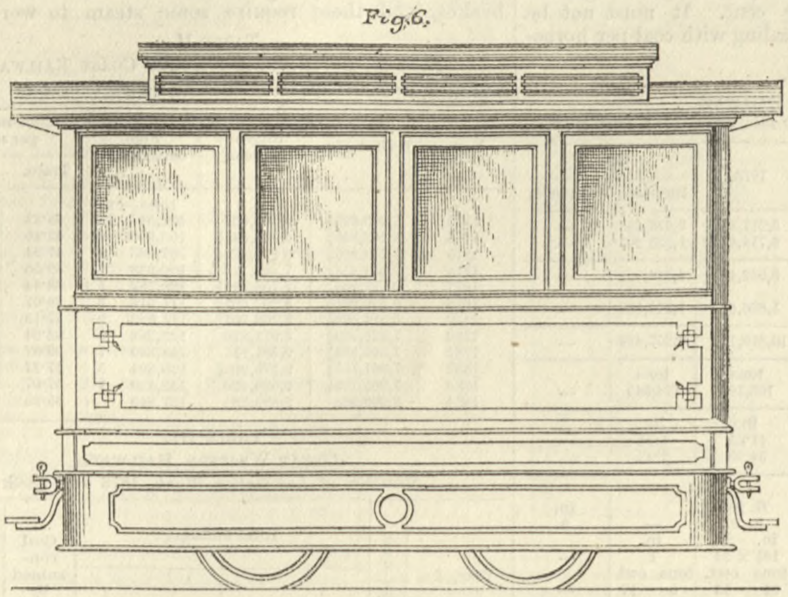
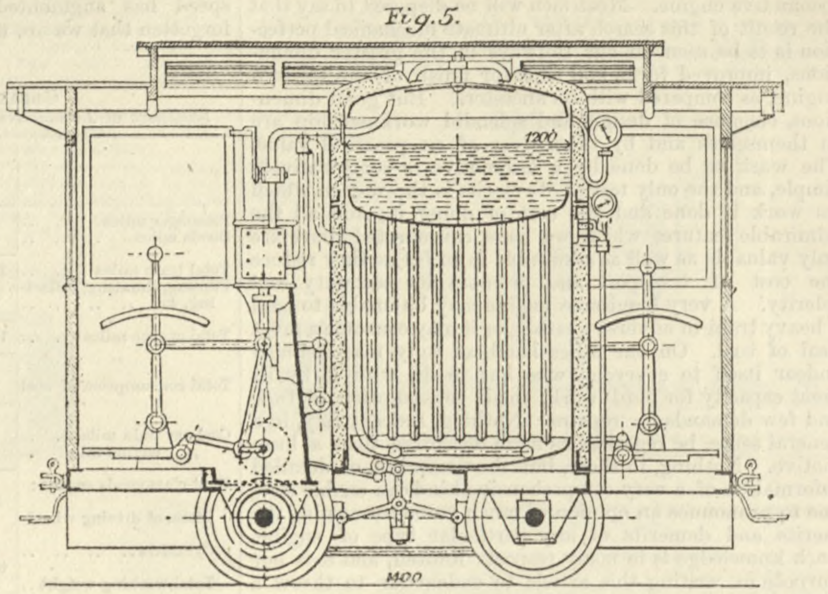


Fig. 5.



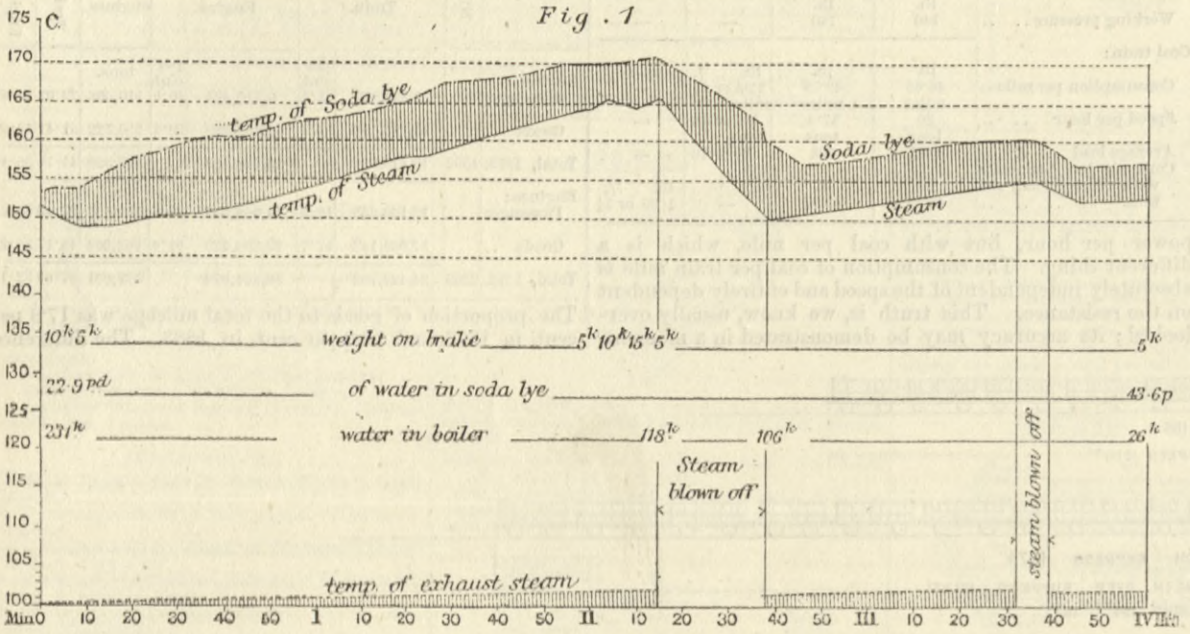
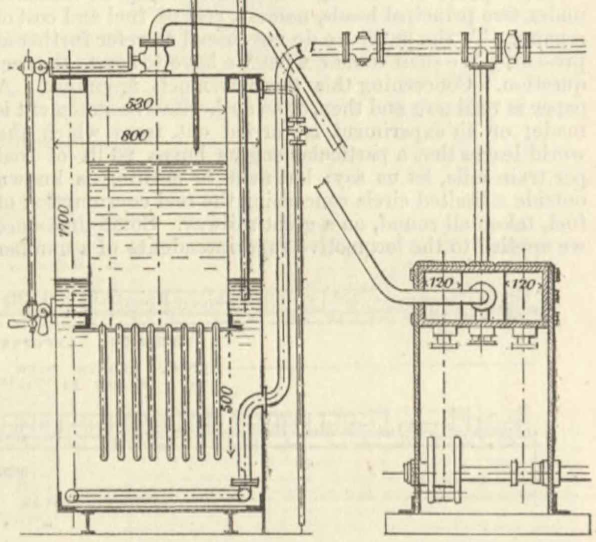


Fig. 2.



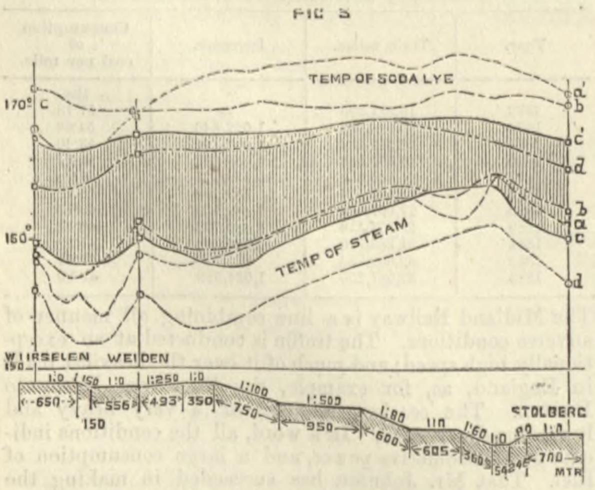
of them being alike in traffic or character. With the types of engine in use on each we have tried to make our readers familiar. The Grosvenor and the Gladstone, Mr. Stroudley's express engines, have appeared in our columns. Not long since we published drawings of Mr. Worsdell's new express engines; one of his latest metropolitan engines will appear in our pages in a short time, and drawings of his new compound engine will follow; and in an early impression we shall give illustrations of Mr. Johnson's new express engines, probably the most powerful machines of the kind ever made. With such facts, figures, and drawings before them, our readers will find plenty of food for reflection, and they will be able to draw deductions and make comparisons, which we do not feel disposed to do at least at present.

One point on which complete ignorance exists is worth notice. It is certain that permanent way is better now than it used to be; steel rails stand well up to their loads, and the tractive resistance of trains ought to be less than it used to be in the days of iron rails. There is, however, no information to be had on this subject, and the question is one demanding further investigation. It would not be difficult to carry out a few experiments which would set the matter at rest.

THE HONIGMANN FIRELESS ENGINE.

The invention of a self-propelling engine, capable of working without fuel economically and for a considerable time, has often been attempted, and was, perhaps, never before so nearly accomplished as about the time of the introduction into practical use of Faure's electric storage batteries; but at the present moment it appears that electric power has to give way once more to steam power. Mr. Honigmann's invention of the fireless working of steam engines by means of a solution of hydrate of soda—NaO HO—in water is not quite two years old, and has in that time progressed so steadily towards practical success that it is reasonable to expect its application before long in many cases of locomotion where the chimney is felt to be a nuisance. The invention is based upon the discovery that solutions of caustic soda or potash and other solutions in water, which have high boiling points, liberate heat while absorbing steam, which heat can be utilised for the production of fresh steam. This is eminently the case with solutions of caustic soda, which completely absorb steam until the boiling point is nearly reached which corresponds to the degree of dilution. If, therefore, a steam boiler is surrounded by a vessel containing a solution of hydrate of soda, having a high boiling point, and if the steam, after having done the work of propelling the pistons of an engine, is conducted with a reduced pressure and a reduced temperature into the solution, the latter, absorbing the steam, is diluted with simultaneous development of heat, which produces fresh steam in the boiler. This process will be made clearer by referring to the following table of the boiling points of soda solutions of different degrees of concentration, and by the description of an experiment conducted by Professor Riedler with a double cylinder engine and tubular boiler, as shown in Fig. 2:—

FIG. 3.

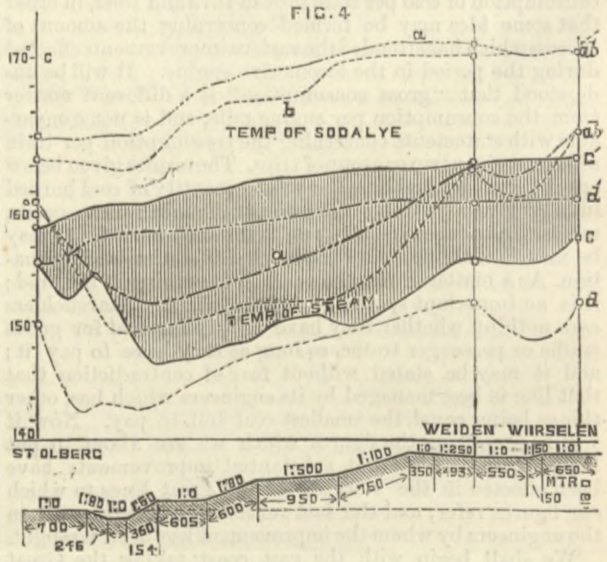


Solution of soda.	Boiling point in Centigrades.	Steam pressure above atmospheric pressure in atmospheres.
100 NaO HO + 10 H_2O	256 deg. C.	40 atm.
" + 20 "	220·5 "	21 "
" + 30 "	200 "	15 "
" + 40 "	185·5 "	10·2 "
" + 50 "	174·5 "	7·7 "
" + 60 "	166 "	6·1 "
" + 70 "	159·5 "	5·1 "
" + 80 "	154 "	4·2 "
" + 90 "	149 "	3·6 "
" + 100 "	144 "	3·0 "
" + 120 "	136 "	2·2 "
" + 140 "	130 "	1·6 "
" + 200 "	120 "	0·95 "
" + 300 "	110·3 "	0·4 "
" + 400 "	107 "	0·3 "

Experiment No. 15.*—The boiler of the engine, Fig. 2, was filled with 231 kilogs. water of 2 atmospheres pressure and a temperature of about 135 deg. Cent.; the soda vessel with 544 kilogs. of soda lye of 22·9 per cent. water and a temperature of 200 deg. Cent., its boiling point being about 218 deg. Cent. The engine overcame the frictional resistance produced by a brake. At starting the temperature of both liquids had become nearly equal, viz., about 153 deg. Cent. The temperature of the soda lye could therefore be raised by 47 deg. Cent. before boiling took place, but as dilution consequent upon absorption of steam would take place, a boiling point could only be reached less than 218 deg. Cent., but more than 153 deg. Cent. The engine was then set in motion at 100 revolutions per minute. The steam passing through the engine reached the soda vessel with a temperature of 100 deg. Cent.; the temperature of the soda lye began to rise almost immediately, but at the same time the steam boiler losing steam above, and not being influenced as quickly by the increased heat below, showed a decrease of temperature. The difference of the two temperatures, which was at starting 1·3 deg. Cent., consequently increased to 7·2 deg. Cent. after 17 min., the boiler having then its lowest temperature of 148·8 deg. cent. After that both temperatures rose together, the difference between them increasing slightly to 9·5 deg. Cent., and then decreasing continually. After 2 hours 13 min., when the engine had made 12,000 revolutions, the soda solution had reached a temperature of 170·3 deg. Cent., which proved to be its boiling point. The steam from the engine was now blown off into the open air during the next 24 min. This lowered the temperature of both water and soda lye by 10 deg. and re-established its absorbing capacity. The steam produced under these circumstances had of course a smaller pressure than before. In this way the engine could be driven at reduced steam pressures until the resistance became relatively too great. The process described above is illustrated by the diagram Fig. 1, which is drawn according to the observations during the experiment.

The constant rise of both temperatures during the first two hours, which is an undesirable feature of this experiment, was caused by the quantity of soda lye being too great in proportion to that of water, and other experiments have shown that it is also caused by an increased resistance of the engine, and consequent greater consumption of steam. In the latter part of the experiment, where the engine worked with expansion, the rise of the temperature was much less, and by its judicious application, together with a proper proportion between the quantities of the two liquids in the engines, which are now in

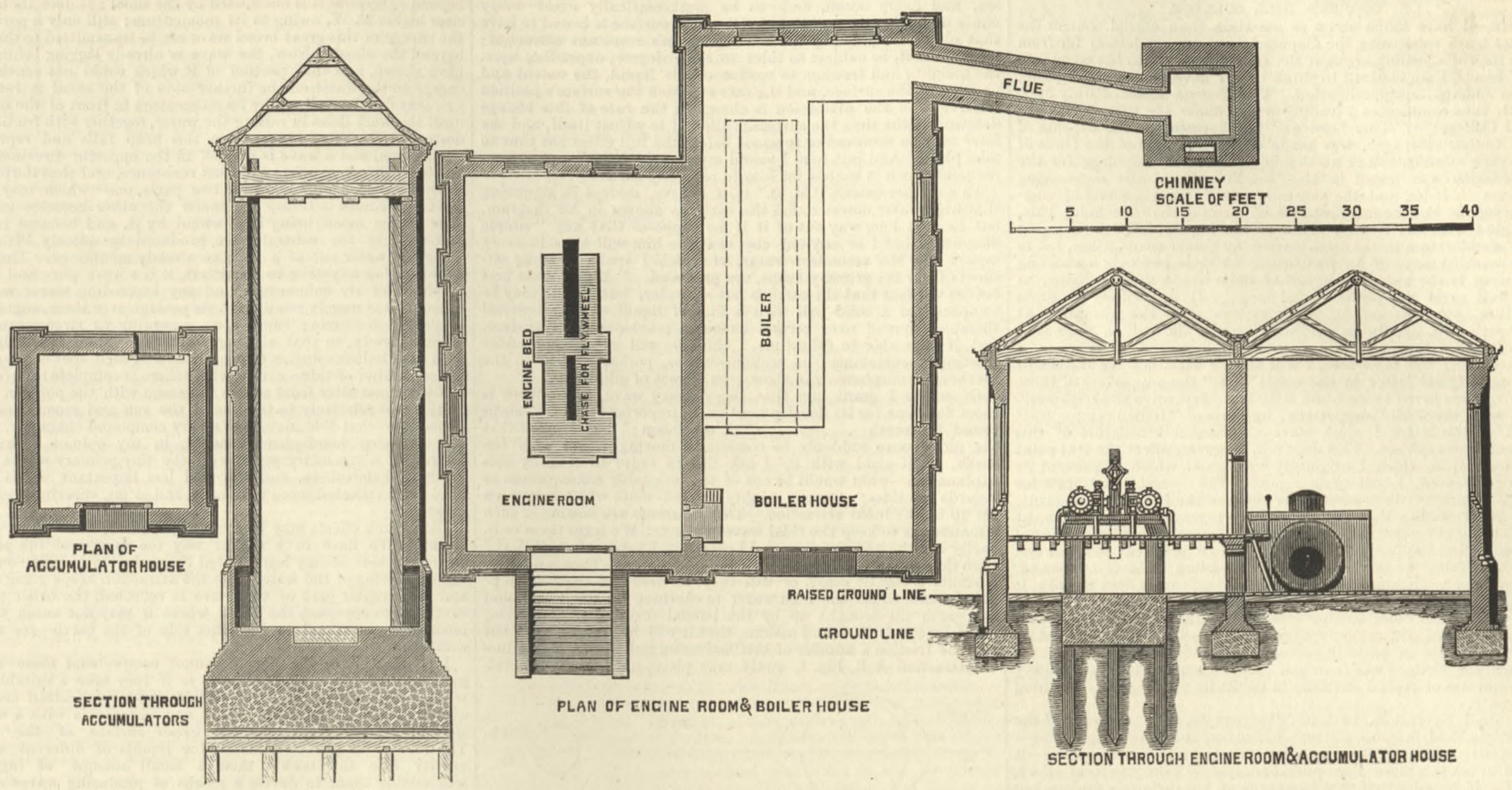
FIG. 4

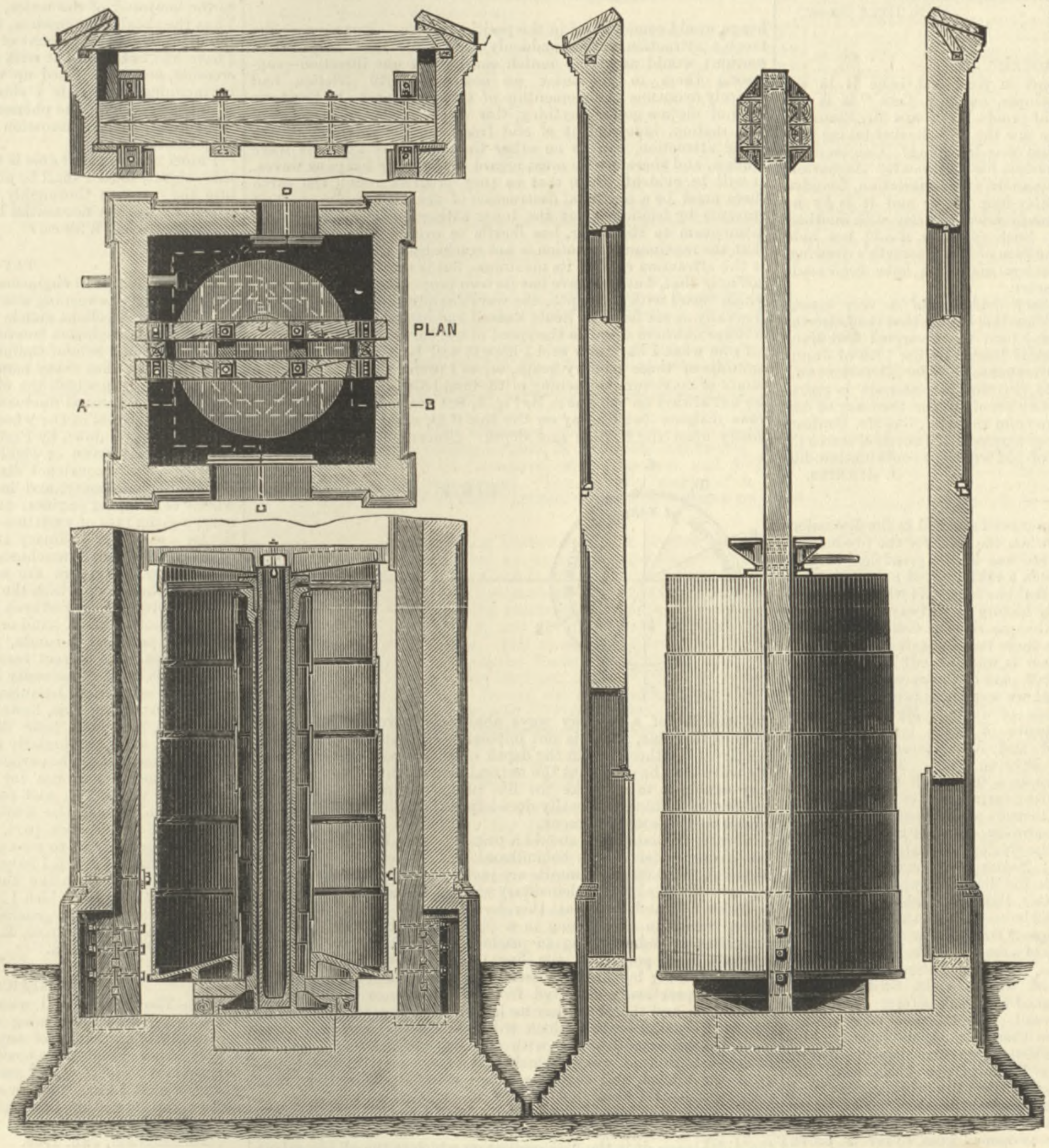


practical use, the rising of the temperatures has been avoided. The smaller the difference is between the temperatures of the soda lye and the water the more favourable is the economical working of the process. It can be attained by an increase of the heating surface as well as by a sparing consumption of steam, together with an ample quantity of soda lye, especially if the steam is made dry by superheating. In the diagrams Figs. 3 and 4, taken from a passenger engine which does regular service on the railway between Würselen and Stolberg, the difference of the two temperatures is generally less than 10 deg. Cent. These diagrams contain the temperatures during the four journeys *a b c d*, which are performed with only one quantity of soda lye during about twelve hours, and show the effects of the changing resistances of the engine and of the duration of the process upon the steam pressure, which, considering the condition of the gradients, are generally not greater than in an ordinary locomotive engine. It can especially be seen from these diagrams that an increase of the resistance is immediately and automatically followed by an increased production of steam. This is an important advantage of the soda engine over the coal-

* Zeitschrift d. Vereins Deutscher Ingenieure, 1883, p. 730; 1884, p. 69.

BOSTON DOCKS—HYDRAULIC MACHINERY.





SECTION AT A.B. SECTION AT C.D.

In our impression for the 26th December last we gave a general account, with illustrations, of the Boston Dock, as designed and carried out by Mr. W. H. Wheeler, M.I.C.E. In a subsequent impression for the 9th inst. we gave illustrations of the hydraulic cranes and coal hoists constructed to Mr. Wheeler's instructions. We now give illustrations of the hydraulic pumping engines and of the engine, boiler, and accumulator house.

The dock has been fitted with hydraulic machinery for working the gates, cranes, coal-hoist, capstan, &c. The contract for this work was let to Messrs. Abbot and Co., of Gateshead-on-Tyne, for £8551, which includes the engine and boiler. The engine consists of a pair of horizontal direct-acting engines, working expansively. The steam cylinders are 18in. diameter, with 24in. stroke, and run at a speed of 60 revolutions a minute, the initial pressure of the steam being 60 lb., and cutting off by double slide variable expansion at from one-third of the stroke. The engine is clearly shown by our engravings at page 66, which also give a detail sectional view of one of the steam cylinders, steam chest, and valve gear; and a sectional view of one of the hydraulic pressure pumps. The force pumps work on the same axis as the piston-rod, and are 4in. diameter, lined with gun metal, the ram being 2¾ diameter, entirely of gun-metal. The fly-wheel is 9ft. in diameter, and weighs 3 tons. The boiler is 6ft. in diameter, 28ft. long, with one 3ft. flue, and has six Galloway tubes and two Bowling steel expansion rings. Only one boiler has been fixed at present, but provision is made in the building for a second. The accumulator is weighted to acquire a pressure of 700 lb. on the square inch, the cylinder being 17in. in diameter, with 17ft. stroke.

Buildings.—The engine and boiler are contained in a red-brick building, with blue Staffordshire dressings and cornices under the eaves, 48ft. long by 41ft. wide. The interior of the engine house is lined for a height of 4ft. 6in. with brown glazed bricks, and above this with red bricks, the roof being open and stained and varnished. The accumulator house is close to the engine house, 18ft. square by 48ft. high. The chimney is near the boiler-house, and is 70ft. high, finished at top with overrailing courses and cornice of black bricks cased together at top with cast iron cup. The concrete foundation of the chimney, accumulator, and engine-bed rest on piles. The cost of the buildings, including foundation and masons' and bricklayers' work in fixing of the engine and boiler, was £1702, the contract being let to Mr. S. Sherwin, of Boston.

The offices and manager's house are placed near the entrance to the dock, where also is placed a weighbridge for carts and wagons. A weighbridge for weighing railway trucks is also fixed on the line leading to the G.W. yard. The cost of the offices and weighbridge, as also the lock-keeper's house, were included in Mr. Rigby's contract.

Sheds.—Four sheds have been erected on the quay one side of the dock, and so arranged that they can be extended as required. It is also proposed hereafter to erect a grain warehouse. Two sheds are for general goods landed from steamers from the Continent, are each 100ft. long by 55ft. wide, with wrought iron roofs, covered with corrugated galvanised iron, the closed sheds being boarded and covered with corrugated galvanised iron. The grain sheds are each 100ft. long by 40ft. wide, the roof and framing being of timber, the roofs covered with slates, and the sides boarded and covered with corrugated iron. The contract for the woodwork of these was let to Mr. Lucas, of Boston, for £1231, and for the ironwork to Messrs. Keay and Co., of Birmingham, for £1300.

TESTING A DYNAMO ELECTRICAL MACHINE.

On Tuesday last we witnessed the conclusion of a remarkable test to which Messrs. Mather and Platt, of Salford Ironworks, have subjected their most recently designed dynamo, at the request of Edison and Swan United Electric Light Company. The dynamo has been run continuously without break for fourteen days and nights at a speed of 1300 revolutions per minute, with an electro motive force between the brushes of over 55 volts, and through an external resistance giving a current equivalent to the feeding of 250 Swan 20-candle power lamps at 55 volts. In the course of this very severe test the brushes have worn nearly ⅛in., and yet at the conclusion of the run there was a total absence of sparking, and the bearings were not unduly heated, remaining to the last what a Dynamicable would call cool. The field magnets were only very slightly warm, and the pole pieces were quite cool to the touch, cooler considerably than the magnet coils. We measured the temperature of the brushes to be 60 deg. Cent., and we presume that of the commutator was practically the same. The dynamo is an Edison-Hopkinson shunt-wound—not compound—with armature 10in. by 10in. We refrain just now from giving any further details, as we propose shortly to publish drawings and a full description of the machine, together with particulars of the test that has just been completed, of which a careful continous record has been kept. At the same time we will illustrate a new very compact type of dynamo that Messrs. Mather and Platt are bringing out, along with two kinds of wheel driving gear specially designed for ship lighting.

A New International Exhibition. — At Königsberg, in Prussia, will take place during the months of May to August of this year an International Industrial and Polytechnic Exhibition for machinery, motors, tools, appliances for mechanics, small manufacturers, &c. The most important feature in this exhibition is the circumstance of its taking place in Königsberg, which is near Poland and Russia. The following are some of the heads of groups under, which exhibits will be classified, viz:—1, motors; 2, transmission appliances; 3, tools and implements for all branches of trade manufacture; 4, chemical and physical apparatus; 5, apparatus for technical instruction; 6, safety and protective appliances; 7, machinery and appliances for household purposes and innkeepers; 8, agricultural implements and appliances, &c. The exhibition takes place under the authority of the directors of the Industrial Central Union of the province of East Prussia. Dr. N. Heinemann, of the new Athenæum Club—Pall Mall East—London, has been appointed special commissioner of the Exhibition for Great Britain. He will give all necessary information to intending exhibitors.

