TRADE DEPRESSION.

THE three Reports of the Royal Commission on the Depression of Trade have been published non-officially, and very many of our readers are, no doubt, familiar with their contents. It will be remembered that a storm of opposition was evoked by the mere proposal that an inquiry should be held; although the inquiry pledged no one to anything. It was argued that the inquiry was only the thin end of Protection, and that the wedge would be driven home on the first opportunity. No investigation of any kind into trade, or the influences affecting it, was to be allowed. If things were wrong, they would right themselves; and so on. The Reports before us contain nothing to justify the alarm expressed by timid or prejudiced individuals. They embody a good deal of information collected from a host of witnesses, some of which is new, and a great deal of which is old; but they leave matters pretty much as they were. It is true that the Fair-Traders — represented by Lord Dunraven and Messrs. Ecroyd, Muntz, and Lubbock—have something to say concerning combatting foreign bounties, and federation, and certain other things, and what they say appears to dispassionate minds common sense; but no one supposes that their recommendations will be carried out. On the other hand, we have an expression of opinion from that thorough-going Free Trader, Professor Bonamy Price, to the effect that to express any doubt as to the operation of shorter hours of labour is a specific repudiation of the great doctrine of Free Trade. Shorter hours of labour do not and cannot, the Professor holds, compensate to a nation for increased cost of production or diminished output. They tax the community with dearer goods in order to confer special advantages on the working-man. They protect him, and that is a direct repudiation of Free Trade. The country is sentenced to dearer and fewer goods. This seems to be pushing Free Trade doctrines somewhat further than working-men will like to go. One of the most noteworthy features in the whole report is the wonderful absence of unanimity manifested by the members of the Commission. The report of the majority admits that the weight of evidence heard is to the effect—(*a*) that the trade and industry of the country are in a condition which may be fairly described as depressed; (*b*) that by this depression is meant a diminution, and in some cases an absence, of profit, with a corresponding diminution of employment for the labouring classes; (*c*) that neither the volume of trade nor the amount of capital invested therein has materially fallen off, though the latter has in many cases depreciated in value; (*d*) that the depression above referred to dates from the year 1875, and that, with the exception of a short period of prosperity enjoyed by certain branches of trade in the years 1880 to 1883, it has proceeded with tolerable uniformity, and has affected the trade and industry of the country generally, but more especially those branches which are connected with agriculture.

Having agreed so far, the Commissioners proceed to differ as to the amount of depression and its causes. Of these the following were suggested and in the main accepted:—(1) Over-production; (2) a continuous fall of prices, caused by an appreciation of the standard of value; (3) the effects of foreign tariffs and bounties, and the restrictive commercial policy of foreign countries in limiting our markets; (4) foreign competition, which we are beginning to feel both in our own and in neutral markets; (5) an increase in local taxation and the burdens on industry generally; (6) cheaper rates of carriage enjoyed by our foreign competitors; (7) legislation affecting the employment of labour in industrial undertakings; (8) superior technical education of the workmen in foreign countries. It will be seen that there is not one subject named in this list concerning which a volume might not be written. We are not surprised to find the questions raised treated inadequately in the reports. They could not be treated adequately for lack of room, if for no other reason.

The more carefully the reports are perused the more clear will it become that there is the widest possible difference of opinion concerning the whole matter, not among the members of the Commission alone, but throughout the country. The Commissioners were from the first puzzled by the ignorance and the prejudice of the witnesses examined. We do not use the words in an invidious sense. No one seems really to understand anything with accuracy about the cause of good and bad trade, prosperity and the reverse. Prejudice steps in and warps the minds of those affected or influenced; and there are almost as many remedies proposed as there are men. The manufacturer holds that if wages were reduced or the hours of labour lengthened we should be better able to face foreign competition, and our trade would revive. The working men, on the other hand, maintain that by shortening hours and reducing output prices must rise and trade get better. The political economist asserts that the working man is totally wrong, and that, the cheaper and more plentiful commodities are, the better off is the country. The Free Trader declares that trade is not free enough. The Fair-Trader asserts that it is in certain respects unnecessarily and harmfully free; and the Protectionist maintains that the great panacea is to be found in high tariffs. Amid all this turmoil it is difficult to find even a satisfactory definition of the meaning of the words "good trade," "bad trade," "depression," and so on. The Commissioners have done their best with this difficulty. In a heterogeneous community such as that dwelling in the British Isles there must be a vast diversity of interests, often incommensurable, and the result is naturally that there is a wide divergence of opinion even as to whether there is any depression of trade at all. The Commissioners say:—"Those who may be said to represent the producer have mainly dwelt upon the restriction, and even the absence, of profit in their respective businesses. It is from this class, and more especially from the employers of labour, that the complaints chiefly proceed. On the other hand, those classes of the population who derive their incomes from foreign investments or from property not directly connected with productive industries, appear to have little ground of complaint; on the contrary, they have profitted by the remarkably low prices of many commodities. As regards the artisans and labourers, the question is rather more complicated. It resolves itself into two:—(*a*) whether the reduction of profits, which has told upon so many of the employers, has prejudicially affected the employed by causing a scarcity of employment; (*b*) whether reductions have been made in their wages, and if so, whether such reductions have been compensated or more than compensated by the low prices of commodities, or by the shortening of their hours of work. There is, however, yet another point of view to be taken. We have to consider the economical condition of the country as a whole, apart from the vicissitudes of particular industries, and to inquire into the national production of wealth, as well as into its distribution among different classes. If the aggregate quantity of commodities produced is on the increase, and is growing at a more rapid rate than the population, we cannot regard the depression in particular industries or among particular classes of producers as an indication of a corresponding national loss. We must not, however, close our eyes to the sufferings which, even in a time of general prosperity, certain classes of producers may have to undergo; and we must bear in mind that what seriously affects one class cannot be without influence on the condition of others."

This is all very well, but it does not seem to advance matters much. Truisms standing alone seldom do. The Commissioners apparently arrived, further on, at the conclusion that depression in trade, as it now exists in this country, means more than anything else a diminution in the profits received by capital, while the working man is better off than he ever was—because his wages have not been reduced, although their purchasing power has greatly augmented. Yet, even as to the reduction in profit, the Commissioners are in doubt. They are not quite sure that it exists. At every turn they have been baffled by the dense ignorance which exists concerning the results of trade in this country. They point out that, while on the one hand, they were assured by witnesses that the country was growing much poorer day by day, on the other hand the income-tax returns show that the country is growing richer. The gross amount of property and profits assessed to the income-tax in the United Kingdom in the year 1885 was £631,000,000, and in the year 1884 £629,000,000. Both of these amounts are largely in excess of the figures of any previous year, and since 1880 no year has shown a decrease when compared with the year immediately preceding. Nor, again, does the increase in these amounts, when compared with the growth of population, point to a very different conclusion. The amount assessed per head in both 1885 and 1884 was £17·6, a figure which has been exceeded in only one year previously, namely, 1876, when it was £17·7; while in the year 1872, notwithstanding the highly profitable character of the trade at that time, the amount per head of population was only £15·3.

The most suggestive passage in the whole Report appears to us to be this: "We have shown that, while the general production of wealth in the country has continuously increased, its distribution has been undergoing great changes; that the result of these changes has been to give a larger share than formerly to the consumer and the labourer, and so to promote a more equal distribution." Under these circumstances capital complains that trade is bad. Enormous sums, too, have been invested in plant, machinery, and other means of producing. With these has grown up an army of workers who depend for their existence on the employment of the machinery and appliances which capital has provided; but employment is not forthcoming, and hundreds—if not thousands—of men are left idle. A percentage of the capital invested is at work, a percentage of the working men of Great Britain are earning wages, and are better off than ever they were before; but for those who cannot get work the times are very evil, and they will admit—nay, clamorously assert—that trade is depressed. It must not be forgotten that there is a certain amount of competition in the world for capital, and that after a time the best investments will secure it. If it appears that ironworks, for example, cannot be made to pay a profit, then capital will be withdrawn, and in the end the iron trade of a district or a whole county may be lost, to the utter ruin of those who have grown up in the expectation that it would support them. It is quite easy to kill the goose which lays golden eggs—that is to say, distribution may be so altered that nothing will be left for capital, all going to labour. Then capital will take to itself wings, and the working man will find too late that without accumulated wealth he is powerless.

Concerning the remedies for trade depression suggested by the Commission a great deal might be said; little need be said. We cordially agree with the statement that if we are to advance, or even to hold our own, "it is obvious that we must display greater activity in the search for new markets, and greater readiness to accommodate our productions to local tastes and peculiarities. Even in matters of so little apparent importance as weights and measures it would seem that our disinclination to adapt ourselves to the requirements of our customers has not been without its effect." There was a time when work came to us; now we must go in search of it. Our condition is very like that of the Western hunter when game is scarce. He who hunts most diligently and most skilfully prospers, while his fellows less active and energetic starve. Not long since we were present at a complimentary dinner given by the head of a firm to his foremen. The firm has never lacked plenty of work, and one of the old hands hit the mark when he said, "Lads, we have not wanted work, because the gaffer always went to look for it long before it was wanted." If we searched more diligently for work and opened up new sources of demand, we would be better off in many respects than we are. For the moment it is likely that the cry concerning depression of trade will be silenced, because there is a wave of demand rolling in on our shores just now; but the wave will spend itself and we shall have the old cry raised again. Let us hope that capital will not now rush in to spoil our markets and ruin existing concerns as it has done before.

We cannot conclude this article better than with the following paragraph, which ought to be learned by heart by every manufacturer in the kingdom. The italics are ours. "The increasing severity of this competition, both in our home and in neutral markets, is especially noticeable in the case of Germany. A reference to the reports from abroad will show that in every quarter of the world the perseverance and enterprise of the Germans are making themselves felt. In the actual production of commodities we have now few, if any, advantages over them; *and in a knowledge of the markets of the world, a desire to accommodate themselves to local tastes or idiosyncrasies, a determination to obtain a footing wherever they can, and a tenacity in maintaining it, they appear to be gaining ground upon us.* We cannot avoid stating here the impression which has been made upon us during the course of our inquiry that in these respects there is some falling off among the trading classes of this country from the more energetic practice of former periods. Less trouble appears to be taken to discover new markets for our produce and to maintain a hold upon those which we already possess; and we feel confident that if our commercial position is to be maintained in the face of the severe competition to which it is now exposed, much more attention to these points must be given by our mercantile classes. There is also evidence that in respect of certain classes of *products the reputation of our workmanship does not stand so high as it formerly did.* The intensity of the competition for markets, while in many respects it has legitimately diminished the cost of production, has also tended to encourage the manufacture of low-priced goods of inferior quality, which have not only failed to give satisfaction themselves, but have also affected the reputation of other classes of goods to which no such exception could be taken. The reputation of British workmanship has also suffered in another way by the fraudulent stamping of inferior goods of foreign manufacture with marks indicating British origin. This appears to be particularly the case with the hardware goods of Birmingham and Sheffield, which have secured so wide a reputation in the markets of the world. We regret, however, to be obliged to add that the practice of fraudulent marking appears from the evidence before us to be not unknown in this country."

WAGES IN GREAT BRITAIN.

No. III.

Bristol.—The most important manufactures of Bristol are those of brass, copper, glass, and zinc. There are also several ironfoundries, lead works, and shipyards. No material change has taken place in the labour conditions during the last ten or twelve years. The district has been free from crises, disputes, and panics, though of late there has been much slackness of work and stagnation. It may be said that the artisan of to-day, compared with the one of ten years ago, knows more, possesses more, and makes better use of what he receives. Attempts are being made to introduce a system of labour partnership, similar to that of France, by which the principles of co-operation are to be applied to production. By this means operatives are, to a certain extent, to be partners in the profits, but do not participate in the losses. The plan is not intended to supersede existing arrangements, but adjusts itself upon them. Fixed or piece-work wages are paid as under the established routine, and at full market rates; but at the end of each business year a share in the net profits realised is assigned as an additional and wholly independent remuneration to the workmen employed. The sum allotted is usually in proportion to the amounts which the men have severally earned during the year for wages. Whether this system will be successful or not is a question which time alone can determine. The expectation is that the labourer's interest in the profits will produce in him such increased amount of attention and energy that there will be larger net returns, part of which will fall to him in consequence of his greater diligence and care to prevent waste. Where this does not follow the system will be a failure; and in some cases it will not follow, because it pre-supposes an amount of care and foresight not usually possessed by the British artisan, though of late he has made considerable improvement in this respect. In many cases work will not be better done, neither will there be less waste in consequence of the prospect of a return in the nature of a bonus at the end of some months. The migratory habits of the workmen, and the difficulty of deciding in times of depression, and when there is not sufficient work for all hands, as to whom are to be dispensed with, further complicates the question. Besides, the relations of capital and labour are not propitious for such an experiment. The representatives of the one are the buyers; the representatives of the other the sellers of labour; and these are the only relations in which they know one another. That absolute separation prevents a community of thought on any subject and often produces an amount of bitterness and dislike between employers and employed. Still, the system is a good one if it can be carried out, and well worthy of an extensive trial. Although the feeling of animosity between employer and employed prevails in many trades, yet, on the whole, it is not so great as in other places. All the large manufacturing establishments which have constructed buildings during the past ten years have made considerable provision for the comfort of their workpeople. One large firm does not take apprentices, but allows every man in their employ to bring up his sons in the same branch of the business in which he is employed himself. Trade organisations are numerous and especially powerful; among the workers in coal, glass, and iron, where their influence is very great, they take particular cognisance of apprenticeship, endeavour to limit the number taken, and sometimes will cease to work in a firm where what they consider the proper proportion is exceeded, and some of the trades sometimes refuse to admit as a member one who has not been properly indentured. Much of the report from Bristol is devoted to the condition of the factory operatives of Trowbridge, and is particularly interesting to those connected with the manufacture of woollen goods, as Trowbridge—a town of 12,000 inhabitants—shows factory life in England under its most favourable aspect. Trowbridge is entirely a manufacturing town; it is large enough to have many of the advantages of more populous places, without burdensome taxation. It is in the midst of a fertile agricultural country, where food products are cheap; and its environs are true country, accessible to its inhabitants in a few minutes' walk. There are no trades unions or societies for regulating hours, prices, or wages, such organisations as exist being of the benefit kind.

Wages Paid per Week in Bristol—General Trades.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Bricklayers	21 3	25 6	29 9
Carpenters	—	25 6	—
Masons	21 3	25 6	29 9
Blacksmiths	27 0	29 3	31 6
Strikers	13 6	15 9	18 0
Brassfounders	—	25 3	—
Ironmoulders	27 11	29 11	31 9
,, (Trowbridge)	20 3	29 11	—
Millwrights	25 5	30 5	40 6
Tinsmiths	20 3	22 9	25 5
Labourers	16 3	18 1	20 3

Wages Paid per Week to Members of Trades Unions.

		s. d.	s. d.
Bricklayers (Cheltenham)	per hour	—	0 7
Carpenters (Tewkesbury)	,,	—	0 6
Masons (Cheltenham)	,,	—	6d.—7
Ironfounders (Bristol)	per week	28 0—	32 0
Shipwrights (Bristol)	per day	—	6 0

Wages Paid per Week of Fifty-four Hours in and in connection with Coal Mines in Gloucestershire.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Branchers	23 3	26 6	30 5
Engineers	21 9	25 3	27 4
Fitters	20 3	23 3	25 4
Hewers	20 3	22 3	33 5
Onsetters	19 3	20 3	21 9
Repairers	20 3	21 9	24 6
Roadmakers	22 9	23 3	24 9
Smiths	20 3	23 3	25 4
Stokers	21 9	23 3	24 6
Labourers	15 2	17 3	20 3

Wages Paid per Week in Iron Shipbuilding and Repairing Yards in Bristol.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Angle iron smiths	—	39 0	—
Blacksmiths	—	33 0	—
Fitters	—	36 0	—
Iron caulkers	—	30 0	—
Iron workers	—	36 0	—
Ship joiners	—	33 0	—
Shipwrights	—	36 0	—
Labourers	—	24 0	—

Wages Paid per Month to Engineers of Steam Vessels in Bristol.

	Lowest. £ s.	Standard. £ s.	Highest. £ s.
Ocean:—			
Chief engineers	14 4	15 4	16 4
Second ,,	10 3	11 3	12 3
Third ,,	6 2	7 2	8 3
Coast:—			
Chief engineers (per week)	3 1	3 3	3 6
Second ,, ,,	2 1	2 3	2 6

Bristol, like other places, has shared in the reduced cost of living caused by the importation of foreign meat, the increased grain production, and the great competition between manufacturers. Besides, many new articles have appeared, at a reasonable price, that add much to comfort. In Bristol, a cottage of from four to six rooms costs from 4s. to 7s. a week; coal is 14s. per ton; and gas from 2s. 6d. to 2s. 8d. per 1000 cubic feet. In Trowbridge a similar cottage may be had for from 2s. 6d. to 6s. a week; coal is 10s. to 19s. 6d. (averaging 15s. 6d.) per ton, and gas 3s. 9d. per 1000 cubic feet. The subject of cost of living is entered into extensively, there being given examples of the expenditure of twenty-one families. These examples differ so in the items, that all which can be done is to give the total amounts expended upon clothing, food, fuel, light, rent, &c.

	Number in family.									
	2.	3.	4.	5.	6.	7.	8.	9.	10.	Average, 6.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Expenses per week	19 8	18 5	22 0	21 10	23 8	24 2	19 9	23 6	27 4	22 3
Income	20 3	24 7	26 11	24 11	26 10	29 8	28 4	24 0	31 3	26 4

Cardiff.—South Wales is one of the chief coal exporting districts. This draws to the parts of the Bristol Channel a large amount of shipping, and in consequence Cardiff, Newport, and Swansea take a prominent position among the great ports of the kingdom. Cardiff is also a place of growing importance as a railway centre. The Great Western Railway passes through from London to its terminus at Milford Haven, and the demands of the coal and iron trades led to the construction of the Rhymney Railway and the Taff Valley Railway. Both lines derive their principal source of income from minerals brought to Cardiff for exportation. Other important industries are those of manufactured iron and tin-plates. The South Wales coal basin is one of the largest in Britain, being something like seventy-three miles in length by sixteen in breadth, and the collieries in the district numbering between 400 and 500. The number of men employed averages 70,000. Wages in the coal trade have for years been governed by equitable arrangements by the sliding scale so generally applied at collieries. The existing scale, which is in operation by virtue of a memorandum of agreement between representatives of the Monmouth and South Wales Colliery Owners' Association and the authorised representatives of the workmen employed, is administered by the joint sliding scale committee, on which eight employers and the same number of workmen sit. The sliding scale is based upon the average net selling price of coal, as ascertained by appointed and representative accountants, at their examination, once in every four months, of the coalowners' books. The standard of wages upon which advances or reductions must be made are the several rates actually paid at the respective collieries for the month of December, 1879, such wages being equivalent to a standard net selling price realised from all the collieries of the association at 7s. 9d. and between 7s. 9d. and 8s. 1d. a ton. The average net prices of coal are taken as for large colliery screened coal delivered free on board at Cardiff, Newport, and Swansea. For coal sold into wagons at the collieries, the equivalent net prices at the ordinary port of shipment are taken in calculating the selling price. The owners of some collieries who do not belong to the association have adopted sliding scales of their own, taking different bases for the calculation of the standard. The hours of labour are the same at all the pits—nine hours from bank. The system of timbering or securing the roof of the working from falling upon the workmen differs in South Wales from the practice adopted in the North of England. There men are specially engaged in the work, and the hands have not anything to do with propping and securing the ceiling. In South Wales the colliers themselves do this class of work, and are expert at it. The proportion of time devoted to this and other necessary labour is about equal to the time employed at face of work—nine hours of hewing would be succeeded by nine hours of clearing away and preparing for more dead working. The manufactured iron trade ranks next in importance to the coal trade, and gives direct employment to about 50,000 men, though the use of native iron is nearly entirely abandoned in favour of foreign, through the percentage of metal in the former being so small. Many of the ironmasters of this district are turning their attention towards steel as a shipbuilding material. Notwithstanding the advantages of this district in the presence of coal and iron, and the existence of some of the largest mills in the kingdom turning out ship plates in large quantities within a few miles of tidal water, shipbuilding beyond the mere business of repairing has hardly been established in South Wales, a country which shows every sign of having a great future before it in the manufacture of rails and ship plates. The tin-plate trade, though nothing near so important as the coal and iron trades, yet gives employment to over 6000 workmen. The relations between employer and employed are good, though there has been considerable friction in the ship repairing trade, and the railway employés complain of their long hours, which are here, like everywhere else, often excessive. Strikes are rare, and much study is everywhere bestowed upon the question of how to prevent accidents in factories, mills, mines, railway works, &c., and very large provision is frequently made for this purpose. In the large manufacturing and mechanical establishments, where a great number of workpeople are employed, a medical man is attached, so as to be always at the service of the men whenever required in cases of accident or sickness. This provision is very necessary, accidents happening from machinery often requiring immediate attention to save life. Payment towards the salary of the surgeon is made by the men employed at the rate of from 2d. to 4d. per week on each £1 received in wages. This secures to the men attendance and medicine free in case of accident or sickness. A similar plan prevails in the colliery districts, the miners contributing 3d. in the pound a week, which entitles them to the same benefits. The only organised conditions of capital are in the cases of the colliery owners and the Cardiff and Penarth shipbuilders. Nearly all the various trades have organised themselves into benefit and protection societies, that of the tin-plate makers being especially powerful, and there is the usual distinction between society and non-society men, though the feeling between the two classes is not so bitter as in larger centres where the numbers belonging to any one trade are greater, and the societies consequently stronger.

Wages Paid per Week in Cardiff—General Trades.

		s. d.	s. d.
Bricklayers		—	33 10
Carpenters		—	34 5
Masons		—	34 0
Blacksmiths		—	34 0
Boilermakers	per day	4 2 —	6 0
Brass finishers	per week	—	30 10
,, founders	,,	—	30 10
Coppersmiths	,,	—	30 10
Cutlers	,,	—	33 4
Engine fitters	,,	—	36 6
Horse shoers	,,	—	30 0
Iron moulders	,,	—	31 8
,, ... Llanelly	,,	—	27 11
,, ... Newport	,,	—	29 11
,, ... Swansea	,,	23 10 —	33 9
Millwrights	,,	—	31 3
Ship smiths	per day	—	6 1
Tin smiths	per week	—	30 5
Labourers	,,	—	20 10

Wages Paid to Members of Trades Unions.

		s. d.	s. d.
Carpenters	per hour	—	0 7½
Amalgamated engineers (Neath)	per week	—	28 0
Ironfounders ... Llanelly	,,	—	27 0
,, ... Swansea	,,	24 9 —	27 0

Wages Paid per Week of Fifty-four Hours in Foundries, Ironworks, and Machine Shops in South Wales.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Foundries, Cardiff—			
Boilermakers	—	39 6	45 7
Fitters	30 5	36 6	40 6
Moulders	—	32 4	—
Patternmakers	30 5	36 6	40 6
Smiths	28 4	32 5	35 6
Labourers	18 3	22 3	28 4
Iron and Steel Works—			
Blacksmiths	30 5	32 5	35 6
Strikers	—	20 3	—
Coal unloaders	—	20 3	—
Fitters	30 5	36 6	40 6
Forge rollers	40 6	43 0	45 7
Furnacemen	—	35 6	—
Helpers	—	20 3	—
Hammermen	27 10	28 10	30 5
Puddlers	27 10	28 10	30 5
Helpers	21 3	21 3	22 3
Machine Shops—			
Enginemen	26 4	26 6	26 6
Erectors	18 3	21 6	24 4
Fitters, foremen	30 5	32 5	34 5
Fitters	26 4	28 6	30 5
Furnacemen	16 2	20 3	24 4
Machinists	16 2	22 3	28 6
Moulders	20 3	28 6	36 5
Pattern makers	30 5	33 5	36 5
Smiths	20 3	28 6	36 5
Strikers	—	18 2	—
Turners	18 3	26 6	34 5
Labourers, fitters	—	15 2	—
,, moulders	—	17 3	—
,, patternmakers	16 2	16 9	17 3

Wages Paid by Messrs. Vivian and Sons, a firm employing over 2300 workpeople, at Swansea.

	Average hours per week.	s. d.
Beltmen	60	21 3
Boilermakers	57	26 4
Helpers	57	14 2
Braziers	72	18 2
Case-makers	54	22 9
Chippers	54	18 3
Cleaners	57	25 4
Coal-trimmers	72	28 4
,, wheelers	58	27 4
Cutters	54	21 3
Dischargers	70	29 5
Dropsmen	72	27 4
Enginemen	66	28 5
Fitters	57	24 4
Apprentices	57	6 1
Foremen	84	42 6
Furnacemen	76	20 3—24 4
,,	84	38 6
Gasmen—foremen	91	83 0
,,	91	35 6
Helpers	60	26 4
Gatemen	63	30 5
Hammermen	54	35 6
Haulers	77	27 4
Hiremen	54	25 10
Hydraulic trimmers	72	28 4
Liftmen	72	15 3
Machine men	60	32 5
Metal heaters	84	15 3
,, wheelers	58	27 4
Millwrights	54	35 6
Mixers	54	83 0
Moulders	57	25 4
Nail bag-makers	54	17 3
Nail drummers	54	22 3
Ore fillers	72	23 4
Ore wheelers	58	27 4
Patternmakers	57	29 10
Apprentices	57	6 1
Picklers	54	15 3 & 24 4
Pressmen	60	25 10
Refiners	63	20 3 & 36 6
,,	72	50 8
Shippers	77	27 4
Slag tappers	72	16 3
Smiths	63	24 4
Strikers	54	15 3
Spike drummers	54	22 3
Stokers	66	20 3
Storekeepers	63	23 10
Timekeepers	63	23 10
Warehousemen	54	25 4
Weighers	54	25 4
Labourers	62	17 3

Wages Paid per Week of Fifty-four Hours in Factories and Mills in Cardiff.

	Lowest. s. d.	Stand. s. d.	Highest. s. d.
Fitters	36 6	36 6	38 9
Millwrights	36 6	36 6	38 9
Smiths	30 5	30 5	32 5
Wheelwrights	30 5	30 5	32 5
Wire rope-makers	21 3	25 4	28 4
Labourers	18 3	20 3	22 3

Wages Paid to Men in the Employ of the Taff Vale Railway Company.

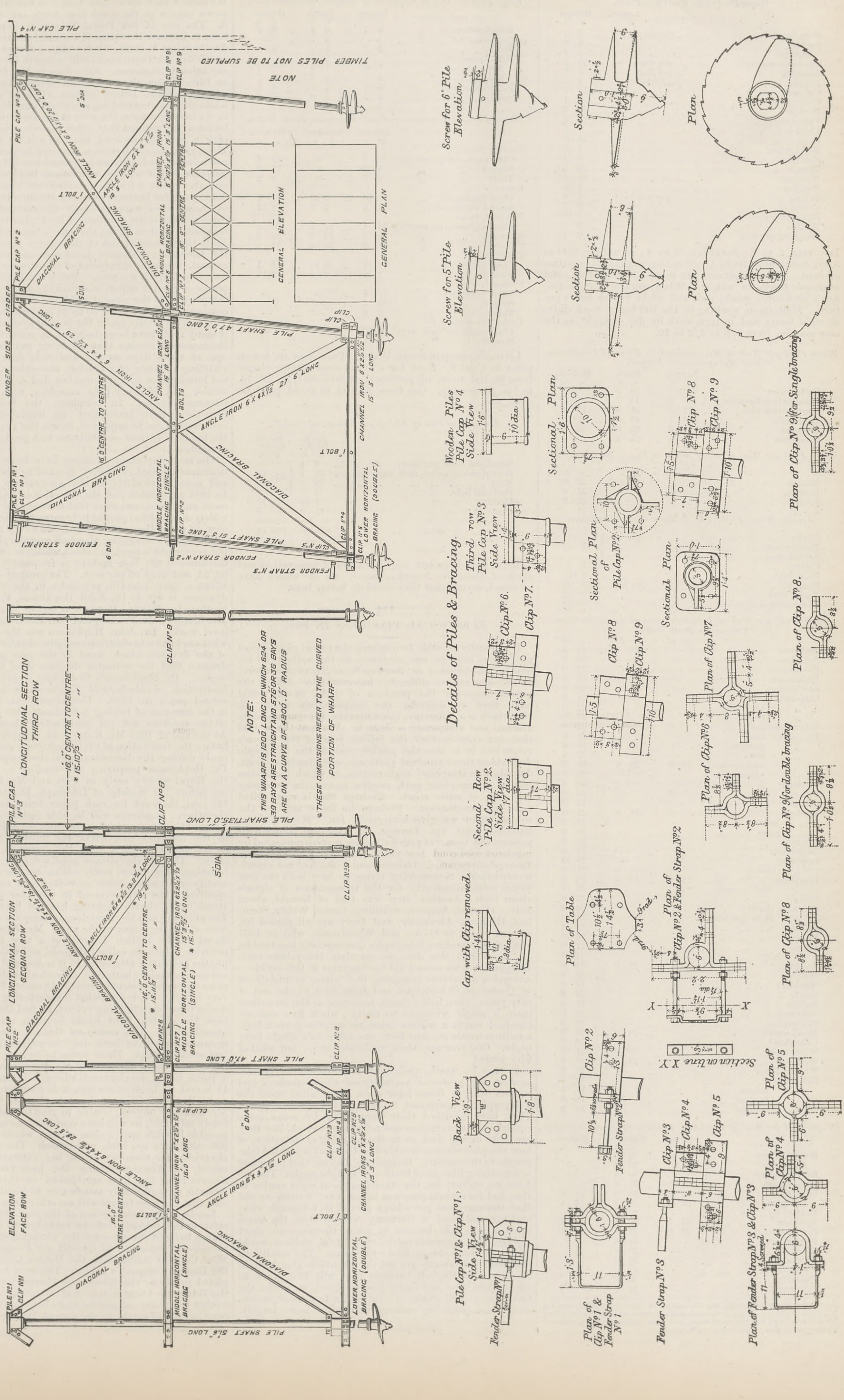
		Lowest. s. d.	Highest. s. d.
Engineering department—			
Gangers	per day	3 9	4 1
Gas fitters	,,	4 1	5 1
Inspectors	,,	5 9	11 0
Platelayers	,,	3 3	3 6
Signal fitters	,	4 1	5 1
Smiths	,,	4 1	5 9
Strikers	,,	2 10	3 1
Labourers	,,	2 10	3 5
Locomotive department—			
Blacksmiths	,,	5 1	6 9
Boilersmiths	,,	4 1	10 2
Carriage builders	,,	3 9	4 11
Coal and coke fillers	,,	3 7	4 1
Coppersmiths	,,	4 0	6 1
Fitters	,,	4 1	7 1
Foremen	,,	10 2	—
Machine-men	,,	3 1	4 9
Patternmakers	,,	6 1	—
Stationary engine drivers	,,	4 3	—
Tinsmiths	,,	4 0	6 1
Turners	,,	3 1	4 9
Wagon builders	,,	3 9	4 9
Labourers	,,	2 10	4 1

Wages Paid in the Tin-plate Trade.

		Lowest. s. d.	Highest. s. d.
Annealers	per week	—	72 0
Assorters	,,	—	40 6
Behinders	,,	—	18 3
Coke wheelers	,,	—	9 2
Engineers	,,	—	28 4
Fitters	per day	6 4	8 5
Forge managers	per week	—	40 6
Mill managers	,,	—	65 10
Scalers	,,	—	20 3

CONTRACTS OPEN—SCREW PILE WHARF AT KURRACHEE.

(For specification see page 49.)



Wages Paid in the Tin-Plate Trade.

		Lowest. s. d.	Highest. s. d.
Shinglers	per day	—	3 1
Smiths	,,	—	6 4
Strikers	,,	—	3 1
Tin-house managers	per week	—	60 9
Labourer	per day	—	3 1
Boxers	per 100 boxes	—	4 3
Catchers	,,	—	12 7
Cold rolling	,,	—	5 1
Doublers	,,	—	23 0
Furnacemen	,,	—	21 8
Picklers	,,	—	6 1
Rollers	,,	—	28 8
Roll turning	,,	—	2 0
Shearers	,,	—	9 1
Tinmen	,,	—	25 4
Washmen	,,	—	25 4
Weighers	,,	—	2 0
Balling	per ton	—	1 8
Couching	,,	—	0 7
Hammermen	,,	—	5 10
Melters	,,	—	3 3
Weighing pig iron	,,	—	0 4

Day men, 6 to 6; Saturday, 6 to 4; in winter, 6.30 to 5.30; Saturday, 6.30 to 4. Standing wages; no overtime allowed. A box contains 112 sheets, 30in. by 14in., and averages 108 lb. in weight. When working by the ton, work alternates weeks day and night twelve hours per turn. Meltermen, working by the 100 boxes, work shifts of eight hours, and in turn work by day or night, as the case may be, 10 to 6, 6 to 2, 2 to 10.

Wages Paid per Week to Men employed in Telegraph Construction and Maintenance in Newport.

	Lowest. s. d.	Stand. s. d.	Highest. s. d.
Batterymen	—	30 5	—
Construction foremen	40 6	44 7	48 7
Construction men	22 3	31 5	40 6
Inspectors	58 5	68 3	77 11
Linemen	18 3	32 6	38 6
Labourers	22 3	25 4	32 6

Wages Paid per Week of Sixty Hours in Copper Smelting Works in Cardiff.

		s d.	s d.
Mixing		21 6	22 6
Refining	piecework	—	57 6
Smelting		—	30 0

Average Wages Paid in Coal Mines in Monmouthshire.

		s. d.
Clerks	per ton.	} 0 $5\frac{3}{5}$
Management	,,	
Surface men	,,	
Cutting	,,	1 8
Dead work	,,	0 $11\frac{3}{4}$
Haulage[1]	per ton	0 $3\frac{1}{4}$
Night work	,,	0 $3\frac{1}{2}$
Underground daymen	,,	0 $2\frac{4}{5}$

Wages Paid per Week of Fifty-four hours at one of the largest Collieries in South Wales.

	s. d.	s. d.	s. d.
Air doors	—	24 0	28 3
Ashfillers	—	—	16 0
Blocklayers	—	—	23 0
Brakesmen	—	—	22 6
Bratticemen	—	—	28 3
Carpenter	—	—	24 6
,, (Air doors)	—	—	22 0
,, (Truck)	—	—	32 0
Coker, foreman	—	—	32 9
Enginemen, fan	—	—	20 0
,, pumping	—	17 0	24 0
,, saw	—	—	17 6
,, underground	20 0	20 6	21 6
,, winding	—	—	26 9
Firemen	—	—	30 0
Fitters	—	—	23 0
Greaser	—	—	12 0
Haulers	—	18 6	22 6
,, master	—	—	24 0
,, pony	—	—	19 0
Hitchers	—	—	22 6
Inclinemen	—	—	19 0
Inspector	—	—	29 10
,, coal	—	17 6	21 6
Lampmen ... 12s. 0d.	18 0	19 6	20 0
,, underground	—	—	24 0
Masons	—	—	32 0
Overman, deputy	—	—	30 0
,, night (pit bank)	—	—	19 0
Painter	—	—	24 6
Pitmen	—	—	26 9
Riders	—	—	21 0
,, bogie	—	—	24 0
Roadmen	—	21 0	24 0
Sawyers	—	—	24 6
Shacklers	—	—	19 0
Smiths	—	—	26 9
Stokers	—	—	21 0
Storekeeper	—	—	20 0
Timbermen	—	—	28 3
Timekeepers	—	18 0	24 0
Unloaders	—	—	19 0
Waste men	—	19 0	31 0
Weighers	19 0	20 0	21 0
Whitewashers	—	—	19 0
Labourers	—	—	19 0
,, cokers	—	—	18 0
,, haulers	—	—	16 9
,, masons'	—	—	18 9

Wages Paid per Week of Fifty-Four Hours in Shipyards in Cardiff.

	Lowest. s. d.	Standard. s. d.	Highest. s. d.
Boiler-makers	—	39 6	—
Assistants	—	23 4	—
Brassfounders	—	40 6	—
Coppersmith	—	36 6	—
Fitters	36 6	38 0	39 6
Assistants	24 4	25 4	26 4
Holders up	—	27 4	—
Moulders	33 5	36 6	39 6
Pattern-makers	33 9	36 6	36 6
Platers	—	42 6	—
Rivetters	—	39 6	—
Smiths	—	36 6	—
Strikers	—	22 3	—
Tinsmiths	—	36 6	—
Labourers	—	24 4	—

[1] Dead work is preparing for the cutting of the coal, that is, making headings, stalls, &c., to get at the coal, and is carried on whenever required by day or night; but the dead work, as a rule, alternates with the coal cutting about every nine hours continuously.

Wages Paid per Day in Shipyards in Newport, Monmouthshire.

	Lowest. s. d.	Stand. s. d.	Highest. s. d.
Boiler-makers	6 1	6 4	6 7
Coppersmiths	—	5 7	—
Fitters	5 7	5 9	6 1
Iron shipwrights	—	6 7	—
Apprentices	1 0	1 9	2 6
Helpers	4 1	4 6	4 7
Pattern-makers	5 1	5 7	6 1
Smiths	5 5	5 9	6 1

Wages Paid to Engineers of Steam Vessels in South Wales.

	Lowest. £ s.	Standard. £ s.	Highest. £ s.
Cardiff, Ocean:—			
Chief engineers (pr. month)	12 2	—	16 4
Second ,, ,,	8 2	—	12 2
Third ,, ,,	6 1	—	8 2
Coast:—			
Chief engineers[2] ,,	3 16	3 19	4 1
Second engineers[2] ,,	2 6	2 8	2 11
Newport, Ocean:—			
Chief engineers (pr. month)	14 4	17 4	20 5
Second ,, ,,	10 3	13 3	16 4
Third ,, ,,	8 2	10 3	12 3
Coast:—			
Chief engineers ,,	2 11	3 16	5 1
Second ,, ,,	1 16	2 3	2 11
Swansea:—			
Chief engineers ,,	17 4	—	—
Second ,, ,,	12 3	—	—
Third ,, ,,	8 2	—	—
Under power boats:—			
Chief engineers (per week)	3 16	—	—
Second ,, ,,	2 11	—	—

Living is cheap in South Wales. Provisions are low in price in Cardiff. Rent for a six-roomed cottage ranges from 3s. 10d. to 5s. 1d. per week. Coal costs from 13s. 7d. to 14s. 2d. per ton. Gas from 2s. 10d. to 3s. 4d. per 1000 cubic feet.

Examples of Cost of Living per Annum in Cardiff.

	Six in family. £ s.	Six in family. £ s.
Bread and flour (per year)	9 4	} 65 16
Butter, cheese, coffee, malt, sugar, tea, &c.	19 1	
Meat	19 5	
Fuel and light	3 7	
Clothing	7 16	11 19
Rent	17 2	13 3
Total	£75 15	£90 18
Incomes	£86 19	£101 5

There have been but very few cases of emigration, and most of these to America, nearly all of whom have returned, saying that they could do better here.

ELECTRICAL PROGRESS IN 1886.

