LABOUR IN EUROPE.

No. I.

THE standing instructions of the United States Government to its agents in foreign countries call for periodical information on all matters of commercial and public interest. In addition to the general subjects upon which the consular and diplomatic officials are expected to inquire and report, at times special instructions are given to them concerning matters of distinct importance. Of the special questions, that of labour and wages is most important, since an understanding of the conditions of the existing relation of labour and wages to capital in other countries is necessary to form a correct judgment upon questions affecting both the working classes and those who employ them.

The importance of gaining such knowledge of the labour conditions of other countries was early recognised, and a compilation of the reports of the several consuls was presented to Congress in 1879. This compilation, though the inquiries upon which it was based were of a limited nature, proved a valuable contribution to statistical knowledge. Its publication attracted much attention, and frequent demands have been made since for the periodical collection and publication of similar information. These demands resulted, in 1884, in the creation of a new administrative office, called the Bureau of Labour. Its duties are to collect information on the subject of labour, its hours, its relation to capital, and the earnings of both men and women. A part of these duties had been anticipated by the Department of States issuing a circular to the consular officers in foreign countries, directing them to obtain and transmit the necessary information concerning the conditions of labour and wages in their respective districts. It is much to be regretted that there are no means in England of obtaining similar information. It is true that the consuls in various foreign countries are expected to furnish reports on matters of interest, but as these are not done upon any system, we have to depend for our knowledge upon the reports of private inquirers or upon those of the United States consular officers. These latter are admirable, and worthy of imitation. An inquiry into the conditions of labour and wages in foreign countries, to be of any value, must be carried on simultaneously in all the countries by responsible agents. From the great expense, the difficulty of obtaining trustworthy reports, &c., few private inquirers are in a position to undertake the subject with any chance of success, and should they be successful, the results of their inquiries are published at a price that is virtually prohibitive. The collection and publication of periodical statistics as to the economic and social conditions of foreign countries can be only done properly by the Government, or some society to whom cost is no object. The necessity for the information is daily becoming greater, and in a short time the attention of Parliament will be called to it, and the establishment of an office similar to that recently erected in the United States proposed. The expense would not be great, the most part of the requisite machinery being in existence in the persons of the numerous consuls and agents abroad.

At the present time, when there is so much depression of trade and so many conflicting theories as to the causes of it, there is the greatest want of a book giving the conditions of the working classes in the various countries of the world in a concise and popular form, and containing the facts only, being free from speculations and theories, and above all published at such a low price as to be within the reach of the masses. Such a work is the Reports from the consuls of the United States in relation to the state of labour in Europe. In a little fewer than 200 pages it contains full information as to rates of wages, hours of labour, cost of food, clothing, rent, and social conditions of the people generally in Austria, Belgium, France, Germany, Great Britain, Holland, Italy, Portugal, Russia, Switzerland, and Turkey. In the reports from the various countries there is much difference. Though the same instructions were issued to all concerned in the inquiry, the reports are not of a uniform length or nature. The same features are variously dealt with. Some reports give greater prominence than others to particular trades, others deal more with the cost of living, others with the relations between employers and employed. They literally bristle with figures and tables, and may be safely pronounced to be the most valuable contributions towards a knowledge of the facts of the labour question that has ever appeared, and it should be in the hands of all engaged in industrial occupations or in any way interested in the matter. There has been issued a companion volume, entitled "History of Trade Guilds in Europe," dealing with the questions relating to organisations of labour in Europe, their history and present state, apprenticeship, trades unions, technical education, and all conditions and regulations relating to trade. Though not so interesting as the labour report, it is equally valuable. The two works together contain almost everything on the subject which they profess to treat of that is or can be known. The first-named work is interesting to the general reader, the latter is rather heavier reading, consisting chiefly of information on technical subjects. Those interested in economic and labour statistics should read both the works, while the casual or general reader will find in the latter work much that is profitable in the consular reports, from Leipsic, in the history of trade guilds; from Genoa, on the trade economy in that town; from Venice, on the trade guilds of the province; and from St. Petersburg on the Russian Artils, or associative labouring societies. That these works are hardly known in England may seem surprising. It may be partly due to the system under which the books of the United States Government, answering in description to our Blue Books, are published. They are neither advertised nor sold, only exchanged for the similar works of foreign Governments, and presented to certain institutions and museums. The consequence is that in the country of their origin the valuable information that they often contain is practically buried, while here their existence is unknown, except from casual references to them in newspapers and periodicals, and even a complete list of the more modern ones can only be obtained with the greatest difficulty.

A perusal of the labour report will prove to any impartial reader that, whatever may be the conditions of the labouring classes of Great Britain, it is much superior to that prevailing in many if not in all the continental nations. In some countries the artisan receives less than half the wages per hour that he obtains in England, while the number of hours he works are longer by 50 per cent., the cost of what he considers the necessaries of life being equal if not greater. The foreign artisan contrives to live upon much lower wages than the British, because he lives in a different manner. The cost of the necessaries of life, according to our idea, do not show anything in the foreign artisan's favour, as will be seen by the table of prices of food in Europe at the conclusion of this article. But in many countries he hardly ever uses any of them. The daily cost to the Italian workman is estimated at 8½d., made up as follows:—Coffee or liquor, 0½d.; bread, 2½d.; salted pork or fish, 1d.; cheese or fruit, 1d.; maccaroni, 1½d.; beans, cabbage, or other greens, 0½d.; wine (one pint), 1½d.; total, 8½d. This diet is suitable to the climate, and is plentiful, much of it, especially vegetables, being within reach of the poorest. But again the Russian artisan, who lives in a very severe climate, and requires food approaching nearer to the English standard, pays for food on an average 5d. a day, or nearly only one-half of the above. This would seem to point to a very low price of the necessaries of life in Russia.

There is an advantage to the continental workman in rent, it generally being lower than in England. One cause of the lowness of wages abroad is the great quantity of female labour. In some countries there are as many females as males working in mines, factories, &c., for as many hours, doing as much work, but receiving only half the wages of males.

Into the important question of the relative value of the work done in various countries the report does not enter, confining itself strictly to conditions and facts. It would be interesting to know, for instance, if a German mechanic receives two-fifths only of the wages of an English one, what are the proportions of the amount and value of the work done in each case. "There are certain artificial and natural conditions which so generally affect the direct conditions of wages as to be entitled to consideration in any analytical examination of the conditions of labour, but from their abstruseness they are less evident to the general mind than the simple relations shown in the reports from the various districts."

Germany.—The German labourer excels in perseverance, patience under the most trying circumstances, industry, and economy. These virtues enable him to sustain existence in his own land on very low wages, and to accomplish the greatest results in almost every field of labour. The relations between employer and employed, though in some districts pretty good, are, on the whole, violently antagonistic. But the entire labour conditions of Germany are in a transition state. In addition to the system of universal military service, socialism, and trades unions, the industry of Germany is affected by the laws concerning it being continually changed, and consequently the regulations and rules of industrial organisations have to be constantly altered. On the establishment of the Empire a general trade law was passed, and all the old regulations upon industries and their exercise abolished. By the legislation since, some of the old restrictions have been restored. Guilds are permitted, and have recovered some of their ancient privileges relating to trade control, and though membership of these bodies is purely voluntary, attempts are being made to render it compulsory by prohibiting any master who does not belong to a guild from taking apprentices. Strict attention is paid to the subject of raising the education of the artisan, so as to enable him to compete with foreign workmanship. Apprentices are encouraged, and in some States compelled to attend the schools for further instruction which are held in the evenings and on Sunday mornings. The fees paid in these schools are low, and a certain proportion of the pupils are admitted free, especially those who left their primary school with a testimonial of proficiency in their studies. In some trades an apprentice before becoming a journeyman has to pass an examination before the elders of the trade guild, and upon failure he may be sent back to serve a further period until qualified. The results of these efforts at improvement are daily becoming more visible. In the last few years the German artisans have made great advances, and in some articles in which other countries excelled they now take the lead. Wages vary much in the different parts of the Empire. They are highest in Alsace-Lorraine, where a mechanic receives for a week of sixty hours 24s. 5d., and lowest in Silesia, being not two-thirds of that amount. In Hesse a nailmaker, with the assistance of his wife and children, and by working from five in the morning until eight in the evening, can earn from 10d. to 1s. 2d. a day. An important factor in the labour question of Germany is that of the labour dogs. The principal part of the haulage of the country is done by women and dogs harnessed together. Women do much of the manual labour, even in mining and foundry work. In some parts they accompany the coal carts through the cities, and put the coal in the cellars while the male driver sits on the seat. Their wages average about one-half those of men. The effects of such a life is not favourable to the development of domestic qualities, and the housekeeping of the working classes is of a most primitive kind. The Germans are a labouring people in the strictest sense of the term, lead a frugal life, and are inadequately remunerated.

Average Wages Paid per Week of Seventy-two Hours in Ironworks in Upper Silesia.

	s.	d.
Forgeman and first puddler	22	6
Welder and hammerman	18	9
Puddlers and shearers	15	9
Shearmen, smiths, and firemen	12	9
Unskilled workmen and boys	10	3
Labourers	4	3

Average Wages Paid per Week of Sixty-three Hours in Ironworks and Machine Shops in Barmen.

	s.	d.
Machinists	20	10
Locksmiths	17	5
Blacksmiths	17	5
Turners	17	10
Planers	16	0
Drillers	14	5
Model-makers	20	10
Strikers	15	10
Mechanics	25	4

Average Wages Paid per Week of Sixty Hours in Foundries, Ironworks, and Machine Shops in Bremen.

	s.	d.
Engineers and moulders	17	10
Foremen boiler-makers	27	9
Blacksmiths, strikers, and turners	17	10
Apprentices	7	4
Labourers	13	11

Average Wages Paid per Week of Sixty-six Hours in Foundries, Ironworks, and Machine Shops in Thuringia.

	s.	d.
Foundries:		
Casters	14	2
Moulders	12	6
Labourers	9	5
Machine shops:		
Locksmiths and turners	13	8
Boiler-smiths	13	2
Blacksmiths	12	6
Welders	12	4
Machine-builders	12	6
Engineers	15	5
Apprentices	8	3
Labourers	9	2

In the iron and steel works in Rhineland and Westphalia mechanics earn on an average 17s. 3d. a week. In his establishment at Essen Mr. Krupp gives the average wages paid per day to his mechanics at 2s. 6d.

Average Wages Paid per Week of from Sixty to Seventy-two Hours in Mines in Silesia.

	Coal.		Iron.		Zinc and lead.	
	s.	d.	s.	d.	s.	d.
Miners	8	8	10	5	10	0
Labourers	*8	9	7	8	8	3
Women	4	7	4	1	4	6
Boys	3	11	4	1	4	6

* Outside labourers in coal-mines.

Average Wages Paid per Month in Mines in the District of Barmen.

	£	s.	d.
Colliers:			
Underground, eight hours a day	6	6	6
Hewer, first-class, eight hours a day	5	4	2
,, second-class ,, ,,	4	1	10
Labourer, twelve hours a day	2	16	6
Woman (in lead and silver mines), twelve hours a day	2	0	2
Boy, ten hours a day	1	11	9

Average Wages Paid per Week of Sixty Hours in Shipyards.

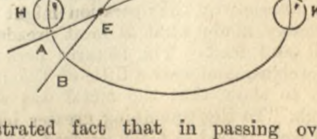
	Bremen.		Stettin.	
Iron shipbuilding:	s	d.	s.	d.
Foremen	28	9	—	
Iron finishers	24	10	16	7
Planers and turners	27	9	14	5
Rivetters	27	9	15	5
Blacksmiths	27	9	18	6
Strikers	17	10	—	
Brass-fitters	22	6	16	7
Painters	16	1	12	11

THE ROYAL INSTITUTION.

THE GREAT ICE AGE.

ON Saturday, January 23rd last, Professor R. S. Ball, LL.D., Astronomer Royal of Ireland, closed his series of three lectures "On the Great Ice Age," of which the following is a summary. He began by exhibiting some stones scratched and furrowed by glacial action, found in the boulder clay of Clew Bay, Ireland, and said that the markings were analogous to cuneiform writing, for they were indentations which scientific men had interpreted by long and assiduous research. At some prehistoric period, all the United Kingdom, and a great part of the Northern hemisphere, had been covered with ice hundreds of feet thick, having a slow motion of its own as possessed by present Alpine glaciers. Every square inch of a column of ice 500ft. high would exert a pressure of 200 lb. to the square inch upon the soil beneath—a pressure as great as that inside the boiler of an express engine. In its slow motion it crushed some of the rock beneath to powder, and scratched and furrowed other pieces, to form beds of clay and stones like those at Clew Bay. The presence of these continents of ice implied great heat at another part of the world, for unless heat evaporated water at one place, it could not fall at another as rain and snow, to form glaciers. Alpine glaciers are small as compared with those of the great ice age, but at present the Southern hemisphere is passing through a sub-glacial epoch; in such epochs, great and small, but one pole of the earth is affected at one time, and both poles have experienced not one, but several, great ice ages, between which a temperate climate has prevailed, as indicated by geological strata.

After setting forth that changes in the earth's axis, changes in solar heat, and changes in temperature caused by an assumed occasional nearness of other suns, are in his belief untenable as explanatory of the great glacial epochs, he said that the perturbations set up by other planets, especially Venus, Mars, and Jupiter, cause variations of the ellipse in which the earth travels round the sun. He also stated the laws by which the length of that ellipse never varies, and the sun is always in one of the foci of the ellipse. The perturbations cause the ellipse to vary in breadth, so that it has a kind of breathing motion, but extending over vast lengths of time. At present the orbit of the earth is so little elliptical, that a diagram of it would be thought to be a circle unless it were measured. Assuming, however, that its ellipticity were now large, the position of affairs may be explained by the accompanying diagram. In this diagram assume E to represent the sun, H the summer position of the North Pole of the earth when the earth is moving in an elliptical orbit, and K its winter position; the black spot marked on the earth indicates the North Pole. It is a mathematically demonstrated fact that in passing over the portion of the orbit to the left of the line B C, the



earth would receive as much heat as when passing over the greater length of orbit to the right of that line. The same holds good with the lengths of orbit to the right and left of the line A D, or any other straight line drawn through the sun and orbit. Also, in passing from A to B it receives as much heat as when passing from C to D, but its velocity of motion is much greater the nearer it is to the sun. Under these conditions the heat of the North Pole is intense during the short summer, and the cold of that Pole equally intense during the long winter; in fact, then giving a sufficiently low temperature to account for a glacial epoch. But, said the lecturer, the objection has been raised that as the earth receives the same amount of heat in all during its short summer as it does during its long winter, these two conditions should balance each other, and keep up an equable temperature. The reply, he said, is, that its motion being so much slower in the winter, it receives that same amount of heat in a different way. For instance, if a horse wanted 30 lb. of food a day, but received 40 lb. a day during one part of the year and 20 lb. a day during the other part, he would feel that in the latter part of the year he was passing through a glacial epoch, and that its extra length was no compensation. Taking these facts into consideration, also the precession of the equinoxes, it seems that the southern and northern hemispheres pass alternately through glacial epochs, and that it takes 13,000 years, which is nothing in astronomy, to transfer the maximum of glaciation from one pole to the other. In causing perturbations of the earth, Jupiter being so far off exercises an attraction half that of Venus. Even the host of little planets between Mars and Jupiter have each a trifling influence; the smallest of them gives a pull strong enough to break a chain cable like that over the Brooklyn Suspension Bridge. Sirius, one of the nearest of the fixed stars, exercises a strain of perhaps 7 or 8 tons, but Venus, Mars, and Jupiter are exceedingly potent agents. These planets, by setting up glacial periods, once ground down and mixed the boulder clay, which men have since dug up and burnt into bricks to build the mighty city of London.

THE WAVE THEORY OF LIGHT.

On Friday, January 22nd, Professor Tyndall delivered a lecture on "Thomas Young, and the Wave Theory." It was largely a digest of Peacock's "Life of Young." Sir W. Bowman presided. Among the listeners were the Earl of Rosse, Earl Percy, and some of the leading men of science of the day. Young, it was stated, was a Quaker, and a man of good conversational powers, although he never became so popular as a public lecturer as his successors at the Royal Institution, Davy and Faraday. He did not originate the wave theory of light, but did much to establish it, in the face of the opposition of such high authorities as Newton and Lord Brougham. Young was the first to divulge the philosophy of the causes of the colours of mother-of-pearl, and other striated surfaces. He officiated at the Royal Institution at the beginning of the present century.

IMPURITIES IN METALS.

On Thursday, January 28th last, Mr. W. Chandler Roberts-Austen, F.R.S., Chemist of the Mint, delivered the first of four lectures upon "Metals as Affected by Small Quantities of Impurity." He said that metallurgy has to deal at once with large masses and with small particles, for the influence of the latter upon the former is out of all proportion to their relative quantities, and their action may be chemical, or physical, or both. Minute impurities in metallic copper would render, he said, ocean telegraphy impossible. Geber proved that the "cry" of tin, or the noise which it makes when bent, can be removed by purification. Arsenic in the most minute proportion will restore the cry of tin, and its action in this respect has been known at least since the third century of our era; arsenic makes tin as brittle as zinc. The fact that such small proportions of foreign matter so alter the character of metals, tended more than anything else to confirm the alchemists in the doctrine of transmutation, and encouraged them in their attempts to make gold by artificial means. A little arsenic in melted lead will make it more fluid, so that when poured down an inclined plane, say, of white paper, the lead will roll itself into small shot; with the arsenic absent, it will merely chill in a black streak upon the paper. The speaker proved this by experiment, and invited attention to the following figures:—

Analysis of Lead Shot.

Lead, with small quantities of antimony, iron, &c.	99·72
Copper..	0·16
Arsenic	0·12
	100·00

This proves what a very small proportion of arsenic is necessary to produce the effect.

Zinc, said the lecturer, melts at 412 deg. C., and standard gold at about 900 deg. C., but if less than 0·2 per cent. of silica be added to gold, it will soften in the flame of a candle. This was demonstrated by experiment. A trace of antimony in melted lead will cause it to oxidise on the surface much more rapidly than would otherwise be the case, and by stirring the mass it is soon transformed into a kind of pasty oxide. Cadmium also promotes the oxidation of pure melted lead, and that too with a play of the most beautiful colours. Mr. Roberts-Austen proved this by illuminating the surface of the melted alloy with a beam of parallel rays from the electric lantern, and projecting upon the screen an image of the surface of the molten mass; as the films of oxide formed they were removed with a little scraper, to make way for fresh surfaces, having somewhat the colours of shot silks. He stated that it may not be generally known that copper can be gilt as well by the application of an alloy of lead and gold to its surface, as it can by an amalgam of mercury and gold. On the application of heat the copper absorbs the lead, and the gold is left on the surface. This process is recorded in a papyrus of the third century, now preserved at Leyden.

The alchemists, he said, through several successive generations down to the year 1746, authoritatively taught it to be a fact that all metals were composed of mercury and sulphur combined in different ways, and those of them who claimed to have made gold, almost invariably said that they had done so "by the aid of a powder received from a stranger." Dr. James Price, of Guildford, a Fellow of the Royal Society, was the last of the alchemists who believed in the transmutation of the baser metals into gold; he lived in the eighteenth century. Raymond Lully was confined in the Tower by one of the English kings, in order that he might make gold for the Mint.

Even the illustrious Robert Boyle believed in the transmutation of metals, because in the usual orthodox way he had "received from a stranger" a powder which would change 1000 times its weight of gold into a baser substance, and he did not see why the operation might not be reversed. He had probably made what is most dreaded at the Mint, an alloy of gold and lead. The lecturer here melted down one hundred sovereigns, and cast a little of the molten metal into a small bar, to show that the metal was strong and malleable, and tough. To the remaining greater bulk of the molten gold he, however, added a trace of lead, and cast the mixture into a large thick bar, which when almost cold, and when held in the palm of the hand, broke into pieces upon being tapped with a hammer. A small trace of lead, he said, will reduce the breaking strain of gold from 20 tons to the square inch to 5 tons, as indicated by a testing machine.

He then stated that palladium will absorb 900 times its volume of hydrogen gas, and give it out again when heated. A remarkable discovery has recently been made in France, that an alloy of rhodium and lead will absorb nitrogen and oxygen, and when heated give them off, as gun-cotton does, with explosive violence. He placed a small piece of rhodium, containing 17 per cent. of lead, in a tube, and next withdrew the air from the tube by means of the Sprengel pump. The heat of a spirit flame was then applied to the end of the tube containing the piece of rhodium and lead, and the alloy broke up with a small explosion, filling the end of the tube with metallic dust. The gases liberated were chiefly the same as those given off by ignited gun-cotton.

PETROLEUM LAMPS.

In many homes—even in those of the well-to-do—gas is supplanted by the petroleum, or, as it is very commonly, however erroneously, designated "paraffine" lamp. Petroleum has been truly termed the poor man's light. Improved methods of refining, and more perfectly developed sources of supply and means of transport, have jointly rendered it a cheap and convenient source of domestic light, as well as as safe a one, on the whole, as gas. It has also to the poor the distinguished advantage over the latter that it is paid for in detail, or just as it is used; it is therefore divested of the evils of the credit system attending on the use of gas. In using the latter, the consumer is periodically called upon to pay a more or less heavy lump sum, the call being sometimes made at a very inopportune time for the poor debtor. A supply of petroleum, on the other hand, may be purchased for as small a sum as twopence at a time. The commodity, however, depends greatly for its usefulness upon the lamp provided for its consumption; and concerning lamps, it must be said that far more attention has been bestowed by those engaged upon their manufacture to make them beautiful than calculated to render them efficient light producers. We are willing to admit that the difficulties attending the designing of a thoroughly good lamp are not easy to overcome, but that they are insurmountable has not yet been proved.

One chief drawback is the frequency with which the reservoir has to be replenished; the oil chambers are usually so roughly proportioned to the size of the burner as to yield some ten hours' light before they are quite emptied. No reasonable fault can be found with this, and some of the larger lamps contain as much as a twelve or fourteen-hour supply, theoretically. Practically, however, not more than half this, even of the very best, petroleum can be burned, if the full lighting power of the burner is needed—and when is it not? After burning some time the flame becomes reduced in size and brilliancy, the reduction taking place in a time short in proportion to the inferiority of the oil. The cause is not far to seek, the failure of the flame is due to insufficient supply of fuel, owing to the increased height which it has to rise to reach the flame. In fact, it may be said that, if the distance between the surface of the oil and the foot of the flame exceeds 3in., the maximum power of the burner will not be secured. Of course a lamp will yield light, and tolerably good light, at a greater distance; but we repeat, not its maximum light. In order to attempt improvement with any prospect of success, it is necessary first to study the conditions present in the problem to be solved. A wick of a certain size must of necessity have a proportionate air supply, and this must reach the flame between its foot and the cover of the reservoir; at least, such seems the assumption of all existing lamp makers. How far it is justified we shall see presently. Judging by all existing lamps, it seems that a certain length of pipe or wick casing is considered necessary to preclude any danger of the heat of the lamp reaching the petroleum in the reservoir in a degree high enough to cause explosion —a very prudent precaution certainly; but here, also, we may observe that the necessity for the great length of pipe present in large lamps has not been proved. To this also we shall presently return.

Supposing the maximum distance between flame and fuel to be determined, then if the lamp is to be drained before requiring a fresh supply, evidently the bottom of the lamp, and not, as is now generally the case, some point about half-way down the reservoir, is the distance or space available for air space and fuel; we say nothing of wick pipe, because it will stand within the air space. Now the object aimed at, or which should be aimed at, is the production of a lamp that will burn some considerable number of hours without replenishing. Some standard of duration, however, must be fixed, and it must be a real, not an imaginary one, as is the case at present where the capacity of a reservoir which is never emptied is the nominal standard. If the vertical space at command is restricted, so also are its lateral dimensions, owing to the shadow thrown by the reservoir, and the extent of this shadow is, of course, measured by the distance apart of two lines drawn from the centre of the flame and produced tangentially past the diametrical points on the reservoir or to the table.

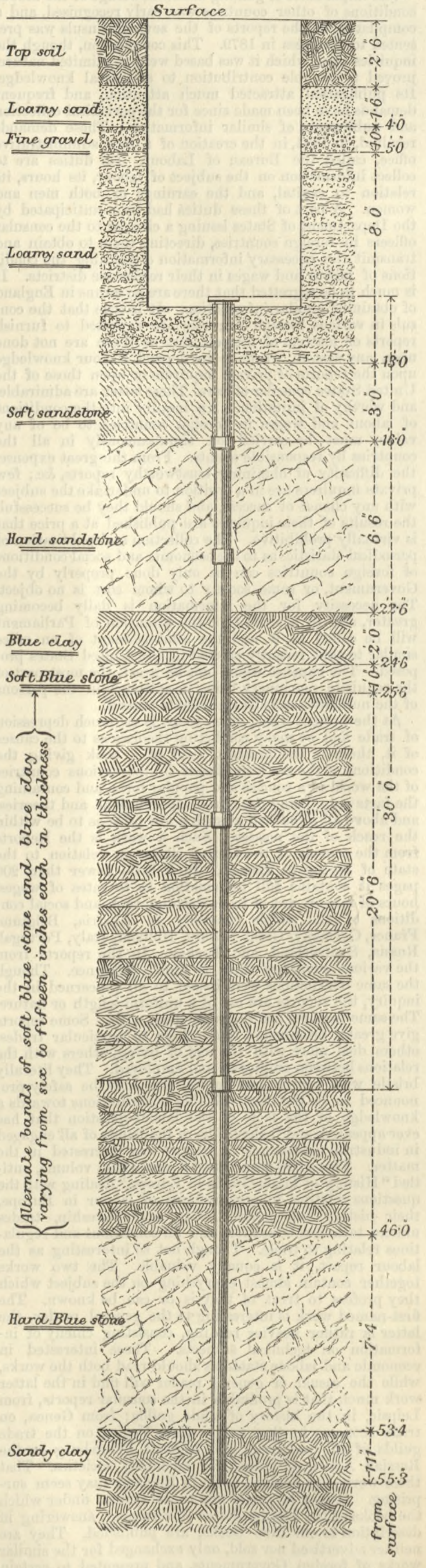
We will now return to the assumption that all the air supply must reach the flame above the reservoir. We, with great respect for practical lamp makers, would ask why no attempts have been made to convey air up through a central pipe fixed in the middle of the reservoir to the flame? We leave the suggestive query to lamp makers to consider, contenting ourselves with observing that the method may probably be found to facilitate considerably the reduction of distance between flame and fuel—admitting, however, that in proportion as the flame is brought near the reservoir, so also is the shadow enlarged; but then, if transparent glass receivers are used, its intensity will be almost totally done away with, while the evils of bulk and top-heaviness attendant upon very shallow receivers of large diameter may be reduced, and also, coming to the short wick pipe danger, the central air pipe would have a sensible effect in keeping the receiver and its contents cool, and thus counteracting the supposed danger due to the use of such a pipe. In any case, the danger of a short pipe cannot be ascribed to its high temperature acting on the oil, because there is always an air space between the two, and if the oil be of the legally low-flashing point, no danger need be apprehended.

A prize might well be offered for a petroleum lamp whose overthrow, whether by accident or when used as a missile while alight, shall be least likely to prove the origin of a fire. *Apropos* also of this subject, we would point out that one element of safety lies ready to the hands of lamp makers, viz., the filling up of at least half the capacity of all the reservoirs of the lamps they now have in stock with some light incombustible material; the oil usually in such places is never burned in any other way than when set alight in the manner we have just indicated, and therefore better that it should be conspicuous by its absence by excluding the petroleum from access to the incombustible substance, under ordinary circumstances; but arranging that in case of overthrow it could serve to absorb and keep in tolerably safe custody a portion, at least, of the petroleum at present free to flow flaming over and between the boards of the flooring. Thus at once, space at present only forming a magazine of combustible stuff, to the common danger, would be converted into a tolerable source of safety.

WATER SUPPLY OF SMALL TOWNS.