LETTERS TO THE EDITOR.

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

COOPER'S HILL COLLEGE.

Sir,—I have taken steps to ascertain from official sources the exact truth concerning the disputed points in my letter; for from the tone of a leading organ of the Indian press which has come into my hands, I am inclined to think that I have, in one assumption, been under a misapprehension. The *Madras Times* of July 31st, 1884, thus commences a leading article under the title, "Cooper's Hill College:"—"This hard and bad bargain, at the expense of the Indian ratepayer, was made during the time of the Duke of Argyle's administration at the India-office. The apology for the foundation was found in the 'insufficiency of the engineering service' in India, and the non-existence of 'a great school of engineering' in this country capable of meeting that demand. This, coupled with his Grace's belief of the impossibility of obtaining the desideratum in the open market by public competition, led to the establishment of an institution which is not only a standing injustice to the technical schools of India but to those at home, as well as to the profession at large." It is needless to quote further, but this article, being written since the alteration at Cooper's Hill, plainly assigns the expense to the Indian, and not to the British ratepayer.

Assuming this to be true, I will at once withdraw the statement in my original latter to the effect that "the supporters of those Colleges are taxed to maintain a far more expensive rival system," replacing the word "supporters" by those of "Indian ratepayers;" and to the latter I must leave the further ventilation of this aspect of the subject. This does not, however, affect the real point at issue upon which I originally wrote, and which, to prevent its being obscured, I will again repeat. The Secretary of State for India founds a College against the views of the Indian Government, the latter stating that it must only be regarded as an experiment which would be distinctly condemned if it could not be conducted on an entirely self-supporting basis. The experiment is tried, and entirely fails, as far as the self-supporting basis is concerned. What then? Because this Government institution does not pay, it is brought into direct competition with existing local colleges "to get rid of the objectionable charges incurred in training its own men," and an education is thus given to a large proportion of its students with an entirely different ultimate object than that for which the College was founded. At the same time further heavy investments of capital continue to be made, to enlarge its teaching capacity.

I shall be curious to hear what can be said in favour of the principle that, because a State institution is not self-supporting—especially one founded under such circumstances as the above—it is to be made a more than probable cause of injury to local effort, unless it be admitted that Government has definitely undertaken the education of engineers for private employment.

University College, Bristol, H. S. Hele Shaw.
January 19th.

THE ROCKET.

Sir,—Mr. Stannard's statement in your last issue is to the point. I will not follow his example, and say that "it is not true," but I will venture to ask for proofs. Perhaps Mr. Stannard can tell us where he was when he saw the 1829 Rocket taking part in the opening procession? What was he doing? Can he name anyone else now alive who will confirm his statements? As matters stand we have nothing but Mr. Stannard's bare assertion, founded on memory, after a period of fifty-four years; and it is by no means impossible that he has confounded one day with another, and one Rocket with another. Such evidence would not hold water in a court of justice in the face of Mr. Nasmyth's drawing, Mr. Stenson's drawing, and the statements which have been made by others, of a very definite character.

There is, moreover, documentary evidence of a very strong character against Mr. Stannard. Thus it is known that the Leicester and Swannington Railway Company paid the Liverpool and Manchester Company £560 for the second Rocket on the 14th of January, 1832, and they paid Messrs. Stephenson £40 for alterations and repairs. This proves, it seems to me, that Mr. Stenson is right. Can Mr. Stannard bring forward any proof of the accuracy of his statements, or is he going to retire from the field, like Mr. Boulton —who, after a tremendous flourish of trumpets and a careful search (?) has failed to adduce one scrap of old writing to substantiate his case. J. Jenkins.

Manchester, January 19th.

Sir,—I think that a point has now been reached in the discussion which has gone on in your pages when the time for the production of proof has been reached. There has been a great deal of preliminary skirmishing, there has been a raking up of memories, and a searching for facts; and a vast deal has been said which, however interesting as bearing on the early history of railways in general, has very little indeed to do with the questions at issue, which are, as I understand them—first, were there two Rockets on the Liverpool and Manchester Railway when it was opened? and secondly, if there were, which of the two took part in the opening ceremony and killed Mr. Huskisson? What we want now is not rumour or memories, but data in the shape of facts. My contribution is not very large, but it may prove of use. I have a set of charge sheets of the Liverpool and Manchester Railway in my possession, extending from 1840 to 1845. These are the originals, not copies. They contain a list of all the engines at work on the railway, and in this list I entirely fail to find a Rocket, although I do find some of the Rocket's contemporaries. Take, for example, the week ending Saturday, April 4th, 1840. The coaching engines at work were the Cyclops, Rapid, Pluto, Leeds, Arrow, Vesta, Speedwell, Ajax, Nasmyth's, Comet, Lightning, Milo, Roderic, and Rokeby, while the luggage engines were the Speedwell, Comet, Arrow, Nasmyth's, Patentee, Goliath, Tiger, and Mammoth. The same engines, it will be seen, did both passenger and goods work. The usual load of a goods train, I may add, was about sixteen wagons. The consumption of coke was 45 lb. per mile. The usual coach load was seven vehicles, the consumption 32 lb. of coke per mile. In the following week we have the Swiftsure, the Leopard, and the Titan, not named the week before. The week following, the Dart was on the road. For the week ending May 2nd, 1840, we have, in addition to those named, the Panther, the Mastodon, and the Samson. Further on are mentioned the Elephant and the Hercules, the Phœnix, the Thunderer, the Eclipse, the Etna, and the Buffalo. For the week ending 23rd May, 1840, there were twenty-two engines at work.

Now, it seems to me that the fact that there was no Rocket on the road ten years after the line was opened goes so far to prove Mr. Stenson's statement that the Rocket sketched by Mr. Nasmyth was sold. I may here add that it ought to be possible to bring forward irreproachable proof. If the Leicester and Swannington Company bought the Rocket, they must have paid for her, and, no doubt, a record of the amount paid could be found if the transaction took place. For myself, I have no doubt at all that the Rocket of 1829 did not open the Liverpool and Manchester Railway; but this is only an opinion which I have gathered from the correspondence in your pages and the *Railway Review*. By the way, I wonder does Mr. Boulton or Mr. Stannard ever see that journal? Comet.

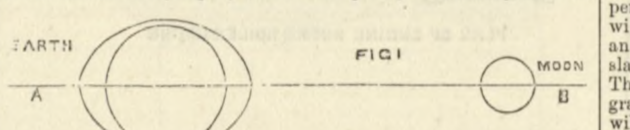
London, January 21st.

TIDAL ACTION.

Sir,—"M. C." is evidently in the same boat as Mr. Boult. He says that owing to his obtuseness or to my want of lucidity—we will just divide the honours—he sees in what I have written on this subject the implication that I believe "a great monster wave to be set up about every twelve hours in the Pacific Ocean," and he completes my dismay by saying that he understands me to say this wave is generated instantaneously. I beg pardon! "suddenly." Nevertheless, I am certain he will have a difficulty in pointing out the text which conveys these false impressions. Let me once more in new language explain that I believe every pool, every lake, every sea, and every ocean, and—to be mathematically exact—every ounce and every drop of liquid with a free surface is bound to have that surface modified by the sun and moon's resultant attraction; must, in fact, be subject to tides to some degree, depending upon the mobility and freedom to motion of the liquid, the extent and position of the surface, and the rate at which the surface's position relatively to the attraction is changed; the rate of this change determines the time the surface is allowed to adjust itself, and the force may be removed or reversed before the full effect has time to take place. And just here I would say that if "M. C." cannot comprehend this it is useless for him to read any further.

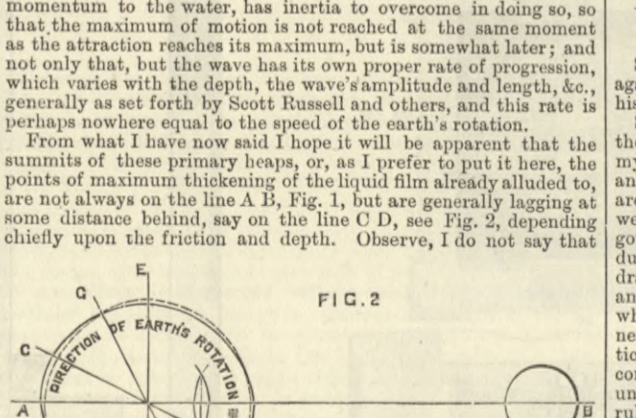
To a certain extent "M. C." is, I believe, correct in supposing that high water moves round the earth as shown in his diagram, but he is a long way out of it if he supposes that any "simple diagram" that I or any one else can give him will show in every aspect how the secondary waves, of which I spoke as being offshoots from the primary heaps, are produced. "M. C." must first realise the fact that the earth is not all water, but rather may be compared to a solid ball with a film of liquid of very unequal thickness spread over certain irregular portions of its surface, and, if he is able to follow me, I think he will admit that under existing circumstances no section—unless, perhaps, taken in the southern hemisphere—can show even a tract of ellipticity.

Of course I grant him that the primary wave, where there is room and time for its development on an important scale, "moves round the earth . . . . after the moon;" but suppose that the moon were suddenly to commence moving round with the earth, as if rigid with it—I ask this in order to simplify this explanation—what would be one of the inevitable consequences as regards the tides? Certain mighty currents exist which have been set up by the lunar attraction. These currents are flowing in such a manner as to keep the tidal wave moving. We term them ordinarily the ebb and the flow, and I need not, I hope, inform "M. C." that they affect the ocean to its greatest depths. Then will these currents instantly cease, or will they, in virtue of their store of momentum, cause the high water to continue its progress round the earth till brought up by the partial reversal of attraction, aided by the friction? I assume that it will be granted that but for the friction a number of oscillations on either side of the line of attraction A B, Fig. 1, would take place, until finally the two



heaps would come to rest in the position shown. But suppose the moon's attraction were to suddenly cease while these heaps are in motion; would not their motion continue in one direction—supposing them to encounter no obstacles—until friction had entirely overcome the momentum of their currents? If Newton's laws of motion go for anything, this would assuredly be so. But this motion, independent of and free from the restraint of the lunar attraction, can be no other than what we know as wave motion, and therefore we must regard the primary heaps as waves. It will be evident, then, that as they progress round the earth there must be a continual destruction of the momentum of their currents by friction. But the lunar attraction, which gives this momentum to the water, has inertia to overcome in doing so, so that the maximum of motion is not reached at the same moment as the attraction reaches its maximum, but is somewhat later; and not only that, but the wave has its own proper rate of progression, which varies with the depth, the wave's amplitude and length, &c., generally as set forth by Scott Russell and others, and this rate is perhaps nowhere equal to the speed of the earth's rotation.

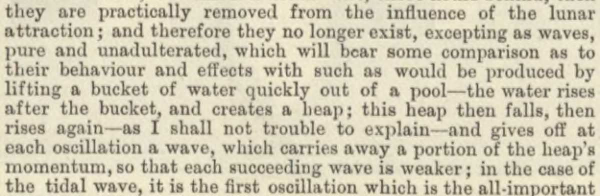
From what I have now said I hope it will be apparent that the summits of these primary heaps, or, as I prefer to put it here, the points of maximum thickening of the liquid film already alluded to, are not always on the line A B, Fig. 1, but are generally lagging at some distance behind, say on the line C D, see Fig. 2, depending chiefly upon the friction and depth. Observe, I do not say that



the summit of a primary wave absolutely never at any point reaches this line, for it is not impossible (?) that in some parts of the Great Southern Ocean the depth of the ocean and strength of the wave may be such that the natural rate of the wave's progress may enable it to overtake the line of maximum attraction A B; but I do not think this really does happen, and if it does, it by no means weakens my argument.

Now, it is plain that, should a primary wave by any possibility get 90 deg. in six hours behindhand, the forces are completely reversed, for then the summits are just where low water—according to "M. C.'s" very elementary theory—should be found, viz., at E and F, and they must therefore have but a brief existence there, owing to their being in a phase opposite to that which attraction is endeavouring to produce there; but when half-way between these points on the line G H—somewhat more, as a matter of fact; but this is a detail—*i.e.*, three hours behind, then they are practically removed from the influence of the lunar attraction; and therefore they no longer exist, excepting as waves, pure and unadulterated, which will bear some comparison as to their behaviour and effects with such as would be produced by lifting a bucket of water quickly out of a pool—the water rises after the bucket, and creates a heap; this heap then falls, then rises again—as I shall not trouble to explain—and gives off at each oscillation a wave, which carries away a portion of the heap's momentum, so that each succeeding wave is weaker; in the case of the tidal wave, it is the first oscillation which is the all-important one. The friction, relatively speaking, is such, I imagine, that the succeeding waves cannot exhibit more than a secondary influence, although I am far from denying them any existence.

I believe, Sir, that it is possible for the primary wave to get this



far—and further—behind. I now submit the following for consideration:—Let the dotted line in Fig. 3—which is intended to represent a section through a portion of the earth's surface—represent mean tidal height; a primary wave W advances as shown, after having for some hours previously been developing itself and gaining magnitude and velocity under favourable circumstances in a comparatively deep and unobstructed area, it encounters the shoal *s*, and is unable to impart the whole of its momentum to the water beyond *s*, because it is obstructed by the shoal; it does its best; it rises higher at W, owing to its momentum; still only a portion of the energy of this great broad wave can be transmitted to the water beyond the shoal. Now, the wave is already lagging behind, as I have shown, and that portion of it which could not continue it, energy to the water on the further side of the shoal is reflecteds *i.e.*, it is first heaped up by its momentum in front of the obstacle until the work done in raising the water, together with friction, has destroyed the momentum, then this heap falls and reproduces momentum, and a wave is sent off in the opposite direction or in whatever direction offers the least resistance, and thus the primary wave may become divided into two parts, one—which may be the least—continues to follow the moon the other becomes independent of the moon, being left behind by it, and behaves in great measure like the central wave produced by quickly lifting the bucket of water out of a pool as already mentioned. The moon no longer has anything to do with it, it is a wave pure and simple in virtue of its momentum, and any succeeding waves which it encounters it merely modifies in its passage over them, augmenting or partly destroying them, &c., according to circumstances of infinite variety, so that although all these causes regularly recur with each half-revolution of the earth, and each spot consequently has some kind of tide—except where there is complete interference, and this must alter from season to season with the position of the earth's axis relatively to the line of the sun and moon's resultant attraction—that tide may be of a very compound character, and in the northern hemisphere consists, in my opinion, practically entirely of a secondary wave, with the tiny primary waves of the northern hemisphere, and the still less important waves which have been reflected more than once, and so on, superimposed upon its surface.

But if such effects may be caused by a shoal, what about a continent? We have in a similar way the motion of the primary wave arrested—see my letter dated November 18th, 1884—owing to the shallowing of the water; but the attraction keeps going ahead, and the greater part of this wave is reflected, the other portion continues to approach the shore, where it may not reach till the moon has got round to the other side of the earth—see map of cotides.

If "M. C." or Mr. Boult cannot comprehend these things, perhaps they will be enabled to do so if they take a suitable tank with glass sides and fill it to a certain depth with clean creosote, and then fill it up with water, and cover this with a wooden slab to prevent waves on the upper surface of the water. The idea is to get two immiscible liquids of different specific gravity into the tank; then a small amount of ingenuity will enable them to devise a means of producing waves on the surface of the creosote. These waves will move very slowly, owing to the buoyancy of the water, and may be thoroughly scrutinised. Thus the shoal phenomenon, the variation in speed according to the depth and arrangement of the bottom, &c., may be witnessed. I have had to be content with a clear glass bottle half filled with creosote, and then filled up with water and tightly corked, and by inclining the bottle I obtained in the estuary at the neck a good illustration of the phenomenon to which Mr. Hurtzig alluded when he began this discussion under the title of "The Manchester Ship Canal."

I must now say that this is the last letter I intend to write upon this subject, until I shall be able, as I hope to be some day, to go into the question thoroughly, and not in this piecemeal fashion, which my worldly necessities have compelled me to adopt.

Hough Green, Widnes. R. Snowdon.

FLY-WHEELS.

Sir,—In justice to engineers I should like to enter my protest against the very sweeping assertions made by Professor Smith, in his otherwise excellent article in The Engineer of January 9th.

So far from engineers treating the proportioning of fly-wheels in the off-hand and rule-of-thumb manner there described, it is within my experience that many manufacturers and designers of engines and machinery in which the efforts and resistances—one or both—are subject to unusual fluctuations, always calculate the requisite weight of material in the wheel rim in a manner somewhat analogous to that laid down by Professor Smith. In my own practice during the last seven or eight years it has been the rule in my drawing-office to construct diagrams of efforts and resistances for any special machinery, and in this way I have designed the fly-wheels of pumping engines, air compressors, and cold air machinery, a given rate of variation of speed being selected for each particular case. For ordinary steam engines driving a number of comparatively small machines, such calculations are, of course, unnecessary, as there are several well-known short, practical rules, by the use of which the weight of the fly-wheel rim can be at once determined. But even here it is untrue to say unreservedly that the method is off-hand or rule-of-thumb, for I submit that a so-called practical formula, if properly applied, is at least as likely to lead to a correct result as a more elaborate method, in which there must of necessity be numerous assumptions as regards the effects of friction, balancing of parts, &c.

Notwithstanding this, however, I think, Sir, that the subject is one which will well bear discussion in the columns of The Engineer, more particularly in relation to the variations of rate of revolution that can be permitted in different classes of machinery, and the methods in use for ascertaining what the efforts and resistances really are, and for determining what provisions are necessary to prevent the fluctuations in speed exceeding a given amount. For my own part, I may say at once that Professor Smith's system seems to me unnecessarily long and tedious, and on a future occasion, when I have more time at my disposal, I should be very pleased to make known through the medium of your columns the method which I have adopted, provided you consider the subject of sufficient general importance.

35, Queen Victoria-street, E.C., T. B. Lightfoot.
January 20th.

THE EFFICIENCY OF FANS.

Sir,—The strange and wholly gratuitous rudeness of Professor Unwin's remarks concerning my contribution to this discussion makes them unworthy of any reply from me. How is it that he knows other people's "objects" so much better than they do themselves? He says I "make some kind of defence." I am unaware that I have done or said anything requiring any defence, and I certainly neither have made nor intend to make any.

The Mason Science College, Robert H. Smith.
Birmingham, Jan. 17th.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty.—Samuel Aston, engineer, to the Indus, for service in the Black Prince; Richard Collingwood, assistant engineer, to the Hercules; Frederick W. Wells, acting engineer, to the Asia, for service in the Collingwood; Lieut. George E. Richards, and Lieut. Francis E. Wheeler, to the Nelson, additional, for the Paluma.

The Institution of Mechanical Engineers.—We have received some correspondence concerning the approaching meeting of this body, but we do not think that any good purpose would be served by the publication in our pages of letters referring to the internal policy and organisation of this or any other society. Such matters are, or ought to be, private, and are of interest only to the members, who ought to be able to arrange their affairs without the assistance of the press. It is extremely difficult to prevent such correspondence becoming unpleasantly personal, and we believe that we serve the best interests of the Institution by declining to have anything to do with disputes between the council and the members.

RAILWAY MATTERS.

THE railway traffic by the Mont Cenis line has been blocked for some days by the snow, which lies 6ft. deep on the Italian frontier.

THE directors of the Great Eastern Railway Company announce a dividend for the past half-year upon the Ordinary Stock at the rate of $3\frac{1}{4}$ per cent. per annum. For the second half of 1883 it was at the rate of $2\frac{3}{4}$ per cent.

THE express train from Tournai to Brussels ran off the rails on the 17th inst. beyond Bierges, and four of the carriages were precipitated down a slope and smashed to pieces. One of the guards of the train received fatal injuries, and fourteen of the passengers were seriously hurt.

DURING the past ten days a sufficient number of accidents more or less fatal have occurred on our lines to keep up reputation, and to give the Board of Trade inspectors something to write about. Chief causes—goods trains not allowed quite sufficient time to get their tails off road. Full reports in the spring.

IN the 45 collisions on the American railways in November, 23 persons were killed and 46 injured, in the 47 derailments 24 were killed and 84 injured, while in the other accidents no personal injuries resulted. Thirty of the killed and 50 of the injured were railroad servants, who thus furnished 64 per cent. of the deaths, 38 per cent. of the injured, and 45 per cent. of the total number of casualties.

THE Telpherage Company has arranged its first contract. This is with the Sussex Portland Cement Company. It is also probable that a line will be erected for the removal of slag; and other lines are under consideration. The company is admitted into the American ring (Edison, Field, Brush, Siemens and Co., &c.) for electric locomotion, and a very large number of inquiries come from abroad, which will, probably it is thought, result in a considerable extension of the system as soon as the cement works line is fairly running, but this is not expected to be completed before July or August.

AN Embassy report just published contains some information upon the scheme adopted by the Spanish Government for introducing reforms in Cuba, and reference is made to a new line of railway projected from Santa Clara, in the centre of the island, to Santiago de Cuba in the south-east. It will traverse the whole of the Central and Eastern departments, and by means of a junction with Santa Clara, with the lines already in existence from Havana, Matanzas, Cardenas, and Sagua la Grande to Cienfuegos, will afford a complete system of railway communication between the north-western and south-eastern portions of the island. The Government is to alter the conditions of the contract for the construction of this line, offering, instead of a fixed sum per kilometre—the original arrangement—a minimum of interest on the capital invested in its construction, and to invite tenders.

ON the 16th inst. an accident occurred near Stoke-on-Trent, resulting in injuries to a number of persons and great destruction to rolling stock. The through 9.15 express from Manchester to Birmingham had left the station and was passing the siding near the Duke of Sutherland's pits, about two miles on the Stafford side, at full speed, when it ran into a mineral train, which was straight across the line. The passenger engine and most of the carriages were thrown off the rails and scattered about. It is stated that the engines came almost to a dead stand the moment they struck each other. It is believed that the driver of the express, who has since died, mistook one signal for another, as he was new to the route. The engine of the mineral train kept to the metals, but it was very much damaged. The guard of the express, who was in a van at the rear of the train, says he felt scarcely anything of the collision, though there were but five coaches in the train.

WHILE some of the principal railway companies in this country have been content to employ four or five different forms of vacuum brakes in the endeavour to find some suitable appliance other than the Westinghouse, the continental companies, continue to advance in just the opposite direction towards an uniform system of air pressure brakes. Following the example of the Baden State Railways which are rapidly equipping their stock with the Westinghouse brake, we learn that the Wurtemberg State has also chosen the same system, and intend to outstrip Baden in fitting up the whole of their stock. The pioneers of railway enterprise are being beaten by those whom they have taught, at all events so far as concerns the matter of brakes; but as our readers are aware, it is not only in the matter of brakes that Germany is advancing and England receding. It is certainly not to our credit, that, notwithstanding our block system and admirable permanent way, most continental trains will shortly be much better protected against accidents than those of some of the principal lines in this country.

UNDER the heading "Scientific Ballast," an American paper says:—"Some years ago a most interesting find of fossils was made at the Portland—U.S.—stone quarries. They were of high scientific value, and it was decided to send them to Yale College for preservation and study. They were accordingly loaded upon a flat car at Middletown and sent on their way, a car load of them. It was at that time that the fine stone bridge of the consolidated road was being built across the Farmington River at Windsor. After the arch of the bridge was set, the space was filled in on top with quantities of broken trap rock from the companies' quarries at Meriden. This broken stone at just this time was being drawn to Windsor by the cars for this purpose. The conductor of one train discovered the car load of fossils side tracked at Berlin, and felt sure it was a lot of ballast for the Windsor Bridge which had been accidentally left behind. With commendable zeal he fastened to it at once, and drew it on to the bridge. There the rare fossils were dumped with the other stones, and there to-day they lie in the solid flooring of the massive bridge."

IN concluding a report on the collision which occurred on the 15th November last at Murton station, on the Sunderland and Hartlepool branch of the North-Eastern Railway, when, through a coupling coming off, a passenger train from Newcastle for Hartlepool, standing at Murton platform, was run into at the rear by a pilot engine which had been assisting the train up the severe gradients which occur between Ryhope and Murton, injuring eighteen passengers, Major-General Hutchinson says:—"There is always a risk of accident from a variety of causes in the use of engines for pushing trains up inclines. It is, no doubt, convenient, and a measure of safety in case of a coupling breaking. But the proper place for the assistant engine is in front of the train; and with a proper brake van at the back of a train fitted with a good automatic continuous brake, the risk of accident from a broken coupling should be very small indeed." There is no doubt that the proper safeguard against accidents of this kind is a good automatic brake; but it would be interesting to hear the opinion of practical men on this question of rear or front bank engine. The rear use has some advantages.

A RETURN just received from India shows the results of the railway traffic for the quarter ending the 30th of June last, and compares them with those of the corresponding quarter of the year 1883. The results are especially striking in the import trade, wherein has to be recorded a remarkable and almost marvellous decrease. The falling off in the import trade during the quarter was as much as 4,043,315 maunds, or 58·12 per cent., compared with the corresponding quarter of the previous year. The bulk of this decrease was due to the decline in the trade in wheat, of which only 1,380,881 maunds were dispatched to Calcutta, against 3,860,360 maunds in the first quarter of 1883-4. The export trade, however, showed a trifling increase of 21,320 maunds or 0·63 per cent., over the returns of the quarter ending the 30th of June, 1883, notwithstanding that there was a decrease of 136,798 maunds in iron, 129,006 maunds in rice, 118,374 maunds in drained and undrained sugar, 74,803 maunds in gunny bags and cloth, and 21,744 maunds in tobacco. No general deductions are attempted in these returns, which show that so far as Bengal and Calcutta are concerned the wheat trade passed through an unfavourable revolution in the spring of last year.

NOTES AND MEMORANDA.

IN Greater London 3598 births, 21·36 per hour, or one every 2·8 minutes, and 2306 deaths, equal to 13·7 per hour, or one every 4·38 minutes, were registered last week. These were equal to annual rates of 36·1 and 23·1 per 1000 of the population.

IN London 2876 births and 1855 deaths were registered during the week ending January 17th. The births and the deaths both exceeded by 42 the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 18·6, 24·9, and 25 in the three preceding weeks, declined to 23·7.

THE deaths registered during the week ending January 17th in twenty-eight great towns in England and Wales corresponded to an annual rate of 24·2 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year. The six healthiest places were Hull, Brighton, Derby, Nottingham, Sheffield, and Bradford.

OUR contemporary, the *Builder*, is responsible for the following: "A lightning-rod put in the ground at Fleetwood fifteen years ago was imbedded in soft clay. When it was removed a few days since, a solid lump of iron ore, weighing 96 lb., was attached to it." It was supposed that the electricity had reduced the oxides, sulphide, &c., of the clay, or assisted in it.

AN American miller sends a note to the *Mechanical Engineer*, giving his consumption of fuel and work done. Referring to the note, an editorial remark says:—"A barrel of flour for 33 lb. of coal—80 lb. to the bushel—is better than many ambitious establishments can show. A mill in Minneapolis makes, or has made, a barrel of flour for 20 lb. of coal, but the appliances are all of the latest and most approved pattern. But he should use an indicator, and his employers ought to furnish one. They can save the cost of it in the first month."

ON the 1st January, 1884, Paris had 65,000 square metres of wood paving; to-day she has 252,000 square metres, and orders have been given which make up 80,000 metres more, and 175,000 more are proposed, so that at the end of 1885 it is thought that Paris will have 500,000 square metres of wood paving, about one-sixteenth of the whole, for the street area of Paris is about 8,000,000 square metres. The wood paving now being laid in Paris is, like that in London, put on a bed of 6in. concrete. In London, however, we break it up the week after it has set.

AT the meeting of the Academy of Sciences a paper was read by M. Berthelot describing experiments made in collaboration with M. Vieille for obtaining a measure of the heat of combustion of various carbons. The method adopted was new, and required two experiments and much time. A calorimetric bomb was employed in which was enclosed compressed oxygen in quantity three times that which is necessary to effect combustion in air. In the bomb or shell the combustion is complete, and lasted but two or three minutes, and gives rise to no carbonic oxide. The measure of heat thus obtained is without error.