It is hardly possible to condense the report of electrical progress in 1886 in one sentence, as the author did his chapter on "Snakes in Norway":—"There are none." It is almost as difficult, however, to define the precise steps in the progress of 1886, as it would have been to describe the snakes that were *nil*. Still there is a difference, the difference between absolute absence and comparative absence. We have been told that not only is 1887 the jubilee year of the Queen's reign, but it is also the jubilee year of the telegraph. Just about three hundred years ago, one Strada, a Jesuit, described an imaginary conversation, in which loadstones played an important part, needles moving in sympathy hundreds of miles apart. Perhaps Strada only culled from his imagination. Perhaps he knew more of the subject than we give him credit for. More than a hundred years ago Lesarge, of Geneva, transmitted messages by means of pith ball electrometers connected by insulated wires. A few years later, Lomond simplified Lesarge's apparatus. Galvani and Volta had not experimented then. Soemmering seems to have been the first to use voltaic electricity for the transmission of signals about 1809. Another step was that of Ronald, about 1818. Œrsted, Ampère, Schilling, Gauss, Weber, Steinheil, Highton, Alexander, and Davy are all passed by, and we come to Cooke and Wheatstone, who in 1837 succeeded in making telegraphy commercially practicable, and it is from this date we calculate the jubilee year. Imagine—for we cannot aid by diagrams in this article—a complex apparatus requiring five wires, as introduced by Cooke and Wheatstone, and from that to the end of fifty years, when half-a-dozen messages at the same time upon a single wire are no rarity; when five and six hundred words a minute cause no surprise; when half-a-million words are sent from one office in a single busy night. One year may show no decided step; but what of fifty years?

It may be worth while here to utter a mild protest against the profound verbosity of those speakers and writers who, in these later days, have called upon the Telegraphic Department to put its lines underground. They have qualified their suggestions by some inane remarks about induction and references to cost, but they are quite in the dark as to the meaning of induction, of how the phenomenon would affect the working of the telegraphs in this country. Roughly we may say that induction is something like one of two forces at right angles. The one force we utilise; but the other force is at right angles to this, and for certain purposes in our way. Critics cry out that Germany has put a large part of its telegraph wires underground; and if Germany was to stick the moon upon a hop pole because so many Germans are short sighted the ignorant rattle of political writers would advise the Englishman to do the same. The conditions that hold in Germany are not the conditions that hold in England. If English business men will first agree to allow more time and insist less on speed, no doubt the Government will gladly get rid of its fast-speed instruments and patronise underground wires more largely. We cannot have speed and cables at the same time, just as we cannot at the same time keep our cake and eat it. The aim of the Postal Telegraph Department has been to increase the speed of working, and not only in this direction but in every other, so far as service is concerned, our Telegraph Department will compare favourably with any other in existence. According to Mr. Preece's paper at Birmingham, the most recent advance has been in the adoption of the Delany system, which in certain cases, where the line is not too long, permits of hexode working, that is, six messages upon the wire at the same time. It may be taken for granted that other considerations than cost play a part in overhead work as against underground. There is no reason, however, that our large towns should not be connected with underground wires for strategical purposes, but it will be understood from what we have said above that a few such connections would be utterly inadequate for business purposes during a time when the overhead wires were generally disarranged. When we come to discuss the question of local circuits, such as the telephonic system gives, the case is somewhat different. From the scientific point of view, there is no reason why the telephonic system of London should not be underground. From the standpoint of the directors of a private company there is a reason. But is not the danger to the public of greater importance than the welfare of a private company? Is the general public to suffer that a private company shall net from 10 to 20 per cent. on its capital? This is what occurs under the present system. We doubt if many roofs have been designed or constructed to bear the increased strains that are being put on them; and one of these days as the materials decay, under the vitiating influence of a London atmosphere, we may see not hundreds of broken wires but find woodwork, slates, stones, and chimney-pots mingling with the street passenger traffic. In telephony the holders of the monopoly have introduced no improvements. The instruments can be improved, as can the connections, but the public is patient—contributes to a good dividend and grumbles.

The most important advances have been made in that branch of applied electricity devoted to electric lighting, and more particularly in the construction of dynamos. In 1881 we pointed out the direction in which improvement must tend, and since that time our views have been widely adopted and proved to be correct. The lines of force now go where they are required, and a very much smaller percentage go straggling about all over the place. The output per weight is much increased, while the efficiency of the machines of the best makers is frequently said to reach 92, 94, and even 96 per cent. The greatest credit for the advance, upon scientific principles, in the construction of dynamos is due to Dr. John Hopkinson, F.R.S., and his brother, Dr. Edward Hopkinson, and to Mr. Kapp; while Mr. Mordey, Mr. Fricker, and Mr. Esson have also done good work. Dr. John Hopkinson was the originator of what are known to electricians as the characteristic curves of the dynamo, which stand in the same relation to the dynamo that the indicator diagram does to the steam engine. Dr. Hopkinson's first paper was read before the Institution of Mechanical Engineers in 1879, and his second paper in 1880. The advance in 1886 has been in the direction of telling beforehand the characteristic of the machine not yet constructed, though designed. At the end of 1885 Mr. Kapp read a paper on dynamos before the Institution of Civil Engineers, and suggestions made during the discussion upon that paper resulted in Dr. Hopkinson preparing and reading a paper before the Royal Society early in 1886, and Mr. Kapp reading one before the Society of Telegraph Engineers, later in the year, the work for each paper being independent of the other. Engineers will be able rightly to judge the value of this work, which is the same for dynamo builders as the indicator diagram of the finished engine, as far as that can be foretold from the design in the drawing-office. Though electricians must not give way to vain boasting, they may justly claim to be able now to specify a dynamo quite as well as an engine can be specified. The improvement in the other paraphernalia attaching to electric lighting has not been so decided. The arc lamp and the incandescent lamp are much as they were at the beginning of the year. Mr. FitzGerald introduced to the British Association a new form of lead peroxide, which he called lithanode, and which, if possessing the properties attributed to it is destined to materially improve secondary batteries, without which it is becoming more and more evident electric light cannot hope to extend very rapidly. It is somewhat disheartening to those who desire to see ship lighting extend, to find that just at the time the electric light would be most valuable it frequently fails. The reason of this in the majority of instances that have been duly investigated is owing to bad workmanship. There seems to be a ray of hope that the miners' lamp, designed by Mr. Swan, has now reached a point in its development where it becomes practical. It is said to be trustworthy, it is compact, fairly light, and tells the condition of the atmosphere of the mine. If Mr. Swan, or anyone, is able to give the miner an absolutely safe light, he will have conferred one of the greatest possible benefits upon a class of men whose dangers and difficulties are too little understood. The utilisation of electricity for tramway work has extended somewhat rapidly in America during the past year, while the reports from the lines established on this side of the Atlantic are sufficiently satisfactory to justify the conclusion that the near future will see other lines projected.

Lastly, in this brief review of the year 1886, we should refer to the extension of the cable system of the world. Owing to political pressure the Government decided to subsidise a company to connect our Possessions on the West Coast of Africa with the Mother Country through the Eastern Company's cables. The work has been completed partly by the Silvertown Company and partly by the Telegraph Construction and Maintenance Company, so that telegrams can now be sent along the West African coast as far as Loanda, to the various Portuguese, French, and English settlements.

[2] Find their own provision.

RAILWAY MATTERS.

A VESSEL has taken from England the rails and other materials for a railway, which is to be built at the Welsh colony of Chubut, in that portion of Patagonia belonging to the Argentine Republic.

MR. JUSTICE HENRY, of the Supreme Court, recently decided that the Dominion Government had not a good title to the land along the Canadian Pacific Railway in British Columbia, as the Legislature of that province had never made a proper transfer of those lands to the Dominion.

A SPECIAL general meeting of the Freshwater, Yarmouth, and Newport Railway Company was held at the City Terminus Hotel on the 10th inst. for the purpose of submitting to the proprietors a Bill proposed to be introduced into Parliament to abandon parts of the line, to make certain deviations, and avoid a tunnel. The bill was adopted.

THE Prussian Government has just offered to purchase eight more private railways in Prussia, the total cost of construction of which amounted to £9,680,000. The price offered by the Government is £7,370,000. The share capital of the companies is £6,910,000, on which a total dividend was paid in 1885 of £169,000, whereas the interest on the bonds offered in payment by the Prussian State, 3½ per cent. Consols, amounts to £170,000, but whilst this interest is above the dividend earned by some railways it is far below that of others. The railways in question are dependent on the Government for their rates of tariff.

THE Russian railways have had agreements with the Prussian and Austrian roads for through rates, at which the imports and exports were made. The Russian Government contended that these rates favoured imports and so tended to neutralise the protective tariff. A meeting of the several railroad interests was held in Kief recently, at which the representatives of the Russian railroads acknowledged that the requests made by their Austrian and Prussian connections were reasonable, but said that they were powerless to grant them. Notice was given that the old import rates would be withdrawn. The rates which take their place are enormously higher, in some cases as much as 70 per cent.

THE London and North-Western Company have made a new introduction into carriage building, which will no doubt prove of great benefit to themselves at the same time that it will form an initiative for the more extended adoption of iron in the place of wood. The carriage frames in future will be made of iron, a method of construction which will be at once strong and durable. The success of this venture would probably lead to the still further displacement of wood by iron. Iron frames have been in use some years on this line, and as iron upper frames and panels have been in successful use on the German and other railways for at least fifteen years, there ought to be no question as to success.

IN England and Wales one mile of railway has been provided for every 4·36 square miles, as compared with 10·42 in France, 9·38 in Germany, 7·82 in Holland, 4·2 in Belgium; while for every 1000 of the population the outlay of railway capital, which yields on an average only 4½ per cent., has been £24,512 in England and Wales, £13,977 in France, £10,593 in Germany, £11,365 in Belgium, and £7252 in Holland. Moreover, wages are much higher at home than abroad. The average per head is in England £62·10; France, £47·12; Belgium, £41·2; Holland, £34·3. It is stated that, "Taking all circumstances into account, England and Wales are better supplied by railways than any other country in the world."

THE New Zealand railway revenue for the first twenty-eight weeks of the financial year was £501,493, as compared with £540,675 for the corresponding period of 1885—a decrease of over £39,000. Of this the working expenses absorbed 75 per cent., or £380,446, as against 68 per cent., or £372,931—an increase of nearly £8000. The net profit is therefore less by £47,000, although the mileage is 1654, as against 1496. There was an increase of 77,235 in the number (1,640,075) of passengers carried, and there were increases of 11,235 in the number of parcels, &c., and 54,391 in the number (471,218) of live stock conveyed. But the goods traffic (947,506 tons) shows a decrease of 67,701 tons, notwithstanding an increase of 32,109 tons in minerals. The deficiency was in grain, merchandise, timber, and firewood.

IN spite of the financial difficulties of Russia there appears no intention on the part of the Government to reduce the expenditure on railway construction. Thus, in the Budget for 1886 a sum of £5,250,000 was set down for the construction of railways and harbours, the Minister of Finance, M. de Bunge, maintaining that such an expenditure was absolutely necessary for developing the commercial resources of Russia during the present stagnation of trade and industrial depression. We now learn, the *Railway News* says, that the Ministry of Communication has recommended expending a similar sum for the next two years. As, however, M. de Bunge has resigned in favour of M. Wietasjeioski, who is a rigid economist, it is doubtful whether the Government will endorse the proposal, especially as the revenue of the country continues to fall off. It has, however, been decided to continue building the railways already in hand, as discontinuation of work would not only mean industrial losses but serious labour troubles.

EIGHTEEN months ago the New South Wales Government, with a view to encouraging local manufacturing industries, invited tenders under specially favourable conditions for the supply of 150,000 tons of steel rails, to be manufactured of native ores. Although several large English manufacturers made inquiries, with a view to satisfying themselves whether the opportunity could be availed of with advantage, nothing came of it; but the *Colonies and India* says, now that the iron trade is very depressed, the Government are disposed to consider favourably the advisability of renewing the offer, if there be any prospect of its being reasonably received. As a further means of encouraging the iron industry, the Minister of Works has reduced the rates for the carriage of iron on the railways. Tenders will shortly be invited for a large number of locomotives for the Government railways. Competition will not be restricted to the colony, but the Government are prepared to show special consideration to local manufacturers if their tenders are reasonable.

A GENERAL classification of the accidents on the United States lines during last November is made as follows by the *Railroad Gazette*:—

	Collisions.	Derailments.	Other.	Total.
Defects of road	—	20	—	20
Defects of equipment	13	15	5	33
Negligence in operating	42	7	—	49
Unforeseen obstructions	8	4	3	15
Maliciously caused	—	2	—	2
Unexplained	—	11	—	11
Total	63	59	8	130

Negligence in operating is thus charged with 37·7 per cent. of the total number of accidents, defects of equipment with 25·4, and defects of road with 15·4 per cent. A division according to classes of trains and accidents is as follows:—

Accidents.	Collisions.	Derailments.	Other.	Total.
To passenger trains	2	16	5	23
To a pass. and a freight	15	—	—	15
To freight trains	46	43	3	92
Total	63	59	8	130

This shows accidents to a total of 193 trains, of which 40—20·7 per cent.—were passenger trains and 153—79·3 per cent.—were freight trains. Of the total number of accidents, 80 are recorded as happening in daylight and 50 at night.

NOTES AND MEMORANDA.

THE deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 24·1 per 1000 of their aggregate population, which is estimated at 9,245,099 persons in the middle of this year.

IN London last week 2623 births and 1860 deaths were registered. Allowing for increase of population, the births were 283 below, and the deaths exceeded by nineteen, the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes which had been 19·7, 23·9, and 26·3 in the three preceding weeks, declined to 23·0.

IN 1885 there were 325,574 telephones in the United States, to say nothing of 18,000 in Canada, while in England there were only 13,000. The number of telephones in the principal towns was as follows:—Berlin, 4248; London, 4193; Paris, 4054; Stockholm, 3825; Rome, 2054; Manchester, 1171; Liverpool, 1169; Glasgow, 1046. At the present time the Wheatstone automatic apparatus could transmit 400 words a minute between London and Liverpool.

IN the course of some litigation on explosives, Dr. Henry Morton, president of the Stevens Institute, testified "that, while at North Adams, in December, 1875, I mixed 52 parts of nitro-glycerine with 48 parts of infusorial earth sent me by the complainants, and made this into a cartridge of the usual form, and inserted in this an 'exploder' or cap containing 16 grains of fulminating mercury. When this was fired in the usual way the cartridge did not explode. I then placed another 'exploder' or cap containing 22 grains of the fulminate in the cartridge, and enclosed the whole in a short wrought-iron tube, tamping the ends with sand. On firing this 'exploder,' the iron tube was split open by the force of its explosion, but the mixture of infusorial earth and nitro-glycerine remained unaffected as before. I am therefore certain that a mixture of infusorial earth and nitro-glycerine in the proportions found by Dr. Hayes between the gunpowder and nitro-glycerine in the Neptune powder of defendants, would be inexplodible."

THE 20th volume of the Tenth Census of the United States ("statistics of wages, necessaries of life, trades societies, strikes and lockouts," by J. D. Weeks), though long delayed, makes a very timely appearance, as its contents throw a flood of light upon the condition of the labouring classes, and will doubtless aid in the solution of the question, "Do strikes pay?" It appears that during the year 1880 there occurred 762 strikes or lockouts. Of these, details were obtained regarding only 226, or less than one-third. As a consequence of these 226 strikes and lockouts, there was a loss in wages of 3,711,097 dols. If the same proportion carries through the others, there was a direct loss to the labourer of nearly 12,000,000 dols., or fully one per cent. of the total wages paid. This takes no account of industries which were broken up or driven away in consequence of such strikes. The American *Sanitary Engineer* says:—An examination of the comparative tables of wages does not indicate that the results in raising wages have been commensurate with this loss.

M. WROBLENSKY finds for the density of liquid oxygen, 0·6 at – 118 deg. C., the critical temperature; 1·24 at – 200 deg.; and $1·212 + ·00428\ T - ·0000529\ T^2$ for intermediate temperatures, T being the absolute temperature. This gives the atomic volume less than fourteen, not sixteen, as Dumas thought. For nitrogen, Wroblensky gets the densities ·4552, ·5842, ·83, ·866 at the respective temperatures – 146·6 deg., – 153·7 deg., – 193 deg., – 202 deg., the freezing point being – 203 deg. Thus, the atomic volume is nearly 15·5. Air, at these low temperatures and pressures, behaves like a mixture of unequally volatile liquids—its composition varies with temperature and pressure, and its density conforms to the theory for mixtures. As Wroblensky employed only slight or moderate pressures, Amagat, who last year got for oxygen a density above 1·25 by 4000 atmospheres' pressures at 17 deg. C., suggests that cold and pressure combined may so far increase the above densities that, while the atomic volumes of S, Se, Te may be equal, that of O may be just half as great.

PROFESSOR D. J. MENDELEJFF, who has been commissioned to study the Baku oil industry on the spot, in a communication to the Russian *Zeitschrift Technik*, says that the mode of working Baku oil is different from the method usually adopted in America, on account of the difference in composition. In his experiments, he succeeds in obtaining 50 per cent. light oil, instead of the 30 per cent. hitherto obtained. It is known as "Bakuol," burns well, and compares favourably with the American product in every respect. The naphtha residues also now possess a higher value, and are not merely used for fuel as hitherto. The "Bakuol," mixed with 30 per cent. of tar-oil and other products, is known to the Petersburg Chemical Society as "Ragosin," and can be burnt in various lamps with the best results. He does not fear the exhaustion of the oil-springs in the near future, it being simply necessary to bore deeper for fresh supplies. In the neighbourhood of Baku, 5 parts of the sand contain 1 of naphtha. According to geological examination the naphtha-bearing layer has a thickness of several metres.

IN consequence of the extended term allowed under the Act of 1883 for the completion of a patent, the statistics relating to the applications in each year cannot be completed until about a twelvemonth after the end of the year. Consequently certain particulars about the 1885 patents appear for the first time in the official journal of the Patent-office of the 12th inst. This number contains a table showing the number of applications which have been abandoned by the inventor before the expiry of the period covered by the preliminary fee. The total number of applications made during the year was 16,101. Of these no less than 7237, or 45 per cent., were not carried beyond the preliminary stage. This percentage is larger than that of the previous year (41 per cent.), which again is higher than the average of recent years under the old law repealed in 1883. The natural conclusion is that the average value of the inventions submitted for patenting is deteriorating, and that the large increase in the number of applications is not accompanied by a corresponding increase in merit. It is also very remarkable that with the present low scale of fees the proportion of voided applications should be so large, the amount required to carry a patent into the second stage being only £3.

THE slipping of belts is an annoyance not always remedied by tightening. A writer in the *Scientific American* remarks that he "has known a slipping belt to be so shortened as to spring the shaft without preventing the slipping. The radical remedy is to keep the belt pliable, so as to hug the faces of the pulleys; but this is not always feasible. The belt may be softened by neat's foot oil or by castor oil. A siccative oil, like linseed oil, is unfit for a leather belt, as it has an affinity for the oxygen of the atmosphere and reverts to its acid base, which is injurious to the leather. When a ready remedy is demanded for a slipping belt, the powder known as whiting, sprinkled sparingly on the inside of the belt, is least harmful of any similar application. Powdered resin is bad, as it soon dries the leather and cracks the belt, while it is difficult to get it out of the leather; whereas whiting may be wiped off or washed out with water. The use of water on belts, preliminary to oiling, is good. The belt should be washed on shutting down at night—on Saturday, after the close of work, is better—and then the oil applied when the belt is partially dry. Never oil or wash a belt when stretched on the pulleys. If iron-faced pulleys were always lagged with leather there would be little complaint of the slipping of belts. But often this slipping is due to too much strain on the belt; there is economy in running wide belts—wider than is the usual practice. Many a 3in. belt has to do duty for a 4in. belt, to the annoyance of the operator and the ruin of the belt."

MISCELLANEA.

AT a meeting of MacLaine's Patent Perfect Piston Company, held on the 14th inst., a dividend of 100 per cent., free of income tax, was declared for the past year.

WE are informed that the fire which occurred last Sunday at Messrs. Clark, Bunnett, and Co.'s works was confined to the foundry, and will not affect execution of work in hand.

ANTWERP is being rapidly put in a state of complete defence. Two points in the province of Liége have been selected for the sites of intrenched camps, to be surrounded with earthworks.

MR. MAX GOSSI, of Antwerp, is endeavouring to introduce a system he has patented for ventilating of ships and warehouses by means of compressed air. The invention consists in throwing compressed air underneath corn or other produce in the ships or stored in warehouses.

AT the City and Guilds of London Institute, Finsbury Technical College, Leonard-street, City-road, E.C., a special course of six evening lectures, on "The Indicator Diagram," was commenced by Professor John Perry, M.E., D.Sc., F.R.S., last evening, at seven o'clock. Five other lectures are to follow on alternate Thursday evenings.

THE accounts of the London City Commissioners of Sewers for the last year have just been issued. The cost of paving the streets was £28,987; lighting, £13,422; cleansing and watering, £39,638; sanitary works, £3070; legal and parliamentary expenses, £2361; contractors and artificers, £4749; stoneyard, £4972; collectors' commission, £5705; officers' salaries, £9347. The Commission paid during the year, for interest on moneys borrowed, £64,824; and to the School Board for London, £138,263.

AN open competition was advertised by the Cleethorpes Local Board for the best scheme of sewerage and sewer outfall for the district of Beaconthorpe, which lies between Grimsby and Cleethorpes. The plans and report sent in by Mr. W. Radford, Assoc. M. Inst. C.E., of Nottingham, have been accepted as the best, and he will be the engineer of the works. The sewage will be conveyed out to low water mark by large iron pipes, and delivered on ebb tide, which will take it straight out to sea. Storage accommodation is provided for the sewage during high tide, and ample flushing and ventilation arrangements are made. Mr. Radford was lately successful in a similar competition for the Newhaven sewage.

WE have received a copy of the "Electrician's Directory and Hand-book," which has reached the fifth year of publication by the proprietors of the *Electrician*. As in former years, but more completely, it contains a quantity of that kind of data and formulæ which make it a hand-book as well as a directory for electricians and electrical engineers, and much of it is not obtainable elsewhere. There is a paragraph about coal and the work got out of it by a steam engine, which is not characterised with that regard for truth which marks things electrical, but this is matter obtainable elsewhere. It also contains a number of biographical notices of men more or less prominent in electrical engineering or in teaching.

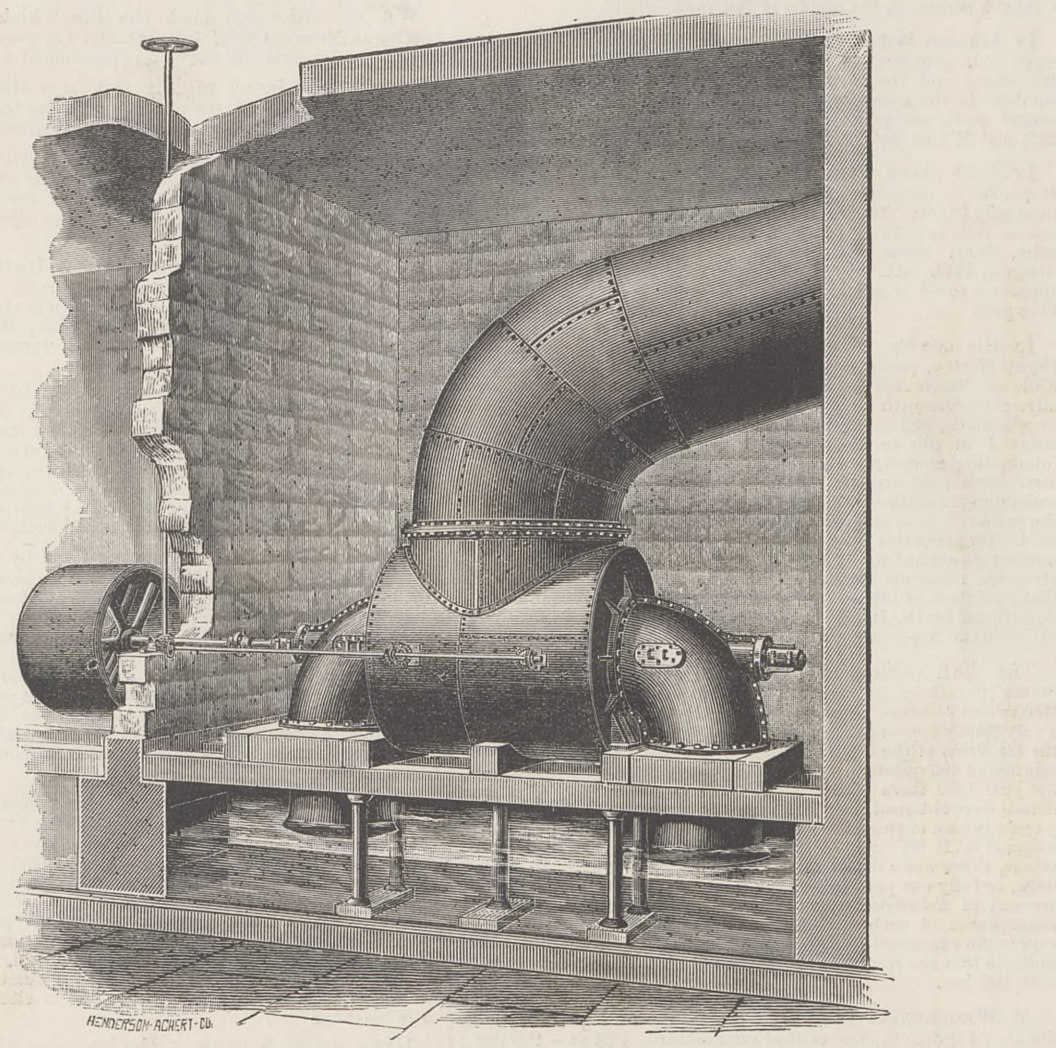
HERR JOSEF SCHULHOF, the inventor of the repeating rifle which has been lately tried by the British military authorities, has returned to England, having made certain alterations in his rifle, so as to adapt it to the Enfield requirements. Experiments made with the rifle prove that the Enfield cartridge can be used with it. The alterations, however, reduce the number of cartridges that can be used to load the repeating magazine from ten to seven. Ten cartridges made up the repeating charge of the original rifle for 7½ mm. cartridges, whereas the Enfield cartridge is one of 9 mm. The Schulhof rifle weighs just 9 lb. One of its great advantages is that the mechanism prevents the cartridge case from sticking in the breech when exploded. The action of reloading jerks out the case.

EFFORTS are being made by John Ericsson to induce Congress to provide for the purchase by the Government of his new torpedo boat the Destroyer, for the defence of New York Harbour. S. C. Bushnell, who is in Washington as Mr. Ericsson's representative, expects to be heard on the subject this week by the House Committee on Naval Affairs. The famous inventor of the Monitor offers the Destroyer for 112,000 dols., which, he says, is less than the vessel cost to construct, but if the Destroyer proves satisfactory Mr. Ericsson desires the privilege of furnishing the Government with ten similar vessels of somewhat larger size, at a cost of 200,000 dols. each. Eleven such vessels, the inventor asserts, will be sufficient to protect all the coast harbours from invasions of foreign enemies.

ON Thursday the 13th. inst., Earle's Shipbuilding and Engineering Company launched from their yard at Hull an iron screw steamer named the Auckland, which they have constructed for the Humber Conservancy Board for salvage and towing purposes on the Humber and neighbourhood. The dimensions are 152ft. by 22ft. by 11ft. 6in., and the vessel is built to Lloyd's highest class of steel, the scantlings being considerably in excess of rule. The ship has a flush deck of chequered plate, with iron bulwark at each end, the midship portion being protected by rails and stanchions, and an extra strong wood belting is carried round outside for chafing. The deck fittings are all of iron, and very strong and substantial for rough work. Large catheads are built into the ship at each end for turning heavy lifts, and bitts and fairleads on the deck are also of ample size. She will be rigged as a fore and aft schooner with two pole masts; the rigging, derricks, &c., are all very efficient, and specially suited to the work that will be required of them. Powerful pumps are fitted in the engine-room, with large deck connections for salvage purposes. The captain and officers are quartered aft, and there is accommodation in the forecastle forward for a large number of men. The remainder of the ship clear of the engine and boiler space is available for stores and wreck-raising material. She will be fitted by the builders with compound engines of 300 indicated horse-power, having cylinders 18in. and 36in. diameter by 21in. stroke, which will be supplied with steam from a large steel boiler made in accordance with the Board of Trade rules for a working pressure of 90 lb. per square inch.

AT a meeting of the Paris Municipal Council on the 9th ult. an important discussion took place on street pavement questions. Experiments have been proceeding for some years. In the course of his remarks the Director of Public Works said:—"In the Rue Saint-Lazare, on a hard concrete bed, a pavement of Yvette stone was laid down. What happened? The stone road pavement weighing upon the concrete, the concrete pressing the side pavements, the pavements communicating with the houses, the result was an enormous hubbub in the streets, and a continual shaking of the houses. Furthermore, the pavement, between the concrete and the carriage wheels, was as if between anvil and hammer. It gave way, and we are convinced that this kind of pavement cannot be laid down upon a bed of concrete. After this, we thought that it was better to have a certain elasticity to the pavement, and that we could obtain this by placing a layer of sand between the concrete and the paving stones. This is the experiment which we are now trying on the Rue de Rivoli. We have just now every reason to hope for a good result. But it is not yet the perfect, the ideal street, such as the wooden pavement would give us. The results with wood paving have, up to date, exceeded expectations. In streets where there is not much traffic, where the circulation is small, the repairs of the wood pavement will be, it appears, much less than the estimated sums. We have made trials on the Rue Lafayette, Boulevard du Palais, and Place de la Concorde. The results obtained were stupefying. The tramway rails seemed to disappear; the shaking no longer exists."

FIVE HUNDRED HORSE-POWER VICTOR TURBINE.

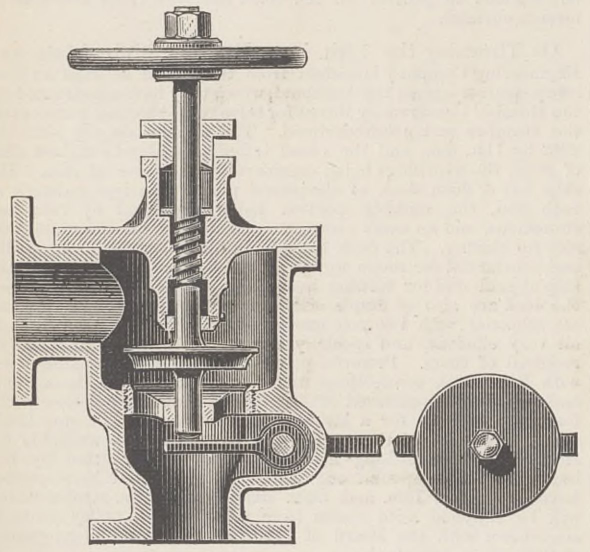


A GREAT TURBINE.

In a recent impression we described the great dynamo, weighing 10 tons, used by the Cowles Electric Smelting and Aluminium Company; we now illustrate the pair of 30in. Victor turbines which drive the dynamo. These turbines work, it will be seen, on one flume, on a horizontal shaft, and give off 520-horse power. This is, we believe, the largest application of water power in the world to electrical purposes. The Victor turbine seems to be winning its way into favour. The agent for it in this country is Mr. Nell, of Mark-lane.

PASQUIER'S SAFETY STOP VALVE.

The accompanying engraving illustrates a safety stop valve, made by Messrs. Broquin, Muller, and Roger, Faubourg du Temple, Paris. It will be readily understood from the engraving. The valve shuts itself automatically in case of rupture of



the steam pipe or the explosion of a boiler in a battery of boilers. It depends for its action on the rush of steam which would take place in such a case, overcoming the resistance of the weighted lever.

EDDINGTON AND STEEVENSON'S TRACTION ENGINE.

We illustrate on page 47 a traction engine constructed by Messrs. Eddington and Steevenson, of Chelmsford, which was exhibited last December at the Smithfield Club Show. This engine contains several novel features. It is made to travel at two speeds in the ratio of 11 to 18, by an entirely new method of change which will be understood by reference to the engraving, Fig. 5. The second-motion shaft is made with an excentric end, so that by turning about one-third of a revolution it moves the centre of the second-motion wheel, so that it can put into gear with the slow-motion pinion in one position, and when in another it is in the right position to slide the fast-speed pinion over the other into gear, so that both pinions gear in the same wheel. It will be understood that the centres are at equal distances from the centre of main axle, so that in each case the large driving wheel is in proper gear with its pinion. Some of the advantages of this arrangement are as follows:—(1) The ratio of 11 to 18 is better than 2 to 1, which is that usual where one pinion slides over the other; (2) the engine can be made narrower; (3) both pinions are close up to the bearing when in gear; (4) saving in weight of the engine, the shafts being shorter are stronger; (5) the slow-speed pinion is keyed tight on to the crank shaft and does not slide; (6) only one fork lever is used. The boiler is divided by a plate from the smoke-box end to a point nearly over the front end of the fire-box. The steam having to travel a considerable distance horizontally over this plate, is admitted to the cylinder in a very dry state, thereby, it is claimed, avoiding priming, and when an engine is descending an incline prevents the water from flowing off the fire-box to the front end of the boiler. The introduction of springs between the driving and driven parts of the second-motion wheel, which, it is claimed, prevents back-lash and noise, and takes up any sudden strain on the gearing, rendering the teeth less liable to fracture. The cylinder is the only part of the engine fixed to the boiler by bolts. The engine is very narrow, only 6ft. 9½in. over all, though the wheels are of full width. The wheels are made of wrought iron, with steel tires and strakes. The compensating motion on the main axle can be locked in a second by a very simple arrangement, which will be understood on reference to Fig. 6. The wearing surfaces are made very large, the crank shaft brasses being 10in. long, the one extending inside the fly-wheel, as shown in Fig. 1, and the other inside the gearing; the connecting-rod brass is 6in. wide; the axle bearings are 12in. long. The crank shaft is made of the best best scrap iron, and bent out of the solid bar, and is 3½in. diameter throughout. The piston is of improved construction, the rings and centre piece are free to revolve, it wears the cylinder very evenly, and the rings cannot break. The winding drum, Fig. 2, is on an independent bearing, and remains stationary when not in use. The rope can be attached to a load and the rope run off as the engine proceeds, and when at the top of a hill the drum is put in gear and the load hauled up by the rope. The centre of the cylinder is very low and close to the boiler, whereby the strain caused in working is reduced, at the same time a long reversing link is used; this is attained by placing the motion shaft above instead of below the centre. The fore-carriage is made on the principle of a ball-and-socket joint, the opening being of the right size to prevent the wheels locking too far. The arrangement is very simple, and the engine steers very easily. A powerful brake is fitted on each hind travelling wheel, so that whatever breaks on the engine or comes out of gear the man can always stop even on the steepest incline; it can also be used for fixing the engine when hauling with the rope. The engine is fitted with the makers' patent removable lagging, which can be taken off and replaced in an hour without damage, also their patent water gauge, which shows the water in the glass down to the dangerous point, at the same time the bottom hole is placed above the top of the fire-box. The cylinder is steam-jacketted; the liner is made of very hard metal; the space round this is excessively large, and forms a capacious steam dome, admitting the steam to the cylinder in a very dry state.

TENDERS.

SWANWICK SEWAGE FARM.

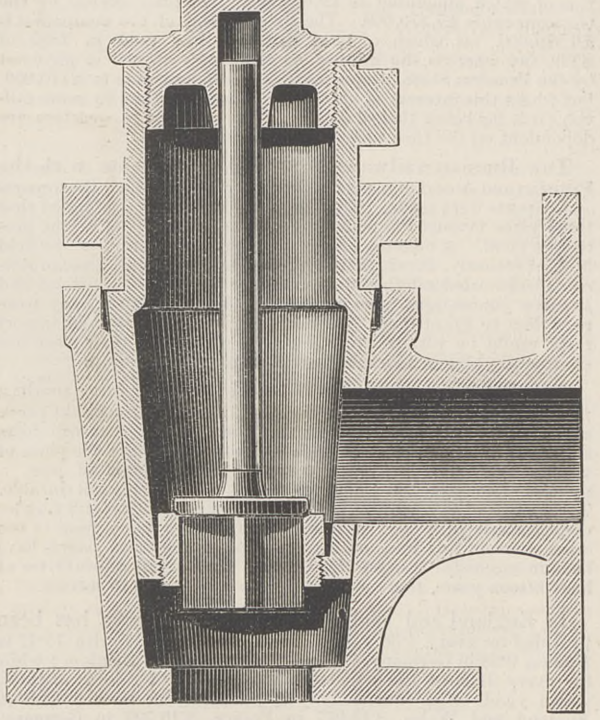
A small farm of 15 acres is now being laid out for sewage irrigation near Butterley Reservoir. The land is a stiff clay, but it is being specially prepared and lightened to a considerable depth with fine ashes, and close drained. It is believed that by this method adopted the strongest clay land may be made suitable for the reception of sewage, and thus one of the great difficulties in the way of sewage purification in some districts will be removed. The farm will receive the sewage from a population of nearly 4000. Mr. W. H. Radford, sanitary engineer, Nottingham, is the engineer for the works.

NEWHAVEN SEWERAGE.

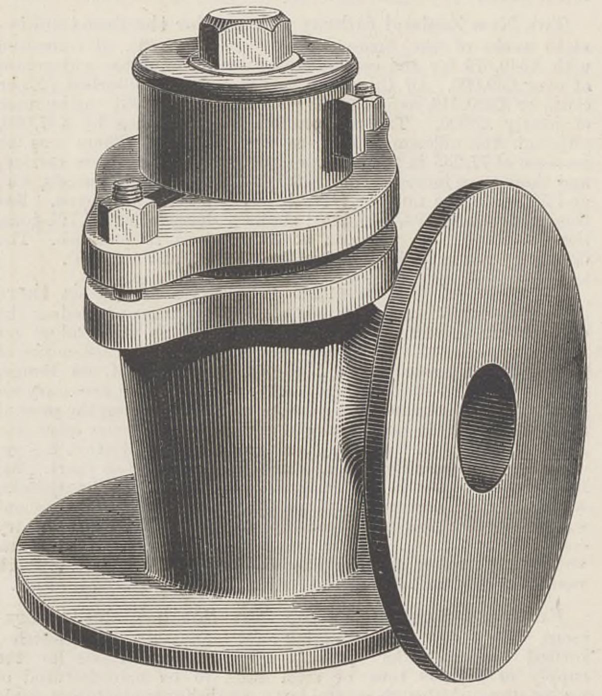
The tender of Mr. James Haywood, contractor, Eastbourne, was last week accepted by the Newhaven Local Board for the construction of a complete system of sewerage, with outfall sewer and storage culvert. The sewage will be delivered during the ebb tide in the river Ouse, at the mouth of the harbour and close to the sea. The amount of the contract is £5557. The scheme has been approved by the Local Government Board and the Harbour Company, and negotiations with the War Department and the Board of Trade are approaching completion. The engineer to the works is Mr. W. H. Radford, Assoc. M. Inst. C.E., Nottingham, and the scheme was selected from twenty designs in open competition.

COMBINED CHECK VALVE AND PLUG COCK.