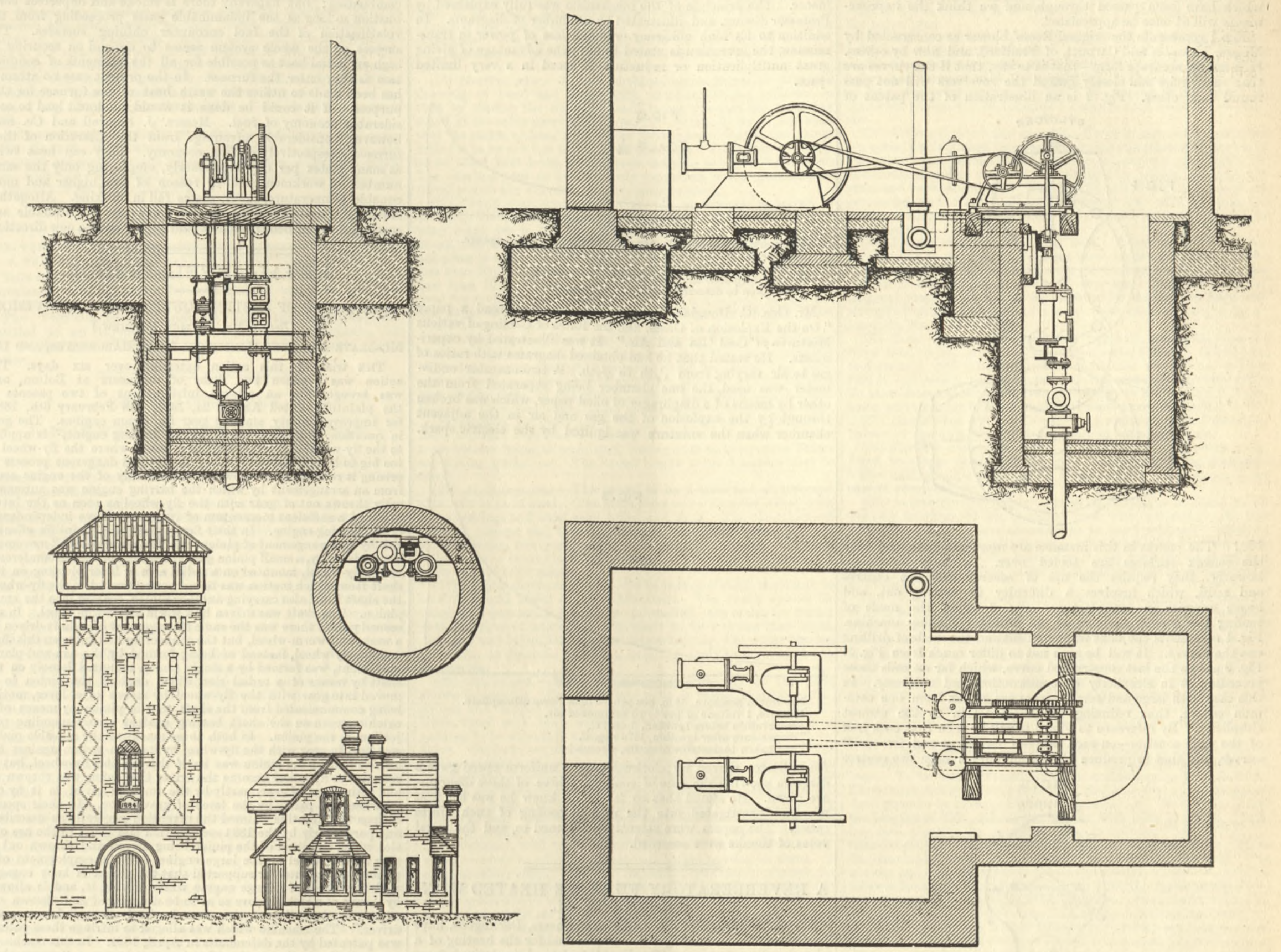
WALLINGFORD.

For some years past the Corporation of Wallingford, Berks, had under consideration, or caused other people to consider for them, the establishment of an improved water supply for the



town, which was dependent almost exclusively upon shallow wells or land springs. Mr. W. A. Ripley, of Bracknell, Berks, was consulted as to the most practicable scheme, and a gravitation system being quite out of the question by reason of its great cost, he determined to ascertain whether a supply could not be economically obtained upon the spot. Accordingly in December,

THE WATER SUPPLY OF WALLINGFORD.



1883, Mr. Ripley instructed Messrs. Le Grand and Sutcliff, of Bunhill-row, London—who had recently procured an abundant supply of water for the Moulsford County Asylum in the adjoining parish—to sink one of their artesian bored tube wells. The site selected is a field adjoining the railway station and gas-works just outside the town, where the upper greensand formation outcrops. This tube well consists of an outer tube or cylinder 8½in. internal diameter, carried down to a depth of 16ft. as an extra precaution to exclude all surface water, and then the well tube proper was tightly driven through sundry beds of clay and soft stone to the depth of 40ft., below which the boring was continued into the denser beds of stone to the total depth of 58ft., as shown in the accompanying section of strata which has been sent us. In these lower beds an ample supply of water was found which rose to within a few feet of the surface, and which upon analysis proved pure in quality and suitable for domestic purposes. A trial pump was applied to the tube well, and run for seventy consecutive hours at the rate of 6000 gallons per hour, without making any appreciable effect upon the head of the water. The existence of a copious supply being so far satisfactorily ascertained, the next step was the sinking of a dry pump pit, 10ft. 9in. deep, 6ft. diameter, constructed of brickwork set in cement, and encased with puddled clay, with a bottom of alternate layers of concrete and cement; and upon its completion the upper tubes of the tube-well were removed and a stop-valve put on to keep the water from overflowing into the pump-pit. A water tower, of which an illustration is given, was built by Messrs. Brasher and Son, of Wallingford, the total height of which from the ground line to the top ridge is 58ft. The brickwork reaches to the height of 45ft., upon which is fixed the cast iron tank 6ft. deep, 21ft. square, capable of holding 15,000 gallons, and this is surmounted by an ornamental tiled roof. A small building extending to the rear of the tower, as shown in the plan, forms the well-house, while the base of the tower constitutes the engine-room. The pumps, consisting of two 6in. ram plungers 18in. stroke, and capable of raising 6600 gallons per hour through a 6in. rising main deliver to the top of the tank 50ft. above the surface. These were supplied and fixed by Mr. S. Griffith, the Railway Foundry, Reading, who also furnished the two 6-horse power Otto gas engines, one of which easily works the pumps while the other is a lay by. Thus, in case of need, they could be worked day and night, and raise over 150,000 gallons in twenty-four hours. The consumption of gas to raise 6600 gallons in an hour is 135 cubic feet, which at the high figure of 5s. 5d. per 1000 cubic feet, charged by the local gas company, only comes to 1·33d. per 1000 gallons of water raised.

Taken as a whole these waterworks may be considered unique, the supply of water being obtained by Le Grand and Sutcliff's tube well system, dispensing with the usual costly shaft, while the introduction of gas engines as the motive power does away with the boilers, boiler-house, and chimney shaft, and secures a very cleanly appearance of the place in the absence of all coals and dirt. The trifling amount of attendance needed for the engine reduces the cost under this head to a minimum. The total cost of the artesian tube well, pumps, engines, and tower, including the cottage for the attendant and the boundary walls, amounts to but £2850. The cost of providing and laying the street mains, hydrants, valves, standposts, &c., was £1450, Messrs. Evans Brothers, of Wolverhampton, being the contractors, making the total cost of the whole scheme £4300. Thus it will be seen that where a supply of water is obtainable within a reasonable distance below the surface, it is within the reach of very small communities. Pumping for the supply of the town was commenced in April last, since which time everything has worked satisfactorily, while as to the supply of water, it may be mentioned there has not been the least sign of falling off notwithstanding the exceptional dryness of the last summer. The population of Wallingford is about 3000, and the rateable value about £10,000, so the water supply works need a comparatively small rate to pay for them.

ROOTS' IMPROVEMENTS IN BLOWERS AND PUMPS.

THE Roots' blower now being a well-known machine in this country, though of American origin, some account of its career may be interesting to our readers. It consists of two revolving vanes or abutments geared together so as to keep up constant contact with each other, and with the internal periphery of a pair of half cylinders. Its success is well-known—so much so,

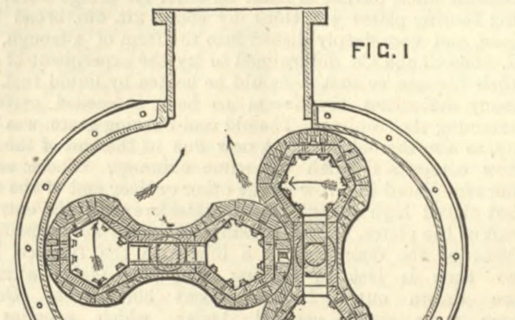


FIG. 1

that the Roots' blower is as much an article of commerce in the machinery world as is a portable engine or a screw-cutting lathe. The blower, as originally constructed, consisted of two vanes or abutments of a form not unlike the figure eight, revolving around each other, their relative positions being determined by wheel gearing. This form, though not scientifically correct, was sufficiently so to ensure an approximate contact when made of wood, and hence it formed an efficient machine for a cold blast; but when used, as is now frequently the case, for exhausting hot gases, it became necessary that the revolvers be formed of iron. Then a difficulty arose as to the form of revolvers, as if made accurately to a semicircle they would not pass round each other, the curves not being of the correct form, and besides that, it necessitated that the whole of the surfaces of both revolvers should be swept over by a tool, rendering the formation a very expensive process.

This want of scientific accuracy in the original form led Mr. Roots to improvements, and fresh patents were taken out in 1881 and 1882, and again in 1885. We will now shortly notice the four patents, which will possibly be the simplest way of

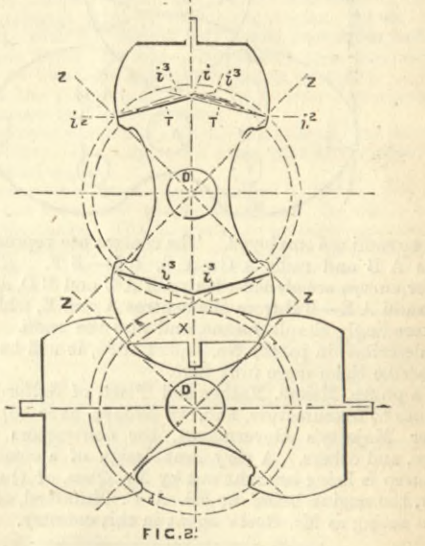
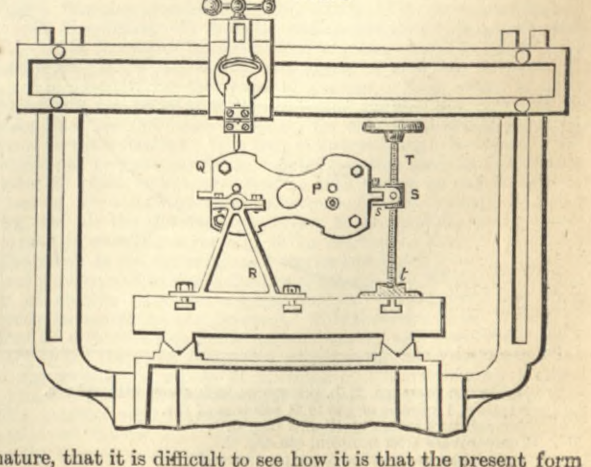


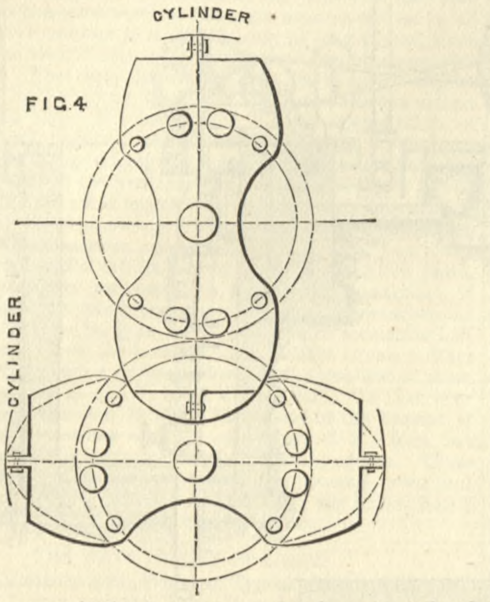
FIG. 2.

pointing out the various improvements which have led to the 1885 patent. This last seems to have reduced the difficulties of construction and manufacture so much, and is of so simple a

FIG. 3


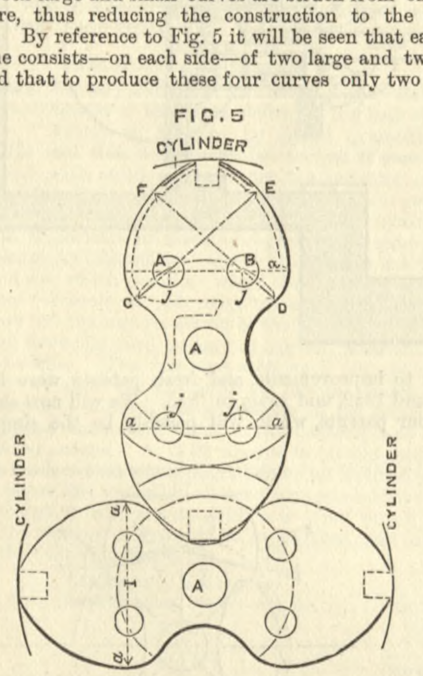
nature, that it is difficult to see how it is that the present form should not have been the one originally adopted. That years of labour and numerous experiments have been expended is another illustration of the fact that even in the design of mechanical tools perfection is only attainable by perseverance and thought. Our illustrations clearly show the various stages which have been passed through, and we think the improvements will at once be appreciated.

Fig. 1 represents the original Roots' blower as constructed by Messrs. Thwaites and Carbutt, of Bradford, and now by others. It is not an accurate form—that is to say, that if the curves are true semicircles and closely geared the revolvers will not pass round each other. Fig. 2 is an illustration of the patent of



1881. The curves in this instance are more accurate, and only the convex surfaces are tooled over. In their formation, however, they require the use of several different centres and radii, which involves a difficulty in setting out, and hence expense in manufacture. Fig. 3 shows the mode of tooling the convex surfaces on an ordinary planing machine. Fig. 4 represents the next improvement and the mode of drilling out the curves. It will be seen not to differ much from Fig. 3. Fig. 5 shows the last constructed curve, which far exceeds those preceding it in simplicity of construction and efficiency. In this case both large and small curves are struck from one common centre, thus reducing the construction to the utmost simplicity. By reference to Fig. 5 it will be seen that each half of the vane consists—on each side—of two large and two small curves, and that to produce these four curves only two centres

FIG. 5

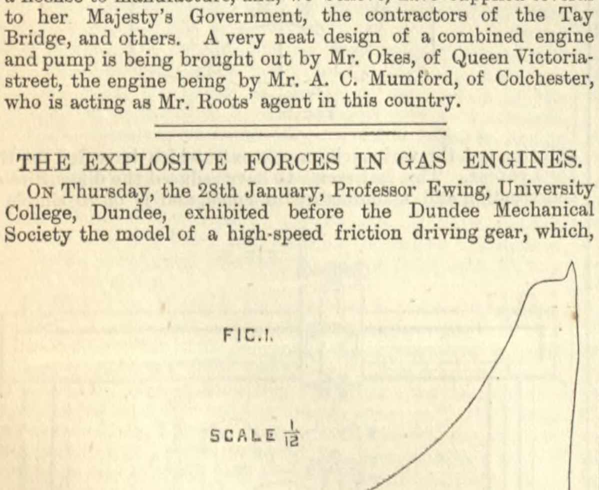


and two radii are employed. The centres are represented by the points A B and radii A C—A E, B D—B F. Thus the two smaller curves are struck with radii A C and B D, and the larger with radii A E—B F from the centres A and B, which are found by exceedingly simple means, and also the radii. These being fully described in patent No. 10,323, 1885, it will be unnecessary to describe them more fully here.

As a pump, Messrs. Mather and Platt, of Salford, have taken a license to manufacture, and, we believe, have supplied several to her Majesty's Government, the contractors of the Tay Bridge, and others. A very neat design of a combined engine and pump is being brought out by Mr. Okes, of Queen Victoria-street, the engine being by Mr. A. C. Mumford, of Colchester, who is acting as Mr. Roots' agent in this country.

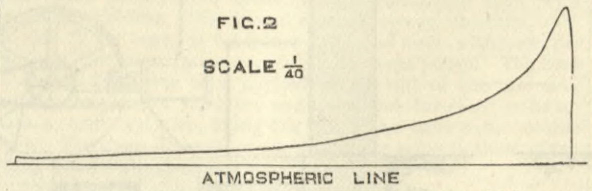
THE EXPLOSIVE FORCES IN GAS ENGINES.

On Thursday, the 28th January, Professor Ewing, University College, Dundee, exhibited before the Dundee Mechanical Society the model of a high-speed friction driving gear, which,



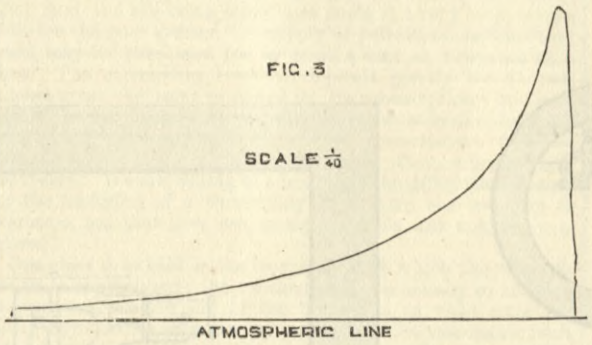
Maximum pressure, 21 lb. per square inch above atmosphere.
Mixture, 1 volume of gas to 21 volumes of air.
Temperature before ignition, 7 deg. C.
Temperature after ignition, 400 deg. C.
Time taken to describe diagram, 4 seconds.

in conjunction with the late Professor Fleeming Jenkin, he had invented. The gear was stated to be specially applicable to cases in which power had to be transmitted from a low speed to a high speed shaft, or *vice versa*, as in driving dynamos, fans, saws, &c., and also in taking powers from a high speed electric motor. The principle of the mechanism was fully explained by Professor Ewing, and illustrated by a number of diagrams. In addition to its high efficiency or small loss of power in transmission, the invention is stated to have the advantage of giving great multiplication or reduction of speed in a very limited space.



Maximum pressure, 33 lb. per square inch above atmosphere.
Mixture, 1 volume of gas to 20 volumes of air.
Temperature before ignition, 5 deg. C.
Temperature after ignition, 618 deg. C.
Time taken to describe diagram, 4 seconds.

Mr. Geo. C. Douglas, Douglas Foundry, then read a paper "On the Explosion of Gases, and the Rates of Cooling of various Mixtures of Coal Gas and Air." It was illustrated by experiments. He stated that he had obtained diagrams with ratios of gas to air varying from $\frac{1}{10}$th to $\frac{1}{30}$th. A two-chamber eudiometer was used, the one chamber being separated from the other by means of a diaphragm of oiled paper, which was broken through by the explosion of the gas and air in the adjacent chamber when the mixture was ignited by the electric spark.



Maximum pressure, 63 lb. per square inch above atmosphere.
Mixture, 1 volume of gas to 10 volumes of air.
Temperature before ignition, 5 deg. C.
Temperature after ignition, 1176 deg. C.
Time taken to describe diagram, 4 seconds.

An indicator moved by clockwork at a uniform speed gave a diagram showing the rate of cooling. Three of these diagrams are given. He stated that so far as he knew he was the first who had investigated into the rate of cooling of such dilute ratios. The papers were attentively listened to, and the usual votes of thanks were accorded.

A REVERBERATORY FURNACE HEATED WITH GASEOUS FUEL.

Messrs. John Shewell and Co., engineers, Darlington, have just succeeded in making use of liquid fuel for the heating of a plate-bending furnace. The liquid fuel used is derived from gas tar, and is simply the residue after the more valuable constituents have been taken out. The burners and the general mode of application are similar to those adopted by Dr. Saddler, of Middlesbrough, for treating boiler furnaces, and substantially the same as were illustrated and described in a paper read before the Institution of Mechanical Engineers, on the use of liquid fuel, two or three years since. Messrs. J. Shewell and Co.'s furnace was originally built and used to burn coal. It then had a fire-grate running the full length on one side, the products of combustion being drawn off by a chimney on the other side, connected by several converging flues. The body of the furnace was made 15ft. by 3ft., and the coal-burning grate 15ft. by 1ft. 3in. This furnace, though it worked well enough for heating plates up to a certain moderate temperature, was not found efficient when required to heat them up to a full red-heat for severe bending. It is obvious that it would be difficult to secure equality of temperature throughout the whole length of so narrow a grate, the ends whereof were, of course, further from the chimney than the middle. The consumption of fuel was excessive, and the quantity of plates heated in a given time relatively small. A few months since, having in hand an order for bridge work, requiring flooring plates $\frac{3}{8}$in. thick by about 2ft. 6in. broad by 12ft. long, and very deeply dished into the form of a trough, Messrs. J. Shewell and Co. determined to try the experiment of altering their furnace, so that it should be heated by liquid fuel. After many difficulties they seem to have succeeded perfectly in attaining their object. The old coal-burning grate was bricked up, as also the old flues. A new flue at the end of the furnace now connects it with the same chimney. There are three burners placed in a row at the other or door end of the furnace, but placed high enough not to interfere with the entrance or exit of the plates. The blocking appliances are immediately in front of the door, and in a line with the furnace, so that no time is lost in dealing with the plates after they are drawn out. Distant about 30ft. from the furnace is a small vertical boiler, which supplies steam at 50 lb. per square inch above atmospheric pressure for injecting and spreading in the form of spray the liquid fuel, and inducing the air necessary to insure complete combustion. It has been found necessary to have a small drain pipe at the lowest part of the steam pipe between the boiler and the injectors, to make sure that the entering steam is free from water. It has also been found necessary to perforate the furnace door with a number of holes, so as to give easy access for the large quantity of air required for combustion. A steam jet has been placed in the chimney, and is found of great service to increase the draught before the furnace has obtained its higher temperatures. The liquid fuel is pumped into a small reservoir near the furnace, so situated that it can flow thence by gravity to each of the three injectors, where the supply is regulated by small taps. The liquid fuel is warmed in the supply reservoir to about its boiling point by a steam coil, and the steam is superheated to some extent by passing it through a circuitous pipe situated in the furnace chamber before it finally enters the injectors. The air is indeed the only requisite of combustion which enters cold. The time required to get up the heat of the furnace is about one and a-half hours. When the furnace is hot the time necessary for heating a $\frac{1}{2}$in. thick plate to a full red heat is about twenty minutes. The value of the liquid fuel is at present $1\frac{3}{4}$d. per gallon. The consumption averages 11 gallons per hour. When the furnace is up to its full heat there is no smoke visible, indicating perfect combustion; but naturally there is smoke and imperfect combustion so long as the inflammable gases proceeding from the volatilisation of the fuel encounter chilling surfaces. The success of the whole system seems to depend on securing as high an initial heat as possible for all the elements of combustion as they enter the furnace. In the present case no attempt has been made to utilise the waste heat of the furnace for this purpose. If it could be done it would no doubt lead to considerable economy of fuel. Messrs. J. Shewell and Co. find, however, considerable advantage from the alteration of their furnace, irrespectively of fuel economy. They can heat twice as many plates per day as formerly, employing only the same number of workmen, and by reason of the higher and more equable temperature, fewer plates fail in blocking. Altogether Messrs. J. Shewell and Co. seem to have made a valuable and successful experiment in what would appear to be a new direction.

LEGAL INTELLIGENCE.

HIGH COURT OF JUSTICE—QUEEN'S BENCH DIVISION.

(*Before* Mr. Justice Mathew.)

Musgrave and Sons (Limited) *v.* Hick, Hargreaves, and Co.

The trial of this action extended over six days. The action was between two firms of engineers at Bolton, and was brought for an alleged infringement of two patents of the plaintiffs, dated August 24, 1881, and February 6th, 1884, for improved safety starting gear for steam engines. The gear in question, which is known as a "barring engine," is applied to the fly-wheel of a larger engine in cases where the fly-wheel is too big to be started by the inconvenient and dangerous process of prising it round with a crowbar. The safety of the engine arose from an arrangement by which the barring engine was automatically thrown out of gear with the fly-wheel as soon as the latter attained a sufficient momentum of its own to move independently of the barring engine. In their first patent the plaintiffs effected this by an arrangement of pinions in a "sun-and-planet" movement—that is to say, a small pinion geared into cogs on the circumference of the fly-wheel, mounted on a radial arm or lever pivoting on the shaft from which motion was to be communicated to the fly-wheel, the shaft itself also carrying another pinion gearing into the small pinion. The shaft was driven by a worm and worm-wheel. In the second patent there was the same arrangement of a shaft driven by a worm and worm-wheel, but the connecting link between this shaft and the fly-wheel, instead of being formed by the sun-and-planet movement, was formed by a single pinion mounted loosely on the shaft by means of a radial slot, which enabled the pinion to be moved into gear with the fly-wheel by means of a lever, motion being communicated from the shaft to the pinion by means of a catch or tooth on the shaft bearing against a corresponding projection on the pinion. In both these machines the movable pinion was held in gear with the fly-wheel by its own action against the cogs so long as the pinion was itself driving the fly-wheel, but as soon as the fly-wheel became the driver the pinion was thrown off and retired out of gear, partly by the impetus given to it by the fly-wheel and partly by the force of gravitation. In their specifications the plaintiffs claimed the invention generally as described, and particularly by the 1884 specification laid claim to the use of a slot which admitted of the pinion being moved and thrown out of gear by the wheel of the large engine, and the employment of a pinion "so mounted or supported that the pinion is kept engaged with the wheel of a large engine while driving it, and is allowed by means of a slot to move so as to be disengaged and thrown out of gear by the action of the started wheel when it becomes the driver." The machine which was alleged to infringe these patents was patented by the defendants in April, 1884. In this machine a worm similar to that in the other two acted upon a "worm-wheel pinion," which, instead of communicating motion to a shaft, was itself capable of moving into and out of gear with the fly-wheel, it being mounted on grooved blocks or slides, on which it could move to and fro horizontally. On setting the machine in motion a lever or brake was applied to the side of the pinion opposite the worm, the effect of which would be that the worm itself would roll the pinion forward until it came into contact with the fly-wheel. The pinion was thrown off, as in the plaintiff's machines, when the fly-wheel attained a higher momentum than the pinion, and was then further drawn away by means of springs. The defendants denied that this machine infringed either of the plaintiffs' patents, and they further contended that if the plaintiffs' specifications were to be construed so as to include the defendants' invention, then the patents were bad as having been anticipated. The plaintiffs contended that prior to their patents there had been no starting gear driven by power in which motion was communicated to the fly-wheel by means of a pinion capable of retiring automatically in the plane of the fly-wheel or a parallel plane. They urged that the defendants' machine embodied all these essential features, and they particularly relied upon the grooved bearing by which the defendants' pinion moved into and out of gear as a mechanical equivalent for the slot specifically claimed by the 1884 specification. The defendants' case, on the other hand, was that their machine differed from the plaintiffs' in several important features, among which were (1) that the pinion retired from the fly-wheel horizontally or in a radial line, while in the plaintiffs' it retired at a tangent; and (2) that in the grooved or slotted bearing the object of the side guards was to prevent any lateral movement of the pinion—a totally different purpose to that served by the slot in the plaintiffs' pinion. As a result mainly of the former difference, the defendants' machine was free from a serious defect alleged to exist in the plaintiffs'—namely, that of the pinion jamming on its bearings when its teeth came end on against the teeth on the fly-wheel, or when it disengaged itself in certain relative positions of the notch on the shaft and that on the pinion. A great deal of evidence was given on this last point, the defendants seeking to show that the plaintiffs had discovered this defect and made various alterations—more or less unsuccessful and quite outside their specification—with the view of overcoming it, and the plaintiffs alleging that if such a defect existed at all it could be obviated by ordinary intelligence in construction. To illustrate this point experiments were eventually made in the presence of the learned Judge upon a machine shown by the plaintiffs in a room adjoining the Court. It was proved that no machine had yet been made for sale in accordance with the plaintiffs' specification. A number of previous inventions were relied on by the defendants as showing an anticipation of the plaintiffs' patent if it was to be construed as covering the defendants'. The earliest of these was one applied by Messrs. Galloway to marine engines as early as 1870, in which a pinion actuated by a worm acted directly upon the large engine wheel, the worm in this case retreating by means of a slot in the worm-shaft. Models were also shown of an invention of the defendants in 1879, where motion was communicated to the fly-wheel from a shaft driven, as in the machines in dispute, by means of two pawls or arms bearing alternately upon the teeth in the fly-wheel. A great mass of expert evidence was given on the various mechanical questions at issue, among the witnesses being Sir Frederick Bramwell for the plaintiffs and Mr. John Imray for the defendants.

Mr. Justice Mathew, who had taken time to consider his decision, on the 3rd inst. delivered judgment in favour of the defendants. His Lordship expressed himself as satisfied that there was a danger of jamming attached to the plaintiffs' machine, and that in the defendants' this danger was avoided by the employment of mechanical means essentially different. Whether, his Lordship said, the plaintiffs' specification of 1884 was to be regarded as claiming a combination of old mechanical means for a new and useful purpose or of old means and an essential part—viz., the slotted pinion—which was new, he—the learned Judge—failed to discover any imitation of the whole or of the essential new part in the defendants' invention, and the plaintiffs, therefore, failed to establish any infringement of that patent. After discussing the patent of 1881, his Lordship observed that that patent seemed to him as far removed from the defendants' as that of 1884. The plaintiffs and defendants seemed to have advanced on lines of invention that did not cross each other. His Lordship added that he desired to guard himself against being supposed to have expressed any opinion upon the validity of the plaintiffs' patent of 1884.