M. BOYMOND has lately published an interesting notice, the *Scientific American* says, upon the weight of drops. It is well-known that the weight depends upon the exterior diameter of the tube; the interior diameter having no influence except upon the velocity of flow. The nature of the liquid determines the weight, whatever may be the proportion of dissolved material that it contains. Boymond used a dropper of $\frac{1}{8}$in. diameter, and determined the weights by an extremely sensitive balance. The mean of his results gave, for 15 grains of distilled water, 20 drops; alcohol of 90 deg., 61 drops; alcohol of 60 deg., 52 drops; alcoholic tinctures from 60 deg. to 90 deg., 53 to 61 drops; ethereal tincture, 82 drops; a fatty oil, about 48 drops; a volatile oil, about 50 drops; an aqueous solution, whether diluted or saturated, 20 drops; a medicinal wine, 33 to 35 drops; laudanum, about 33 to 35 drops.

FOUR sheets containing the results of the past year's meteorological observations conducted at Nottingham at a station 182ft. above half-tide level at Hull, under the direction of Mr. M. O. Tarbotton, M.I.C.E., have been published, and these contain a good many figures of interest. The total range of atmospheric pressure was 1·806in., that of the previous year being 1·965. The highest reading in 1884 was 30·698 on the 3rd October, lowest 28·892 on the 27th January. The highest temperature in the shade was 91·1 F. 12th August, lowest 23·7 on 30th November. Highest reading in sun, with blackened bulb *in vacuo*, 149·1 on 23rd August. Lowest reading on grass 22 F. on 30th November. Total rainfall in year 20·1in. measured on the ground, and 18·314in. measured 39ft. above ground. The monthly weight of a cubic foot of air varied through the year from 528·9 grains to 551·2 grains.

DURING the week ending December 20th, in twenty-six cities of the United States, having an aggregate population of 6,158,600, there died 2444 persons, which is equivalent to an annual death-rate of 20·6 per 1000. The deaths under five years of age, according to the official returns published by the American *Sanitary Engineer*, numbered 809, and the percentage, 37·3, is obtained from twenty-five towns. The annual death-rate in the North Atlantic cities was 18·8, in the Eastern 21·8, in the Lake 18·7, in the River 17·8, and in the Southern cities 19·1 for the whites and 33·1 for the coloured. During the week ending December 27, in twenty-nine cities, population 7,147,300, there died 3068 persons, equivalent to an annual death-rate of 22·3 per 1000. The rate in the North Atlantic cities was 21·2, in the Eastern 24, in the Lake 19·7, in the River 21·6, and in the Southern cities for the whites 16·3 and for the coloured 32·4 per 1000.

THE report of the Kew Committee for the year ending 31st October, 1884, contains the tabulated results of the magnetic deflection and vibration observations made at Kew between October, 1883, and September, 1884. They were made by Mr. T. W. Baker with the collimator magnet marked K C 1, and the Kew 9in. unifilar magnetometer by Jones. The declination observations were also made with the same magnetometer, collimator magnets 101 B and N E being employed for the purpose. The dip observations were made with dip circle Barrow No. 33, the needles one and two, $3\frac{1}{2}$in. in length, only being used. The results of the deflection and vibration observations give the values of the horizontal force, which, being combined with the dip observations, furnish the vertical and total forces. They are expressed in both English and metrical scales—the unit in the first being 1ft., 1 second of mean solar time, and 1 grain; and in the other 1 millimetre, 1 second of time, and 1 milligramme, the factor for reducing the English to metric values being 0·46108. By request, the corresponding values in C. G. S. measure are also given. The value of log. $\pi^2 K$ employed in the reduction is 1·64365 at temperature 60 deg. Fah. The induction coefficient μ is 0·000194. The correction of the magnetic power for temperature t_0 to an adopted standard temperature of 35 deg. Fah. is $0·0001194\ (t_0 - 35) + 0·000,000,213\ (t_0 - 35)^2$. The true distances between the centres of the deflecting and deflected magnets, when the former is placed at the divisions of the deflection bar marked 1·0ft. and 1·3ft., are 1·000075ft. and 1·300097ft. respectively. The times of vibration are each derived from the mean of twelve to fourteen observations of the time occupied by the magnet in making 100 vibrations, corrections being subsequently applied for the torsion force of the suspension thread. No corrections were made for rate of chronometer or arc of vibration, these being always very small. The value of the constant P, employed in the formula of reduction $\frac{m}{X} = \frac{m'}{X'}\left(1 - \frac{P}{r_0^2}\right)$, is $-$ 0·00129. In each observation of absolute declination the instrumental readings have been referred to marks made upon the stone obelisk, erected 1250ft. north of the observatory as a meridian mark, the orientation of which, with respect to the magnetometer, was determined by the late Mr. Welsh, and has since been carefully verified.

MISCELLANEA.

A LIST of the Rider hot-air engines now at work shows that there are between two and three hundred of these engines at work.

AT Königsberg, in Prussia, will take place during the months of May to August of this year an International, Industrial, and Polytechnic Exhibition for machinery, motors, tools, appliances for mechanics, small manufacturers, &c.

THE Alexandra Palace International Exhibition directors have concluded an agreement with the Gülcher Electric Light Company for illuminating the Palace and grounds with what is called the largest combined installation in England.

AT some recent reaper trials in Australia, the first prize has, we are informed, been awarded to the Walter A. Wood's harvester and binder, in competition with various makers, at Inglewood, Nov. 12th, Benalla, Nov. 27th, and Rochester, Nov. 28th, all three trials in Victoria.

AT a meeting of the Manchester Society of Engineers, Employers, Foremen, and Draughtsmen, Mr. Alderman W. H. Bailey delivered an interesting inaugural address, his subject being "The Reign of Law in Relation to the Unification of Engineering Knowledge." The various systems of metrology formed the chief part of his subject.

MEETINGS of the Accidents in Mines Commission were held on Tuesday and Wednesday at its offices, 2, Victoria-street, Westminster. There were present the chairman, Mr. Warington W. Smyth, F.R.S., Sir Frederick Abel, C.B., F.R.S., Professor Clifton, F.R.S., Mr. W. Thomas Lewis, and the secretary, Mr. Arthur J. Williams.

THE Austrian railway men have a system of co-operative stores, where they can supply themselves with food and other necessaries of life, at considerably less than the ordinary retail prices. This does not please the regular hop-keepers, who, at a recent meeting, resolved to memorialise the Government, asking that a law should be passed limiting the proportion of goods which a man should be allowed to purchase in this way to, say, one-third of his salary. Shopkeepers, at this rate, will have to go to real work, for it is hardly likely the Government will interfere in such a matter.

THE death is announced of Mr. Charles Brand, of Mains of Fordoun, one of the nearest relatives of the poet Burns. Mr. Brand was born in the year 1804. He was a well-known contractor, and on the formation of the Scottish North-Eastern Railway he erected, among other works, the viaduct over Drumlithie Den. He also executed several large contracts on the Duke of Sutherland's estate, and, in partnership with his son, took the contracts for the Glasgow Tramways and the Grangemouth Docks, the latter involving an expenditure of upwards of £250,000. The firm also took up other large undertakings. Isobel Burns, the grandmother of the deceased, was aunt to the great Scotch poet, and Mr. Brand warmly promoted the erection of the statue to Robert Burns in Montrose.

A CORRESPONDENT, writing to a Trinidad contemporary, calls the attention of the public of Trinidad to the unsatisfactory working of the Pitch Lake leases in relation to the Government. It seems that, except five acres reserved by the Crown, the whole of the lake is practically in the hands of three individuals, at an annual rental of only about £260. Last year the exports were 4868 tons of boiled and 34,277 tons of raw asphalt, the duty on which was about £1100, the Government thus receiving about £1360 only. The expense of digging and shipping is under 8s. or 2 dols. per ton; freight to Europe, 20s.; and to the United States, 3 dols.; and selling price there 40s. to 45s., and 12 dols. in Trinidad; leaving a certain profit of 3 dols. per ton, or, say, 120,000 dols. per annum to be divided between a few individuals, not one of whom can be said to have any substantial stake in the island beyond what they thus get out of it. This is checking the extension of the application of this very useful material.

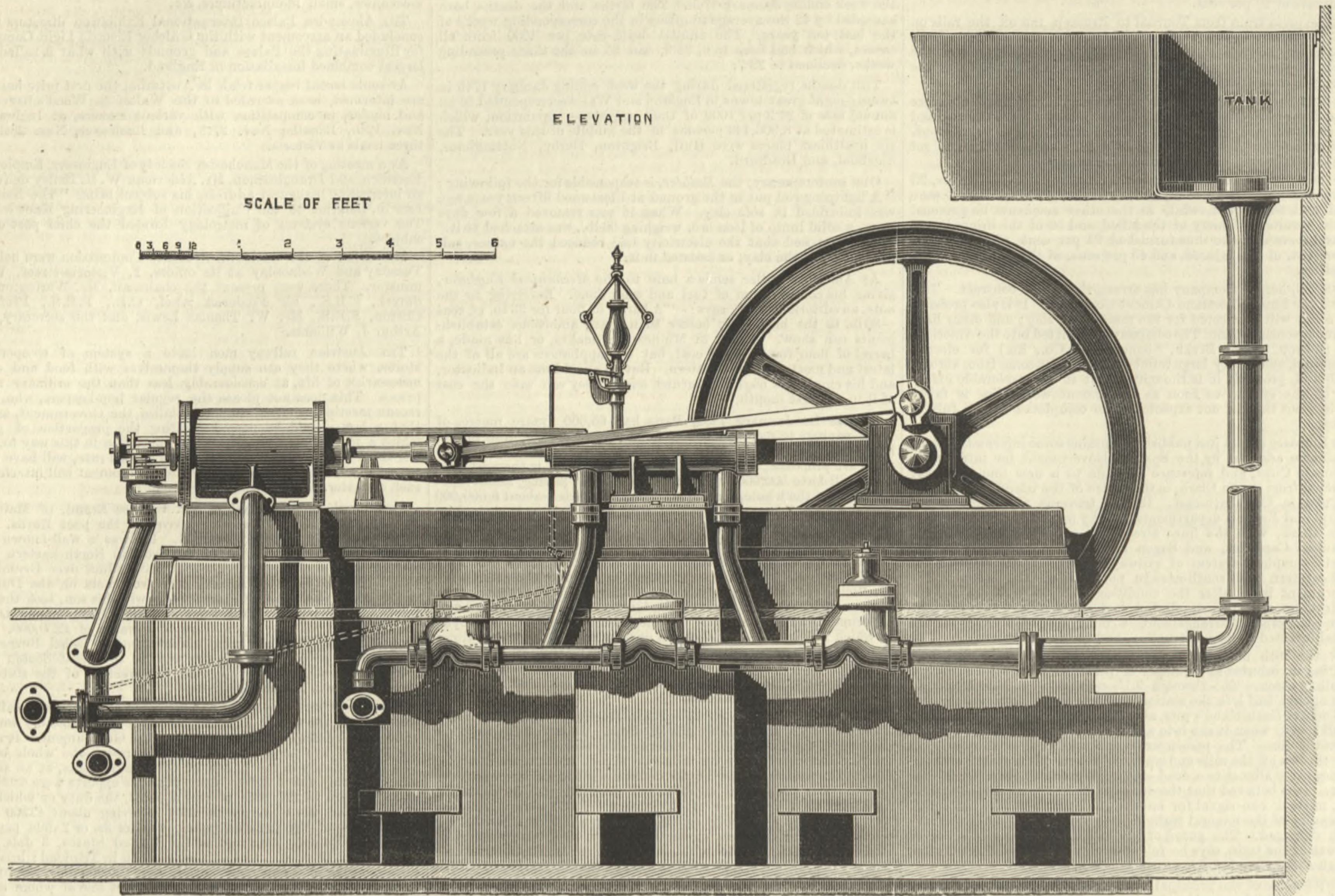
VICE-CONSUL WHYTE, reporting on the commerce of Medellin, Columbia, mentions that gold and silver mining is the most important local industry, and supplies six-sevenths of the value of the total exports, some 3,000,000 dols. being forwarded to Europe annually from the State of Antioquia; but owing to difficulties of transport, high customs duties, &c., the mines are worked under great disadvantages. Foreign mining undertakings there generally fail owing to the want of sufficient working capital, while the great difficulty experienced in establishing any other industries, owing to the impossibility of transporting adequate machinery over the bad roads, deters capitalists from entering into the many other fields of industry which otherwise could be undertaken to develope the resources of the State. The country possesses mines—iron, coal, copper—so conveniently situated that if only easy communication with the rest of the Republic were established, Antioquia would become a small Belgium. A local railway in course of construction makes slow progress and taxes the power of the Government to the utmost to complete a very insignificant portion yearly, and unless foreign capital be obtained, the line will perhaps never be completed.

MESSRS. HATHORN, DAVEY, AND CO., of the Sun Foundry, Leeds, have completed some fine hydraulic machinery for Marseilles; it is to the order of La Société Anonymé de Charbonnages des Bouches du Rhone, and comprises plant for draining a colliery where the ordinary conditions of pumping are not applicable. The colliery is subject to periodic inundations during the wet seasons, so that whatever machinery is laid down would sometimes be under water. Messrs. Hathorn, Davey, and Co. have carried out a hydraulic scheme by which the water is pumped by means of hydraulic engines placed underground in the workings, these engines being actuated under a system of hydraulic transmission from steam engines situated on the surface. The hydraulic pumping engines below are constructed so that they can be started or stopped from the engine-house on the surface. The surface engine is of the compound type, and of 150-horse power, which is transmitted to two large hydraulic pumping engines at the bottom of the mine, employed in pumping water between 4000ft. and 5000ft. The surface engine is provided with a steam accumulator, instead of the ordinary weighted accumulator.

MR. D. PIDGEON at the Society of Arts, on January 21st, read a paper on "Labour and Wages in America." Following, in the early part of his paper, somewhat closely on the lines of his recently published book, "Old World Questions and New World Answers," Mr. Pidgeon first drew attention to the radical differences which distinguish native American from alien labour, exemplifying the high condition of the former by the Lowell of forty years ago, as described by Dickens, Miss Martineau, and others. He then sketched the social life of certain existing industrial towns, the "fastnesses" to which native American labour has, so to speak, been driven by immigrant operatives, who have imported into the States the lower life conditions exhibited by their class in Europe. After considering the efforts which are now being made in America by the State, and by individuals, to raise the status of alien labour to the levels of the past, he concluded that it was doubtful whether or not it is now rising or sinking in the social balance. Passing next to economic considerations, he stated what wages are now being paid to factory operatives in the States, their relation to the cost of subsistence, and to wages and cost of subsistence in this country, concluding that while an English mechanic might vastly better his social condition by residence in the States, he would probably find himself little richer, in money, after paying the enhanced prices for subsistence, and conforming to the higher standard of life prevalent in America. Finally, he attacked the doctrine that import duties influence wages, and showed that the movements of American and English wages during the last twenty-three years have been determined by some common cause which cannot possibly be due to the traiff, since this is operative in one of the two countries only.

BOSTON DOCKS—HYDRAULIC MACHINERY.

For description see page 63.)



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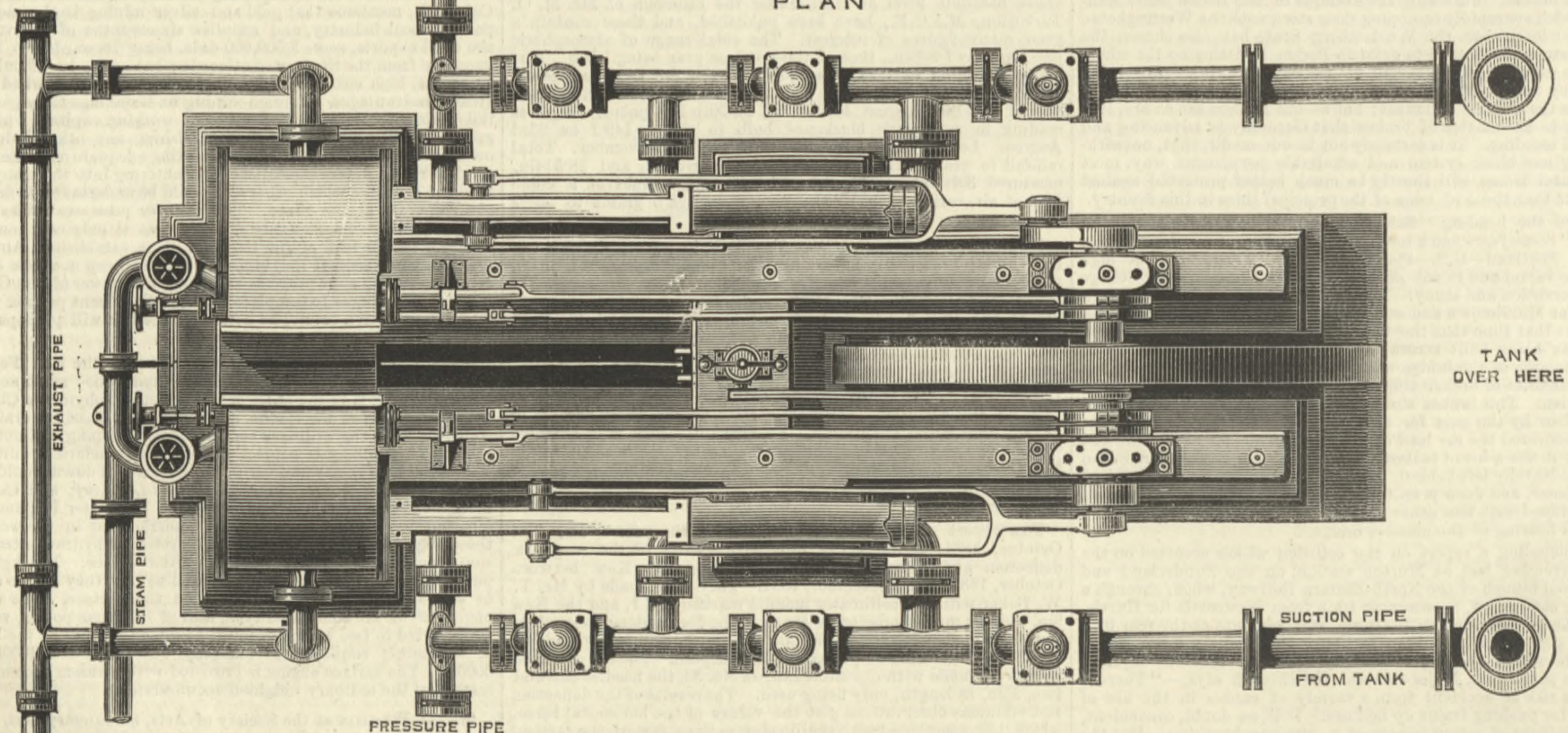
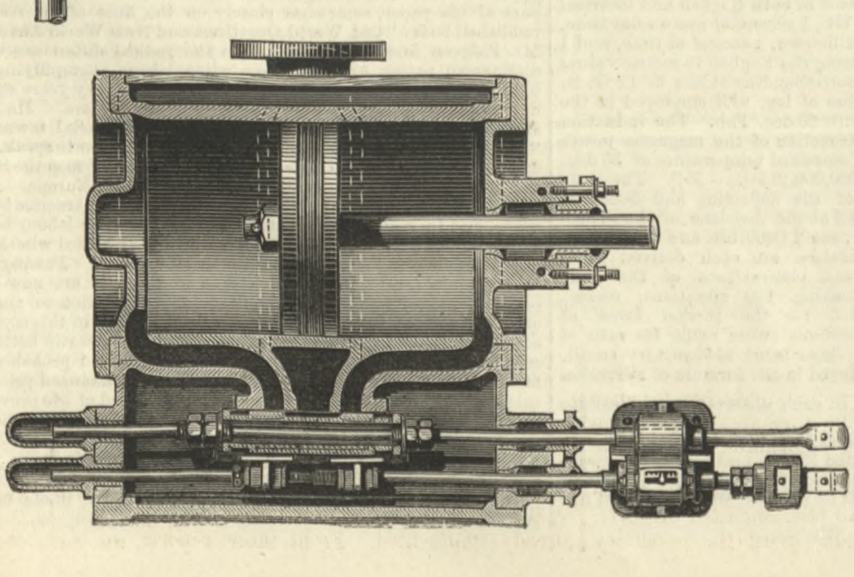
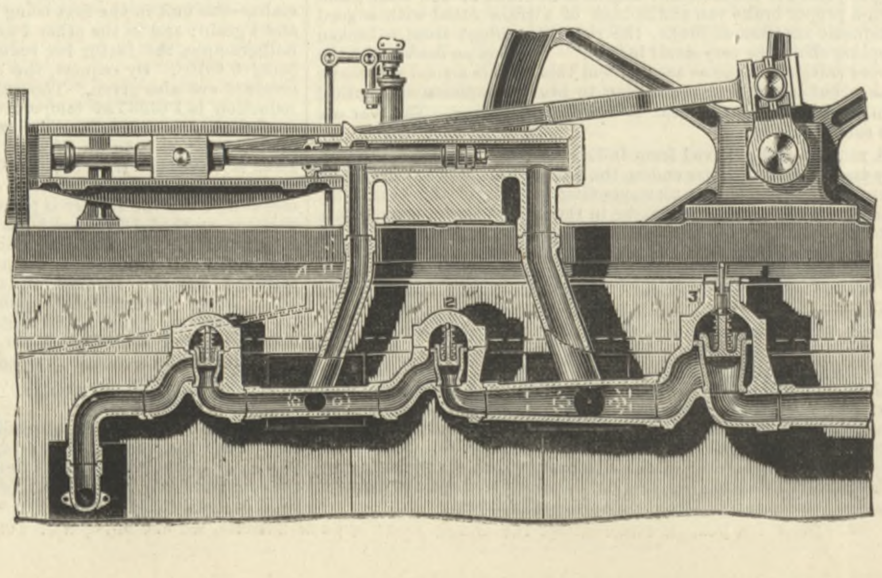






TO CORRESPONDENTS.

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

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

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

LLOYD'S WELDING PROCESS.—*A letter on this subject awaits the application of " J. B. G."*

G. T. B.—*We are not in possession of the name of the makers of the cane lubricators, and believe they are not made in England.*

WILLS.—*We published a working drawing of the Great Northern express ogie engine, to which you refer, on September 27th,* 1871. *It is long since out of print, but you can see a copy at our office if you wish.*

H. W. B.—*You will find engravings of a Great Eastern Railway express engine fitted with Joy's valve gear in* THE ENGINEER *for April 20th,* 1883, *and a full description of the Westinghouse brake in* THE ENGINEER *for July 25th,* 1879.

B.—(1) *The Patent Act extends the time for paying the £50 fee to any time within four years from the date of the patent, and it may be paid by instalments instead of a lump sum.* (2) *Yes.* (3) *We are not certain. We must wait till events develope themselves. It is too soon to decide.*

H. BALL.—*There is no book of the kind you require yet published on the gas engine. One is to be published in a short time. We believe your arrangement of pistons for the purpose stated is new. There will, however, be a great deal to do between the possession of this idea and working out all the details that follow.*

P. (Cork).—*The gas used in a Siemens furnace is totally different from illuminating gas. The latter is mainly a hydrocarbon—namely, a combination of hydrogen and carbon, and is a very complex compound of several gases. The former is a compound of oxygen and carbon, known as carbonic oxide* (CO). *When burning fuel is supplied with insufficient air one atom of carbon combines with one atom of oxygen. The gas so made is conveyed to a distance and supplied with more air, when the carbon takes up another atom of oxygen, becoming* CO_2, *intense heat being evolved at the same time. In producing coal gas air is carefully excluded, lest* CO *or* CO_2 *should be produced.*

WILSON'S PATENT PISTON RINGS.

(*To the Editor of The Engineer.*)

SIR,—I shall be very much obliged if any of your readers can inform me where to procure steel piston rings made according to Wilson's patent with a rebated joint. P. I.

January 19th.

EYELETS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me where I can get first-class eyelets in this country? I have tried many makers, and every eyelet I get here splits. I get some from Paris which do not, but give a very neat result, and I am led to believe that these are made in this country.

Whitechapel, January 21st. G. E. C.

GAS FURNACES AT THE FORTH BRIDGE.

(*To the Editor of The Engineer.*)

SIR,—We notice in your issue of the 16th inst. that you give, amongst other illustrations, a sketch of a gas furnace in use at the Forth Bridge works. The design of the furnace was kindly furnished to us by the late Sir W. Siemens in February-March, 1883, and is of a type for which, we believe, Messrs. Siemens hold the patents.

TANCRED, ARROL, AND CO.

2, Westminster-chambers, Victoria-street,
London, S.W., January 20th.

STEEL ROOFS.

(*To the Editor of The Engineer.*)

SIR,—We shall be glad if you will correct an error which appeared in your issue of yesterday. You state in your "Notes from Lancashire" that the Darlington Forge Company has introduced a novelty in the shape of steel roof-supporting beams, &c., for mining purposes. It is not the Darlington Forge Company, but the Darlington Steel and Iron Company, which has done so.

N. BUTCHART, Secretary,
The Darlington Steel and Iron Company.

Darlington, January 18th.

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 27th, at 8 p.m.: Ordinary meeting. Paper to be discussed, "A Comparison of British and Metric Measures for Engineering Purposes," by Mr. A. Hamilton-Smythe, B.A., M. Inst. C.E. Paper to be read, time permitting, "The Design and Construction of Steam Boilers," by Mr. David Salmond Smart. Friday, Jan. 30th, at 7.30 p.m.: Students' meeting. Paper to be read and discussed, "The Iron Bridges on the Hull, Barnsley, and West Riding Junction Railway," by Mr. F. W. Stokes, Stud. Inst. C.E. Mr. B. Baker, Member of Council, in the chair.

INSTITUTION OF MECHANICAL ENGINEERS.—Thursday, Jan. 29th, and Friday, Jan. 30th, at 7.30 p.m. on each evening: The annual report of the Council will be presented to the meeting. The annual election of the president, vice-presidents, and members of Council, and the ordinary election of new members, associates, and graduates, will take place at the meeting. Notices have been given of motions to be proposed at the meeting for alterations in the bye-laws. The following reports and papers will be read and discussed as far as time will admit:—"Final Report on Experiments bearing upon the Question of the Condition in which Carbon Exists in Steel," by Sir Frederick Abel, C.B., D.C.L., F.R.S., Honorary Life Member. "Second Report of the Research Committee on Friction." "On Recent Improvements in Wood-cutting Machinery," by Mr. George Richards, of Manchester. "On the History of Paddle-wheel Steam Navigation," by Mr. Henry Sandham, of London. "Description of the Tower Spherical Engine," by Mr. R. Hammersley Heenan, of Manchester.

SOCIETY OF ARTS.—Monday, Jan. 26th, at 8 p.m.: Cantor Lectures. "Climate, and its Relation to Health," by Mr. G. V. Poore, M.D. Lecture III.—The chief sources of atmospheric impurities, both inorganic and organic—climatic diseases and climatic health resorts. Tuesday, Jan. 27th, at 8 p.m.: Foreign and Colonial Section. "With the British Association to the Canadian North-West," by Mr. Stephen Bourne, of the Statistical Department of H.M. Customs. General Sir John Henry Lefroy, K.C M.G., C.B., F.R.S., will preside. Wednesday, Jan. 28th, at 8 p.m.: Eighth ordinary meeting. "The Influence of Civilisation upon Eyesight," by Mr. R. Brudenell Carter, F.R.C.S. Mr. R. J. Mann, M.D., F.R.C.S., will preside. Thursday, Jan 29th, at 8 p.m.: Howard Lectures. "The Conversion of Heat into Useful Work," by Mr. W. Anderson, M. Inst. C.E. Lecture V.—The discharge of artillery—work done on the projectile, and on the gun and carriage—limits of efficiency—gas engines—nature of their action—mechanical details—limits of efficiency—results actually obtained.

THE ENGINEER.