The accompanying engravings illustrate a form of check valve with detachable seat combined with a plug cock. The section shows the valve to consist of a large hollow plug, fitted at its lower end with a seat, upon which the valve sits, the

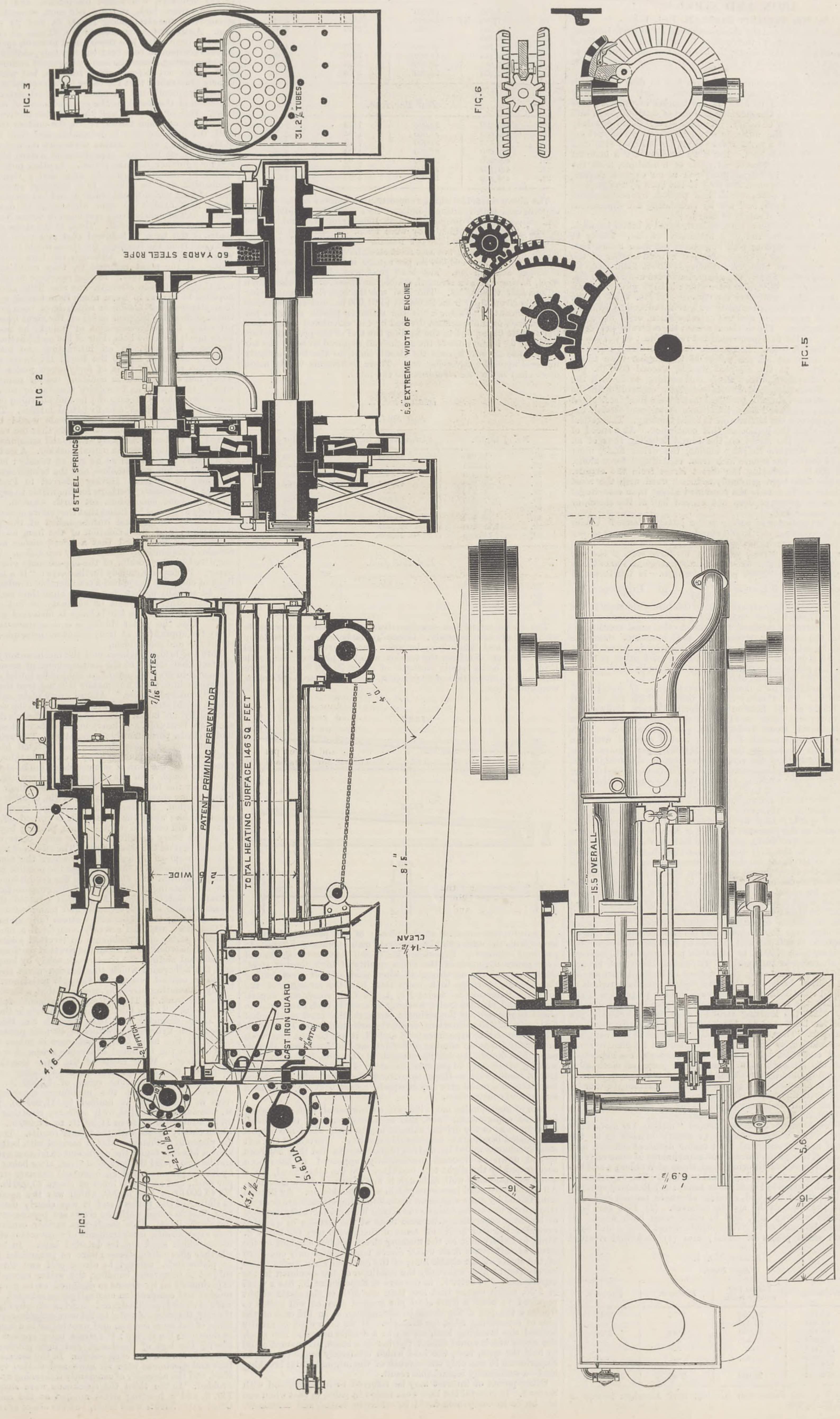


stem of the valve being guided by a hole in the screw cap at the top of the plug. A gland with studs and nuts is provided for keeping the plug in the case, and a lug is cast upon the top of the plug for turning it round. This lug is in some cases substituted by other means of turning. The valve is also made as



a stop valve combined with a plug cock. It will be seen that when at any time it becomes necessary to examine or repair the valve or valve seat, it is only necessary to shut off all communication by turning the plug. The valve and seat may then be taken out and replaced at leisure, small projections within the seat making it easy to turn the seating. There are many applications for this combined valve, which is made by Mr. T. Murphy, Fairfoot-road, Bow.

Shipbuilding on the Clyde.—The *Glasgow Herald* has published an annual review of the shipbuilding trade on the Clyde during the year 1886. The total tonnage of new shipping constructed last year was 21,018 tons less than it was in 1885, which shows that the great depression in trade experienced now for fully two years still continues. At the close of 1885 a few contracts were backed, and many inclined to the belief that with the new year would dawn brighter days for the Clyde shipbuilders; but this has not been realised. The work in hand is not much, if any, in excess of the work at the beginning of 1886, and the contracts now in the market are not very numerous, nor of sufficient magnitude to warrant the belief that there is to be an immediate and decided improvement. There were launched during the year 166 vessels, of an aggregate tonnage of 172,440 tons, of which 116,165 tons were of steamers and 56,275 of sailing ships. Of the total tons, 116,932 were constructed of steel, 55,217 of iron, and 291 of wood. In 1885, 241 vessels, of 193,458 tons, were launched; so that there was last year a decrease of 75 vessels and of 21,018 tons. In 1884, when the depression was first felt, the tonnage was 296,854, which is 124,414 more than the past year. It is when compared with some of the largest years, however, that the great difference in the state of trade is shown. In 1883, when the Clyde shipbuilding trade was briskest, the output was 419,665 tons—almost three times what it was last year. In 1882 it was 391,933 tons, nearly 220,000 tons more than last year; and in 1881 it was double the figure for last year. Indeed, only in one year since the trade has assumed its present importance—since 1868—has the tonnage been less, namely, in 1877, when the total was 169,710.



TRACTION ENGINE.

MESSRS. EDDINGTON AND STEEVENSON, CHELMSFORD, ENGINEERS.

(*For description see page 46.*)

SOME NOTES ON THE WORKING STRESS OF IRON AND STEEL.[1]

By MR. BENJAMIN BAKER, M. Inst. C.E.

THE author has selected the above somewhat elastic title because, whilst anxious to accede to the request to bring certain results of his experience before the society, he has not had sufficient time in the pressure of other duties to analyse and arrange these results as he could wish.

Few engineers of experience who have had to deal both with machinery and with structural ironwork, such as railway girders, can have failed to note inconsistencies in practice, and general vagueness as to the meaning and use of such terms as safe working stress of factor of safety. Rankine defines factor of safety as the ratio in which the ultimate strength exceeds the working stress, and assigns to it a value of four to six for ordinary steel and iron subject to a variable load. But if we consider for a moment how the proportions of almost all parts of a machine, from the axle of a country cart to the coupling rod of an express engine, have been arrived at, we shall see that it has been by the gradual strengthening of the parts which had proved by accumulated experience to be too weak, and not by calculating the dimensions on the basis of a factor of safety of four to six.

To illustrate this fact we cannot, indeed, select a better example than that of the coupling rod of a locomotive engine. Thirty to forty years ago the coupling rods in general use were round rods about 2⅜in. in diameter at the centre and a trifle smaller at the ends. They were next changed to flat rods about 3½in. deep by 1¼in. thick, and subsequently the dimensions were modified to 4in. by 1½in. Finally, we have now on many railways girder section rods 4½in. deep, 2¼in. wide over the flanges, and ⅞in. thick in the web. Why were the successive modifications introduced? Obviously as the result of experience, and not of calculation, or of increased power in the engines. The sectional area at the centre of the round rod was 5·4in.; of the first mentioned flat rod 5·25in.; of the second 5in., and of the last 6·4in. In no case would the direct stress on the rod, even assuming all the power of the engine were transmitted through it to the coupled wheels, exceed 6000 lb. per square inch; therefore, direct stress had nothing to do with the alterations. What happened was this—failures occurred with the round rods, and some shrewd, practical man instinctively concluded that the fracture occurred from transverse stress, and altered the section to a deep flat bar better able to resist bending. Theoretical considerations show the justice of this conclusion. At a speed of fifty miles an hour, the stress on the round coupling rods of an old-type Great Western Railway engine, the writer finds, must have been 14,500 lb. per square inch from centrifugal force alone, or, say, 17,000 lb., including the direct stress from the engine. This stress has since been gradually reduced, until with the most modern girder section rods the combined stress from centrifugal force and steam pressure does not exceed half of the above, or 8500 lb. per square inch.

Now what is the factor of safety in the latter instance? Under direct pull the coupling rod would stand an ultimate stress of say 50,000 lb. per square inch; under direct compression say 20,000 lb.; and under transverse stress, which, as we have seen is the one determining fracture, the calculated ultimate stress on the extreme fibres would be about 80,000 per square inch. Is the factor of safety here $\frac{80,000}{8500} = 9{\cdot}4$, or is it $\frac{17,000}{8500} = 2$? Experience has shown that the coupling rods are sure to fracture ultimately if the stress reaches 17,000 lb. per square inch; and the writer's experiments, to be hereafter referred to, point to the same conclusion. By making the working stress half the breaking stress as determined by actual practice, adequate security is found to be attained. As it is with coupling rods so it is with other parts of machinery. A pin or some other member repeatedly fractures; it is made somewhat larger and stands.

Let us now consider for a moment another class of structure—railway bridges. The Conway tubular bridge, which has carried the heavy traffic of the London and North-Western Railway for the past thirty-six years, is 412ft. in span, and under its own weight the tensile stress is 13,000 lb. per square inch. With ordinary trains the stress is 17,000 lb., and if covered with the heaviest engines in use on the line 20,000 lb. per square inch. The ultimate strength of the rivetted structure is about 42,000 lb. per square inch. No indications of weakness have developed during the thirty-six years' working, nor anything to suggest that the factor of safety, of, say, 2 to 2½, is unduly low.

On the other hand, railway experience has amply proved that with small span, and therefore light girders, such stresses as the above would quickly lead to destruction. For that reason, in structures such as the Elevated Railway of New York, the stresses are wisely limited to 8000 lb. per square inch in the flanges of the girders, 7500 lb. in the web bracing, and 4500 lb. where members are subject to alternate tension and compression. Although in Great Britain the Government regulations still authorise 11,200 lb. per square inch on the net section, and in France 8500 lb. on the gross section, irrespective of the character of the load or the span of the girder, engineers of the present day do not act up to these regulations. In Great Britain a stress of 9000 lb. per square inch net section is seldom exceeded in light girders. In a recent German bridge over the Danube, the permissible stresses ranged from 6900 lb. to 13,000 lb.; and in a recent Hungarian bridge, over the same river, from 8700 lb. to 11,000 lb. per square inch, according to the character of the loading. In one of the latest French bridges the Government authorised a stress of 11,400 lb. per square inch gross section, in lieu of the usual 8500 lb., on the grounds of the dead load constituting an exceptionally large proportion of the whole. Again, the Russian Government last year issued new regulations by which the limiting stresses were fixed at 8500 lb. per square inch for bridges under 50ft. span, and 10,300 lb. for those over 100ft. span. Thus, whether we take the case of the coupling rod of a locomotive, or the bridge over which the locomotive runs, we find that engineers have learned by experience the important truth that the strength of a structure or piece of mechanism cannot be determined by the simple process of breaking a piece of the material in a testing machine, but must be ascertained either by the gradual accumulation of the results of actual working or by testing the material under conditions as far as possible analogous to those obtaining in the case under consideration.

Wöhler's experiments on the so-termed "fatigue" of metals are well-known. The writer, wishing to satisfy himself as to the behaviour of modern structual steel under different stresses, has, during the past few years, carried out experiments in some respects similar to, and in others differing from, those of Wöhler's; and has also made analogous tests of hard steel and iron. The experiments many be roughly classified under four heads: (1) Rotating spindles with a weight at the free end, causing alternate tension and compression on the fibres as the spindle revolves. (2) Flat bars bent in some cases one way only, and in other cases both ways. (3) Specimens so designed as to give alternate direct tension and compression on small pieces of metal; and (4) Full-sized rivetted girders.

SERIES NO. 1.

Soft Steel.

No.	Revolutions.	Stress per square inch.	Factor *a*.	Factor *b*.
1.	40,510	36,000	1·75	2·45
2.	60,200	36,000	—	—
3.	68,400	34,000	1·84	2·56
4.	92,070	—	—	—
5.	107,415	—	—	—
6.	128,650	—	—	—
7.	155,295	—	—	—
8.	14,876,432	26,000	2·42	3·4
Hard Steel.				
9.	5,760	67,000	1·88	2·82
10.	7,560	65,000	1·93	2·90
11.	14,600	53,500	2·36	3·45
12.	16,300	—	—	—
13.	26,100	46,500	2·72	4·10
14.	32,415	51,000	2·40	3·60
15.	157,815	40,500	3·03	4·55
16.	472,500	34,000	3·70	5·55
Best Bar Iron.				
17.	108,160	34,000	1·70	2·38
18.	110,000	35,000	1·66	2·32
19.	141,750	34,000	1· 0	2·38
20.	389,050	32,000	1·90	2·65
21.	408,000	30,200	2·00	2·80
22.	421,470	32,000	1·90	2·67
23.	480,810	31,000	1·95	2·75

[1] Presented at the Fourteenth Meeting, 1886, American Society of Mechanical Engineers.

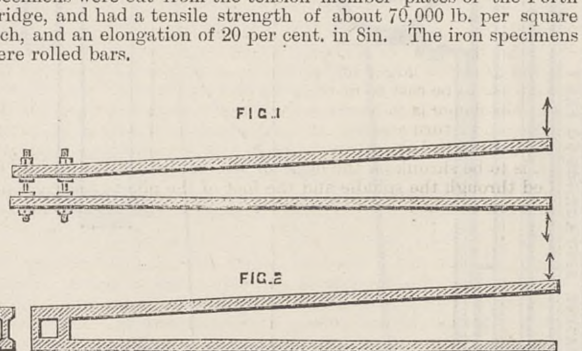
The above series includes a representative number of the writer's experiments with rotating spindles. As a rule, the spindles were 1in. diameter, and projected about 10in. from the end of the revolving shaft in which they were fixed. A speed of between fifty and sixty revolutions per minute was maintained day and night. The soft steel was fine rivet steel, having a tensile strength of from 60,000 lb. to 64,000 lb. per square inch, and an elongation of 28 per cent. in 8in. The hard steel was a high-class "drift" steel, having a tensile strength double the above, and an elongation of one-half the extent. The iron was the best rivet iron, having a tensile strength of from 58,000 lb. to 61,000 lb., and an elongation of 20 per cent. "Factor *a*" is the ultimate tensile strength per square inch of the specimen divided by the calculated stress upon the outside fibres, due to the load on the end of the projecting bar. "Factor *b*" is the ratio of the static load required to bend the bar a moderate amount beyond the elastic limit, to the load actually imposed upon the revolving bar. These definitions will be made more clear in further references to the table.

SERIES NO. 2.

Soft Steel.

No. of bends.		Stress per sq. inch.	Factor *a*.
24.	12,240	44,000	1·59
25.	12,325	--	—
26.	12,410	—	—
27.	18,100	42,000	1·67
28.	18,140	—	—
29.	72,420	36,000	1·94
30.	147,390	34,500	2·03
31.	262,680	34,000	2·05
32.	1,183,200	27,500	2·55
33.	3,145,020	34,500	2·03
Best Bar Iron.			
34.	184,875	34,000	1·68
35.	250,513	—	—
36.	3,145,020	—	—

The above series is a selection from the writer's experiments with flat bars bent laterally. Generally the bars were 1in. wide by ½in. thick, and 32in. long between the bearings. The steel specimens were cut from the tension member plates of the Forth Bridge, and had a tensile strength of about 70,000 lb. per square inch, and an elongation of 20 per cent. in 8in. The iron specimens were rolled bars.



A careful consideration of the results of the preceding experiments will, the writer thinks, illustrate many points of interest to practical engineers. Experience has shown that screw shafts and axles generally, made of the finest quality of high tension steel, are not practically as strong as when made of soft steel, having theoretically perhaps little more than half the strength of the former. Referring to Series No. 1, we find, comparing experiments 8 and 14, that under working stresses in each case equal to about 40 per cent. of the ultimate strength, the hard steel failed with only 32,445 revolutions, while the soft steel stood 14,876,432. Again, comparing experiments 16 and 23, it will be seen that with practically the same number of revolutions the hard steel, though more than double the tensile strength of the iron, broke under a working stress only 10 per cent. greater. It is impossible, in the face of results such as these, to contend that the ordinary laboratory tests of a metal give any adequate measure of its value as a material of construction.

Iron of high quality holds its own, as compared with mild steel, in these experiments, and this is consistent with the general experience as to the driving axles of locomotives, which are subject to repeated bendings of considerable severity. Certain of the soft steel specimens would have given higher results had they not been turned down as fracture occasionally appeared to have been accelerated by the slight tool marking. On the other hand, No. 8 stood exceptionally well, although it was a turned-down specimen. All of the hard steel bars were put in with the skin on. An illusion entertained by some engineers that alternating stresses are destructive only if the stress exceeds the elastic limit is effectually disposed of by these experiments, because none of the stresses in question exceeded the said limit and some of them were very far below it. Thus, in Experiment 16, the working stress was but one-half of the stress at the elastic limit under direct tension, and only one-third of the stress at the elastic limit of the material when under transverse stress; which was really the condition of the specimen in the experiment. "Factor *b*," in the case of Experiment 16, has a value of 5·55, which means that less than one-fifth of the static weight required to bend a hard steel pin a small amount will suffice to fracture the pin if the stress be alternating, as in the case of the pins of connecting rods, for example. If we take what is usually termed the breaking load, or, say in a ductile material like steel, the stress which would deflect the bar as a beam, an amount equal to half the span, then the load which ultimately broke the bar in Experiment 16 was only one-seventh of the original static breaking load—a sufficiently remarkable result.

Other points of interest may be referred to in connection with Series 2. In general the bars were tested in pairs, so that when one bar broke its companion could be otherwise tested and examined. For example, the companion to No. 28, after being subjected to 18,140 bendings, was tested for tension, and failed with 48,000 lb. per square inch, and 2·6 per cent. elongation; the original strength of the steel being 70,000 lb. and 20 per cent. elongation. Again, the companion to No. 32 was, on close examination, found to have a flaw like those found in crank shafts. Nos. 33 and 36 were companion bars bent one way only, so that the stresses were not alternating, hence the largely increased endurance. They were both taken out before actual fracture, but with deep set flaws, clearly illustrating that the cause of failure under repeated stresses is very frequently not so much a gradual deterioration or crystallisaton of the metal, as the establishment of small but growing flaws. This, of course, is well known to locomotive and marine engineers; and on some railways it is the custom to run crank axles until the incipient flaw is detectable, and then to hoop the webs of the cranks; whilst marine surveyors do not condemn a shaft necessarily on the first appearance of a flaw, but licence it to be run for a further definite period. Another noteworthy fact illustrated by these experiments was, that a structure or piece of mechanism may be subject to a repeated stress equal to 90 per cent. of that which would break it, and yet specimens cut from the metal may exhibit no signs whatsoever of deterioration. The broken half of nearly every specimen in Series No. 2 was tested by the writer with that result. Thus, as the stress was applied at the centre of the bars, it followed that at a point 90 per cent. of the half span from the bearings, the stress would be 90 per cent. of that which broke the bar. Although the bars broke short off at the centre, at the point referred to, they could invariably be bent double without fracture. Having reference to this fact, and to the fact that the tensile strength was also little affected, it is clearly hopeless to expect to learn much from testing specimens of metal from structures or machines which have been long in use. Unless the experimenter happens to hit off the right moment immediately preceding the commencement of failure, he need not expect to learn much from the behaviour of the metal in the testing machine. Professor Kennedy, in an interesting and instructive lecture recently delivered before the Royal Engineers at Chatham, has given the results of tests of forty-seven pieces of iron and steel, which had either been in constant use for many years until they were so much worn as to require renewal, or which had broken in actual use; but in no case did he find anything distinctly pointing to a weakening effect due to actual fatigue. This is exactly the result which the writer's experiments would have led him to anticipate; but it by no means follows that the very piece of metal tested by Professor Kennedy and found uninjured would not have broken a few days after in actual working. A man of seventy years of age may be as sound as he was at twenty; but the fifty years have told on him nevertheless, and the breakdown is certainly near and may be sudden. Having referred to Professor Kennedy's lecture it is necessary perhaps for the writer to say that he does not agree in some conclusions set forth therein. Thus, Professor Kennedy expresses his belief that the failure of coupling rods occurs as much by the gradual disintegration of the dirt between the laminations, and the oxidation of the iron, as by vibration and repetition of load; and that a homogeneous material like steel remains comparatively uninjured by repetition. This, of course, is negatived by the results of the experiments cited in the present paper. Professor Kennedy further says: "If a load exceeding the limit of elasticity be applied a considerable number of times the bar will be actually broken, but at the same time we know that if any load exceeding the limit of elasticity be but once applied the structure to which the bar belongs is distorted and rendered useless." This, the writer thinks, is a dangerous fallacy, tending to delay the application of truly scientific principles to the design of structures and mechanism.

Both the bridge engineer and the mechanician must reckon with the fact that, owing to the contingencies of manufacture, parts of the metal in every structure are subject to initial stresses exceeding the elastic limit; but fortunately it is not true that the structure is thus "rendered useless." Almost every plate and angle bar of the bridge is cold straightened before going into the work, which means, necessarily, an initial stress exceeding the elastic limit. Boiler shells are bent cold, and heavy initial stresses close up to the elastic limit remain permanently in operation. The writer has calculated the intensity of these stresses, and verified his results by cold straightening bars, planing away the outside skins on each side, and thus relieving the bars of one couple of initial stresses, and leaving the other couple near the neutral axis to operate. The result has been that the bars have ceased to retain their straightness, and have become curved to the extent of ⅛in. or other amount indicated by calculation. Similarly, lathesmen well know that a long shaft often wobbles when the outer skin is turned off, and many other instances will occur to practical men, proving beyond contest that, in almost every metallic structure, some parts of the metal are stressed beyond the elastic limit. The effects of repetitions of stress cannot therefore be ignored even where the nominal, or average, stress on the metal is small, because the possible heavy initial stress near the neutral axis may lead to the establishment of a growing flaw, commencing at the centre of the cross-section of the bar, and therefore undetectable. As regards rivetted structures it is of course the aim of both engineer and manufacturer to ensure every rivet gripping the plates with a stress fully up to the elastic limit. M. Considère, who has recently completed a most important and scientific series of experiments on rivetted joints, sums up thus: "In all constructions in which the rivetted portions have not already commenced sliding, the rivets work solely by longitudinal tension, and the adherence which this tension gives rise to between the plates in contact constitutes the sole resistance." And further: "Any alternating stress in excess of that adherence rapidly dislocates the work." The writer's experiments fully confirm these conclusions. At the Forth Bridge the rivets in the heavy bedplates are 1$\frac{1}{16}$in. diameter and pass through 8in. thickness of plates. Closed with hydraulic rivetters of 40 tons pressure, the rivets as a rule fill the holes fairly; but care is taken that the stress is kept within the frictional adherence arising from the elastic grip of the rivets. With rivets of the same length as those in the bedplates the average resistance to sliding was found to be equivalent to a shearing stress of 14,500 lb. per square inch of rivet area; whilst the maximum shearing stress on any rivet in the bridge is limited to 11,200 lb. per square inch. M. Considère found that with ordinary rivetting he could reckon up an adherence of from 11,300 lb. to 14,400 lb. per square inch, which closely agrees with the former results. The writer, by testing plates in ordinary condition secured with bolts screwed up to a known tension, found the coefficient of friction averaged one-third; and he also found the soft steel rivet, after being closed up under hydraulic pressure, had an increased ultimate strength of 10 to 15 per cent., and an elastic limit of about 45,000 lb. per square inch. No 45,000 lb. × ⅓ = 15,000, which was the ascertained resistance to sliding of the plates; and it was clearly demonstrated, therefore, that in sound work the rivets are permanently strained up to the elastic limit. This result was further confirmed by temperature experiments, measurements of contraction of rivets, and other means which need not be detailed here. In order to ascertain whether alternating stresses were as prejudicial to members, such as piston-rods, subject to direct pull and thrust, as to shafts subject to transverse bending, the writer carried out a series of experiments on specimens so designed as to give alternate direct tension and compression on small pieces of metal. These specimens were of three types illustrated—not to scale—by Figs. 1, 2, and 3. In the first, the pieces of metal tested were sometimes of round and sometimes of flat cross section, and were bolted to a couple of spring bars, as shown on the sketch; the stress being applied by opening and closing the legs of the tongs, and thus putting the metal into alternate tension and compression. In the second group the spring bars and specimens were all sawn and slotted out of one piece of steel, and the necessity of constantly tightening up the nuts was thus avoided. In the third the specimens were shaped as shown by Fig. 3, and a bending stress applied at the centre of the bars. Other experiments were made, but the above are sufficient to prove that alternating stresses are at least as prejudicial when the stresses are direct as when they are indirect.

SERIES No. 3.

Soft Steel.

	No. of bends.	Stress per square inch.	Factor σ.
Fig. 1.	28,008	37,000	1·90
	49,320	38,000	8·84
Fig. 2.	11,880	28,000	2·50
	29,568 (hard steel).	16,700	4·90
Fig. 3.	230,513	35,000	2·00
	204,735	20,000	2·80

SERIES No. 4.

The writer has availed himself of the opportunity afforded by the large use of special plant and machinery at the Forth Bridge works to note the influence of varying stresses on full-sized rivetted steel girders. These observations are still in progress and can be but very briefly referred to herein. In one instance the lever of a large plate-bending press is of box girder section, built up of eight 4in. by $\frac{5}{8}$in. angle bars, two 13in. by $\frac{7}{8}$in. web plates, and two 17in. by $\frac{1}{2}$ by $\frac{5}{8}$ flanges. The span is 15ft. 8in., and the ordinary daily working stress on the metal is 43,000 lb., and occasionally 57,000 lb. per square inch. Many thousand applications of this stress have been made, and the beam has taken a permanent set of $\frac{5}{8}$in., but so far is otherwise intact. Observations are also being made of the behaviour of sixty rivetted steel box girders of 18ft. span, built up of two 12in. × 3in. channels and two flange plates; which girders are subject to very many thousand repetitions of stress ranging from zero to 13 tons per square inch.

As regards the important question of the proper working stress on iron and steel, the writer's experience leads him to believe that both the old-fashioned Government regulations giving the same limiting stress for all kinds of loading, and the modern formulæ, based chiefly on Wöhler's experiments, fail to meet the just requirements of the practical engineer. It is in many cases a great economical advantage and convenience to have reference not merely to the variation of stress, but also to the probable number of applications. For example, the writer knows the bending press box girder lever, previously referred to, will last its time, although the working stress is about two-thirds of the ultimate strength of the material; and it would have been a mere waste of money to make it four times as strong, and so give it the factor of safety of six, usual and proper enough for a structure such as the Elevated Railway of New York, where a practical infinite number of repetitions of stress have to be provided for. Again, in many instances it is preferable to face the fact of occasional breakages than to give the strength required to insure absolute durability. Thus, in case of railway springs, a fractured leaf is a common and unimportant incident, little to be wondered at, as the working stress often ranges from 60,000 lb. to 80,000 lb. per square inch, on steel having in its tempered condition an ultimate tensile strength of about 160,000 lb. per square inch. If it were as essential to guard against the failure of a spring leaf as it is to guarantee the safety of a railway bridge, it would be necessary to more than double the number of leaves in most springs.

In all works, temporary or permanent, where the stress alternates from tension to compression, large rivet area must be provided, as a very few repetitions suffice to loosen rivets. Where metal has been subject only to compressive stresses of varying intensity, the writer has not so far been able to detect any deterioration, and he takes account of this fact in settling the proper working stress on the struts of bridge trusses and similar works.

Twenty years ago, being uncontrolled by Government regulations, the writer adopted a working stress of 16,000 lb. per square inch on many large iron girders carrying a heavy dead load; although at that time a departure from the universal 11,200 lb. per square inch was regarded with suspicion. The results of modern research have, however, now given the engineer a free hand, and the British 5 tons per square inch, and the Continental 6 kilos. per square millimetre, have ceased to be regarded with superstitious reverence. A machine or a bridge can only be well proportioned by carefully considering the special conditions of the case, in the light of experimental data and past experience. A string of formulæ will not make an engineer.

In concluding this necessarily very hurried and imperfect paper, the writer would like to bear testimony to the admirable behaviour of a very good friend of his—mild steel. During the past three years he has had to deal with about 24,000 tons of that material, and to submit it in many cases to very harsh treatment. He has had more cases of so termed "mysterious fractures" with the few tons of wrought iron, used for certain temporary purposes, than with the whole 24,000 tons of steel. This rest of his experience may be of interest to brother members of this society who now are, or will doubtless be, large users of mild steel; and the testimony is perhaps of the greater value as the work at the Forth is pressed on day and night, and no precautions are taken which would not equally be necessary were the material the highest class of Lowmoor iron, costing double or treble the price of the steel.

ECONOMICAL ROADMAKING.—At the last meeting of the Manchester Association of Students of the Institution of Civil Engineers, a paper was read by Mr. Bracegirdle on "Road-making." Mr. R. Vawser, M.I.C.E., was in the chair, and in the discussion which took place, Mr. W. Spinks, A.M.I.C.E., called attention to the effects of good road-making in manufacturing towns. The streets occupied by the working classes are always the playground for the children, who, when the streets are unpaved, are continually breathing a vitiated air given off from the damp and reeking surfaces. He was convinced that the clean, dry, impervious pavements were a most important factor in the reduction of the death-rate. He then gave some facts concerning the introduction of first-class impervious pavements. He said:—"Taking roads of ordinary inclinations, formed of gritstone or boulder pavements laid on ashes for a foundation, a one-horse lurry carrying twelve bales of cotton, each weighing $4\frac{1}{2}$ cwt., or 2 tons 14 cwt. per load, travels at the rate of one mile in twenty-three minutes, including stoppages. On a pinch five trips per working day are made, and at 1s. 3d. per ton this makes the earnings 13s. $7\frac{1}{2}$d. per day. On a first-class impervious granite roadway the same load can be taken, with less wear and tear to horse flesh and damage to lurry, comfortably six times a day, travelling at the rate of one mile in seventeen and a-half minutes, without stoppages, the earnings being increased to 16s. 11d. per day. Now supposing we have a railway goods depôt, employing twenty-four horses each day, the earnings would be increased £4. The outgoings for rent, provender, &c., being the same, but repairs, &c., considerably less, the same work exactly as on the old roads could be done by twenty horses. The average working life of a good cart horse, costing now from £70 to £90, is six years on these old roads, and about seven and a-half years working on first-class roads. So, with twenty-four horses, one horse per annum is saved. 324 tons, or 65 wagons, are emptied each day by twenty-four horses drawing loads over the old roads; on the new 390 tons, or 78 wagons, a day can be emptied, each wagon being 18ft. long. There would be at the close of each working day a clearance to the extent of 70 yards additional sidings. Now some may urge that these facts only show a gain to the carriers, and not to the manufacturer and consumer; but the laws of supply and demand will soon equalise the saving effected, which goes even farther than I have shown, as the owner of horses has less for the wheelwright, coachbuilder, harness maker, farriers, and veterinary surgeon to do; and I have also shown that by saving life good road-making increases the earning number of a community and keeps more houses occupied. Thus if we have a slight increase in local taxation, we have very great gains in other ways, and the outgoings of money in that direction are brought back."

CONTRACTS OPEN.

KURRACHEE HARBOUR BOARD SHIP WHARF EXTENSION.

THE Indian Government require tenders for the construction of a screw pile wharf at Kurrachee. The work to be carried out under this specification is the supplying and delivering on board ship in one or more of the ports named in the form of tender the whole of the ironwork of the substructure of a screw pile ship wharf, 1200ft. long, consisting of one row of seventy-five wrought iron piles, 6in. diameter and 52ft. 3in. long, and two rows each of seventy-five piles, 5in. diameter, 47ft. 9in., and 35ft. 9in. long respectively from the heads of the piles to the points of the screws. They are to be braced together horizontally and diagonally in a longitudinal and transverse direction, in the manner shown in the drawings on page 43. The row of wooden piles will be provided at Kurrachee, but the cast iron pile caps for them are included in this contract.

2. The piles, bearings, tie-rods, clips, straps, bolts and nuts, pins, &c., are to be of wrought iron, the screws and pile caps of cast iron.

3. The wrought iron is to be of quality satisfactory to the engineer, and is to be capable of sustaining a tensile strain of 20 tons to the square inch under a blow struck with a heavy hammer.

4. The clips, straps, bolts and nuts, and pins to be of the best approved scrap iron. The clips to be carefully bent to the form shown in the drawings, and the parts bent are in no case to be reduced to a thickness less than they had previous to bending. The whole to be approved by the engineer.

5. The cast iron is to be of the toughest description, cast clear, sharp, and true to form, and free from air and sand holes and other defects. Specimen bars of this iron, 2in. by 1in. and 3ft. 6in. long, are to be cast from time to time as may be directed by the engineer, and are to be tested as follows:—They are to be laid on edge with a clear bearing of 3ft., and if they break with a load of less than 28 cwt. at the centre, all the castings made from such iron are to be rejected.

6. All the fitting and other workmanship throughout is to be done in the best and soundest manner, and such fitting, drilling, &c., as the engineer may consider most convenient to be done at the time of erection is to be left—see particulars under their respective heads.

7. The pile shafts are to be planished, and the remainder of the wrought ironwork, before it is exposed to corrosion, is to be coated with boiled linseed oil, applied hot; and as soon as the wrought and cast ironwork has been inspected and approved at the factory the whole is to be scraped, cleaned, and covered with two good coats of best anti-oxide oil paint.

8. A portion of the wharf, consisting of three piles in each row, is to be erected complete on the contractor's premises. The parts so erected are to be made from the same pattern, templates, or models, as the corresponding parts of other portions.

9. The quality of materials, workmanship, and preparation for shipment are throughout to be subject to the inspection and approval of the engineer in England appointed or authorised by the Secretary of State in Council, whose interpretation is also to be taken and accepted on any discrepancy or doubt found or arising in the plans, specifications, or measurements.

10. The figured dimensions on the plans are to be adopted in preference to scale measurement.

11. The shafts of the piles are to be $51\frac{1}{2}$ft., 47ft., and 35ft. long in the three rows respectively. They are to be shod with cast iron screws and crowned with cast iron caps as shown on the drawings.

12. The heads and feet of the pile shafts are to have two of their sides flattened by $\frac{3}{4}$in. each; the heads for a distance of 8in. to receive the screwing keys, and the feet for 12in. to fit into the screws.

13. The screws are to be of the forms shown. The diameters of the flanges are to be the same for the two sizes of pile, but the spindles are to be larger for the 6in. than for the 5in. piles, and the sockets are to be cast to fit the piles exactly.

14. The flange is to be saw edged and to make $1\frac{1}{2}$ turns on the spindle, and 1 turn and 3in. at the circumference with a 6in. pitch. The spindle is to have an auger point. A wrought iron ring $\frac{1}{2}$in. thick is to be shrunk on the neck of the screw. A hole is to be drilled through the spindle and the foot of the pile to receive a pin 1in. diameter, which is to be provided and left to be rivetted. The ends of the hole are to be enlarged to a conical form and the pin to be formed with a corresponding conical head. Each screw is to be fitted on its own pile at the factory and numbered accordingly.

15. The caps for the p le heads are shown in the engraving. Those on the face piles are to be fitted with wrought iron clips to serve as lugs for the connection of the diagonal bracings. Those for the two inner rows of iron piles to have lugs cast on them, and those for all the timber piles to be of cast iron without lugs.

16. The caps are each to have four $1\frac{1}{4}$in. bolt holes in the table for fastening down the main girders. The holes for all these bolts are to be drilled at the factory exactly to the measurements shown.

17. Three pins, $1\frac{1}{4}$in. in diameter, and of lengths slightly in excess of the outside diameters of the caps, are to be provided for each pile head to secure the same to the cap, but the holes to receive them are not to be drilled either in the cap or the pile head.

18. For convenience of stowage, both the caps and the screws are, after being fitted, to be detached from the pile shafts and shipped separately.

19. The piles in the face row are to be connected longitudinally by two lines of horizontal braces, the centres of which are to be placed at 11ft. $8\frac{1}{2}$in. and 24ft. 5in. respectively below the heads of the pile, the former consisting of one channel iron, 6in. by $2\frac{1}{2}$in. by $\frac{1}{2}$in., and the latter of two similar channel irons, which are to be connected at the centre of their length by a 1in. bolt passing through a cast iron circular distance piece 2in. thick. The same piles are also to be connected by two diagonal braces between each pair of piles carried from the head of one pile to the level of the lower horizontal brace on the adjoining pile, each consisting of an angle iron 6in. by 4in. by $\frac{1}{2}$in. The two are to be bolted together, and to the horizontal braces at the crossing with three 1in. bolts passing through cast iron distance pieces where necessary.

20. The piles in the second row are to be connected by one line of horizontal bracing at the level of 11ft. $8\frac{1}{2}$in. below the heads of the piles, consisting of one channel iron 6in. by $2\frac{1}{2}$in. by $\frac{1}{2}$in., and by two diagonal braces between each pair of piles carried from the head of one pile to the level of the horizontal bracing on the adjoining pile, each consisting of an angle iron 6in. by 4in. by $\frac{1}{2}$in., and bolted together at the crossing with one 1in. bolt.

21. The piles in the third row are to have no longitudinal horizontal bracing.

22. The piles of the second row are to be connected to the piles of the face row transversely by two horizontal braces, at the sama level as the longitudinal horizontal braces; the upper one consisting of one and the lower of two channel irons 6in. by $2\frac{1}{2}$in. by $\frac{1}{2}$in.; also by two diagonal braces from the heads of the piles of one row to the level of the lower horizontal braces of the corresponding piles of the other row, each consisting of a single angle iron 6in. by 4in. by $\frac{1}{2}$in., which are to be connected together at the crossing in the same manner as in the case of the longitudinal bracing.

23. The piles of the third row are to be connected to the piles of the second row by one horizontal brace at the same level as the upper braces above described, consisting of one channel iron, 6in. by $2\frac{1}{2}$in. by $\frac{1}{2}$in., and by two diagonal braces from the heads to the level of the horizontal braces, consisting of angle irons, 6in. by 4in. by $\frac{1}{2}$in., connected together at the crossing by one 1in. bolt.

24. The whole of the braces are to be cut to the lengths shown on the drawing, with square or oblique end, as may be required; and the holes for the bolts are to be drilled in the channel iron or horizontal brace; but in the angle iron or diagonal braces, except in those required for the two bays to be erected in England, the holes are to be drilled at one end only, those at the other end being left to be drilled at Kurrachee.

25. The clips for the attachment of the braces and the fender straps, to be hereafter described, to the piles, are to be of nine different patterns, as shown. They are so arranged that any one of them can be removed or replaced for purposes of renewal or repair after the completion of the structure, and this condition must be carefully preserved. The holes for the $1\frac{1}{4}$in. bolts by which the braces and fender straps are to be attached are to be drilled with accuracy in the positions shown, and each clip is to be sent out with its bolt in place, together with such iron packing pieces as are required, as shown on the drawings. Spare bolts are to be provided, as per schedule attached.

26. Wrought iron fender straps of the form shown are to be provided for all the face piles. The upper and lower straps upon each pile are to consist of bars of flat iron 2in. by $\frac{1}{2}$in. bent as shown with a round bar $1\frac{1}{4}$in. diameter welded on to each end, the ends of which are to be screwed and provided with nuts to enable them to be secured to and tighten the clip. The middle strap is to consist of a bar 3in. by $\frac{1}{2}$in., bent as shown, and with a hole at each end, and a bolt $1\frac{1}{4}$in. diameter passing through each end hole, and securing it to the clip in the manner as in the case of the upper strap with two nuts.