Judgement was accordingly given for the defendants, with costs. Sir FARRER HERSCHELL, Q.C., Mr. ASTON, Q.C., and Mr. GOODEVE appeared for the plaintiffs; and the Attorney-General (Sir RICHARD WEBSTER), Q.C., Mr. BOUSFIELD, and Mr. HARGREAVES for the defendants.

CHANCERY DIVISION.

(*Before* VICE-CHANCELLOR BACON.)

THE DRIFFIELD AND EAST RIDING PURE LINSEED CAKE COMPANY *v.* THE WATERLOO MILLS CAKE AND WAREHOUSING COMPANY.

THIS case raised for the first time the question whether a person threatened with an action for infringement may bring an action for damages if the threat be contained in a private letter.

The VICE-CHANCELLOR decided that the plaintiffs were entitled to an injunction preventing further annoyance, but not to damages. The defendants must pay the costs of the action.

CONTRACTS OPEN.

PADDLE-WHEEL ENGINES FOR THE INDIAN GOVERNMENT.

THE Indian Government requires tenders for paddle-whee engines for the Bengal Marine Service. The conditions of contract are as usual.

(1) The work required under this specification consists of four pairs of compound diagonal direct-acting paddle-wheel engines, fitted with surface condensers and feathering wheels, with independent centrifugal pumps for circulating water in condensers. Two pairs are to be placed in one boat. The engines are to be arranged in general conformity with the drawings on page 124, and which are to be taken as merely showing the desired arrangement of machinery. Parties tendering may do so, if they please, upon designs more in accordance with their own patterns, but they must submit drawings with their tender in that case and a full specification.

(2) *Cylinders.*—To be two in number for each pair of engines, to be of hard, close-grained iron, a mixture of Scotch No. 1, Blaenavon and good clean scrap, the high-pressure cylinder to be 28in. in diameter and the low-pressure cylinder 53in. in diameter, both cylinders arranged for a 48in. stroke. The cylinders to be fitted with escape valve at either end having guards to prevent accidents. Drain cocks to be fitted at ends of cylinders and high-pressure slide casings with copper pipes to bilge. To be worked from the starting platform. A supplementary valve to be fitted on to the reservoir with a 2in. pipe, for the purpose of admitting steam to low-pressure slide casing to assist in starting the engines. The gear for working the same to be led to starting platform. The reservoir between cylinders to have a relief valve fitted capable of adjustment whilst engines are at work. Indicator pipes with the necessary cocks and gear are to be fitted to either end of both cylinders for the purpose of taking off indicator cards. The cylinders to be felted in all parts, neatly covered with polished teak wood, tongued and grooved and secured by polished brass bands. The piston-rod and slide-rod glands to be fitted with brass bushes, and the stuffing boxes lined with brass, as shown in drawing. The high-pressure cylinder to be fitted with a false face for slide valve, of hard close-grained cast iron, secured with brass pins having countersunk cheese heads.

(3) *Cylinder Covers.*—The cylinder covers to be in cast steel of single plate form ribbed, fitted with polished loose covers in steel plate secured to cover, the space between to be filled with felt.

(4) *Slide valves.*—To be of the same mixture of iron as the cylinders. The high-pressure valve to be single-ported and fitted with expansion valve on back, and the low-pressure valve double-ported, with an approved arrangement for relieving pressure on back of both slide valves. Valves to be arranged to cut off at two-thirds of stroke. The doors of slide valve castings to be in cast steel.

(5) *Expansion valve.*—To be in cast iron, working on back of high-pressure valve, of the gridiron form; to be so arranged as to cut off steam at any portion of the stroke from two-twelfths to two-thirds. The hand gear for working the same to be led to starting platform.

(6) *Pistons.*—To be in cast steel of the single plate form. Edge of junk ring to be flanged. The metallic rings to be in cast iron fitted with the usual steel springs, having solid blocks to carry weight of piston. Junk ring bolts to screw into brass nuts and the heads of bolts to have secure stops.

(7) *Piston-rods.*—To be in steel, equal in strength from 26 to 28 tons per square inch breaking strain. The nuts to secure rods to be on outside of piston as shown, to suit ordinary spanner. The upper end of piston-rod to be forged solid and cut out to take brasses secured by steel cap bolts and nuts. The lower edge to be formed so as to receive guide block, brasses to be lined with Parsons' white brass, No. 2.

(8) *Connecting-rods.*—To be of forged steel of the same quality as piston-rods, of not less length than 9ft. 6in. centre to centre, to have T-end with steel caps, bolts, and nuts. Brasses to be lined with Parsons' white brass, No. 2. To have a solid key cast on under side of brasses and let into T-end of connecting-rod, as shown in drawing. The connecting-rods, brasses, straps, and bolts to be interchangeable. The lower end to be forked, long enough to allow of connecting-rod being turned up clear of piston-rod cap nuts.

(9) *Guide bars.*—To be in forged steel, securely bolted to cylinder bottom and cross stay as shown in drawing. Oil ways to be cut on upper surface, and care to be taken to prevent them being run to outer edge.

(10) *Slipper for guide bar.*—To be in two parts, joggled and bolted together, lined with Parsons' white brass, No. 2; to be in cast steel.

(11) *Slide valve rods.*—To be in steel, secured to valves by double nuts and stop pin at bottom end, and with cone and collar at top end. The rods to be guided at both ends, at lower ends by brass bush secured by pins to slide valve casing, and independent of the cover over end of rod. The upper ends to have an eye forged solid, fitted with steel bolts and nuts for adjusting rocking brasses carrying sweeps. The rod below this eye to be forged square, for the purpose of guiding the upper end; to have cast iron guides fitted to casings as shown in drawing.

(12) *Excentrics.*—To be in cast iron, in halves to be bolted together with steel bolts and nuts carefully stopped. The straps to be of gun-metal, fitted with steel bolts and nuts brought as close to side of excentric as possible, to have provision cast on for taking T ends of excentric rods, with through steel bolts and nuts. Lubricators to be cast on straps.

(13) *Excentric rods.*—To be in steel of flat section, to have forked ends fitted with adjustable brasses, steel bolts and nuts for attachment to sweeps. If found necessary, these rods are to be trussed.

(14) *Sweeps.*—To be in steel, not less in length than 15in. between centres. To be made of two bars with pins forged on the solid. The suspension bar for shifting sweeps to be double, to be attached to go-ahead excentric pins, and to be fitted T-ended with adjustable brasses, steel bolts and nuts stopped. The starting shaft and levers to be in forged steel, the pins to be stopped in end of levers. Blocks for carrying starting shaft to be in cast iron, with steel bolts and nuts.

(15) *Expansion gear.*—Lever links and rods to be in steel; the links to be double, arranged generally as shown in drawing. The excentric and ring to be cast from same pattern as used for main slide gear. The gear for shifting radius bar to be carried to starting platform, having index plate marked to show the amount of cut-off.

(16) *Starting gear.*—To be a combined arrangement, as shown in drawing, of hand and steam, with water-controlling cylinder, so that by placing the starting handle in any position the links may stand at the same proportionate part of stroke, to be so arranged that the steam or hand gear can be used independently, the steam cylinder to be not less in diameter than 11in. All packing glands to be lined with brass, and all rods and pins to be in forged steel. The starting gear to be efficiently supported, and in general conformity with the drawing; the supports in steel.

(17) *Crank shaft and crank pins.*—To be arranged as shown in drawing, the crank pins and coupling to be cut from solid, the wing crank pin to be long enough to enter eye of paddle shaft crank, and to have the sides flattened for driving against gun-metal cod-piece in eye of paddle crank. The bearings of shaft to be not less than $10\frac{1}{2}$in. diameter and $14\frac{1}{2}$in. long; the crank pins to be not less than $10\frac{1}{2}$in. diameter and $11\frac{1}{2}$in. long. The couplings to be used for coupling the two engines together are to have bolts fitted into taper holes, rimered out so as to insure good fitting bolts. Shafts to be in steel.

(18) *Main stay.*—The main stay running from the plummer blocks to cylinders to be in forged steel. The main plummer block bolts to go through upper end, and the lower end fitted against faced provision cast on cylinders, secured by four-screwed pins having nuts at either end, turned and fitted into rimered holes; to have boss forged on for taking support, with double nuts.

(19) *Support for guide bar.*—To be in steel, each guide bar to have separate supports, consisting of two steel stays extending from bottom frame to main stay, having nuts to carry cross beams supporting guide bar. The cross beams to be I-section cast in steel.

(20) *Air pump gear.*—The levers to be double and all pins and side rods to be in steel. The main links to be T-ended, fitted with brass bearings and steel caps, bolts, and nuts. The air-pump rod through plunger and top nut to be in steel, with gun-metal box nut at bottom, the cross-head to be in steel and turned. The side links to have brass blocks and through steel bolts and nuts, the bolts to have solid collars.

(21) *Paddle shaft and crank.*—To be in forged steel, the crank to be shrunk and keyed on to paddle-shaft. The crank eye to be fitted with gun-metal side pieces dovetailed into crank for taking flattened sides of crank-pin. The shaft to be not less than $10\frac{1}{2}$in. diameter and $14\frac{1}{2}$in. long in entablature bearing, the outer bearing to be 12in. in diameter and 24in. long, the shaft to taper as shown in drawing.

(22) *Condensers.*—To be in cast iron, generally of the form shown in drawing. The tube-plate to be in rolled Muntz's metal, drilled and tapped for $\frac{5}{8}$in. outside diameter tubes, 18 B.W.G. thick, fitted with brass screwed ferrules, the ends of which next packing to be smoothly rounded in lathe. Tube-plate to be $1\frac{1}{8}$in. thick. Tubes to contain not less than 70 per cent. of copper. The cooling surface to be not less than 1250 square feet. The steam to be condensed externally and the circulating water to run twice through the tubes, entering top rows of tubes first from centrifugal pump. A brass cock to be fitted on to exhaust pipe for injecting soda solution. All bolts, studs, and nuts inside of condenser to be of Muntz's metal. Drain cocks to be fitted as directed. The condenser, with tubes packed in place, to be tested with cold water pressure to 5 lb. per square inch before putting on doors. A supplementary supply pipe with regulating cock into condenser, for making good any loss of feed-water. The gear for opening and shutting same to be led to starting platform. Provisions to be cast on sides of condenser to form continuation of main frame, which is to be bolted to faced flanges on top of condenser, the bolts and nuts to be in steel and holes rimered out.

(23) *Air pump.*—The barrel, plunger, and bucket with guard to be in gun-metal, the top and bottom chambers in cast iron, and so arranged that foot and delivery valves can be removed without disturbing other than the two doors. The cover guides and blocks for crosshead to be in cast iron. The cover to have gun-metal glands, the stuffing-box to be lined with gun-metal. The air pump to be not less in capacity that 21in. diameter and 20in. stroke. To be fitted with air valve and adjusting screw. The guides to be made in two pieces bolted together top and bottom, secured to faced provision on air pump cover. Cover to be ribbed below guides.

(24) *Foot and delivery valves.*—The seats and guards to be in gun-metal, the valves in india-rubber, and so arranged that the valves can be removed without lifting the seats.

(25) *Hot well.*—To be in wrought iron, arranged with closed top and manhole door and air pipe, as shown on drawing.

(26) *Feed and bilge pumps.*—To be one in number of each, the barrels in cast iron, plungers, glands, and bushes in gun-metal, the stuffing-boxes to be lined with gun-metal, each pump to be of not less capacity than $4\frac{1}{2}$in. diameter and 20in. stroke. The feed pumps to be fitted with suction cock and snifting valve on pump and escape valve on delivery pipe. The valves and seats to be in gun-metal, with adjusting screws for regulating lift of delivery valves for feed, the feed pump to draw direct from hot well. The bilge pumps, two in number, fitted off same pattern as feed pumps to deliver overboard, fitted with roses and suction pipes in lead, and delivery pipe overboard in copper.

(27) *Entablature.*—To be in cast iron of the box section and generally of the form shown in drawing, to be bolted to top of condenser with turned steel bolts and nuts and rimered holes. To be fitted with gun-metal bearings for main shaft lined with Parson's white brass, the bolts to have solid collar, with nuts and caps to be in steel. The distance through stay with nuts to be in steel, and the thimbles in cast iron. The forward end of entablature to be secured to box beams by at least six steel bolts and nuts, with cast iron washer plates on fore side of beam; bolts, nuts, and washer plates to be provided. The palms of the two midship portions of entablature to have faced provision, as shown in drawing, for bolting together, but no bolt holes are to be drilled, but turned bolts $1\frac{1}{2}$in. diameter and nuts are to be provided.

(28) *Bottom connecting frame.*—To be in cast iron of the box form, the ends to be planed and securely bolted to condenser and cylinders with turned steel bolts and nuts, the holes to be rimered out. The provision for taking guide support to be faced in machine.

(29) *Holding-down bolts, nuts, dogs, and washers.*—The necessary holding-down bolts, &c., to be in steel, and the whole to be provided for use with engines. Holes to be cast in flanges about 15in. apart for 1in. bolts.

(30) *Paddle-wheel.*—The diameter of wheel to centre of motion to be 14ft. The floats to be feathering, with rings attached to arms inside and outside floats. The floats, eight in number, to be not less than 9ft. 3in. by 3ft. 3in., to be American elm, in two planks, with through $\frac{5}{8}$in. galvanised bolts and nuts, planed and chamfered as shown. The pins for the floats to be cased in gun-metal, and the arms to be bushed with gun-metal. The gun-metal covering to pins is to be turned and the bushes to arms to be bored and turned. The arms to be in centre of bosses for carrying floats, and to have stops fitted to arms and rivetted on to rings behind each arm. Diagonal stays to be fitted through holes cast in bosses with double nuts on each side, to have T ends on to rings with two through bolts and double nuts. The rings to be butt jointed, with double butt plates and bolts and double nuts and rivets as shown. Athwartship stays to be as directed as with T heads. All holes to be rimered out and the bolts to be a driving fit with square nuts, the bolts to be placed far enough apart to work close-ended spanner. Bolts to be turned.

(31) *Levers and brackets.*—To be as shown on drawing. The holes for pins to be bored out taper, and the pins turned in to fit, rivetted over to secure them in place, fitted with washers and split cotters beyond angle brackets. The pins for radius rods to be cased in brass, turned, to be fitted into lever in same manner as the larger pins.

(32) *Radius rods.*—To be round bushed with gun-metal at both ends, and swelled in the centre.

(33) *Material for paddle-wheel gear.*—The arms, radius rods, levers, and brackets to be in wrought iron. The gun-metal to be of the following mixture:—Tin, 20; copper, 112; zinc, 6. Specimen bushes will be required for analysis, at least two of each size.

(34) *Excentric wheel and support.*—To be in cast iron, with steel pin coned and cottered into cast iron support, as shown in drawing. The excentric to be bushed with gun-metal, and the pin cased with gun-metal provision to be cast on carriage for taking fore and aft stays and vertical support. The pins for radius rods to be cased in gun-metal, and to have split cotter pins at end with stops under head. Bolts, nuts, and washers to be found for securing same to spring beam.

(35) *Paddle boss.*—To be in cast iron. Provisions to be cast on for chipping so as to make a driving fit of arms into place. To be bored and fitted on to shaft with three keys, with thickening provisions cast on boss in wake of keyways. Diagonal holes for diagonal stays and facings for nuts to be cast on, to have two wrought iron rings bored and shrunk on to ends of boss, to be at least 4ft. 9in. in diameter.

(36) *Outer bearing.*—To be in cast iron with gun-metal brass at lower side, on top side a light cast iron cover forming tallow-box, and secured into place by two wrought iron straps, one on each side of tallow-box, and fastened with 1in. screws and double nuts. To have loose plate in cast iron, with the necessary joggles, keys, bolts, and nuts for holding block and plate to outer bearing.

(37) *Stuffing-box for paddle shaft.*—A stuffing box and gland, in halves, of cast iron, to be fitted on side of vessel as shown.

(38) *Throttle valve and gear.*—A throttle butterfly valve to be fitted to steam pipe, and the gear taken to starting platform. Valve casing and spindle to be in gun-metal. The whole to be easy of removal.

(39) *Lubricators and pipes.*—Brass lubricators to be fitted to all working bearings, of the ordinary form with worsteds. No soft solder to be used; where necessary to be hard soldered. Pipes to lead oil as required, neatly fastened with brass clips for both ends of connecting rod. The lubricators to be fixed on supports and wipers to be fitted; slide valves and cylinders to have lubricators as directed.

(40) *Donkey engines.*—An approved donkey engine to be supplied of sufficient dimensions so as to be able to feed the boilers easily to pump from sea and hot well. To have delivery to deck, fitted with stuffing-box on under side of deck and deck-plate, with short and long goose necks. Pump to have escape valve fitted. The valves and seats to be in gun-metal, capable of easy removal, and the delivery valves to be fitted with adjusting screws. All sea and hot well connections to be fitted. Three-way cocks are not to be used. A screw stop nozzle to be fitted on steam branch. To exhaust either into condenser or overboard, to be fitted with all pipes and connections.

(41) *Pipes.*—Main steam pipes to be in copper in four lengths of 10ft. each, with flanges and bolts and nuts, the flanges to be left loose. To be $6\frac{1}{2}$in. internal diameter, and thickness No. 5 B.W.G. The bend shown in drawing to be $6\frac{1}{2}$in. diameter, No. 4 B.W.G. thick. Feed pipes to be in copper $2\frac{3}{4}$in. in diameter, No. 10 B.W.G. thick. Six lengths of 10ft., with loose flanges, with bolts and nuts. Donkey feed pipes to be in copper, $2\frac{3}{4}$in. in diameter, No. 10 B.W.G. Four lengths of 10ft., with loose flanges and bolts and nuts. Pipes for circulating water to be arranged as shown in drawing. The suction and delivery pipes to have loose flanges, except where they join condenser, and pumps to be No. 10 B.W.G. Exhaust pipe from low-pressure cylinder to be fitted in place, $12\frac{1}{2}$in. inside diameter, No. 10 B.W.G. Pipes to starting engine for steam and exhaust. The steam pipes to be in four 10ft. lengths, with loose flanges, bolts, and nuts. The exhaust pipes to lead to condenser, fitted in place. Donkey steam pipes, in four 10ft. lengths, No. 10 B.W.G., with all flanges loose, bolts and nuts.

Donkey exhaust into condenser and overboard to be fitted in place. Bilge suction pipe and rose box to be in lead, arranged as shown in drawing. Bilge discharge pipes to be in copper, in two 10ft. lengths, with flanges, bolts, and nuts; thickness, 12 B.W.G. Steam and exhaust pipes to circulating engine. Steam to be in 10ft. lengths, with all flanges left loose, and bolts and nuts. Exhaust pipes fitted in place. All bends, pipes, &c., shown in drawing to be fitted independent of those specified. All pipes subjected to the pressure of steam to be proved to a pressure of 180 lb. per square inch by cold water.

(42) *Circulating pump and engine.*—An independent centrifugal pump to be fitted of an approved form, with an approved single-acting expansion engine.

(43) *Gauges.*—One steam gauge marked to 180 lb., one vacuum gauge, and one compound gauge for receiver, the whole to be of Bourdon's own make. The gauges to be arranged on a mahogany board, French polished, with 30ft. of piping in 10ft. lengths, with unions complete. Lamps to be fitted for night work.

(44) *Telegraph.*—One telegraph of approved construction, with answering dial in engine-room, and all connections for 100ft. in length, complete in all respects, lamps, &c.

(45) *Screw stop nozzle for circulating water.*—The casing to be in cast iron. Valves, seats, screws, nuts, to be of gun-metal; to be so arranged with two separate and distinct valves, one for pumping from sea, and one for pumping from bilge. The bilge valve to be free of screwing down spindle.

(46) *Hand pump.*—One hand pump to be fitted, single barrel $4\frac{1}{2}$in. diameter, to pump into boilers and on to deck. To be fitted with all the necessary cocks, pipes, deck plates, &c.

(47) *Drawings.*—The contractors, previous to commencing work, are to submit for the approval of the Inspector-General, two complete drawings showing arrangement of engines, with details of pumps, paddle-wheel, &c., and the starting gear in position with all connections. Two drawings showing the arrangement of keelsons and all in and out board work necessary for taking and fixing the engines on board vessel for the use of the shipbuilders in India.

(48) *Painting.*—The machinery where usual to have two coats of paint.

(49) *Working pressure on boiler.*—To be 90 lb. per square inch.

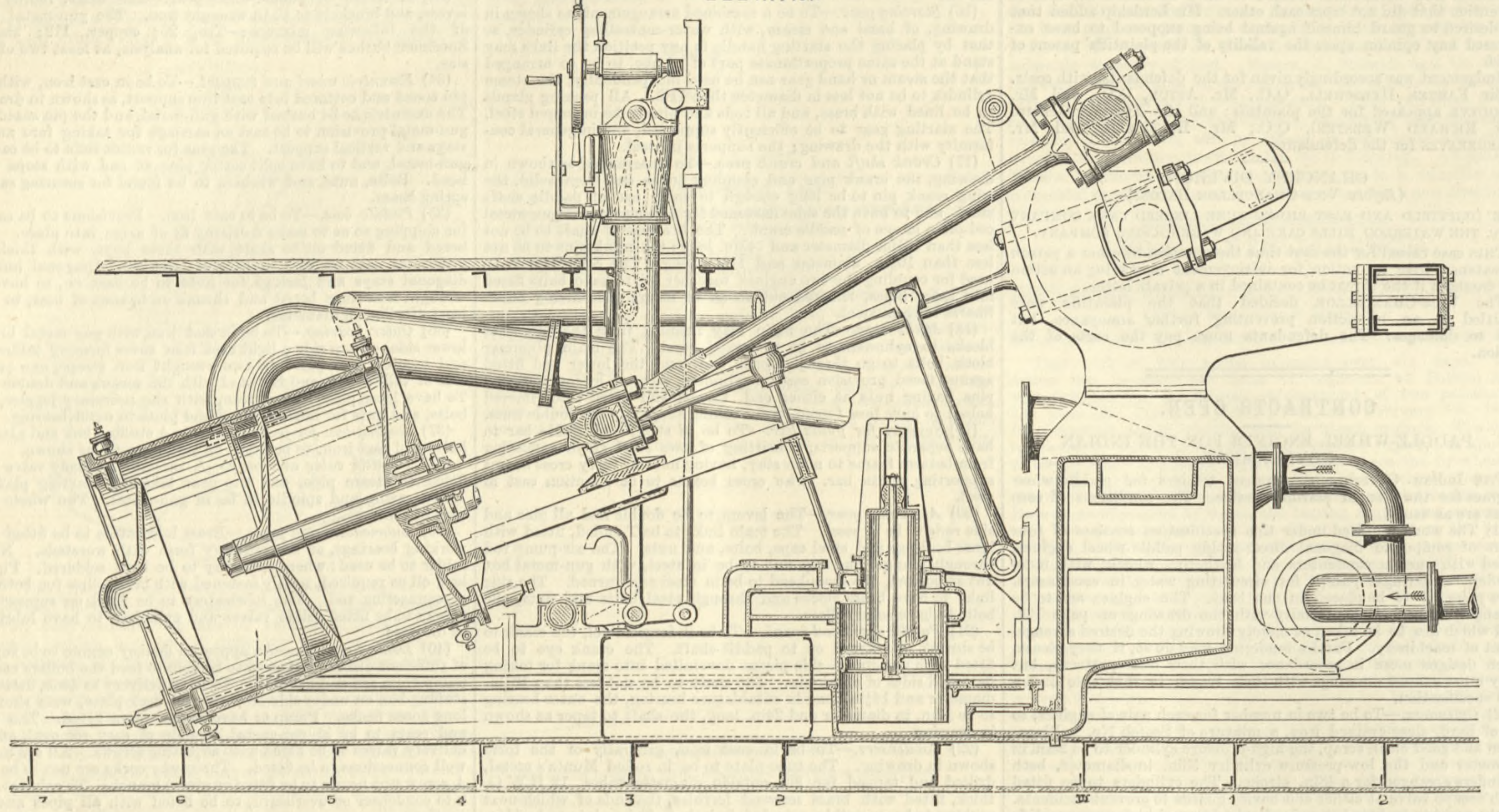
(50) *Completion.*—It is to be understood that this specification shows the quantities for one pair of engines, except in list of tools and spare gear, which is to be considered as applying to and sufficient in quantity for two pairs of engines. Each vessel is to be fitted with two pairs of these compound engines, and care is to be taken that the two pairs necessary for one vessel are to be made right and left-handed. The four cylinders being placed aft. The engines and wheels are to be erected in shop and the spare gear fitted in place, when accepted as satisfactory by the Inspector-General, are to be dismantled as required for the purpose of packing, and all the different pieces are to be carefully painted and packed in suitable cases, and to be marked as may be directed. The whole of the materials and workmanship are to be of the very best quality, and this specification is intended to include all fittings in connection with the engines necessary to complete the same ready for service in every respect. It is therefore to be understood that all minor fittings not mentioned herein, and considered necessary by the Inspector-General as requisite for the proper completion of the machinery, are to be provided by the contractors without extra charge. The threads of all bolts and nuts to be Whitworth's. The engines whilst manufacturing and erecting in shop are to remain at the risk and expense of the contractors until accepted by the Inspector-General.

Tenders to be sent in before 2 p.m. on Tuesday, the 16th of February.

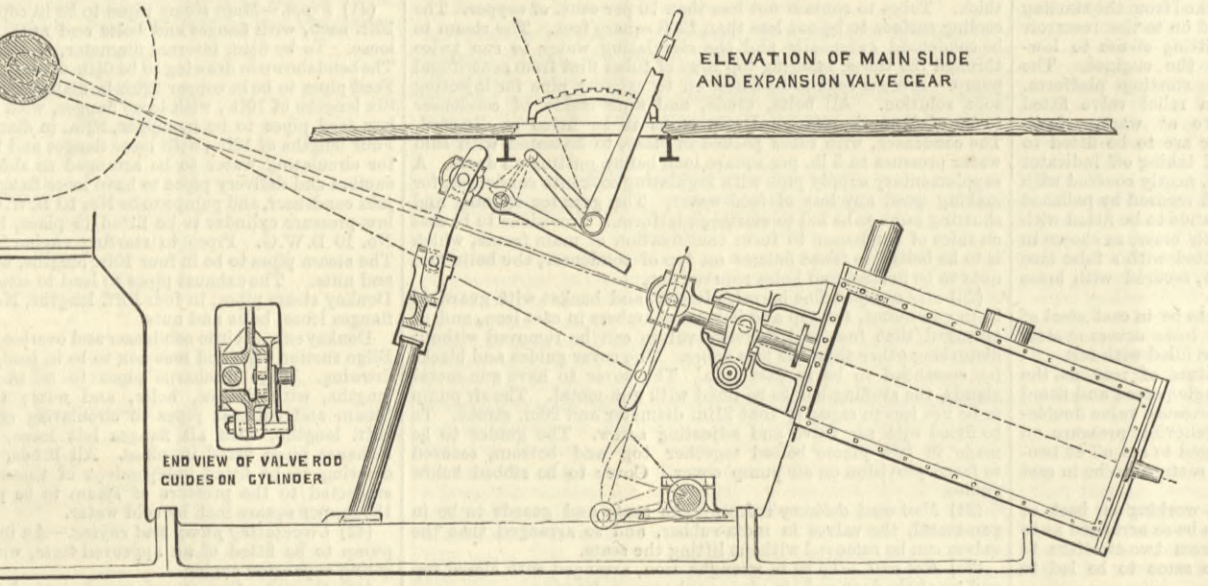
CONTRACTS OPEN.—COMPOUND PADDLE ENGINES FOR THE INDIAN GOVERNMENT.

(*For specification see page* 123.)