JANUARY 23, 1885.

RAILWAY RATES.

A SHORT time back we commented upon the charges made by railway companies for the conveyance of goods over their lines. For some time these charges have caused much discontent in trading circles, but business men have confined their discontent to words. More than words, however, now become necessary, because so far from lowering their goods rates, the railway companies are bringing no less than nine bills before Parliament, which, if allowed to become law, will endow the great carrying companies with powers to levy increased rates from those using their lines. That these bills will meet vigorous opposition may be taken as a matter of course, as for example the recent meeting held at the City Terminus Hotel, Cannon-street, London, the object of the meeting being "to consider what course of action should be adopted in consequence of the notice given by the leading railway companies of Private Bills to alter their maximum rates." Representatives from the Chamber of Commerce and of Agriculture, as well as from other trade societies, attended. Action has been speedily taken. The Derby Chamber asks for a Special Commission, representative of the principal commercial and agricultural interests of the country, to be nominated by the Board of Trade, to whom the proposals of the railway companies should be submitted. The Hull, Wolverhampton, and Cleckheaton Chambers content themselves with asking the executive of the association to oppose the Bills generally. The Worcester Chamber advocates an Act of Parliament providing for the compulsory purchase by adjoining canal companies of canals controlled by railway companies; the fixing of through rates for goods carried over canals, the canal companies to borrow money to widen their locks so as to enable them to receive barges capable of navigating the Thames, Mersey, or Severn; and lastly, that public trusts be formed for the acquisition and working of waterways. The next meeting will take place at the Westminster Palace Hotel on the 24th, 25th, and 26th of February. It is a noticeable coincidence that just about this time a paper, by Mr. John C. Smith, having the title "The Practicability of Reducing Railway Rates in Ireland," has been read before and discussed by the Institute of Civil Engineers of that country. All who seek improvement in railway rates—or, to put the matter in another way, who seek a reduction in the cost of transport by rail—are met by the argument that railway companies are private traders, and being such, ought to enjoy the same privileges as any other private traders, this meaning that the various carrying companies have a right to charge what they like. From this view we beg leave to dissent. No other trading bodies enjoy the same privileges as those already conferred upon these companies. They got compulsory powers to acquire land; their lines are essential to the trade, health, and recreation of the entire nation; the growth of the railway system, while it increased, probably a thousand-fold, the necessities to travel and to move merchandise, at the same time destroyed virtually all other methods of movement over distances of any magnitude. In a word, railways are now as much a necessity of existence as the air we breathe. Capital invested in a concern that every one must deal with, and whose stock-in-trade is to a large extent of a permanent and immovable nature, is well invested. Consequently the conditions under which railway companies carry on their business differ materially from those influencing all other trading bodies; and therefore, because railways are a national necessity, it follows that the voice of the nation has a right to be heard in any question of railways and the charges made by their controllers. We do not yet know what are the grounds upon which the railway companies are seeking from Parliament power to increase their present rates. They may put forward the blunt statement, "We want to make more money if we can;" or they may say, "Under existing Acts, we as trading bodies are at a disadvantage as compared with other trades;" or they may say, "Our lines being at present glutted with traffic, we want to reduce that glut by an increased tariff, in the same way that a bank might reduce the draw on its gold reserve by raising its interest rate."

With the first of these reasons we have nothing to do. Public opinion may well be left to deal with it. With regard to the second we can only refer our readers to what we have said above as regards the great privileges already possessed by the carrying companies. As to the third reason—over pressure of traffic—the remedy is in the hands of railway men themselves. Let them extend the work of enlarging their lines in all the congested districts. Parliament, we are sure, will readily grant the necessary power; and in the present dearth of good investments, railway companies will experience no difficulty in obtaining capital should they require it. It must be said that even if the railway companies possess, or think they possess, the most convincing arguments for seeking powers to increase their rates, they have selected a very unfavourable time for the experiment. On all hands trade is depressed to an exceptional degree. In some branches the depression is almost without precedent—the shipping or water-carrying industry, for example—and yet though goods can be conveyed over the Atlantic at less cost than from Birkenhead, say, to Leeds, the docks are packed with idle steamers; still, in face of this state of things, railway companies, who, be it observed, have made no reduction in their rates though steel rails are now cheaper than iron rails were a few years ago; though most of the articles used in railway work are obtainable at low prices, seek not to lower, but to increase their charges. We have already pointed out that inasmuch as the nation has cheerfully endowed these companies with great privileges, so ought it confine their powers to consult their own private interests, to the detriment of the other trading interests of the country. Those privileged have their responsibilities as well as their rights. Besides this, railway history shows that a liberal policy has almost always, if not, indeed, invariably, been the most beneficial policy for shareholders. For although railway trading differs from others in some respects, yet in several it is subject to the same financial laws; thus, as we indicated in a recent article, modern keenness of competition has so reduced profits that contractors have to reckon well how much they will have to pay for the transport of their stuff, tools, and men, before venturing to tender for an advertised contract; and this item alone may largely influence the placing of contracts; and where a contractor would have tendered and got the work if transport charges did not exceed a certain figure, the railway would have earned money, and a consequent benefit would have accrued, at all events, to it.

It is not alone in rates in the abstract that the grievance of the various trades lies, but also in their inequality, want of intelligible codification, and sundry anomalies. As an example of this we cite an instance given by Mr. W. G. Strype, at the discussion in Dublin on Mr. Smith's paper, already referred to. "I have found," said he, "on one occasion, the cheapest way to send a quantity of heavy goods to Sligo was to ship them from Dublin to Liverpool, and there re-ship them direct to Sligo." "Another curious case," said the same speaker, "occurred upon the railway itself. I can send goods cheaper to St. Johnston—a station this side of Londonderry—by booking it through to Londonderry, and then sending it back to St. Johnston, than I can by sending it to that station direct, although the goods pass through it going to Londonderry in the first instance." We have it on good authority that if a steam engine—say an 8-horse power horizontal—be sent put together, the railway rate is different to that charged for the same taken to pieces. A railway passenger can travel from Chester to Holyhead for four shillings less money by purchasing a ticket for the North Wall, Dublin, than by simply booking to Holyhead. So long as anomalies like these exist, the public opinion, rightly or wrongly, will judge that there is financial mismanagement somewhere in railway administration; and the tendency of popular belief is that companies having made extensions on speculations which have turned out losing transactions, charge the deficit on the more actively employed sections of their lines; a proceeding which the trading community may justly resent, as it virtually amounts to the companies making trade risks of their own, and saddling the resulting liabilities on their customers' shoulders. One of the speakers on Mr. Smith's paper dwelt with much pertinence upon examples of success attending reduced charges in other branches of business, as, for example, the penny postage and the purchase and working under reduced charges of the telegraphs; and he also referred to the opinions held by capable railway men that moderate rates paid shareholders best. Thus the Commissioners in 1868, whose number included an eminent railway manager, an eminent engineer, and a representative of the Treasury, all held this view. The Board of Trade returns, too, for thirty years for passenger traffic, show that a decrease of average fares of 56 per cent. brought about an increase of passengers per mile of 175 per cent.

If we turn from railway to other forms of public transport, we see ocean steamers, street trams, and even omnibuses, all pursuing their business at reduced rates, and railway companies, in taking their present action, move in a direction the opposite of that being pursued by all kindred industries. One of the arguments brought forward against a reduction of existing railway charges is that, even admitting that a remunerative increase of traffic would ensue, it would not do so sufficiently soon to prevent a temporary loss, and therefore ought not to be initiated. This, however, is a very narrow and short-sighted policy. It has been suggested that a subsidy from Government might be made to overcome this difficulty; but such a suggestion is altogether unreasonable. There is no more reason for paying a railway company to adopt a policy that in the end will benefit itself, than there is for paying any other company or individual getting a living by serving the public. By over-charging their customers, railway companies run the risk of making the coasting trade by sea a formidable competitor, when inland towns will suffer. The driving of the rail trade to the coast may be cited as an example. But much capital is at present idle. Steamers of all classes are to be had almost for the asking; and very little might suffice to divert a wide margin of coast-line transport work from the rail to the steamship.

THE BOARD OF TRADE ON BOILER EXPLOSIONS.

WE have before us Mr. Thomas Gray's "Report to the President of the Board of Trade upon the Working of the Boiler Explosions Act, 1882." This is in continuation of the report dated October 17th, 1883, on which we have already commented. From these reports we learn that during the twelve months ending the 30th of June, 1884, eighteen persons were killed and sixty-two injured by explosions coming under the Act of Parliament; and particulars are thus classified by Mr. Gray. Deterioration and corrosion are accountable for sixteen cases, the death of one person and the injury of twenty-six. Defective design or construction caused six failures, the loss of four lives and the injury of eleven persons. Over pressure burst four boilers, killed two people and injured six. Shortness of water is accountable for three explosions, one death, and four individuals injured. Ignorance or neglect of attendants caused the explosion of three boilers, six persons being killed and seven injured, while to miscellaneous causes are assigned eight explosions, resulting in four deaths and injuries to eight persons. We have pointed out ere now that to the officers of the Board of Trade anything is an "explosion." Thus, for example, the feed-pipe of a traction engine was carried away by the breaking of some part of the machinery; no one was hurt. The event is classed as a "boiler explosion." Again, the cover of the delivery valve box of a feed pump blew off, because the men in charge began to unscrew the nuts, the feed pump failing to act; one man was killed, the other injured. This also is classed as an "explosion." A rectangular oil tank was blown up by the ignition of vapour from hot pitch, and two men were injured. This is called a boiler explosion.

Mr. Gray writes: "As the explosions can be attributed to neglect or ignorance on the part of the boiler attendants in three cases only, or in four at most, there is still no reason for assuming that any material diminution in the number of explosions may be expected to result from the systematic examination of, and granting certificates to, the men employed in working the boilers. The prevailing cause of explosion continues to be the unsafe condition of the boilers through age, corrosion, wasting, &c.; and a noticeable feature in many cases is the absence of any effort on the part of the steam user to ascertain the condition of the boiler, and consequently of any attempt on his part to repair, renew, or replace defective plates or fittings."

We are disposed to agree with Mr. Gray so far as to say that the mere passing of an examination will not make a competent fireman. Yet we think that if it could be shown that even three explosions per year could be prevented by employing better men than those now engaged, it would be worth while to take so simple a precaution. In the three cases cited by Mr. Gray no fewer than six persons were killed and seven injured. Thus the deaths resulting from incompetence amounted to one-third of the total. The cases are officially numbered 69, 78, and 80. On examination of these it turns out that only one of them was a boiler explosion properly so called. A little old wagon boiler, used to drive a chaff-cutter, burst because the man in charge screwed down the safety valve too tight. We are in doubt if this can be called evidence of ignorance or neglect, for the probability is that the wretched little boiler was quite unsafe at any pressure. Nos. 69 and 78 were so-called explosions of boiling vessels. The first occurred in a paper mill at Godalming, when a cast iron cylinder rag boiler was blown to bits, the pipe leading to the safety valve having been plugged up with straw. Case 78 was nearly similar. The manhole of a rag boiler was blown off while there was a pressure of about 15 lb. per square inch in it, as a result of the man in charge slacking some of the bolts holding the door in place. Mr. Gray's argument is stronger than he has made it, because as a matter of fact, he has not seen fit to attribute any true boiler explosion to neglect on the part of an attendant.

Mr. Gray cannot resist the temptation to attack the boiler insurance companies. Even Lloyd's is not permitted to escape: "Inspection by insurers of boilers does not insure safety, for we find that in seven cases the boilers were under the inspection of insurance companies. It is, however, but fair to add that in one of these cases—No. 78—the explosion was caused by the negligence of the attendant, while in another case—No. 68—it was due partly to this cause and partly to a defective fusible plug. In two others—Nos. 58 and 79—the company had previously pointed out the defects. There were also four explosions on board vessels classed by Lloyd's or the Liverpool Register; but in one of these cases—No. 56—the boiler was not defective." The cases named are Nos. 56, 58, 60, 68, 78, 79, and 83. Eliminating those named above by Mr. Gray, we have Nos. 56, 60, and 83 as examples of the inefficiency of inspection by insurance companies. Turning to Mr. Gray's table of particulars, we find that No. 56 was the collapse of the flue of a Lancashire boiler owing to shortness of water. One man was injured; no one was killed. The explosion took place at night, when the premises were in charge of a watchman, and the fires were banked. We really fail altogether to see why this should be cited as an example of the inutility of insurance. It seems to us that the National Boiler Insurance Company, on whose books the boiler stood, is entirely free from any trace of responsibility in this matter. In case 60 the boiler was of the Lancashire type. It was six years old. It was inspected and insured by the Boiler Insurance and Steam Power Company, Manchester. The rear end being rent open, Mr. Gray's comment is "weakness of the longitudinal joint, at which primary fracture occurred. There was a flaw at this point caused by the use of the punch while the boiler was under construction." Here again it is difficult to see how anything unfavourable to the company can be deduced. The congenital defect was in all likelihood quite beyond the ken of any inspector. Lastly, we come to No. 83. This can hardly be called a boiler explosion at all. The lid of a boiling kier was blown off, because the thread was worn off the bolts holding the lid on. This again is no evidence of want of efficiency on the part of the Boiler Insurance and Steam Power Company.

We do not suppose that Mr. Gray really intends to deprecate the insurance of boilers; but he has so unfortunately worded his report that it would appear that he does. We fancy that his intention has been to show that insurance, with its attendant inspection, will not do everything; and that steam users and boiler owners and attendants must not imagine that because a boiler is insured they are clear of all responsibility. At all times boilers should be worked with vigilance and forethought. But it is quite beyond question that competent inspection is the most valuable safeguard that it is possible to employ. "It is still true," says Mr. Gray, "that the words 'inevitable accident' and 'accident' are wholly inapplicable to these explosions; and in many cases it is difficult to understand how an explosion could have been so long deferred." We may add, that ignorance is above and beyond all other causes the most prolific of disaster; ignorance, namely, of the condition in which a boiler is. If only steam users could tell from day to day in precisely what states their boilers were, we should hardly ever hear of a disastrous explosion; but incredulity and ignorance go hand in hand, and so we read year after year of catastrophes which have no possible reason for their existence save the absence of frequent and thorough inspection, and want of honourable purpose on the part of a few men who have not yet learned that it is possible to be penny-wise and pound-foolish.

THE STEAMSHIP TRADE.

THE check to shipbuilding has not only arrested the growth of the steam shipping industry in the United Kingdom, but now there has commenced a retrogression that will in time very greatly affect the freight market. The report of the Registrar-General shows that in the month of December there was a fall in the tonnage of the steam shipping of the United Kingdom, the first of moment for many months. There were added to the register twenty-four steamships built of iron or steel and one built of wood, the net register tonnage of the twenty-five being 12,452. But in the return a large number of hoppers are included, and also some vessels of tonnage such as forty-two and eighty-six, which can scarcely be classed as steamships, though steam being their propelling power they are so entered. On the other hand, there were twenty-three iron steamers whose registers were closed by the vessels being lost, sold, stranded, &c. The tonnage of these was 16,872. There were also three wooden steamers removed from the registry, and thus twenty-six steam vessels were taken off, the total net tonnage being 16,989 tons. These were mostly vessels of the ordinary sea-going type, and thus it is clear that both in the number and the tonnage of the steamships owned in the United Kingdom there was last month a decrease. The extent of the decrease was 4508 tons—an amount that is very considerable for one month, more especially when it is probable that in the next few months there will be a further fall in the tonnage. Gradually the freight market must feel the relief that will thus accrue, and a more healthy condition will be the result. It remains to be seen whether the orders that have been of late given out for steamers will in the course of a few months, when these are built and added to the register, check that decrease; but the fact that there has now set in a fall in the tonnage must have its effect on the freight market, and should also cause a few additional orders to be given out for vessels. But the state of the freight market is such that it will probably be years before there is that great activity that was known in the shipbuilding yards of the kingdom twelve months ago.

MINES' DRAINAGE IN SOUTH STAFFORDSHIRE.

AN announcement of great importance to the colliery and iron interests in the Birmingham district was recently made at a monthly meeting of the Mines' Drainage Commissioners in Wolverhampton. The chairman—Mr. Walter Williams—claimed that the underground engineering of the Commission was now in so complete a state, that it had been demonstrated "once and for ever" that the Tipton district was safe, and that soon the Bilston district also would be free from any fear of an inflow of water which would overpower the miners. The former district is that in which most of the coal for iron-making is now being mined. Steadily, seams for some time wholly beyond reach through the underground flooding, are being uncovered, and so made workable. In the Bilston district hardly any coal is being got, so extensively are the pits drowned out. Such are now, however, the pumping appliances of the Commission, that not long hence quite a new feature of activity will be given to many hundreds of acres on whose surface there is now an appearance of blank desolation. This success in mines' drainage engineering is leading in another direction to a state of things the very opposite of satisfactory to the traders. Hitherto the Commissioners have been supplying the local canal gratuitously with much of the water which they have pumped up from the mines. The quantity is now so great that they seek to be reimbursed for it. The canal company decline to recognise the new order of things. In the expectation of bringing the canal company to terms, the Commissioners are sending the water down their surface courses to the sea, and the canal company is so short of water that it prohibits certain of its locks being opened for a boat unless there is one also approaching from the opposite direction. Of this the result is that some short journeys from the sources of mineral supply in the Wolverhampton district to the consuming blast furnaces take twenty-four instead of twelve hours, and that over thirty mineral-laden canal boats were recently detained at one lock waiting their turn to get through. Complaints about this, we see by our report, were rife on that day at the quarterly meeting of ironmasters.

THE CANNOCK AND HUNTINGTON SINKINGS.

THE shareholders of the Cannock and Huntington Colliery Company are called to an extraordinary meeting to determine upon the voluntary winding-up of that concern. The company was started with a capital of £100,000 to sink for coal on the estate of Lord Hatherton, between the acknowledged Cannock Chase section of the coalfield of South Staffordshire and the nearest edge of the North Staffordshire coalfield. Borings had shown that the coal existed beneath a bed of shifting pebbles profusely charged with water. As the engineers deemed the ordinary methods of sinking practised in the district would be of but little avail through these pebbles, they determined, after visiting Belgium, to place the sinking in the hands of M. Chaudron. Two shafts were sunk, and after much difficulty were lined with the sections of iron tubbing necessary under M. Chaudron's process. Whether or not the engineers correctly calculated the depth of the water-bearing strata to the bottom of which they specified that the tubbing should be sunk, is not quite clear. Certain, however, it is that when both shafts had been lined to the depth intended, the water and pebbles came in from below in so disastrous a fashion, that the capital having by this time been pretty much exhausted, the work had to be abandoned. Attempts to raise further capital have not been successful. The colliery plant has been sold to realise certain of Lord Hatherton's claims, with the result that a balance still remains due to his lordship; and the directors in their report to the shareholders explain that "any small sums which might remain after the affairs of the company are wound up would be payable to him with other creditors of the company, thus preventing any repayment of capital, however trifling, to shareholders by the liquidator."

LITERATURE.

Geology of Weymouth, Portland, and the Coast of Dorsetshire, from Swanage to Bridport-on-the-Sea; with Natural History and Archæological Notes. By ROBERT DAMON, F.G.S. New and enlarged edition. Weymouth: R. F. Damon. London: Edward Stanford, Charing-cross. 1884.

MR. DAMON'S choice little volume is entertaining as well as scientific, and by means of elementary and explanatory notes is made especially instructive for those whose knowledge of geology is not of an advanced character. The illustrations are good, and a coloured map aids the text. Altogether the book is an excellent work of its kind—a result which might be expected from the nature of the assistance which the author has received in its preparation, his acknowledgments of personal help being made to Mr. Henry W. Bristow, Senior Director of the Geological Survey of Great Britain; Mr. W. Topley, Mr. Etheridge, and others. In his introductory chapter we meet with references to the denuding action of the sea along the coast-line—a subject deserving of more attention than it commonly receives. To this natural operation, during geologic periods, we owe many a pleasant nook and picturesque bay along the coast-line. Mr. Damon points out how different formations have yielded unequally, giving to the shore its uneven outline, forming curves, bays, natural arches, caverns, peaks, and insulated portions. Hence the various "coves"—Durdle, Lulworth, and others. Where the south-west frontier of the chalk first rose out of the sea cannot be determined, but it must have been considerably in advance of its present line. From Portland to the Land's End, where harder rocks prevail, the coast is more linear; but where the softer formations come in, the coast line recedes. Out of this purely mechanical operation has mainly arisen that varied scenery which gives such a charm to much of the southern shore of England. Where art and industry step in, there is danger lest the beauty of the landscape or the seashore should be impaired. The upper beds of the Coral Rag in the vicinity of Abbotsbury consist of sand, cementing together oolitic grains of hydrous oxide of iron, in such quantities as to form a rich ore, pronounced on good authority to contain 46 per cent. of metallic iron. Mr. Bristow reckons the thickness of these iron beds as not less than 30ft. or 40ft. We are told that former Earls of Ilchester were conscious of the value of this formation at Abbotsbury, but some of them rather regretted its existence, fearing it might give encouragement to projects that would destroy the natural scenery and wild solitude of that part of their estate. But Mr. Damon considers it inevitable that those beds will be turned to account at some period, either by the erection of furnaces on the spot, or, more probably, by the conveyance of the raw material to existing furnaces elsewhere.

If iron ore is to be feared as threatening the integrity of the picturesque, the discovery of coal would be still worse. The Wealden boring has found nothing more ominous than gypsum; but while the true carboniferous strata have evaded discovery in that part of our island, the bituminous and inflammable nature of a portion of the Kimeridge Clay affords an approximation to the genuine article. When coals bore a high price, the Kimeridge stratum was worked in Dorset, the product fetching 9s. a ton. The sea-waves throwing up their spray on the bituminous schist on the face of the cliff in Ringstead Bay, excited spontaneous combustion in 1826, and the phenomenon continued for some years. The inflammable shale of the Kimeridge clay is said to be not unlike the bitumen of the Dead Sea, and the smoke from it resembles that of the latter in its odour. A suggestion is made that the Kimeridge shale could possibly be so treated as to yield a permanent supply of gas for the lighting of Weymouth. A quantity of sulphur would have to be eliminated, and probably some other impurities. There are two bituminous strata, and concerning these Mr. Bristow states, that each ton of the material will produce 11,300ft. of 20-candle gas; but he adds, "it has a most abominable odour." At the north end of the island of Portland are bands of bituminous shale rich in oil and other products, which a few years since were quarried for chemical treatment.

Concerning the stone quarries of Portland we have a quotation from a parliamentary report "with Reference to the Selection of Stone for Building the new Houses of Parliament." The actual selection is not thought to have been a very happy one; and the report itself specifies that Portland stone does not do well in the atmosphere of towns. Attention is called to the several frustra of columns and other blocks of stone which were quarried at the time of the erection of St. Paul's Cathedral, and were lying on the ground after the lapse of more than 180 years, wholly uninjured by atmospheric influences. In the pure air of the country the stone became covered with lichens, which afford protection, and beneath a covering of this kind the chisel-marks of the mason were detected sharp and clear on the old blocks at Portland, while the stone which went to form the fabric of the Cathedral was found in many parts to be mouldering away, especially where the aspect was south or south-west. But we believe vegetable growth has been discovered even on the exterior of St. Paul's, though in a very different form from the healthful and vigorous lichen. How best to protect the stonework of city structures is an interesting question. Szerelmy's process proved a failure, and most others; but the plan adopted with the Cleopatra obelisk is said to have been successful, as also in many instances elsewhere, and is the more to be approved as it makes no alteration in the natural appearance of the stone.

We might follow Mr. Damon into sundry interesting bye-paths, but we must refrain. The Chesil Bank affords a fine topic for speculation, and is duly considered by our author, who quotes a curious fact from Mr. Godwin-Austen:—"If two corks, one of which is weighted to sink to the bottom, be thrown into the sea, the floating piece keeps its distance from the shore, while the weighted one will be thrown upon the beach." The law of the shingle is worthy of careful study, and, for practical reasons, needs to be well understood. As for the mutations of land and sea, Mr. Damon says, "That Great Britain, geologically speaking, belongs to the Continent, is placed beyond all reasonable doubt." There is a political analogy, connected with the Channel Tunnel, which may here suggest itself to the reader. But the engineer cares a little for politics, and we do not consider it a desirable thing to connect by a tunnel in the chalk the lands that are severed by the sea.

The Practice of Ore Dressing in Europe. By WHEATON B. KUNHARDT. 8vo., pp. 110. New York: Wiley and Sons; London: Trübner and Co. 1884.

THIS is a reprint of a series of articles that have appeared in the "School of Mines Quarterly Journal" of New York, founded upon observations taken by the author during a visit to the principal mining centres in Europe, for the purpose of comparing their several methods of dressing ores. The great development of mechanical appliances in this particular branch of mineral technology during the past twenty years has to a great extent rendered the earlier literature of the subject obsolete, and as that of more recent dates is for the most part scattered through the technical journals of different countries, a compendium such as the author of the present volume has provided will be welcomed by many readers. As may be imagined from the small compass of the work, it does not go into detailed or systematic descriptions of schemes of ore dressing as carried out in particular localities, but the remarks are of a general nature, with critical discussions of debateable matters, such as the comparative values of vibrating riddles and drum sieves in sizing, and of frames and jigging hutches in slime dressing. No very decided opinions are expressed in either case, but the reasons governing the selection in different works are given with sufficient detail. The author is strongly opposed to the practice of hand spalling, considering it to be painfully primitive, and to retard, or even prevent, a healthy physical development of the youth of the mining population, a statement that will surprise most persons who are familiar with the habits of these same youthful population when off work. We should be rather inclined to think that in the modern striving for a large output, preliminary relation is too often neglected, and large quantities of sterile or very poor ore materials are ground up and passed through the dressing machinery which might with advantage have been sent to the waste tip instead of manufacturing it into mud and fouling watercourses with it. The general utility of the work could have been increased by a more liberal use of illustrations; but their place is to some extent supplied by the very full references to published accounts of the different machines given at the foot of each page. Taken as a whole, the volume is a very favourable specimen of technical school literature, and gives good evidence of the sound system of training adopted at Columbia College School of Mines.

The Assay and Analyses of Iron and Steel. By THOMAS BAYLEY. 8vo., pp. 91. London: Spon. 1884.

THIS is a reprint of a series of articles which have appeared in the *Mechanical World*, with some additions for the sake of completeness. It contains within a very small compass details of the various methods pursued in the systematic examination of iron and steel ore slag, and fuel, both solid and gaseous; in fact, of everything used likely to require analysis in ironworks, except fluxes, an omission which strikes us as rather odd. The author has adopted an excellent plan in his descriptions, giving those that are in most general use in large type, while modifications which are new or less known are printed in smaller type. Unfortunately the value of this arrangement is lessened by the omission of almost all references to the original descriptions. Taken as a whole, the work is likely to be useful to students, although the author has put in an unnecessary puzzle in the shape of Mr. F. W. Clarke's table of the atomic weights, "because no book in practical chemistry is complete without such a table." From this we gather that the atomic weight of iron is $55{\cdot}913 \pm 0{\cdot}012$ when $H = 1$, or $56{\cdot}042$ when $O = 16$. At the same time we are told that for ordinary purposes it is unnecessary to use more than the nearest first decimal place, in which case the superfluous decimals and probable errors are only a nuisance. The chief novelty in the book is the description of a combined hot water oven and still for providing distilled water, which seems to be well suited to the requirements of small laboratories.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—At an ordinary meeting of this Society, on the 14th inst., a paper on the "Appropriate Ornamentation of Works in Iron," was read by Mr. G. Richards Julian, A.R.I.B.A. The author said that if this problem was to be solved at all, it must be done either by the united efforts of the engineer and the architect, or by the development of a new species of workers, who might be denominated artist-engineers. The application of artistic principles to the design of structural ironwork had been delayed by the very rapid spread of the use of metals; the designing had been done in a hurry, and all the real thought had been bestowed on the scientific side of the question. Directly engineering attempted to do anything more than erect structures of simple utility, directly a curve or a moulding was added for the purpose of pleasing the eye, it became amenable to the same artistic laws as architectural design. Mr. Julian then stated those artistic principles which appeared to apply especially to the subject; the avoidance of falsehood, either by direct imitation of other materials, or by imitation of forms of ornamentation appropriate to other materials or by the use of sham constructive features; the modes of expression of proportion, harmony, and contrast were described, and the value of refinement pointed out. These principles were then applied to the design of the coverings of concealed ironwork in fireproof buildings, and visible ironwork both wrought and cast. Attention was especially directed to the ornamental treatment of stancheons as opposed to columns and to the foliated ornament of early Greek and of Byzantine work, as possessing the characteristics of crispness and sharpness of outline which should accompany low relief.