27. All bolts, straps, and other small articles are to be packed for shipment either in strong wooden cases, or securely bound together in bundles of convenient size. The smaller bolts to be in strong bags inside the cases.

28. All the articles to be marked K. H. B., and numbered consecutively in paint, and a shipping specification descriptive of the several articles with the outside dimensions and weight of each to be furnished at the time of shipment.

Conditions same as the Indian State Railways. Tenders are to be sent by the 25th inst.

JOHN ROACH.

THE death is announced of Mr. John Roach, the most celebrated shipbuilder that America has produced. The career of Mr. Roach was identified with the chequered history of the shipping and shipbuilding industries of the country of his adoption. He had built from first to last about 100 iron vessels, of an aggregate tonnage of about 210,000. He was almost from the commencement the leading shipbuilder in the United States, although the industry of iron shipbuilding was also carried on to a smaller extent elsewhere than at his works in Philadelphia, and especially at New York, Buffalo, Pittsburgh, Wilmington, New Orleans, St. Louis, Detroit, Cleveland, Portland, and San Francisco. Some of Mr. Roach's vessels for the Pacific line ran up to 5000 tons; and he had, at one time or another, built a number of the chief vessels in the United States Navy.

The history of the shipbuilding industry of the United States is an eventful and instructive one. The records of the trade extend as far back as 1797. In that year, 57,600 tons of shipping were built in the United States as a whole. Four years later this tonnage was more than doubled. In 1811 the shipbuilding yards of the United States launched 147,000 tons of shipping, and in the following year the first steamship that was constructed on American waters was launched. It was, however, many years before steam gained the ascendency. In 1837, when the question of establishing regular steam communication with the United States had been solved by the achievements of the Sirius and the Great Western, 126,000 tons of shipping were launched on American waters, of which only 33,000 tons were built in steam. When Brunel commenced, about this time, to use iron in the hull of ocean steamships, the experiment was regarded as a very doubtful one. Up to 1850, indeed, there had only been 57,000 tons of iron shipping in the merchant marine of Great Britain, and in that year the total tonnage launched in iron was only 12,800 tons. But from 1850 the progress of iron shipbuilding was rapid and decisive. Five years later, the tonnage launched in iron was about one-half of that built in timber—the figures being 214,900 in the latter, and 108,000 in the former. Again there was a pause, and of the tonnage launched during the next six years iron ships never came up to 100,000 tons. A revival set in once more about 1862, when 122,000 tons were launched in iron, as compared with 229,000 in timber. In the following year iron made a still greater stride, with 216,000 tons against 410,000 in timber. In 1865, for the first time in the history of the trade, the tonnage built in iron exceeded that constructed in timber by nearly 60,000 tons, and from this time forward iron held the field as the dominant material.

From this time forward the shipbuilding relations of England and the United States underwent a very marked change. Until 1863 the tonnage of vessels of all kinds built and registered within the United Kingdom had never, in any one year, exceeded 350,000 tons. In the United States, however, the tonnage frequently shot far ahead of that figure, having been as high as 537,000 tons in 1854, and rising to 583,000 tons in 1885. In 1863, when the new tonnage launched in Great Britain rose at a jump from 351,000 to 626,000 tons, the industry of the United States only showed an increase from 175,000 tons to 311,000 tons. During the next few years the events of the war helped England and hindered her rival. When the war was over the reign of iron shipbuilding had been fairly established in this country. At the end of 1868, of 1,341,000 tons on the British register only 122,000 tons were in timber. Meanwhile, however, the American shipbuilders continued their old-fashioned ways. They soon found themselves left behind in the race. The days of the famous Baltimore clippers had gone for ever—at any rate for ocean purposes. Steam and iron had won the day, and were destined to keep possession of the field. Hence it happened that in the ten years ending 1885 the American shipbuilders never, in any one year, got up to 300,000 tons a-year, whereas Great Britain rose for several consecutive years to over 1,000,000 tons annually. The construction of timber vessels has practically ceased to be carried on in our own country. In the United States, on the contrary, timber is still the material chiefly employed. Indeed the official records show that the tonnage of iron and steel ships built in the United States has never in any single year exceeded 35,000 net tons. In 1885 the tonnage so launched was 44,028 gross, or 32,619 net tons, of which 15,936 net tons were built at Philadelphia, 4235 tons at Wilmington, 3355 tons at Michigan, 2588 tons at Cleveland, and 2758 tons at New York. The whole of these, with one exception, were sailing ships. The average size of the iron ships built in the United States is, however, exceedingly small. The number of ves els to be set against the 32,619 net tons built in 1885 was 48, which gives an average of only 679 tons per vessel.

At the present time the American shipbuilding industry is distributed over four great centres—the New England coast, the seaboard generally, the Mississippi river and its tributaries, and the Great Lakes. The tonnage launched in 1885 was, according to a *Times* correspondent, 159,000 tons over the whole, towards which total the New England yards contributed 48,000 tons, the Mississippi 11,200 tons, the Great Lakes 26,890 tons, and the seaboard the remainder.

SPIEL'S PETROLEUM ENGINE.

MESSRS. A. SHIRLAW AND CO., BIRMINGHAM, ENGINEERS.

(*For description see page* 54.)

FIG. 1

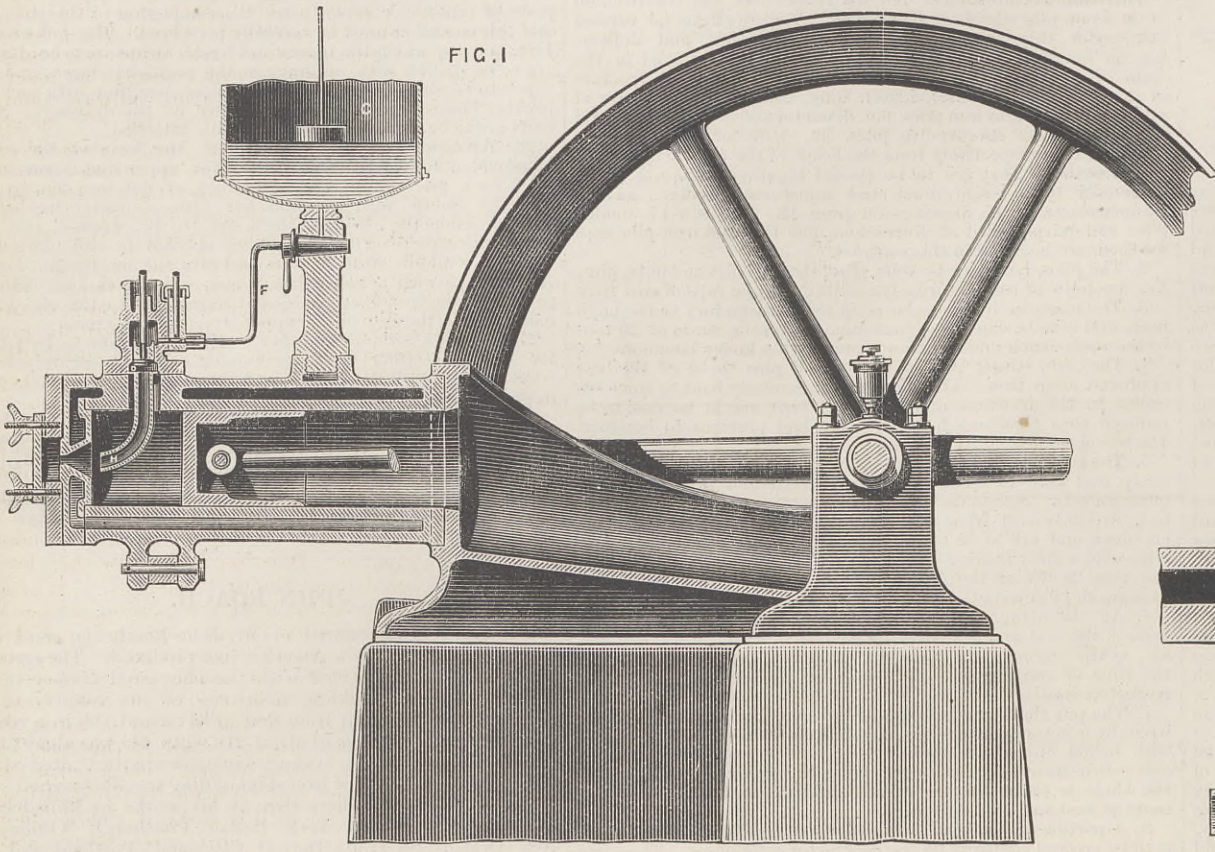


FIG. 5

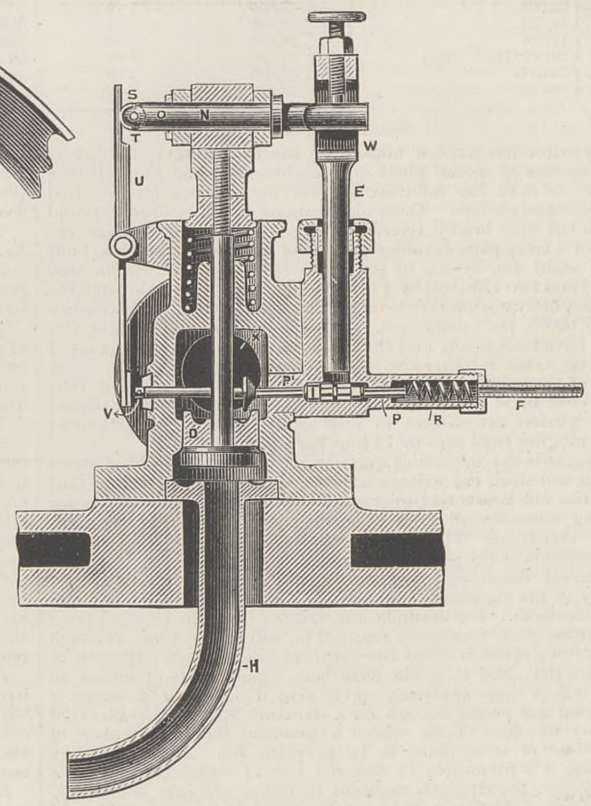


FIG. 2

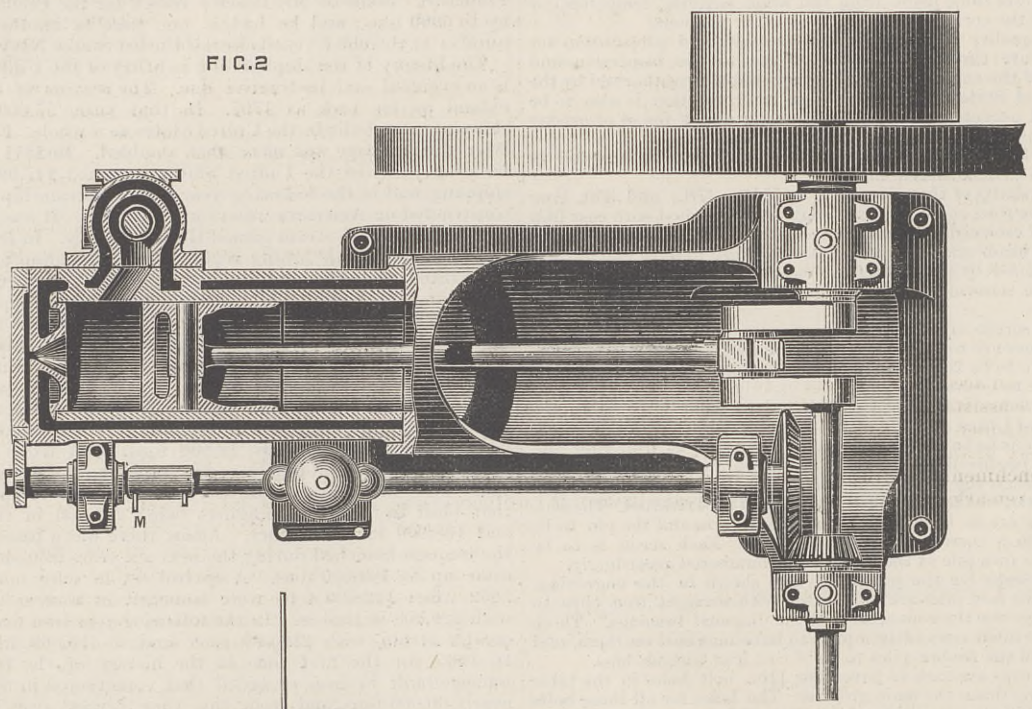


FIG. 6

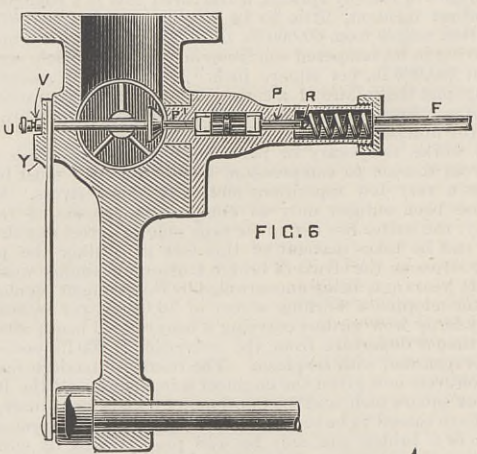


FIG. 7

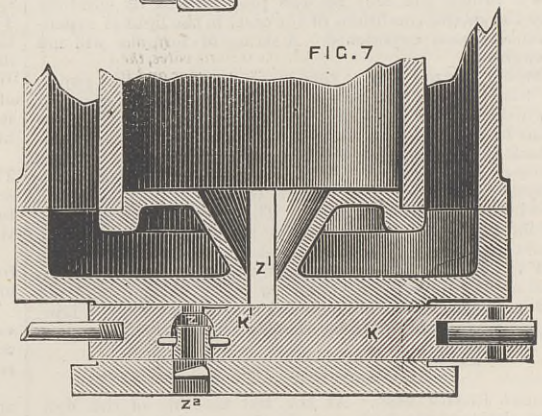


FIG 3

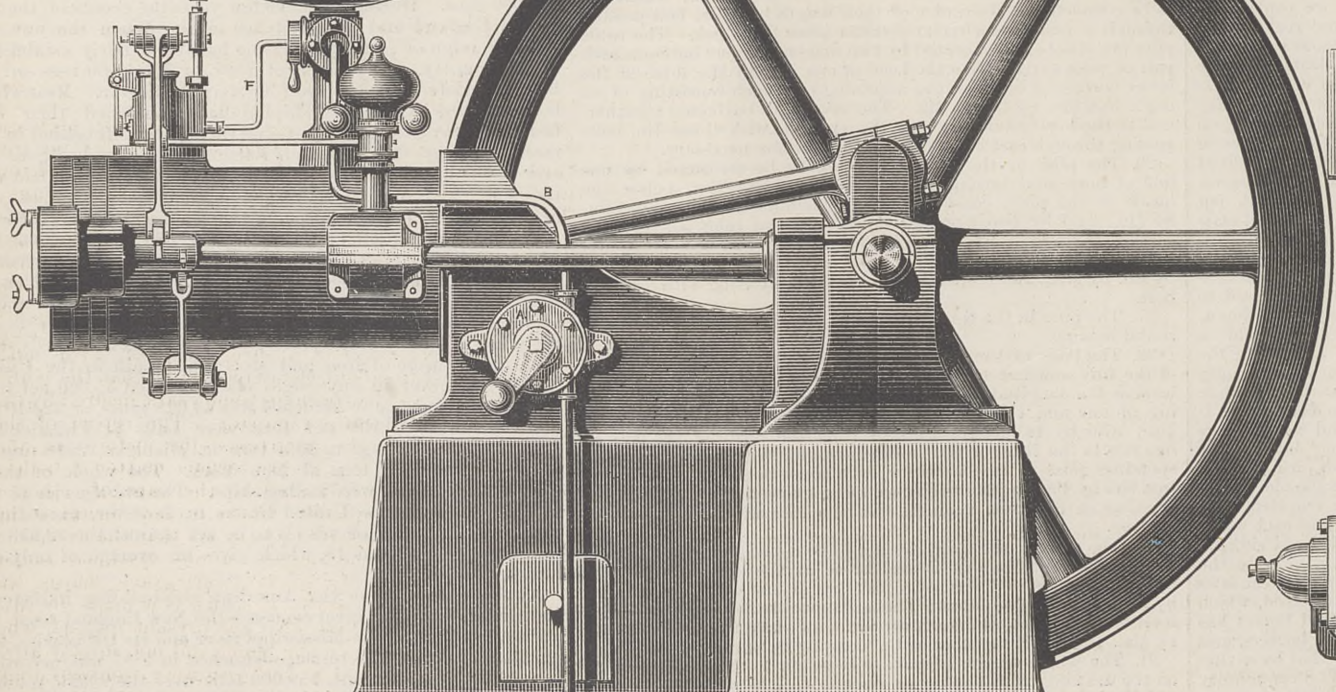


FIG. 8

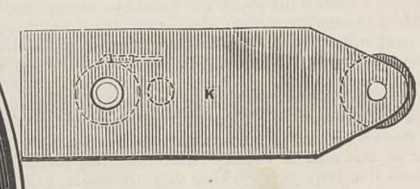
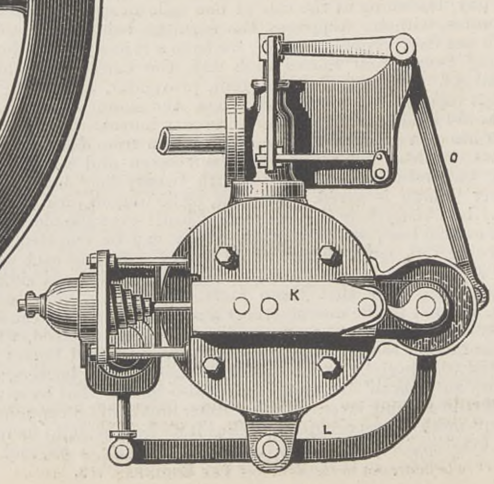


FIG 4



JOHN SWAIN.

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TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

*** *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.*

EXPERIENCE.—*So far as we know, the water was taken from the river or the docks.*

H. S.—*We regret that we are unable to give any information beyond that already published in our last impression.*

B. J. B.—*There may be just as much vibration in a paddle-boat as in a screw-boat, only it is of a somewhat different kind.*

ENGINEER.—*The hunting of your governor may be due to several causes. For instance, the shape and construction of the throttle valve. If, for example, a very small rise in the governor nearly closes the throttle valve, the governor is sure to hunt. Send a dimensioned sketch of the governor and its connection with the throttle valve.*

P. R. G.—*The principle involved in your scheme might be worked out practically. There are, however, difficulties. If the cage got locked, it is not easy to see how it would be freed without adding somewhat to the complexity of the mechanism. It seems, too, that the pit-head frames would in many cases have to be raised. The idea is, however, worth thinking out. Whether it is quite new or not we are not prepared to say.*

OIL.—*At the time when the glands want oil they are probably drawing a little air, which will leak through a stuffing-box quite steam-tight. A little steam is always condensed in the stuffing-box. The resulting water is sucked into the cylinder by the air rushing in. By oiling the glands you make them air-tight. The water is no longer drawn in, collects in the stuffing-box, and is blown out by the steam at the beginning of the stroke. This is one explanation of the peculiar action to which you refer.*

ASAPH.—*For all purposes relating to the expansion curve of steam used in a steam engine the clearance space must be taken into account, because the curve depends upon the quantity of steam within the cylinder at the point of cut-off, whether admitted or previously there, though, of course, it is affected by condensation, which will not necessarily be the same when compression up to initial pressure takes place as when compression is not used. In the former case clearance should not be reckoned on when taking out the steam consumption.*

GRINDING WOOD.

(To the Editor of The Engineer.)

SIR,—Can any of your readers kindly inform me if there are any mills in or near London where I can get wood ground into a fine powder?

January 18th. W. B.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, January 25th, at 8 p.m.: Ordinary meeting. Papers to be read with a view to discussion:—I. "Sewage Sludge and its Disposal," by William Joseph Dibdin, F.C.S., F.I.C. II. "Filter Presses for the Treatment of Sewage Sludge," by William Santo Crimp, Assoc. M. Inst. C.E., F.G.S.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, January 24th, at 8 p.m.: Cantor Lectures. "The Diseases of Plants, with Special Regard to Agriculture and Forestry," by J. L. W Thudichum, M.D., F.R.C.P. London. Lecture I.—Introduction—Comparison of animal and vegetable pathology—Definition of principal disease causes as living parasites—Fungi—Bacteria—Bacilli—Sarcinæ—Zooglœa—Micrococci—Description of potato disease as illustrating the combined action of Endophytes and Saprophytes—Survey of parasitic fungi—National economy and politics as affected by epidemic diseases of plants. Tuesday, January 25, at 8 p.m.: Foreign and Colonial Section. "The Volcanic Eruption in New Zealand," by J. H. Kerry Nichols, F.R.G.S. Sir Francis Dillon Bell, K.C.M.G., C.B., will preside. Wednesday, January 26th, at 8 p.m.: Ordinary meeting. "Photographic Lenses," by J. Traill Taylor. James Glaisher, F.R.S., President of the Photographic Society, will preside.

THE SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS.—Thursday, January 27th, at the Institution of Civil Engineers, 25, Great George-street, S.W., at 8 p.m.: "Telephonic Investigations," by Professor Silvanus P. Thompson, B.A., D.Sc., Member.

SOCIETY OF ARCHITECTS.—Tuesday, January 25th, in the Freemasons' Tavern, Great Queen-street, W.C., at 7 p.m.: Ordinary meeting. Paper to be read:—"Architectural Styles, Old and New," by Mr. Basil Champneys, B.A., Camb.

THE ENGINEER.

JANUARY 21, 1887.

THE PARIS RAILWAY EXHIBITION.

IN our last impression we published the condensed programme of the Jubilee Railway Exhibition, to be opened in Paris next May. This Jubilee has nothing to do with that of Queen Victoria. In 1837 the first railway in France—Paris and St. Germains—was opened, and the engineers of France desire to celebrate its fiftieth anniversary with an Exhibition. It will be remembered that a Jubilee Exhibition was held at Darlington in 1875, just fifty years after the opening of the Stockton and Darlington line. Ours was a comparatively modest affair. The proposed Exhibition in Paris is to be carried out on a magnificent scale. A meeting to promote it was held on Tuesday, at the Cannon-street Hotel. Mr. Edward Woods, President of the Institution of Civil Engineers, was in the chair. The proceedings have already been fully reported in the daily press. It will suffice to say here that according to M. Louis, the Governor-General, the Exhibition will be carried out on a very grand scale indeed. The loan of not less than 900 acres of ground in the Bois de Vincennes has been obtained from the Paris Municipality; and a double line of rails five miles long will run round the Exhibition grounds. The buildings will cover about 30,000 square yards. As a proof of the sincerity of the promoters, caution money to the extent of £40,000 has already been deposited with the authorities, and a proper list of guarantors has been prepared. It appears therefore that unless political complications—that is to say, a war with Germany—take place the Exhibition will be an accomplished fact. It is not necessary to add that the assistance of Great Britain has been invoked, and the gentlemen who were present at the Cannon-street meeting were unanimous that it ought to be given.

That Frenchmen should desire to hold an exhibition of the kind is not remarkable; to what extent Great Britain is called upon to take part in it is open to question. It is very difficult to believe that the sale of English railway engines, carriages, or appliances will be materially promoted by the Exhibition. France is quite competent to provide all these things for herself. If the views held in France concerning the proper construction of locomotives differ somewhat from English ideas, the fact does not prevent French railways being worked satisfactorily and even economically. It is quite possible that we could teach French engineers something; but it seems to be carrying the operation of the *entente cordiale* rather far; if we not only teach our friends at the other side of the silver streak, but do so at our own expense. The Great Northern Railway Company might, for example, exhibit one of Mr. Stirling's magnificent express engines and a train of passenger coaches, and we have not the least doubt that they would evoke admiration; but who is to pay for sending them to France? The cost would be considerable. Would the directors be justified in spending the shareholders' money in this way? Again, some of our great locomotive building firms may send locomotives. Is it too much to ask what will be their reward? It was, no doubt, pleasant to find the gentlemen at the Cannon-street meeting cordially aiding in promoting the wishes of the Exhibition Committee; but it is worth notice that not one of those present will incur any expense other than that which will be inseparable from a trip to Paris next summer. Not an English railway man, save Mr. Scotter, of the South-Western, was present; not a single representative of British firms building locomotives or carriages, or making signals, or railway appliances of any kind, put in an appearance. The promises and sympathy of the meeting really count for very little; they are gratifying to French people, no doubt, but it was to the promisers an inexpensive gift—sympathy, so far, costs nothing. We want to hear the voice of those who will have to pay; if they express themselves quite willing to incur the cost of exhibiting there is no more to be said.

It may, of course, be argued that under the circumstances Great Britain must exhibit. That is always said about every Exhibition held anywhere. We confess that we are so obtuse that we fail to grasp the reasons why "must" should be used. There are two reasons why Great Britain may exhibit. One is that she may gain pecuniary profit directly or indirectly; the other is that she is good-natured and willing to oblige. Now, it is certain that although the first motive may operate with locomotive and rolling stock and signal builders, it can have no existence in the case of railway companies. These therefore can only exhibit to oblige France, and, as we have said before, it would perhaps be well if the directors consulted the shareholders in the first instance. As to the private firms, we cannot see what they would gain; unless, indeed, they sent engines and rolling stock specially suited for colonial work on the chance that purchasers might be found to give them orders. It is too often forgotten that the English locomotive and its road must be taken together. They have been designed for each other and cannot be divorced. One of Mr. Johnson's Midland express engines would not induce a colonist to give an order to an English firm, because no machine more unsuitable for a light half-made railway could be found. "Sir," said an American tourist, "I calculate your railways are well done; ours are mostly slack-baked." This was said years ago, and American railway practice has improved; but the fact holds good that the superlative productions of 1886 are not typical of the proper rolling stock for use abroad. It seems therefore that English and Scotch firms would gain nothing by sending rolling stock, representing English practice, to France. However, such firms may have sufficient good nature, or pride in their productions to exhibit, and thus earn the gratitude of our friends in France. We have no doubt that, if they do they will worthily maintain splendid reputations.

After all, it seems to us to be open to question whether France wants our help. The railway system of the country is so vast, and her engineers are so skilful and ingenious, that there can be no lack of material for a most interesting and valuable exhibition. With this they ought to be satisfied. There are a few engineers who in this country carp at French practice. This they do because they forget the modifying conditions—the environment, so to speak, which settles the type of locomotive and rolling stock. We are still apt to be too insular in our ways, and an Exhibition of French railway appliances cannot fail to be of value to English engineers. We are selfish enough therefore to say that we wish the Exhibition every success. Indeed, we will go further and say that it is to be hoped that English good nature and liberality will in this case, as it has often done before, triumph over self-interest, and that a reasonable display may be made by Great Britain; only we think it would be well to make it clearly understood that we exhibit out of pure good nature and a friendly spirit; and that there is not the least chance that any British exhibitor will reap one farthing of pecuniary profit. It is just as well that this should be understood at the outset; it will save trouble afterwards. The railway companies of the United Kingdom will have to make up their minds without delay, and the same may be said of private firms. No intimation has yet been given as to whether other countries besides France and England are to participate. Belgium could send something worth notice.

We may add a word of warning in conclusion. It is just as likely that harm as good may be done to Great Britain by this exhibition unless the truth is carefully kept before the world. This was very clearly set forth by Mr. Hyde Clarke at the Cannon-street meeting. As what he said has not been reported elsewhere, we give his words here. He said, the observations of Sir J. Fowler and Sir C. Gregory induced him to put a question on the objects of the Jubilee. It had been stated that the Jubilee dated from 1837, when the small St. Germain line was opened on the example of the Liverpool and Manchester, and produced no effect in France. The real date for French railways was some years later, twenty years after the Stockton and Darlington Railway, when English capitalists, English engineers—Locke and others—English contractors—Brassey, Allcard, Buddicombe, and others—English directors, and English managers, and also English navvies, took charge of constructing the French railway systems. Then the Paris and Rouen, Rouen and Havre, Great Northern, and Paris and Lyons laid the real foundations. After the expression of goodwill on the part of their French friends, it would be in that spirit to acknowledge the foundation by the English of the French railway system forty years ago. Otherwise the affair, which would doubtless be a successful show, might prove disastrous to English manufacturers. The French might be shown before the natives of South America, for example, as entering into competition with English engineers, they might appear as the inventors of the railway system of the world, and as possessing the school of perfection. Thus the French might get the solid fruits, and the English lose more of their customers.

THE BOARD OF TRADE AND BOILER INSURANCE.

ON the 8th of October, 1886, a vertical boiler exploded at the Clifton Works, Neepsend, Sheffield. Two men were killed and three much injured. The boiler was vertical, of the Field type. It was nearly 12ft. high and about 5ft. in diameter. It stood over a kind of pit into which flowed the waste gases from a steel ingot heating furnace, which gases then passed away up the chimney. The boiler was about fourteen years old and was worked at 70 lb. pressure. In the side near the bottom was a fire-door opening. This had been closed up for some time before the catastrophe took place. The lower part of the fire-box was lined all round inside with fire-bricks. The fire-box collapsed, the plates close to the fire hole being wasted to the thickness of a sheet of paper. The most remarkable feature about the explosion is that the boiler was at the time, and had been for some years, insured by the National Boiler Insurance Company. The report of the Board of Trade on the occurrence lies before us, and deserves attention. It is a very serious matter if boilers which are regularly entrusted to the care of a boiler insurance company explode. In the present instance the Board of Trade does not hesitate to say that the explosion was due mainly to the neglect of the National Boiler Insurance Company. As this is a very grave charge, we reproduce the precise words in which it is made by Mr. Traill:—"It would appear that the present owners, who had just got possession of the boiler, did not employ any-one to examine it, and that the insurance company took the risk without *internal* examination, and without applying the hydraulic test. A few weeks after the insurance had been re-effected the boiler exploded, injuring three persons, one seriously; but, worst of all, two men were killed. This case most clearly shows that such partial examinations are not sufficient to prevent explosions, and although such examinations, coupled with insurance, may be in a pecuniary sense not altogether unprofitable, nevertheless they are not such as to minimise explosions." Before proceeding further, we may say the National Boiler Insurance Company has now under its care no fewer than 12,000 boilers. Lest there should be any doubt as to the view taken by the Board of Trade officials, we quote from the report of Mr. W. H. Woodthorpe, who investigated the circumstances of the case. After speaking of the condition of the boilers he goes on, "Possibly the amount of work the inspectors generally have to get through does not permit the complete examination to be made—especially when the parts are difficult of access, as in this case—which is the only safeguard against explosions resulting from defective condition." No further illustration of the view taken by the Marine Department of the Board of Trade is, we think, required. We may now proceed to see whether these grave charges are or are not substantiated by the facts.

There can be no question that the boiler exploded because it was corroded. It is also certain that Mr. Bethune, who inspected the boiler externally for the insurance company on the 15th September, knew that it was corroded inside the fire-box. That was about four weeks before the catastrophe took place. Mr. Armistead made a thorough inspection on the 29th of September, 1885. That was the last thorough inspection made—that is to say, a little more than twelve months before the boiler burst. It is clear that it was impossible to see much of the fire-box or the shell by lowering a candle down into the 4in. space between the two. The upper half of the fire-box could not be hammered because of the Field tubes. It was known that the stay bolts between the inside and outside fire-box were wasted. But the inspector held that the boiler was quite safe for 70 lb. pressure, and he was right, for the boiler worked at that pressure for twelve months after his report was made. The point at issue between Mr. Trail, representing the Board of Trade, and Mr. Henry Hiller, engineer and manager of the insurance company, turns on whether the inspector did or did not know enough about the condition of the boiler to pronounce a valuable opinion. Mr. Hiller holds that he did; that the boiler was in insurable condition in September, 1885, and that rapid corrosion subsequently took place, as a result of feeding the boiler with water from the river heavily charged with sulphuric acid. No one denies that the feed-water drawn from the river was very bad. It was so bad that Mr. Hiller strongly advised the owners of the boiler either not to use it at all or, at all events, to use town water from time to time, and this was actually done. But the water from the main costs a good deal of money, that taken from the river nothing. The temptation is strong to use the latter, and so it was used. Mr. Trail has, it is clear, no direct answer to such an argument as this. If it is conceded that the boiler was safe in September, 1885, the boiler insurance company is exonerated, because anything in the way of corrosion might take place in twelve months. Mr. Trail therefore contends that the boiler was unsafe in 1885, and that if it had been properly tested its defects would have been discovered. As such a boiler was not easily inspected in the ordinary way, Mr. Trail lays stress on the argument that it ought to have been put to the hydraulic test, when its weakness would have been discovered, and also that it ought to have been drilled. Mr. Hiller, in giving his evidence, which he did in the most straightforward way, dwelt on the fact that neither he nor any of his inspectors had any reason to think that the boiler was in very bad condition at the time of the last thorough inspection, and no one can prove that it was. The Board of Trade has nothing to go on but assumption. The case of the department is very well put by Mr. Woodthorpe:—"The capricious action of acid-charged water," he writes, "is well known, but I cannot think the wasting in this case attributable to any extraordinary or unusual cause. The description of the boiler, its age, the method by which it was fired, the fact of its having been subjected to similar conditions for many years from the time it was first put to work at this place, its present appearance, and the want of sufficient examination render it quite unnecessary, in my opinion, to seek far for an explanation of its failure." This is negative testimony. Against it we have the positive testimony of Mr. Armistead. On the day when he made his thorough inspection, he had only made two other inspections, so that he was not, as Mr. Woodthorpe implies, pressed for time. He is held, moreover, to be an extremely competent inspector. Mr. Hiller very properly pointed out, in the course of his examination, that the hydraulic test is easily abused, and that he very much prefers proper inspection, and there is much to be said on his side. The value of the hydraulic test is easily overrated. For example, we are informed that the boiler of an engine on the Blackburn and Over Darwen Tramway, a tube in which recently burst causing the death of one man, had been tested to 240 lb. a short time before, the working pressure being 150 lb. If Mr. Hiller's contention is sound, then it is clear that the hydraulic test applied in 1885 would have revealed nothing. But he is quite ready to admit that he had "no doubt whatever that if the hydraulic test had been applied to the boiler at the Clifton Works shortly before the explosion the furnace would have failed, and thereby prevented the explosion; but that although the hydraulic test, if applied to the exploded boiler, would probably have collapsed the fire-box, yet he should never apply such a test to a boiler in such a condition as a thorough investigation would have shown this to be in."

The lesson to be drawn from the whole affair is, we think, somewhat different from that suggested by the Board of Trade. It is quite possible for an inspector to overlook a defect. For example, the Marine Department of the Board of Trade was satisfied to let the Great Eastern steamship go to sea last year with a huge steam pipe corroded over a large area, so that it was not much thicker than a piece of paper, and this after what was called a thorough inspection. It is quite possible that Mr. Armistead was mistaken, but we see no reason to conclude that he did not do his best. There was, we think, no sufficient reason for applying the hydraulic test. There was nothing, in a word, sufficiently bad about the appearance of the boiler to induce much suspicion. The facts prove very clearly, we think, that it is a mistake to use as furnace boilers steam generators designed originally for other purposes. It is a still greater mistake to use bad water, and the only point of difference between Mr. Hiller and ourselves is, that if we had to act under similar conditions, and knew what the water was, we should have drilled the fire-box in three or four places to ascertain its thickness. The badness of the water should have produced more caution than was actually manifested. We would here repeat a suggestion which has appeared already in our columns, namely, that all boiler insurance companies should act with a higher hand than they do. In only too many cases—we do not even hint that this was one of them—they accept for insurance boilers which have a very small margin of safety. They argue, we know, and not without force, that a weak boiler kept properly inspected is really safer than a strong boiler not inspected at all. But nothing is required but a resolution on the part of all the insurance and assurance companies combined to raise the standard of boilers all over the kingdom. It is especially desirable that this should be done, for a determined effort will we fear be made ere long by the Board of Trade to get the inspection of all boilers by its officials made compulsory; a movement sufficient to alarm the whole manufacturing interest of the country. Our readers will be able to judge of the merits of the Sheffield case, for we have endeavoured to put the arguments of both parties before them. Our own view of the matter is, as we have said, that Mr. Hiller, and the company which he represents, and the inspectors which they employ, do not deserve the censure which Mr. Trail has passed upon them.

THE DRAINAGE OF RICHMOND.

Satisfactory progress is being made with the scheme of Mr. Melliss, C.E., with reference to the sewerage of Richmond-on-Thames, and some other adjoining parishes. The complete undertaking involves an expenditure of £100,000, and will affect a population of about 50,000 people. Mr. Melliss, at a meeting in Richmond on Wednesday evening, of the Joint Committee of the Richmond Urban and Rural Sanitary Authorities, was requested to prepare specifications for the intercepting sewers and precipitation works. Tenders will shortly therefore be invited for some heavy contracts. The total sewers and manholes required for the scheme are roughly estimated to cost £35,000; the pumping-station, £13,680; and the filters, £6280. The details of the specifications are not yet decided upon; but the precipitation works, when complete, will have to be raised one foot above the highest flood level of the Thames, and must comprise the following structures and fittings:—Pump chamber and pump house, engine house, boiler house, coal store, workshops, chemical stores and mixing-room, a supplemental pump house, a board room, office, laboratory, eleven precipitating tanks, covered sludge chamber, press house, tramway, high-level filters one acre in extent, low-level filters half an acre in extent, a dock and wharf, and some other small structures. And in connection with these works the following machinery will be required:—Three sets of engines and pumps; three boilers, each 100-horse power; two 12-horse power steam engines, to work singly or together; two steam pumps of 14-horse power, to lift effluent water; and sufficient modern sludge-pressing machinery, including three 30-chamber 36in. square presses; one set of hydro-pneumatic forcing receivers; one sludge pump, an air pump, a steel receiver, and other pieces of machinery. It will thus be seen that the specifications shortly to be issued with reference to this undertaking are worth looking out for by ironfounders, machinery-makers, and those engaged in similar trades. It is expected that the contracts will be ready to let in about ten weeks.

SHIPBUILDING ON THE EAST COAST.

According to the old proverb, "A straw shows which way the wind blows." In the same way the probable course of development of a great industry is sometimes indicated by a few remarks made by someone conversant therewith, when he seems to be discussing merely his own affairs. Mr. William Gray, of the firm of William Gray and Co., West Hartlepool, and a member of Lloyd's Committee, attended the annual dinner of the Boilermakers' and Iron Shipbuilders' Association, at Hartlepool on the 3rd inst.; and afterwards made some observations as to the future of shipbuilding on the East Coast. He said his policy had been to keep his yard going as fully as possible, even at some loss. Last year he had turned out 13,600 tons of shipping, which was a fair amount considering the extreme depression of the trade. He had made special efforts to get repairing work, and had succeeded in obtaining vessels for this purpose from ports even as far distant as Liverpool and Southampton. His neighbours had adopted the same policy, and the operatives of Hartlepool had therefore suffered less than elsewhere. The prospects for the present year were greatly improved. He had now as much tonnage on order as was equal to his entire output for last year. All this had, however, been taken at extremely low prices, in reliance that the men would continue to work steadily and harmoniously with their employers. His firm were about to take an adjoining yard and add it to their present one; this was not because their work in hand justified any extension, but because the class of ships now most in demand were larger and longer than they had been accustomed to build. Fashions in shipbuilding changed as in other things. Ships of great length and tonnage were now most in vogue; they had had to decline to quote for these hitherto, because they had not room in their present yard to build them. With the new yard added to the old one, they would be able to build up to a length of 600ft.