ELEVATION



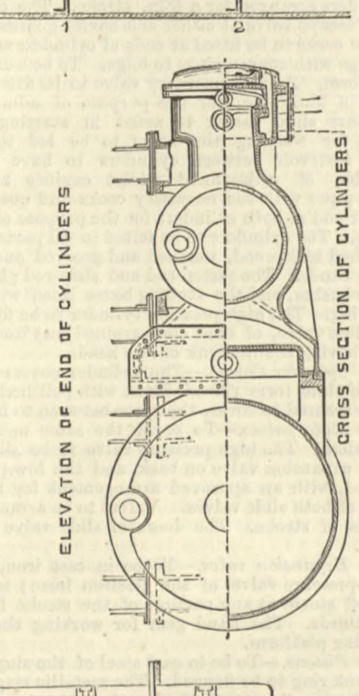
ELEVATION OF MAIN SLIDE AND EXPANSION VALVE GEAR



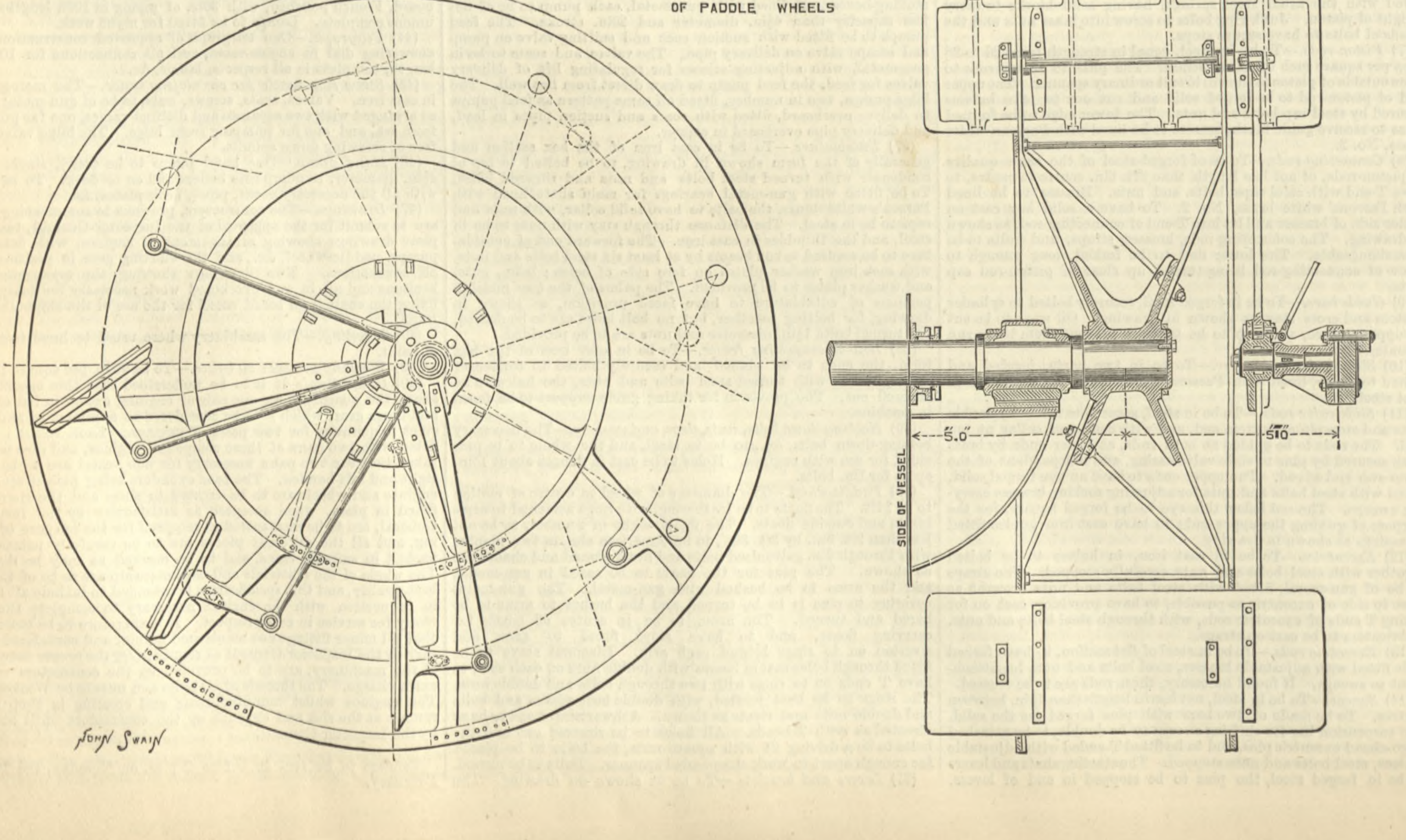
END VIEW OF VALVE ROD GUIDES ON CYLINDER

ELEVATION OF END OF CYLINDERS

CROSS SECTION OF CYLINDERS



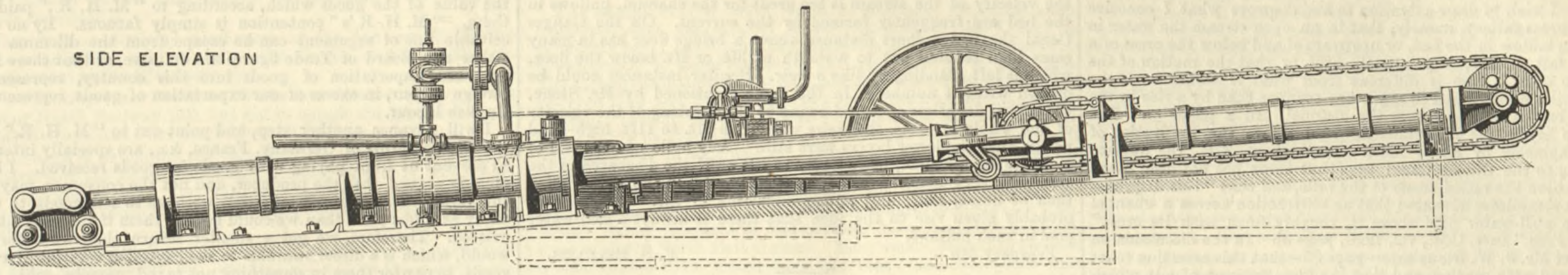
ARRANGEMENT OF PADDLE WHEELS

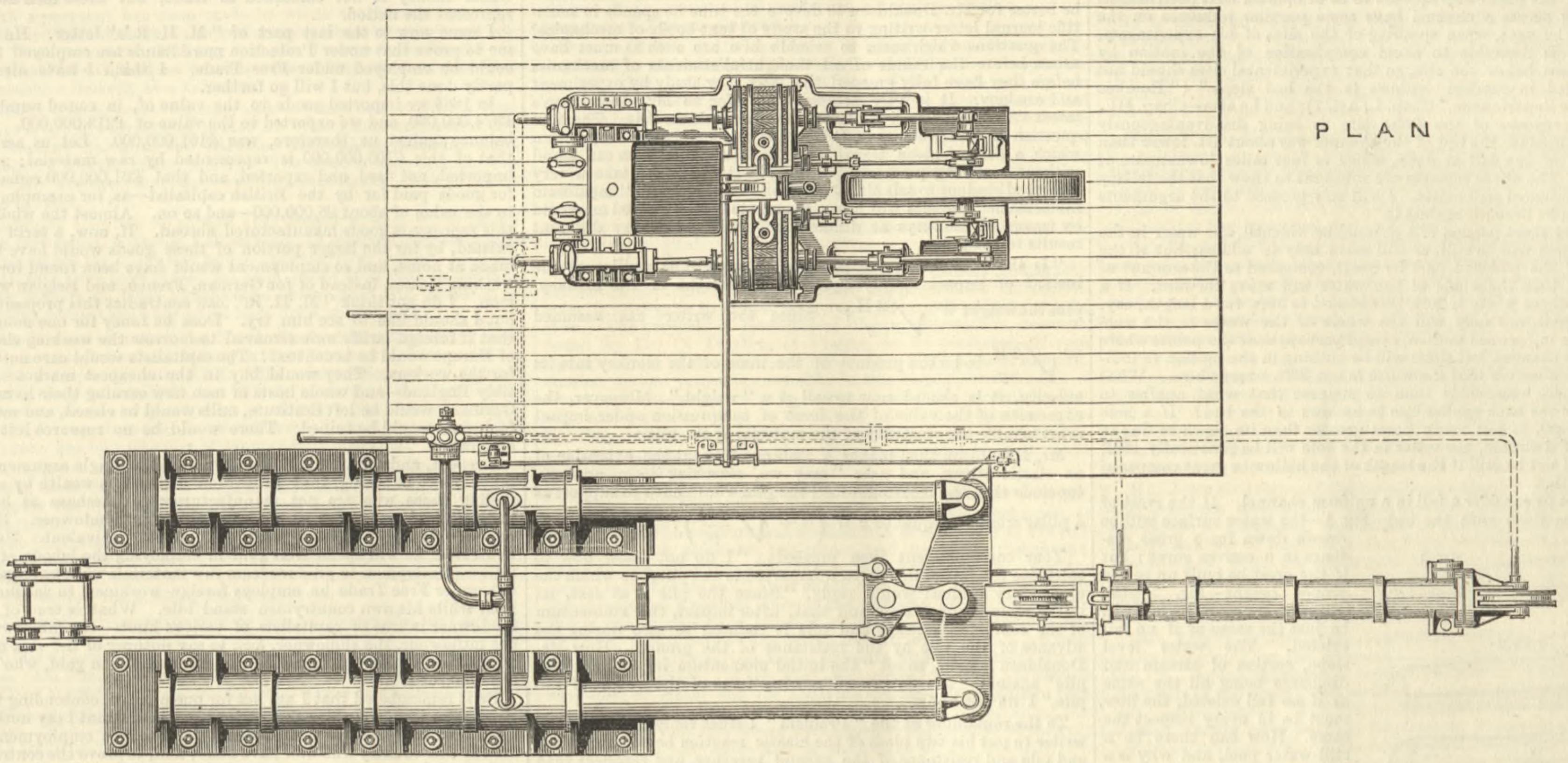


HYDRAULIC MACHINERY FOR SLIPWAY AT HIOGO FOR THE JAPANESE GOVERNMENT.

MR. HENRY J. COLES, SOUTHWARK, ENGINEER.

SIDE ELEVATION





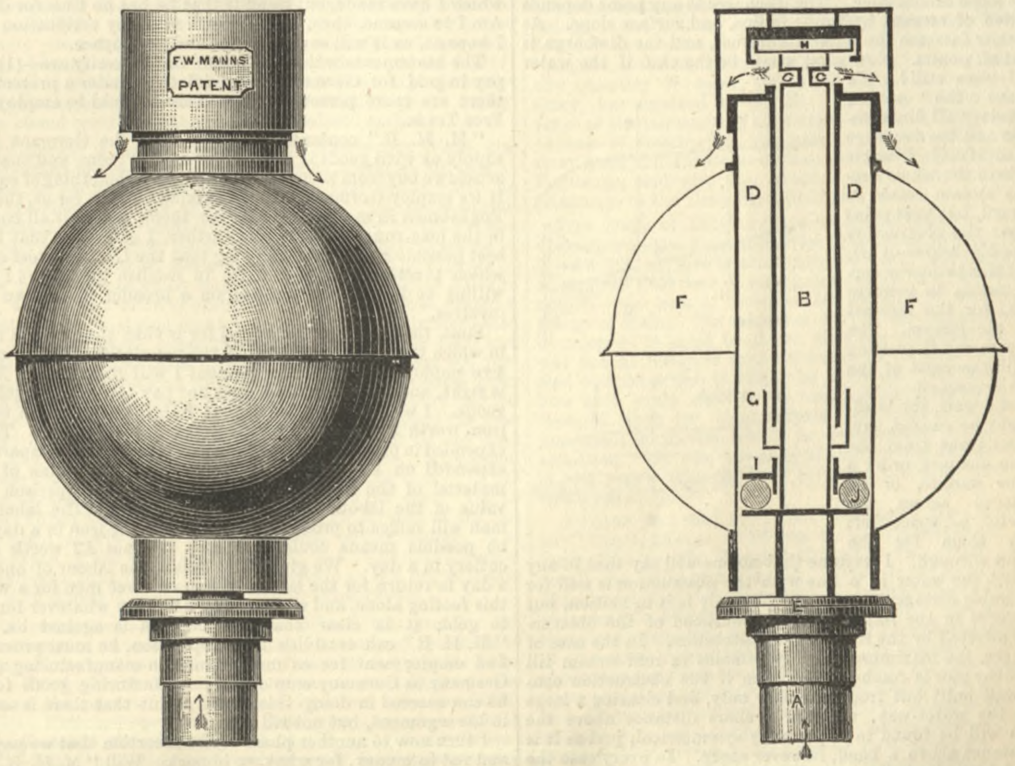
HYDRAULIC SLIPWAY AT HIOGO.

WE illustrate above a set of hydraulic machinery for a slipway, which has been erected and set to work at the Imperial Japanese Government Yard at Hiogo. It was designed and constructed by Mr. H. J. Coles, Sumner-street, Southwark, for hauling vessels of 1300 tons up a slipway having an incline of 1 in 20, and consists of a set of double rams coupled to a massive forged steel crosshead to which a smaller crosshead is coupled by heavy steel links. Wrought iron links are attached to the smaller crosshead, which are carried between and extend beyond the ends of the main hauling cylinders, the links being supported at their extremities by a carriage fitted with wheels running on rails. The cradle links are attached to the carriage. The crosshead and links are all connected by turned steel pins fitted in holes carefully and accurately bored out, so that a perfectly central and divided resistance may be met by each ram. The holes in the crossheads are also arranged so that should either ram by any means precede the other during the operation of hauling, and thus throw the crosshead out of line, increased resistance would immediately fall on the forward ram and equilibrium be restored. The large rams have a stroke of 10ft. 6in., and the length of the cradle links is 10ft. A smaller cylinder and ram fitted with a ram and bucket is fixed opposite the centre of the crosshead connecting the large rams, for the purpose of returning the large rams, also for lowering the cradle and hauling it up when empty, the latter operations being performed by means of a strong chain passing under the cylinder and returning over the top, by which means the cradle can be moved 20ft. at each stroke of the ram. Pumping power is obtained by a pair of direct-acting horizontal engines having steam cylinders 15in. diameter, and pumps of the ram and bucket type of 2½in. and 3½in. diameter respectively, the whole being suitable for a working pressure of 2000 lb. per square inch, should this pressure be required. The engines and rams are manipulated by two levers placed in close approximation, one lever being coupled to the slide starting valve of the engines, and the other to an extremely simple form of valve for diverting the current of water from the pumps to either the large or small rams, according to the operation which is being performed. When working the empty cradle the only alteration necessary is to close a stop valve on the pressure main leading to the large rams, and attach the hauling up chain to the cylinder of the small ram. Extremely satisfactory reports have been received of the working of this machinery since its erection in Japan.

MANN'S HIGH-PRESSURE CISTERN VALVE.

THE valve shown in the accompanying illustrations has been designed with the object of utilising the power given by the force with which water propels itself through mains from any elevated point. The pressure, which varies according to the head of water—say, from 20 lb. to 100 lb. to the square inch—is, in this invention, used as a means for stopping the supply the moment the cistern becomes full; the shutting off and sealing power of the valve being equal to the given force of the supply, the water leaving the cistern by design, defective outlets, or from any cause whatever, has no effect on the valve; the valve having filled the cistern, remains firmly locked until released by stopping the pressure of water on the main or service pipe, when it unlocks itself for refilling the cistern. On the intermittent system of supply the pressure is taken off by the turncock each day; on the constant service a small ¾in. stop-cock—conveniently placed for the householders' use—will, by turning off for a short time, renew the supply when turned on, and fill any ordinary cistern in a few minutes. The supply is then stopped by the water pressure itself, and no more water can enter the cistern until the pressure of the supply is taken off. It is consequently a compact water-waste preventer at the source of supply.

The illustrations show an elevation and section of the apparatus. The water enters the valve at the inlet union A, passes up the stem B, and issues, at full pressure, from outlets C until the cistern is charged. As soon as the level of water in the cistern has reached and covered the lower half of the ball F, the ball and cylinder D commence rising from the base-plate E. Having risen ⅛in., the force of water, by the partial closing of the outlet ports C, immediately takes possession of the interior of the cylinder D, by passing down the annular tube between the cylinder and the stem B into the pressure receiver G. The force of water from this receiver being directed upwards, strikes the upper internal portion of the cylinder D, thereby causing the ball and cylinder to leap from the level of the water in the cistern to the rubber seating H at the top of the valve. This at once seals the outlets C. The full pressure then acts instantaneously between the internal head portion of the cylinder D and the loose flange collar I resting on the rubber seating J. This seating, by the pressure of water on the flange collar, expands, and effectually closes the lower portion of the cylinder D; and thus, in conjunction with the air confined in the cylinder, the supply is immediately stopped in a silent manner. The working portion of the valve has free play, and is free of any kind of packing. On an intermittent service a cistern of 150 gallons is filled and the supply cut off in a few minutes; drawing off or emptying the cistern directly after filling has no effect on the valve, as it will not give a further quantity by the falling of the ball. The day's supply having been delivered, the valve remains locked until released by the turncock in the roadway, when it resets itself for the next supply. On constant service a supply of fresh water need only be admitted by the householders when required. The free inlet and outlet passage of the valve and its ability for shutting off instantaneously while full on renders the apparatus noiseless in its action, and the unpleasant hissing sound made by the water in passing through the house to the cistern is removed. The supply is under the consumers' control, and the quickness of delivery being equal to about 800 gallons per hour, cisterns of 50 gallons will be of sufficient capacity for any premises. It has been severely tested, and its use sanctioned by several London water companies. It is made by Mr. F. W. Mann, Stonenest-street, Tollington Park, Holloway.



MANN'S CISTERN VALVE.

ROYAL METEOROLOGICAL SOCIETY.—The Council of the Royal Meteorological Society have arranged to hold at 25, Great George-street, S.W.—by kind permission of the Council of the Institution of Civil Engineers—on the evenings of March 16th and 17th next, an exhibition of barometers. The committee will also be glad to show any new meteorological apparatus invented or first constructed since last March.

LETTERS TO THE EDITOR.

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

FLOW IN OPEN CHANNELS.

SIR,—I wish to draw attention to and disprove what I conceive to be a gross fallacy, namely, that in an open stream the water in any long hollow in the bed, or upstream of and below the crest of a weir or fall, is still, or practically still, or that the motion of the water in such a case is different from what it would be if the obstruction were caused in any other manner than by a rise in the bed or bar extending across the channel. In a paper on "The Roorkee Hydraulic Experiments," read before the Institution of Civil Engineers by Major Allan Cunningham, R.E., the author, referring to the Ganges Canal, says that there has not been much silting above the raised crests of the falls, and that "this disproves the idea sometimes advanced that an obstruction across a channel causes a still-water pool above it, roughly flush with its crest" ("Min. Proc." Inst. C.E., vol. lxxi., page 3). In the discussion on the paper Mr. J. W. Stone says—page 85—that this assertion must be accepted with caution, and that the large amount of silt which accumulated above some weirs which he had built "went to show that the author's deduction was not invariably correct." The author of the paper also appears to be of opinion that obstructions extending across a channel have some peculiar influence on the flow, for he says, when speaking of the sites of his experiments, that "it is desirable to avoid complication of the motion by obstructions below the site, so that experimental sites should not be situated in marked hollows in the bed slope" ("Roorkee Hydraulic Experiments," Chap. I., Art. 7); and he also—Chap. III., Art. 13A—speaks of the Belra site as being disadvantageously situated, because the bed of the channel was about 2ft. lower than the crest of the fall at Jaoli, which is four miles downstream of the site. The above remarks are sufficient to show that the fallacy above mentioned still exists. I will now proceed to the arguments which can be brought against it.

If a very short portion of a channel be widened, the water in the wide portion will be still, or will move only in eddies; but if the length of the widened part be great, compared to the amount of widening, then the whole of the water will move forward. If a channel whose width is 20ft. be widened to 30ft. for a length, say, of 100 yards, not only will the whole of the water in the wide portion be in forward motion, except perhaps near the points where the width changes, but there will be nothing in the motion to indicate to an observer that the width is not 30ft. everywhere. What can be more reasonable than to suppose that what applies to hollows in the back applies also to hollows in the bed? If a hole whose length is not many times greater than its depth be dug in the bed of a stream, the water in the hole will be practically still, but it will not be still if the length of the hollow be great compared to its depth.

Next let us consider a fall in a uniform channel. If the crest of the fall be flush with the bed—Fig. 1—the water surface will be drawn down for a great distance in a convex curve; but if the crest be built up to the proper height—Fig. 2—the water level above the fall will be just the same as if no fall existed. The water level slope, section of stream and discharge being all the same as if no fall existed, the flow must be in every respect the same. How can there be a still-water pool, and why is a site above the fall worse than any other? If the discharge of the channel be increased, there will be a "draw," as in Fig. 1; and if the discharge be reduced, there will be a heading up, as in Fig. 3. A site might be considered objectionable because it was in the length so affected; but this has nothing to do with the bed being above or below the crest of the fall.

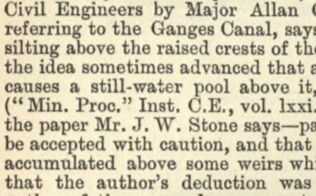


FIG. 1. FIG. 2. FIG. 3.

Now take the case of a weir across a uniform channel—Fig. 3. It is immaterial whether or not there be a fall just below the weir. The water surface assumes the form of a concave curve, the depth and sectional area of the water increasing towards the weir, and the surface slope diminishing. The discharge at any point depends on the section of stream, hydraulic radius, and surface slope. As the two former increase the latter diminishes, and the discharge is the same at all points. Now what would be the case if the water below A B were still? We should have the section, radius, and slope all diminishing together and the discharge remaining constant! There is a point where the whole section of the stream ceases to move forward, but that point is very near the obstruction where the eddy begins—C D, Fig. 4. At this point the surface slope begins to increase to make up for the reduced section of the stream. The slope increases and the section decreases till the crest of the obstruction is reached.

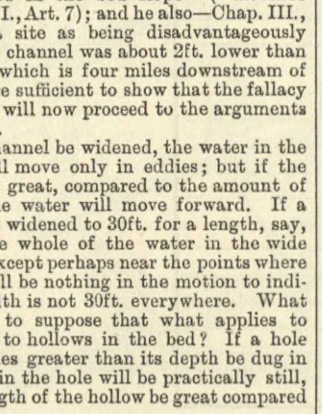


FIG. 4. FIG. 5.

Instead of a weir, the heading up might be caused, say, by walls built out from the sides of the channel, or by a pier in the middle, or by baulks placed across the channel, with a space left underneath them for the water to flow through. I presume that no one will say that in any of these cases the water in a line with the obstruction is still for any considerable distance upstream. Not only is it in motion, but the flow, except in the immediate neighbourhood of the obstruction, is not affected by the form of the obstruction. In the case of a central pier, the maximum velocity remains in mid-stream till just before the pier is reached; and even if the obstruction consists of a wall built out from one side only, and clearing a large portion of the water-way, the flow a short distance above the obstruction will be found to be perfectly symmetrical, just as it is a short distance above a bend, however sharp. In every case the flow, except for a short distance above the obstruction, is exactly the same as it would be if the heading up were caused by the debouchure of the stream into a lake or river, or by a rise in the bed—Fig. 5. There is no reason why it should be otherwise in the case of a weir.

The section where the flow becomes influenced by the form of the obstruction may be a little upstream of the commencement of the eddy. The water in the hollow *e f* may be moving slowly. This, however, affects only the distribution of the velocities in the cross-section, and does not appreciably affect the water level. There may be a corresponding slowly-moving portion of stream in the case of an obstruction built out from the side, but a very short distance above the obstruction the flow will be symmetrical. Given the amount of heading up at G H, the condition of flow above G H—and practically, as far as water level is concerned, above C D—will be the same in all cases whatsoever. In the Roorkee experiments most of the work was done at sites which were frequently within the influence of heading up caused by raised crests of falls, or by baulks placed across the channel; and yet the experimenter objects to obstruction caused by a rise in the bed!

The above arguments appear to me to be pretty conclusive, but there is yet another. In a silt-bearing stream a short recess in the back or hole in the bed silts up almost immediately, but a long hollow or reach upstream of a weir or raised crest of a fall does not necessarily silt at all, as it most certainly would were the lower layers of water still or nearly still. And more than this; if the velocity of the stream is too great for the channel, hollows in the bed are frequently formed by the current. On the Ganges Canal the bed a short distance above a bridge floor has in many cases been scoured out to a depth of 3ft. or 4ft. below the floor, which is left standing up like a weir. Similar instances could be quoted without number. In the cases mentioned by Mr. Stone, the silting doubtless occurred owing to the checking of the velocity of the whole stream—the weirs were from 8ft. to 11ft. high—and not because the lower layers were still. Any hollow in the bed of a stream is, of course, more likely to silt up if the discharge of the stream is very much reduced, as all the water in the hollow may then be nearly still; and silting occurring in this way has very probably given rise to the idea that there is always a still-water pool in such hollows.

February 5th. E. S. BELLASIS.

PILE DRIVING.

SIR,—For the sake of the readers of THE ENGINEER, would it not be better for Mr. Donaldson to devote the time he spends in scientific journal letter-writing to the study of text-books of mechanics? The questions which seem to trouble him are such as must have arisen before the minds of all thoughtful students of mechanics before they have fully grasped the laws they study by experiment and analogy. It is only necessary to refer to Mr. Donaldson's latest "Problem" in your last issue to illustrate this. The first question in the problem is, "What is the maximum momentum which a pile of given length and given sectional area can stand without receiving permanent injury?" It would not take a very advanced student to tell Mr. Donaldson that there is no "maximum momentum" the pile will bear; that we may apply equal momenta by means of monkeys at different velocities with very different results to the pile.

"Is the load which the pile has to support as a pillar at the instant of impact simply equal to the weight of the monkey, plus the weight $W \sqrt{\frac{2H}{g}}$?" Since the writer has assumed $W \sqrt{\frac{2H}{g}}$ to be the product of the mass of the monkey into its velocity, it is absurd now to call it a "weight." Moreover, the expression of the value of the force of compression under impact must involve the elasticity of the material of the pile.

Mr. Donaldson then makes a statement about the extension of an elastic string, and asks "may we, reasoning from analogy, conclude that the maximum load the pile would have to support as a pillar would be equal to $2W\left(1 + \sqrt{\frac{2H}{g}}\right)$?" Certainly not.

Your correspondent then proceeds: "I do not know how to calculate the initial momentum imparted to the pile," to which the elementary student would reply, "Since the pile is at rest, its initial momentum is zero, and that, after impact, the momentum of the combined monkey and pile is reduced to zero during the advance of the pile by the resistance of the ground. How Mr. Donaldson is going to set "the initial momentum imparted to the pile" against "the downward moving force of the weight of the pile," I do not know.

To the remainder of the "Problem" I must reply by asking the writer to put his two ideas of the elastic reaction between monkey and pile and resistance of the ground together, and recollect that two and two make four.

I had expected to place this before your readers much more briefly, but the little extra space I hope you will excuse, so that I may ask, Why should not Mr. Donaldson's "Problems" be relegated to less valuable space than the pages of THE ENGINEER? SCRUTATOR.

February 3rd.

FREE TRADE AND NO TRADE.

SIR,—I am not quite clear whether your correspondent, "M. H. R.," does or does not mean to discuss Free Trade and Protection with me. He asks me to verify certain statements which I have made, but he adds that he has no time for discussion. Am I to assume, then, that he will take my verification as final? I hope so, as it will save my time and your space.

The statements which he wants me to verify are—(1) That we pay in gold for German goods; (2) that under a protective tariff there are more persons employed than would be employed under Free Trade.

"M. H. R." contends plausibly that the Germans could not supply us with goods if we did not supply them, and that for each article we buy from them we must sell them something of equal value. If we employ Germans, say, in making cutlery for us, they employ Englishmen in making calicoes for them, and so it all comes right in the long run. Before going further, I may state that I have the best possible reasons for knowing that the German steel castings to which I referred were paid for in English gold; but I am quite willing to handle the subject on a broader basis than this fact involves.

First, then, all that I contend for is that that nation is best off in which the greatest number of the population can find remunerative employment. For the moment I will grant that "M. H. R." is right, and that England does not pay Germany in gold, but in goods. I will suppose, then, that we give Germany a ton of pig iron, worth £2, in return for £2 worth of table-knives. The labour expended in producing a ton of pig iron is very small compared to that expended on £2 worth of table-knives. The value of the raw material of the knives is little or nothing in comparison with the value of the labour spent on that material. The labour of one man will suffice to produce many tons of pig iron in a day, but by no possible means could one man produce £2 worth of cheap cutlery in a day. We give, so to speak, the labour of one man for a day in return for the labour of two or three men for a week. On this footing alone, and without any necessity whatever for alluding to gold, it is clear that the balance is against us. Before "M. H. R." can establish his proposition, he must prove that we find employment for as many hands in manufacturing goods for Germany as Germany employs in manufacturing goods for us. If he can succeed in doing this, I will admit that there is some force in his argument, but not till then.

I turn now to another phase of the assertion that we pay in kind, and not in money, for what we import. Will "M. H. R." explain how it is that the value of what we import enormously exceeds the value of what we export? In 1884 we imported from France goods to the value of £37,000,000; from Holland, £26,000,000; from Belgium, £15,000,000, or a grand total of £78,000,000. To pay for this we sent to France £17,000,000; to Holland, £10,000,000; and to Belgium, £6,000,000 worth of goods, or in all £33,000,000. That is to say, we paid for £78,000,000 worth of commodities with £33,000,000 worth, leaving a balance of £45,000,000 to be accounted for. How was this paid? Is it a purely fictitious figure? Did the goods we imported acquire value while they were at sea? Did the importers in France, Belgium, or Holland buy from us for £33,000,000 what they sold to the French, Dutch, and Belgian producers for £78,000,000? I must really ask "M. H. R." to occupy a scrap of his time in explaining this puzzle to me. It may be answered that the difference is represented by interest on British capital lent in France, Holland, and Belgium, which is paid us in kind, and not in gold, by the borrowing nation; but to concede this is to concede exactly that which I assert, namely, that British capital is, under the operation of Free Trade policy, finding employment for the foreigner instead of for the Englishman.