PROSPECTIVE PRIVATE LEGISLATION.

IF the actual number of private schemes to be submitted to Parliament in any one Session were a gauge of the amount of work prepared for members of Parliament in committees, counsel, agents and others concerned in the various projects, members might contemplate their labours with equanimity springing from fore knowledge, counsel and agents could calculate their gains, and promoters their expenses. But this is unfortunately by no means the case, as all who have had experience of select committee work well know. With regard to the most ordinary Bills, a fair guess may be made as to what is involved; but the estimate is too often falsified to encourage predictions, while in respect to the more enterprising schemes, it is rash indeed to speculate with confidence. In such cases the parties are too well furnished with the sinews of war to consider anything but the ultimate result, and frequently fight to the last moment with a sublime indifference to cost. Of this no better or later instance can be given than the bold project for connecting Manchester with the sea by means of a canal from that city to the Mersey, and so away to the ocean. This, one of the most daring engineering and commercial enterprises of modern times, after a more or less vigorous agitation during several years, was presented to Parliament two Sessions ago, backed by enormous sums of money, and resisted by public bodies with almost unlimited means. Referred to a specially constituted Committee, the Bill was expected to engage the Committee perhaps three weeks, but in the end it lasted something like eight weeks—that is, thirty-nine actual sittings. Approved by the Commons, it passed to a Committee of Peers, and by them was rejected after an enquiry of ten days' duration. The measure again came up last session, in a somewhat modified form, and after an examination by a Commons Committee occupying very much the same time as the first enquiry, was thrown out. On each of these occasions the calculations as to time, work, and cost, fell far short of the reality, and we mention these facts merely to illustrate the "glorious uncertainty" of private bill legislation, as well as of the law. Among other examples of unexpected longevity and vitality in the last few years might be cited the scheme for carrying water from Thirlmere to Manchester, the Hull and Barnsley Railway and Docks Bill, the project for drawing water to Liverpool from Lake Vyrnwy, the Barry Docks Bill, and some others equally fresh in the memory of promoters and engineers. The Bills prepared for the resumed Session this year have been deposited for some time past, and the Examiners have commenced their sittings to consider how far the Standing Orders have been complied with. It may, therefore, be well now to glance at the prospects of the Session in regard to private measures. The total number of Bills presented is 248. That is forty-seven less than the total last year, but this difference gives no indication of what the relative amount of work will be, for the reasons already pointed out. This total of 248 embraces 119 Railway Bills, 29 Tramway and Subway Bills, 28 Water, Gas, and Lighting Bills; 28 Town Improvement, Market, &c., Bills; 18 Harbour and Dock Bills, 20 miscellaneous Bills, 5 Road and Bridge Bills, and 1 Canal Bill, the solitary one being the Manchester Ship Canal Bill. This classification for the most part indicates the nature of the schemes, but under "Miscellaneous" comes such measures as the Bill for Providing a Cathedral for Bishop Ryle at Liverpool; a Bill for forming an Albert Palace Association; a British Agricultural Association Bill; a measure promoted by the Canada North-West Land Company, which is assisting the Canadian Pacific Railway Company to populate millions of acres of unoccupied territory; a Manufacturers' and Millowners' Mutual Aid Association Bill; a Bill dealing with Ward's City of London School for Girls; and some other schemes, with singular titles and equally unusual objects. With these we have no concern, but they are interesting as showing the multifarious business of Members in the Committee Rooms of Parliament. As usual, railway Bills largely preponderate over all the rest, this year numbering very nearly one-half the whole. They cover proposals of every description, from important and extensive new works down to small junctions and mere extensions. But coming from the top to the bottom of the list, we may first briefly consider the Canal Bill in its new aspect.

The proposal last year was to construct an inland waterway of twenty-one miles length from Manchester to the Mersey, and to continue the canal by a low-water channel formed by training walls to a point ten miles further down the estuary of the Mersey. It was this latter part of the proposition that roused the strenuous opposition of the Mersey Dock Board and other authorities concerned in the navigation of the river, and upon their contention of serious injury to the whole of the river and the bar through the proposed estuary works, the scheme once more came to grief. But towards the end of the inquiry something like a compromise was arrived at between the contending parties, with a view to a subsequent Bill. An alternative to the estuary project was suggested and virtually agreed upon, and this has been embodied in the Bill brought forward by the Ship Canal Committee this year. Practically the canal proper part of the scheme remains as it was in the original designs of Mr. Abernethy and Mr. Leader Williams, the engineers of this great work. The essential change is with regard to the estuary, the works in which are completely altered in the new plans. Instead of training walls in the centre of the estuary, the canal, which was previously to have terminated at Runcorn, will be continued down the same side of the river until it reaches deep water several miles below Runcorn Bridge. In reaching this point it will keep close to the Cheshire shores, and indeed for a part of the distance will cut through the land skirting the river. In this way it will avoid the centre of the estuary, where it is asserted the former plan would have wrought so much mischief to the whole river, and while thus escaping any such ill consequences, will provide sufficiently well the desired means by which ocean-going vessels may proceed direct to and from the docks at Manchester. We need not now discuss engineering aspects of this *viâ media* as compared with those of the original scheme; but, in brief, the work will be carried out in this way. Where the canal skirts the shore, the water will be kept in by an embankment faced with stone on either side, and inland the canal will be faced in like manner. The embankment is intended to be constructed several feet above high water of spring tides, in order to protect the water-way from storms and to make it always easy to navigate. Weirs will be constructed here and there to enable the tide to rise and fall in the canal at the same rate as in the estuary, and also to allow the water of the river Weaver—which the canal will cross—and other streams to flow into the estuary as they now do. Locks will be made in the embankments opposite the Runcorn and other docks along its course, so that vessels may pass freely into or out of the estuary, and the promoters further assert that the canal will be of great advantage by enabling vessels to reach the Upper Mersey ports at neap tides, instead of having to wait in the Lower Mersey for high water, as they are at present obliged to do. Finally, this canal will be thirty-five miles long, and will be buoyed and lighted, and so made navigable both night and day. The practicability and harmlessness of this new scheme will, of course, have to be demonstrated before the Committees of the two Houses, but upon that point the two engineers whom we have named, and many other eminent civil and marine engineers, entertain no doubt. If they satisfy the Committees in the same direction, it may with moderate safety be assumed that sometime during the coming session this gigantic and costly project will be sanctioned by Parliament.

There are a few other Bills affecting navigable rivers, but with these, as with the majority of the Bills, we shall deal when they reach the Committees. Incidentally, it is curious to note, in recollection of what took place a few sessions ago, that there is only one electric lighting Bill put forward, that one coming from Birmingham; but as it were in place of schemes of that order, there are some for promoting the subways which appear to be coming into favour. The mere names of these Bills will sufficiently describe their nature for the moment:—Clapham and City; Islington (Angel) and City; King's-cross, Charing-cross, and Waterloo; Marble Arch and City; Greenwich and Millwall; London Central; and Liverpool and Birkenhead.

There appears to be no one Railway Bill likely to arouse anything like general public interest, although there are some of a costly character. For example, a scheme is presented for establishing direct railway communication between Charing-cross and Euston, the line to begin by a junction with the South-Eastern system on the Surrey side of the Thames, thence crossing the river either by means of a new bridge or an addition to the present bridge, through Villiers-street—which will have to be closed as a thoroughfare—under Adelaide-street, and so up to Drummond-street and Euston station. In connection with this it is proposed to construct a subway under the Strand, and a new street to the Embankment in place of Villiers-street, and the cost of this extensive and by no means easy undertaking is estimated at about a million and a-half. Another instance is the proposal of the London and North-Western Railway Company, in their bulky "general powers" Bill, to take authority to increase their dock accommodation at Garston, on the upper shores of the Mersey, to an extent requiring the outlay of nearly half a million. The only other Railway Bill we will now refer to is that promoted for the purpose of connecting Felixstowe and Ipswich with the Midland Counties. To effect this fifty miles of rails must be laid down, as an estimated cost of rather over a million. These Bills are among the limited number of high-class measures, but speaking generally, the array of Private Bills this year is both less in numbers and less suggestive of excitement, or even vigour, than it has been for many years past.

GLASGOW ENGINEERS' ASSOCIATION.—The seventh meeting of this Association was held in their rooms, Bothwell-street, on Thursday, the 8th inst., Mr. Archibald A. Swan, B.Sc., C.E., in the chair. A paper upon rivetting machines, illustrated by about twenty diagrams of machines and examples of machine rivetting, was read by Mr. Alexander Jack. Beginning with the application of the principle of Bramah's press to rivetting machines by Mr. Charles May, in 1846, the author described the development of the rivetting machine down to the most improved pattern in modern use. Its invention, he stated, like that of many other labour-saving machines, was due to a strike of skilled workmen. Sir William Fairbairn, who invented the first rivetting machine, gives the following account of the circumstance: "In this dilemma I was driven to the necessity of supplying the place of rivetters by a passive and unerring workman, which from that day to this has never complained, and did as much work in one day as was formerly accomplished by twelve of our best rivetters and assistants in the same time." Commencing with power rivetters, mention was made of Nabholz's frictional rivetter, patented in 1880, which for small shops, where only one or two are required, the author regarded as one of the most economical, having an advantage over hydraulic machines, inasmuch as they required no elaborate arrangement of pumps and accumulators. Referring to pneumatic machines, the portable pneumatic rivetters patented by Mr. J. F. Allen, of New York, were considered. These machines, the author stated, held much the same position in America as the hydraulic machine does here, and this, he thought, was caused to some extent by the climate. The long and severe winter in most parts of America would be apt to cause trouble by freezing with a hydraulic machine. Mr. Allen's rivetters are better adapted to bridge and boiler than to shipbuilding work; due, doubtless, to the slow development of iron shipbuilding in America. Lastly, with regard to hydraulic rivetters, these machines patented by Messrs. McKay and McGeorge and Mr. Arrol were noticed, the latter of which are being used in the construction of the Forth and Tay bridges. Mr. Jack then proceeded to describe three machines invented by Mr. Ralph Tweddell—than whom no engineer has shown more ingenuity in adapting hydraulic machine-tools.

THE NEW CHEMISTRY.—At the Royal Institution of Great Britain, Albemarle-street, Piccadilly, W., a course of eleven lectures, on the New Chemistry, will be delivered by Professor Dewar, M.A., F.R.S., Fullerian Professor of Chemistry, R.I., Jacksonian Professor of Natural Experimental Philosophy, Cambridge, on the following days at three o'clock:—Lecture I, Thursday, January 15th, 1885; Lecture II, Thursday, January 22nd; Lecture III, Thursday, January 29th; Lecture IV, Thursday, February 5th; Lecture V, Thursday, February 12th; Lecture VI, Thursday, February 19th; Lecture VII, Thursday, February 26th; Lecture VIII, Thursday, March 5th; Lecture IX, Thursday, March 12th; Lecture X, Thursday, March 19th; Lecture XI, Thursday, March 26th. Subjects of the course:—Alchemists on Chemical Action; Doctrines of Black and Lavoisier; Essai de Statique Chemique, Berthollet; New Principles of Chemistry, Dalton; Laws of Gaseous Combination, Gay-Lussac; Hypothesis as to Nature of Gaseous State, Avogadro, Ampère; Isomorphism, Mitscherlich; Law of Dulong and Petit; Gaseous Laws, Work of Regnault; Laws of Diffusion, Graham; Thermal Effects of Fluids in Motion, Joule, Thomson; Continuity of the Liquid and Gaseous State of Matter, Andrews, Wander Waals; Dissociation, Deville; Relation between Temperature, Pressure, and Chemical Stability; Light and Chemical Actions; State of the Elements at the moment of Chemical Change, Brodie; Theory of Chemical Action, Williamson; Study of Chemical Affinity, Guldberg and Waage, Van 't Hoff; Electrical Theory and Chemical Affinity, Davy, Berzelius; Thermal Values of Chemical Reactions, Thomsen, Berthelot; Thermo-Dynamics and Chemical Action, Gibbs; Electrolytic Laws, Faraday; Motive Power of Heat, Carnot; Mechanical Equivalent of Heat, Joule; Heat of Electrolysis, Joule; Mechanical Theory of Electrolysis, Thomson; Researches in Electrolysis, Helmholtz; Radical Theory, Liebig; Organic Substitution, Dumas; Explanation of Etherification, Williamson; Work of Gerhardt and Laurent; Compound Ammonias, Wurtz, Hoffman; Organo-Metallic Bodies, Bunsen, Frankland; Organic Synthesis, Wöhler, Berthelot; Nature of Fermentation, Lavoisier, Liebig, Pasteur; Chemical Function of Carbon, Kekulé; Graphical Methods of denoting Chemical Structure, Kekulé; Valence or Atomicity, Wurtz, Frankland; Chemical and Physical Isomerism, Wöhler, Pasteur; Rotatory Polarisation, Biot; Hypothesis of Le Bel and Van 't Hoff; Hypothesis as to Constitution of Matter, Clausius, Maxwell; Vortex Motion, Helmholtz, Thomson; Classification of the Elements, Ampère, Dumas; Spectrum Investigations, Kirchoff, Bunsen; Periodic Law of the Atomic Weights of Elements, Newlands, Mendeljeff; Investigation of Atomic Weights, Berzelius, Stas; Hypothesis of Prout. Subscribers to Lectures, not being members, for this course pay one guinea.

LAUNCH ENGINE WITH BREMNER'S VALVE GEAR.

MESSRS. ROSS AND DUNCAN, GOVAN, ENGINEERS.

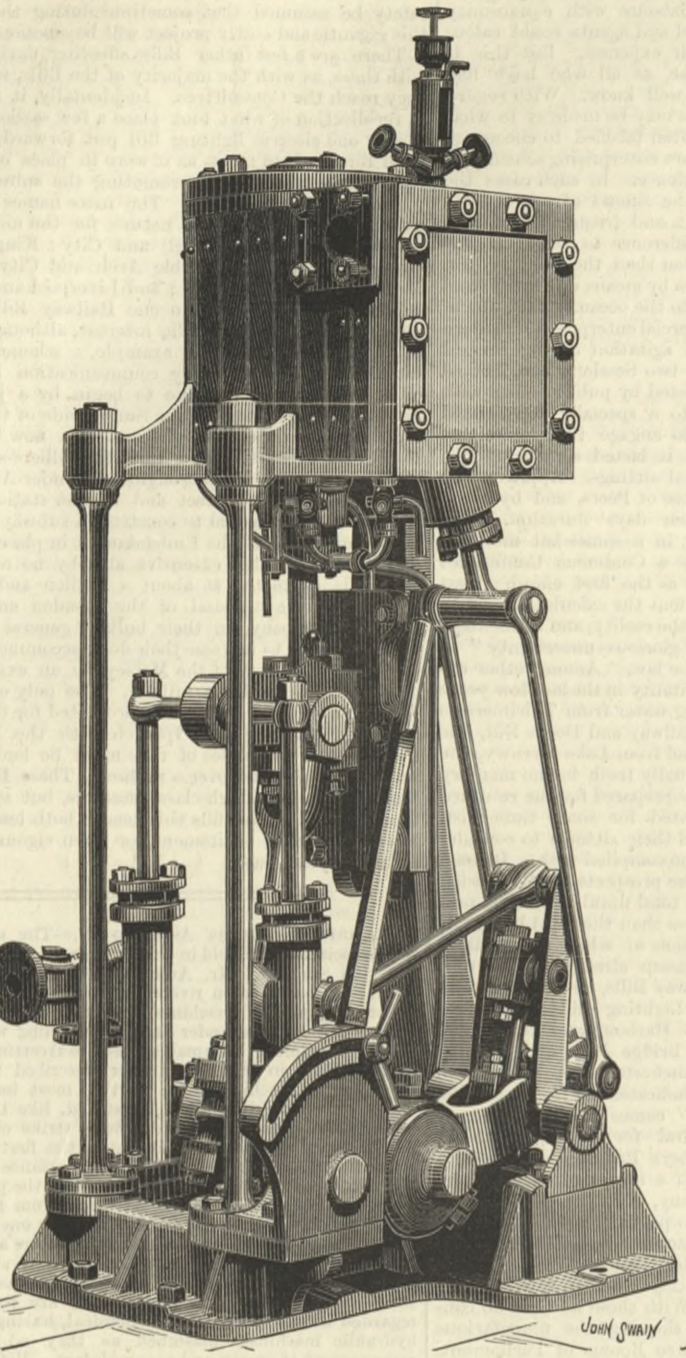
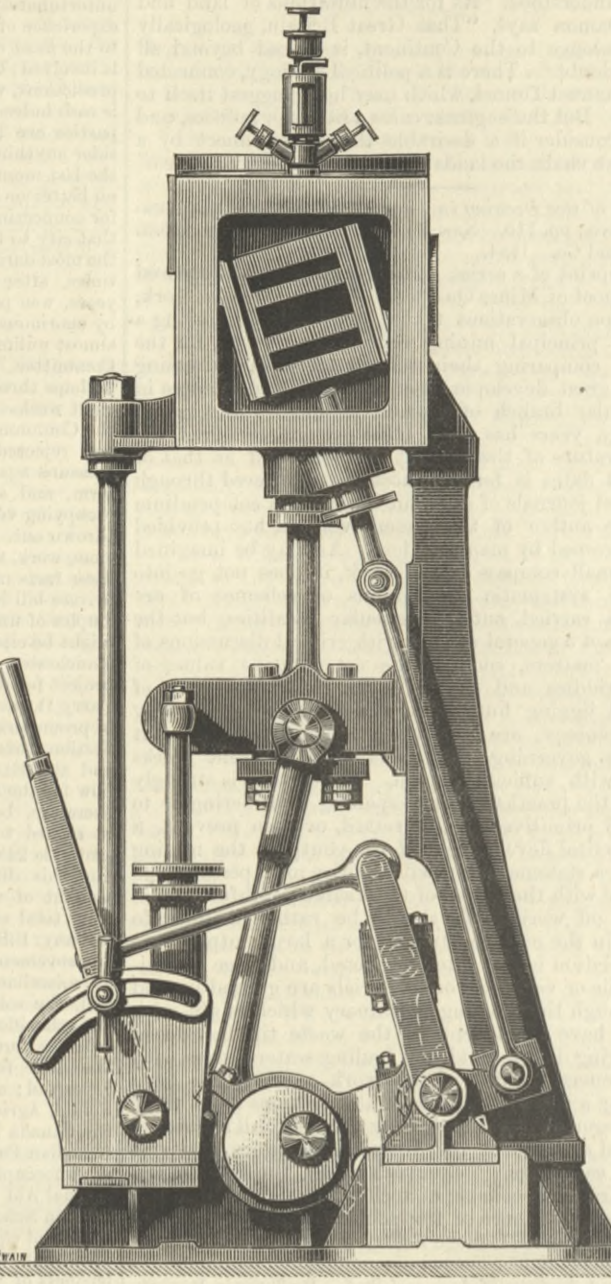
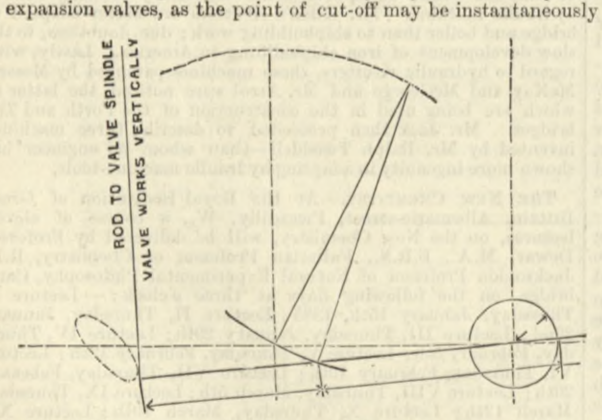


FIG. 2



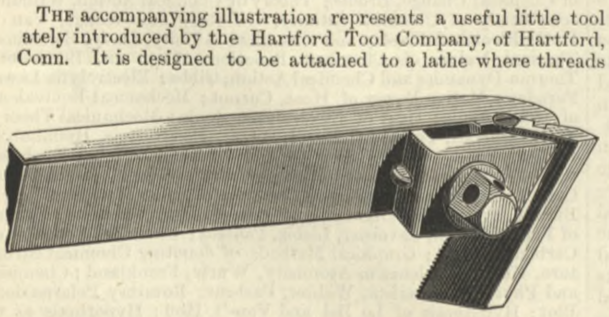
THE accompanying engravings illustrate a launch engine fitted with Bremner's patent valve gear, which, it will be seen, is of much the same type as Marshall's. The Bremner gear is a development of Klug's, well known on the Continent. It is claimed for the gear that it effectively dispenses with separate expansion valves, as the point of cut-off may be instantaneously



adjusted between the limits of ·25 and ·7 of the stroke, without affecting the distribution of the steam. The construction and mode of action of the gear are clearly shown, a swinging link, it will be seen, being employed to give the reversing action. The outline diagram will render further explanation unnecessary.

THE GARDNER AND WOODBRIDGE SCREW-CUTTING TOOL.

THE accompanying illustration represents a useful little tool ately introduced by the Hartford Tool Company, of Hartford, Conn. It is designed to be attached to a lathe where threads



have occasionally to be cut to the correct form. The cutter is supplied carefully milled to the exact shape of the thread required, Sellers, Whitworth, or V, and can be sharpened by grinding the top surface, without interfering with the form of the thread cut. The holder is also milled all over to exact shape and case hardened.

NICHOLSON'S PATENT COUPLING.

THE accompanying illustrations show a very ingenious coupling for tramways and railways invented and patented by Mr. Nicholson, engineer and manager of the South Staffordshire and Birmingham Steam Tramway Company, and manufactured by Messrs. Lee, Howl, Ward, and Co., of Tipton. The coupling

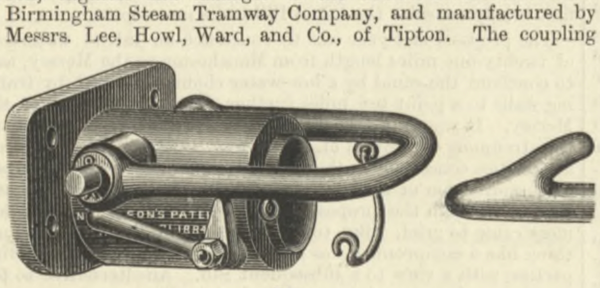


Fig.

consists of a cylindrical casting to which a strong drag-link is attached; within this casting is a buffer pressed outwards by a strong spring; the outer end of this buffer is concave and receives the rounded end of the drawbar. The drawbar is of the form shown in Fig. 1. To couple the engine to the car the drag-link is supported in a horizontal position on the pawl—Fig. 1—and the engine backed into the car; directly the drag-link touches the drawbar the pawl drops, and the drag-link rising over the hook falls on to the drawbar and is held by the

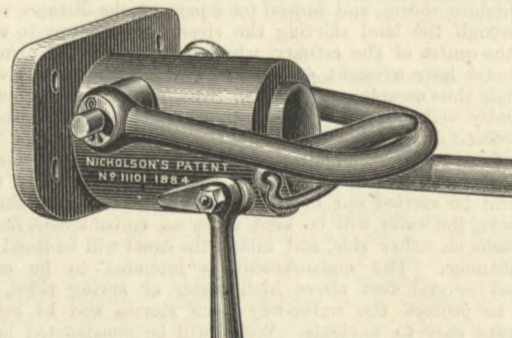
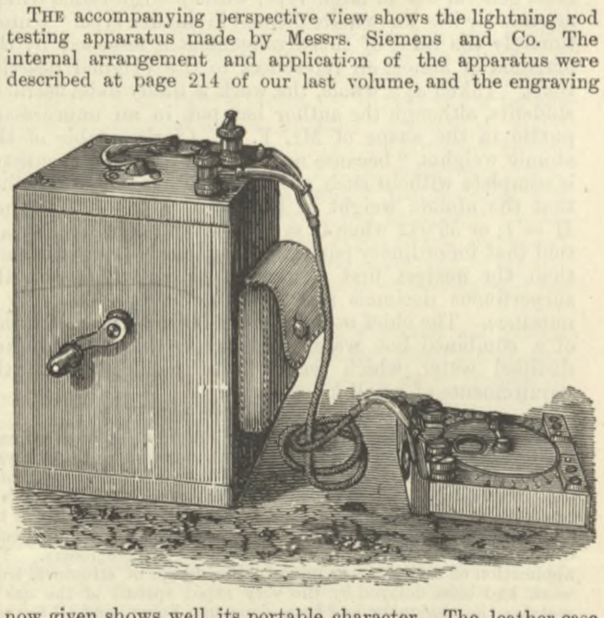


Fig. 2

hook. To uncouple the car brakes are put on hard, the engine backed, and the drag-link raised. To prevent the drag-link being accidentally lifted when the buffer is compressed a safety link passes under the drawbar and hooks into two eyes on the drag-link. The safety link is shown unhooked—Fig. 1—but is always kept hooked as—Fig. 2—when the car is coupled to the engine. The advantages claimed for this are that it is automatic in its action; the conductor has not to go between the engine and car to couple, and thus avoids the risk of being crushed; the coupling acts as a central buffer; the drawbar radiates freely; the coupling allows for any difference in height between the engine and car; the buffer always pressing against the end of the drawbar keeps the drag-link tight against the hook, all slack is taken up, and back-lash and jerking is prevented; it is perfectly secure when pushing or pulling, and it is simple, strong, and cannot get out of order.

SIEMENS' LIGHTNING ROD TESTING APPARATUS.

THE accompanying perspective view shows the lightning rod testing apparatus made by Messrs. Siemens and Co. The internal arrangement and application of the apparatus were described at page 214 of our last volume, and the engraving



now given shows well its portable character. The leather case at the side of the wood case carries the indicator when packed up. The great necessity for occasional testing of lightning conductors makes this portable apparatus a very desirable electrical acquisition.

BRIDGE OVER THE HOOGHLY.

WE commence this week the illustration of the new steel bridge to be erected over the Hooghly for the East Indian Railway. Further illustrations and descriptions will be given in a succeeding impression.