LONDON PLUMBERS AND THE PLUMBERS' COMPANY.

Some time back we noticed with approval a proposal that had been made by the Plumbers' Company to grant certificates to and register those of the plumbing trade who would consent to pass a qualifying examination. When doing so we pointed out how very important it was to the healthiness of modern dwellings that the work entrusted to men of this trade should be properly performed. Nothing more dangerous can be conceived than scamped work of this character, nor is there any other branch of skilled labour in which such work can more easily remain undetected until the evils arising out of it have worked their effect. It is therefore very pleasant to learn that a very large number of the trade, both of masters and workmen, have voluntarily submitted themselves to the test desired by the company before it would grant its certificate of competency. We may be tolerably confident that men who have earned this honourable distinction will exert themselves not to forfeit it, and superior reliance will naturally be placed by those seeking the services of plumbers upon those who possess it. Indeed, we may well recommend those who have work of this nature to be performed to insist, as far as may be possible, on such registered men being supplied to them. If such a course was general, those men who now hang back from the trial imposed would find it necessary to qualify themselves for it, and we should thus be guarded against the dangerous consequences of incompetent or dishonest workmen being employed in this most important branch of constructive work.

HAMMERSMITH BRIDGE.

Great progress has been made with the renewal of this structure since we last referred to it. The new chains have now been erected, those to be superseded by them having been left *in situ* to serve as a scaffold upon which their successors have been built up. The angle of the old land chains, however, being considerably more acute than that given to the new, special scaffolding had to be provided for their erection. The contrast between the dimensions of the two sets of chains, as they now hang together, shows very markedly the great increase of strength designed for the restored bridge. On the Surrey side of the river great progress has been made with the construction of the platform, which is strongly stiffened by lattice girder work. It had been determined not to be necessary to widen the old masonry piers, outside of which the footways on either side of the bridge will be carried upon cantilevers, ample width for the carriage way being secured over the solid masonry of the piers. The ornamental casings of the towers, and those over the anchorage saddles, are now almost completed, and are of handsome design. There seems every prospect of the bridge being completed ready for traffic within a few months from this date, when the present temporary bridge, which forms a great hindrance to the river traffic, will be removed. The scour upon the Surrey bank caused by this obstruction to the free passage of the water has rendered necessary a considerable length of stone revetment work above bridge.

PROPOSAL TO SELL THE NEW SOUTH WALES RAILWAYS.

Sir Henry Parkes, in his recent address to his constituents in Sydney, referred to in our last issue, made the following suggestion for the disposal of the New South Wales Railways. He said:—"He had sometimes thought that if they could get public companies to take their railways at their proper value—he would be very sorry to see one company take the railways, because it would be too strong; but if one company took the Northern system, another took the Southern system, and a third the Western system—that was only an idea of his thrown out, and to which he did not pledge himself—but he had thought that if that was the case there would be a stream of new capital brought into the country. An honorary board could do the work in the meantime, and they could pay off a greater part of their public debt and escape from taxation. The railways would be better worked—worked by new capital, which would flow into other channels and fructify—worked by new ideas and new energies, and at the same time, instead of being overburdened by debt, they would be the least taxed, the least burdened community in that part of the world. He thought that that was well worthy of consideration by thoughtful people; but whether that was done or not, one thing was clear as daylight—that the railways ought to be regarded as State properties, worked in the interests of the whole people, and that no political influence whatever should be brought to bear upon them. The present state of things could not go on."

VICTORIA UNIVERSITY.

The engineering department of the University College, Liverpool, has fallen upon a rich vein, and is to be congratulated upon its success in enlisting remarkably substantial aid for the establishment of an engineering laboratory and chair. Only a few weeks ago it was announced that in consequence of the representations of Professor Hele Shaw a sum of £15,000 had been given by Sir Andrew Walker for the construction of the necessary building and purchase of machines and apparatus. We now learn that Mr. Thos. Harrison, the shipowner, of Liverpool, has given £10,000 to endow the professor's chair. Professor Shaw is also to be congratulated on all this good fortune and upon the pleasure it will afford him to extend the practical engineering courses of instruction which he has commenced, and for which he has already received very high praise.

LITERATURE.

The Gas Engine. By Dugald Clerk. London: Longmans, Green and Co. 1886. 279 pp.

In his pursuit of the experimental study of the gas engine the author of this book has acquired a mass of special information which places him at the head of English writers on this subject. Readers generally will gladly accept this little book as a systematic treatise on the applied theory of the gas engine, and those whose studies and practical experience have rendered them masters of the gas engine as made to-day will welcome it as giving some notions of the direction in which work may be done with a reasonable expectation of not only increasing its efficiency as a heat engine, but as a controllable mechanical motor. Mr. Clerk has expended years not only in experimental inquiry with gas engines, but has devoted much attention to the behaviour of gases burned in closed cylinders. The results of these experimental observations he has placed before the world in papers read before the Institution of Civil Engineers, and has thus elicited the opinion of many who are capable of giving an opinion of some service. On these subjects therefore he has anticipated this book, but in the latter he has weeded out the unnecessary and the irrelevant, and he has gone more fully into those questions which are of prime importance in the theory of gas engines as modified by reference to every practical point affecting it.

The book opens with a brief historical sketch, but one which is sufficiently detailed to give a very satisfactory notion of the character of the early engines, and to show how long many valuable notions concerning the gas engine have been public property, not counting mere suggestions such as that of Huyghens in 1680, who proposed the use of gunpowder for obtaining motive power, but such as that of Bensanto and Matteuci in 1857, which was the free piston engine that pointed the way for Otto and Langen, and the Lenoir engine, which with the inventions of Million and Beau de Rochas, may be said to have led the way to everything that has been done since, although it is not quite certain that much was known until recent years of De Rochas' anticipation of the Otto cycle.

This historic review, with comments upon the errors of past inventors, is followed by several chapters on the thermo-dynamics of gas engines, and includes a consideration of "the gas engine method"—that is to say, method of using its fuel; the theory of pressures, volumes, and temperatures of gaseous mixtures under atmospheric and under higher pressures previous to combustion; the causes of loss in the gas engine; different types of engine in use, and of igniting arrangements, and other mechanical details, such as governors and starting gear. A chapter is devoted to a consideration of the theories of the action of the gases in the modern gas engine; and in this the theories as brought forth by Otto, Slaby, Fleming Jenkin, Schoettler, and others are most dwelt upon. The exploded notions which by some expert witnesses have been much insisted upon concerning the stratification of the gaseous charges receives attention. The theory as put forth by the advocates of this notion is very fairly stated from published reports; and then the author discusses Mr. Otto's theory, and it is this latter, together with the last chapter, which is on the future of the gas engine, that will be most read by experts of gas engines. In this last chapter the various causes of loss are reviewed, and deductions made as to future improvements.

The greater loss—at least 50 per cent.—is in heat carried away by the water jacket round the cylinder, and about 30 per cent by the exhaust. The great comparative efficiency of the modern gas engine is due to the use of compression, and the utmost efficiency of an Otto or a Clerk engine is about 18 per cent. No considerable or any saving can be made by further compression; but there is much to be done, as no doubt everyone will agree, by further expansion; and judging by the relation between actual and theoretical efficiency of either of the above engines, the practical efficiency might be increased to 25 per cent. if expansion could be carried to atmospheric pressure, and this would bring the gas consumption down from 20 cubic feet to under 15 cubic feet of gas per indicated horse-power. With larger engines the loss to the cylinder walls is less than from the smaller engines, and the author points out that this will reduce the greater source of loss, especially as larger engines will make it possible to use longer strokes and higher piston velocity, and thereby the greater range of expansion. But he afterwards points out that he has found the gas consumption by an Otto engine to be less by 10 per cent. when the water in the jacket was just upon boiling than when it was about 62 deg., although he does not say why as high a temperature as this cannot always be used. If the loss of heat through the cylinder could be totally suppressed the possible efficiency of the gas engine might reach 50 per cent.; and although this is impossible, the author looks forward to a gas engine giving 40 per cent. efficiency using hot cylinder liners, expanding to atmosphere, double-acting with diminished impulses instead of diminished frequency of impulse, and as controllable as a steam engine. By the time Mr. Clerk has got his 40 per cent. gas engine the steam engine will perhaps have moved on, from its present 12 per cent. efficiency, at which many maintain it is far more economical in money than gas engines even of the larger sizes.

We might ask whether it will not become possible to use a much larger proportion of air to gas than has yet been used in the gas engine. In our impression for the 12th February last, page 122, will be found diagrams obtained by Mr. George C. Douglas, of Douglas Foundry, with mixtures of 20 and 21 to 1 of gas, giving a maximum temperature of 752 Fah. and of 1144 Fah., and pressures of 21 lb. and 33 lb., the temperature before ignition being 45 Fah. and 41 Fah.

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TORPEDO-BOAT CATCHERS.

THE question of how the attack of fast unarmoured torpedo vessels on a fleet should be met was brought forward more than ten years ago by the late Director of Naval Construction, at a meeting of the Institution of Naval Architects. Speaking of the effect of torpedoes on the bottom of a ship, Sir N. Barnaby then said, "The assailants ought to be brought to bay before they could get within striking distance of the ironclad by consorts armed like the attacking vessels with the ram and the torpedo, which may take, like them, the chances of being sunk. Each costly ironclad ought to be a division defended against the ram and the torpedo by numerous smaller but less important parts of the general forces." At that time it was not considered likely that torpedo boats would be met on the high seas, but retained for harbour and coast defence; hence, Sir Nathaniel's words apply more to the larger torpedo vessels, which are rapidly being added to most European navies. When, however, it was found that the increased dimensions of torpedo boats would enable them to accompany ironclads and take part in an action, in addition to the danger to which a blockading squadron would be subject from their attacks, it became evident that what are now termed torpedo-boat catchers or destroyers must form an essential part of future fleets.

Before denoting the qualities which should be embodied in such craft, it is necessary clearly to define their functions. In an action between two fleets their task would be to destroy the enemy's torpedo boats before the latter could get within range of the ironclads. During a blockade they would cruise inside the blockading squadron for the same purpose, and give warning of all movements by the enemy. When cruising with a fleet, they would act as scouts in conjunction with larger despatch vessels, and be a means of communication with detached squadrons or single ships. To perform these duties efficiently, they should be able to keep the sea independently in all weathers, and maintain a speed of 20 knots against a moderate breeze. Their turning circle should be small. Their armament should consist of quick-firing guns, and a powerful electric light is indispensable. Protection should be limited to what can be given by coal and inch-steel plating. The supply of coal should be sufficient to carry them a thousand miles at a speed of 18 knots. To prevent them falling an easy prey to more powerful vessels, and also to enable them to be utilised for torpedo attack, they should be fitted with a submerged tube in the stem and one on each side above water. The displacement should not exceed 500 tons.

France, as usual, has taken the lead in this branch of construction. While we were deliberating and endeavouring to reconcile the conflicting opinions of constructors and naval officers, the Bombe had been launched and seven more of the same class commenced. With a displacement of about 320 tons the Bombe has attained a speed of over 19 knots. Her armament is to comprise two light guns and three Hotchkiss revolving cannon. She has also a torpedo tube on each side above water. One important feature is the light draught, which at normal sea trim will not much exceed 6ft. She will thus to a great extent escape the liability of being herself destroyed by a torpedo. These missiles are usually arranged for the depth most destructive to the bottom of an ironclad, and moreover do not readily maintain a course near the surface. If, on the other hand, the dimensions and draught of the torpedo-boat catcher are materially increased, she becomes herself worthy of attack, and a fair mark, both in length and depth, for the torpedo-boat. In such a small vessel as the Bombe the armament must be exceedingly limited, and therefore it would seem desirable to have one description of gun, the most suitable for destroying a torpedo-boat or engaging another vessel of her own species. Under these circumstances, it would be difficult to find a weapon superior to the quick-firing gun with 3 lb. projectile. As regards torpedo equipment, the French are wise in restricting the number of positions; but we are surprised that the submerged tube has not been adopted. In this system the torpedo and all its appliances are well protected up to the moment of discharge, and it leaves the ship uninfluenced by the action of the sea. It was stated by Commander Gallwey, in a lecture at the United Service Institution, that very successful practice had been carried out from the bow tube of the Polyphemus up to a speed of 18 knots. As, however, we are dealing now more with the question of how torpedo attacks should be frustrated, we will leave the subject of torpedo equipment for a future occasion; but there is no doubt that should the seaworthy qualities of the Bombe prove satisfactory, she and her consorts will be valuable adjuncts to a fleet. We are now preparing four vessels of somewhat similar description, but intended to be superior to these French ships. These are the Grasshopper, Rattlesnake, Spider, and Sandfly, and more inappropriate names it would be difficult to select. They are to have a displacement of 450 tons and 2700 horse-power, with which it is expected a speed of 20 knots will be realised. Their armament is to consist of one 4-in. breech-loading gun forward, and several quick-firing guns. Four above-water torpedo tubes will be fitted; one in the stem, another right aft above the keel, and one on each broadside. The draught of water is to be 8ft. It is thus evident that these vessels are larger and more powerful than the Bombe class, so that they ought to be able to maintain their speed better in moderately rough weather. We should be inclined to dispense with the stern torpedo tube, as little reliance can be placed in the accuracy of the torpedo discharged into the disturbed water of the wake. It can, however, easily be removed if unsuccessful. The general opinion seems to be that each large ironclad should be attended by one—if not two—of these craft, and therefore it is a pity we have not more than four preparing. The number should be completed to twelve as soon as possible.

Spain has shown much enterprise of late in naval matters. She has secured an excellent specimen of a torpedo-boat catcher in the vessel just built by Messrs. Thomson, of the Clyde. With a displacement of 350 tons, the Destructor has realised a speed of over 22 knots. The armament is intended to comprise one 9 cm. gun, four 6 lb. quick-firing guns, and two 37 mm. Hotchkiss cannon. She is also to have five torpedo tubes. The coal capacity of her bunkers is sufficient to carry her 700 knots at full speed. Fair protection is given by the fuel and subdivision into compartments. We cannot commend the intention to have three descriptions of guns, involving different ammunition, and three torpedo tubes would be ample. There is always a tendency to place in ships more than they can conveniently carry or work, and weights are added which seriously affect the speed when the vessel is completed for service.

A smaller class of torpedo-boat catcher is one built by Mr. White, of Cowes, and purchased by our Government. She is 150ft. long, and with a displacement of about 130 tons has realised a speed of 20 knots. One great advantage she possesses—that of turning with remarkable quickness—is due to the peculiar construction of the after-body, originated by Mr. White, and now familiarly known as the "turnabout" system. It is only surpassed by boats on the Mallory principle, in which the rudder is dispensed with, its work being done by moving the propeller to either side by means of a small engine in the stern. The effect is almost instantaneous in altering the boat's direction. The chief disadvantage is, that when the main engines are stopped control over the boat ceases. For torpedo service also the auxiliary engine is much exposed, and therefore, in this country at least, the system has not been adopted. Although Mr. White's latest production has several valuable qualities, we doubt if she is sufficiently large for a torpedo-boat catcher; but we see no reason why his turnabout system should not be applied to a vessel of 350 tons.

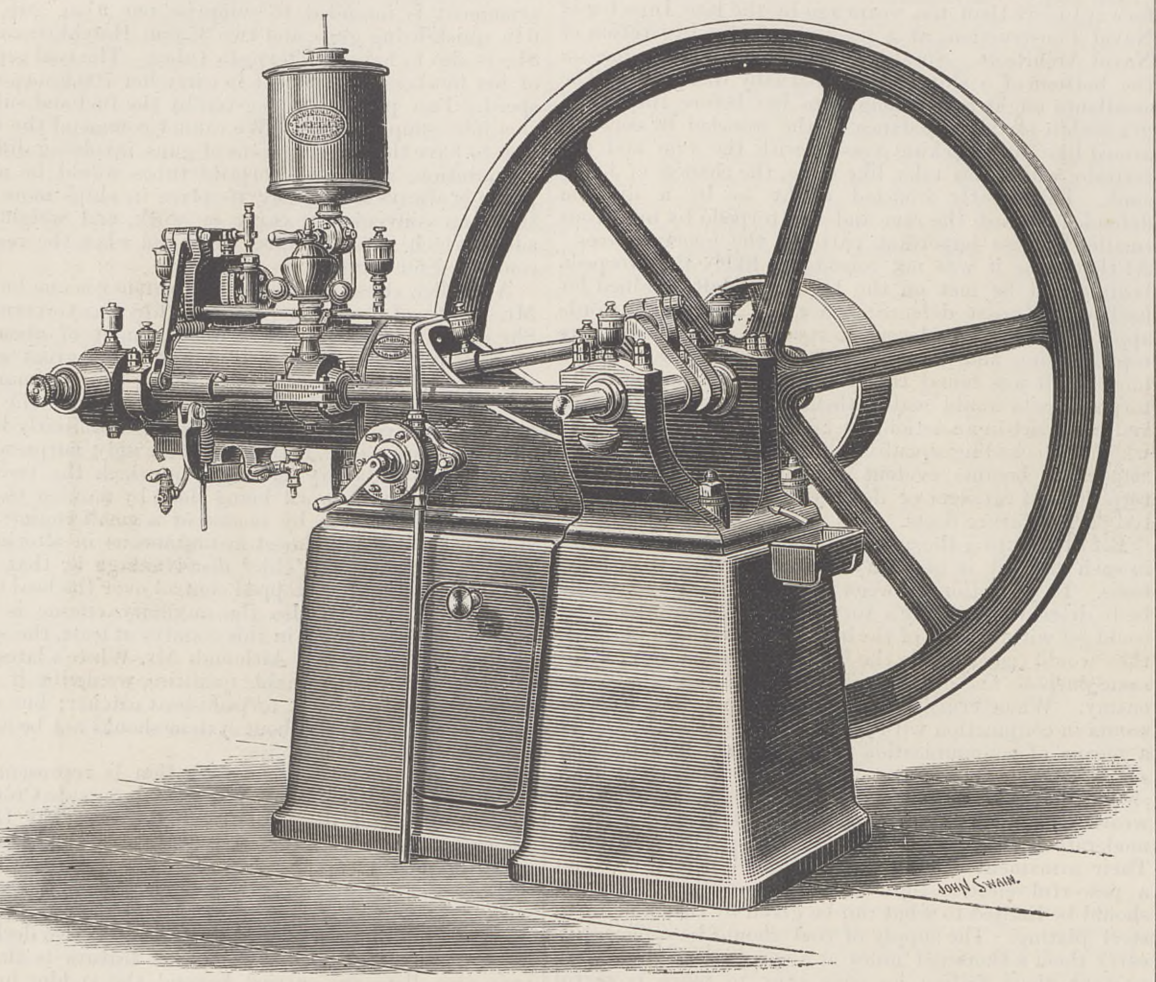
In Russia this type of construction is represented by the Ilyin, which has lately been tried outside Cronstadt in the presence of the Minister of Marine. The Ilyin is somewhat larger than our own vessels, having a displacement of 600 tons, and her equipment in guns and torpedoes of a more extensive nature. She is to be armed with eight 47 mm. and six 37 mm. Hotchkiss guns, in addition to seven torpedo tubes. A steel projective deck runs throughout her length. A curious feature is that her twin propellers are carried beyond the rudder in order to give increased speed. In some of the earlier torpedo boats this system was adopted, but the rudder exerts a greater turning power when abaft the propeller. The length of the Ilyin is 228ft., beam 24ft., and draught of water 9ft. With a pair of triple expansion engines developing 3500-horse power a speed of 20 knots has been obtained. Comparing this vessel with the Grasshopper, we find that she is 28ft. longer, with 1ft. more beam and draught. In the Russian vessel the length is 9·5 times the beam, whereas in the English ship it is 8·7 times, so that the latter, though smaller, ought to prove steadier in a sea. We must regard the Ilyin more in the light of a torpedo vessel than a catcher, as evidenced by the number of torpedo positions it is stated she will have, though the intention is evidently to combine both functions. Taking all things into consideration, we cannot admit that the additional 150 tons, with the increased armament it permits, sufficiently compensates for the disadvantages of greater length, draught, and cost, more especially as regards the ability of dealing with a number of hostile torpedo boats.

It is only natural that Italy, who in maritime affairs has for the last fifteen years shown so much energy and originality, should not neglect small swift vessels while preparing such leviathans as the Italia and Lepanto. Seven years ago she launched the Marcantonio Colonna, a 16-knot vessel, with a displacement of 660 tons, but whose usefulness was impaired by not having twin screws. Four vessels are now preparing of 750 tons, which, with a horse-power of 3600 and twin propellers, should give them a speed of 20 knots.

We thus find that all the principal nations are alive to the importance of these swift auxiliaries, and to this country especially is it essential to possess an adequate number of them. In any future naval operations undertaken by our fleet it must be prepared for determined attacks by torpedo boats, against which nets and the most perfect subdivision into compartments, would offer an insufficient protection, unless supplemented by numerous small craft fulfilling the conditions indicated at the beginning of this article.

ANOTHER SET OF LARGE PUMPS FOR ITALY.—No doubt many of our readers will remember the large set of centrifugal pumping machinery built and erected by Messrs. John and Henry Gwynne, of the Hammersmith Ironworks, at Ferrara, North Italy, in 1873, for draining the marshes. This plant, which includes four pairs of pumping engines, discharges more than double the quantity of water flowing in the Thames at Hampton; and since it was started its work has been very heavy, it frequently having to run continuously for months together without stoppage. One instance may be cited upon which the pumps worked day and night from the 10th October, 1878, to the 31st May, 1879, but nothwithstanding the heavy duty we are pleased to learn that the plant has worked in a most satisfactory manner, giving first-class results. At the time the Ferrara machinery was being put up on the left side of the river Volano Messrs. Stork, of Holland, were erecting on the opposite side four of their improved scoop wheels for draining the Marozzo marshes, which, after working for thirteen years, are to be replaced, in accordance with the recommendation of a Commission of engineers, by the more efficient Invincible centrifugal pumps. Accordingly, Messrs. John and Henry Gwynne have received the contract for two of their pumps, each capable of discharging about 62,000 gallons per minute, to be driven by the engines hitherto employed in working the scoop wheels. In addition, Messrs. Gwynne have received an order for a supplementary pumping engine for the same installation, to be capable of discharging 70 tons per minute. This machine is to be one of the firm's "Invincible" compound centrifugal pumping engines, of the same pattern as those supplied for draining the Fos marshes in the South of France, for the Société des Travaux Agricoles.

SPIEL'S PETROLEUM ENGINE.



SPIEL'S PATENT PETROLEUM ENGINE.

By the engravings on page 50, and those annexed, we illustrate Spiel's petroleum engine as made in this country by Messrs. A. Shirlaw and Co., of Birmingham. In the engravings on page 50 Fig. 1 is a longitudinal section of cylinder, air valve, &c.; Fig. 2 is a ground plan of engine, with cylinder in section showing exhaust valve; Fig. 3 is a general elevation of engine, and Fig. 4 an end elevation showing the levers by which the air valve and oil pump and exhaust valve are worked; it also shows the firing valve arrangement; Figs. 5 and 6 are enlarged views of air valve, oil pump, and governing arrangement; Figs. 7 and 8 are enlarged views of firing valve. The supply of petroleum is drawn from a cask or drum, which may be kept in any convenient place by the rotary hand pump A, Fig. 3, and delivered through the pipe B to the reservoir C which supplies the cylinder direct through the pipe F.

The action of the engine is as follows: At the first, or induction

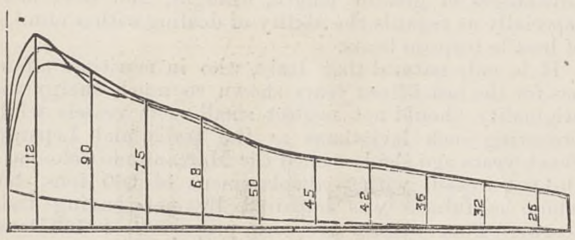


Fig. 9—DIAGRAM FROM 1-H.P. PETROLEUM ENGINE.

stroke, the cam M, Fig. 2, is in a position to just open the air valve D, Figs. 1 and 5. The piston then draws in behind it a supply of air through the valve D; at the same time the oil plunger E descends and measures in a definite quantity of petroleum. At the end of this first out stroke the air valve D closes, and the oil plunger E is lifted ready for another supply. The mixture of air and oil that is thus measured into the cylinder is taken down through the tube H, Figs, 1 and 5, where it is thoroughly mixed before entering the cylinder. During the second, or compression stroke, this mixture is compressed

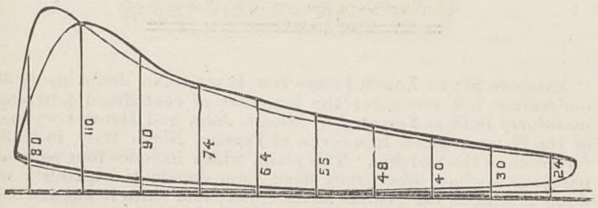
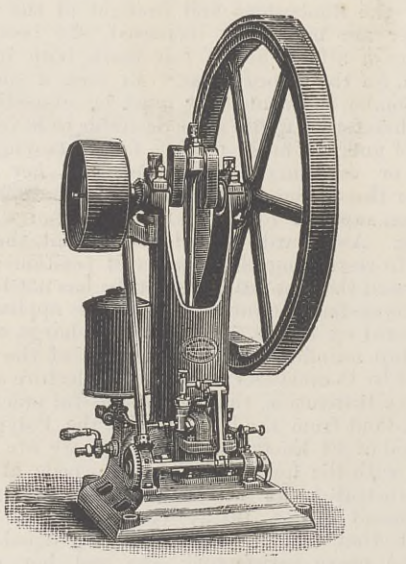


Fig. 10—DIAGRAM FROM 2-H.P. PETROLEUM ENGINE.

by the piston to about three atmospheres, and when at the end of the compression stroke is exploded by the firing valve K, Fig. 4. The next out stroke is the power or working stroke, and at the end of this the exhaust valve is opened by its lever and cam L, Fig. 4. During the next return stroke the cylinder is cleared of the products of combustion, and at the end of this stroke the cam M, Fig. 2, is again in a position for another induction or charging stroke. The manner in which the petroleum is admitted into the cylinder is as follows: The crosshead N, Fig. 5, has a certain amount of vertical travel through the cam M and lever O, Fig. 4. In Fig. 5 the valve P is held open by the spring R, which at the same time holds the valve P_1 shut. This admits the petroleum through the pipe F underneath the plunger E. When the crosshead N descends the roller S catches against the projection T, which has the effect of pressing the lower end of the lever U against the ram V, which closes P and opens P_1 before the crosshead N touches the plunger E at W; then the plunger E descending forces the petroleum through the open valve P_1 against the cam X, which breaks it into a spray. It is then carried along with the air down the pipe H.

The governing is arranged in the following manner. When the engine revolves above its normal speed the governor, by an arrangement of wipers and small rocking shaft, forces the slide Y, Fig. 6, forward till the thick part of Y covers the end of the ram V, so that when the bottom of the lever U presses inward the ram V is not touched, therefore the valve P_1 remains shut and the valve P remains open; then when the plunger descends the petroleum is forced through the open valve P and the pipe F to the reservoir C instead of to the cylinder. It will be seen from this that when the governor acts air only gets into the cylinder, and thus there are no explosions till the engine falls to its normal speed, when the governor also falls, and again a spray of oil is admitted into the cylinder. The igniting valve K, Fig. 4, has about one inch travel, and is forced forward by the hooked cam on right of sketch, and shot back by the volute spring on left. In the section Fig. 7, supposing the piston is at beginning of compression stroke, the chamber



SPIEL'S VERTICAL PETROLEUM ENGINE.

Z is opposite the opening to cylinder Z_1. When the piston compresses, it forces a quantity of the explosive charge into the chamber Z, and by the time the piston is at the end of the compression stroke the hooked cam referred to has forced the valve along till it is in the position shown in sketch Fig. 7, and opposite the opening in valve cover Z_2, which is filled with a spirit lamp flame. Here the mixture in chamber Z is ignited, and the hooked cam leaving its roller allows the volute spring to shoot the valve back, carrying with it a flame in chamber Z which explodes the charge of air and petroleum in the cylinder. When the hooked cam has moved the chamber Z out of communication with the aperture Z_1, the small slot K_1 allows a stream of the explosive mixture to pass to Z, which keeps the flame in Z alight. The indicator diagram, Fig. 9, is from one of these engines, indicating 3·45-horse power and giving at the same time 2·24 brake horse-power, the engine running at 245 revolutions per minute and being of 1-horse power nominal. Fig. 10 is from an engine of 2-horse power nominal, indicating 5·5-horse power, and giving on the brake 3·25-horse power actual, the speed being 210 revolutions per minute. The highest pressure in Fig. 9 is 112 lb., and the average pressure 57·6 lb., while the average of Fig. 10 is 61·5 lb. with a maximum of about the same.

An experimental test run was made with one of these engines some time since, by Dr. J. Hopkinson, F.R.S. The diameter of the cylinders of the engine tested was 5⅞in.—15 cm.—and the stroke 11in.—28 cm. The diameter of the fly-wheel is 4ft. 11in. A suitable friction brake, loaded with 28 lb., was fitted on the fly-wheel, and the engine was run with this load for over five hours. Dr. Hopkins, in his report, says:—"The engine was not stopped during the run, and it was found that at the end of the experiment all the bearings were cool, proving that the engine was by no means overloaded. The piston was taken out, and the interior of the cylinder examined and found to be in a perfectly satisfactory condition. The run lasted from 12.36 to 5.40, or 304 minutes. The consumption of petroleum was 25 pints in 303 minutes, or 4·95 pints per hour, 0·0825 per minute. The lubricating oil consumed was a minute quantity in excess of half a pint. The weight on the brake corresponds to a uniform rate of working of 2·87-horse power effective. The specific gravity of the petroleum is 0·7, and I have ascertained that it can be bought at from 6½d. to 7d. a gallon. From this experiment many interesting conclusions may be drawn, both as to the practical value of the engine, and as to the way in which it compares with other engines from a scientific point of view. The engine tested is easily able to develope 2·87-horse power on the brake without pulling up, and without heating any bearing in continuous work of five hours. The consumption of petroleum is with this rate of working 1·724 pints per horse-power per hour, and the cost of such oil at 7d. per gallon, is 1½d. per horse-power per hour. The cost of lubrication would be less than ⅛d. per horse-power per hour. It is, however, interesting to examine further the significance of these figures; French weights and measures are adopted, as the calculations are more easily made and more easily verified by others." Most of these we omit, as few of our readers will be disposed to agree with Dr. Hopkinson as to these French figures. "The nominal 2-horse power Otto gas engine is of very nearly the same size as the engine tested, and may form a basis of comparison of the two engines. The gas engines of the same size as Spiel's engine tested by me would, when running 160 revolutions per minute, indicate 4·1-horse power, and give about 3-horse power on the brake. It would consume of London gas about 50 litres per minute with a heating value of 280,000 gramme degrees; thus the dynamical efficiency of Spiel's engine is, when run as when I tested it, very slightly less than that of an Otto gas engine of the same size; 50 litrea of gas per minute is 106 cubic feet per hour, costing in London 3·8d. or 1·27d. per effective horse-power per hour. It is worthy of remark that petroleum is hardly any dearer than London gas as a fuel. The engine has been worked out into a thoroughly practical form, and is now fit to be trusted in the hands of users of power with the same confidence as the best gas engines."

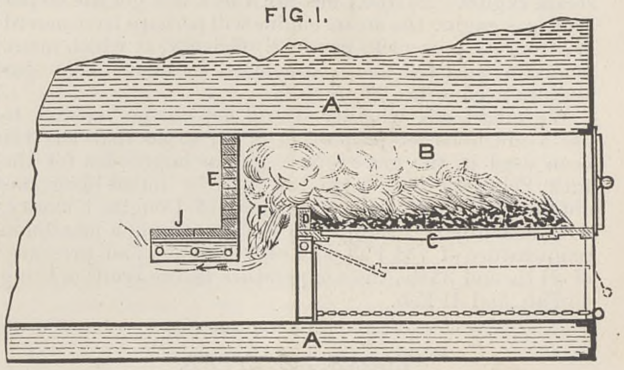
Since Dr. Hopkinson's test was made, Messrs. Shirlaw have, we are informed, been able to make a further reduction in the consumption of petroleum, and to increase the brake horse-power as compared with the indicated. These recent attainments are given in the foregoing. The indicator diagrams show that without an excessive initial pressure an effective, steady, and well maintained pressure is obtained throughout the stroke.

A considerable number of the engines have now been at work some time, and Messrs. Shirlaw and Co. have devised the vertical form shown by the accompanying engraving, which illustrates a three-man power engine occupying a ground space of only 18in. square. A horizontal 1-horse nominal engine is, we are told, driving a twenty-two 20-candle incandescent lamp installation.

"CLIP DRAUGHT" FURNACE.

The accompanying engravings illustrate what Mr. J. Lee, of Whitehall, Hipperholme, calls his "clip draught furnace." Fig. 1 is a front elevation in section of boiler fitted according to his invention. Fig. 2 is an end view of Fig. 1. Mr. Lee thus describes them:—"A is the boiler, B is the fire-box, C are the

FIG. 1.

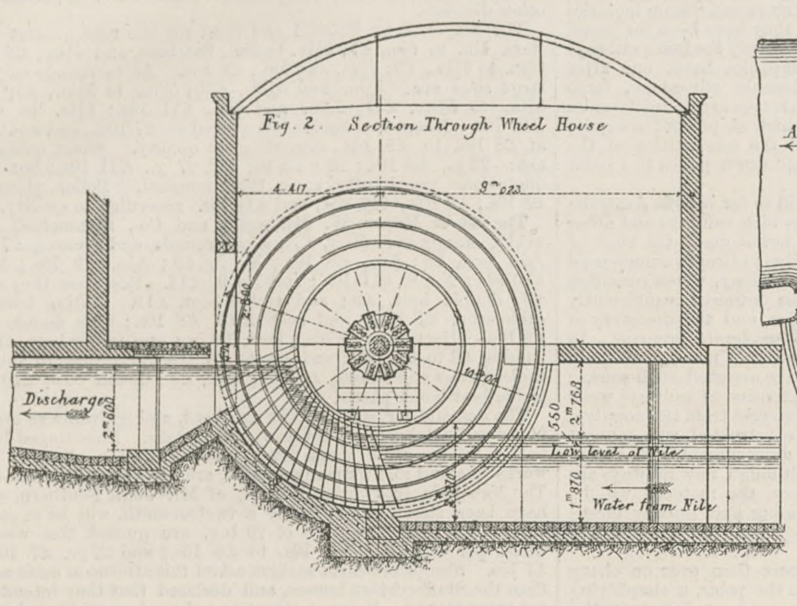


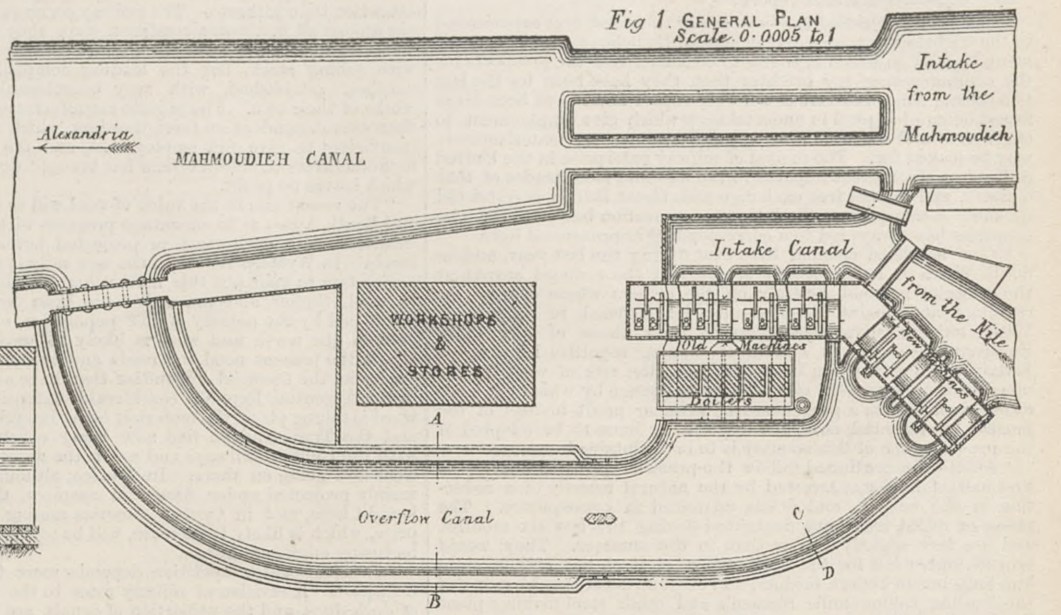
fire-bars, D is the ordinary front bridge; E is the back bridge which is placed at a proper distance from the front bridge, that is, the space F between should be about the same area as the space over the front bridge. The bottom of the bridge E must come below the front bridge D, so that it draws the smoke and flames downwards, and causes them to clip or combine together. When a fresh supply of coals is put upon the fire, the damper is opened so as to cause a good draught; this draws down the smoke, which quickly passes between the bridges, which are red hot, and causes a gradual ignition, combustion, and explosion of the smoke or gaseous vapours. As the fire brightens, and the smoke is consumed, the damper should be lowered or closed. The top of the fire-box may also be wholly or partially arched over with thin fire-bricks or fireclay; the second or back bridge may be supported in various ways." Numerous advantages are claimed. To the making of smoke-burning, coal-saving devices, there is no end.

Fig. 2.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—Thomas New, chief engineer, to the Mohawk; Francis J. Moore, chief engineer, to the Osprey, reappointed on promotion; James F. Babb, chief engineer, to the Aurora; William J. Firks, engineer, to the Mutine; Matthew W. Ellis, engineer, to the Hecate; Alfred Wood, inspector of machinery, to the President, additional, for temporary special service; Joseph T. Robinson, fleet engineer, to the Cordelia, to date January 25th; Henry G. Bourke, chief engineer, to the Calliope; Alfred M. Trivess, engineer, to the Cordelia; William Milton, engineer, to the Calliope, to date from January 25th; G. G. Knight, assistant engineer, to the Cordelia; James R. Robbey, assistant engineer, to the Calliope, to date from January 25th.

IRRIGATION IN EGYPT.—WORKS AT ATFEH.





used to tell me that in turning a handle, there are two weakest points—forgive the grammar—and two strongest points in the circle, and when there are two handles to a winch these points should not coincide. J. W.

Sizewell, January 17th.

ALUMINIUM ALLOYS.

SIR,—Referring to the article in last week's ENGINEER headed "Aluminium Alloys," permit me to state, in connection with your remarks relative to the test of a cast bar of our aluminium bronze made by the Leeds Forge Company, that the machine used was the well-known type made by Messrs. Joshua Buckton and Co., the casting from which the test bar was made being taken from several tons of our bronze supplied upon an order here, the metal being specially made by us with the view to great strength, and with little or no elongation. To explain this I append a list of our several grades of bronze, classified according to tensile strength and ductility:—

Aluminium Bronze.