The Board of Trade returns for January, 1886, have just been made public. I hope your correspondent likes the story they tell. In January, 1885, we imported goods to the value of £35,669,000; in January, 1886, the value of imported goods was £28,983,000—a falling-off of £6,600,000. In January, 1885, we exported goods to the value of £21,875,527; this year, £20,693,890. Thus in a single month we received goods worth ostensibly £8,000,000 in excess of the value of the goods which, according to "M. H. R.," paid for them. "M. H. R.'s" contention is simply fatuous. By no conceivable line of argument can he escape from the dilemma that either the Board of Trade figures are delusive, or that there is an immense importation of goods into this country, representing foreign labour, in excess of our exportation of goods representing English labour.

I will advance another step, and point out to "M. H. R." that the hostile tariffs of Germany, France, &c., are specially intended to prevent us from paying with goods for goods received. I have already argued that the producer, and not the consumer, may pay the tariff. It is quite certain that we have to sell goods to Germany at a less price than we could get for them if no hostile tariff existed. Therefore, we get a smaller return than we otherwise would, which is a direct stimulus to the capitalist wanting German goods, to pay for them in something not taxed, namely, gold. It is indisputable that this country, under the operation of free trade, is a paradise for the man with a fixed income, and for the capitalist whose money is not embarked in trade, but these men do not represent the nation.

I come now to the last part of "M. H. R.'s" letter. He asks me to prove that under Protection more hands are employed than could be employed under Free Trade. I think I have already partly done this, but I will go further.

In 1885 we imported goods to the value of, in round numbers, £374,000,000, and we exported to the value of £213,000,000. The balance against us, therefore, was £161,000,000. Let us assume that of this £100,000,000 is represented by raw material; goods imported, not used, and exported, and that £61,000,000 remained for goods paid for by the British capitalist—as, for example, silk to the value of about £6,000,000—and so on. Almost the whole of this represents goods manufactured abroad. If, now, a tariff had existed, by far the larger portion of these goods would have been made at home, and so employment would have been found for our working classes, instead of for German, French, and Belgian workmen. I do not think "M. H. R." can contradict this proposition, but I should like to see him try. Does he fancy for one moment that if foreign tariffs were removed to-morrow the working classes of Europe would be benefitted? The capitalists would care nothing for the workers. They would buy in the cheapest market—possibly England—and whole hosts of men now earning their living in Germany would be left destitute, mills would be closed, and manufacturers would be ruined. There would be no resource left but emigration.

I repeat, and "M. H. R." has not urged a single argument to prove me to be wrong, that Protection distributes wealth by compelling those who are not manufacturers to purchase at home instead of abroad. Let us take the case of a landowner. He is paid his rents, not in kind, but in gold or its equivalent. Under Protection he will spend that gold in employing the labour of his fellow-countrymen to produce from raw materials what he requires. but under Free Trade he employs foreign workmen to labour for him, while his own countrymen stand idle. What is true of the landowner is true of capitalists of various kinds—the mineowner, the millowner, the shipowner, &c., to say nothing of the vast mass of the population paid salaries, not in kind but in gold, who buy freely abroad.

Be it remembered that I am not for one moment contending that Protection is a good thing for the world. About that I say nothing now. My argument is that Protection would give employment to men in this country who now have none; and, to prove the contrary, "M. H. R." must show that the difference between the value of our imports and our exports has no real existence; and that for every foreigner working for us there is an Englishman working for the foreigner. When he has done this I will admit that he is right, not before. TRADER.

February 8th.

TUNNELLING LINES.

SIR,—In your account, January the 22nd, of the Mersey Tunnel, you say:—"One of the most creditable features of this work is the almost absolute accuracy with which the two sections of the tunnel under the river—being bored, of course, separately, and dependent upon correctness of calculation—were eventually brought together. Engineers, at all events, will appreciate the merit of the work when they learn that the deviation where the two sections met in the middle of the river was only 1in. Neither of the shafts at Birkenhead nor Liverpool was in the centre line of the railway, and the greatest length of base line that could be secured for working from was 12ft. The distance across from shaft to shaft was 1770 yards, or rather more than a mile."

It would be interesting to have further particulars, and to know what were the amounts and directions of the deviations of the north and south instruments respectively. Assuming that the deviations were in opposite directions, then the average error of the two instruments reduced to circular measure would be $\frac{1}{63720}$; an extremely good result. If, however, the deviations happened to be compensating—that is, either both to the east or both to the west—then each instrument error may have been indefinitely greater than the above.

Last year, in tunnelling through Knightsbridge and Piccadilly for metropolitan main drainage works, the following results were obtained:—All the shafts were 12ft. in length clear of timbering. No. 1 shaft, 25ft. deep, was sunk opposite Wilton-place, and 396ft. east of open cutting work at Albert-gate. No. 2, 34ft. deep, at St. George's-place, 644ft. east of No. 1; and No. 3, 45ft. deep opposite Apsley House, Hyde Park-corner, and 576ft. east of No. 2. No. 1 shaft line going westwards showed a deviation of one-tenth of an inch as compared with the true centre line at Albert-gate, or equivalent to an absolute instrument error of $\frac{1}{47520}$ in circular measure. Between No. 1 and No. 2 shafts there was a curve, and the intersection point was fixed by measurements from No. 2 shaft and two-thirds of the curve completed, and upon the junction heading being afterwards driven, the No. 1 shaft tangent came to within one-eighth of an inch of the intersection point, or an average instrument error of $\frac{1}{61824}$. No. 2 and No. 3 shafts were both on the same tangent, and the deviation of lines at the junction was one-tenth of an inch, equivalent to an average instrument error of $\frac{1}{69120}$. In this case the lines were not produced to the opposite shafts respectively so as to determine the separate instrument errors, but the lines appeared parallel for a length of 100ft. at the junction, and hence it is taken that the deviations were non-compensating.

The average of the last two fractions is almost identical with that given above for the Mersey Tunnel, and the results are to a great extent comparable, as the lengths of shaft base lines happened to be in both cases the same.

GEO. P. CULVERWELL, B.A., Assoc. M. Inst. C.E.

3, Victoria-street, Westminster, February 5th.

LIQUID FUEL.

SIR,—With reference to the editorial note appended to my letter, published in your issue of the 5th inst., I beg to state that the Himalaya arrived in the Thames from Granton on Sunday, the 22nd November last, whereas the article referred to appeared in your issue of January 8th last.

Going down to Granton the oil-burning apparatus was too small for the boiler, so, of course, she could not keep up full pressure of steam; but returning to London, they made all the steam they wanted. PERCY TARBUTT.

75, Lombard-street, London, E.C., February 9th.

[*For continuation of Letters see page 134.*]

RAILWAY MATTERS.

A CONTRACT has been signed for the continuation of the Manitoba Central Railway from Brandon to Battleford.

It is stated that Sir Edward Watkin means to persevere with the Channel Tunnel Bill, despite the intention of the Board of Trade to oppose it.

THE Jury on Railway Appliances at the Antwerp Exhibition have awarded the gold medal to the Rowan steam car and the silver medal to the Cleminson car.

THE Metropolitan Board of Works has decided to oppose the Bexley Heath Railway Bill, but not to oppose the Wimbledon and West Metropolitan Junction Railways Company.

THE work of extending the tramway from the centre of the town of Barrow to the Ramsden Dock, a distance of a mile and a-half, has been commenced, and will be completed in about a month. The extended system of tramways will be opened for traffic in April or May next.

THE Metropolitan Board of Works, it is believed, will not oppose the Hyde Park Subway Bill, but they will oppose the Millwall and Greenwich Subway Bill, and also, among others, the Lea Purification Bill, and the West India Docks Bill, and the Horse Guards Avenue Bill.

AN agreement has been made by which the Manchester, Sheffield, and Lincolnshire Railway Company undertakes to work both the West Lancashire Railway and the Liverpool, Southport, and Preston Railway, and to purchase the rolling stock of the West Lancashire Railway at a valuation.

WHEN giants come together suddenly and as in a tearing rage, there is usually something to look at. Two goods trains came into collision at Dava, on the Highland Railway, on Saturday night, and great was the effect thereof. The drivers and firemen were seriously injured, and there was a considerable destruction of rolling stock.

A SHORT time ago we noticed that Messrs. P. and W. M'Lellan, iron merchants, Glasgow, had secured the contract from the Indian Government for a railway bridge over the river Jumna. We now learn that they have placed the steel, about 4000 tons in amount, with makers in West Cumberland, where they will obtain it on cheaper terms than they could have done in Scotland.

THE annual report of the North Staffordshire Tramways Company is regarded as satisfactory in that it shows a decrease in the traffic receipts of only £118. The entire decrease of revenue during the year was £430, but this is more than made up by the decrease in the expenditure of £1144. The ordinary share dividend was therefore increased from 3¼ to 3½ per cent. The company has now 6¾ miles of tramways in operation.

A MEETING of the North of England Iron Manufacturers' Association is to be held on the 11th inst. at Newcastle, in order to consider the question of railway rates as affecting the northern iron trade. It is probable that a petition to the Depression of Trade Commissioners will be adopted praying for an investigation. The concise conclusions arrived at and formulated by Sir Bernhard Samuelson, and embodied in his report to the Associated Chambers of Commerce, meet with general approval.

THE traffic through the Mersey Tunnel during the first week of opening was extraordinary, and, including those of the 7th, nearly 200,000 tickets were issued at the various booking-offices along the line. On Sunday it was estimated that the number of people who utilised the tunnel was about 20,000. There was a great crush, it is said, on Saturday, and many persons were compelled to take the boats. The receipts were at the rate of £80,000 per annum, so that traffic will have to grow to make a dividend.

THE London, Brighton, and South Coast Railway has declined to join in the proposed fusion of its system for working purposes with the London, Chatham, and Dover Railway. The Bill for that purpose, therefore, cannot proceed. Negotiations are, however, proceeding for effecting an arrangement for a division of profits at competitive points, and the joint use of certain stations, similar to the arrangements existing between the Brighton Company and the South-Eastern and South-Western Companies.

THE Hoodsworth Local Board have decided to oppose the Bills to dissolve the Tramways and Omnibus Company, and to empower the Birmingham Central Tramway Company to acquire existing tramways and construct other lines. In reference to the application of the Central Tramway Company to construct a double line of rails in the place of the single line now laid in Birchfield-road, it was decided at the last meeting of the Board to take no further action until a deputation from the inhabitants of the district had been received.

OWING to the breaking of a point lever bolt or rod on Tuesday morning at Potter's Bar station, on the Great Northern Railway, a total wreck was made of a goods train. The engine, in moving from the main line into the siding, left the rails and ploughed its way through a brick wall, and almost embedded itself in the concrete pavement of the up line of Potter's Bar station, when it turned over on its right side, falling across both tracks of the main line. The engine-driver and stoker miraculously escaped injury, but the engine is a total wreck.

GENERAL ANNENKOFF, who is in charge of the railway which is to connect the Caspian with the Amu-Daria, has contributed a paper on the subject to the French Geographical Society. The Russian officer describes the railway as a purely military route, and dwells on the fact that the work has been entrusted to army officials. A correspondent of a contemporary, in sending a note on the paper, and quoting it, says:—"Economy has thus been practised, as Russia is not rich enough to sacrifice hundreds of millions for a political object." It may be said that if this is true Russia has learned a new lesson. "The railway, as you are aware, is now open as far as Askabad; but the line to Ghiaours is ready. Between Ghiaours and Merv the railway is also finished, with the exception of the bridges and stations. General Annenkoff adds that the line which is to connect Merv with the Amu-Daria will soon be commenced. He gives a glowing account of the condition of Merv, and says that since that town has become Russian, houses have everywhere sprung up, and that it will develope into a beautiful city."

FOGS have been taking their turn at railway work this week, and, as usual, the interference not being successful, can be seen by its effects, though these are the result of not being able to see. The twelve o'clock express out from Euston had a narrow escape when running into Crewe station, where it hit with great force a passenger carriage which was being shunted. On Wednesday morning, during the prevalence of a dense fog, an alarming accident, involving injuries to a large number of persons, occurred at Finsbury Park station, the junction of the Great Northern and North London Railways. The accident took place a little before half-past eight, a time at which all the City trains are very crowded. The Great Northern train, timed to leave Finsbury Park for Moorgate-street at nineteen minutes past eight, was slowly moving from the platform. A North London train entered the station at a high rate of speed, dashing into the rear of the outgoing one. The shock was severe, the windows of carriages in some cases being shattered. Both trains were crowded and many of the passengers were badly shaken, while about a dozen had severe wounds, none, however, so far as could be ascertained, of a dangerous nature. The guard of the Great Northern train was injured, mainly by the plate glass in the roof of the van breaking and falling upon him through the violence of the collision. It is supposed that in consequence of the fog some misunderstanding existed on the part of the driver of the North London train as to the signals. At the time of the accident there was a large number of people on the platform, and great excitement prevailed. The traffic was, as a result of the collision, considerably delayed.

NOTES AND MEMORANDA.

IN no part of the southern hemisphere is population increasing so rapidly as in Sydney. In 1870 the population of the city and its suburbs was about 140,000; at the close of 1885 it was estimated at 290,000, having more than doubled in fifteen years.

THE rainfall of New South Wales, as compared with some other countries, does not support those who regard the Colony as peculiarly arid; but diminished rainfall is not so disastrous in its consequences in more temperate climates as it is in Australia. The meteorological records of England show that during the period between 1740 and 1750 there was only 71 per cent. of the average rainfall. In some parts of Europe—Sweden and Russia—the rainfall is as low as 15in. per annum; the average for twenty years at Marseilles was 12·8in., and at Alicante the total for the year has fallen as low as 7·1in.

A CURIOUS note comes from abroad, but as it is electrical, we need express no surprise at its being not quite credible:—"Lieutenant Immer Gosende, of the German Navy, and Dr. Kummel, have explored North-East Guinea. They report that they reached a spot twelve days' march from the coast, and discovered that their compass was useless, owing to the presence of a tree which possesses the properties of a highly-charged electrical battery. Dr. Kummel was knocked down when he touched it. Analysis showed it to consist of almost pure amorphous carbon. It has been named Elsassia electrica."

THE amplitude of the oscillation of chimneys has been exactly measured by observation of their shadows cast by the sun upon the ground. The oscillations of a chimney 115ft. high and 4ft. in diameter externally at the top, near Marseilles, were observed last summer by the shadow, during a high wind, to attain a maximum of 20in. It was estimated that the chimney deflected by an initial impulse, would have made four or five oscillations before returning to a state of rest. On the contrary, by a succession of impulses isochronous with the oscillations, a chimney may finally be overthrown. Such is the explanation of the destruction of certain chimneys in which, nevertheless, all the conditions of statical stability were fulfilled.

HITHERTO no substance amongst those which exhibit diamagnetic properties has been observed to possess any permanent diamagnetic polarity analogous to the permanent paramagnetic polarity of hard steel. The property of retention of diamagnetisation is, however, found by Dr. O. Tumlirz, of Prague, to be possessed by rock crystal. Both those specimens which show right-handed and left-handed optical properties are alike in this respect, and the axis of diamagnetisation appears to be independent of the crystallographic axis, and dependent only on the axis of initial magnetisation. Dr. Tumlirz, whose investigation is published in *Wiedemann's Annalen*, appears to think that these facts negative Becquerel's theory of diamagnetism.

DURING some experiments on the laws of compressive strength, by M. Banshinger—"Proceedings" Inst. C.E.—two were made, in one of which the pressure was applied to a portion only of the end-surfaces of the prismatic test-pieces, and uniformly distributed, while in the other the distribution was not uniform. For the former experiments small steel cubes were used for concentrating the pressure on a portion only of the surfaces of the test-pieces. When one surface was entirely supported, while pressure was applied to a part only of the other, fracture resulted in a pyramid having the smaller surface under pressure for its base being driven into the test-piece. When two steel cubes of equal dimensions were used at either end for applying pressure to a cubical test-piece, the results showed that the force required for crushing was the same as if the test-pieces were a prism with a base equal only to that of the steel cubes and of the height of the test-cube, the material surrounding this prism appearing not to affect the strength.

A CHEMICAL process for making carbon filaments for incandescent lamps is described by Mr. A. Smith in *Dingler's Polytechnisches, J.* 257, 338. Hydrogen chloride is passed through furfuraldehyde, or fucusaldehyde, and a black liquid is obtained which is placed between two glass plates. From this liquid a thin layer of carbon separates after eight or ten hours, and the thickness of the layer is regulated by inserting wires between the plates. This layer is removed, cut into strips, and twisted, and heated to 100 deg. Cent. Afterwards these filaments are heated in closed crucibles, through which a current of marsh gas is passed. Their electric resistance can be changed by the addition of 2½ per cent. of lamp black to the furfuraldehyde. For the preparation of carbon rods for arc lamps finely powdered carbon is mixed with from 60 to 70 per cent. of furfuraldehyde, and the mixture subjected to powerful pressure in suitable moulds. The rods thus formed are exposed to the action of gaseous hydrogen chloride, after which they are highly heated in closed crucibles covered with powdered carbon.

COPPER mining is largely carried on in New South Wales, the most important mines being the Great Cobar, situated 497 postal miles west of Sydney, in the centre of the vast plains which lie between the Macquarie and the Bogan Rivers. The ore is so rich and abundant that the industry has been a very profitable one until a very recent period, notwithstanding the great distance of the mine from the settled portion of the colony. The produce of the mine has to be hauled by wagons a distance of eighty miles to Nyngan, the nearest railway station. The industry has caused a large settlement to spring up at Cobar, and it is estimated that within a radius of three miles the population is within 3000 and 4000. The Great Cobar Mine gives employment to about 900 persons. The company working the mine at present experiences great difficulty in getting the copper to market. The amount of refined copper produced during the year was 4765 tons. During the year 1884 the Great Cobar Company raised 21,561 tons of ore, and smelted 23,899 tons, yielding 2769 tons of fine copper. At the end of the year the company had ready for smelting 1000 tons of 10 per cent. ore, 5000 tons 8 per cent., and 2233 tons 5 per cent. Up to the close of 1884 the company had smelted 122,795 tons of ore, the average yield of which was 13·17 per cent. of fine copper. The greatest depth of the main shaft is 564ft., and from that diamond drills have been sunk 60ft. further. The lode at this depth is said to show a thickness of 40ft. of fair yellow sulphide ore.

THE following are among the prizes offered this year by the Paris Academy of Sciences:—Geometry: A study of the surfaces admitting all the symmetrical planes of one of the regular polyhedrons—3000f.; Francœur prize, the work most conducive to the progress of the pure and applied mathematical sciences—1000f. Mechanics: Extraordinary prize of 6000f. for any work tending most to increase the efficiency of the French naval forces; Montyon—700f.—invention or improvement of instruments useful to the progress of agriculture, of the mechanical arts or sciences; Plumey—2500f.—improvement of steam engines or any other invention contributing most to the progress of steam navigation; Dalmont—3000f.—the best work by any of the Ingénieurs des Ponts et Chaussées in connection with any section of the Academy. Astronomy: Laland prize—gold medal worth 540f.—for the most interesting observation on work most conducive to the progress of astronomy; Damoiseau—10,000f.—best work on the theory of Jupiter's satellites, discussing the observations and deducing the constants contained in it, especially that which furnishes a direct determination of the velocity of light; Valz—460f.—for the most interesting astronomical observation made during the course of the year. Physics: Grand prize of the mathematical sciences—3000f. for any important improvement in the theory of the application of electricity to the transmission of force. Statistics: A prize of 500f. for the best work on the statistics of France. Chemistry: Jecker prize—5000f.—for the work most conducive to the progress of organic chemistry. Geology: Vaillant prize, on the influence exercised on earthquakes by the geological constitution of a country by the action of water or of any other physical causes.

MISCELLANEA.

THE Manchester Ship Canal Company has lodged the £20,000 it was required by its Act to deposit in respect to the undertaking of the Bridgwater Navigation.

THE American Elevator Company has obtained the contract for the hydraulic elevators for the Northumberland Avenue Hotel—four in number. The water is to be furnished by means of a Worthington steam pumping engine.

RAPID desiccation of timber by means of cool air is being tried, and is said to effect a complete "seasoning" in about three days. Some holders of large stocks of timber are somewhat alarmed at the announcement of the invention, but they need not be. Very rapid desiccation can never produce a really sound timber.

THERE were twenty-nine shipwrecks reported during the past week, five of which were steamers, making the total for the present year 170. Ten were lost off the British coasts, three were abandoned at sea, three foundered, three sank by collision, and one was missing. The number of British-owned vessels was fifteen.

THE death is announced on the 1st inst., at 22, St. Helen's-road, of Captain John Kell, in his eighty-second year, late of East India-road, London, and Plumstead-common, Kent. Captain Kell was superintendent of the stowing of the first Atlantic cable in the Agamemnon, which returned disabled, and had to re-land the cable.

IT is doubtful whether the Corporation Tower Bridge, which was sanctioned by Parliament last year, will, after all, be carried out. The bridge authorised was an opening bridge, but the question has now arisen whether a solid bridge should not be constructed. If that plan is decided upon the present Act will lapse, and a new Bill must be promoted.

MR. DEPUTY WHITE has proposed—"That a special committee be appointed to confer with the owners of property and the wharfingers between London Bridge and the proposed bridge at the Tower, to ascertain if conditions could be arranged whereby a solid bridge of similar elevation to that of London Bridge could be substituted for that proposed, and to report."

THE Blackwall Galvanised Iron Company has started working a new galvanising bath, which is the largest bath in England. It is constructed to galvanise large tanks, plates, and machinery of all kinds, cast and wrought. In many cases the size of such work as can now be galvanised has had hitherto to be modified, because there was no bath large enough to galvanise it.

THE prospectus has been issued of the West Gloucester Water Company, formed for the supplying of part of Bristol and several outlying districts with spring water. Works are at present in course of construction for supplying one district within the area, and containing about 40,000 inhabitants. The capital is to be £60,000, in 600 shares. Mr. H. J. Marten, M.I.C.E., is the engineer, and the offices are in Alliance-chambers, Bristol.

MR. JOHN CLAYTON, of the Soho Ironworks, Preston, who made and fixed the boilers, and carried out the ventilation system in the House of Commons, the boilers in the British Museum, and a large number of boilers for the Royal arsenals and dockyards, and who also made the compressed air tram engine which gained the gold medal at the Inventions Exhibition, and the enormous floating gates for the East and West India Docks at Tilbury, has recently died in his eighty-fourth year.

THE Admiralty authorities, considering that the torpedo boats lately completed for the Austrian Government by Messrs. Yarrow and Co., Poplar, represent a notable advance in the construction of vessels of the class, lately ordered a special report to be made of their performances. The practical result of this has been that Messrs. Yarrow have received instructions to immediately put in hand and to finish with all despatch a similar boat for her Majesty's Navy, but subject to several important improvements.

A BOARD of Trade Report, by Mr. G. Carlisle, has been published concerning the explosion of a fuel economiser at the Canal-street Works, Todmorden, of Messrs. Lord Bros. From this it appears that the explosion was due to high pressure and thinness of pipes, the pipes being incrusted and corroded. In the evidence of Messrs. Green and Son it was stated that the economisers are tested to from 350 lb. to 400 lb. per square inch when intended to work at 60 lb. to 80 lb., that the bursting pressure when new would be about 1000 lb., and that the life of the apparatus is from twenty to twenty-five years.

THE Custom House of the harbour of St. Petersburg has recently caused soundings to be made in the Neva channel from the Palace Bridge to the landing quay for foriegn steamers. The depth was found in some places to be no more than 11ft. The Custom House, recognising the difficulty thus imposed on foreign steamers drawing any quantity of water, which are obliged to land at the Grand Quay, has signified to the St. Petersburg Municipal Council its sense of the necessity of allotting a credit of 3000 roubles for the expense of clearing out the channel for the whole length of the river from the entrance of the maritime canal to as far as the Exchange, and also the channel of the Little Neva from the Exchange to the Toutchkow Bridge.

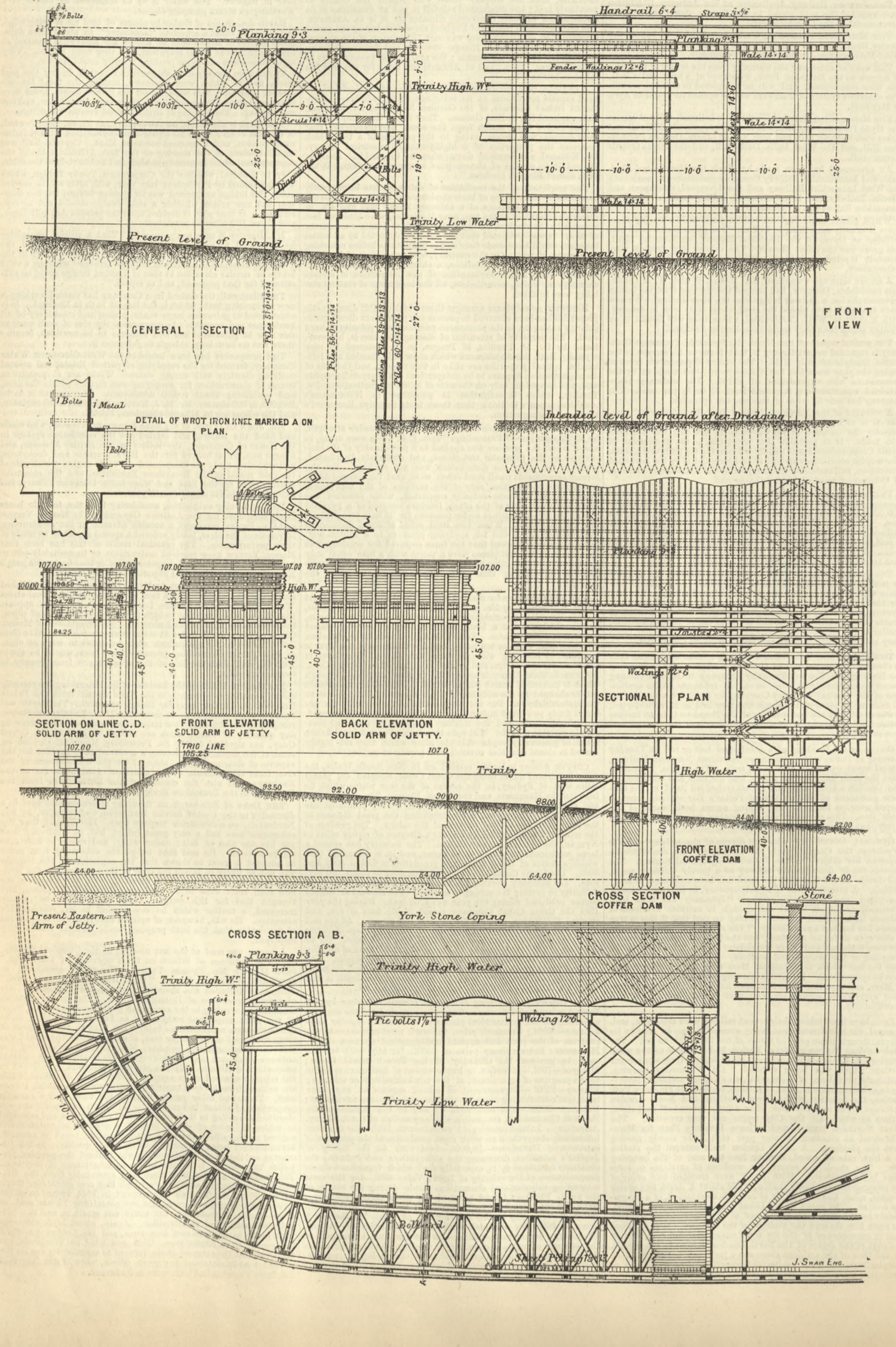
THE Duke of Edinburgh on Saturday afternoon took part in a discussion in the United Service Institution upon a paper, by Mr. Nordenfelt, on a submarine torpedo boat. He thought that the submarine boat had a very great future, but he evidently does not like the idea of being under water, and seems to look into things a little. He said that before the submarine boat could be adopted it must be shown that the explosion of the torpedo was not as likely to injure the crew of its own boat as the iron-clad against which it might be directed. He did not quite see how such craft were to be used against vessels in motion, and thought that for this purpose their speed must be greatly increased, a matter which he commended to Mr. Nordenfelt's attention. He was, however, of opinion that it was on the surface of the water that the boat proposed could be most successfully employed.