AT the works of M. Farcot is a 20-ton crane worked by means of dynamo-electric and electro-dynamic gear constructed by Messrs Sautter, Lemonnier, et Cie.

great transformation has been made in this entrance by the carrying out of judiciously planned works. By the construction of the two breakwaters, starting from the shore at a considerable distance apart, approaching each other as they extend seaward into deep water, the sand bar has ceased to exist, having been removed by the combined action of the induced scour and dredging; the breakwaters extending into deep water thus prevent the waves from lifting fresh sand, the waves losing their force after they enter on account of the widening out of the works, and at the same time the tidal scour has been greatly improved by reason of the large area enclosed by the breakwaters. The foreshore has only slightly advanced, and from the rapidly increasing depth seaward there is little danger of any serious trouble from this cause. The entrance to the Tees has undergone a somewhat different treatment, the river having been taken through the estuary between half-tidal groining walls, but these not having proved as successful as the Tyne works, it was decided to construct two breakwaters in some respects similar to those on the Tyne, one of which has been constructed and the other is in progress, the result so far being most satisfactory, for since the completion of the south breakwater, a considerable improvement has already taken place, the bar having been lowered several feet. The entrance to the Liffey, near Dublin, is one of the most interesting and instructive examples of the successful treatment of a difficult bar. The improvement works were commenced in the last century by the construction of the great south wall, extending seaward in almost a straight line with the river, crossing the low foreshore known as the South Bull Sand. The effect of this wall was to fix the direction of the channel. Several plans were suggested early in the present century for further improving the entrance, and if possible for the removal of the bar. Eventually it was decided to construct the great north wall, starting some distance up the coast and converging towards the end of the great south wall, thus enclosing a great tidal area for scouring purposes, at the same time forming with the south wall, a sort of nozzle, directing and concentrating the action of the tide on the bar, and likewise protecting the inside harbour from the waves. Although these works are placed at great disadvantage on account of the shallowness of the sea for some distance from the entrance, they have been designed so as to make the best possible use of the available scouring power, and their success is established by the fact that the bar has been lowered to the extent of 10ft. The following figures give a progressive account of the effect of these works since their completion:—1822—minimum depth on bar at low water, 6ft. 3in.; depth on bar at standard high water, 19ft. 3in. 1828—minimum depth on bar at low water, 9ft. 6in.; interval, 6 years; rate of increase of minimum depth per year, 6·50in.; increase of minimum depth, 3ft. 3in.; depth on bar at standard high water, 22ft. 6in. 1833—minimum depth on bar at low water, 10ft. 6in.; interval, 5 years; rate of increase of minimum depth per year, 2·40in.; increase of minimum depth, 1ft.; depth on bar at standard high water, 23ft. 6in. 1856—minimum depth on bar at low water, 13ft.; interval, 23 years; rate of increase of minimum depth per year, 1·82in.; increase of minimum depth, 3ft. 6in.; depth on bar at standard high-water, 26ft. 1873—minimum depth on bar at low water, 16ft.; interval, 17 years; rate of increase of minimum depth per year, 2·11in.; increase of minimum depth, 3ft.; depth on bar at standard high-water, 29ft. An interesting history of the Dublin works will be found in Mr. J. J. Mann's book on "The Removal of River Bars by Induced Tidal Scour." Another history will be found in the "Minutes" of the Institution of Civil Engineers, vol. lviii., in a paper by Mr. J. P. Griffith, M. Inst. C.E. From these cases it will be noticed that there are certain fixed principles involved in each and all of them. The first is that the entrance is fixed at a point in a direct line with the direction of the river, and in as deep water as circumstances will allow. The second is that the works are so constructed that the force of the waves is dispersed as soon as they pass the entrance, on account of the widening out of the works. The third is that whilst the flood-tide approaches from all directions, and any material it may bring in is deposited near the entrance, as soon as it arrives in comparatively still water the ebb-tide and the upland waters having their forces directed and concentrated in a certain fixed direction, are therefore able to remove, and carry well out to sea, any deposit that may have been left by the flood-tide, and at the same time maintaining a straight channel out to sea. Having so far endeavoured to bring forward general principles, it is now proposed to see how they can be applied in dealing with our rivers, and in doing so it must be remembered—to quote the words of Sir John Hawkshaw—"that there is nothing more certain than that each one must be dealt with according to its own special *régime*." At the entrance to the Hunter River, Newcastle, there is a remarkable instance of a natural breakwater, illustrating the advantage of protection works—natural or artificial—extending into deep water. By referring to the plan of the river taken in 1816, we see a channel of three fathoms marked under the lee of a reek extending from the mainland to Nobby's Head. But as this reef only afforded partial shelter, we find the waves struggling with the tidal current, and reducing the width of the channel to very narrow limits by the formation of the dangerous "oyster bank." The improvement of the reef by the construction of the southern breakwater somewhat reduced the "oyster bank," and now the breakwater has been extended beyond Nobby's Head. The entrance being thus more perfectly protected from the waves, we see a most satisfactory improvement by the widening of the channel, and the almost entire removal of the "oyster bank," brought about by the comparatively undisturbed action of the tidal and upland water scour. At the present time the entrance is so far protected by the breakwater on the south, and the bay-like line of the coast on the north, that the tidal and upland waters have decidedly the best of the situation; and thus we see a progressive state of improvement. Although this harbour possesses great natural advantages by the position of the reef upon which the south breakwater has been built, and by the deep water and absence of sand to the south of the entrance, it labours under a serious disadvantage on account of the great curvature of the river at the harbour, the effect of which, as is well known, is to cause the currents to scour out deep holes at certain points, and to throw up banks at others, and there is no doubt that this action will necessitate a large amount of dredging to keep the harbour of uniform depth. In investigating how far the general principles set forth above, and illustrated by the works at the Tyne, Tees, and Liffey may be applied in dealing with our rivers, it may be well to take the Richmond and Clarence rivers as examples, and in dealing with these cases to show how, with modifications to suit local circumstances, they may be generally applied to the other rivers along our coast. The Richmond River flows through one of the most fertile districts of the colony, and is navigable for vessels of moderate size for some distance from the entrance; but, as is unfortunately the case with most of our rivers, it is blocked by a very dangerous shifting bar. The width across the entrance is about 6000ft. The North Creek joins the main river at nearly right angles, opposite the centre of the entrance, thus forming a somewhat complicated combination. The general tendency of the waves is to heap up the sand-bar across the entire distance between the heads, with the exception of a narrow channel under the North Head, and occasionally there is a second channel at the South Head, but this is not permanently navigable. In attempting to improve this entrance, the first thing to be considered is at what point should the entrance channel be fixed, and in fixing this point it is necessary to study the effect of the tidal waters from the North Creek upon the tidal waters of the river, and, if possible, to combine them into one concentrated stream, to act jointly upon our fixed point on the bar. Looking at the case with the above considerations before us, it appears that the best point on which to focus our large available scouring power would be in the neighbourhood of A on the plan, as near as possible in a direct line with the centre of the last reach of the river, and somewhat to the north line of the North Creek. Having determined this point, we have to consider what works would be necessary in order that the tidal and upland water scour might be concentrated at that point. Firstly: By the construction of a breakwater starting from the South Head, extending seaward for about 2000ft. in an easterly direction, the entrance would then be protected from the south and south-easterly weather; at the same time the tidal waters would be directed so as to improve the South Channel. Secondly: By the construction of a wall from the pilot station in a south-easterly direction, crossing the sand-bank, and terminating by a breakwater of about the same length as the proposed south breakwater, leaving an entrance of about 1500ft. between the extremities of the works. The northern works would protect the entrance from the north-easterly and easterly weather, which, as is well known, are the principal agents in heaping up bars; they would, in conjunction with the southern breakwater, direct and concentrate the tidal action on the bar, thus enabling the ebb-tide and upland water to carry the sand well out to sea. Considering the large amount of tidal water available, and the great depth of the sea a short distance from the entrance, there can be no doubt that in a short time after the completion of these works there would be a sufficient depth at the entrance to enable the largest steamer afloat to enter; moreover, the lower reach of the river, being protected from the prejudicial action of the waves, and having its direction fixed by the position of the entrance, would soon make for itself a permanent deep channel. Judging from the effect of the works at Dublin, where an insignificant river has been made available for a first-class shipping trade, by the correct application of sound principles, the author has every confidence in predicting that if works were carried out on the lines proposed this great natural highway, which is now closed to all except small steamers and coasting craft, would be available for our first-class inter-colonial steamers, the effect of which, as far as enhancing the value of property and increasing the prosperity of this district, cannot well be gauged or, in these times of advancement, even imagined. After the maturest consideration of this case, the author feels convinced that by the application of the most modern and improved construction, these works could be carried out for a sum not exceeding £200,000 or £220,000. The Clarence is undoubtedly the most important of all the rivers of this colony running into the Pacific. It flows through one of the most productive districts of New South Wales; and from the wonderful richness of the soil, there can be little doubt that this district is destined to play an important part in the development of the great agricultural resources of this colony. But for the existence of the bar at the entrance of this great natural means of internal communication Grafton and the Clarence district would, there is little reason to doubt, be next in importance to Sydney herself, for with the entrance once secured the port would be the natural outlet for the trade, not only from the immediate district itself, but from the whole of the country stretching away to the tablelands of New England and beyond. The pressing necessity, therefore, of removing this obstruction to the progress of this important part of the colony cannot be over-estimated. In examining this case the same contending forces are seen at work—namely, the struggle between waves and tide, the result being that the entrance has been driven into a most awkward corner by the action of the north-east winds, the river being diverted from its straight course into one of the most ugly bends imaginable, with the result that, instead of a good channel, we see a succession of deep holes and sandbanks, and to make matters worse there are several dangerous sunken rocks in this already uninviting entrance. Nature has done much towards the removal of this most unsatisfactory state of things, the entrance being well protected on the south by the South Head; moreover, an enormous volume of tidal water is available, only wanting skilful directing in order that it may become a most powerful agent, and one that would be more than equal to the task of removing all obstructions. Wanting such directing, this great natural power is expended in dredging deep holes in places where they are not required, and heaping up sandbanks on the site of the much desired entrance, at the same time on account of the frequent changes of direction, troublesome eddies are formed to further increase the difficulties of navigation. There should be no great difficulty in fixing the entrance and removing the bar, considering that nature has provided perfect protection on the south side; all that appears necessary is the construction of a breakwater to protect the entrance from the north and north-easterly weather. At the same time the channel should be straightened by cutting through the spit, and deflecting the stream from the south side of the river by the construction of a dyke from the south bank to Rabbit Island, extending a short distance into the main channel. The breakwater once constructed, the removal of the spit would be an easy matter; for by cutting a narrow canal parallel with Queen-street, Iluka, the tide would soon complete the work of cutting a good channel. The new channel being straight, the banks would moreover require but little protection, as they would not be subjected to the excavating action inseparable from curved channels. The advantages of this plan of treatment must be commendable to the most casual observer. Firstly, the entrance being protected on the south by the South Head and on the north by the breakwater, extending into deep water, the protection from the waves is complete. Moreover, the channel being straightened, the tidal and upland waters unimpaired by any abrupt changes of direction, would do the work of maintaining and improving the channel, and at the same time keeping the entrance clear of all obstructions. Secondly, the entrance being well protected and in deep water, and the channel being straightened and removed from the neighbourhood of the sunken rocks, the port would be made available for the passage of large vessels, and could be entered without danger in all weathers. The benefit that would follow the opening up of this seaport, and the increased wealth and prosperity it would confer upon this valuable portion of our territory, does not require to be enlarged upon in this paper. The straightening of the entrance channel would be by no means as formidable an undertaking as it at first appears, for with the proposed breakwater once constructed, this would be the natural course of the river. A remarkable instance of the ease with which the channel of a river may be diverted from one bank to the other is given in the case of the Missouri River, where by the construction of a comparatively inexpensive dyke, the centre of the channel of this great river was shifted from the west to the east bank, a distance of nearly 2000ft.; and in a few months the river cut for itself a new channel many feet in depth—see *Railroad Gazette* of New York for November 30th, 1883. This case clearly demonstrates the practicability of the works proposed for the Clarence. The entrance to the Clarence has been compared to that of the Hunter, and it has been argued that works carried out on similar lines in the two cases should have like results. Careful consideration will show that there is but little grounds for such conclusions. The two entrances are alike in this respect, that they are both protected on the south by a natural breakwater; but in the most important particular, as far as the treatment of the bars is concerned, the cases are widely different, for whilst the entrance to the Hunter is in a great measure protected from the north-east wind by the easterly direction of the coast-line between Newcastle and Port Stephens, the Clarence is exposed to its full force, and, as is well known, the long prevalence of north-east winds has a very prejudicial effect on the river entrances exposed to them, as is evidenced by the heaving up of the sand at all such rivers; thus clearly showing the necessity of treating each case according to its own special requirements. To carry out the works proposed by the author at the entrance to the Clarence, would probably cost about £150,000 to £160,000. In coming to the above conclusion as to the best method of treating the Clarence River, the author has been guided by the experience gained in the successful treatment of the Tyne, Tees, Liffey, Danube, the Kurrachee mouth of the Indus, and the recent great works at the mouth of the Mississippi, in all of which cases the object kept in view has been the protection of the entrance from the wave action, and improving the scour by making the entrance channel as straight as possible; whereas the existing works on the Clarence, in his opinion, merely deal with the result brought about by the disturbing action of the waves and tide, instead of treating with the cause by protecting the tidal action from the disturbing action of the waves, which would be the case if the works proposed by the author were carried out. The entrance to the Bellinger River is rather a complicated case, judging from the country map and the Admiralty chart, and in the absence of a detail chart of the river it would be unwise to speculate on the best method of improving it. The Nambuccra and Manning Rivers have more direct entrances than any of the rivers above mentioned, and could probably be dealt with by the construction of much less stupendous works at a moderate cost. The entrance to the Macleay River is one that would require careful study; but as it is well protected on the south by Trial Bay, and having a large volume of tidal water available for maintaining the entrance, there should be no great difficulty in acquiring a satisfactory channel across the bar. The entrance to the Hastings River at Port Macquarie could be much improved, and at the same time a valuable harbour formed, by taking advantage of the sand-bank opposite the town, and constructing a breakwater on the north in the direction shown on the map. This breakwater would protect the entrance from the north-easterly weather, and at the same time steady the tidal current along the south side, thus forming a deep channel near the town, and by the increasing width of the harbour, the force of the waves in time of easterly gales would be broken; the current at the same time would be focussed at the entrance, and be enabled to keep down the bar. With skilful handling many of the inlets that are now practically closed for navigation might be made available, and those that at present can only be frequented by the smallest craft might be used by a much larger class of vessels. But in all cases the first principle to be kept in mind is that the battle has to be fought with the waves. As to the best system of carrying out such works as are proposed in this paper, great strides have of late years been made in this branch of civil engineering by the use of large concrete blocks, breakwaters having been constructed at a speed altogether unknown a few year since. Thus 710ft. were added to the Manora breakwater, Kurrachee, in less than four months, by the use of concrete blocks of 27 tons each, placed in position by suitable machinery. At the same time this work was carried out at a very moderate cost, compared with similar work under the old system. Many other instances might be quoted, where, by the use of concrete in its different forms, works have been rapidly constructed at a moderate cost, that would have been well nigh impossible to carry out, except at an enormous outlay, but for the aid of this most valuable material. Another great advance has been made in the direction of cheapening such works by the use of large mattresses, made of fascine, which, when sunk in position, prevent the sand from being washed out. Layers of stone are placed on these mattresses, which in their turn are covered with other mattresses, the work being thus well bound together. This system has been used with great advantage in America, and has recently been adopted in Holland, where the extensive works at the mouth of the river Maas have been carried out on this system at a very moderate cost, and at the same time giving great satisfaction. In conclusion, the author's apology for bringing this subject under the notice of the Royal Society of New South Wales, is its vital importance to the best interests of the coast districts of the colony; the improvement of the river entrances being the principal work necessary to develope the resources of these rich agricultural lands. From valuable instruction in the principles that govern the movements of solid matter held in suspension by tidal and wave disturbed water, imparted by Dr. James Thomson during an engineering course at the Glasgow University, and from careful study of the subject extending over several years, and from personal inspection of many important harbours, the author is convinced that all that is necessary to ensure success in the treatment of our different rivers is: "The close observation of physical features and effects, and the adoption of means to assist the operations of nature instead of opposing them"—that is, as expressed in the charter of the Institution of Civil Engineers, "directing the great sources of power in nature for the use and convenience of man."

The usual votes of thanks to the authors of the papers concluded the meeting.

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, January 10th.

During the past six days trade developments indicate a general reduction of price of fuel and material. In manufacturing channels the most important is the weakening of the anthracite combination of several furnaces by the presidents of the companies to agree upon a basis of production and prices for the ensuing year. The manufacturing interests are loud in their protests against monopoly control over the anthracite coal-fields, and it would not be surprising to see legislative proceedings once more inaugurated in order to break this combination, which for nearly ten years has been successful in maintaining high prices. Several causes are at work, the chief of which are, that the general manufacturing and domestic demand has fallen off considerably. Bituminous coal-fields have been largely developed in Pennsylvania, Maryland, and West Virginia, resulting in sharp competition between the two fuels, bringing bituminous to 3 dols. 50c. per ton in Boston, and 2 dols. 75c. in New York. Manufacturing requirements are now met with what, heretofore, was refuse coal; sizes known as Pea and Buckwheat. The coal companies can mine over 40,000,000 tons of coal, but with a demand of barely thirty million per annum. Competition is better, and outside coals are crowding the anthracite markets, and outside irons are threatening Pennsylvania irons. Manufacturing interests are confident that the present reign of high prices in raw coal will soon come to an end, despite the combination, and from any impartial standpoint, the probabilities point strongly that way. In iron the usual January demand has been postponed, and furnacemen and millmen in all branches of the trade are very short of orders, and as they will not run without assured sales, a great many mills are idle, and a probable shutting down of furnaces is under consideration. One or two local enterprises are calling for structural iron, for local rapid transit purposes; between two and three thousand tons, in all, will be wanted. A number of rail mills will remain closed indefinitely. Steel wire rod is under good inquiry. Stocks are ample and prices firm. No. 1 foundry is selling at 18 dols.; No. 2 at 17 dols., in the exchange. Arrivals of Scotch iron have been extremely light, and prices are weakening. Gartsherrie, nominally 21 dols., to arrive; Glengarnock, 19 dols. 50c., to arrive; Eglinton, 19 dols., to arrive; Clyde, 19 dols. 50c., to arrive; foreign Bessemer, 19 dols. 50c. to 20 dols., according to brand; Spiegel, 26 dols. for 20 per cent.

The Chicago rail mill will resume in a few days. Its production for the past year was 147,000 tons of ingot. The Pennslyvania rail mills, through their representatives here, report fair inquiry for summer delivery, but small orders for prompt delivery on a basis of 29 dols. There is a decided improvement in commercial circles, and in manufacturing circles there is a spirit of improving confidence. Wheat has advanced in sympathy with foreign markets. The farmer will hold stocks for better prices. The visible supply is forty-three millions, against forty-five million bushels for same time last year. Cotton is improving and wool is firm, and manufacturers are making larger purchases. Congress will not interfere with business interests by the agitation of Radical legislation, and nothing but the most urgent legislative requirements will be met.

Advices from the interior to-day, by telegraph, indicate a slightly improving demand in the agricultural districts for material and merchandise of all kinds, and the local and tide water jobbing interests are meeting with more favourable inquiry for stocks for spring requirements. The probabilities are more favourable this week for normal activity in all channels of trade. The abundance of money and the low rates of interest are favourable to further improvement. The failures of small traders are on the increase, but this course is regarded as favourable rather than otherwise. The liquidation of values is progressing, and in commercial circles the depression is being discounted already.

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

(*From our own Correspondent.*)

BUSINESS in the iron trade is beginning to assume a somewhat more settled character after the interruptions caused by the holiday stoppages, stocktaking, and repairs, and by the occurrence of the quarterly meetings. But it cannot be reported that the condition of the market gives cause for any satisfaction, or that evidences are appearing of an increased demand this quarter over last.

Orders are being placed a trifle more freely this week for finished iron, since merchants can see their way to operate with advantage more clearly than a fortnight or so ago. There is, however, an utter lack of spirit in the trade, and the prices attached to inquiries are as wretched as ever. The demand from London reflects the quiet state of the Australian markets, and Liverpool orders evidence the severe depression in the North American trade. Ironmasters are prepared to meet merchants wherever it is possible in the matter of price rather than let the inquiries pass to other districts, but in many cases the rates offered have still to be firmly declined.

Specifications in fulfilment of orders previously booked are not easy to get in. If they were, there would be less partially employed labour about the ironworks. Yet the sheet makers are generally pretty well engaged on work for the galvanisers, and for local consumers of working-up sheets. Messrs. Jno. Lysaght and Co., who roll sheets here for consumption in their galvanising works at Bristol, are very busy, and are employing some 700 men with exceptional regularity. The recent removal of severe competition in some local directions is welcomed by the sheet makers, but prices fail to strengthen. Common sheets, singles, are quoted £7, but 5s. per ton less is freely accepted for good orders. Doubles are £7 7s. 6d. to £7 12s. 6d., and lattens £8 10s.

Prices of galvanised sheets are in buyers' favour, and the demand is tame at date. Ordinary qualities of 24 gauge, bundled, delivered Liverpool, may be had at £11 5s. to £11 10s. Morewood and Co., in their list for this month, show a reduction in sheets of 24 g. of 10s. per ton, and of 26 and 28 g., £1 per ton.

Their new quotations for 24 gauge are £12 5s. to £12 15s.; 26 gauge, £13 15s. to £14 5s.; and 28 gauge, £14 15s. to £15 5s.; while 30 gauge is quoted £16 15s. to £17 5s.; all delivered Liverpool or London. Their close annealed flat sheets are £15 for 24 gauge, £16 for 26 gauge, £18 for 28 gauge, and £19 for their 30 gauge; while their "Anchor" brand of galvanised tinned sheets are £17, £18, £20, and £21, according to gauge.

In the bar trade the demand is running on small sizes of common quality for early consumption at prices ranging from £5 15s. to £6 5s., the earlier figure being the price paid by merchants. Second-class bars are weak and variable, according to makers' circumstances; £6 10s. to £6 15s. are the basis figures. Marked bars remain upon the official basis of £7 10s., with £8 2s. 6d. nominal for Earl Dudley's qualities, but with a very limited business. The better makes of shoe and tire iron command fair sales.

Hoops are not brisk, but some moderate lines have been given out this week to the order of London agents buying for the Australian markets. Bedstead hoops are in pretty good call for local consumers, but coopers' hoops are particularly tame. Prices of export hoops range from £5 10s. and £5 12s. 6d. and upwards. The request for wrought iron tube strip is irregular, and the mills are in very partial operation. Selling rates are £5 12s. 6d. to £5 15s. Nail rods were also £5 12s. 6d. Chain and rivet iron are in backward request.

Steel is coming into the district with some freedom. In most bulk it comes in as billets, slabs, and ingots to be rolled into sheets for stamping and for tin-plate making; while for ordinary working up purposes, the travelling trunk manufacturers and the rest make larger demands month by month. Its price is so low that a superior article can be manufactured of the material, and occasionally offered at a lower price than when high-class iron is used. Larger quantities are likewise being used for tube and for bedstead strip.

When, in April, the Staffordshire Steel and Ingot Company, which turns out the basic quality, has resumed work after the late boiler explosion, the addition to the current supply will be very considerable. The late battery of ten boilers is being replaced by a battery of fifteen boilers, and in other works improvements are being perfected, designed to alike augment and improve the supply.

Pig iron is only selling with briskness in those cases in which the representatives of makers in other districts are prepared to offer tempting prices to consumers. In such instances good contracts are here and there being booked. Native makers are not entering into new contracts on satisfactory terms, but rather than stock heavily they will accept prices to leave but a narrow margin of profit. Northampton pigs are 40s. to 41s. delivered to railway stations, and good Derbyshire pigs 42s. delivered. Native second-class pigs are 45s. to 42s., and common sorts 37s. 6d. to 36s. 3d. per ton. Welsh scrap iron is slow of sale at 45s. delivered.

The manufacturing coal trade is unrelieved, and rates are without strength. Common forge coal is 5s. to 5s. 6d., and inferior, 6s. to 6s. 6d.; mill coal is 7s. to 8s., according to the locality where mined. Furnace coal is 8s. to 9s. Best rough slack is 4s. 6d., and fire engine slack as low as 2s. per ton. Cokes are rather easier on the week. Derbyshire and Yorkshire furnace sorts are 15s. delivered, and Welsh furnace 14s. 6d.

The millmen at the ironworks are doing their utmost to keep up their high remuneration. A few of the employers have, with the consent of their men, been recently making private arrangements which reduced the wages previously received. This having come to the knowledge of the Millmen's Association, a meeting to protest against such action has just been held at Bilston, and a resolution strongly condemning it was passed. The men affected promised not to go to the works again. Another resolution was also passed suggesting that some united action should be taken to prevent these private arrangements in the future.

The sliding scale agreement in the Cannock Chase coal trade is to be revived. The masters refused to continue to support the Conciliation Board unless the men would consent to a new scale. On Tuesday, therefore, the operatives instructed their delegates to acquiesce in the masters' request, with a minimum fixed at 2s. 4½d. per stint. The delegates are also authorised to make any amendments in the basis that they may think desirable.

Operations for re-opening the northern end of the Shropshire coalfield, which has for some years been abandoned, have been actively begun by Messrs. Hopley, of Madeley. They have taken over 3000 acres at a royalty, under Sir T. Meyrick, and they are now getting out water, and putting the works in order. The coal is of a manufacturing and house sort.

A small strike against a proposal to reduce wages 7½ per cent. has been begun by the operatives of two nail-casting firms in the Birmingham district, and the men affected are being supported by the whole operative trade. Four years ago a reduction of from 10 to 30 per cent. occurred, and the men state that the employers then promised to make no further reduction.

The unemployed workmen in Birmingham are beginning to indulge in very discreditable proceedings. The Relief Committee have opened stoneyards for them, but as is nearly always the case, the bulk of the men are dissatisfied with the scale of pay. On Tuesday, after passing a resolution at an open-air mass meeting protesting against the pay, an excited procession formed and marched towards the stoneyard to fetch the workmen out. However, the police got wind of the affair and dispersed the mob amid some excitement. The ironworkers in the east end of Wolverhampton, who have of late been wholly thrown out of employment by the closing of works, are suffering privation, and some organised means of relief is contemplated for them and their families.

The annual meeting of the Birmingham, Tame, and Rea District Drainage Board was held on Tuesday. The estimated expenditure for the forthcoming year was £53,000. After deducting the estimated income there remained £33,000 to be provided, and a precept was ordered to be issued for the raising of this amount.

The directors of the Union Rolling Stock Company, Birmingham, will recommend for the half-year just ended a dividend at the rate of 10 per cent. per annum, with a 2 per cent. bonus for the ordinary shareholders. The directors of the Railway Rolling Stock Company, Wolverhampton, are only able to recommend an ordinary dividend at the rate of 2 per cent. per annum for the past half-year.

All the Pottery towns and Newcastle-under-Lyme are to be united by telephone. The work is being taken up by the National Telephone Company, under the auspices of the North Staffordshire Chamber of Commerce, and it is hoped that the circuit will be completed in about a couple of months.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—There is still no visible sign of improvement in the iron trade of this district, either present or prospective. Here and there a slight increase of business is reported, and a few fairly good orders have been given out since the commencement of the quarter, there are also inquiries in the market for delivery over the year; but there is a continual absence of any weight of actual buying generally, and the year, so far, has opened more discouragingly than has probably been known for a very considerable time past. Quoted rates do not go any lower, but the position generally continues weak, and in most cases orders of any moment are only being got at very low figures.

There was a good attendance on the Manchester Iron Exchange on Tuesday, but I heard of no large buying, and generally business was reported as extremely dull. In the pig iron trade Lancashire makers are kept going with small orders, and they still hold to 41s. and 41s. 6d., less 2½ per cent., as their minimum quotations for forge and foundry qualities delivered equal to Manchester. In district brands, however, there are some very low prices spoken of in the market, and Lincolnshire forge iron could be readily bought at about 40s. per ton, less 2½ per cent., delivered into the Manchester district, although the leading makers ask fully 1s. per ton above this figure, and foundry brands are quoted at 42s. to 42s. 6d., less 2½ per cent., delivered here.

In the manufactured iron trade new business still comes forward very slowly, and some of the forges are only being kept partially employed. Good qualities of ordinary bar iron delivered into the Manchester district do not average more than £5 10s.; hoops are quoted at about £6 per ton, but in some cases could be got at a trifle less, and local made sheets average about £7 per ton delivered here.

In my last week's "Notes," in referring to the introduction of steel beams and props in the place of wood for underground mine workings, the name of the firm which is carrying out the orders for this class of work should have been the Darlington Steel and Iron Company, and not the Darlington Forge Company. In correcting this error, I may add a few further particulars with which I have been furnished. In addition to the rolled steel girders and beams which the Darlington Steel and Iron Company has introduced for use in collieries in the place of wood beams and props, it is also executing orders for steel channel bars to be used at the end of the girders for supporting the side walls where lateral as well as vertical pressure is met with. There is little doubt that the greater strength of steel, its lightness to handle, and the increased head room which, as I pointed out previously, is secured, are advantages which will lead ultimately to a much larger introduction of what at present is a novel feature in colliery workings. A further development of the use of steel to take the place of wrought iron work in constructive purposes is also going on in its application to wagon and carriage building, and the Darlington Steel and Iron Company has recently taken an extensive order for rolled steel channel bars of large section for the framing of railway carriages for an Indian railway. This introduction of steel affords greater strength, with less weight on the wheels and a consequent saving to axles, axle-boxes, and springs, as well as to the permanent way, which, for many classes of work, must prove a considerable advantage over wrought iron, and there would seem to be considerable scope for railway carriage and wagon designersi n the free use of steel channels, angles, bars, and sheets for constructive purposes.