Grade.	Tensile strength (castings).	Elongation (castings).
	lbs.	per cent.
A	75 to 80,000	10 to 15
B.	55 to 60,000	15 to 20
C.	35 to 45,000	20 to 30
D.	25 to 35,000	35
E	20 to 30,000	10 to 20
Special C.	40 to 50,000	40 to 50
Special.	100,000 to 128,000	Nil to 5

The above variations are produced by the addition of different percentages of aluminium and silicon to pure Lake Superior copper. These percentages range from 1¼ per cent. in the "E" grade to 11·3 of aluminium and silicon combined in the grade "special," the silicon being in amount about one-tenth the percentage of the aluminium.

The following table represents the same qualities as found in aluminium brass, which is made by adding spelter to aluminium bronze:—

Aluminium Brass.

Grade.	Tensile strength (castings).	Elongation (castings).	Composed of
	lbs.	per c'nt.	
I.	65,000 to 80,000	5 to 10	3 parts "C" bronze and 1 part spelter.
II.	50,000 to 65,000	10 to 20	2 parts "C" bronze and 1 part spelter.
III.	35,000 to 45,000	30 to 50	Treated for extreme elongation.

It is thus seen that the amount of aluminium in the aluminium brass is respectively from 1¼ per cent. to 3¾ per cent. by weight, and this metal is more than proportionately less in price than the bronzes.

Every ingot of alloys made at the Cowles Works has a test bar made from it, which is tested in a machine built by Tinius Olsen and Co., of Philadelphia—a trustworthy machine, and the one used in many of the colleges and ironworks in the United States—and the record of all tests is carefully preserved. The grade, tensile strength, and elongation is stamped upon each ingot. In short, our alloys are all carefully made, and with the same system of mechanical tests and chemical analysis as iron and steel are subjected to by the best makers.

The above scale of tensile strength and ductility was only adopted after many hundreds of trials of the respective grades of alloys both on the test machine referred to and many others. It can be thoroughly relied upon. EUGENE H. COWLES.

The Cowles Electric Smelting and Aluminium Company,
36, Lombard-street, E.C., January 19th.

PRESTON AND THE RIBBLE NAVIGATION SCHEME.

SIR,—I have been particularly interested in the perusal of the curious letter from Mr. S. H. Roberts, C.E., in your impression of the 14th inst., respecting the river Ribble and estuary improvements.

He states that up to or about 1853 there was a deep-water channel from Lytham to the Irish Sea buoyed along its course. This would indicate that if the place where this channel joined the sea had been properly indicated, with, perhaps, the assistance of coast lighthouses, that mariners could have entered the channel and made a safe passage at least to Lytham with vessels of any tonnage, and so been out of harm's way. This channel, he says, was silted up in consequence—if I understand correctly—of operations carried on higher up the river, on the recommendation of Messrs. Stevenson, and under an Act obtained by the Preston Corporation. These operations were probably the forming of retaining walls to prevent the wandering of the river in the estuary, and to keep it within a limited course. I believe it is a fact that at one time the Ribble channel came close to Southport, though now some eight or nine miles more to the north, and the present channel is now known by the name of the "North Channel." This wandering of rivers is well known in estuaries, and is not peculiar to the Ribble. The formation of training walls has been adopted by engineers to correct the tendency to wandering, and the success of such work must depend in a great measure upon the judgment of the engineer as to the method of carrying out such work.

I agree entirely with Mr. Roberts that an outlay of £500,000 for dock accommodation at Preston should not have been incurred until the training walls and the deepening of the river had been carried out, and until the permanency of the channel with deep water from Lytham to the sea had been established. It would be a serious outlay for any corporation to undertake on doubtful premises. We know what bars in rivers mean—look at the Menai Straits and the river Mersey at Liverpool. If vessels at low water spring tide have no greater depth on the bar than 2ft. or 3ft., as stated in Mr. Roberts' letter, for all practical purposes the docks at Preston would be comparatively useless. There is this to be said, the eminent engineers who have the Ribble works in hand must have confidence in their scheme. Associated as they have been for so many years with the Ribble improvements and the town of Preston, it is hardly likely they would remain silent if they saw any indication of probable failure. There is nothing so easy as fault-finding, however undeserved it may be. I must make one observation before I close this letter. I will not say what I should have advised to have been done betwixt Lytham and Preston, but I may state my emphatic opinion that the danger of the closing of the open channel does not come from the sea, but from the river Ribble itself. J. B.

Pontnewydd, Monmouthshire, January 15th.

COMPOUND LOCOMOTIVES.

SIR,—Allow me to correct an error which you have made in your article on the compound engine built by the Great Eastern Railway, in which you state that it is the first "compound goods engine constructed." As a matter of fact, Messrs. Robert Stephenson and Co. made some in 1884 for South America. They are on Webb's patent, and the reports of their performances as compared to the old engines doing the same work are most satisfactory both as to consumption of fuel and water, the latter being the more important of the two. H. C.

113, Victoria-street, Westminster, London, January 17th.

IRRIGATION IN EGYPT.

No. III.

THE works at Atfeh existed before the Irrigation Company was constituted. They were constructed by the Government and worked under its direction until they were passed over to Mr. Edward Easton, to whom the changes necessary to give increased power were entrusted. The works at this time consisted of four groups of beam engines fitted with one cylinder each. These four groups were placed in a line, in a building 50 m. long by 13·50 m. broad. The steam was generated by a double battery of boilers placed behind the engine house. The pumps drew the water from the Nile through a small canal, and forced it through a discharge canal into the Mahmoudieh behind the locks. The elevation of the water varied from 0·50 m. to a maximum of 2·60m.

Mr. Easton, on undertaking the charge of the works, decided (1) to change the pumps and boilers, which were of too old a construction and extravagant in the working; and (2) to increase the power of the engines and to utilise the steam better by the addition of a small cylinder, and thus to transform them into engines of the Woolf type by expansion in two cylinders. The large wheels of the pumps were changed and replaced by others of more perfect form, and tubular boilers were substituted for the old generators. These modifications, some of which, and amongst others the addition of a second boiler, were excellent, did not suffice to augment the original capacity of the works from 800,000 cubic metres to 1,500,000 cubic metres, according to the stipulation of the contract. It is true that the work was rendered a little less costly by a better utilisation of the steam and by a more economic evaporation of the water; still the maximum discharge required was not attained.

It was at this time, being charged with the direction of the company, that the Egyptian Government resolved to make radical changes in the works; to increase their power to enable them to furnish easily and at all times a discharge of 2,000,000 cm. in twenty-four hours, not taking into account the reserve engines supplied under the new contract of the Government. It was decided in the first place that the beam engines, which although old were still in good condition, should be made use of, and that a new apparatus of a better kind should be substituted for the centrifugal pumps. It was decided also to transport to Atfeh two of the engines from Katatbeh in order to complete the new installations; they were no longer required at the latter place in consequence of the alterations in the works made there. Upon the suggestion of M. L. Vigreux, it was arranged to exchange the centrifugal pumps for scoop wheels of low speed and high efficiency, constructed like the Sajebien wheels. These wheels were made by MM. Feray and Co. from M. Vigreux's designs. The present works consist of the four old twin beam engines with a Sajebien wheel worked by each, and of the two compound engines from Katatbeh set up in a new building attached to the oldone, each working two scoop wheels. These wheels are not all of the same size, as they had to be adapted to the available space. The beam engines being placed at unequal distances, necessitated this difference of size; two of them are consequently 3 m. wide, and the two others 3·60 m. Their exterior diameter is 10 m. and the depth of their buckets 2·30 m. When the Nile is at its lowest they dip in its waters 1·70 m.; their normal speed has been fixed at 2·29 rotations per minute, which corresponds to 1·20 m. per second of the exterior circumferences. The buckets to the number of eighty are in a slanting direction, and reduced to a circle of 2 m. in diameter. The iron shafts of the 3·60 wheels have a diameter of 0·54 m., and those of the 3 m. wheels 0·46 m.; there are ten arms of iron which attach the buckets to the centre of the wheels. The wheels work in a circular case of masonry covered with cement. The exact curvature of this enclosure has been obtained by means of a circular striker of cast iron; it is perfectly formed, and sunk into the lock. This mode of construction has reduced the clearance between the wheel and its case by at least 0·005 m. As to the four wheels of the compound engines, being set up in a new building, and not therefore being limited to space, they have been able to make them of the requisite size to give a larger delivery; like the others they have a diameter of 10 m. and a width of 3·60 m. The buckets are 2 m. deep, and dip into the Nile 1·20 m. below the lowest water mark; the number and direction of the buckets are the same as those of the four previous wheels, as well as the manner of their construction, except as regards the thickness of the shaft and of the arms, which are a little weaker. The normal speed of these wheels has been fixed at 1·91 m. revolutions per minute, which corresponds to 0·90 m. per second of the outer circumference. It has been observed that the speed of the two groups of wheels is not equal. In order not to change the position of either of the twin beam engines the shaft of the fly-wheel has been united by a coupling crank placed between the two engines, to an additional shaft placed in continuation and bearing the chief pinion, which moves a large cog-wheel keyed on the scoop wheel. The diameter of the two gearings corresponds to twelve revolutions of the engines to one of the wheels. It will be observed that this speed is inferior to that at which the engines previously attained; this was consequent, as has been said on the imposed limits as to the dimensions of the wheels. Up to the time of the changes made in the works, the lowest water mark of the Nile was reckoned at 0·30 m. above the level of the sea. As the level in the discharge canal varies during the season, the upper extremity of the structure in which the wheel moves instead of being fixed is movable, and composed of plates of iron, their numbers varying with the position of the water level. The aim in this arrangement is to prevent all losses in the fall between the wheel and the discharge canal.

Experiments made by the Government engineers have proved that the wheels could give—the average level of the Nile being 0·80—a discharge of 144 cm. per revolution by the compound engines, and 146 cm. and 175 cm. respectively by the two other models of wheels worked by the beam engines. Thus the eight wheels taken together discharge at the lowest water-mark of 0·30 m. a volume of 2,922,708 cm. in twenty-four hours, when they are worked at their normal speed. The discharge necessarily increases as the Nile rises. These Sajebien wheels, besides their greater yield, have the advantage of enabling an exact computation of their discharge to be made by a simple calculation; they are, in fact, themselves water meters. This question is a much more difficult one with the centrifugal pumps at Katatbeh. At Atfeh it is sufficient to know the number of revolutions of the engines to be able to calculate the discharge of each wheel at a given height of the Nile; while at Katatbeh experiments have had to be made of the quantities thrown into the discharge canal at different speeds of the engines by means of floats and the Pitot tube. Different modifications have been made in the engines, on the recommendation of M. Vigreux. For instance, the mode of working the beam engines has been improved, and each twin engine has been transformed into a compound engine with an intermediate reservoir by making the small cylinder of the one communicate with the large cylinder of the other. The Nile Canal has also been entirely remade, the old one being found inefficient for the greater discharge.

The new works of Atfeh were inaugurated in 1885; they have thus had the proof of two seasons. They have been a perfect success, and very economic as regards the consumption of coal. The amount saved is over 35 per cent., having been reduced to 1·40 kilo. per hour for the whole of the eight wheels. This calculation is not the result of an isolated experiment, but that of repeated tests. The general results do great honour to M. Vigreux—who projected the improvements—as well as to MM. Feray, the constructors of the wheels; in fact, the whole of the apparatus furnished by their house has been found perfect in all points.

FROM the Yorkshire coal fields the quantity sent to Hull during 1886 was nearly 1,418,000 tons, or an increase of 90,000 tons; about 64,000 tons less were sent by water, but 155,000 tons more by rail. Shipments from this port fell 12,000 tons, the Belgian trade showing a marked decline.

ENGINEERING TRADES IN 1886.

WE take the following from Messrs. Matheson and Grant's half-yearly engineering trades report:—

"The year just closed has been one of the worst ever experienced in the engineering trades, but in several branches a slight improvement has set in which bids fair to continue, and the prospects for the coming spring are brighter than they have been for the last two years. Since the date of our July report there have been large investments of capital in undertakings which give employment to engineers, and an increasing expenditure among manufacturers may be looked for. The revival of railway enterprise in the United States has given great impetus to the iron and steel trades of that country, and though free exchange with Great Britain is restricted by their fiscal system, the intimate connection between the two countries has always led to a corresponding improvement here.

"*Coal* has been cheaper than ever during the last year, and in South Wales as in the North of England the reduced output at the collieries has told severely on the owners whose charges for royalties and maintenance cannot be reduced in proportion. With natural advantages greater than those of any other European country, the system of mining royalties is in Great Britain more onerous on those who have the risk of working the minerals than anywhere else, and some change by which the land-owner shall receive a percentage of price or profit instead of the present preferential charge will probably have to be adopted if the pre-eminence of this country is to be maintained.

"*Iron.*—The continued fall in the prices of pig iron during the first half of 1886 was arrested by the natural remedy of a reduction in the output, and prices advanced in consequence. The prices of rolled iron have fluctuated during the last six months, and are now slightly higher than in the summer. They would be still higher but for the competition of steel, not only in ship-building, but in boilers, bridges, and other structures. At many of the leading rolling mills Siemen's and other steel-making plant has been established to meet the altered demand, and at some of the works favourably situated for suitable ore and fuel, the puddling furnaces and other appliances for making wrought iron are likely to be abandoned altogether.

"*Steel* which in the spring and summer of 1886 fell even more rapidly than iron, has during the last few months recovered from 5s. to 10s. per ton. Owing to the collapse of the English and continental rail makers' combination, prices of heavy steel rails fell as low as £3 12s. 6d. per ton, but the price now is from £4 to £4 5s. Although this recovery is assisted by the considerable manufacture of ship and bridge steel, the immediate cause has been the revival of the American demand. The total output capacity of the rail mills in that country is about two millions of tons per annum, and the contracts already made, and in view, absorb most of this quantity for 1887. The present duty of 17 dols. per ton barely excludes English rails, and it is likely that the few orders already placed on this side will be increased. But a large export of steel blooms for rails and plates, and billets, principally for wire, is now taking place, for the duty on these being less than on the rails, plates or wire, into which they are ultimately made, there is the apparent anomaly and curious effect of the protective system, that American buyers can offer as much for these unfinished forms of steel as for finished rails. An exceptionally large contract for 50,000 tons of rails for Victoria has just been secured by the German firm of Krupp. In that protectionist colony it is desired to ignore the British manufacturer, and, when the goods cannot be made in the colony, to place all orders through local merchants. To encourage this, the seller is not only called upon to deliver there, but to submit the rails on arrival, instead of at the place of manufacture, to all the tests of quality by which acceptance or rejection is determined. Partly owing to these causes which disinclined though they did not entirely hinder English com petition, and partly to the low freight obtainable from Continental ports, the order was lost to this country. The price obtained was equal to about £4 2s. 6d. per ton, free on board, and £4 17s. 6d. delivered in Melbourne. The tendency in England for bridge work is still towards milder steel, a breaking strain ranging between 27 and 31 tons per square inch being specified. It is more and more evident that the quality and trustworthiness of finished steel depends upon the amount of work upon it, that is, on the relation which the thickness of the finished plate or bar bears to that of the original ingot.

"*Mechanical Engineers* are, as a rule, busier than they have been for the last two years, but this trade is so divided into special branches that no general statement is possible. Events seldom exactly repeat, and new developments are necessary to meet the altered trade of the country; mining appliances, electric light equipments, naval armaments, and harbour improvements being directions in which progress is apparent. Ironfounders have had to meet the lowest prices ever encountered, and such cheap goods as pipes and railway chairs follow closely the rates current for pig iron. But for miscellaneous castings improvement is dependent on the general engineering trades, and founders will at once benefit by any amelioration in this direction.

"*Iron and Steel Shipbuilding.*—This trade, which is almost entirely limited to Scotland and the North of England, has not only shared in the general depression of the two last years, but has felt it more keenly, because of the vast extension of manufacturing power in 1882-3. On the Clyde alone the annual tonnage launched, which had grown from 240,000 tons in 1880 to 420,000 in 1883, fell off to 194,000 tons in 1885, and has only been 172,000 tons in 1886. The statistics for the Tyne and the Wear, though on a smaller scale, show a similar reduction, but there are signs that a recovery is commencing, which is likely to grow. The great reduction in the merchandise carried has been one more of value than of volume, and it is the latter, of course, which determines the number of vessels employed.

"*Iron and Steel Structures.*—A very large tonnage of bridgework has been made during the past year, most of it for export. Prices have risen slightly during the autumn, owing rather to the upward movement in the value of material than to any growing demand for the finished structures. The supercession of iron by steel advances slowly but steadily, the advantages of using it for small as well as large spans being obvious if the gain in strength and permanency are set against the extra cost. Taking £10 to £14 per ton as the present prices of iron bridges, according to design and quantity, an addition of 20s. to 30s. per ton will represent the extra cost of steel. The export of bridges to India has been maintained during the year, and the extension of railways there and in Burmah may be expected to continue it. There is a considerable export now going on to South America and Japan. In the Colonies English and American bridge builders come into competition, but there is less difference in style than formerly. In the United States the increased weight and frequency of railway traffic is telling severely on the earlier bridges, and engineers there are at last realising that solidity and permanency against the impact of heavy trains, require a weight and strength greater than their former method of dealing with theoretical strains provided. Iron roofing in additional station buildings are continually needed; there has been erected in London a large iron and steel building, about 300ft. wide and 100ft. high, with pivotted columns and other novel features of design; tenders have just been sent in for an unprecedented iron tank structure in Buenos Ayres, weighing 14,000 tons, to hold 80,000 tons of water, and manufacturers here get a fair share of orders from other parts of South America where building materials are scarce, and iron structures, many of them ornamental, are regularly imported from Europe.

"*Locomotives and Rolling Stock.*—There are about a dozen leading firms engaged in this trade, none of whom can be earning much profit, most of them indeed hardly paying the expenses of working and maintenance. There are no prospects of an extended demand at home, for there is little extension of railways, and the existing companies, while curtailing expenditure, are making more and more of their own engines. There has been a falling off in orders for the Indian State Railways, and although there has been considerable export to South America and other countries the quantity has borne a small proportion to the producing capacity available. Tramway engines occupy more attention than hitherto. The railway carriage and wagon factories are almost all in a worse condition than they have been for years. These factories were established mainly to supply the home railways with rolling stock, but the leading companies have, one after another, established, with very questionable advantage, large works of their own. The private manufacturers are therefore more than ever dependent on foreign orders, which at present are quite insufficient to give full employment, and the competition of the manufacturers to obtain orders has brought down prices to a point which leaves no profit.

"The recent rise in the value of wool will so far benefit Australia and South Africa as to encourage progress with railways and other works already authorised or projected but stopped for want of funds. In Western Australia the new railways already commenced are certain to open out this most valuable colony, whose resources in wool, timber and minerals have been hitherto insufficiently developed by the paucity of her population, and the discovery of gold in the north and west is likely to accelerate progress. In Brazil the present need for roads and railways must soon again overcome the financial difficulties that have arrested such works; in the Argentine Republic considerable extension of railways westward is taking place, the materials being brought from this country; and the Trans-Andean line now being constructed will connect with the Chilian Railways and assist the development and extensions now going on there. In Mexico, although new railways are mainly projected under American auspices, the material will be bought here, and in Central America mining and railway enterprise, which is likely to increase, will be to the advantage of manufacturing engineers here.

"International competition depends more than ever on cheap transport. A revision of railway rates to the ports, a simplifying of dock dues, and the utilisation of canals, are immediate remedies which would help British trades, while ocean freights as low as those from Antwerp and Germany, which at present favour continental manufacturers, are necessary if the export of engineering material is to be maintained and extended."

TELFORD AND THE SHROPSHIRE ROADS.

AT the recent quarter sessions meeting of the Shropshire magistrates the death of Mr. T. Groves, for many years the county surveyor, was referred to, and the appointment of his successor discussed. Speaking on this matter, Mr. C. C. Walker said he had seen the advertisements respecting the county surveyorship, but although the probable salary was mentioned, it was not stated whether the candidate was to be permitted to engage in private practice. This seemed to be necessary, for the amount of salary named was too small to attract a first-rate man unless he had private practice, and as it was not intended to prohibit him from undertaking this, it should be known. Before he sat down perhaps the court would permit him to state what might not be generally known, and what would probably be interesting. They were about to have a meeting that day to consider what steps should be taken to celebrate the jubilee of her Most Gracious Majesty the Queen, and he was sure they would all be delighted to celebrate so important an event as the fiftieth year of her beneficent reign. It was a curious thing that just twice fifty years since this very year the county magistrates of Shropshire made an appointment of the county surveyor that was destined to have great historical results in civil engineering, and, indeed, a mark in our national history. In the year 1787 an excellent young man named Thomas Telford, who had been a working mason, and the fatherless child of a shepherd, came to Shrewsbury to superintend some alterations at the castle for Mr. Pulteney, whose residence it was, who was then member for this borough. While there the county surveyorship fell vacant, and the magistrates appointed Telford to the post. He lived in Shrewsbury, and did much work for the county. He built the county gaol. The benevolent John Howard came there, and by his advice the plans were altered to the approval of the magistrates, and the building made more healthful and humanising to the prisoners. The bust of Howard which graces the front of the gaol is in remembrance of this circumstance. Telford did all the usual county work. He built no less than forty-two bridges in this county, several of iron, then a new material for bridges, and all his work bears the stamp of his genius and ability. The iron bridge at Build was his, and was the third bridge built of iron in England. The magistrates were so satisfied with the performance of his duties that several of them induced him to make the Ellesmere Canal, and from the experience which he gained he made the finest bridges and canals, harbours and docks throughout Great Britain; but so many excellent roads, that he became the most eminent road maker in the world. The Holyhead road, with the splendid iron suspension bridge over the sea at Menai Straits, the wonder of its day, is a beautiful thing always, was the eventual outcome of the experience he gained while faithfully performing his duties as county surveyor of Shropshire. Indeed, it is not too much to say that by the confidence in iron for bridge construction inspired by Telford the progress in civil engineering has been so advanced, and we see the results in those iron bridges and viaducts that are made and being made all over the world. There is no appointment that the county magistrates can look back upon as made by their predecessors with more satisfaction than the appointment of Telford. Every Shropshire man should read his life. He became, not only the first civil engineer of his day, but the first president of the eminent Institution of Civil Engineers, which he held till his death. This distinguished man always remembered what he owed to the magistrates of Shopshire for his introduction to public works. He received many foreign decorations from foreign sovereigns in his long, laborious life, was a great benefactor to his race, and, moreover, to our country an example to all, and revered by everybody. He now reposes with the illustrious dead in Westminster Abbey.

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

(*From our own Correspondent.*)

THE meetings of the iron trade this week have been less excited than a week ago. This, however, is only what was to be expected, since the gatherings immediately succeeding quarter day are always somewhat quieter, and no feelings of hesitancy as to the character of the revival are engendered.

The exceeding firmness which marks the pig market influences the finished iron makers to be more than ever resolved this week not to sell at the old minimum prices.

The meeting which was held last week of the strip makers, at which it was determined to advance 5s. per ton if the consent of all the makers could be got, is possibly the foreshadowing of similar meetings concerning the declaration of advances by makers in other of the unmarked finished iron branches.

Advances of 5s. per ton may now be said to prevail upon medium and common finished iron of nearly all sorts other than sheets, and some bar and strip makers are trying for a rise of 7s. 6d. per ton. Consumers are not forward in paying the advanced prices demanded, and are disposed to limit their contracts for the present.

Common bars are quoted £5 to £5 5s.; merchant bars, £5 10s.; and superior bars, £6; common hoops are also quoted £5 5s., and narrow tube strips £5 upwards; nail rods are likewise quoted at 5s. advance, making them £5 5s. to £5 10s. at the works, £5 15s. to £6 delivered Liverpool, and £5 17s. 6d. to £6 2s. 6d. delivered London in quantities for export. Welsh puddled bars delivered into this district are advanced to £4 per ton. The marked bar trade shows but little change, and the demand is kept down by the competition of mild steel of local production and imported from other districts.

The list of John Bagnall and Sons for the new quarter is:—Bars, 1in. to 6in., £7; 6½in. to 9in., flat bars, and 4½in., £8 10s.; 4⅝in. to 4¾in., £9; 4⅞in. and 5in., £9 10s. As to rounds only the large sizes are:—5⅛in. and 5¼in., £10; 5⅜in. to 5½in., £10 10s.; 5⅝in. to 5¾in., £11; 5⅞in. and 6in., £11 10s.; 6¼in. to 6½in., £12 10s. Hoops and angles are quoted at £7 10s., and rivet iron at £8 10s. to £9 10s., according to quality. Sheet quotations are:—20 g., £8 10s.; 24 g., £10; and 27 g., £11 10s.; but these quotations are hardly more than nominal. Boiler plates are £8 10s., £9 10s., £10 10s., and £11 10s. according to quality.

The list of Messrs. W. Millington and Co., Summerhill Ironworks, stands at:—Bars, £7; small rounds and squares, £7 10s.; 5/16in. bars, £8; ¼in., £8 10s.; No 5, £9; 3/16in. £9 10s.; No 7, £10 10s.; No. 8, £11 10s.; and No 9, £13. Best bars they quote £8; double best, £9; and treble best, £11. Plating bars and cable iron, £7 10s.; and best ditto, £8 10s.; with double best, £9 10s. Rivet iron, £7 10s.; best, £8 5s.; and double best, £9 15s. Angles, £8 to £8 10s.; and on to £9 10s., according to quality. Boiler plates and sheets, £8 10s.; best, £9; double best, £10; and treble best boiler plates, £12.

The demand for sheets keeps excellent, and galvanisers are still pressing for deliveries from nearly all makers. Encouraged by the better prices, some sheet firms, who have been allowing their works to stand idle for many months, are now preparing to re-start. The New Side Ironworks, Walsall, of Mr. John Southern, which have been standing for nearly a twelvemonth, will be re-started early next month. Sheets of 20 b.g. are quoted this week at £6 5s. per ton; 24 g., £6 10s. to £6 15s.; and 27 g., £7 10s. to £7 15s. Shropshire sheet makers asked this afternoon more money than the Staffordshire houses, and declared that they intended to get more money. Some of them quoted singles, £6 10s.; doubles, £7; and lattens, £8.

Galvanised corrugated sheets are firm at the 10s. advance recorded last week, bringing nominal prices up to £10 10s. to £10 15s. f.o.b. Mersey. This is an advance of 20s. per ton since September, and is said by makers barely to cover the rise in block iron, and to allow them nothing for the advance in spelter, which is from 20s. to 30s. per ton dearer. Considering the time of the year, the present demand may be said to be almost unprecedented. The exports of this class of iron during the past year showed a considerable increase over 1885.

Galvanised corrugated sheets of the Red Star and Lion brands are quoted by Messrs. Morewood and Co. at £10 15s. to £11 5s. for 20 b.g.; £11 to £11 10s. for 24 b.g.; £12 10s. to £13 for 26 b.g.; £13 10s. to £14 for 28 b.g.; and £15 10s. to £16 for 30 b.g. Annealed flat sheets are quoted £13 for 20 g.; £13 10s. for 24 g.; £15 10s. for 26 g.; and £16 10s. for 28 g., in cases. Cold rolled ditto are £14, 10s., £15, £16, and £18, according to gauge, while best ditto are £17, £18, £20, and £21 per ton.

Wire rods were to-day reported in increased demand from the Shropshire works at the basis quotation of £5 5s. per ton for rolled Nos. 1 to 6. The United States, Australia, and some other export markets are sending in increased orders.

The extensions which are going on at local steel works give rise to much satisfaction. The Patent Shaft and Axletree Company, Wednesbury, is erecting three new 8-ton open-hearth basic converters, for the manufacture of steel from common Staffordshire pigs, and one such converter it has already erected, besides Bessemer converters. The company will also shortly have ready for starting a large new mill, for the rolling of heavy sectional steel, at its Brunswick Works.

The continued upward movement in the pig iron market is taking buyers by surprise, and is making them increasingly anxious to place forward. Some brands continue to be wholly withdrawn from the market. Hematite sellers are especially independent. Certain of them are this week in possession of renewed instructions from their principals not to quote. 57s. 6d. to 60s. is now a very general price for forge numbers delivered in this district. The Carnforth Company, for example, quotes 60s. for forge and 61s. to 62s. 6d. for foundry numbers; while the Tredegar Company quotes 57s. 6d. for forge, with the customary difference for foundry numbers. Imported Midland pigs are very firm at 40s. for Derbyshires delivered; best brands, 42s. 6d.; while Lincolnshires are 42s. to 42s. 6d.; Wiltshires, 39s. to 39s. 6d.; and the Thorncliffe brand of pigs, 50s. per ton.

Native pigs keep in demand in excess of supply, and additional furnaces will before long be put on. 55s. is being quoted for all mines, though the selling price is in some cases rather less, and 30s. to 32s. 6d. is quoted for common forge pigs. Iron which a few months ago was offered at 25s. 6d. to 27s. has last week realised 32s. 6d. per ton, and current prices are in the case of some exceptionally favoured makers declared to be 20 per cent. above those of three or four months back.

The improved position which is now occupied by steel rail and sleeper makers, and which is steadily strengthening their quotations, also makes the prices firmer of blooms, billets, and bars imported into this district. Upon the open market the full 10s. advance which has taken place since last September upon steel of this description rolled in Wales is this week again quoted. Steel sleepers, it is understood here, have been advanced by some of the Welsh firms to the nominal quotation of £5 10s., while even more than £4 5s. is quoted for rails.

The eagerness displayed by American merchants to buy up iron and steel scrap is sending up prices considerably. Welsh scrap, composed mainly of sheet shearings, is quoted 2s. 6d. to 3s. 6d. per ton advance upon a few weeks ago, making the quotation, delivered into this district, 45s. at stations, or 46s. delivered at consumer's works. Some sellers asserted this afternoon that they had booked at as high as even 46s. 6d. to 47s. Also largely in consequence of the American demand purple ore is advanced 1s. 6d. to 2s. per ton, making the price 14s. 6d. to 15s. f.o.b. at Saltney, or 20s. per ton delivered here.

Messrs. A. Baldwin and Co., part of whose proprietary are also the proprietors in the East Worcestershire firm of E. P. and W. Baldwin, expect to start their new tin-plate works, near Newport, next month. Four mills, capable of a production of 2000 boxes per week, will be set going, and the chief production will be upon Siemens' plates from Messrs. Wright, Butler, and Co.'s steel, of Newport, who are shareholders in the new concern. It is expected that by-and-bye the mills now laid down will be further supplemented.

Finished iron prices are strengthened by the determined spirit which the ironworkers are showing to resist any attempt to reduce wages by taking off the extras now paid at mills and forges. The masters' proposal for this alteration has occurred at a somewhat awkward time, and it would now be very difficult to persuade the men to forego any advantages which they have hitherto possessed. Indeed, at one of the works in the West Bromwich district, where the masters have already attempted to interfere with the extras, the men are now on strike. The operatives' secretary to the Wages Board has received instructions to meet the employers' claim by demanding an advance of 10 per cent., and in any event the men express themselves determined to resist any interference with the present "extras."

At a quarterly meeting of the South Staffordshire and East Worcestershire Mining Accident Fund, held at Wolverhampton on Wednesday, the question of concentrating the mining accident funds was brought to a definite issue. In view of the passing of Sir Joseph Pease's Bill, by which surplus funds will be available for distribution by the Home Secretary, the fund sought to remove the difficulty of two bodies applying for the proportion falling to South Staffordshire by amalgamating themselves with the Miners' Provident Society. The miners themselves approved of the suggestion, since the benefits accruing to them would be extended, and grants would be made not only to widows of miners killed by accidents, but also to those miners who, through accident, were disabled. The trustees of the Mining Accident Fund, however, find themselves debarred by the expense of a transfer from adopting the amalgamation proposals, but they have sanctioned a recommendation of the committee to annually authorise the Miners' Provident Society to consider all applications, and to make the necessary grants, the question of a transfer of the funds being left open, in case the miners are able to raise sufficient money to disburse all attendant expenses.

The strike among the South Staffordshire and East Worcestershire horsenail makers has been partially successful. All the employers, with one exception, have agreed to pay the advance of 3d. per 1000. The fifty operatives thus left on strike will continue to play on.

The South Staffordshire horsenail makers yesterday resolved that in all cases where the masters refused to pay 2s. 6d. per 1000 the men should strike work.

The sudden death is announced on Monday, at the age of sixty-seven, of Mr. Thos. W. Shaw, one of the most important of the export merchant firms in Wolverhampton.

At the Miners' National Conference, which concluded at Birmingham on Friday, several matters affecting the position of the miners were discussed. It was agreed that a restriction could be secured by shorter hours of labour each day; but as suggestion could not be adopted without a powerful form of organisation, it was decided to form a federation embracing the whole of Great Britain. A resolution was passed calling upon Government to form an institution into which shall be paid a certain tax upon royalty rents for the benefit of disabled and superannuated miners, and for the relatives of those who may be killed in or about the mines. Other questions for ameliorating the social condition of the mining population were considered.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The upward movement of the market, so far as all descriptions of raw material are concerned, although occasionally fluctuating slightly, still goes on practically unchecked, whilst users of the raw material in this district are scarcely able to establish any really appreciable advance upon late rates. This, of course, is an abnormal condition of things which cannot last for any great length of time, and the question is whether the price of common pig iron and hematites will have to come down, or whether manufactured iron and steel will be forced to a higher price by the very fact that manufacturers cannot afford to go on making under present conditions, and will have no other alternative than either to close their works, or get better prices. The present advance in pig iron and hematites is unquestionably due largely, if not mainly, to heavy buying on American accounts, and in some measure to speculation. No doubt a good deal of the iron which has been sold recently has gone into the hands of consumers, but this has not been because of any actually increased wants, but having hitherto been working from hand to mouth, the advance in prices has frightened consumers into buying beyond their present requirements. This, however, does not represent any real improvement in trade, but simply that a large weight of buying has come upon the market now which would otherwise have been spread over a longer period; and as a matter of fact, neither in the steel trade, the manufactured iron trade, nor the engineering branches of industry in this district is there any substantial improvement which could at all justify the advance which has taken place in prices, and this, as I pointed out in my last week's "Notes," is only too significantly borne out by the inability of users of the raw material to obtain any corresponding advance for their manufactured goods to cover the higher prices which have now to be paid for pig iron and hematites.

There was a full attendance on the Manchester Iron Exchange on Tuesday, and a very strong market, with a considerable business doing. In pig iron there was again an advance on the prices of the previous week. Lancashire makers, who have been booking moderate orders at the recent advanced prices, are now quoting 40s. to 41s., less $2\frac{1}{2}$, as their minimum for forge and foundry qualities delivered equal to Manchester, and they are not at all keen sellers even at their present quoted rates. In district brands open quotations have in some instances been practically withdrawn; for Lincolnshire iron the average selling price may be taken at about 39s. 6d. to 40s. 6d., less $2\frac{1}{2}$, for forge and foundry qualities delivered into the Manchester district, with 1s. per ton above these figures quoted in some instances, and Derbyshire foundry iron ranging from 43s. 6d. to 45s., less $2\frac{1}{2}$, delivered here. In outside brands offering in this market there has also been a further upward tendency; good named brands of Middlesbrough foundry are now quoted at 47s. 4d. to 48s. 4d., net cash, delivered equal to Manchester; and following the advance in warrants higher prices are also being asked for Scotch iron. Hematites, in which large sales have recently been made, show a strong advance upon last week's prices; in one or two cases sales are reported at 59s. to 60s., less $2\frac{1}{2}$, for No. 3 foundry delivered into the Manchester district, but these may be regarded as the very top figures, and large buyers would probably be able to place out orders at a little less.

So far as the steel trade of this district is concerned, the prices which have to be taken to secure orders for castings are almost quite as low as ever, and with the exception that plates have gone up a little and better prices are being got for steel rails, the prices for general manufactured goods have still to be cut excessively low to effect business.

In the manufactured iron trade, although quotations have nominally been put up 5s. per ton since the quarterly meetings, the prices which are being actually got by makers here are very little better. Local forge proprietors would be quite content to book orders at an advance of 2s. 6d. per ton upon late rates, but even this is very difficult to get. At the old prices there was a tolerably good business being done, and on that basis trade was in a fairly good condition; but as a necessity of the advance in pig iron, makers have been compelled to ask more money for their manufactured goods, and this they find buyers not at all willing to pay. The basis of present quoted rates is about £5 2s. 6d. to £5 5s. per ton for bars delivered in the Manchester district.

A rather more hopeful tone as to the future is met with here and there amongst representatives of the engineering trades, but it is difficult to find any substantial basis for any more encouraging outlook. There are, it is true, works that are busier, and some branches of industry that are rather better off for orders; but in the general condition of the trade there is no real improvement, and the new work that is being got has still to be taken at excessively low prices. The returns as to employment for the past month issued by the leading trades union societies connected with the engineering branches of industry are scarcely a trustworthy indication of the present actual demand for labour, as the usual suspensions for the holidays and stock-takings at the close of last year have temporarily thrown a number of men upon the books who might otherwise have been at work. But for this it is probable the returns might have shown some slight improvement. As it is, they remain practically unchanged. The returns of unemployed issued by the Amalgamated Society of Engineers still show about 8 per cent. of the members in receipt of out-of-work support, and the returns of the Steam Engine Makers' Society show about four per cent. As to the condition and prospects of trade, the reports from some districts are rather more cheerful as to the future, but they do not record anything very tangible in the shape of present improvement, and the basis is scarcely more substantial than a pretty general expectation that trade has started in the direction of an improvement. Some of the stationary engine shops in Lancashire are reported to be rather better off for orders; these are all similar reports with regard to some of the locomotive building firms; tool makers are fairly off for work, and firm orders are reported to have been received in one or two of the shipbuilding centres. But, taking the condition of trade all through, the reports show no marked improvement anywhere, and many important centres continue very slack, with trade in the Manchester and Salford district still only very moderate.

An improved system of metallic packing for piston and valve rods, pistons, pump brakes, &c., has just been patented by Mr. H. G. Small, of Manchester. This consists in composing the packing of hollow rings or helical coils of suitable diameter or width to fit easily the stuffing boxes or other parts. These rings or coils being made of soft metal alloys, such as white metal, and bearing or resting upon each other in the middle part of their width, the tightening of the glands or junk rings causes the sides of the rings or coils to bulge out, and thereby make them fluid tight. By preference Mr. Small uses rings or coils having flat surfaces on their inner or outer periphery, and convex surfaces on the under and upper side, but rings or coils of circular or oval section so long as they bear one upon another in the middle part of their width can be used, provided, of course, that the rings or coils in all cases are constructed hollow. When the metal has become worn on the rubbing surfaces the rings or coils can be further bulged out by tightening the glands or junk rings, and this operation can be repeated until they have completely collapsed or are worn through.

At the meeting of the Manchester Association of Engineers on Saturday last when Mr. Alderman W. H. Bailey, the President delivered his inaugural address on the chief mechanical inventors of Lancashire, which is dealt with in another column, Mr. Thomas Ashbury, C.E., in proposing a vote of thanks to the President for his address, observed that Lancashire might freely be considered as the home of inventors, and probably no county in the United Kingdom had so many contributors to the Patent-office as Lancashire. They owed a great deal in Lancashire to the feature of accuracy which had been introduced by Sir Joseph Whitworth, and the success which had been achieved, had been due in large measure to theb accuracy which had characterised the work done in Lancashire. If Lancashire engineers were to maintain their superiority, they must follow the old Lancashire men in the example they had set of conscientious and accurate workmanship. Mr. Rawlinson remarked that if English engineers were to place themselves in the position to meet successfully the strong competition which was growing up against them in every part of the world, they would not only have to apply themselves to the work as they had done in the past, but they would have to apply themselves to sound technical education, and they would have to be thoroughly on the alert for the future.