A PAPER was read at the last meeting of the Chemical Society, on "The Influence of Silicon on the Properties of Cast Iron," Part III., by Mr. Thomas Turner. The paper considered in detail the Woolwich Report, "Cast Iron Experiments, 1858." This report included the chemical analyses and mechanical tests of seventy specimens of British cast iron. The author classifies these irons according to the amount of phosphorus present. Some of the more important results are as follows:—(1) Only eight specimens were mentioned as being "too hard to turn;" seven of these contained under 0·9 per cent, of silicon, while the eighth was rich in phosphorus and sulphur, facts strongly supporting the author's conclusion that a softening effect is produced by a suitable proportion of silicon. (2) The six best specimens mentioned in the report contained on an average 1·393 per cent. of silicon, while the author, from his own experiments, recommended about 1·4 per cent. These and other results support the view that a suitable proportion of silicon is beneficial. (3) When the specimens are classified according to their proportion of phosphorus and arranged in tables in order of silicon present, a gradual improvement is noticed as the silicon increases until a certain point is reached, beyond which point the metal deteriorates in quality. In the discussion on the paper, Professor Unwin noticed the popular prejudice that silicon is a very injurious constituent of cast iron. This prejudice arose a long time ago, apparently from the difficulty experienced in smelting very rich iron ores containing much silica. Thus, the Turkish Government in 1844 wished to utilise an exceedingly rich ore—magnetic ore containing 12 per cent. of silica—found at Samakoff, but could not smelt it, and the difficulty was attributed to the silica. Again, about 1853, attempts were made to improve cast iron guns, and Mr. Cochrane advised the use of Nova Scotia iron. This was tried at Woolwich, but the Chemical Department there refused to sanction its use on the ground that it contained too much silicon, notwithstanding that Fairbairn's mechanical tests were in its favour.

DETAILS OF TIMBER WORK, ROYAL ALBERT DOCK EXTENSIONS.

MR. ROBERT CARR, M.I.C.E., ENGINEER.

(*For description see page 109.*)



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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Friday, Feb. 12th, at 7.30 p.m.: Students' meeting. Paper to be read, "Gold Mining in the Wynaad, Southern India," by Mr. A. S. B. Oakley, Stud. Inst. C.E. Mr. John Arthur Phillips, F.R.S., M. Inst. C.E., in the chair. Tuesday, Feb. 16th, at 8 p.m.: Ordinary meeting. Paper to be read, with a view to discussion, "The River Seine," by Mr. L. F. Vernon-Harcourt, M.A., M. Inst. C.E.

ROYAL METEOROLOGICAL SOCIETY, 30, Great George-street, Westminster, S.W.—On Wednesday, Feb. 17th, at 7 p.m., the following papers will be read:—"General Remarks on the Naming of Clouds," by Captain Henry Toynbee, F.R. Met. Soc., F.R.A.S. "On the Thickness of Shower Clouds," by Mr. Arthur W. Clayden, M A., F.G.S. "On the Formation of Rain, Hail, and Snow," by Mr. Arthur W. Clayden, M.A., F.G.S. "On Three Years' Work by the Chrono-barometer and Chrono-thermometer, 1882-84," by Mr. William F. Stanley, F.R. Met. Soc., F.G.S.

PARKES MUSEUM OF HYGIENE, 74A, Margaret-street, Regent-street, W.—Thursday, Feb. 18th, at 8 p m.: Lecture by Mr. Victor Horsley, M.B., F.R C.S., Professor-Superintendent of the Brown Institute, "On Hydrophobia."

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, Feb. 15th, at 8 p.m.: Cantor Lectures. "Science Teaching," by Professor F. Guthrie, F.R.S. Lecture I.—Science as an element in education. Tuesday, Feb. 16th, at 8 p.m.: Foreign and Colonial Section. "The Present State of the Colonial Possessions of Great Britain," by Mr. Robert James Mann, M.D., F.R.C.S. The Hon. Sir Saul Samuel, K.C.M.G., Agent-General for New South Wales, will preside. Wednesday, Feb. 17th, at 8 p.m.: Eleventh ordinary meeting. "Some Points in Electrical Distribution," by Professor George Forbes, M.A., F.R.S.E. Friday, Feb 19th, at 8 p.m.: Indian Section. "Historical and Recent Famines in India," by Mr. F. C. Danvers, F.S.S., Registrar and Superintendent of Records at the India-office. Mr. J. M. Maclean, M.P., Member of the Council, will preside.

THE ENGINEER.

FEBRUARY 12, 1886.

COLLISION BULKHEADS.

THE principle of bulkhead subdivision of a vessel's hold, considered as a source of safety, originated with the employment of iron as a material for ships. There were, of course, bulkheads in wooden ships before the use of iron was introduced, but such partitions were for division of cargo, stowage of stores, and separation of the habitable parts from the remainder of the vessel. It is doubtful whether in those days the idea of keeping a damaged vessel afloat by means of her original bulkhead subdivision was ever entertained, although it is well known that stranded vessels were often floated by means of temporary arrangements of the kind. The materials of such vessels and the consequent modes of combination were not such as would be likely to contribute to the trustworthiness of bulkheads under such circumstances as a collision either with a rock or with another vessel. Water-tightness of the kind being secured by fastening and caulking long lengths of planking, it is clear that any penetrative shock received at one part of a plank would start the remainder, and so the effect of the damage would be widely distributed and probably extended beyond the bulkhead partition which was intended to localise its consequences. Collision bulkheads were, therefore, not adopted simply because they would only be of use under rare and exceptional circumstances. But the methods of combination rendered necessary by the employment of iron in shipbuilding, together with the physical qualities of that material, altogether altered the conditions of the case. The effects of a penetrative blow on the hull of an iron or steel vessel are local in their character, and usually confined within limits which do not extend far beyond those of the absolute contact of the penetrating body. The form and fibre of wood materials are determined by the growth of a tree, but iron or steel can be bent, rolled, or forged to any shape whatever, and the limiting conditions of dimensions are overcome by the aid of the rivet. Hence with the advent of iron ships we find provision made for their safety in the form of bulkheads. This was no doubt partly due to a sense of timidity in venturing upon the sea in a vessel built of such an unlikely floating material as iron—especially with a shell relatively so thin when compared with that of a wooden ship. The man who first ate an oyster has been generally credited with much courage and enterprise—but to us it seems that far higher qualities of that kind were exhibited by those who first ventured to embark upon the ocean in a vessel of iron.

Transverse water-tight bulkheads, and collision bulkheads in particular, date then from the earliest sea-going iron ships. Indeed, as far as concerns sailing vessels, water-tight subdivisions were carried to a greater extent thirty years ago than now. Very few iron or steel sailing ships built at the present day have more than the one transverse bulkhead, which is known as the collision bulkhead; but steamers are better provided in this respect, having also bulkheads at the fore and after boundaries of their machinery spaces, a bulkhead aft, and in larger vessels a bulkhead dividing the fore and main holds. The machinery space bulkheads are primarily intended to separate the engines, boilers, coals, &c., from the cargo; but all the transverse bulkheads are expected to serve the purpose of keeping the vessel afloat in the event of any of the compartments being penetrated so as to admit water. This being so, it becomes a matter of importance to insure —(1) that no single compartment may hold enough water to sink the vessel; and (2) that each transverse bulkhead is strong enough to endure the pressure due to the compartment which it bounds being filled with water to the load line. Except she be in the Royal Navy, we are not aware of any vessel afloat which fulfils the first of these conditions, although many of those on the Admiralty selected list for employment as transports and cruisers approximate very closely thereto in their structural arrangements. To fulfil the condition is, in fact, very difficult, and commercially speaking impracticable. It may be attained in regard to most of the compartments, but rarely in that which contains the machinery and boilers; and even in the cargo spaces, an extensive subdivision is found to be a costly arrangement when the questions of storage, loading, and discharging are taken into account.

The problem therefore resolves itself into one which chiefly concerns the efficiency of the collision bulkhead, the name of which sufficiently indicates the valuable purpose which it is intended to serve—viz., that of keeping the vessel afloat when her stem and bow plating are fractured through collision. This duty is a possible one, and the value of the collision bulkhead has very many times been satisfactorily demonstrated by the preservation of life and property. The volume of the fore peak space will never be very considerable when the position of the bulkhead is wisely fixed, and therefore the quantity of water which it will contain—or rather the loss of buoyancy due to its penetration—will not seriously impair the seaworthiness of the vessel. At the same time it is prudent to fit the bulkhead sufficiently far from the stem to be well abaft any damage which the bow would be likely to receive from such a cause as collision. A happy mean has therefore to be struck between the limits suggested by these considerations; there must be neither too much space in the fore peak, nor must the bulkhead be too close to the stem.

We have next to consider the structural qualities of the bulkhead, which, when the bow is broken, becomes the shell of the vessel. This is a subject which has not until recent years received the attention which it merits. There is no more fertile source of damage to shipping at the present day than collision. A large proportion of the total losses, regarding which no particulars come to light, are doubtless due to this cause—both the parties having succumbed in the encounter. Now remembering that in collisions between two ships it almost invariably happens that the bow of one strikes some part of the other, it would appear that one at least of the colliding vessels should, in most cases, survive with injuries not too considerable to prevent her from reaching port. That this is often the case must be admitted, but it might perhaps happen oftener if the collision bulkhead were properly placed and properly made. The position of the bulkhead is usually more satisfactory than its construction, although both are sometimes at fault. When we hear of a bulkhead being unable to endure the pressure of water against it without the assistance of shores on its aftermost side, we may be sure that either such a bulkhead is insufficiently stiffened or else that it is so close to the seat of damage as to be injured where it is connected to the side of the vessel. Now there is no excuse for an iron or steel bulkhead being insufficiently stiff, for with such material a bulkhead may be made as stiff and rigid as one please. Mr. Clarke Russell, in his nautical novel, entitled "Jack's Yarn," describes a shipwreck through collision, in which the vessel, which was of iron, had to be abandoned because, with all their shoring, the collision bulkhead could not be kept in place. But this collision bulkhead was of wood, and probably the only one of that material that was ever fitted in an iron ship. Such a thing should never happen to an iron or steel bulkhead—nor do we think it would to one of the most recent construction.

The stresses to be resisted by a collision bulkhead when the bow is damaged are, hydrostatically, the same as those acting upon the steel plating, but the dynamical stresses are generally much less considerable, as the force of blows from the sea will be much broken by the portion of the bow still remaining in place. But the direction of the vessel's motion in the water being perpendicular to the plane of the bulkhead, it consequently happens that the plating composing it endures greater pressure, under such circumstances, than the ordinary plating of the bow. Now, remembering that the shell of the vessel is of a curved form, while the plating of the bulkhead is flat, it will at once be seen how much superior is the former, on that account only, to the latter, in its ability to resist the stresses acting upon it. The shell of a vessel may, indeed, be likened to the cylindrical portion of a boiler, and the collision bulkhead—when the bow is damaged—to either of the flat plates of the ends, which require the assistance of stays in order to put them in an equal condition of strength with the parts that are curved. But while the shell plating of the vessel is stiffened with ribs composed of frame and reverse bars spaced 24in. apart, besides deck stringers, &c., the collision bulkhead was, until of late, stiffened with comparatively small angle bars, spaced as much as 30in. apart. The vertical stiffeners now used are much larger, and the enforced use of horizontal stiffeners on the opposite side of the bulkhead, still further contribute to equalise the strength of the collision bulkhead with that of the shell of the vessel. But the form of the collision bulkhead is not strong in itself, and even more than has hitherto been done seems still to be needed in order to make it perfectly trustworthy under all conceivable conditions when the stem and bow plating are punctured or partly carried away. Should two or more completely laid deck flats rest upon a stringer rivetted to the after side, there would in that case be no fear of the bulkhead being dangerously deflected by water. When vessels have very deep holds, by reason of hold beam stringers and widely-spaced beams taking the place of decks, it certainly seems necessary to give more support to the collision bulkhead than is afforded by the vertical and horizontal stiffening angle-bars. The stresses upon the bulkhead when forced through the sea and made to perform the functions of a stem, are much greater than the bulkheads of deep ballast tanks are called upon to endure. The latter are stiffened with plate bulb iron rivetted to the vertical stiffeners, and such an arrangement would furnish all the support that the collision bulkhead is ever likely to need. Under any circumstances a horizontal plate stringer should be rivetted to either the fore or after sides of the bulkhead whenever a tier of widely-spaced beams is fitted in lieu of a laid deck flat.

The contingency against which the bulkhead provides may, perhaps, by some be considered remote; but as long as the risk exists, if we provide against it at all, we should do so thoroughly. But the contingency is not a remote one, as the owners of cargo steamers, and the underwriters too, have good reason to know. That so many vessels are saved every year by these bulkheads is the most satisfactory proof of their importance, but that any should be lost because their bulkheads are not strong enough is a reason for giving still further consideration to the subject. The matter has not escaped the attention of Lloyd's Register, who have recently added considerably to their requirements in this respect; and there can be no doubt, should it become apparent to that body that further strengthenings are necessary to collision bulkheads, provision for the same will speedily be made in their Rules.

DOMESTIC FIREPLACES.

MANY months have elapsed since our old friend, the domestic fireplace, has been made the subject of newspaper controversy. Mr. Pridgen Teale has been the first to disturb public repose this year. On Monday night he delivered a lecture on "The Domestic Fireplace," at the Royal Institute. Mr. Teale had literally nothing new to say on the matter; all the old stock arguments in favour of a system of warming our houses different from that in general use were furbished up, made to look as bright and attractive as possible, and placed before a more or less sympathetic audience. The lecturer admitted that he could say nothing that had not been said to our forefathers by Count Rumford. He has devised a fireplace in which coal is to be burned at a dull red heat. This result is obtained by reducing the admission of air. Unlike many engineers and other inventors of fireplaces, Mr. Teale holds that the best results are got by burning coal at a low instead of a high temperature. By the use of his fireplace he has succeeded in reducing his coal consumption by one-fourth. He produces no smoke to pollute the air, and he has no cinders to go to the parish dust heap. He urges others to go and do likewise. It is no disparagement of Mr. Teale to say that we have heard something closely resembling his arguments, his description, and his advice a hundred times before. The result on the London mind of all this talking and lecturing and arguing is simply *nil*. Mr. Teale and his fellow-workers claim our admiration; but we cannot resist the temptation to smile even while we admire. The weak spot in their arguments possibly is that they have missed the whole essence of the question at issue. In one word, the public are so well satisfied with what they have got that they do not desire a change; and men of reasoning powers not inferior to that of Mr. Teale will see in this placid satisfaction something that needs explanation. If only mankind was discontented with its domestic fireplace, the fireplace would vanish like a dream. Mr. Teale and his fellow-workmen have to combat content with things as they are before they can bring about a change. They must persuade the householder that the hearth which he loves is really a very bad thing. It is waste of breath to tell him that other things are better. For the matter of that, it seems to be equally vain to tell him that the way in which he burns his coals is shameful. Mr. Pridgen Teale would do well to ask himself whether the conservatism of the householder is or is not well founded. Most men accustomed to look below the surface of things know that most so-called abuses, when they enjoy popular favour, are not so bad as they seem to be at first sight. Perhaps it may be so in this case. Let us see.

Mr. Teale and his fellow workers advocate alterations on the existing fireplace for two principal reasons, round which, as the main body of attack, skirmish a multitude of smaller reasons, which we need not concern ourselves with at present. The first of the two reasons is that with improved fireplaces we should save coal; and the second is that we should avoid the production of smoke, and so leave the air of our great towns pure. Now as regards the first, it is almost impossible to obtain any accurate figures concerning the saving of fuel effected by improved grates and fireplaces; but such evidence as is available goes to show that it is not large. We have no doubt whatever that Mr. Teale can himself, by looking after his own fires, save a good deal of coal; and this would be true even if he used the ordinary builders' "stove" instead of his own invention. But would it be true of his invention, in the hands of the ordinary householder and his servants? There is in existence a certain Smoke Abatement Committee, and an exhibition was held at South Kensington in 1882 under the auspices of this body. It is a suggestive circumstance that the Committee was threatened with legal proceedings, under the Smoke Nuisance Act, by those who lived near the Horticultural Gardens. But this is perhaps a digression. Very elaborate tests were carried out with a very large number of open fireplaces and close stoves. The close stoves were more economical than any of the open fireplaces. Among these last, however, there seems to have been very little to choose. Let us, for example, take the results obtained with a few of the inventions tested, and compare them. The value of each is estimated in terms of the rise in temperature produced in a room per pound of coal burned. Mitchell's common grate, with a fire-clay lining and floor, which is extremely like Mr. Teale's arrangement, raised the temperature 3·56 deg. per pound. Barnard and Bishop, with a "glow fire," and rather rapid combustion, did better, having as a figure of merit 4. Taylor's fireplace, with a perforated fire-brick back, 3·12. M. Perret, radiating fire-grate, fire-brick lining and roof, 2. Some fireplaces were tried which heated the air sent into the room. Two of these gave 2·66 and 2·16 as their figure of merit. In one word, fireplaces with all sorts of additions and improvements did not prove better or more economical than ordinary fireplaces. As to smoke, attempts were made to measure the quantity of carbon carried up the chimney, with only one result, namely, that it was so small that it could not be measured; thus bearing out C. Wye Williams' statement, that a few ounces of coal would suffice to account for the black trail, miles long, left behind her by a steamship. Let us take it for granted that Mr. Teale saves one-fourth of his coal bills. If he burns 20 tons a year he must have a large house and many fires. The saving in money will be in that case about £6 per annum. A man burning 20 tons of coal per year to warm his house will regard £6 as a very insignificant affair. Mr. Teale's fires are, moreover, not cheerful; and besides, it is not necessary to have one of Mr. Teale's grates in order to have what is popularly known as a "bad fire;" the same result can be obtained by "slacking down a fire." It requires a good deal of faith to believe in Mr. Teale's system in this weather. He would be more successful in making converts in July. The principle he adopts strikes the ordinary mind, uneducated in the matter of domestic fireplaces, as being very much like that of the man who kept down the cost of his horse by giving him very little to eat. Mr. Pridgen Teale saves coal by limiting the supply of air. He does what he can to keep his fire from burning up. Here is the description of his invention, nearly in his own words. He said that he had been learning for twelve years. The last stage in his education was the discovery that the burning of coal in an ordinary fireplace could be controlled and retarded by the adoption of a very simple and inexpensive contrivance. This contrivance, which he had named an "economiser," was simply a shield of iron, standing on the hearth, and rising as high as the level of the grid at the bottom of the grate, converting the hearth space under the fire into a chamber closed by a movable door. One of the effects of this was that combustion went on at an orange, not at a white heat. A white heat in a fire meant rapid combustion, owing to the strong current of air which passed under the grate, through the centre of the fire, and up the chimney. An orange heat meant that the coke—*i.e.*, the red hot cinder—was burning with a slowly applied stream of oxygen, a degree of combustion which was only possible when the coal was kept warm by the hot chamber beneath. He had applied economisers one by one to all his grates, kitchen included. The result had surpassed his expectations. There was a saving of at least a fourth of his coal. The experience of others confirmed his own results.

The simple answer to all Mr. Pridgen Teale's arguments is, that there is nothing new in fireplaces with what engineers call ash-pit dampers; and that the average British householder likes a bright, cheerful fire in cold weather. Instead of saving £5 a year in "orange" fires, he would be more likely to pay £5 a year extra if only he could secure a "white" fire for the outlay. This is the sum and substance of the passive opposition which all those who introduce new-fangled domestic fireplaces have to contend against. The British householder likes a big bright, open fire, and he is quite willing to pay for it. He is also desirous to have it with the least possible amount of trouble. He does not want hoppers or screws or automatic shovels, or other devices to get out of order and worry himself and his servants. The ordinary fireplace meets all his wants and his wishes, and so he is content. It is almost impossible to persuade people in such a state of mind that they are really fools. Besides, it is evident that if economy is actually worth considering, that can be secured at once, and in the largest possible measure, by adopting the German or Austrian tiled stove. There is nothing like the stove for reducing coal bills. The Teale fireplace is not in the race with the continental appliances; but no man living will persuade the English householder that he ought to have stoves instead of open fireplaces. In this case instinct speaks, and instinct is right. All things considered, we see no chance of success so long as Mr. Teale and his co-workers base their claims to a hearing on economical grounds.

As regards the smoke nuisance, we have over and over again shown that, in so far as soot is concerned, little or nothing can be done, because the evolution of soot per chimney is extremely small. By far the larger proportion produced goes away in the sweep's bag, being collected in the chimney. That which really makes smoke objectionable is the carbonic acid and the carbonic oxide which are evolved when coal is burned. These are the resulting poisonous ingredients in the products of combustion, and no man has yet ever suggested that we should try to burn coal so that these gases will not be evolved.

LONDON FIRES.

CAPTAIN SHAW'S report on London Fires for 1885 is remarkable as showing the smallest percentage of "serious fires" on record. The ratio is now down to 7 per cent., the lowest previously being 8 per cent., and the average much higher. This speaks well for the increasing efficiency of the Brigade, and the result, we apprehend, may be partly attributed to the more extended use of the telegraph and the telephone for purposes of fire alarm. Something perhaps may also be said for the extent to which hydrants have superseded fire plugs, though these are matters on which Captain Shaw's report gives us no direct information. The account given of the yearly operations is very concise, we might say painfully so. There are pages of statistics, and the driest possible summary of the proceedings. No doubt Captain Shaw could write with a touch of enthusiasm in describing what the Brigade have done during the year. But there is no such development of the subject, and the reader has to exercise his imagination in order to realise what is covered by the cold official phrases and the impassive array of figures. There are even some other dry facts we should like to be made acquainted with. During the year there have been thirteen cases of short supply of water. This is a serious matter, and we should like to be informed as to whether one particular company is more to blame than the rest. Are all alike guilty, or are some of the companies so exemplary that they never fail to give a good supply? Captain Shaw says that "all the companies have made great efforts" to serve the Brigade, and he offers them "the warmest thanks for their successful exertions in this respect." But the turncock has been late on seventeen occasions in the twelve months, and has been altogether absent nine times, so that there are altogether thirty-nine unsatisfactory instances. Concerning the proportion of serious fires, it must be borne in mind that the ratio is affected by the total amount of fires, serious and slight. The number of fires recorded as "serious" was not in itself so low as on some previous occasions, though less than in most years, and decidedly less than in the year immediately preceding. So also the total number of fires was somewhat less than in 1884. But that year was unfortunate in having more fires than any of the years that had gone before. Captain Shaw states that the fires of 1885, compared with the average of the previous ten years, show an increase of 441. The actual number was 2270. We observe *en passant* a statement that the abolition of payment for calls has been attended with very satisfactory results, having appreciably reduced the number of unnecessary alarms. It is evidently believed by Captain Shaw that nothing has been lost in the opposite direction. The introduction of alarm circuits round the fire stations has facilitated the calling of the Brigade. These circuits furnish more than 260 "call points," and the system is being extended. Telegraphs and telephones also connect the fire stations with each other, and in some cases connect these stations with public and other buildings. To summon the Brigade by touching a button seems to imply the height of civilisation, though we may in some cases go a step further and make the fire itself start the electric signal.

The reduction in the number of "serious fires" may strike the reader as singular, seeing how often the newspapers tell of a conflagration such as cannot be called slight. These seem to have been particularly numerous of late. But the reduced ratio of last year permits of three such fires in a week, and this number would make an impressive appearance in the morning papers. Taking fires of all degrees, it is an awkward fact that 659 are specified out of the 2270 as arising from causes "unknown," creating an untoward percentage of 29. This figure gives force to the appeal for the establishment of "fire inquests," concerning which it is always stated that when Mr. Coroner Payne held them for a time there was a perceptible diminution in the number of fires in his district. Captain Shaw is opposed to the idea of an official investigation into the origin of fires, as unnecessary and expensive; but the Metropolitan Board are in favour of it, with the proviso that the power should be vested in some officer other than the coroner. Among the ascertained causes of fires, that of "light thrown down" takes the highest number, accounting for nearly one-tenth of the total. Next in order we have the upsetting of spirit lamps, followed by accidents from candles, which slightly exceed the cases characterised by "spark from fire." These four causes combined account for considerably more than one-third the cases in which the origin of the fire is known. If we look to the trades concerned we find a large number of fires among "victuallers," though only in nine cases is the cause undetermined. Half the fires among tobacconists are of the ambiguous class. Serious damage figures high in the trades of the oil and colourman. Taking the range of the twenty-four hours, fires prevail most between nine and ten o'clock at night, but there is no great difference among the several days of the week. It is curious that Sunday is quite up to the average in the number of fires, while the day of fewest fires is Friday. Do these Sunday fires arise in some measure out of sundry revelries on the Saturday night? To a certain extent this may be the case, but there are a good many fires after eight o'clock on the Sunday evening. There are fires every hour, every day, except, strange to say, between eight and nine o'clock on a Thursday. Such was the case last year, though Thursday was not the day of fewest fires. To those who believe there is some connection between Quarter-day and fires we may commend the fact that the greatest number of fires in any week of last year was between the 23rd and 30th of December. Looking down the list of months we find that May had the greatest number of serious fires, and June the greatest in the total of serious and slight, while February was the least fiery of the twelve. The brightest feature in the year's history, as written by Captain Shaw, consists in the deeds of heroism performed by his officers and men, five being commended for special merit. The *personnel* of the Brigade is excellent, and so is the *matériel*, so far as it goes. But a stronger force is needed, and it is to be hoped the Board will succeed in getting rid of the present absurd restriction of a half-penny rate for the purposes of the London Fire Brigade. If another farthing is wanted, as the law now stands it is not to be had, except by the roundabout process of an indemnity granted by Parliament in the clauses of the Board's annual Money Bill.

CANTERBURY WATER SUPPLY.

CANTERBURY is one of those towns which are provided with water from wells. Canterbury is in danger of drinking sewage-contaminated water. In June, 1824, the Canterbury Company obtained an Act to supply Canterbury with water, and spent on the works down to 1866 £7500. The water was pumped from the river Stour and delivered to the consumer without filtration or any purifying process whatever. In 1866 these works had to be abandoned, and the company obtained an Act for new works, which have been erected and in operation during the last sixteen years. The sum spent upon them down to the present time is about £50,000, and an average daily quantity of 382,000 gallons of water is supplied to 3611 houses and about four-fifths of the inhabitants of the water district. The water in the new supply is obtained from deep wells or boreholes sunk 525ft. into the chalk, and the pumping station is placed outside the municipal boundary in the parish of Thanington, at a spot where no danger was apprehended from pollution. But it appears that about four years ago certain lands were sold for building purposes, and the builders began to sink cesspools, and get rid of the sewage by percolation into the ground. The soil here is gravel and light loam overlying the chalk, and therefore admirably adapted for absorbing and carrying the sewage down to the chalk. Attention was drawn to the matter by the company's engineer, and ultimately a sewer was built which served these houses; but since then more houses have been built, and as it is asserted that the sewer is not big enough for more houses, more cesspools have been built. It has been found that by measuring the rise and fall of numerous wells in the vicinity, that they fall with the water company's pumping, and thus show the way the water percolates, and the communication between wells, and, presumably, between wells and cesspools. A Local Government inquiry is being made into the matter, upon which a dispute has arisen in consequence of the failure of the authorities to provide proper and adequate sewerage to prevent water pollution. The water company had better see what can be done with Stour water before its valuable rights in that respect are too much neglected. It is quite clear considerable difficulty will be met with in the endeavour to prevent contamination of the well water if that is to be measured or indicated by rise and fall of other wells.

NORDENFELT'S SUBMARINE BOAT.

MR. NORDENFELT read a very interesting paper at the United Service Institution on Friday, February 5th, on his submarine boat. He introduced his subject by touching on earlier designs for boats made with the same end in view. The mo remarkable of these was one made in the American War of Independence in 1776, in the form of two turtle-backs screwed together, in which a miserable man was supposed to creep, propelling the boat by a hand screw, pumping in the water in order to descend also by hand. He was to let go 200 lb. of ballast when he wished to rise to the surface. He was supposed to creep under the bottom of an enemy's ship and screw a sort of petard on it containing 150 lb. of powder, which was to be exploded by clockwork after he had departed in his turtle. We need hardly add that this never "came off." A man was found sufficiently sharp and enterprising to undertake to blow up the English vessel, the Eagle, in it; but he appears to have simply disposed of himself in some less dangerous manner for the night and claimed his reward in the morning. Passing over subsequent designs, we may come at once to Nordenfelt's. He certainly grasps the question with a bold hand. His position is that previous designs have failed—(1) because they were small and weak; (2) they tried to act by actual contact with the enemy's ship's bottom, which was very dangerous and difficult, especially if the ship was pitching at all; (3) black powder was used, which is an unsuitable explosive for the work; (4) propulsion was effected by hand power, which taxed the crew too severely; (5) the means of ascending and descending were untrustworthy. Nordenfelt discarded the idea of the furtive fragile boat, and made one to act in a systematic way on a much larger scale. A boat that would show fight and hold its own, and under many circumstances, so he maintains, would be a safer vessel than an ordinary one. This fast boat was 64ft. long, 9ft. beam, over sponson 12ft., with 60 tons displacement, and 100-horse power engines. Speed, 9 knots, capable of going 150 miles without re-coaling. It carried a fish torpedo outside to be discharged mechanically. It is intended to run on the surface, but blowing its smoke out under water, till it nears an enemy, when it descends and moves "awash," with a cupola alone above water. When this is liable to be seen she descends altogether under water by means of propellers. The vessel is kept in the horizontal position longitudinally by means of rudders in the bow, which by the action of a plumb weight bring the boat back to this position should anything suddenly make her leave it. Three features are specially emphasised by Nordenfelt:—(1) The employment of heated water to give off steam as any unfailing reservoir of energy; (2) the submersion of the boat by mechanical means, which is much safer than depending on specific gravity, because practically the density of water alters so slowly with the depth that a vessel that descends below the surface may descend to a great depth. The horizontal position protects the boat from dangerous impetus downwards, and the mere cessation of working the special propellers causes the boat to rise. (3) The use of rudders to keep the vessel always horizontal. There is no difficulty as to sufficiency of air and heat. After fourteen miles run, when the crew had been enclosed for three hours, the temperature was only 32 deg. C. or 90 deg. F., and a tallow candle even on the floor burnt without visible diminution. The turtle back of the boat can be protected against machine or quick-firing guns by an inch steel plate, but it is so oblique to the direction of fire that it would, Mr. Nordenfelt believes, resist it without. When "awash" the water would protect the vessel. Two Whitehead fish torpedoes are carried, but more is expected from an electrical controlled torpedo, which would push in any protecting netting and would fire 300 lb. of dynamite. There is a quick-firing 2-pounder for use against torpedo boats if necessary. Finally Mr. Nordenfelt prognosticated the employment of such boats in the defence of channels all over the world, declaring them to be most sober, business-like affairs, although they might be suggestive of the conceptions of Jules Verne.