As regards the engineering trades of this district, and in fact generally throughout the country, the opening of the year shows but very unsatisfactory prospects. In no single instance do the reports sent in from the various branches of the Amalgamated Society of Engineers return trade as good, and during the past two months there has been an increase of something like 2 per cent. in the number of members coming upon the books for out-of-work support. "Bad" or "moderate" is the general tenour of the branch reports, and taking them all through, the tendency is in the direction of decreasing activity rather than of improvement. The average number of members now in receipt of out-of-work support throughout the country is about 5½ per cent., and the district round Manchester would seem to be in the best position as regards employment, with about 5 per cent. of the members in receipt of "donation benefit." One discouraging feature of the returns is the number of pattern makers out of employment, which is larger than has been known for several years past, and as the pattern-making shop is the first intake for new work, this may be taken as an indication that there is a dearth of new orders coming forward. Following the pattern shop is the foundry, and the report of the Moulders' Association is quite as discouraging as that of the Amalgamated Society of Engineers. The monthly report just issued by the Steam Engine Makers' Society shows that, so far as members of this branch are concerned, the number of unemployed remains without any very material increase, and the average is not more than about 3 per cent., but the tendency as regards employment is in the same direction as in the other trades' union societies; and the report sets forth that the new year has not opened up, so far as it has gone, any improvement in trade. In marine engine districts there was believed to be a slight improvement, but there was a perceptible decline in stationary engine building, as their Wigan and Preston branch reports very forcibly showed; whilst in other districts a despondent tone was prominent. Locomotive builders, engineers, tool makers, and cotton machinists were, however, kept busy. The report further adds that the unemployed list was not materially changed from that recorded in December, and for this they ought to be grateful, as the demand for labour was so limited at present that it was somewhat agreeable to know they had not a greater number of members out. Should, however, a revival not show itself shortly, they were afraid that want of employment would be more severely felt in their branches.

As emigration has recently been urged by some advocates of the interests of the working classes as a remedy for the present depressed state of trade, so far as the workmen are concerned, a few further facts taken from the reports of trades' union societies will be worth noting. If emigration is to be the remedy, the question arises where, with the impoverished resources of the trades' union societies, are the necessary funds to be found? And supposing that from other sources they are forthcoming, where can the men emigrate to find employment? The depression in trade is certainly equally as great, if not greater, abroad than at home; and that their position would be quite as bad in the manufacturing centres abroad where employment for English workmen would, in all probability, be sought, is abundantly proved by the returns from the American and colonial branches of the Amalgamated Society of Engineers, which in most cases report trade as bad or working short time, and very many instances at a reduction in wages.

In the coal trade there is a fair amount doing; but still business is only moderate for the time of the year, and prices are not being more than maintained at late rates. The better qualities of round coal are moving off tolerably well for house fire consumption. The common sorts are, however, bad to sell for steam and forge purposes, and are very low in prices. Engine classes of fuel are in fair demand at about late rates. At the pit mouth best coal does not average more than 9s. to 9s. 6d. per ton; good seconds qualities, 7s. 6d.; inferior sorts, 6s. 6d.; common round coals for steam and forge purposes, 5s. 9d. to 6s.; burgy, 4s. 6d. to 5s.; best slack, 4s.; and common sorts, 2s. 9d. to 3s. per ton.

For shipment there is still a tolerably good demand at low prices, steam coal delivered at the high level, Liverpool, or the Garston Docks, averaging about 7s. 3d. to 7s. 6d. per ton.

Barrow.—I have to report a continuance of the steady but quiet tone in the hematite pig iron trade of the Furness and Cumberland district. Makers are quoting rather higher values, 46s. being the quotation for parcels of mixed Bessemer net at works. The output of the furnaces is steady, but only three-fifths of the furnaces are in blast, and the production is quite equal to the demand, while stocks remain large, although as compared with the position two months ago, they have been reduced. The continental inquiry is limited, although some large parcels have been sold in that quarter, but the home account, although shown to be quiet so far as immediate business is concerned, is, nevertheless, not without spirit, as shown by the inquiry, which, while not resulting in much business, is simply checked in this way by the desire of makers to refrain from buying forward consignments at the increased value which makers now place upon them. The steel trade is busier than it has been, and orders are fairly held both in the rail and merchant departments. The output of steel is below the average, but it is expected to increase after the season has advanced a little. The shipbuilding trade is dull. Finished iron is in limited demand. Iron ore finds a poor market, prices ranging from 8s. 6d. to 10s. per ton net at mines. Coal and coke have a quiet but steady sale at late values. Shipping is inactive, and freights are at an unremunerative rate both for foreign and coasting shipments. Mr. W. S. Davy has decided to retire from his position as manager of the Barrow Hematite Iron and Steel Company at the expiration of his three years' term of office in April next. The directors have officially intimated their satisfaction at the improvements Mr. Davy has made in the mechanical part of the works during their re-arrangement.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Denaby Main dispute still continues, and the various suggestions made for its settlement appear to fall on indifferent ears. The latest proposal comes from one who says that he has had nearly thirty years' experience and management of extensive collieries in England and Wales, and as he is not in any way connected with the Yorkshire district, he claims to be fairly listened to by both sides. He earnestly advises the men to lose no time in asking their employers to arrange for the pit to be worked by the single-shift system. The double-shift, he contends, has always proved unsatisfactory, "and is likely ever to be so." If the masters concede this point, he strongly urges the men to go to work at once, and fairly and honestly try the system proposed to them, and which he believes "is correct and proper, and will result in being mutually beneficial."

An official of the Wharncliffe Silkstone Collieries states that they have never experienced a winter season in which the demand for coal has been so extraordinarily slack. In reference to a statement that the colliery managers "have had to commence working two shifts a day to supply orders," and that "in addition to the extra output, a large quantity of coal is being filled up from stock," I am not surprised to find an authoritative denial. The company, it turns out, is loading for stock entirely for gas contracts, for which extra quantities are always required at this season of the year. "The collieries, like ourselves," adds the official, "realise the fact that the season is very bad for the house-coal trade, and the outlook for the year is not better."

Meanwhile, the miners have met in conference at Barnsley, where delegates attended from nearly every mining district of Yorkshire. There was no lack of subjects for discussion—the programme ranging from unsatisfactory coroners to the appointment of a labour representative to contest one of the Ridings. Mr. Benjamin Pickard, secretary of the Yorkshire Miners' Association, has been selected as the miners' candidate, and a fund is to be raised to meet the expenses of his election. Mr. Pickard is a strong man from the colliers' point of view. He has been conspicuous in all agitations for obtaining advances and resisting reductions in wages. At the conference he contended that the Employers' Liability Act should require the managers and officials to prove that they were not to blame in the case of an accident, instead of the collier having to prove their liability. He also insisted upon "a daily inspection"—I suppose he means an official inspection—of mines, and not, as it was done now, "by a man who might be twenty, thirty, or fifty miles away," which appears rather a paradoxical way of putting it. He complained of coroners' courts, urged the necessity of a change in regard to stipendiary magistrates, and closed by declaring that the miners were determined to have a power equal to any body in Yorkshire. If the miners are really determined to return a candidate they are strong enough to do so.

At the Sheffield Chamber of Commerce on the 15th inst. a letter was read from Lord E. Fitzmaurice, M.P., upon whom a deputation had recently waited, urging that the present moment was favourable to renewed efforts to obtain from the Spanish Cortes the ratification of the protocol of December, 1883. Lord E. Fitzmaurice wrote to say that the negotiations at Madrid had practically terminated in that result being attained. Her Majesty's Government had engaged to apply to Parliament to raise the limit of the one shilling duty on wine from 26 to 30 degrees, and the Spanish Government had agreed to apply to the Cortes to grant "most favoured nation treatment" to British trade. Provision had also been made for subsequent negotiations which, if successful, might be expected to involve further modifications of the wine duties in the United Kingdom, and a revision of the Spanish tariff with the view to promote trade between the two countries. This information is very satisfactory to Sheffield manufacturers and merchants, whose business with Spain has been greatly crippled of late years by the unfair prohibitory tariff of that country.

Mr. Frederick Brittain, one of the vice-presidents, and Mr. J. E. Bingham, the Master-Cutler, brought before the Sheffield Chamber of Commerce a resolution as follows:—"That a memorial be presented to the Prime Minister, praying that her Majesty's Government will invite to a conference, to be held in London, properly accredited representatives from all her Majesty's colonies and dependencies for the purpose of considering the expediency of establishing a Zollverein or Customs League, by means of which absolute free trade might be established between all parts of the British Empire; and, further, of considering upon what conditions the produce and manufactures of foreign nations should be admitted into the British Zollverein." The resolution was subsequently amended by the omission of the word "absolute;" but even in this amended form it was lost by a majority of one. There was, I understand, a very able and animated discussion on the question; but as the proceedings were not open to the press, the arguments used have not seen the light.

The Penistone railway accident was again brought into prominence this week by the conclusion of the inquiry into the death of Mr. Wm. Harrison, manufacturing wood turner, of Sheffield, who was one of the victims of that disaster on New Year's Day. Mr. Charles Sacré, the chief engineer of the company, gave evidence, in the course of which he stated that the iron of the axle which broke—the property, it will be remembered, of the Shireoaks Colliery Company —was "extremely good, except that originally it was brittle, and would have been better for a little more work. He had had a piece of bar made from the axle, and it was a magnificent specimen." The jury returned a verdict of "accidental death."

Another broken axle—this time on the Midland Railway—caused the Scotch express from Bristol to Glasgow, on Saturday morning, to be two hours and twenty minutes late in arriving at Sheffield. The train is stated to have been travelling at high speed. When the trailing axle of the tender attached to the engine suddenly broke, and displaced several check-rails at crossings near Ashchurch. Fire was seen to fly from the tender, and the driver drew up in time to prevent serious results. Fortunately the engine and carriages kept the rails. Another engine was procured, and the train, with a fresh engine attached, proceeded on its journey.

The skate trade has suffered very seriously by the excessively mild winters of late years. One of the largest manufacturers, Mr. Frederick Harris, of the Eclipse Works New George-street, had nearly £2000 locked up in these goods. He was waiting for a good season and intended to retire from the business after realising his stock. The good season has never come, and Mr. Harris has been mentally affected by his troubles. On Saturday morning his body was found in Whirlow Dam, near Sheffield, and the coroner's jury returned a verdict of "Found drowned."

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

BUT little business has been done in Cleveland pig iron during the week. Prices were somewhat easier again at the market held at Middlesbrough on Tuesday last, but consumers were not tempted. They evidently believe that a lower level will yet be reached. Merchants were offering No. 3 g.m.b. for prompt delivery at 35s. per ton, and forge iron at 33s. 6d., or 3d. per ton less in either case than at the market of the previous week. They, however, hold but little, and many of them would doubtless be glad to purchase themselves at these prices, if they could find smelters willing to sell. Some makers have gone so far as to accept 35s. 3d. for No. 3, but the majority still hold out for 3d. to 6d. per ton more. Makers are also asking 3d. to 6d. more for forge iron than merchants.

Messrs. Connal and Co.'s stock of pig iron at Middlesbrough decreased 100 tons during the past week, and their stock at Glasgow was reduced 48 tons.

The rough weather of the last few days has interfered with shipments from the Tees, and they have, in consequence, fallen behind last month. The quantity of pig iron exported to Monday last was 35,871 tons, as against 40,047 tons last month. Of manufactured iron and steel, 11,687 tons were shipped up to Monday last.

The manufactured iron trade continues dull. Prices are precisely the same as last week, and but little business is proceeding. Messrs. Jones Brothers have re-started a sheet mill and eight furnaces, and at Messrs. Dorman, Long and Co.'s Britannia Works at Middlesbrough, several additional puddling furnaces have been temporarily set to work.

The accountants' certificate issued under the Cumberland Miners' sliding scale agreement shows that the average net selling price of coal for the quarter ending December 31st was 7·37d. per ton above the standard. Miners' wages will therefore be advanced 2½ per cent.

The workmen at Messrs. Raylton Dixon and Co.'s shipyard at Middlesbrough have agreed to accept the reduction of 5 per cent., of which they received notice last week. At Stockton and Hartlepool the men have consented to the following reductions, viz., 7½ per cent. on payments for bending frames and shells, but no alteration in boss and oxter allowances; 5 per cent. on platers' wages; 5 per cent. all round on payments for caulking and rivetting. Time wages to remain as at present. There is still some difficulty with the drillers and helpers, both on the Tees and Tyne, but it is hoped the matter will be arranged without stopping the yards.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THE pig iron trade has again been very quiet in the past week, the demand being very limited for both home and foreign consumption. Speculative business in warrants, so far as the outside public are concerned, is in an exceedingly backward state, and the tendency of quotations is downward. The shipping trade in Scotch pig iron is small, the past week's shipments having been 6391 tons, compared with 7576 in the preceding week and 9229 in the corresponding week of 1884. The inquiry from the United States does not show any improvement, although there is every inducement to ship pigs to New York at present in the fact that freights are in some cases *nil*, the iron being accepted as ballast.

Business was done in the warrant market on Friday last at 42s. 4d. to 42s. 2½d. cash. The tone of the market was flat on Monday, at 42s. 1d. to 42s. 2d. cash; while on Tuesday business took place at 42s. 3d. to 42s. 2d. cash. Business was done on Wednesday down to 42s. cash. To-day —Thursday—the quotations were 42s. 0½d. to to 42s. 1d. cash, closing with buyers at 42s. 0½d.

The market values of the special brands of makers' iron are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 52s. 3d.; No. 3, 47s. 3d.; Coltness, 55s. 6d. and 51s.; Langloan, 56s. 6d. and 51s. 6d.; Summerlee, 52s. 6d. and 47s.; Calder, 52s. 6d. and 47s. 6d.; Carnbroe, 49s. and 46s. 6d.; Clyde, 47s. and 43s.; Monkland, 43s. and 41s.; Quarter, 42s. 6d. and 40s. 6d.; Govan, at Broomielaw, 43s. and 40s. 9d.; Shotts, at Leith, 52s. 6d. and 51s. 3d.; Carron, at Grangemouth, 49s. (specially selected, 53s. 6d.) and 48s.; Kinneil, at Bo'ness, 45s. and 44s.; Glengarnock, at Ardrossan, 49s. and 43s.; Eglinton, 43s. 6d. and 40s. 3d.; Dalmellington, 47s. 6d. and 43s. 6d.

Owing to the dull state of trade the ironmasters are considering the desirability of reducing wages.

In the locomotive works there is much activity, a large proportion of the output being for abroad. Four engines and tenders, valued at £12,000, were despatched from Glasgow a few days ago for Sydney, and three worth £5100 for Bombay.

The demand for abroad in the case of cast iron pipes, railway plates, sleepers, &c., is somewhat quiet just now, but large shipments are being made of orders formerly in hand.

The coal trade is in a fairly satisfactory condition. Despite the lack of orders for manufacturing purposes of a general nature, the inland business is very considerable, and with it and a good shipping trade, most of the collieries are making tolerably good time. At Glasgow the week's shipment of coal exceeded 20,000 tons. Greenock, 115; Grangemouth, 2671; Ayr, 8090; and Troon, 4111 tons. There is practically no alteration in prices.

Messrs. Merry and Cuninghame are extending their workings in the neighbourhood of Irvine, with a view to the extension of the output of what is known as "blind" coal.

The coalmasters of Fife and Clackmannan have held a meeting to consider a proposal that the wages of the miners be further reduced. A long discussion took place, and it is said that considerable diversity of opinion prevailed, but it was ultimately agreed to make no change in the rates in the meantime.

With the opening of the year there came a decided improvement in homeward freights, and the circumstance was accepted by many as an indication that we were about to experience a revival in the shipping trade. The freight market is again, however, considerably weaker. For the carriage of goods outwards, very low rates are accepted, and there is a notable shrinkage in general trade, which it is hoped will only be temporary.

A considerable number of new vessels, mostly of small size, were launched from Clyde shipyards this week, and several orders have been booked; but there is not much change in the general aspect of the trade, which continues dull.

On account chiefly of one or two firms having withdrawn from the arrangement to reduce wages, the reduction, which was to have taken effect on Monday last, has been postponed for ten days, and the employers are in the interval to receive deputations from the workmen with regard to the subject.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

VERY little attention has been given publicly to the proposed amalgamation between the Bute Docks and the Taff Vale Railway system. After the first announcement the whole thing seems to have fallen into obscurity. I may now state that it will be severely opposed. The fight will be quite equal to that of the Barry Docks, and, as far as Wales is concerned, will be the biggest fight of the session. I have heard of some of the opponents. The principal will be Sir George Elliott. Lord Windsor and the Great Western Railway will figure also amongst the chief in opposition.

As the coalition will to some extent relieve Mr. W. T. Lewis, it has been suggested that he should be induced, if possible, to represent one of the county divisions in Parliament.

Farmers got their representative, as in the case of Herefordshire, and colliers are making strenuous efforts to get "Mason," the Rhondda miners' agent, to contest one of the new districts as parliamentary representative. I expect the coal industry will be disturbed shortly, as the colliers are divided in their choice of men.

Important changes are announced. Mr. David Evans, of the Rhymney Works, is now publicly stated to have accepted an important post at Barrow-in-Furness, and Mr. William Jones is rumoured as retiring from the more active duties of general manager at Cyfarthfa.

I should not be surprised at other changes at Cyfarthfa, seeing that Mr. William Crawshay is now heir at Caversham Park consequent on the death of Mrs. Crawshay, relict of William Crawshay, the iron king.

It is gratifying to record that a steamer is now at Newport, Mon., loading 3000 tons of steel rails for Calcutta. This is the first tolerably good shipment we have had for some time.

There is not much lifting of the clouds in the steel or iron trade. Business, practically, is about the same. The College Works, Llandaff, have been closed. These are excellent little works and well managed, but the bar trade is everywhere bad. A stoppage is anticipated at Monmouth Forges and Tin-plate Works. Notices are up for cessation of contracts at the end of January, and this means reduction or stoppage; the latter is feared. Against these gloomy signs I have to place the prospect of the Garth Works being let, and the certainty of De Bergue's old works being taken for a wagon and boiler works. These will be carried on by Mr. Williams, of the Llantrissaint Works.

In coal a better tone is coming into note. With the exception of Lletty Shenkin, the Aberdare collieries are now at full work. In the Rhondda, which has suffered much, there is an improvement, and the house collieries are doing better. The Plymouth colliers and the manager have arranged differences. The coal clearances to foreign destinations from Cardiff amounted last week, in round numbers, to 140,000 tons; from Newport, 30,000 tons; and from Swansea, 35,000 tons. Seventy-five vessels came into Swansea last week. Patent fuel trade is better, but small steam coal is not so good.

Quietness prevails in the tin-plate trade, and there are grave fears prevailing with regard to the continuance of the American trade in anything like vigour. Efforts are being made in the United States to make black plate, and, rumour states, with some degree of success. Hitherto we have enjoyed a monopoly almost in the make, having the varieties of coal necessary for making the best kind.

Present coal prices:—Best colliery screened, 9s. 6d. to 10s. 6d.; No. 2, 8s. 6d.; No. 3, 9s. Patent fuel price, 10s. Iron ore is in little demand.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

13*th January*, 1885.

426. FUSES, D. F. Downing, Woolwich.
427. FEEDER for LIQUID HOLDERS, W. Foxcroft, Birmingham.
428. SAFETY BICYCLES, J. S. Edge, Birmingham.
429. WINDING YARNS, B. A. Dobson, Manchester.
430. SOWING SEEDS and MANURE, D. Jones, Lymington.
431. COMPOUND MARINE STEAM ENGINES, A. C. Kirk, Glasgow.
432. CLOCK and WATCH DIALS, J. Eshelby, Dublin.
433. AUTOMATICALLY-CONTROLLED SAFETY PERAMBULATOR, W. Crawford, Dudley.
434. TOOTH BRUSH, J. Willis, Henley-on-Thames.
435. POLICE and other WHISTLES, J. Hudson, Birmingham.
436. DISH-COVER HANDLE, &c., T. H. Daniel and T. R. Arter, Birmingham.
437. TORPEDO RAILWAY SIGNALS, T. G. Palmer, London.
438. STEAM PUMPING ENGINES, S. G. Browne and W. Boby, London.
439. MARKING-INK PENCILS, H. W. Langbeck, London.
440. WRITING INK, L. H. Armour, London.
441. HOLDING, &c., POSTAGE STAMPS, A. B. Calder, Glasgow.
442. IMPARTING PRESSURE to the COVERS of SILOS, C. F. Roberts, Halifax.
443. ROTARY MOTOR, J. Poyser, London.
444. RAISING and FORCING WATER, R. Balcombe and N. Balcombe, London.
445. SMOKING PIPES, V. P. Eadon, London.
446. SHIRTS, J. E. Jones and E. H. Jones, London.
447. PURIFYING VEGETABLE FATS and OILS, W. P. Thompson.—(*C. Hellfrisch, Offenbach-on-the-Main.*)
448. TRAMWAY RAIL CLEANERS, T. Hayes and F. Salter, Liverpool.
449. PATTERNS for PLATE MOULDING, G. Oulton, Liverpool.
450. STOVE, J. Yeadon, London.
451. BOW STEERING GEAR, C. A. Ganthony, Richmond.
452. RUDDER FASTENERS, C. A. Ganthony, Richmond.
453. REDUCING the HEAT of a BODY of WATER to an EQUAL TEMPERATURE THROUGHOUT, H. J. Worssam, London.
454. BOTTLE STOPPERS, H. C. Walter, London.
455. PRINTING TELEGRAPH, G. M. Hathaway, London.
456. PROVIDING a MEANS of COMMUNICATION BETWEEN DEAF and DUMB PEOPLE, H. W. Eaden, London.
457. GENERATION of ELECTRICITY, G. F. Redfern.—(*A. Bernstein, Frankfort-on-the-Main.*)
458. PICKING STRAPS for LOOMS, T. Fryer and J. W. Bairstow, London.
459. MOVING TOY SKIPPING FIGURES, C. L. Watchurst, Lee.
460. TURNING, &c., SCREWS, &c., E. P. Baville and H. J. Petit, London.
461. SLIPPERS, &c., W. Lichfield, London.
462. MECHANICAL OILERS, H. J. Haddan.—(*H. P. Humphrey, United States.*)
463. CONCENTRATING SULPHURIC ACID, S. B. Bowen, London.
464. SUSPENDING HATS in BOXES, G. Vuitton, London.
465. COMBINED TRUNK and BED, G. Vuitton, London.
466. LOOKING GLASS SWIVELS, J., J. W., and J. Mark, London.
467. LOOMS, H. Bradbury, London.
468. CARTRIDGES, H. F. Clark, London.
469. EXPANSION JOINT for STEAM and WATER PIPES, H. W. Allan and J. G. Whitehead, London.
470. SECURING PICTURES, &c., in FRAMES, B. Maddock, London.
471. BLEACHING WEBS or YARNS, W. Mather, London.
472. AIR-GAS APPARATUS, J. Imray.—(*P. J. Carmien, Issy.*)
473. TIME-KEEPERS, A. J. Boult.—(*J. Fischer, Vienna.*)
474. CONNECTING PARTS of FURNITURE, &c., A. J. Boult.—(*V. Coll, Tarbes.*)
475. FEED-WATER HEATERS and ECONOMISERS, A. R. and F. R. Donisthorpe, and G. White, London.
476. MANUFACTURE of FELT, A. J. Boult.—(*A. Munzinger, Olten.*)
477. PASSING AIR into CASKS, &c., J. P. Kendall, Roehampton.
478. SAFETY UNSPILLABLE LAMP, W. Stobbs, London.
479. MANUFACTURE of IRON or STEEL, J. L. y Sardà, London.
480. DISINTEGRATING, &c., DIAMONDIFEROUS SOIL, &c., H. J. W. Raphael and J. Syme, London.
481. GAS CHECKS for PROJECTILES, C. K. Farquharson and R. R. Gubbins, London.
482. FLEXIBLE DIAPHRAGMS, R. R. Gubbins and C. K. Farquharson, London.
483. ENSURING UNIFORM TENSION of WARP THREADS of LOOMS, H. Gardner.—(*L. Fleurot and E. Vial, France.*)
484. DEVELOPING, &c., FORCE in an ELECTRIC CIRCUIT, J. S. Williams, New Jersey, U.S.
485. ELECTRICAL ACCUMULATORS, J. S. Williams, New Jersey, U.S.
486. PRODUCING DEVICES in or between SHEETS of GLASS, J. L. Hancock, London.
487. MAINTAINING DIRECT ELECTRICAL COMMUNICATION between the SHORE and any VESSEL, F. Le B. Bedwell, London.
488. MANUFACTURE of WOVEN FABRICS, H. Benn, London.
489. FALSE SHIRT FRONTS, A. M. Clark.—(*G. W. Lee, U.S.*)
490. PORTABLE FOLDING BEDSTEADS, J. Dixon, London.
491. NITRO-CELLULOSE COMPOUND, W. V. Wilson and J. Storey, London.
492. SHIRT COLLARS, W. D. Butler, London.
493. VALVES for PUMPS, &c., W. R. Lake.—(*A. Riedler, Aachen.*)
494. FRICTION CLUTCHES, W. R. Lake.—(*W. Van V. Lidgerwood, U.S.*)
495. FACILITATING the CONTROL of RAILWAY or other TICKET OFFICES, W. R. Lake.—(*J. Müller, Schaffhausen.*)
496. COMBS for FLAX, &c., W. F. Hall, London.

14*th January*, 1885.