Intelligence was received with very general regret on the Manchester iron market on Tuesday of the somewhat sudden death that day of Mr. Joseph Carrick, partner in the well-known firm of Messrs. Carrick and Brockbank, iron merchants of Manchester; the deceased gentleman had been connected with the iron trade of the above district for the last twenty years, and was very highly respected.

In the coal trade a fairly active demand is maintained for all descriptions of fuel, and pits are being kept on full time, with stocks, in many cases, still being filled up to meet the requirements of customers. Prices are firm at late rates and at the pit mouth average 9s. to 9s. 6d. for best coals, 7s. 6d. to 8s. seconds, 6s. to 6s. 6d. common house fire coals, 5s. to 5s. 6d. steam and forge coals, 4s. 6d. to 5s. burgy, 3s. 6d. to 4s. best slack, and 2s. 9d. to 3s. per ton for common sorts.

For shipment there is only a moderate demand, but prices are steady on the basis of 7s. 3d. for good qualities of steam coal delivered at Garston Docks or the high level, Liverpool.

Barrow.—The aspect of the hematite pig iron trade is more cheerful, and the position of the market is much more active than it has been for some time. The demand for pig iron is, in fact, much greater than makers can possibly supply at present, and it is therefore justifiable on the part of producers to put idle furnaces in blast, and thus increase the production. The works are, generally speaking, producing from one-half to two-thirds of the actual weight of iron they could put into the market if all their plant was in full work. It is noticeable that the increased demand has led to the belief that hematite will soon be a scarce article, and that the demand will be greater than the ability of makers to compete with. On the other hand, it is very evident that if makers put the whole of their furnaces in blast, the output will be so increased that it would be impossible, unless the demand continues good, to keep prices up to the present rates. Bessemer in mixed parcels was quoted last week at 49s. 3d. per ton, and this week it has advanced to 52s. 6d. per ton. Those makers who are best situated for orders are declining to sell even at these prices for large parcels or for deliveries well forward. Stocks of iron are not great, but many holders of stock are as firm as makers, and are expecting fuller prices shortly. The steel trade has not improved so much as that of pig iron, but there is, nevertheless, a full and a satisfactory demand. Makers at Barrow have put up their prices to £4 5s. per ton net at makers' works, or f.o.b. at local ports, and business has been refused at lower figures. The makers in the district are all well placed with orders, and it is fair to assume that they have a good twelve months' work in hand. Other descriptions of steel are in good request. Blooms and billets are in good demand, especially from America, and prices have lately advanced to a considerable extent. The trade in ship steel has been quiet for a long time, but within the past few days more enquiries have come to hand, and local shipbuilders have within the past fortnight received numerous enquiries for terms as to the building of steamers which are likely to lead to the acceptance of several orders. Iron ore is firmer in tone, and ordinary good samples are now quoted at 12s. per ton. Many raisers of ore are declining to sell in large parcels until they see the attitude trade will ultimately assume. In the meantime native raisers have it in their favour that Spanish ores cannot readily be bought. Coal and coke firmer, and fuller prices are expected. Shipping is expected to be busier.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

IT becomes increasingly evident that in the States, both in iron and steel, consumption has overtaken production, and the Americans are therefore turning to this country for supplies. Steel firms in the States are making their steel into rails. Hence the large American demand for blooms and billets. The "boom" seems pretty like that of 1879, and will probably last about as long. On the other hand, the demand for finished iron has not much increased. Staffordshire has felt it a little, but Yorkshire and the North have been very little affected as yet. What is needed for the finished iron trade is a revival in shipbuilding. Manufacturers of finished iron goods will find themselves somewhat in a difficulty if pig and other irons continue to rise and the values of their productions do not take an upward turn.

The Lancashire and Yorkshire Railway, I hear, has given an order for thirty locomotives to the Vulcan Foundry Company, Newton-le-Willows, and during the last few days sixty further locomotives to Messrs. Beyer, Peacock, and Company, Manchester. A considerable quantity of the material required for these locomotives will no doubt be made in this district as usual. I have heard it stated that the first order has been placed at £37 10s. a ton, said to be the lowest figure ever touched for that class of work. £50 a ton is said to be a moderate price in ordinary times.

I understand the Admiralty have ordered three more plates, 16in. thick, for experiments, from each of the two firms—Messrs. John Brown and Co., and Messrs. Charles Cammell and Co. Inquiries are also received for armour for cruisers to be built for a foreign Government.

The Manchester, Sheffield, and Lincolnshire Railway Company is asking for tenders for 10,000 tons of steel rails, which will, no doubt, be locally placed.

On Wednesday hematites were offered as high as 60s. per ton, showing that the market is very firm and still advancing. For Brown's foundry and forge iron advances of 3s. to 4s. a ton are readily obtained—foundry averaging 38s. and forge 36s. a ton at works.

The subject of American competition in Australia is being brought to the front. In the cutlery trade the leading firms have recently had a special representative in the colonies, making dilligent inquiry into the real condition of affairs. The result is that a wider and more valuable connection is confidently expected. On this head a Sheffield traveller, who has recently returned from Australia, supplies some interesting figures. He points out that, during the months of February, April, and September, in last year, there were shipped to the Australian colonies from America the following quantities of goods:—Hardware, 1837 cases; electro-plate, 167 cases; tools, 557 cases; shovels and spades, 108 cases; nails, 907 cases; saws, 35 cases; axes and hatchets, 3242 cases; lamps, 1000 cases; sewing machines, 573 cases. These figures no doubt account, in some measure, for home depression in our hardware trades. The colonists say that the Americans adapt themselves to the actual wants of the country, and add that they would gladly prefer British-made goods if they were equally suitable to their purpose. Several of our local firms have ceased to hold the ideas that what is good for home is good for anywhere. Adversity has taught the useful lesson that manufacturers must supply what the customer wants, not what they think he wants.

The Chamber of Commerce are now exhibiting a further collection of Chinese productions, which were forwarded to them by instruction of the late Earl of Iddesleigh. They are accompanied by a report from her Majesty's Consul at Swatow on the tools in common use by Chinese carpenters, and consist of thirteen parcels containing samples of the various objects, with the price at which they are sold marked on each. The Consul states that the tools—which comprise files, chisels, carving tools, plane irons, hammers, &c.—are made of soft iron with a very thin plate of steel welded on so as to form the cutting edge. The Consul adds:—"My attention was chiefly called to this class of goods by the fact that I have always noticed in the Chinese carpenter's tool-box at least one if not more old European plane irons or chisels, in many instances worn down to a third of their original length. This seems to me to indicate a preference for European steel, and that were tools made of such steel obtainable at anything like the market rate for Chinese tools, a large trade might be the consequence, for the carpenter plays a very important part in Chinese house-building." The articles have to be returned to the Government, and the Chamber has consequently ordered reproduction of them to be made as rapidly as possible. Hopes are entertained that a good business will yet be done with China, where English cold chisels and files are very much used already. An interesting note for spade and shovel manufacturers is the use of the broad hoe, which takes the place of the English spade, and, to some extent, with small proprietors, of the plough.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE tone of the Cleveland pig iron trade continues extremely firm, and prices are steadily advancing. At the market held at Middlesbrough on Tuesday last an unusual number of buyers were present, and most of them evinced great anxiety to make contracts. Few sellers have much iron to dispose of for prompt delivery, and, as no one will sell far ahead, but a limited amount of business is proceeding. No. 3 g.m.b. was on Tuesday last in strong request, and for prompt delivery could not be bought for less than 38s. per ton, that being 6d. more than the price current on the previous Tuesday. Makers declare that they have sold parcels for this month's delivery at as much as 39s. per ton, and they are now talking of raising that price to 40s. Consumers are usually willing to give 38s. 6d. for delivery to the end of March, and 38s. 9d. for delivery over the second quarter; but in the present excited state of the market they find great difficulty in meeting their requirements at those figures. Forge iron has advanced 6d. per ton during the week; 36s. is now the lowest price at which it can be purchased, and most holders ask more.

Messrs. Stevenson, Jaques, and Co.'s current quotations are:—"Acklam hematite," mixed Nos., 50s. per ton; "Acklam Yorkshire, Cleveland," No. 3, 39s. per ton; "Acklam basic," 40s.; refined iron, 54s. to 64s.

The demands for warrants continues brisk. The price current at Glasgow on Tuesday last was 39s. $1\frac{1}{2}$d. per ton, but buyers were in excess of sellers.

The stock of Cleveland pig iron in Messrs. Connal and Co.'s Middlesbrough store on the 17th inst. was 308,845 tons, being a decrease of 349 tons for the week.

Shipments are still light, but the knowledge of this fact seems to have no effect upon the market. Only 21,354 tons of pig iron left Middlesbrough by sea during the first seventeen days of the present month.

The finished iron trade does not by any means keep pace with the trade in pig iron. There is certainly a little more inquiry, but makers finding great difficulty in obtaining orders at even the modest advance last reported, hesitate to ask more. The most that can be obtained for ship-plates and common bars is £4 15s. per ton on trucks at makers' works, and angles are offered at 2s. 6d. less.

The total value of goods exported from Middlesbrough during the month of December, exclusive of coal and coke, was £174,543, representing an increase of £76,443 in comparison with December, 1885. The exports from Newcastle were valued at £173,940, representing an increase of £14,425.

On Saturday last the Council of the Northumberland Pitmen's Union had a meeting to consider the position of their constituents in respect of the impending strike. Returns in their possession show that notices have been given at between thirty and forty collieries, and that at about a dozen, the owners of which are not members of the Employers' Association, no notices have been given. The number of colliers actually under notice appears to be about 8000, and about 4000 men, who are not actually pitmen, but who work with them, will also be thrown out of employment. These latter will, of course, have no claim on the funds of the union. The Council came to no definite conclusion as to their course of action. But they decided to meet again in the course of a few days to consider what may have happened in the interim, and to determine whether, in the event of a stoppage, they shall call upon those who still remain at work to come out and make common cause with the rest.

A curious case under the Employers' Liability Act was heard at Gateshead County-court on the 8th inst. A cupola man named Gaffrey brought an action against his employers, John Abbott and Co., to recover £250, as compensation for the loss of his eyesight and other injuries. He had made complaints as to the limited space in which he had to work the cupola, involving, as he considered, risk of accident to himself. On June 1st last he saw metal running out with the slag. He proceeded to block up the hole, when the metal came away and burned him severely in the face. He is now quite blind. For the defence it was contended that there was no negligence on the part of the employers. The jury returned a verdict for the plaintiff, and put the damages at £200. Judgment was given for the amount with costs.

The steel makers of the Cleveland district are not to be allowed to realise the benefit of the better times which seem now to be commencing. Scarcely have they got to work upon the contracts recently entered at paying prices, when their men are down upon them for more wages. At a largely attended meeting of steel workers, held at South Bank on Saturday last, it was unanimously resolved to give notice for an advance of 10 per cent., and to order 1000 printed notice forms to be distributed for signature and use in case of a refusal of the demand. This is very hard upon the shareholders, who have had to put up with small dividends or none at all for so long, and who have kept their works going for years, simply and solely in the interests of the workmen.

Working-men are wont to assert pretty loudly that one man is as good as another, and that class distinctions are merely the outcome of pride and arrogance. They profess to be themselves perfectly free from the unamiable exclusiveness which they think characteristic of the upper and middle classes. Yet what in this way ever equalled the present doings of the men of New Seaham Colliery? The union men there have just taken a ballot of their members to determine whether or not they shall give fourteen days' notice to their employers to cease work unless the latter will make a rule that non-union men shall not go up or down the pit in the same cage and at the same time as themselves! Here is tyranny, selfishness, and class distinction of the very worst type. How the employers would have been execrated if they had, in their own interests, originated any such intolerant regulation.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

GREAT interest is manifested in the pig iron market, although the amount of business in ordinary pig iron has not been quite so large as it was last week. The quantity of warrants changing hands has, however, been much greater than is usual in ordinary times, and the prices have, on the whole, been well maintained, in the face of renewed attempts at "bearing" the market. The inquiries from America are still affecting the market, and the shipments of ordinary pigs are now showing that larger quantities are being despatched than was the case at this time last year. There is a small increase in the stocks in Messrs. Connal and Co.'s Glasgow warrant stores. The furnaces in blast number seventy-five, as compared with ninety-two at the same date last year. The pig iron shipments from Scotch ports in the past week were 8865 tons, against 4725 in the corresponding week of 1886; while the total shipments for the three weeks to date show an increase of 7674 tons. The imports of Middlesbrough pigs at Grangemouth for the week are 6110 tons, as compared with 2640 in the same week of last year.

Business was done in the warrant market on Monday at 47s. 3d. to 47s. $4\frac{1}{2}$d. cash, closing with buyers at 47s. $1\frac{1}{2}$d. cash. On Tuesday, transactions occurred from 47s. $2\frac{1}{2}$d. to 46s. $6\frac{1}{2}$d., closing at the same figures as on the preceding day. Business was done on Wednesday at 47s. 1d. and 46s. 5d. cash. To-day—Thursday—business was done at 47s. 1d. to 46s. 10d., closing with buyers a penny less.

The current values of makers' pigs are nearly all higher, as follow:—Gartsherrie, f.o.b. at Glasgow, No. 1, 55s.; No. 3, 47s.; Coltness, 60s. and 47s. 6d.; Langloan, 56s. 6d. and 47s. 6d.; Summerlee, 57s. 6d. and 46s. 6d.; Calder, 54s. 6d. and 45s. 6d.; Carnbroe, 50s. 6d. and 45s. 6d.; Clyde, 49s. 6d. and 45s.; Monkland, 48s. 6d. and 44s. 6d.; Govan, at Broomielaw, 48s. 6d. and 44s. 6d.; Shotts, at Leith, 52s. 6d. and 46s. 6d.; Carron, at Grangemouth, 52s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 53s. 6d. and 45s. 6d.; Eglinton, 48s. 6d. and 44s. 6d.; Dalmellington, 49s. 6d. and 45s.

The Spanish ore trade is in a somewhat remarkable position at present. Merchants are understood to have made considerable contracts to deliver it over the greater part of the present year, but both the prices of the ore and the cost of its carriage have risen in an unexpected way within the last few weeks, and it is feared that losses in some quarters will be the consequence. Cumberland hematite pigs have been in extra demand on the Glasgow Exchange this week, and there has been a marked advance in quotations.

The steel trade continues active, both the demand for Siemens and basic steel being such as to induce great activity at the works. The Steel Company of Scotland have voluntarily increased the wages of their workmen by about one-half the reduction that was made about a year ago. This week there have been renewed inquiries for plates for shipbuilding purposes.

In the course of the past week there was shipped from Glasgow a screw steamer in pieces, valued at £17,150, for Rangoon; engines for a Russian vessel valued at £16,000, for Sebastopol; machinery, £5890; sewing machines, in parts, £1335; steel goods, £7200; and general iron manufactures, £27,620.

The demand for coals is fully equal to the supply, and main coal is higher in price, being quoted f.o.b. at Glasgow 7s. per ton. Ell coal is also in request, but the price is somewhat lower. There is not so much inquiry for steam coals, although the trade in that department is better than was expected in consequence of an improvement in the shipping trade. The past week's shipments were, at Glasgow, 21,428 tons; Greenock, 1217; Ayr, 7240; Irvine, 1640; Troon, 6279; Burntisland, 19,777; Leith, 1913; Grangemouth, 2904; and Bo'ness, 3730; total, 66,128, as compared with 47,349 in the same week of 1886.

A crisis is threatened in the labour market of the coal trade. Stimulated by the recent substantial advances in the price of pig iron, the colliers refuse to wait longer for an increase of wages, and threaten to maintain a general strike from about the end of this week until their demands are conceded.

There have been several additional shipbuilding orders placed on the Clyde since last report, and the trade looks as if it would ere long be in an active position.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

WHATEVER be the cause, "middlemen" are having much less to do now than formerly in connection either with iron or coal. In the times of Anthony Hill bar iron and nail rods were sent to Bristol, and traders in Wales had to apply there for "parcels." The other day—I mention this by way of contrast—the largest works in Wales sold a couple of tons of rails direct to a small contractor. There is great force in the argument, that the user, knowing his exact requirements, would be able to get just what he required by direct purchase.

The Welsh industries are looking up, and prices are steadily advancing. Pig iron is close upon 5s. a ton advance, steel billets 10s. a ton, coke 1s. a ton. Even steam coal is hardening, and small steam and small bituminous are advanced from 3d. to 6d. per ton.

Nettlefold's works, near Newport, made a practical essay a few days ago, with excellent results. It is expected that 500 men will be employed there.

The Landore Steel Works, Swansea, sent off a few days ago a consignment of 300 tons of steel plates for America. This, I understand, is part of an order for 10,000 tons. Good American orders for rails will also soon be in hand, and altogether, though Barrow competes successfully with the Welsh works in the bar trade, prospects here are encouraging, and what with rails and bars, trade promises to be brisk, and at better prices.

As might have been expected, the improving tone of things has affected tin-plate as much as anything, and low quotations even for ordinary wasters are not heard of. Bessemers are at 14s.; Siemens, 14s. 6d.; charcoal tin-plates touch 17s. 6d.; charcoal ternes are up to 15s.

From Swansea over 65,000 boxes of tin-plates were sent away last week. I may name a few of the items. To New York 3200 tons; to Baltimore and Philadelphia, 2200 tons, principally tin-plates, chemicals, &c.; Hamburg 110 tons plates; Palma, Leghorn, and Genoa small consignments.

The obstinacy of the tin-plate strikers in various districts has a tendency to better the going works, but I see a few are giving way, and arrangements also making for re-starting others. The extensive works of the Pontypool Tin-plate Company at that place and at Pantymael and Pontnewyd are to be started forthwith.

The Morriston tin-plate men have passed a resolution to support the action against Monmouthshire masters where owners insist upon a reduction of wages.

Those ironmasters who have secured good stocks of foreign ore are to be congratulated, as prices have gone up to about 12s. per ton at Cardiff. For a long time prices were fixed at 10s. to 10s. 3d. It was pretty evident that they could not be lower, and equally clear that rails were at their lowest. Ironmasters have taken a leaf from colliery books, and will make increased make pay for low price. The arrangements at Cyfarthfa and Dowlais towards this end are admirable. The same may also be said in a degree of other works, the tendency being everywhere to minimise the cost and increase the make.

As the year advances, permitting outdoor work, there will be considerable progress shown in various undertakings, notably the Barry Dock and Railway, the Rhondda and Swansea Railway—the tunnel of which is now the chief important need—and the Roath line in connection with the Taff Vale.

The coal trade of Swansea was rather dull last week on account of the weather, and the consequent small tonnage that came in. Newport showed a fair average, and sent away 23,777 tons coastwise. Cardiff exported to foreign destinations 160,000 tons—a gratifying total that gave a little more animation to business. If prices had moved as well it would have been more satisfactory, but in face of my statement lately of large contracts taken at 6d. to 9d. less per ton than last year, what can be expected otherwise? The utmost is the hardening of best qualities.

The Barry Dock Company is advertising for dock gates and caissons thus showing progress.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

THE Rhenish-Westphalian iron market begins the new year with undoubted firmness, with prices showing a decided upward tendency. The improvement is expressed by steady advances, and the favourable moment is being utilised in making arrangements to avoid the disadvantages to trade which have shown themselves to exist in the iron industry during the last dull period. The demand is everywhere an active one, and in Silesia, as well as in Rhineland-Westphalia, the Siegerland and the Saar districts, conventions have already been, or are just on the point of being, completed. In Silesia, although the holidays and stock-taking, as elsewhere, have been a hindrance, the situation of the iron trade is generally a very favourable one. In fact the iron industry has so far improved that the millowners have ceased to offer their ores for sale, and are reluctant to contract forward at present prices, as there is now a prospect of mines once again being worked to a profit as prices rise, which have already got up to M. 12 to 13 for calcined steel stone—sparry carbonate—whilst some of the rolling mills are so well booked forward with orders that fresh trains, which have long remained dormant, are again being put into operation. In general, the demand for pig iron of all sorts is good, and prices are rising rapidly from week to week, perhaps too much so for a beginning; consequently the smelters will not entertain offers for long delivery ahead, in which policy they may be right, as there is every prospect of prices still rising in the near future, for at the end of December the stocks at the Westphalian Works were only 21,400 t., whilst orders were in hand for 77,100 t. The present price of forge pig is M. 45 to 47, and in the Siegerland as much as M. 50 has been asked; but whether buyers are able to give that price yet awhile is doubtful, because makers of finished iron cannot always realise a correspondingly advanced figure. Basic pig has gone up to M. 40 to 42, and Luxemburg to 30f. to 32f., and both will probably advance still higher, as stocks have materially diminished of late. Foundry pig has risen M. 1, and now stands at M. 54 No. 1, 50 to 51 No. 2, and M. 9 for No. 3. Bessemer and spiegeleisen have risen sensibly, the first costs now M. 46 to 49, and the latter up to M. 55 and 60 has been asked for superior brands. Rolled iron is in more request than when last reported, and as far as quantity is concerned there remains little to be desired. The price has again been raised, and now stands at M. 100 to 105 per ton. For the time of year there is an unusually active demand for girders, and customers have been notified that a rise of M. 10 per ton has been agreed upon by the makers, so that the price is now M. 108 to 110 per ton. There is no great change for the better in boiler and other kindred sorts of plates, at least no rise sufficient to compensate for the dearer raw materials used in their manufacture. The ground-price has been fixed for the present at M. 140 p.t., and 135 to 139 is what they really can be bought for. Thin black sheets are as much called for as ever, and cost in the Siegerland M. 135 to 140 p.t., whilst those made of Bessemer metal cost M. 145 to 150 p.t. The wire rod mills are busier than they ever have been before, and still orders keep coming in, particularly for export account. The price has also risen commensurately with the dearer raw materials, and if the blast furnace proprietors do not unduly force up their prices, a very encouraging future is in store for this branch. Iron wire rods are noted at M. 102 and higher, and in steel M. 110 and higher, and have risen therefore in all M. 15 to 20 p.t. since better times set in. The steel rail makers received some orders for domestic consumption last quarter, and others are in near prospect, so that this branch does not enter the new year in quite so drooping a condition as was the case almost throughout the one just closed. The English and Belgian competition is still feared, which has a depressing effect on the trade, but, on the other hand, hopes are fostered of orders from America, which would be a partial compensation. Steel rails are quoted at M. 120 to 125 p.t. Billets and other articles in steel are also being produced, and the quantity is gradually increasing. Hoops in iron are noted at M. 103 to 107, in Bessemer quality at M. 107 to 115 p.t. Steel sleepers are at M. 115 to 120 p.t.; wheels and axles complete, M. 300; and tires, the set in steel, 225 to 230. Light steel rails for mines, M. 100 to 104 p.t. With the exception of a few machine shops and foundries, which report favourably, the rest have little work on hand. Some heavy orders are in the air, but the prices offered are so exceedingly low that they are scarcely worth acceptation. The wagon works are working off old orders from last year, and this branch is now very quiet.

A Zinc Convention is shortly to be formed for this country with the object of regulating prices, and most likely the English works will participate in it, or at least, will be invited to do so. In the Westphalian and Silesian coal trade there is a firm tendency, and the mineowners are no more inclined to contract ahead at present prices. A new outlet for Westphalian coke has been opened up to Bohemia in consequence of reduced railway rates having been accorded on all the railways concerned; gas coal costs at present M. 5·40 to 6·20; best flaming quality, 6·40 to 7·80; lumps, 7·60 to 8·40; round coal as brought to bank 5·20 to 6; coking coal, 3 to 4; best coke, 8 to 8·50; blast furnace coke, 6·60 to 7·60 p.t., all at mines.

A large shipment of 50,000 tons of old Hungarian rails has just been made at Fiume for American account.

According to news from Berlin, Krupp has lately made an arrangement with the Japanese Government to establish a branch of his cannon-making business in Japan, and is to manufacture all the heavy artillery the Government may require.

A statement having become current that the Schwarzkopf Machine Factory at Berlin had contracted with the Italian Government for 6,000,000 marks worth of work, the board of directors has thought it prudent to avoid exaggeration, this being a public share company, to explain that this sum is to be expended over seven years, that the land they have acquired at Venice for the branch establishment and a place to experiment with torpedoes is loaded with a heavy yearly rental payable to the town; that the contract for making 700 torpedoes for the Italian Government was completed and arrived at Berlin on the 8th inst., and that no fresh capital would require to be created to establish the branch works. Simultaneously there is a talk of the Spanish Government being in treaty with a house in Westphalia to furnish to it also a large number of torpedoes. It seems strange that England is never named as participating in such orders, as if the manufacture of torpedoes were confined to Germany alone.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, Jan. 7th.

OUR advices this week from the interior are that the new year has opened with a fresh rush of orders for railroad construction, bridge building, boat and car building, and for material for tools and agricultural implements. The impression gains ground in American markets that prices will advance during the next six months, and if so, that an unhealthy stimulus will be imparted to manufacturing. The present feverish condition is due to the fact that everybody is buying more than they need in order to guard against the advance which all are looking for. The representatives of British houses have recently placed large contracts for rail blooms, billets, and slabs, and I learn to-day that some further heavy contracts will be closed either this week or next. Bessemer pig will also be wanted, and a few lots of spiegeleisen will probably be purchased.

Railroad building is doing the mischief. It is generally conceded that one-third more mileage will be laid in 1887 than last year, and this, of course, necessitates a general rush for material entering into all kinds of construction. The building of manufacturing establishments will also be pushed very rapidly, and the demand for machinery will be greater than it has been on account of the construction of so much mileage and the necessities which that construction creates. The machine shop capacity all over the country has been extended more or less, and it is quite certain that much more re-building will be done, especially in the Middle States, and particularly in New York and Pennsylvania.

Bar iron is sold from three to six weeks ahead, and prices to-day at mill are 2c. for best quality and one to two-tenths off for poorer qualities.

The supply of old rails has been cut off in home markets, and we are now depending mainly upon foreign markets, the result of which has been to crowd up prices about 1 dol. Steel rails are now quoted at 37 dols., with buyers of small lots ready to pay 38 dols. Bridge iron has not been as yet advanced, but we are looking for an announcement in that direction.

Plate iron is strong at $2\frac{1}{4}$ to $2\frac{1}{2}$, and some intimations are thrown out that the plate iron makers will put up prices one to two dollars per ton. Gaspipe is very active, and the new mills under construction will start up with six months orders ahead. The blast furnace output will be increased some 10,000 tons per week, and all the furnaces under construction and projection are blowing. The quotations for crude iron are 18 dols. to 21 dols. 50c. for No. 2 and No. 1 foundry, and for mill irons 16 dols. to 18 dols. 50c. The advances that have been made affect the makers of iron, and as yet they have been unable to effect a corresponding advance in the manufactured product. The demand for steel and iron wire rods is growing, and the imports will average 2250 tons per week. Tin-plate is very active and firm, and shipments are absorbed as fast as received. Stocks are not very heavy, as the consumption is growing.

Quite a number of new furnaces are projected. The estimated number is put at twenty. Two of these furnaces will be at Oxanna, Ala. They will be 150-ton furnaces. English pig iron is being used at Chattanooga, Tenn., for the manufacture of Bessemer steel. A supply is expected from the North Carolina region as soon as furnaces can be erected. A Bessemer steel plant, with two 3-ton converters, is to be erected near Ashland, Ky., and near to a natural gas supply. Three or four furnaces will be built in Tennessee. Two large furnaces are to be erected in Pennsylvania. A large sum of money will be invested in mining and coal properties in Pennsylvania, where iron and steel can be made at almost as low a price as the prices ruling in Northern Alabama.

THE SIZE OF OCEAN STEAMSHIPS.—The following table gives the name, date of construction, tonnage, length, breadth, and depth of the principal steamships plying between European and American shores:—

Name.	Built.	Gross tonnage	Length.	Beam.	Depth.
City of Rome	'81	8144	546	52	37
Umbria	'84	7800	500	57·2	38·1
Etruria	'84	7718	501·6	57·2	38
Servia	'81	7392	515	52·1	37
Aurania	'82	7269	470	57·2	37·2
Le Bretagne	'86	7012	508·4	52·4	38·4
La Bourgogne	'86	7000	508·6	52·2	38·8
La Champagne	'86	7005	508·7	51·6	38·4
La Gascogne	'86	7008	508·7	52·2	38·3
Alaska	'81	6932	500	50·6	38
America	'83	6500	432	51·3	35·8
Normandie	'82	6062	459	50	37
Westernland	'83	5736	455	47	35
Saale	'86	5500	455	48	38
Trave	'86	5500	455	48	38
Aller	'86	5500	455	48	38
City of Berlin	'74	5491	488·6	44·2	34·9
Noordland	'83	5212	400·7	47	35·3
City of Chicago	'83	5202	430	45	33·6
Eider	'83	5200	450	47	33·6
Arizona	'79	5147	464	46	37
Ems	'84	5129	430·5	47	34·5
Fulda	'83	5109	450	46	36
Werra	'82	5109	450	46	36
Belgravia	'81	5080	398·2	44·5	32·2
Germanic	'74	5008	455	45·2	33·7
Britanic	'74	5004	455	45·2	33·7
Elbe	'81	4911	420	45	36·5
England	'65	4898	437	42·5	35
Egyptian Monarch	'80	4709	370	44	35·8
Egypt	'71	4610	440	44·3	36·5
France (Fr.)	'65	4647	384	44	36
Amerique	'64	4637	394	42·0	36·9
City of Richmond	'73	4607	452·6	43	36
Erin	'64	4500	415	41	35
City of Chester	'73	4565	475	44·3	35
Spain	'71	4512	425·4	43·2	36·2
City of Montreal	'71	4451	419·1	44	34·3
The Queen	'65	4457	381·1	42·4	37·3
Grecian Monarch	'82	4364	381	43	33
Greece	'63	4310	390·7	41·3	35·3
Devonia	'77	4269	400	42	32
Hammonia	'82	4247	375	45	34
Italy	'70	4169	389	42·3	38·7
Anchoria	'74	4168	480	40·1	33·8
State of Nebraska	'80	4000	385	43	34
Ethiopia	'73	4005	402	40·2	33
Lydian Monarch	'81	3916	360	43	32·4
Adriatic	'71	3888	437·2	40·9	31
Celtic	'72	3867	437·2	40·9	31
Denmark	'65	3724	342·9	42·2	36
Republic	'71	3707	420	40·9	31
Baltic	'71	3707	420	40·9	31
Suevia	'74	3704	360	41	34
Wisconsin	'70	3700	378	43·2	32

Other well-known ships are the France, State of Nevada, State of Pennsylvania, Monarch, Rhynland, Abyssinia, Australia, Lessing, Wyoming, Rugia, Belgenland, Wieland, Nevada, State of Alabama, Westphalia, Pennland, Zeeland, Assyrian Monarch, State of Georgia, Bohemia, State of Indiana, Acadia, Nederland, Alexandria, and Assyria. These register from 3600 to 1082 tons. The Acadia is the smallest.

NEW COMPANIES.

THE following companies have just been registered:—

Anglo-Sardinia Antimony Company, Limited.

This company proposes to search for antimony and other mineral substances in the Island of Sardinia, or elsewhere, and for such will adopt an agreement for the purchase from Lugi, Marquis of Saliceto, of 44, Seymour-street, Portman-square, of a concession from the Italian Government, for mining under certain lands known as Sa Mina Corte de Rosas and S'Arrauaxin, Commune of Ballao, in the Island of Sardinia, containing about 1200 hectares. It was registered on the 12th inst., with a capital of £70,000, divided into 15,000 A shares, and 55,000 B shares of £1 each. The A shares are entitled to preferential and cumulative dividends of 12 per cent. per annum. The purchase consideration is £5000 in cash, and 55,000 fully-paid B shares. The subscribers are:—

	Shares.
E. M. Richardson Cox, 22, Walton-street, Cadogan-square	1
H. T. Grainger, C.E., 95, Albert-road, Dalston	1
J. Archer, 77, Dalbey-road, Brixton	1
A. Sweeny, 45, Reaston-street, New Cross-road, accountant	1
W. S. Wellborne, 15, Vicarage-road, Camberwell, accountant	1
W. Taylor, Eunice-road, Chiswick	1
R. W. Winch, 17, Braincote-road, South Bermondsey, clerk	1

The number of directors is not to be less than three, nor more than nine; the subscribers are to appoint the first and act *ad interim*; remuneration, £500 per annum.

Automatic Match Supply Company, Limited.

Upon terms of an agreement of the 6th inst., between Henry William Jeffrey and James Cosway, this company proposes to purchase the manufactory and business carried on by the Ecliptic Match Box Company at 4, Huggin-lane, E.C., together with the patent, trade marks and royalties (particularly the use of the word "Ecliptic"), and other effects of the said business. It was incorporated on the 12th inst., with a capital of £50,000, in £1 shares, to manufacture all kinds of matches and fusees. The subscribers are:—

	Shares.
J. J. Fleming, 178, Elderfield-road, Clapton, clerk	1
D. W. Money, 98, Brixton-road	1
C. Berry, 72, Harrogate-road, South Hackney, accountant	1
Leslie Jeyes, C.E., 9, Victoria-chambers, Westminster	1
E. J. Wallace, Winchester House, Hornsey-lane	1
L. S. Lupton, Ray House, Forest Gate, ship-broker	1
P. B. Oppenheim, Gresham House, merchant	1

The number and names of the first directors will be determined by the subscribers, who act *ad interim*; remuneration, £500 per annum, and also 2 per cent. after £10 per cent. has been paid to the shareholders.

Bath Crystal Ice Company, Limited.

Registered on the 12th inst., with a capital of £3900, divided into 300 ordinary, and 300 founders' shares of £6 10s. each, to purchase the business and assets of the Bath Pure Ice Company. The subscribers are:—

	Shares.
T. W. P. Isaac, Bath	17
A. G. D. Moger, Bath, banker	20
G. Strange, Bath, job master	20
J. Day, Bath, engineer	70
J. A. D. May, Bath	10
W. S. Loder, Bath	27
E. Hill, Bath	10
A. J. King, Bath, solicitor	30
J. Stuckey, Bath, job master	40
E. G. Peacock, Bath, fishmonger	50
H. Butcher, Bath, chartered accountant	6

Registered without special articles.

Dickinson's Tramway Appliance Company, Limited.

This company proposes to trade as manufacturers and merchants of railway and tramway appliances, and with such object will acquire the letters patent, dated 20th May, 1885, and numbered 6164, granted for improvements in wheeled carriages for use alternately upon railways and roadways. It was registered on the 10th inst. with a capital of £50,000, in £10 shares. Power is taken to finance and support inventors of improved appliances for railways and tramways, and to promote and support their application for patents in respect thereof. The subscribers are:—

	Shares.
B. S. Biram, Edgbaston, contractor	1
G. Rose, Mellish-road, Walsall, solicitor	1
F. Howe, 4, Waterloo-street, Birmingham, solicitor	1
E. Holmes, Wednesbury, accountant	1
W. Jackson, Wednesbury, clerk	1
J. Payne, 49, Corporation-street, Walsall, clerk	1
E. Wilson, Wood Green, Wednesbury, clerk	1

The number of directors is not to be less than three, nor more than ten; qualification, £250 in shares or stock; the subscribers are to appoint the first; the company in general meeting will determine remuneration.

Globe Worsted Company, Limited.

This company proposes to acquire property for the purpose of carrying on business as worsted manufacturers. It was registered on the 11th instant, with a capital of £120,000 in £10 shares, with the following as first subscribers:—

	Shares.
*J. Crowther, Marsden, Huddersfield, woollen manufacturer	100
*F. W. Taylor, Mirfield, Huddersfield, woollen manufacturer	100
*W. Crowther, Claithwaite, Huddersfield, woollen manufacturer	100
*E. Crowther, Cambridge-road, Huddersfield, woollen manufacturer	100
*J. Lodge, Edgerton House, Huddersfield, woollen manufacturer	100
*J. Brierley, Slaithwaite, Huddersfield, woollen manufacturer	100
*J. France, Honley, Huddersfield, woollen manufacturer	100

The number of directors is not to be less than three, nor more than seven; the subscribers are the first; qualification, 100 shares; the company in general meeting will determine remuneration.

J. and G. Rennie, Limited.

This is the conversion to a company of the business of millwrights, manufacturing engineers and shipbuilders, carried on by the firm of J. and G. Rennie, at Holland-street, Blackfriars, the Creek Yard Boiler House, Ravensbourne-street, Greenwich, and at the Iron Shipbuilding Yard, Thames-street, Greenwich. It was registered on the 6th inst., with a capital of £80,000, in £100 shares. An agreement of the 20th September cites that the partnership between John Keith Rennie and George Banks Rennie having expired, they have resolved that, instead of renewing the same, the business shall in future be carried on by a joint-stock company. Messrs. Fuller, Horsey, Son, and Cassell have made a valuation of the land, building, fixed plant and machinery, loose tools and utensils, stock and stores used in the said business, and have estimated them to be of the value of £88,767. Since the valuation certain new machinery has been added, increasing the value to £89,500, for which amount the property will be taken over by the company. The consideration is payable as follows:—£29,500 by one or more mortgages—as the vendors may direct—of the lands and buildings, bearing 4 per cent. per annum interest, and £60,000 in fully-paid shares. Messrs. Cecil Gordon Crawley and Wm. Hugh Browning have each agreed to subscribe for 100 fully-paid shares, and to pay the full amount represented by the same. The subscribers are:—

	Shares.
*J. Keith Rennie, 2, Eccleston-square	1
*G. B. Rennie, 20, Lowndes-street	1
*Keith T. Rennie, 2, Eccleston-square	1
W. S. Lewin, 2, Rose-villas, Bexley Heath	1
*C. G. Crawley, Stockwood, Luton	1
*W. H. Browning, 9, Cadogan-square, S.W.	1
Capt. Arthur C. H. Paget, H.M.S. Euphrates	1

The number of directors is not to be less than three, nor more than six; qualification, £10,000 in shares or stock; the first are the subscribers denoted by an asterisk. The remuneration of the board will be as follows:—To the chairman and vice-chairman, £2 each, and to each ordinary director £1, for every working day devoted to the business of the company, but such payments are not to exceed £500 per annum each for chairman and vice-chairman, and £250 per annum for each ordinary director.

South Shields Tramways Carriage Company, Limited.

This company proposes to acquire from the Corporation of South Shields a lease of tramways constructed or to be constructed under the powers of the South Shields Corporation Tramways Order, 1881; and to establish and work tramways, railways, and omnibuses in the county of Durham. It was registered on the 11th instant with a capital of £10,000, in £10 shares. The subscribers are:

	Shares.
Wm. Turton, Hayfield House, Leeds, tramways proprietor	120
D. Busby, 303, Edge-lane, Liverpool, tramways proprietor	120
G. W. Turton, Chapeltown, Leeds, corn merchant	10
J. Turton, Chapeltown, Leeds, army contractor	10
R. Turton, Chapeltown, Leeds, coal merchant	10
H. B. Arundel, Higher Broughton, Manchester, machine maker	10
H. Brown, Newhurst, Leicester, retired fruit merchant	10
J. Wright, Seel-street, Liverpool, corn merchant	10

The number of directors is not to be less than three, nor more than five; the subscribers are to appoint the first; qualification, 10 shares or £100 stock; the company in general meeting will determine remuneration.