AN IMPORTANT ENGINEERING SCHEME.

THE agitation in the matter of sea communication with the Midlands continues. The traders of Birmingham and South Staffordshire will never rest until they have that communication clear. The latest scheme is that of Mr. G. W. Keeling, C.E. He proposes to improve the water communication between Birmingham and the Bristol Channel, by deepening the Birmingham and Worcester section of the Birmingham and Gloucester Navigation sufficiently to accommodate vessels of from 150 to 200 tons burden. This would allow coasting vessels to be brought by steam haulage direct from Cardiff or Sharpness to Birmingham, *viâ* the Gloucester and Berkley Ship Canal, the river Severn, and the Worcester and Birmingham Canal. At one point between Worcester and Birmingham there occurs a distance of three miles with a flight of thirty-six locks. Here it is proposed to substitute an incline by which a tank trough containing the vessel could be raised or lowered by hydraulic power. The cost of the work is estimated at £600,000. The scheme would involve the alteration of sixty bridges and culverts, at an estimated cost of £45,000; the widening of 184½ chains of tunnel, £203,000; the construction of hydraulic incline and works, £52,000; the construction and alteration of locks, £96,000; the widening of the canal in many parts, £144,000; and the provision of additional water space and wharf accommodation at Birmingham, £60,000. Mr. Keeling hopes to reduce the cost of the canal transit from Sharpness to Birmingham of grain and timber from 6s. to 3s. 6d. per ton; and for other distances and materials in proportion. It is stated that there is reason to believe that the Birmingham and Gloucester Navigations would, under guarantees that it should not fall into the hands of the railway companies, transfer their interest in the Birmingham and Worcester Canal, on the new company undertaking the existing liabilities with respect to it. Mr. Keeling will probably explain his scheme in about a week's time to a meeting of Midland merchants and manufacturers, presided over by the Mayor of Birmingham.

GOOD AND BAD WORK.

THE views expressed in our leader last week upon "Good and Bad Work" have been borne out in a striking manner by independent authorities. At about the time the article was being penned, Mr. W. W Walker, of the firm of Messrs. T. W. and J. Walker, hardware merchants, Wolverhampton, was addressing a special meeting of the Wolverhampton Chamber of Commerce "On the Effect of Continental Competition upon the English Hardware Trades in the Colonies." Good workmanship and good material, we last week urged, were essentials to success. What is the testimony of the Midland manufacturers? Mr. Walker said that in steel toys the competition of German firms was most severely felt, and in answer to a communication which he had addressed to Messrs. Timmins and Sons, of Birmingham, that firm, after giving their views of the causes of German success, had complained of a lack of good workmen. There was not a man within fifty miles of Birmingham who could make a spring divider, and there were only about two men who could make wrought iron vices. In fact, for tools which required clever handiwork, the rising generation were not filling their fathers' places, the principal reason being that they did not begin to learn early enough. And Mr. Walker further observed that as to the quality of the German goods there could be no doubt. The Germans had introduced the best machinery, and their workmen had received good technical instruction. Now these remarks—whether or not they can be accepted in their fulness as regards the artisans of the midland metropolis—show undoubtedly the need for the lesson we last week tried to enforce as to the necessity for good workmanship and good machinery. Undoubtedly, if these points are attended to, the complaints of German competition will be less loud and less frequent. During the address and the discussion that followed, both of which were most instructive, other remedies for continental competition were suggested.

WORKING GUNS BY ELECTRICITY.

THE question of training and working heavy guns by means of electrical motors has for some time occupied the attention of the War-office authorities, who have carried out a series of experiments. The system of employing small motors, actuated by a dynamo machine driven by a steam engine placed under cover in a sheltered position, will probably be adopted in preference to the present plan of transmitting the motive power by means of shafting. We understand that the guns of the Spithead forts are to be immediately fitted with the new electrical training gear.

LITERATURE.

Ancient Rome in 1885. By J. HENRY MIDDLETON. Edinburgh: Adam and Charles Black. 1885.

FOR adding one more to the long list of works on the archæology of Rome, Mr. Middleton makes needless excuse. He reminds us in the introduction that the last few years have been extraordinarily fertile in discovery by recent excavations. To say nothing of the complete exposure of the Forum Romanum, the determination of the form of the Rostra of Julius Cæsar, the discovery of remains of the Temple of Vesta, the Regia, the House of the Vestals, the line of the Via Nova, and of the great Servian Agger, with countless early tombs and houses of all dates, and perhaps the most important of all from the standpoint of primitive history, of the large Etruscan Necropolis on the Esquiline Hill, and the results of excavations elsewhere in former times and more recently, have been found sufficient warrant for innumerable guide-books, large and small, and learned papers addressed to various societies. Mr. Middleton's work properly used is indeed an excellent guide-book for existing remains of "Ancient Rome" and *vade mecum* for the student of history and archæology; but it is something more than this; and his modest apology for publishing his work may be gratefully allowed, and the work itself heartily welcomed, if only for the descriptions of the buildings of Ancient Rome, as he himself says, "with increased attention to detail and methods of construction, points usually passed over too lightly by those antiquaries who are without practical acquaintance with actual processes and materials used in building."

The first chapter, in some respects the most valuable in the book, treats (1) of the geology of the site of the city, with some slight reference to the country immediately surrounding it; then (2) of the quarried materials used in construction and decoration, of architectural styles, of methods of construction, of the use made of stone and bricks, and of the composition of mortar, cements, and concrete. We are shown how to the volcanic origin of the seven or more hills of the famous city the earliest building material, *tufa*, is due, varying from softer quality which can be cut with spades to a concreted mass about as hard as Bath stone. This badly weathering stone, probably, however, always simply faced externally with stucco, was very early succeeded by *peperino*, volcanic also, and quite fire-proof, quarried in the Alban Hills and at Gabii; and lastly, by *travertine*, from Tibur, a very hard pure carbonate of lime. With the exception of so-called *silex*, really lava, employed chiefly for paving, these seem to have been the only stones used in the earliest constructions of all—those in *opus quadratum*, or masonry in rectangular blocks. For other stones in later times, used almost solely for decorative purposes, granites, porphyry, and marble, and others, the Romans had to go further afield. The primitive *opus quadratum*, though never entirely superseded, began very early to give way to the use of faced concrete, by far the most important and largely used of all the building materials of Rome. Matchless, indeed, were the Roman builders, or rather engineers, in concrete. The massive *opus quadratum*, with its perfectly fitting masonry in joints and beds, scarcely needing the cardboard-thin lining of slime or mortar, has perhaps made their reputation as builders with most of us; but in concrete the Romans were masters.

The builders had, in Rome, the finest materials in the world on the spot, and their skill and daring in the use of concrete, not only for foundations and walls, but for vaults and domes of the magnitude of the Pantheon, are perfectly astounding even to the engineers of our time. Mr. Middleton, indeed, in describing the various sorts of concrete employed—consisting in the earliest form of broken lumps of *tufa* and *peperino*, or again, of *travertine* and lava, with lime and sufficient water to reduce the whole to a fluid state—later on, of broken bricks and marble from earlier buildings—does not hesitate to say that *pozzolana*, lying in thick strata just as it was showered down from the volcanoes, resembling a sandy earth mixed with larger lumps of the size of coarse gravel, when mixed with lime setting hard even under water, more than any other material contributed to make Rome proverbially the "eternal city," for without it the vaulting and large domed buildings would have been impossible. Their daring use of concrete, and confidence in the tenacity of materials, enabled the Roman engineers to achieve feats most astonishing; and the discovery that a concrete vault or dome is really an arch without lateral thrust rendered possible such a building as the Pantheon, which is essentially nothing but a big pot with a lid popped on the top.

Of bricks, whether *crudi*, or sun-dried, or *cocti*, or kiln-baked, Mr. Middleton says no solid wall is to be found in Rome. They were used simply as inner facings of concrete to form a smooth level surface, upon which was laid in cement the decorative outer face of stucco, and rich slabs of marble or other imported stones. The bricks merely tail a few inches into the enormous masses of concrete which they hide. The method of building with concrete, apart from the materials used, seems to be exactly the same as that employed now and always, and casts of the hollow boxes into which this was poured, where not concealed by brick facing, are to be seen to this day. Throughout the book there is constant reference to the employment of concrete even as the core for 7in. party walls with the double facing of triangular bricks, and stucco, or marble; and to the so-called relieving arches of 2ft. tiles, the use of which to the depth of about 5in. upon the surface of a 20ft. concrete wall is not very clear. These cannot be for ornament, for they are always covered over, and add nothing to the constructional strength. Are they simply level-guides for the bricklayer?

An excellent and exhaustive description, both as to material and methods of use, is given of the famous Roman cements and stucco. How the smooth brick facing was keyed for the cement, not as now, by raking out the joints of the bricks, but by driving large iron nails or marble plugs through the brickwork into the solid concrete behind, the projections left being afterwards concealed by the marble or other outer coating embedded in the cement thus laboriously keyed:—how the marble itself was often surfaced with beautiful cement of finely pounded marble:—how a quick-setting stucco surface was rapidly moulded in relief figures by the hand of the artist, assisted by a few simple wooden tools:—how the surface was prepared for fresco and surface painting—all this, and much more of similar detail, is told by Mr. Middleton partly as the result of his own observations, partly from close study of the accounts left by the Augustan architect Vitruvius. By the use of concrete, good foremen, and any number of unskilled servile labourers, the shell of enormous structures was speedily and substantially run up, and the field left clear for artificers and artists in stucco, sculpture, and painting; and Nero, Caracalla, or Vespasian, with ruthless spoils of Greece, Asia, and Egypt for surface enrichment, would have a huge palace or therma finished in a time which would put builders of Law Courts to the blush. From Vitruvius and Pliny—Pliny, it seems, is often a mere plagiarist of Vitruvius—and his own acute observation, Mr. Middleton solves what mysteries there may be in fresco, tempera, varnish, and encaustic paintings with which surfaces of stucco and the exquisite marble cements were ornamented.

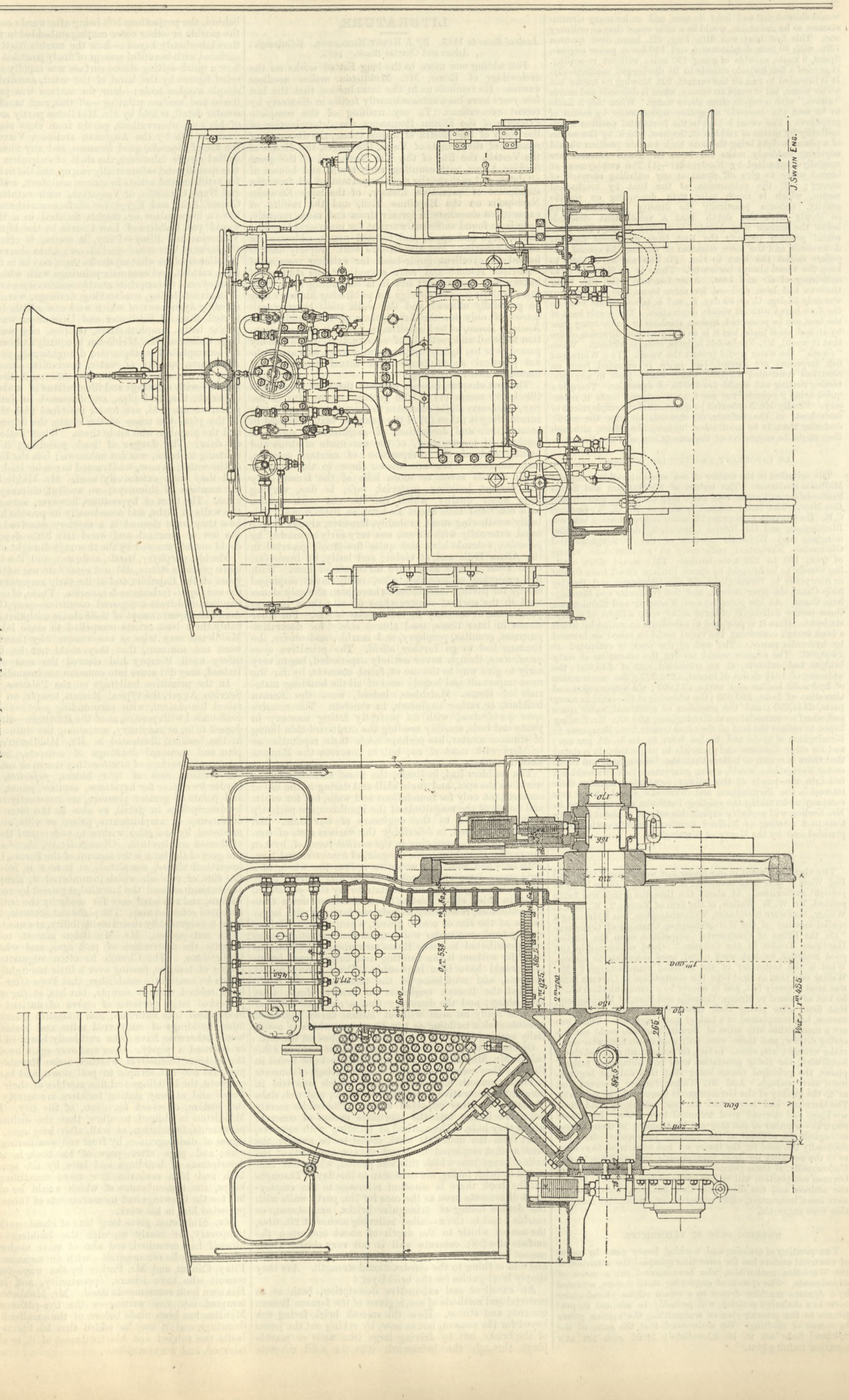
In street-paving, roadmaking, drainage, warming apparatus by *hypocausts*, of which we know a little by our own buried cities of Silchester and Uriconium, water supply, public baths, amphitheatres, temples, city walls, or the huge Coliseum, Mr. Middleton is equally at home whether as accomplished antiquarian, draughtsman, or engineer. Aqueducts, quality of water, reservoirs, sizes of pipes, taps, turn-cocks and drain-tiles—we omit the classical names—with drawings and illustrations of makers' marks on brick, tile, and pipe, are discussed in detail. Lead pipes, we are told, are found inscribed with the capacity of the pipe, the name of the estate, the imperial owner, and the plumber who made them. What better evidence of date? The danger of lead poisoning, it is almost amusing to learn, was not unknown; but the lime deposit of the water, as now, was trusted to render lead pipes safe, and they were extensively used. Mr. Middleton makes no mention of chimneys; no ancient chimneys, indeed, exist. The flues of hypocausts, however, were carried up the walls in baths, and occasionally in private houses, and how they were cleaned is a mystery unsolved; possibly, the use of charcoal and wood left little deposit which could not be removed by the thorough draught of the flues.

Marble, porphyry, basalt, alabaster, and the harder and more precious stones, did not come into use until the last years of the Republic and of the early emperors. Indeed, the *vox populi* forbade such luxuries. These, of course, were requisitioned from conquered countries—poor Greece and Asia Minor were swept of their choice sculptures, and probably their best artists compelled to slave labour. Mr. Middleton may take as one reason why these materials were not common, that they could not be brought in safety until Pompey had cleared the seas of pirates. Indeed, they did come into common use immediately after.

In the primitive buildings on the Palatine, the great Servian Agger, the typical Roman temple, on *podium* or raised foundation, with surrounding *porticus*—not to be confounded with *portico*, as of the Pantheon—enclosing the domed *cella*, or sanctuary, containing the statue of the god in the basilica, illustrated in Mr. Middleton's book by plan and sectional drawings of concrete, brick inner facing, and surface of ornamenting stucco or marble slabs, the various uses of *tufa* blocks, *peperino*, and the harder *travertine* for keystones, capitals, joints, voussoirs, and points of greater pressure, are constantly referred to by descriptions in detail, as also in the later structures of thermæ or amphitheatre, palace or villa, and must be mastered by one who wishes to understand the alphabet of Roman architecture. Of such details, above all perhaps the gem of the book is the account of the Forum Romanum, unearthed almost completed, as it now is, from beneath the 40ft. of rubbish which incumbered it, compiled from ancient sources and the knowledge gained by recent excavations, and rendered easy for study by the author's well-executed coloured map. The plans and sections, if one may form a judgment by their intelligibility, are most excellent.

As antiquarian, Mr. Middleton almost too bitterly laments the destruction of past ages, and what is now being done. The Church he often stigmatises as the robber of temples, passing over a little too lightly the fact, which he constantly establishes, that Pope after Pope may have robbed without scruple, but has, at the same time, preserved large portions of scores of ancient buildings modernised into churches, and immense quantities from other buildings of sculptured relics and material which would otherwise have been ruthlessly burnt in lime-kilns or adorned a pigsty. Over and over again he shows how the ancients themselves, whether under Republic or Empire, did not scruple to pull down, and break up for concrete, the buildings and fine marbles of their ancestors. Popes and railway station builders are merely following the custom, *damnosa hæreditas*, of the city. Even Mr. Middleton is obliged to allow that the disinterment of pavements, foundation, or wall, after long ages, is but the signal of disintegration by frost and weathering by exposure; and page after page of his book is filled with descriptions of buildings laid bare by the spade in the 14th and 15th centuries, now mere crumbling rubbish heaps, the remembrance of which would be utterly lost but for the drawings and measurements of those who have preceded him in his work.

Mr. Middleton gives long lists of classic authors—contemporary, or nearly so, with the builders—whom he himself has consulted, and also of more modern writers, whose works he recommends—with an occasional fling at Pliny, Canina, and Mr. Parker by the way—for those to consult who have leisure, opportunity, and inclination. His own book recommends itself. Mr. Middleton is never tempted into fine writing or the bye-paths of legend. Mention has been made before of the excellent maps and drawings, and it may be added that his literary style, as befits the subject and his treatment of it, is simple, unadorned, and workmanlike.

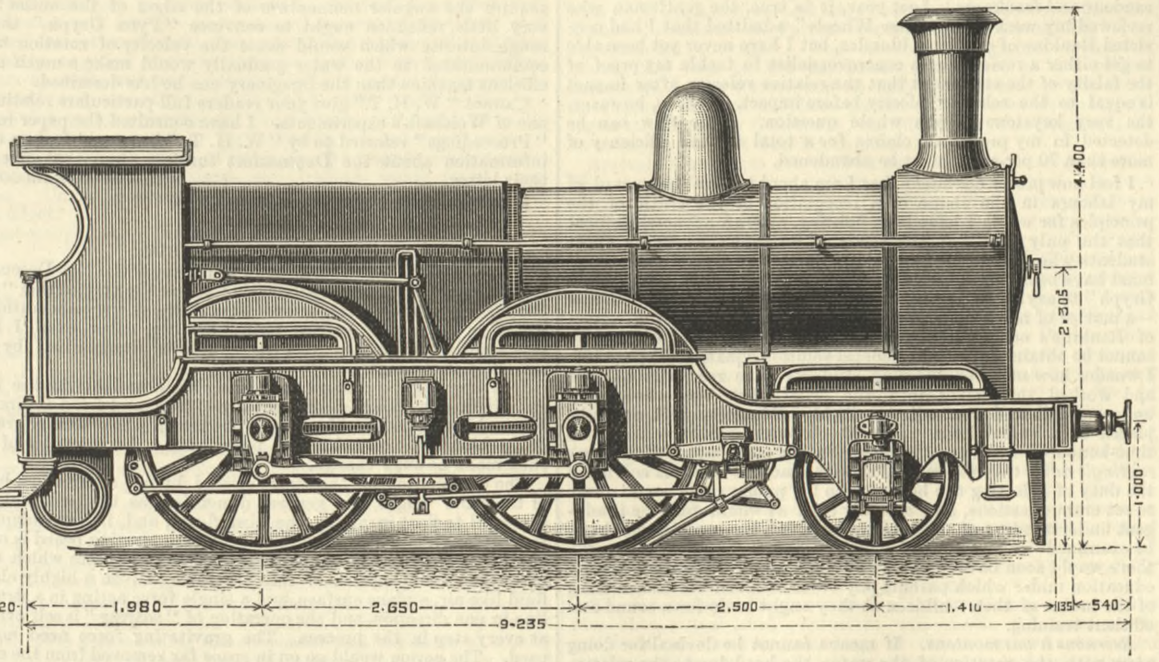


EXPRESS LOCOMOTIVE, BELGIAN STATE RAILWAYS.

MONS. M. L. BIKA, ENGINEER.

(For description see page 133)

BELGIAN EXPRESS LOCOMOTIVE.



BELGIAN LOCOMOTIVE.

In our last impression we gave a two-page engraving of a Belgian locomotive; above we give an external view of this engine. On page 132 will be found cross sections, which complete our illustrations of this engine, a complete description of which will be found on page 101. Our illustrations this week show very clearly the peculiar grate and enormous fire-door rendered necessary by the use of very small coal. They show how the quality of the fuel used modifies the type of locomotive.

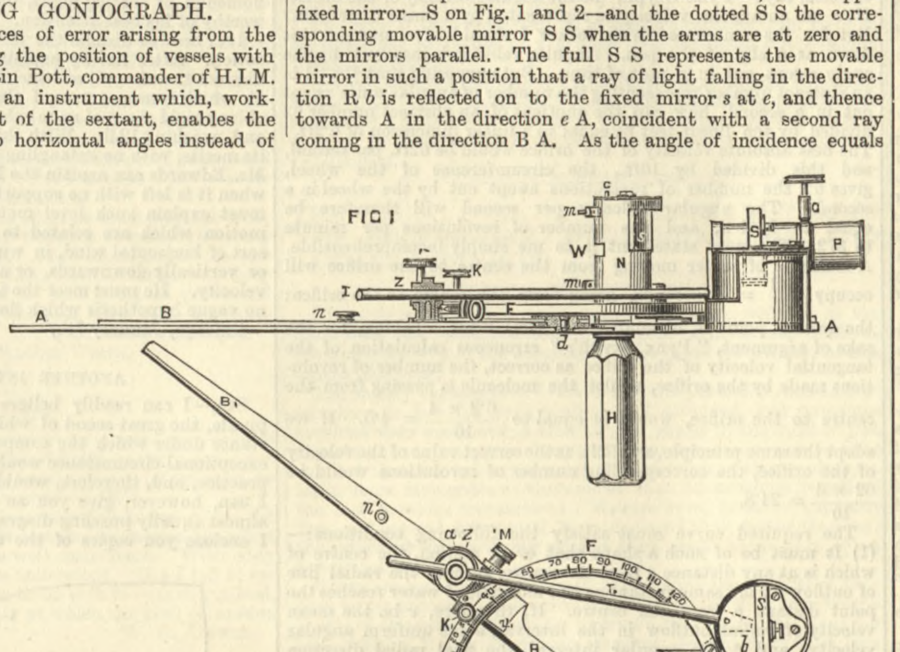
DOUBLE-REFLECTING GONIOGRAPH.

To avoid the errors and sources of error arising from the complicated method of measuring the position of vessels with the compass, Lieutenant Constantin Pott, commander of H.I.M. Monitor Maros has constructed an instrument which, working on a similar principle to that of the sextant, enables the observer, however, to measure two horizontal angles instead of one at one operation. By means of a system of straight-edges working in combination with the mirrors, when the images of three objects, whose position is known, cover one another, the angles formed by their line of direction with the po nt of observation, recorded by the three straight-edges, have a common apex.

The Pothenot problem of determining a fourth position from three known points is thus graphically solved, as, when an observation has been made, the instrument can be laid down on a chart, and the point of observation be fixed by the apex of the angles recorded.

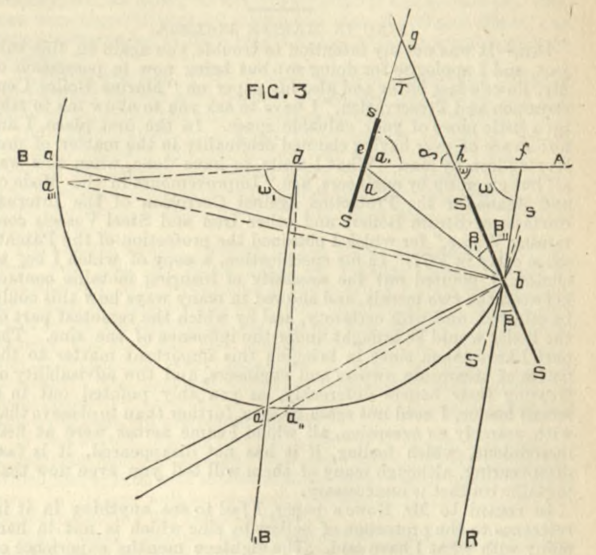
The construction of the instrument is as follows:—Figs. 1 and 2, a straight-edge A is fixed to the horizontal circle F, its left-hand edge is in the axis, and forms the basis of the instrument. Two movable arms B B_1 are jointed at the point of intersection of their bevelled edges with A at the centre of the horizontal circle F by the hinge D in the horizontal plane of the instrument. The centre of the hinge is bored at d for the convenience of transferring measurements direct to a chart or survey. The straight-edge A is prolonged behind the hinge D, and widened out and strengthened on both sides A_1 to support frame G, into which a telescope or diopter can be inserted, so that its axis is parallel to that of the instrument. On either side of G, and as near as possible to it, two movable mirrors S S and S_1 S_1 working on two axes b and b_1 perpendicular to the plane of the instrument are fitted; equidistant from the centre of the hinge D the left-hand mirror is raised its own height above the right-hand one. Two studs Z Z_1 turning on the vertical axes a and a_1 are fitted to the upper surfaces of the movable arms B B_1. The axes a a_1 are exactly the same distance from the centre d of the hinge D as the axes of the mirrors S S_1. Two cylindrical slide bars I I_1 are fixed at one end to the base plates of the two mirrors S S_1, and the other ends are free to slide in guides drilled for the purpose in the studs Z Z_1, by which means the movement of each mirror is made to coincide with the movement of the straight-edge on the same side of the instrument. Two small fixed mirrors s s, one above another, are fixed in a housing N between G and D in the axis of the instrument, in such a position that one receives the image reflected by the mirror S S, the other that reflected by S_1 S_1, and transfers the same in a parallel direction to the axis towards the telescope. The housing N is slotted front and back, the middle of the front opening W coinciding with the axis of the telescope P, so that the observer can see through N, and at the same time see a portion of the upper and lower mirrors s s. When the movable arms B B_1 are set at zero and their bevelled edges coincide with the left side of the straight-edge A, each of the larger mirrors will be exactly parallel to its respective smaller mirror. For the purposes of correcting any error of parallelism, and as the larger mirrors are fixed to their base plates definitely, two screws m_1 m_1 are fitted on the front part of the housing N for the purpose of adjusting the smaller mirrors, as in a sextant. In the same manner the vertical adjustment is corrected by the small screw C. The clamp screw on the top of G and the button r at the point of junction of A with F are handy for moving the instrument about. H is the handle for holding the instrument while taking an observation, held in place by a spring and snap f. The arms B B_1 are also fitted with knobs n and n, for using as a protractor. The Diopter given with the instrument has two eyepieces, one over the other, the upper one for observing the left-hand, the lower one the right-hand angle.