497. TREATMENT of SPENT OXIDES of IRON, &c., J. Robinson, Liverpool.
498. WHIP SOCKETS, J. Cottrell, sen., Bristol.
499. STIRRING and MIXING FLUIDS, &c., F. B. Welch, Manchester.
500. BOILING SUGAR, F. B. Welch, Manchester.
501. ROASTING COFFEE by means of GAS, T. Fletcher, Manchester.
502. CLOCK and WATCH DIALS, G. A. Fisher, Birmingham.
503. ARTISTS' EASELS, H. W. Pugh, Liverpool.
504. KNAPSACK, G. Warner, Paris.
505. SYPHON WATER WASTE PREVENTERS, M. Syer, London.
506. ELEVATOR BUCKETS, S. S. Stott and R. Birtwistle, Manchester.
507. DIMINISHING the FRICTION of the CHAINS in HAWSE PIPES when LIFTING ANCHORS, A. A. McDougall and F. Thompson, Glasgow.
508. NEEDLES, J. Darling, Glasgow.
509. PHOTOGRAPHIC SHUTTERS or CAPS, W. H. Marshall, Scarborough.
510. FURNACES, J. Riley and W. Crossley, Glasgow.—8*th November*, 1884.
511. BICYCLE BELLS and GONGS, S. Snell and W. Hickin, London.
512. BICYCLE BELLS and GONGS, S. Snell and W. Hickin, London.
513. OSCILLATING SHUTTLE GUARD for PREVENTING SHUTTLES from FLYING, G. Bradley, Oldham.
514. DRIVING the FLYERS of SPINNING MACHINES, J. W. Dawson and H. Simpson, Manchester.
515. REMOVING, &c., the PANS of EARTH CLOSETS, D. Barclay, Glasgow.
516. WATCHES, &c., F. G. Swinden, Birmingham.
517. SHIPS' SIGNAL LAMPS, S. Jenkinson, London.
518. COLLECTING and DIFFUSING HEAT, T. Pickup, London.
519. TARGETS and BUTTS for RIFLE PRACTICE, R. Thomson, Glasgow.
520. APPLYING SMOKE TEST to DRAINS, &c., F. Botting, London.
521. CIRCUIT CLOSERS, the Hon. R. T. D. Brougham and J. K. D. Mackenzie, London.
522. ENVELOPES, J. Hodgson, London.
523. CHECKING APPARATUS, J. Lott, London.
524. CLEANING CARPET, T. J. Stewart, London.
525. LITHOGRAPHIC STONES, H. Maclure, London.
526. WINDOW RACK PULLEYS, W. Hitchin, Birmingham.
527. PERAMBULATOR JOINTS, L. L'Hollier and T. Luckett, Birmingham.
528. DISTRIBUTING or TURNING-OVER GRAIN, &c., P. Evans, London.
529. LIFTING, REFINING, and PRESERVING BEER, S. Bennett, London.
530. MASTS, R. Bateman, Birmingham.
531. FILING ACCOUNTS, R. T. W. Cave and J. Harrison, London.
532. TWISTED GUN and PISTOL BARRELS, W. James, London.
533. BRUSHING the BRIMS of SILK HATS, &c., R. J. Jewell and H. W. Casperd, London.
534. STOPPER, W. Cullman and A. Sieber, London.
535. WINDOW SASH-LINE FASTENER, R. Henry, London.
536. FINGER-BOARD for MUSICAL INSTRUMENTS, P. von Jankó, London.
537. PUMPS, J, Parker and A. Bladon, London.
538. VELOCIPEDES, A. C. Sterry, London.
539. PIANOFORTES, C. Collard, London.
540. CLOCKS and WATCHES, P. Bettle, London.
541. INJECTING, &c., GASEOUS FLUIDS, R. M. Deeley, jun., and J. J. Robins, London.
542. LAWN TENNIS NET POSTS, G. G. Bussey, London.
543. GAS MOTOR ENGINE, F. J. Odling, London.
544. FIXING REELS upon FISHING RODS, T. C. Hughes, Redditch.
545. SEPARATING MICRO-ORGANISMS, &c., from their LIQUIDS, T. R. Shillito.—(*Dr. K. Mölter, Kupferhammer.*)
546. CASES for NEEDLES, &c., J. Cottrill, Birmingham.
547. WAXING and OILING PAPER, H. Mason and W. Rawlinson, London.
548. SIMULTANEOUSLY ALTERING the DISTANCE APART of TOOLS or SPINDLES in MULTIPLE DRILLING MACHINES, R. M. Bailey, jun., London.
549. BORING and FACING RAILWAY, &c., WHEELS, R. Hadfield, London.
550. TRUSSES for SUPPORTING WHEELS on the AXLES of RAILWAY VEHICLES, W. R. Lake.—(*C. E. Eaton, United States.*)
551. STEP and BOLSTER BEARINGS for the SPINDLES of SPINNING MACHINES, G. E. Taft and H. F. Woodmancy, London.
552. GUNPOWDER, H. S. Maxim, London.
553. PINS, W. L. Wise.—(*M. E. Grow, United States.*)
554. SYPHON, W. R. Lake.—(*G. Stollwerck, Cologne-on-the-Rhine.*)
555. WARMING and DRYING BOOTS or SHOES, R. E. Keen, London.
556. BOOTS and SHOES, E. C. Hutchings, London.
557. TUBE EXPANDERS, G. Sonnenthal.—(*E. Sonnenthal, Berlin.*)
558. PIPE WRENCHES, G. Sonnenthal and W. Keen, London.

15*th January*, 1885.

559. SADDLE BARS, L. Rolleston, London.
560. CUTTING CYLINDRICAL RODS, D. Massey, Manchester.
561. FURNITURE CREAM, R. Williamson, Kingston-upon-Hull.
562. TELEGRAPH SIGNAL, &c., POLES, W. B. Incledon, Liverpool.
563. CONVEYING BULK CARGO to and from SHIPS, H. D. Brandreth, Liverpool.
564. UNHAIRING, &c., HIDES, T. Wheelhouse, Halifax.
565. SECURING the LIDS or COVERS of PACKING-CASES or BOXES, E. H. Lawton, London.
566. PREVENTING TRAPS in LOOMS, D. Greenhalgh, Halifax.
567. GROOVING, &c., the SHAFTS of UMBRELLAS, W. H. Ronald, Bannockburn.
568. CONNECTING and WORKING CYCLOMETERS, J. Harrison, Birmingham.
569. REVERSIBLE SPINNING TOY, J. Davies, Buckley.
570. STEAM HAMMERS, G. Stevenson, Glasgow.
571. BOTTLES and STOPPERS, H. B. Creeke and M. Dempster. Burnley.
572. ANNEALING IRON CASTINGS, G. Asher, Birmingham.
573. COUPLING, &c., VEHICLES, T. F. Barlow, W. Schofield, and J. Royston, Manchester.
574. WORKING SIGNALS, &c., J. Royston, R. Turner, and R. Webb, Manchester.
575. HOUSEBREAKING, &c., PROTECTOR, H. Schoolhof, London.
576. BICYCLE SAFETY GUARD, H. Cockson, Liverpool.
577. WET SPINNING FRAMES, J. B. Pirrie, Carrickfergus.
578. MACHINE for GROOVING ROLLERS, G. F. Thompson, Chester.
579. COMBINATION LADDER, STEPS, or TRESTLE, S. Graham, Liverpool.
580. BARREL LOCK, T. H. Brindley, Birmingham.
581. CLOCKS, V. L. A. and C. N. Blumberg.—(*M. Redier, Paris.*)
582. TELESCOPIC LATTICE WINDOW-GUARD, H. R. Hughes, London.
583. BOOTS and SHOES, J. Cutlan, London.
584. FASTENING for STOPPERS for BOTTLES, W. P. Adams, Barnes.
585. DISTRIBUTING LIQUIDS, C. F. Claus, South Wimbledon.
586. BRAKES, B. C. Evers.—(*J. R. Baker, U.S.*)
587. COMBINED TABLE, WASHSTAND, or SIDEBOARD, C. Wilton, London.
588. GOODS WAGONS, J. Riley, Strand.
589. BRUSHES for CLEANING BOTTLES, I. K. Rogers and A. Applegate, London.
590. FILTERS, G. Haycraft, Lyme Regis.
591. JOINING TRICYCLES to form TANDEM, F. J. J. Gibbons.
592. ARTIFICIAL FUEL, J. Robbins, London.
593. ELECTRIC CONTACT APPARATUS, G. Binswanger, London.
594. TRAVERSE NET, A. C. Travell, Nottingham.
595. STEAM ENGINES, G. Porteous, London.
596. LOOMS, P. Young and J. Mathieson, London.
597. CONNECTING TELEGRAPH CABLES, R. Aitken. London.
598. TOOLS, &c., for PLANING, H. E. Newton.—(*A. Heurteir, Jeune.*)
599. EDGE-BINDING, A. Keats.—(*J. Keats, Frankfort-on-the Main, and K. Schultheiss, Vienna.*)
600. GAS APPARATUS, H. C. Turner, London.
601. UTILISING the FALL of WEIGHTS as MOTIVE POWER, J. Read, London.
602. WATCHES, &c., H. Ellis, London.
603. FEEDING APPARATUS for CHAIN-MAKING MACHINERY, F. Ley.—(*E. L. Howe, U.S.*)
604. APPARATUS for MAKING CHAINS, F. Ley.—(*E. L. Howe, U.S.*)

605. Coupling Railway Garriages, P. Lindo, London.
606. Appliances for Preventing Dirt from Passing through Pipes, J. Kirkaldy, London.
607. Rigging Yachts, R. R. L. Rosoman, London.
608. Gauging Sheets, &c , W. H. M. Neave, London.
609. Ventilating Appliances, E. Tomlinson, London.
610. Gas Engines, J. H. Johnson.—(*J. E. Lenoir, Paris.*)
611. Compressing Air, E. Edwards.—(*A. A. E. G. de Vicq De Cumptich, Turnhout.*)

16th January, 1885.

612. Dynamo-electric Machines, F. Preston, Manchester.
613. Tire Heater, W. Fisher.—(*Messrs. I. Bidwell, United States.*)
614. Chronoscopes, R. M B. White, Nunhead.
615. Appliances for Oil Lamps, J. Roots, London.
616. Machinery for Solidifying Coal, &c., H. G. Fairburn, Cardiff.
617. Screen for Dividing Rooms into Sections, W. H. Briggs, Halifax.
618. Combination Screen, Table, and a Receptacle for Coals, A. Barr, Glasgow.
619. Holder for Spools, &c., A. Barr, Glasgow.
620. Railway Keys for Chairs, S. L. Broom, Llanelly.
621. Rack Pulleys, E. V. Bailey, C. Mackey, and N. Brough, Birmingham.
622. Shoes for Horses, R. Longdon, Manchester.
623. Securing Door Knobs and Handles, E. V. Bailey, Birmingham.
624. Breech-loading Small Arms, T. Woodward, Birmingham.
625. Dust Collector for Flour Mills, W. Stringer, Manchester.
626. Propelling Vessels, &c., W. M. Walters, Liverpool.
627. Apparatus for Exhibiting Names on Walls, &c., J. C. Claxton, Liverpool.
628. Miners' Safety Lamps, I. Lucas, London.
629. Purifying and Utilising Sewage and Impure Waters, H. Wagener and A. Müller, London.
630. Tempering Steel by Electricity, A. Thomson and R. O. Ritchie, London.
631. Coal Savers, R. Rowbotham, London.
632. Improvements in Locomotive Engines, E. Fletcher, London.
633. Flour Dressing Machines or Screens, L. Reynolds, London.
634. Construction of Wheels for Velocipedes, W. Cross, London.
635. Apparatus for Feeding Puppies, &c., F. A. M. Boycott, London.
636. Cinder Sifter, S. R. Alexander, London.
637. Heating and Purifying Water for Steam Boilers, J. Atkinson, London.
638. Indicators for Steam Engines, J. Atkinson, London.
639. Arc Lamps, R. P. Sellon, Surrey.
640. Block Signalling on Railways, R. R. Harper, London.
641. Gas Engines, G. Barker, London.
642. Producing Surfaces Resembling Marble, &c., J. Budd, London.
643. Chairs or Stools, A. Gillespie and J. Bayne, London.
644. Feeding Water into Steam Boilers, T. and D. McCulloch, and T. White, London.
645. Steam Boilers, O. Meredith, London.
646. Boxes for Leads, &c., E. H. Schmidt, London.
647. Composition for Joining the Ends of Driving Bands, M. Berlinger, London.
648. Boots and Shoes, W. R. Thorpe and J. W. Greasley, London.
649. Fog, &c., Signals, S. Keys, G. Edlington, and J. Footit, London.
650. Opening Internally Stoppered Bottles, J. Kay and G. Jackson, London.
651. Kitchen Boilers, W. Braithwaite, London.
652. Telephone Transmitters, T. J. Handford.—(*E. H. Johnson, U.S.*)
653. Treatment of Animal Bladder and Gut, J. Baily, London.
654. Economic Production of Electric Light, B. J. B. Mills.—(*C. J. M. Barbier, Lyons.*)
655. Desiccating Air, J. Dick, Glasgow.
656. Steam or Air Slide Valves, &c., G. T. Parnell, London.
657. Interfering Boot for Horses, &c., P. M. Justice.—(*H. W. Kampf, Hanover.*)
658. Distilling Alcoholic Liquids, E. Edwards.—(*J. A. de Peyronny, France.*)
659. Boats, E. L. Berthon, London.

17th January, 1885.

660. Kitchen, &c., Fire-grates, T. S. Clapham, Keighley.
661. Cues for Billiards, &c., W. H. Blackwell and J. Redyard, Ashton-under-Lyne.
662. Folding Ambulance Chair, R. A. Mowll, Portsmouth.
663. Closing and Opening Bottles, S. Bunting, Dublin.
664. Hoisting Apparatus, T. H. Ward, Tipton.
665. Binnacles, W. T. C. Pratt, Newport.
666. Controlling the Shuttle-boxes of Looms, R. L. Hattersley and J. Hill, Keighley.
667. Bicycle and Tricycle Lamps, J. Thomas, Birmingham.
668. Pipe and Flue Cleanser, T. Thorp, Whitefield, and T. G. Marsh, Failsworth.
669. Tiles, &c., P. Walker, Glasgow.
670. Coats, Jackets, &c., S. Wood, Manchester.
671. Treating Ores, S. Trivick, Clapham.
672. Trousers, &c., S. Wood, Manchester.
673. Combined Belt and Cartridge Carrier, R. Kew, Manchester.
674. Dyeing or Washing Hanks of Yarn, &c., E. Boden, Manchester.
675. Stretching Rollers, J. Hawthorn and J. P. Liddell, Manchester.
676. Fireplaces, J. Smith, Liverpool.
677. Box End for Looms for Weaving, J. Yates, Burnley.
678. Velocipedes, W. Martin, London.
679. Swivel Joints for Gas, &c., Pipes, T. Fletcher, Manchester.
680. Steam Boilers, G. H. Baxter, Glasgow.
681. Warping Mill Bobbins, R. Topott, London.
682. Spring Inside of a Bracelet Case, W. Nathan, London.
683. Parlour Cricket, M. F. Bailey, London.
684. Cranks, J. F. Hall and J. Verity, London.
685. Ventilating, &c., Buildings, S. von Kosinski, London.
686. Heating, &c., Apparatus, R. Jackson, Halifax.
687. Bleaching, G. Kassner, London.
688. Compound Steam Engine, R. H. Twigg, London.
689. Perambulator Bodies, M. R. Cook, London.
690. Gas, J. F. Schnell and J. Read, Manchester.
691. Hose or Pipe Couplings, J. H. Fenner, London.
692. Opening and Closing the Doors of Hansom Cabs, E. Powell, London.
693. Production of Sugar, C. D. Abel.—(*M. M. Rotten, Germany.*)
694. Machines for Cutting Roots, B. Tomlinson, London.
995. Portable Apparatus for Soldering Operations, W. W. Hacking, London.
696. Boilers, &c., for Heating Water by Gas and Air, W. H. Staynes, London.
697. Rails for Railways and Tramways, J. Hughes, London.
698. Insulated Hats and Helmets, W. Johnson, London.
699. Electric Batteries, C. W. Stewart and R. Oakley, London.
700. Watches, &c., for Denoting the Day of Twelve or Twenty-four Hours, J. S. Johnson, London.
701. Suspenders or Braces, D. and T. Taylor, London.
702. Velocipede Wheels, G. Singer, London.
703. Life-rafts, C, Wraa, London.
704. Flexible Joints employed in Working Railway Brakes, J. H. Johnson.—(*MM. Lecouteux and Garnier, France.*)
705. Domestic Hand Lamps, C. Barton and E. G. Colton, London.
706. Governors for Motive Power Engines, T. Heather, London.
707. Sewing Machines, E. J. V. Earle.—(*R. Hochstrasser, Switzerland.*)
708. Pocket Books, G. A. Mower, London.
709. Warming Food, H. Poths, London.
710. Fixing Printing Plates, C. E. and E. J. Layton, London.
711. Making Packing Cases, &c., S. S. Bosworth, London.
712. Hulling, &c., Beans, W. R. Lake.—(*G. Stollwerck, Germany.*)
713. Facilitating Calculation, W. R. Lake.—(*T. Bourgeois, France.*)
714. Aerostats, &c., J. H. Johnson.—(*J. Buisson, France.*)
715. Rotary Cutters, J. M. Black, London.

19th January, 1885.

716. Removing Railway Carriages, W. Cooper, Nantwich.
717. Heating Water by Gas, J. Hart, Reading.
718. Fret Saw or Piercing Frames, J. H. Herbert, Wolverhampton.
719. Clocks, J. Wood, Halifax.
720. Cutting, &c., Sausage Meat, W. G. Gregory, Salford.
721. Boxes, E. H. Cashmore and F. W. Mole, Birmingham.
722. Gymnastic Apparatus, R. Aubrey, Liverpool.
723. Perambulator Hood Joints, &c., B. E. Saunders, Birmingham.
724. Pincase Clip or Fastener, F. W. Amsden, Birmingham.
725. Bricks for Paving Cattle Sheds, C. G. Tebbutt, Bluntisham.—*26th July*, 1884.
726. Paris Ride, H. Thwaites, Preston.
727. Ventilation of Diving Bells, F. J. Lynam, Ballinasloe.
728. Mechanically Shaping Roofing Tiles, T. and H. Grimbleby, Hull.
729. Safety Bicycle, C. E. Hodges, London.
730. Spindle and Flyer Apparatus, W. C. and J. H. Whitehead, Leicester.
731. Producing Chlorine and Hydrochloric Acid from Solutions of Chloride of Calcium, T. Twynam, London.
732. Covered Cotton Cores, J. A. Sparling, London.
733. Weaving Wire Picket Fences, G. Q. Adams, New York.
734. Thrashing Machines, J. Marshall, London.
735. Card Case, A. Ingram and C. May, London.
736. Training Hops. &c., A. D. Curling, London.
737. Opening Lemonade, &c., Bottles, N. Booth, Leytonstone.
738. Thrust Bearings, W. J. Carver, London.
739. Travellers for Spinning Machinery, P., R., and J. Eadie, Manchester.
740. Treating Sulphides of Calcium, E. F. Trachsel, London.
741. Production of Albuminous Matters, I. Lucas, London.
742. Steam Boilers, G. W. Claussen, jun., Germany.
743. Silos, W. Bayliss, London.
744. Bottle Stopper, J. C. Schultz, London.
745. Using Electro Plates in Stereotype Plates, J. M. le Sage, London.
746. Curing Smoky Chimneys, G. Pickett and G. A. Skinner, London.
747. Axle Bushes for Carts, R. B. Black and W. Jones, London.
748. Power Accumulating Brakes for Tram-cars, C. A. Ivensen, London.
749. Constructing, &c., Electrical Machines, J. S. Williams, Riverton, U.S.
750. Regulating Electrical Machines, J. S. Williams, Riverton, U.S.
751. Utilising Electric Force, J. S. Williams, Riverton, U.S.
752. Utilising Electric Force, J. S. Williams, Riverton, U.S.
753. Obtaining Conditions in Electrical Apparatus, J. S. Williams, Riverton, U.S.
754. Operating Metallurgical Processes, J. S. Williams, Riverton, U.S.
755. Pressing Seams of Garments, T. R. Douse, London.
756. Decomposing Bi-sulphide of Barium, E. F. Trachsel, London.
757. Purifying Hydrate of Strontium, E. F. Trachsel, London.
758. Boxes, J. Rogers, London.
759. Composition for Increasing Speed of Steamers, J. S. Carter and R. H. Vigor, London.
760. Arranging Printed Strips in Form, A. W. Granville, London.
761. Type-writing Machines, M. H. Dement, London.
762. Motive Power Apparatus, A. Pifre, London.
763. Measuring Electro-motive Force, R. Threlfall, London.
764. Apparatus for Firing Ordnance, C. D. Abel.—(*J. Jenc, Austria.*)

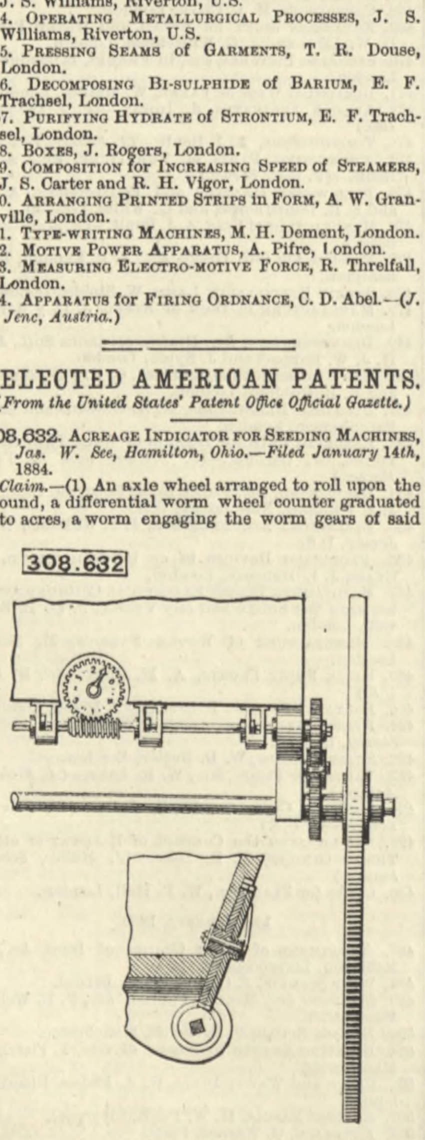
SELECTED AMERICAN PATENTS.

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

308,632. Acreage Indicator for Seeding Machines, *Jas. W. See, Hamilton, Ohio.—Filed January 14th*, 1884.

Claim.—(1) An axle wheel arranged to roll upon the ground, a differential worm wheel counter graduated into acres, a worm engaging the worm gears of said

308.632

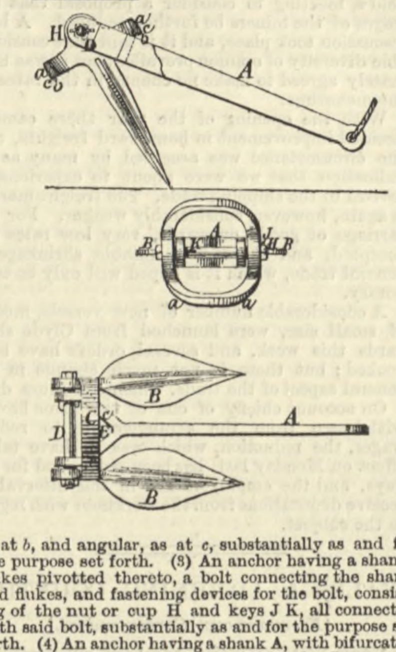


counter, and converting gearing arranged to transmit rotary motion from said axle to said worm, all combined and arranged for operation substantially as set forth. (2) An axle wheel arranged to roll upon the ground, a series of seed cups, and seed cup shaft, a worm upon the seed cup shaft, a differential worm gear counter graduated into acres and engaged by said worm, and converting gearing arranged to transmit motion from said axle wheel to said seed cup shaft and worm, all combined and arranged for operation substantially as set forth. (3) A seed box, a series of seed cups secured thereto, a seed cup shaft engaging said seed cups, and provided with a worm, an axle-wheel arranged to roll upon the ground, converting gearing arranged to transmit motion from said axle wheel to said seed cup shaft and worm, and a differential worm wheel counter graduated into acres and secured against the seed box in such position that the plane of separation of the two worm gears of the counter will cut the axis of said seed cup shaft, all combined and arranged for operation substantially as set forth.

308,646. Anchor, *Joseph T. Williams, Easton, Pa.—Filed November 20th*, 1883.

Claim.—(1) An anchor having a shank with a bifurcated crown and ears at the ends of the crown, flukes with ears coincident with the ears of the crown, and a bolt passing through the eyes, and a double arch-shaped yoke, which is formed seamless and integral with the flukes, said parts being combined and operating substantially as and for the purpose set forth. (2) In an anchor, a yoke connecting the flukes formed integral therewith, and having its external face rounded, as at *a*, the front or top face broadened,

308.646

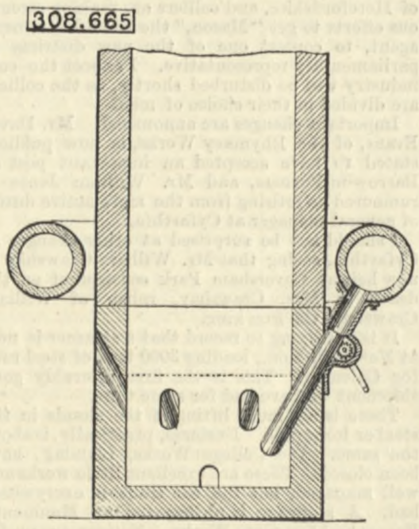


as at *b*, and angular, as at *c*, substantially as and for the purpose set forth. (3) An anchor having a shank, flukes pivotted thereto, a bolt connecting the shank and flukes, and fastening devices for the bolt, consisting of the nut or cup H and keys J K, all connected with said bolt, substantially as and for the purpose set forth. (4) An anchor having a shank A, with bifurcated crown E, flukes B, pivotted thereto, a yoke C, connecting said flukes, and an independent bolt D, said bolt connecting the flukes with the bifurcated crown of the shank, said yoke and both flukes being integral and seamless, and said yoke having its external face rounded, as at *a*, the front or top face broadened, as at *b*. and the edge angular, as at *c*, substantially as and for the purpose set forth.

308,665. Cupola Furnace, *Fred. W. Gordon, Pittsburg, Pa.—Filed February 18th*, 1884.

Claim.—(1) The combination of a walled vessel adapted to receive a charge of molten metal, a circumferential series of tuyere receiving apertures through the wall of said vessel, each aperture being arranged at an angle with its interior end below the metal line of the vessel and its exterior end above the metal line of the vessel, and tuyeres fitted to reciprocate through said apertures into the bath of metal and connected with a source of blast, and mechanism for withdraw-

308.665

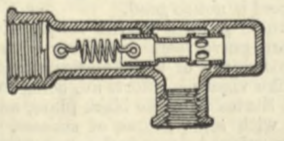


ing the tuyeres from the wall of the vessel. (2) The combination of a walled vessel adapted to receive a charge of molten metal, a circumferential series of tuyere receiving apertures arranged in the wall of said vessel and disposed angularly, and with their interior ends below the metal line, as set forth, a stack part above said vessel, but separated from it, and retractile tuyeres fitted to be reciprocated through said apertures, protruded into and withdrawn from the charge of molten metal, and protruded inward through or withdrawn entirely from the vessel wall.

308,757. Automatic Cylinder Drainer, *D. R. Dingley, New York, N.Y.—Filed January 23rd*, 1884.

Claim.—(1) In a steam engine, the combination, with its cylinder, of a trap having a valve seat, a sliding perforated valve, and a spring connected to said valve and adapted to be expanded by the steam heat and contracted by the water of condensation to move the valve to alternately open and close the open-

308.757

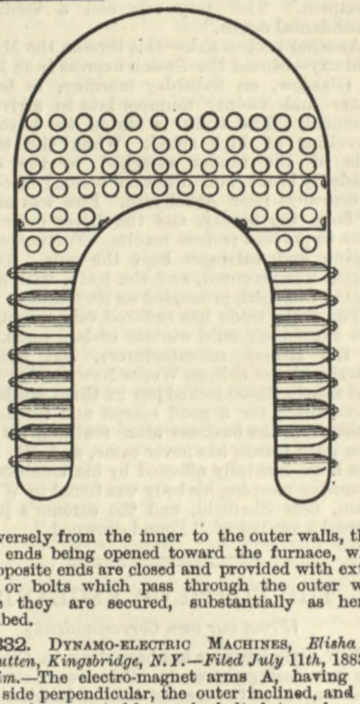


ings, substantially as described. (2) The traps composed of the casing formed with valve seats c^1, in combination with the hollow sliding valve perforated on its side near its end, and a spring adapted by expansion and contraction to move the valve in opposite directions to open and close the same, substantially as described.

308,677. Steam Boiler, *William Kincaid, Oakland, Cal.—Filed September 26th*, 1884.

Claim.—In a steam boiler, a water leg or space surrounding the furnace or fireplace having inner and outer walls, together with short tubes extending

308.677

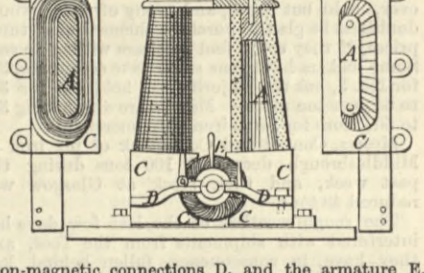


transversely from the inner to the outer walls, their inner ends being opened toward the furnace, while the opposite ends are closed and provided with extensions or bolts which pass through the outer wall, where they are secured, substantially as herein described.

308,832. Dynamo-electric Machines, *Elisha B. Cutten, Kingsbridge, N.Y.—Filed July 11th*, 1883.

Claim.—The electro-magnet arms A, having the inner side perpendicular, the outer inclined, and the upper ends connected by a yoke bolted to each one of them, in combination with the pole pieces C, having

308.832



non-magnetic connections D, and the armature E, provided with bearings in said connections D, whereby the resistance will be decreased without a corresponding decrease in the wire turns or the strength of the field, as described.

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