THE RESECOP CANAL.—The Russian Government has concluded an arrangement with the firm of Messrs. H. Hersent and Co., of Paris, for the raising of a sum of 25,000,000 roubles gold, in order to construct the Resecop Canal, in the Crimea. M. Louis Coiseau, one of the principal engineers of the Suez Canal, has been appointed to direct the works.

LIVERPOOL ENGINEERING SOCIETY.—The usual fortnightly meeting of this Society was held at the Royal Institution, Colquitt-street, Liverpool, on Wednesday, January 12th; Mr. J. J. Webster, M. Inst. C.E., president, in the chair. A paper by Mr. A. W. Brightmore, M.Sc., entitled, "The Flow of Water," was read by the author. The author commenced by pointing out that the present theory of hydrodynamics is only applicable to one form of motion of water, and that the least prevalent in nature from an engineering point of view. After explaining under what circumstances this was the case, and on the other hand the conditions of motion to which it did not apply, he described the motion of water under three conditions which most commonly present themselves to the engineer—viz., the motion of water in streams, in pipes, and the motion of ships in water. With regard to the first of these three, the theory was of but little use, and empirical laws of various degrees of complexity had been proposed, of which he mentioned the one of easiest application, and giving results probably as accurate as the others. In describing the motion of water in pipes, he pointed out that when the velocity was slow enough the motion came under the present theory; but after attaining a certain critical velocity, depending *cæteris paribus* inversely on the size of the pipe, the motion became sinuous, and an empirical law had been found to express the flow under these conditions. This law, owing to the more restricted conditions under which the flow took place, was of a more definite nature than in the case of streams. Proceeding to the motion of ships in water, after describing Froude's experiments on the resistance of plane surfaces moving through water, and his experiments on H.M.S. Greyhound and a model of the same, he went on to point out that the resistance of ships in water was due to three causes, which were skin friction, dead water eddies, and the energy imparted to the water to produce waves. He concluded by showing how the resistance of a full-sized ship at different speeds can be inferred from that of a small scale model run at corresponding speeds with very great accuracy.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

11th January, 1887.

396. Advertising, J. M. Murphy and J. Paterson, London.
397. Tobacco-pipe Cleaning Apparatus, A. Lehmann, London.
398. Metallic Blades of Oars, &c., G. W. Green, Birmingham.
399. India-rubber Overshoes Sunk-heel, A. Wellsley, Bedford.
400. Lamps, H. J. Allison.—(*W. C. Baird, United States.*)
401. Ships, R. McC. Fryer, London.
402. Platinum Lamps, H. Schlichter, London.
403. Keel and Sides of Self-righting Lifeboats, &c., S. J. Fane, Southport.
404. Sawing-in Machine for the use of Bookbinders, &c., C. King and H. J. Creese, Leicester.
405. Brace Buckles, H. M. Picken, Birmingham.
406. Comb Feeder, for Wool or other Fibres, J. Crabtree and B. Banks, Leeds.
407. Garden Head-rest and Lounge, S. A. Rothschild, London.
408. Machines for Lasting Boots and Shoes, O. Imray.—(*S. W. Paine, United States.*)
409. Cutting Instruments, T. W. Rammell, London.
410. Lighting Cigars, &c., W. Walton, Bishopwearmouth.
411. Preventing Explosions in Oil Tanks, T. Ray, Sunderland.
412. Automatically Measuring Liquids, G. A. J. Schott, Bradford.
413. Case for Holding Bottles, F. Gartside, Glasgow.
414. Water-closets, T. Whalley, London.
415. Clearing Tram Rails, J. Prosser, London.
416. Connecting Telegraph Wires, R. W Hale and J. F. Swann, London.
417. Artificial Ivory, A. M. Clark.—(*S. G. A. Depont, France.*)
418. Detachable Handle Bars for Velocipedes, W. Starley, London.
419. Working Rotary Hair or other Brushes, F. Reast, Hastings.
420. Drill Guns, &c., J. W. Lowdon and W. White, Dundee.
421. Sewing Leather Belting, J. K. Tullis, D. Tullis, J. T. Tullis, and E. Mackie, Glasgow.
422. Tools for Interlocking the Edges of Sheet Metal Plates, E. Small, London.
423. Skid for Vehicles, C. H. Wainwright, London.
424. Roads and Pavements, W. White, London.
425. Catching Flies, C. Frauenholz, London.
426. Railway Rail Joints, J. Siegel, Canada.
427. Holders for Hanging up Trousers, &c., W. Peterson, London.
428. Lathes, W. P. Thompson.—(*L. W. Spencer, United States.*)
429. Telephone Toll Collectors, C. Wittenberg, London.
430. Horseshoes, J. Spencer, London.
431. Nail-driving Machines, T. B. De Forest, London.
432. Clearing Away Snow, R. Huskinson and A. Bailey, London.
433. Treatment of Minerals, J. Beveridge, London.
434. Fastening Seed Bags, &c., J. Hodgson, London.
435. Belting, A. H. Reed.—(*A. D. Westbrook, United States.*)
436. Ladies' Companion, H. Agar, London.
437. Ventilators and Chimney Cowls, J. D. G. Thompson, Glasgow.
438. Weighing, &c., Scales, J. E. Pitrat, London.
439. Extending Tables, C. E. Hawley, London.
440. Window-sash Fasteners, G V. Butler, London.
441. Spinning Hemp, &c., A. V. Newton.—(*J. Good, United States.*)
442. Rendering Mills Fireproof, &c., J. and S. Stott, Manchester.
443. Dyeing Unspun Textile Fibres, G. Jagenburg, London.
444. Promoting Circulation of Water in Steam Boilers, A. Goodwin and A. Goodwin, jun., London
445. Siphons, A. Natterer, London.
446. Locks, S. Simson, London.
447. Crushing Apparatus, H. J. Haddan.—(*M. Neuerburg, Germany.*)
448. Explosive, E. Edwards.—(*R. Sjöberg, Sweden.*)
449. Pianoforte Actions, A. Kampe, London.
450. Corner Pins for Lawn Tennis Grounds, H. Lunn, London.
451. Combination of Ingredients for Disinfecting, &c., R. V. Tuson, London.
452. Screw Propellers, A. Vogelsang, London.
453. Utilising Force to Move Bodies, W. H. Hall, London.
454. Cleaning out Tobacco Pipes, C. F. Hall, London.
455. Key for Locking up Chases of Type, R. Henesey, London.
456. Door Locks, G. B. Underwood and D. A. Dobie, London.
457. Steam Engine Governors, F. M. Rites, London.
458. Rectal Specula for Treatment of Hemorrhoids, R. S. Packson, London.
459. Motive Power, M. P. W. Boulton and E. Perrett, London.
460. Electrical Switching Apparatus, H. H. Lake.—(*C. C. Gould, W. Smith, and P. W. Scribner, United States.*)
461. Looms for Weaving, H. H. Lake.—(*S. T. and W. S. Thomas, United States.*)
462. Lithographic Printing, C. F. C. Hacker and L. C. F. Godenschweger, London.
463. Ore Separators, H. H. Lake.—(*W. White, United States.*)
464. Wheels for Railway Purposes, H. H. Lake.—(*J. W. Cloud, United States.*)
465. Spring Motor, F. Campbell, London.
466. Cricket Wickets or Stumps, G. C. Thorne-George, London.

12th January, 1887.

467. Measuring the Extension of Test Bars, W. C. Unwin, London.
468. Measuring the Extension of Test Bars, W. C. Unwin, London.
469. Feed-water Heating, A. MacLaine, Belfast.
470. Warming or Cooling, W. Matthews and J. Yates, Manchester.
471. Gas Tap Key and Taper Holder, T. W. and F. G. Redford, Bolton.
472. Packing Springs, H. Lancaster and R. F. Christmas-Tonge, Manchester.
473. Bowls used in Mangles, &c., J. Oliver, Manchester.
474. Engraving Copper or other Rollers, S. Knowles and J. Chadwick, Manchester.
475. Bottle Stopper Fastenings, S. S. Woodbury, Manchester.
476. Hook and Eye Fastening, J. Mennie, Manchester.
477. Inflating, &c., Footballs, &c., E. H. Seddon, Brooklands.
478. Presses for the Embellishments of Bricks, &c., J. van de Loo, Berlin.
479. Gullies and Sinks, J. Shaw, Willington-upon-Tyne.
480. Valveless Flushing Syphon, J. Buckle, Hull.
481. Bicycles, &c., J. Parr, Leicester.
482. Rolling Metal Tubes, &c., E. Whitehouse, Bilston.
483. Secure Fixings for Coffin Handles, &c., E. Wilson, Bradford.
484. Grinding Carding Engine Cylinders, J. Bullough, Accrington.
485. Extending the Range of Sporting Guns, J. Bullough, Accrington.
486. Toy Carts, &c., J. Worthington, Blackpool.
487. Stretching Silk, &c., W. Stannard, Leek.
488. Regulating the Flow of Liquids, H. Babington, Birmingham.
489. Saving Life from Fire, J. Izard, London.
490. Melting Snow, J. A. W. Reeve, London.
491. Protecting the Soles and Heels of Boots, H. M. Kemp, London.
492. Invalid's Chair, G. Charnock, London.
493. Duplex Telephony, A. R. Bennett, Glasgow.
494. Filling Sacks, &c., W. P. English, London.
495. Stamped Steel Spiked Horseshoe, J. E. Hill, Stourbridge.
496. Mortice Machine Metal Cutter, &c., A. E. Kennard, Lewisham.
497. Registering Mechanism, A. Warner, J. P. Rock, and W. H. Davis, London.
498. Velocipedes, G. Singer and J. Dring, London.
499. Wearing Apparel, J. Y. Johnson.—(*F. St. Clair, United States.*)
500. Lamps, J. Y. Johnson.—(*F. Rhind and C. S. Upton United States.*)
501. Furnaces, P. Ewens, London.
502. Sign-plates, A. J. Boult.—(*E. Bais-Gombert, Belgium.*)
503. Shifting Tramway Switches, F. Servus, Liverpool.
504. Gas Tap, A. Brayshaw, Liverpool.
505. Stirrups, A. J. Boult.—(*C. Grassi, P. Brigatti, and L. Pirola, Italy.*)
506. Skates, A. E. Adlard, London.
507. Pipes, J. Lakeman, Middlesex.
508. Lamps, C. Ashbury, London,
509. Blocks of Artificial Fuel, E. Edwards.—(*A. Lego, France.*)
510. Telegraphic Instruments, J. E. Spagnoletti and J. Crookes, London.
511. Insulator, J. E. Spagnoletti and J. Crookes, London.
512. Needle Collar Studs, R. E. Henry, London.
513. Cutting Apparatus, A. G. Dawson and A. Ridgway, London.
514. Dredging Machinery, J. Wilson and J. A. Radley, London.
515. Bronzing Paper, F. Schilling and G. Brüning, London.
516. Gas Engines, G. W. Newall and J. F. Blyth, London.
517. Corrugated Paper, H. H. Lake.—(*E. R. Wiggin, United States.*)
518. Winding Thread, J. Keats, London.
519. Burning Liquid Fuel, M. F. Rydén.—(*C. Qvarnstrom, Russia.*)
520. Extinguishing Lamp Flames, A. Rettich, London.
521. Wines, E. Beanes, London.
522. Means of Stoppering Bottles, &c., W. C. Church, London.
523. Corrugated Paper Machinery, H. H. Lake.—(*E. R. Wiggin, United States.*)
524. Stopping Bottles, &c., H. J. Haddan.—(*J. Says, Spain.*)
525. Cleaning Carpet, E. Hammerton, London.
526. Lozenges, H. H. Leigh.—(*F. Guillot and L. A. Pailliard, France.*)
527. Centre Pivotted Mounting, J. Vavasseur, London.
528. Ploughshare, &c., P. Lankester, London.

13th January, 1887.

529. Reservoirs of Oil Burners, T. Archer, London.
530. Copying Presses, W. Risk, Glasgow.
531. Twining Cotton, W. Hardcastle and J. Bentley, Halifax.
532. Reels, C. Longbottom, Bradford.
533. Opening, &c., the Feed Hole of Diffusers, I. Webster, Kirkstall.
534. Tubes, &c., D. Adamson, Manchester.
535. Tubes, &c., D. Adamson, Manchester.
536. Sewing Machines, H. Encke and J. H. Armitstead, Manchester.
537. Ink Wells, &c., A. W. Calvert, Leeds.
538. Bench Stop, &c., J. A. E. Mitchell, Keighley.
539. Polishing, &c., Powder, J. and J. W. Davies, Manchester.
540. Lamps, W. J. Spurrier and W. H. Pasley, Birmingham.
541. Cameras, J. Ashford, Birmingham.
542. Safety Lamp, J. Lane, Barrow-in-Furness.
543. Signal Valve and Clearance Cock, A. H. Sheppard, Sussex.
544. Attaching Handles to Saucepans, &c., E. J Shingler, Birmingham.
545. Revolving Machine, W. Rockliffe and T. Walshaw, Sunderland.
546. Blind-roller, E. H. Ledger, Shrewsbury.
547. Ornamenting Panels, J. Wilesmith, London.
548. Portable Stand, J. Blakey, London.
549. Muffs, R. Bernhard, London.
550. Signalling, J. Greenup, London.
551. Protecting Telegraph Wires from Snow, H. J. Newcome, Shenley.
552. Stopping Bottles, D. Rylands, Barnsley.
553. Softening Water, H. Porter, London.
554. Steering Gear, J. McLean, Glasgow.
555. Screw-propellers, T. Leach, Glasgow.
556. Mechanical Musical Instruments, F. E. P. Ehrlich, London.
557. Fire-lighters, A. Cameron, Glasgow.
558. Lamp Chimneys and Globes, A. Bosch, London.
559. Controlling the Speed of Sewing Machines, G. Remmer, Sheffield.
560. Mechanical Stokers, W. Whittaker, London.
561. Filters, E. Perrett, London.
562. Purse or Receptacle, M. Sugar, London.
563. Dynamo-electric Machine H. H. Leigh.—(*J. L. Clerc, France.*)
564. Electric Motor, H. H. Leigh.—(*J. L. Clerc, France.*)
565. Electric Transformator, H. H. Leigh.—(*J. L. Clerc, France.*)
566. Jacquard Looms, E. Edwards.—(*J. R. Hoffman, Germany.*)
567. Chiming Apparatus set in Action by a Clock, J. Harrington, London.
568. Printing Designs on Embroidery, &c., G. Downing, London.
569. Pencil Cases or Holders, F. Hardtmuth, London.
570. Permanent Way of Railways, &c., H. S. Stewart, London.
571. Switch for Telegraphic Transmitting Keys, R. M. Cunningham.—(*T. H. Davies and C. Peeling, Brazil.*)
572. Holding Fibrous Material during the Process of Scutching, &c., J. McGrath and E. Manisty, London.
573. Arithmetical Computations, C. F. Findlay, London.
574. Brougham-hansom Cabs, W. T. Thorn, London.
575. Lamp Burner and Extinguisher, W. G. Cloke, London.
576. Handling Crucibles, P. M. Justice.—(*Société Anonyme des Manufactures de Glaces, Verres, Vitres, &c., Belgium.*)
577. Cement, P. M. Justice.—(*C. Deitzsch, Germany.*)
578. Furnaces for Burning Limestone, &c., P. M. Justice.—(*C. Deitzsch, Germany.*)
579. Lamps, T. C. J. Thomas, London.
580. Making Heads of Casks, A Dunbar, London.

14th January, 1887.

581. Tramways, D. R. Williams and J. Thompson, Monmouthshire.
582. Sharpening Horse Shoes, &c., R. Heaton, Lancashire.
583. Lamp Stove, W. H. Pasley, Birmingham.
584. Counter-balancing Sliding Sashes, P. Parrett, Yorkshire.
585. Fastening Rails in Chairs, B. J. Warman, London.

586. ENGINES, A. Foster, Hertfordshire.
587. UMBRELLA STICK, H. Marx, London.
588. OILS, W. S. Somers, Liverpool.
589. FIREPROOF CONSTRUCTION, J. M. Murphy, Liverpool.
590. COUPLING and UNCOUPLING RAILWAY TRUCKS, C. Skidmore, Birmingham.
591. BATHS, G. R. Anderson, Glasgow.
592. STEAM-TRAPS, J. B. Stubbs, Manchester.
593. HANDLES, E. Banks, Birmingham.
594. DENTAL PLATES, T. B. Place, F. H. Billing, and E. Pillow, Crewe.
595. SIGNALLING, J. Reid and C. Eggar, Glasgow.
596. STOPPERS, A. S. Tanner, Middlesex.
597. SPRINGS, J. H. Goodwin, Sheffield.
598. VALVES, J. G. Bonner and C. Dutton, London.
599. TYPE-WRITERS, F. Mitchell, London.
600. EMPTYING BOTTLES, &c., T. Latimer, London.
601. STEAM-BOILERS, T. Taylor, London.
602. SUGAR MILLS, R. A. Robertson and J. G. Hudson, Glasgow.
603. REIN HOLDER, G. J. Harcourt and E. Shaw, London.
604. PROPELLING MACHINERY, T. Morse, London.
605. SCORING CARDS, J. MacCallum, London.
606. PREVENTING OVER-WINDING, T. Kirkland, jun., and T. Barnett, London.
607. LOOMS, J. Lambert, London.
608. SOAP, R. G. Price, J. Harvey, and A. J. Dodd, London.
609. FIRE-GRATES, G. G. Brodie and J. D. Prior, Middlesex.
610. OILS, J. Lyle, Glasgow.
611. LEATHER-LIKE MATERIAL from FELT, C. Scheibler and O. Bluth, Middlesex.
612. PROPELLING of BOATS, A. Myall.—(*A. Stenhouse and H. Fenoulhet, New Zealand.*)
613. BORING, A. J. Boult.—(*E. Clausolles, France.*)
614. SHOES, W. D. Hutchinson, London.
615. GAS BURNERS, F. L. Rawson and C. S. Snell, London.
616. ALLOYS, L. Bell, London.
617. COCKS, C. E. Gittens, London.
618. LOCKS, S. and S. R. Chatwood, London.
619. ADJUSTING ORDNANCE SIGHTS, G. Stuart, London.
620. STIRRUP IRONS, A. E. Bishop, London.
621. BENDING METAL, P. M. Justice.—(*L. Dow, United States.*)
622. MECHANICALLY CONVEYING CASH, M. C. Denne, London.
623. INDICATING the NUMBER of SEATS OCCUPIED in RAILWAY CARRIAGES, A. E. Scott, London.
624. METAL INGOTS, H. H. Lake.—(*J. Illingworth, United States.*)
625. GYROSCOPE, J. E. Bostock, London.
626. CHARGING and DRAWING GAS RETORTS, G. Rook, London.
627. ROLLING RULES, L. C. Jackson, London.
628. DISINTEGRATION of CLAY, J. F. O'C. Wood, London.
629. ELECTRO-CHEMICAL GENERATION of CHLORINE, D. G. Fitz-Gerald, London.
630. STEEL, J. H. Darby, London.
631. STEEL or INGOT IRON, J. H. Darby, London.
632. CLEANSING and SEASONING CASKS, J. Thompson, London.

15th January, 1887.

633. MITRE-SCREW for PICTURE-FRAME MAKING, G. Jackson, Manningham.
634. ELECTRICITY METERS, J. Hopkinson, London.
635. SECURING and SEALING POSTAL BASKETS, &c., E. S. Norcombe, London.
636. BOOT PROTECTORS and NAILS, W. E. Partridge, New Oscot.
637. SHARPENING and CALKING of HORSES' SHOES, G. Thompson, Manchester.
638. PHOTOGRAPHIC CAMERAS, J. Williams, Aston.
639. WOVEN FABRICS, F. A. Gatty and J. Leemann, Manchester.
640. MECHANISM for ACTUATING the DOFFING COMB of CARDING MACHINES, E. Gaunt and W. Firth, Bradford.
641. PNEUMATIC ACTION for ORGANS, M. Hetherington, London.
642. NEW ARTIFICIAL STONE, F. V. Hadlow, Parkhurst.
643. WINDOW SASHES, J. W. Cropper, Rochdale.
644. METALLIC HANDLES for STICKS, &c., G. T. Carr, Sheffield.
645. MACHINERY used for LEATHER, &c., J. and A. Hill, Leeds.
646. COMPOSITION for DRESSING LEATHER, W. P. and G. A. Kermann, Liverpool.
647. UTILISATION of a WASTE PRODUCT, W. O. A. Lowe, Liverpool.
648. DUPLEX TELEPHONY, A. R. Bennett, Glasgow.
649. INTERNALLY STOPPERED BOTTLES, D. Rylands, Barnsley.
650. BREECH-LOADING SMALL ARMS, A. Martin, Glasgow.
651. KITCHEN COOKING FIRE GRATES, H. C. Johnston, Glasgow.
652. TOOLS for FORMING the MOUTHS of BOTTLES, D. Rylands and B. Stoner, Barnsley.
653. HEARTH RUGS, J. Wilson, Halifax.
654. END FRAMES for WRINGING MACHINES, &c., H. L. Wilson and J. Clegg, Halifax.
655. BEARINGS of AXLES of ROLLERS in WRINGING, &c., MACHINES, H. L. Wilson and J. Clegg, Halifax.
656. PERAMBULATOR JOINTS, T. J. Harris, Erdington.
657. SHOT FIRING, M. Settle, Manchester.
658. CARDING ENGINES, W. Lawton, Halifax.
659. STEAM ENGINES, A. and J. T. Holt, Rochdale.
660. FOG SIGNALLING of TRAINS, J. H. A. Child and R. Crisp, Holmwood.
661. SAFETY TIP-WHEEL GEAR for TRICYCLES, &c., P. Howell, Barrow-in-Furness.
662. RENDERING ENAMEL PAINTING on STAINED GLASS, O. Paterson, Glasgow.
663. PUMPS, T. H. Ward, Tipton.
664. DEEP WELL PUMPS, V. Morris, Ipswich.
665. WASHING BOARDS, A. Drummond, Glasgow.
666. MANUFACTURE of PIPES, G. E. Vaughan.—(*R. and M. Mannesmann, Germany.*)
667. TREATMENT of WOUNDS, &c., A. Rosenthal, London.
668. GAS and OIL STOVES, L. W. Leeds, London.
669. TAP for WATER, &c., Zehren Frères, Paris.
670. NIGHT LIGHTS, J. Broad and Sons, and G. C. Fowler, London.
671. HOLDERS for CARRYING PARCELS, F. Bosshardt.—(*J. F. Wolff, Germany.*)
672. STUDS or WEARING PIECES for HORSESHOES, T. H. Heard, Sheffield.
673. GAS TAPS and WATER TAPS, W. Beaumont, London.
674. COFFIN LOOPS, W. J. Bowling, London.
675. BORING, &c., SHELLS, W. Craven, London.
676. COMPUTING or CALCULATING DATES, E. O'Brien, Liverpool.
677. OPEN BOILERS or COPPERS, A. Arnold and W. H. Webb, London.
678. PAVING BLOCKS, E. W. Jones and C. Brand, London.
679. ORNAMENTING WOOD, J. R. Corsan, London.
680. BRAKES for PERAMBULATORS, W. J. Parker, London.
681. ZITHER, J. J. Bennell, London.
682. MOUNTING of MONCRIEFF, &c., GUNS, A. Moncrieff, London.
683. HOLOPHOTES, A. Siemens, London.
684. ROOFING TILES, F. U. Benekendorff and C. Yüngst, London.
685. OIL LAMPS, A. M. Silber, London.
686. SELF-ACTING AIR VALVE, A. Boulouse, London.
687. SADDLE BAR, F. W. Mayhew, London.
688. CONCRETING AMBER SHAVINGS, J. Karpeles, London.
689. BOXES for DELIVERING CIGARETTES, O. Melachrino, London.
690. ATTACHING DRAW-OFF COCKS to CANS, S. Beach, London.
691. CONVEYING WATER to BATHS, &c., D. Noble and G. A. Ruddock, London.
692. OBSTETRICAL INSTRUMENTS, H. H. Lake.—(*S. Saleh, France.*)
693. DEVICES for CONTROLLING HORSES, J. W. Buckle, London.
694. VERTICAL TUBULAR BOILERS, G. F. Redfern.—(*J. Rainchon, Belgium.*)
695. SPORTING GUNS, G. F. Redfern.—(*L. Lairesse, Belgium.*)
696. GRINDING, &c., ROUND HOLES, &c., R. Peacock, London.
697. BELT or STRAP FASTENERS, J. Scherbel.—(*T. Remus, Saxony.*)
698. WATER WASTE PREVENTER, O. Elphick, London.
699. SELF-RECORDING THERMOMETER, G. A. Biddell, London.
700. ELECTRIC FURNACES for HEATING, &c., S. Z. de Ferranti, London.
701. ELECTRICAL METERS, S. Z. de Ferranti, London.
702. DYNAMO-ELECTRICAL MACHINES, S. Z. de Ferranti, London.
703. BOTTLES, &c., S. Holman, London.

17th January, 1887.

704. COATING SHEETS of IRON, H. Hall, London.
705. LIFTER for RAILS, &c., P. Golightly and J. K. Golightly, Hooley Hill, near Manchester.
706. HAFTING BACON KNIVES, B. Tupholme, Sheffield.
707. DISSOLVING SNOW, B. H. Thwaite, Liverpool.
708. STEAM SCOURING DREDGES, A. Harrison, London.
709. DRIVING and other BANDS, I. Jackson, Manchester.
710. VELOCIPEDES, &c., S. Watts and R. J. Powell, Bath.
711. SEWING HAT LEATHERS to HATS, T. M. Cockroft, Sheffield.
712. PRESERVING VEGETABLE PRODUCTS, J. M. Fletcher, Cheshire.
713. CANDLE SHADE SUPPORT, C. E. Jeffcock, Sheffield.
714. TILTING CASKS, W. H. Haines and W. Little, Birmingham.
715. LETTERPRESS PRINTERS' BLOCKS, R. Sanson, jun., and J. Thomson, Edinburgh.
716. GAUGING the CONTENTS of BARRELS, &c., J. L. Greaves, Bakewell.
717. DISC DYNAMO-ELECTRIC MACHINES, W. B. Sayers, London.
718. TEMPLES for LOOMS, W. Lupton, H. E. Lupton, and J. C. Lupton, Accrington.
719. SEWING MACHINE SHUTTLES, J. Jackson and P. A. Martin, Birmingham.
720. FIXING the RIBS of UMBRELLAS, H. Lane, London.
721. WARP KNITTING MACHINES, J. Berry, Glasgow.
722. STEREOTYPERS' SIZING MACHINE, R. Sanson, jun., and J. Thomson, Edinburgh.
723. SURGICAL DISTENDING PADS, W. Matthews, London.
724. CIRCULAR COMBING MACHINES, C. Bradley and J. Richardson, Bradford.
725. APPLIANCE for TRANSFERRING PHOTOGRAPHIC DRY PLATES into DARK SLIDES, L. T. Merry, London.
726. SOFTENING LEATHER, J. H. Hope, Leicester.
727. ACCORDIONS, &c., A. Lengnick.—(*Messrs. Fiedler and Seidel, Saxony.*)
728. LOCK-CLIP FILE CABINET, A. E. Walker, London.
729. EXTRACTING JUICE from LEMONS, W. P. Thompson.—(*C. Nielson, Denmark.*)
730. CONVERTING MARINE ENGINES into TRIPLE EXPANSION ENGINES, G. Rollo, Liverpool.
731. SHIPS, &c., P. Hanrez, London.
732. HEEL PLATES, A. J. Boult.—(*A. Buckingham, France.*)
733. TELEGRAPH POSTS, F. R. Lipscombe, London.
734. TREATING WOOD with ANTISEPTIC, &c., FLUID, T. Royle, London.
735. TRAMWAY POINTS, W. E. Kenway, London.
736. STRAINING DRAWING PAPER, &c., G. Ledford, London.
737. COLOURING MATTERS, O. Imray.—(*The Farbwerke vormals Meister, Lucius and Brüning, Germany.*)
738. SCREENING ORES, C. D. Abel.—(*A. Klönne, Germany.*)
739. PRESSING FRAME for RACKETS, J. Osmond, London.
740. GENERATING ILLUMINATING GAS, A. Kitson, London.

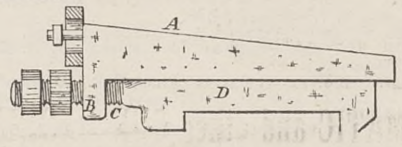
SELECTED AMERICAN PATENTS.

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

351,127. GIB AND KEY, *John H. Robinson, St. Joe, Pa.—Filed May 17th, 1886.*

Claim.—(1) The combination, with the key A, provided with an eye B, upon one edge of its wider end, of the gib D, provided with the threaded shank C, received in the eye B, and provided with nuts *a b*, substantially as herein shown and described. (2) The

351,127

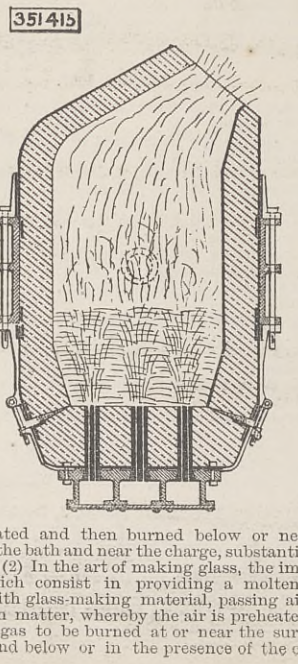


key A, provided with the eye B and the stud *c*, in combination with a gib having a threaded shank passed through the eye of the key and provided with a nut, the slotted bar *d*, and the nut *e* on the stud *c*, substantially as herein shown and described.

351,413. ART OF MAKING GLASS AND VITREOUS OR PORCELANEOUS PRODUCTS, *Jacob T. Wainwright, Allegheny, Pa.—Filed August 20th, 1886.*

Claim.—(1) In the art of making glass, the improvement which consists in providing a molten bath charged with glass-making material, passing air and gaseous or volatile fuel in separate but simultaneous blasts into the molten matter, whereby the air and fuel

351415

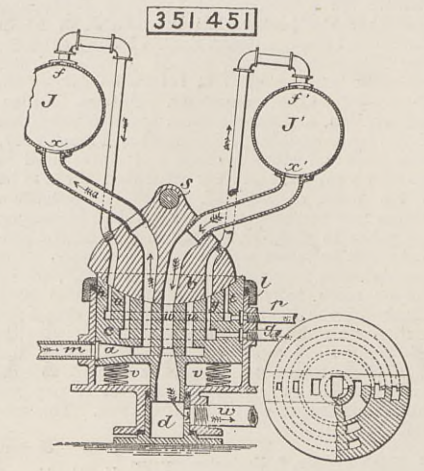


are preheated and then burned below or near the surface of the bath and near the charge, substantially as set forth. (2) In the art of making glass, the improvements which consist in providing a molten bath charged with glass-making material, passing air into this molten matter, whereby the air is preheated, and supplying gas to be burned at or near the surface of the bath and below or in the presence of the charge, substantially as set forth. (3) In the art of making glass, the improvement which consists in providing a molten bath charged with glass-making material, passing gaseous or volatile fuel into the molten matter, whereby this fuel is preheated, and supplying air to produce combustion below or in the presence of the charge, substantially as described.

351,451. SELF-REGULATING BOILER FEEDER, *Charles A. Lockwood, Far Rockaway.—Filed April 1st, 1886.*

Claim.—In a self-regulating automatic trap and boiler feeder, the combination of an oscillating valve having yielding bearings, and provided with steam and water

351 451

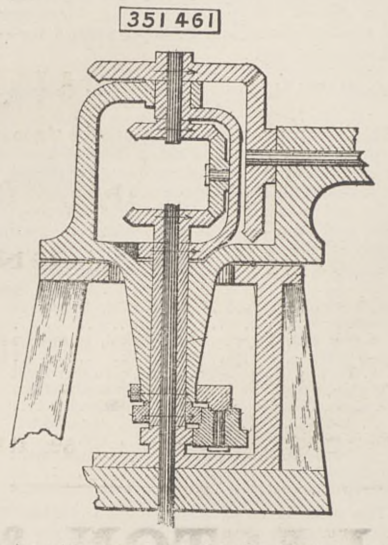


ports, and rigidly connected water chambers located upon tee opposite sides of and above the valve trunnions, with a yielding chest or seat having steam and water ports that register alternately with the inlet and exit passages and with the corresponding ports in the valve, substantially as described.

351,461. GEARING FOR WINDMILLS, *George H. Pattison, Freeport, Ill.—Filed August 3rd, 1886.*

Claim.—In a gearing of the class described, the combination, with a plate adapted to be attached to the tower of a windmill, of a turntable journalled in said plate, a wind-wheel shaft journalled in the turntable, a planet gear revolving with the turntable and

351 461

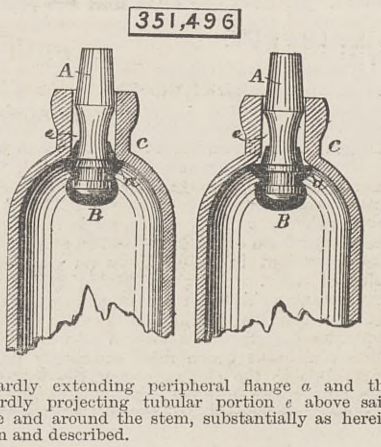


engaging with a gear fastened to the tower, a second planet gear interposed between the wind-wheel shaft and the planet gear revolving with the turntable, gearing connecting the two planet gears, and gearing connecting said second planet gear with the wind-wheel shaft.

351,496. BOTTLE STOPPER, *Joseph Conner, New York, N.Y.—Filed March 13th, 1886.*

Claim.—The internal bottle stopper consisting of the stem A and elastic packing B, which surrounds the lower end of said stem, and which has the flexible

351,496

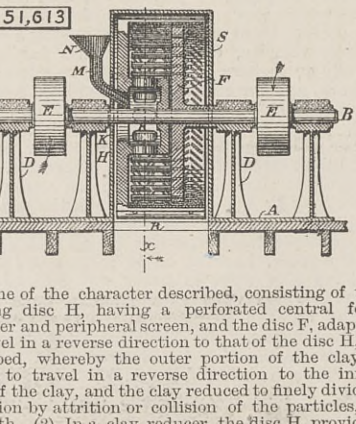


outwardly extending peripheral flange *a* and the upwardly projecting tubular portion *c* above said flange and around the stem, substantially as herein shown and described.

351,613. CLAY REDUCER AND PULVERISER, *James C. Anderson, Highland Park, Ill.—Filed May 25th, 1886.*

Claim.—(1) A clay reducing and disintegrating

351,613

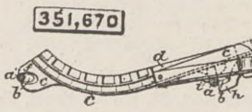


machine of the character described, consisting of the rotating disc H, having a perforated central feed chamber and peripheral screen, and the disc F, adapted to travel in a reverse direction to that of the disc H, as described, whereby the outer portion of the clay is caused to travel in a reverse direction to the inner body of the clay, and the clay reduced to finely divided condition by attrition or collision of the particles, as set forth. (2) In a clay reducer, the disc H, provided with the perforated central hub K, and the peripheral screen O, adapted to travel in one direction, in combination with the disc F, adapted to travel in a direction the reverse of the disc H, the disc F being provided with a series of arms G, arranged close together in the outer edge of said disc, as set forth. (3) In a clay reducer, the disc H, provided with the central perforated chamber K, and the feed spout adapted to project into said chamber, whereby the clay is fed into the central portion of the discs and projected toward the periphery of the disc by centrifugal force, as set forth. (4) In a clay reducer or pulveriser, the disc H, provided with the perforated chamber K, and a screen surface secured to its periphery, which projects over the disc F, as set forth.

351,670. THRASHING MACHINE, *Christian Tostenson, Oswego, N.Y.—Filed January 25th, 1886.*

Claim.—(1) The combination of the metallic concave frames C C, formed with the rearwardly-extended arms *c c*, and with the combined stops and re-enforcing

351,670

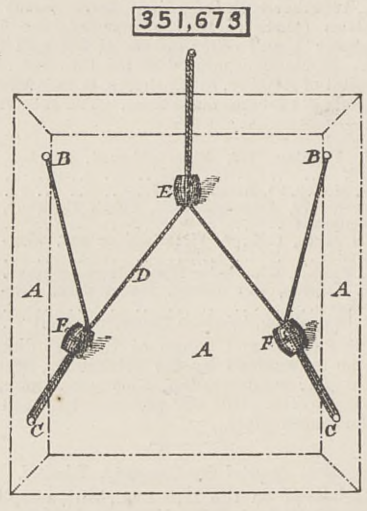


ribs *d d* on said arms, the grate frame A, pivotted on the arms *c c* near their junction with the frames C and under the stops *d d*, and a vertically adjustable support for the rear portion of the frame A, all constructed and combined substantially as described and shown, for the purpose set forth. (2) In combination with the thrashing cylinder and the rock shafts *a a*[1], provided with lugs *b b*, the metallic concave frames C C, formed with the hooks *e* and guards *f* at the front, and with the rearwardly-extended arms *c c*, and pivotted at the extremities of said arms, and the grate frame A, pivotted on the arms *c c* at their junction with the concave frames, and formed with the hooks *h* and guards *i*, all constructed and combined to positively adjust the grate at either end, substantially in the manner specified and shown.

351,673. DEVICE FOR HANGING PICTURE FRAMES, &c., *Henry Vosburgh, Allegan, Mich.—Filed June 1st, 1886.*

Claim.—The combination, with a picture or other frame A, of the pins B C, secured to the back thereof,

351,673

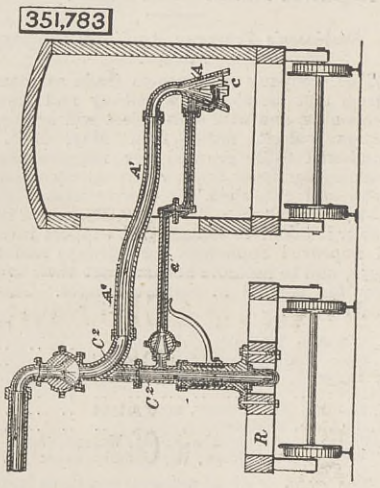


the cord D, secured to the upper pins or nails B, and passing under and upward between the lower pins C, and the perforated slides E F F, arranged to be moved over the loops of the cord to adjust the said frame, substantially as described.

351,783. PNEUMATIC APPARATUS FOR TRANSFERRING GRAIN, *Joseph Lewis, South Evanston, Ill.—Filed February 13th, 1886.*

Claim.—The combination, in a pneumatic grain transfer apparatus, of the grain pipe A^6 A^7 and nozzle A, made of metal and connected by flexible joints, as set forth, with the air pipe C *c* and its flexible or hose connections C^{10}, substantially as specified. The combination, with the post, of the grain pipe A^6 A^7 pivotted to the post at A^{10}, and the hose section A^9,

351,783



connecting said pipe to the discharge pipe, substantially as specified. The combination, with the car R, of the post supporting both grain and air pipes, as set forth, and an air compressing engine connected to said air pipes, substantially as specified. The combination, with a rotative post, of the globe jointed discharge conduit, substantially as specified. The post C^2, the grain feed pipe, and the grain discharge pipe communicating with said feed pipe and joined to the post by a globe joint, in combination with blast producing apparatus, substantially as specified.