The principle of construction is shown in the following Fig. 3, in which A B represents the axis of the instrument, s s the upper fixed mirror—S on Fig. 1 and 2—and the dotted S S the corresponding movable mirror S S when the arms are at zero and the mirrors parallel. The full S S represents the movable mirror in such a position that a ray of light falling in the direction R b is reflected on to the fixed mirror s at c, and thence towards A in the direction c A, coincident with a second ray coming in the direction B A. As the angle of incidence equals



DOUBLE-REFLECTING GONIOGRAPH.

the angle of reflection $\alpha = \alpha'$ and $\beta = \beta'$, also as opposite angles $\beta = \beta''$. In the triangle $b\ g\ e$, $\alpha = \gamma + \beta'$ therefore $\gamma = a - \beta'$ or (I.) $\gamma = a' - \beta''$. As, however, the angles δ and ϵ as opposite angles are equal to one another, the sum of the two supplementary angles in the triangles $g\ h\ e$ and $f\ h\ b$ must also be equal, *i.e.* (II.) $\gamma + a' = \omega + \beta''$, or by amalgamation $2\gamma = \omega'$, *i.e.*, in words: The angle which the two mirrors S S and s s form, when the ray R b is reflected in the direction e A, equals half the angle formed by the ray and the line e A. It is therefore necessary that the angle described by the movable straight-edge must be double, so that the observation may be read off correctly at once. This is the case, as will be seen from Fig. 3. d is the centre of hinge, $b\,a$ indicates the cylindrical slide bar attached to the mirrors S S, when the latter, as shown by dotted lines, is at zero; $d\,b$ indicates the position of one arm B, forming with the axis of the instrument the angle ω. In this case the point a —axis of stud on arm B—is moved to a', and the slide bar takes the position $b\,a'$ and forms the angle $a\,b\,a'$. As the distances from the hinge d to the movable mirrors S S and to the centres of the studs Z Z are equal $b\,d = a\,d$, and a circle described from d with a dia. $d\,a$ will pass through a and b. As, however, the angle ω' described by the motion of the arm B from a to a' is central, and the angle $a'\,b\,a$ described by the slide bar I over the same distance peripheral, the former is twice as large as the latter. It is, therefore, evident that the angle described by the arm B is equal to that formed by the lines R b and e A or $\omega' = \omega$. In actual construction the instrument is somewhat different, inasmuch as the studs Z Z' are not placed on the edge of the arms. Their actual position is shown by dotted lines, where a becomes a' and a' becomes a'''. The relative proportions of the angles described by the arms and by the slide bars remains the same, 2 : 1. It will readily be seen that this instrument is not



only applicable to measurements at sea, but may be used for various operations on land for which the sextant is not adapted.

PRIVATE BILLS IN PARLIAMENT.

The latest report of the Board of Trade respecting the promotion this session of railway, tramway, subway, canal, gas, and water Bills, furnishes details respecting those measures more minute and precise than could otherwise be obtained. To some extent we have dealt with these schemes in our "Private Bills" *résumés*, but there are facts in this report which will more especially interest investors in such undertakings. The report confirms our own statements as to the material falling off in the number of Bills in most of the classes set forth, mentioning that the new tramways proposed are only slightly more than half the length of those projected last year, while the capital to be raised with respect to many of the Bills is less than half the amount proposed last session. The Bills advanced by existing companies are only seventy, as against ninety-seven last year, the new mileage being 120 miles instead of 148, and the estimated capital £9,934,400 as against £15,661,026. Last year there were thirty-five Bills promoted by new companies; this year the number is but twenty-one, the length of lines projected being 246 miles against 392, and the capital to be raised £8,229,883 as against £28,726,963. The discrepancy between the estimated capital in each year when compared with the relative lengths of new railway will strike most people as remarkable, but the most probable reason is a difference in the character of the districts affected and in the nature of the property to be interfered with. The combined Bills of old and new companies thus number ninety-one, the total mileage being 366 miles against 540 miles, and the aggregate of capital to be raised amounting to £18,169,283, as against £44,387,989, or a decrease of £26,218,706. The £18,000,000 odd, however, includes the capital required for the acquisition by a company of the Bute Docks, viz., £3,850,000. Next to this sum the highest amount proposed to be raised is £800,000 by the Mersey Railway Company, and then come the Manchester, Sheffield, and Lincolnshire Company with £666,000, and the Hull and Barnsley Company with £500,000. From that point the sums drop to £400,000—by three companies—£320,000, £300,000, and so on till they reach £160,000, which the South-Eastern Company proposes to raise. In view of the controversy respecting the payment of interest out of capital during the construction of the ship canal, it is well to notice that no fewer than eighteen of the Bills under consideration propose to take that power. Parliament will thus have ample ground for laying down some clear and even final decision upon this question. Of the existing companies' Bills fifty-nine relate to England, and propose to construct 117 miles of new line at a cost of £9,534,400; seven are for laying down three miles of rail in Scotland at a cost of £325,000, and the remaining four propose an outlay of £80,000 in Ireland. The twenty-one new companies' Bills include seventeen for laying down 215 miles in England at a cost of £7,631,883; and four for the construction of thirty-one miles in Ireland at a cost of £598,000.

Turning next to the Tramway Bills, it appears that there are nineteen for England and one for Ireland, their object being to authorise the construction of fifty-eight miles at an estimated cost of £1,472,000—that is, £730,000 less than the total capital proposed by the Bills of last session. In this connection it will be convenient to refer here to the Provisional Orders respecting tramways, for applications have been made to the Board of Trade. Of these there are twenty—the same number as of Bills—proposing the construction of seventy-one miles of new tramway, or an increase of twenty-nine miles upon last year. The estimated cost is £453,770, which is an increase of £215,751. Together, the Bills and the Provisional Orders project the laying down of 129 miles of new tramway; and in stating this, the report refers to the recently published return, which showed that up to June, 1885, 1161 miles of tramway had been authorised by Parliament, and 811 miles had then been opened, of which 117 miles were in the metropolis. Besides these railway and tramway Bills, there are eleven Bills and eleven Parliamentary Orders for the supply of gas alone; eight Bills and one Parliamentary Order for supplying gas and water; seven Bills and nine Parliamentary Orders for the supply of water only; and one Bill and two Parliamentary Orders relating to electric lighting, one of the latter, however, only seeking to amend a previous order. Some of the tramway Bills and Parliamentary Orders make provision for the use of locomotive or other motive power, from which it may be inferred that the promoters have in view, if not in actual intention, the use of electricity as a means of propulsion. Again, a number of the Bills relating to gas, water, and subways contain provisions with respect to the laying of electric lighting wires, and to the supply of electricity, under the general powers already possessed by the promoters for that purpose.

South Kensington Museum.—Visitors during the week ending Feb. 6th, 1886:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 12,714; mercantile marine, Indian section, and other collections, 2860. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 4 p.m., Museum, 1151; mercantile marine, Indian section, and other collections, 74. Total, 16,799. Average of corresponding week in former years, 14,059. Total from the opening of the Museum, 24,623,006.

LETTERS TO THE EDITOR.

(*Continued from page* 126.)

ZINC IN MARINE BOILERS.

SIR,—It was not my intention to trouble you again on this subject, and I apologise for doing so; but being now in possession of Mr. Rowe's last letter and also his paper on "Marine Boiler Construction and Preservation," I have to ask you to allow me to take up a little more of your valuable space. In the first place, I am not aware of ever having claimed originality in the matter of preserving iron by zinc. What I claim to have done, when zinc was all but given up by engineers, are "Improvements in the Mode of and Means for the Protection against Corrosion of the Internal Surfaces of Steam Boilers and other Iron and Steel Vessels containing Water," for which I obtained the protection of the Patent-office early in 1877. In my specification, a copy of which I beg to enclose, I pointed out the necessity of insuring metallic contact between the two metals, and showed in many ways how this could be effected, and with certainty, and by which the remotest part of the boiler would be brought under the influence of the zinc. The part I have taken since in bringing this important matter to the notice of steamship owners and engineers, and the advisability of treating their boilers differently, as you ably pointed out in a recent leader, I need not again go into, further than to observe that with scarcely an exception, all whom I came across were at first incredulous, which feeling, if it has not disappeared, it is fast disappearing, although many of them will tell you even now that metallic contact is unnecessary.

In regard to Mr. Rowe's paper, I fail to see anything in it in reference to the protection of boilers by zinc which is not in harmony with what I have said. The eighteen months' experience of "the engineer of an establishment on the Tyne," which Mr. Rowe confirms in one paragraph, but qualifies in the next, I doubt very much. Common salt alone in pure fresh water will not, I know, produce sufficient, if any, electrical effect, either by the "electrogene" or any other mode of applying zinc to protect iron from corrosion. What effect salt may produce on the deposit complained of I am not in a position to say. There might be other things present which would account for the softening of the deposit, were the matter investigated by a competent person. Only a few days ago I was written to by a firm who are troubled with lime deposit, and who were using the "electrogene" and a fluid composition in their boilers.

Mr. Rowe's own experience and that of the "several engineers who twelve months ago"—from the date of his paper—"had no faith whatever in the efficiency of zinc," but who "after twelve months' trial are so convinced of its great protective powers that they would not abandon its use for anything," fully confirms what I have said in my previous letters. Their experiences, in point of time, amount to twenty-one months only. But it is not this I complain of; it is the way in which the matter was brought before the public. DAVID PHILLIPS.

Chipping Sodbury, January 21st.

MOMENTUM AND INERTIA.

SIR,—I quite agree with "Φ. Π." in the conclusion at which he has arrived, that no good can be gained by continuing the discussion further; and if I knew for certain that he is merely what his letters justify me in believing him to be—a young student in engineering—I should not reply to his last. From some remarks which have been made to me, I am compelled to conclude that he is a man likely to be regarded as an authority by students, and in their interest I ask you to give me a little space to expose, not only the gross blunder in which he still persists, but the fresh ones he has perpetrated in his last letter.

It is clear that "Φ. Π." does not know the difference between acceleration and moving force. Leaving resistance of the atmosphere out of consideration, the statement about the bodies falling from the kitchen window is perfectly correct. Surely "Φ. Π." must see that the result of the experiment proves that the accelerations produced in different bodies by a given moving force during a given time do not vary as the masses of the bodies accelerated. If they did, the rate of acceleration of the 2 lb. weight, acted upon by the same moving force as the 1 lb. weight, would be double that of the 1 lb. weight, whereas the experiment shows that the rate of acceleration is the same in both cases, although the moving forces are proportional to the masses. "Φ. Π." is quite right in objecting to the term initial momentum. I ought to have said maximum momentum. The "well-known rule" quoted by "Φ. Π." viz., $\frac{m\,V^2}{2\,g} = F =$ foot-pounds of work in the monkey is one which I have never seen before, and is certainly utterly wrong. In the beginning of the discussion "Φ. Π." stated that mass and weight had no connection with each other, but now we find him coolly substituting mass for weight. The foot-pounds of work in the monkey at the instant of impact are equal to $\frac{W\,v^2}{2\,g} = WH$. Again, what about F? In a continuous discussion the same symbol must have the same meaning throughout. In a previous letter "Φ. Π." quotes the equation $F = m\,f$, in which F is a moving force. How can a moving force be equated to foot-pounds of work? In working out the example "Φ. Π." uses the weight 200 lb., not the corresponding mass, so that he evidently considers "R." in the formula.

$$R\,S = W\,(H + S)$$

as the correct measure of the "stress"—his own word—on the top of the pile. Suppose, instead of the case of a 200 lb. weight falling 16ft. and driving the pile 1in., we apply the rule to a 10 cwt. monkey falling 4ft. and driving the pile only ⅛in.—not at all an uncommon instance. The "stress" on the pile would be, according to "Φ. Π." $\frac{10\text{ cwt.} + 48\text{in.}}{\frac{1}{8}\text{in.}} = 192$ tons. Is "Φ. Π." prepared to assert that a 12in. pile standing 16ft. out of the ground could stand a load of 192 tons without suffering permanent injury? Such piles, however, do sustain the momentum of 10 cwt. monkeys falling 4ft. with no more than ⅛in. penetration without injury, except, of course, the bruising of the head.

If two bodies are moving freely in a vacuum with momentums M_1V_1 and M_2V_2 respectively, the total momentum after impact, viz., $M_1V_1 + M_2V_2$, is equal to the sum of momentums before impact. But surely "Φ. Π." must see that there is no analogy between this case and that of a monkey falling on a pile.

It is utterly impossible to impart the whole of the momentum of one body to another unless both bodies are perfectly elastic, and then only under special conditions. The masses of the bodies must be equal, and one of them must be at rest before impact. No bodies are perfectly elastic.

In closing this discussion with "Φ. Π.," I wish to impress upon him, with all courtesy, the absolute necessity of cultivating candour and exactness of statement. "Φ. Π." has a second time, notwithstanding the explanations given in my last letter, affirmed that I have attributed to him the origin of previously well-known definitions. I have, as a matter of fact, attributed to him the authorship of only one definition, of which he himself claims to be the original propounder, viz., the definition of "inertia" as "capacity for motion." WILLIAM DONALDSON.

2, Westminster-chambers, February 6th.

REACTION WHEELS.

SIR,—It is a pity that "Pynx Gryph" has been guilty of the inconsistency of stating that he has very little faith in your powers of indulgence and of wasting your space by quoting Rankine's *ipse dixit* on the subject under discussion. "Pynx Gryph" should not have entered on the discussion if he was not prepared to fight his own battle without sheltering himself behind the screen of authority. His having done so renders it necessary for me to discuss the authority. In my opinion the whole of Rankine's investigations on the impact of fluids and on the turbine theory are not only founded on misconceptions, but in some cases the actual calculations themselves are erroneous. I have for a long time been endeavouring to prove this point, but have never yet met with an antagonist willing to argue the question in a spirit of candour and frankness. Last year, it is true, the gentleman who reviewed my work "On Water Wheels" admitted that I had convicted Rankine of one gross blunder, but I have never yet been able to get either a reviewer or a controversialist to tackle my proof of the falsity of the statement that the relative velocity after impact is equal to the relative velocity before impact. This is, however, the very keystone of the whole question. If no flaw can be detected in my proof, all claims for a total turbine efficiency of more than 70 per cent. must be abandoned.

I feel now pretty confident that I am about to reap the reward of my labours in the shape of a recognition of the truth of the principles for which I have been fighting, and an acknowledgment that the only result of the study of Rankine's works on those students who profess to understand them and find them correct must have been the addling of their brains. What has "Pynx Gryph" to say about Rankine's solution of Case V., page 169, and —a matter of much more importance in a teaching point of view— of Rankine's omission to point out that the solution of Case V. cannot be obtained from the general solution equation (9) page 166. I wonder how many engineering students have read this chapter and worked themselves into the belief that they thoroughly understood it and that all was right. Education will never be placed on a sound basis until schoolmasters recognise the two time-honoured maxims, "*Non multa sed multum,*" "*Non cuivis contingit adire Corinthum.*" If the examiners to whom is entrusted the duty of selecting the best men to fill public posts would cease to set cram questions, and set only such as would test the intelligent understanding of the subjects on which the competitors are to be examined—the number of which ought to be much reduced—there would soon be an end of the evils of the present system of education under which parents pay twice as much for the addling of the brains of their children as they ought to do for a sound and efficient training.

Revenons à nos moutons. If means cannot be devised for doing away with the rotation of the water, the head due to the relative velocity of discharge will be double the net head due to the fall, or, adopting "Pynx Gryph's" notation, double h_1. If, therefore, the absolute velocity of the orifice is only equal to $\sqrt{2\,g\,h_1}$, the issuing water will still have an absolute velocity equal to $\cdot 4\sqrt{2\,g\,h}$.

The curves of the arms would in all cases be similar, and could therefore be represented by a general equation. The size only would vary. I cannot follow the reasoning of the whole of the rest of "Pynx Gryph's" letter, but will point out where I think he is in error.

The theoretical velocity due to a height of 64ft. will be 64ft. Let this, says "Pynx Gryph," be the angular velocity of the orifice. How can an angular velocity be represented by a linear dimension? But for the sentences which follow I should of course put this down as a slip of the pen. Angular velocity is measured by the angle swept out in a unit of time. But supposing that the 62 is an abstract number representing the number of angular units swept out in a second, how can the quotient of an abstract number 62 divided by ten linear feet be equal to a linear dimension of 6·2ft.? The best absolute velocity of the orifice would be 62ft. per second, and this divided by 10ft., the circumference of the wheel, gives 6·2 the number of revolutions swept out by the wheel in a second. The angular velocity per second will therefore be equal to $12{\cdot}4\,\pi$, and the number of revolutions per minute to 372. The next statement is to me simply incomprehensible. A molecule of water moving from the centre to the orifice will occupy $\frac{6{\cdot}2}{1{\cdot}5} = 4$ seconds, going from the centre to the orifice; the decimal point is, of course, a clerical error. Taking, for the sake of argument, "Pynx Gryph's" erroneous calculation of the tangential velocity of the orifice as correct, the number of revolutions made by the orifice, whilst the molecule is passing from the centre to the orifice, would be equal to $\frac{6{\cdot}2 \times 4}{10} = 4{\cdot}5$. If we adopt the same principle, and 62ft. as the correct value of the velocity of the orifice, the corresponding number of revolutions would be $\frac{62 \times 4}{10} = 24{\cdot}8$.

The required curve must satisfy the following conditions:—(1) It must be of such a shape that every section, the centre of which is at any distance ρ from the centre, reaches the radial line of outflow at the same instant as the molecule of water reaches the point distant ρ from the centre. If, therefore, v be the mean velocity of radial outflow in the interval, ω the uniform angular velocity, and θ the angular interval the final radial direction of outflow, and a radius through the point distant ρ from the centre when the molecule is at the centre, the time of sweeping out the angle θ will be equal to $\frac{\theta}{\omega}$, and we must have the following equation of relation—$\frac{v\,\theta}{\omega} = \rho$ or $v = \frac{\omega\,\rho}{\theta}$. If, therefore, R represents the radial distance of the orifice from the centre, the mean radial velocity must have been equal to $\frac{\omega\,R}{\theta}$. Assuming that the curve of the arm should not extend beyond a quadrant, we get for the minimum value of the mean velocity $v = \frac{2\,\omega\,R}{\pi}$. In the example selected this would be equal to $\frac{2 \times 12{\cdot}4\,\pi \times 1{\cdot}5}{\pi} = 37{\cdot}2$ft. If the curve extended over the whole circumference the mean velocity of flow would be 9·3ft. per second. If "Pynx Gryph" cannot find a flaw in this calculation he must admit that no arm can be devised to do away with the creation of angular momentum in the water. (2) The tangential component of the relative velocity of the water must at every point be equal to the absolute velocity of the corresponding point in the arm and in the opposite direction. It is quite out of my power to conceive how the result can be achieved. It is evident that if it can, the relative velocity must be due to the net head h, and the absolute velocity of the orifice must be much less than $\sqrt{2gn}$, since the radial velocity of flow, likewise due to the head h_1, must be considerable. The conditions of the problem require also that none of the head must be expended in doing work from the centre to the orifice of discharge. If any part was so expended, the final relative velocity and the corresponding angular velocity of the wheel would be proportionately diminished. The moving forces on the wheel therefore must be due solely to statical pressure, and will, as explained in my paper, be equal to the difference between the pressures on the projection of the area of the orifice on the back of the arm normal to a plane passing through the axis of the wheel and the nozzle. The relative velocity of the water in passing over this section, cannot, under the assigned conditions, be appreciably different from that of the relative velocity of discharge, so that even if an arm could be designed to satisfy conditions (1) and (2), it is evident that the water would have no effect in making the wheel rotate at the assigned velocity. The work of doing this would therefore have to be performed by some external force other than that of the water flowing through the wheel.

In the case of the drum, "Pynx Gryph" states that his omission of the work of friction is quite beside the mark. But surely a very little reflection will convince "Pynx Gryph" that in this instance the effect of friction is at the root of the whole matter. Is he not aware that if a cylindrical vessel containing water, with its axis vertical, is made to rotate round that axis, every particle of the water—owing to surface and internal fluid friction—rotates with the angular velocity of the vessel in which it is contained; and that the surface of equilibrium is not a horizontal plane, but a paraboloid of revolution in which the vertical height of the surface in contact with the vessel above the vertex is equal to the height due to the velocity of rotation of the sides of the vessel? Supposing the sides were perfectly smooth, and "Pynx Gryph's" picture represented a possibility; what would happen directly the water entered the outlet? Would it not by impulse at once acquire the angular momentum of the edges of the outlet? A very little reflection ought to convince "Pynx Gryph" that a rough interior which would cause the velocity of rotation to be communicated to the water gradually would make a much more efficient machine than the imaginary one he has described.

Cannot "W. H. T." give your readers full particulars relating to one of Weisbach's experiments. I have consulted the paper in the "Proceedings" referred to by "W. H. T.," but could find no more information about the Domnarfort turbines than that given in their letter. WILLIAM DONALDSON.

2, Westminster-chambers, February 6th.

THE SOARING OF BIRDS.

SIR,—H. C. Wynne Edwards, in your issue of the 25th December, is outside of the record in attributing to me the supposition "that the friction of the air can be overcome without any expenditure of work" in the case of soaring birds. On the other hand, I have persistently shown how this friction was antagonised by the activities of the case.

It is very easy to account for soaring flight by ignoring the facts exhibited, or by postulating what is not true, and I can assure Mr. Edwards that the idea of constant change in the centre of gravity of the bird in the air is born of pure fancy. As a matter of fact they make no such change.

The explanation of "soaring" offered by me applies to a board of the same weight and general dimensions as the bird, which is supposed to float in air as the bird floats, and, in my judgment, any explanation which would not explain a soaring board is of no value. A bird merely makes use of mechanical forces which exist in absolute independence of that creature. Given a highly elastic fluid like air, a plane surface, and a single force acting in a straight line in one direction, and the operation of "soaring" is self-evident at every step in the process. The gravitating force need not be used. The action would go on in space far removed from the earth or any other body.

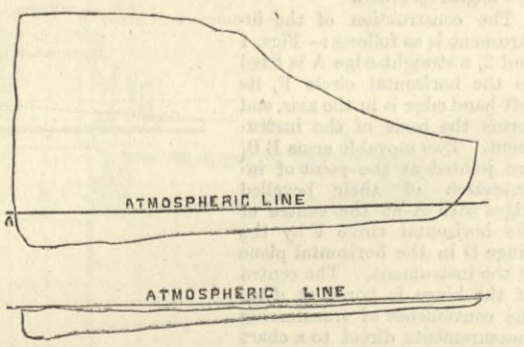
I call Mr. Edwards' attention to a letter of mine in THE ENGINEER in the early part of November last, which contains the whole matter in a nutshell. The question is asked, if on adding 12 oz. of weight to the plane the rear push would continue at 16 oz. or fall to 4 oz.? If it falls to 4 oz. "soaring" is explained. It is explained as completely as the motion of a grindstone is explained when it is referred to the muscular force of the boy who turns it. If it does not fall to 4 oz., the doctrine of the conservation of energy ceases to merit the consideration of any man. I can assure Mr. Edwards that if he be interested in the phenomenon of soaring flight, there is matter in that simple question worthy of his best attention.

It is best to dismiss the bird entirely in seeking reason for its action. After having explained soaring by framing forty-seven distinct theories, all of which were based on suppositions of bird or air which were not true, I abandoned that creature and took an oblong rigid sheet of metal about 12in. by 72in., as thin as possible, and weighing 12 lb. With this "soaring" could be examined on its merits, with no entangling alliance with the birds. Now, when Mr. Edwards can explain the horizontal translation of this surface when it is left with no support in free air the matter is ended. He must explain such level motion in all conditions of atmospheric motion which are related to the earth—in a dead calm, in any sort of horizontal wind, in wind which moves vertically upwards or vertically downwards, or at any sort of obliquity and with any velocity. He must meet the issue squarely, and presume to rest on no vague hypothesis which flatly contradicts the plain facts.

Chicago, January 7th. I. LANCASTER.

ANOTHER INDICATOR PROBLEM.

SIR,—I can readily believe your explanation of the diagram puzzle, the great secret of which was the very exceptional circumstance under which the compound engine was working, but which exceptional circumstance would hardly ever be met with in actual practice, and, therefore, would not occur to one person in twenty. I can, however, give you an instance in my own experience of almost equally puzzling diagrams I took from a compound engine. I enclose you copies of the diagrams, and will invite, with your



kind permission, the opinions of your readers taking an interest in these questions, as to what these diagrams indicate. The engine was originally a single cylinder engine, afterwards compounded; and if your correspondents will express their opinions as to whether the compounding was properly or improperly done, &c., I will reply and tell them what was done, which will probably be surprising as well as instructive to most of them. JOHN SWIFT.

Stanmore-road, Birmingham, January 26th.

BELGIAN ROLLED JOISTS.

SIR,—With reference to your statement of last week on this subject, what led to Belgian iron rollers going so largely into the manufacture of rolled joists is this: When the Belgian railway system was nearly complete, and steel rails began to supersede those of iron, there was no work for the mills put up to roll iron rails; so the makers took to rolling joists, for which the mills were best adapted after rails. They soon flooded the home market, and the low price attracted English iron merchants. Belgium can compete with England in this article, because Belgians work longer hours and are content with less wages than Englishmen, and the English rollers demand fancy prices for all sectional iron—that is to say, anything beyond flat, round, and square bars. Moreover, the freight from Antwerp to Birmingham, *viâ* Bristol and then per canal, is very low, notwithstanding transhipment. Each Belgian finished ironmaker has his own set of sections, which he sticks to; so there is very little changing of rolls, and still less fresh cutting, and the merchant makes up his varied order by taking a little from each. J. WALTER PEARSE.

Brussels, February 9th.

WIND PRESSURE.

SIR,—Amongst the "Notes and Memoranda" in THE ENGINEER for January 29th, there was a description of the effect of a severe gale on the Minot's Ledge lighthouse on the North American coast, and while reading it, it occurred to me that the account would have gained in interest and usefulness if the strength of this gale had been expressed in pounds pressure per square foot. Although the highest wind pressure is for structural purposes generally assumed at 50 lb. per square foot, scientific men are not altogether agreed as to the correctness of this datum, and it seems to me, therefore, that lighthouses, owing to their exposed situations, would be especially suited for the application of anemometers, as no near objects could either obstruct the full force of the wind or interfere with the direction. Comparisons between different instruments might also be instituted, as doubts have sometimes been expressed as to their accuracy. In fact, I consider that lighthouses are for the above-named reasons particularly well adapted for meteorological observations in general, and that they should be supplied with barometers, thermometers, and hygrometers as well; and as lighthouse keepers cannot be constantly employed and are always on the spot, they would be the best persons for making continuous observations, and could be easily trained for the purpose. For instance, an unbroken serles of observations on the force of gales on the eastern and western coasts of England, Scotland, and Ireland, would be of great value. Could not the Meteorological Society do something to that effect? J. G. HORNER.

Fenborough-road, West Brompton, February 9th.

GOOD AND BAD CHAINS.

SIR,—Our attention has been called to an advertisement in your issue of 22nd ultimo, consisting of a circular from the New British Iron Company, and copy of an apology from a firm of so-called "chain cable makers," trading under the style of Wm. Ingley and Co. It appears to be thought that the similarity of name may cause confusion and lead to the supposition that we are in some way mixed up in this matter; we therefore beg to state that we have no connection whatever with any firm bearing the same or a similar name. We also consider that the term "chain cable maker," as used in the apology, is misleading. It would certainly be understood by this expression that the people in question were manufacturers of *ships' cables*, which is not the case.

We have read your article on this subject with much interest, and, as the largest makers of chain and cable iron in this country, we thoroughly endorse the statements you make. We suppose there is no firm who have suffered more severely in this particular line than ourselves. For nearly forty years we have made this special class of iron, and have acquired a considerable reputation for it. It is a usual thing for merchants and engineers to specify that their chains are made from "Hingley's" iron, and they would doubtless be surprised to hear that they very often do not get it at all; or if they do, it is a small proportion of "Hingley's," and a good deal of some inferior make.

Of course this chain goes out abroad as being made from "Netherton iron, and you may imagine what we have to contend with in consequence, and the great injury that is done to us.

As to punishment, one cannot be always going to law; besides which it is very difficult to obtain sufficient evidence to convict upon.

With regard to the testing of chains, and even cables, we do not exaggerate when we say that one-half of the private test certificates that are issued in this country are worthless. It is not only that the bulk of the chain so certified is untested, but even when proved it is not properly examined, and any expert knows that the chain is almost worse than if it had not been tested at all.

We also can bear testimony to the good work done by Mr. Traill, of the Board of Trade; but there is more to be done yet. In our opinion it should be *compulsory* for all chains for engineering and mining purposes, &c., and all rigging and winch chains for British-built ships, to be tested at an authorised public proof house, and Lloyd's surveyors should call for an official certificate in the same way they do for the bower and stream cables.

As regards the export trade, it is difficult to remedy the evil; but it would be a step in the right direction to make it a felony to issue a false certificate for a chain. Until something of the sort is done, it will be impossible for those manufacturers who keep testing machines and a large staff of men going to prove and carefully examine their chains, to compete with their less scrupulous opponents. N. HINGLEY AND SONS.

Netherton Iron Chain-Cable and Anchor Works,
Near Dudley, February 10th.

FLOW IN PIPES.

SIR,—Mr. Thrupp asks me in your last issue some very definite questions, to some of which perfectly definite answers could not at present be given. He will find nearly all the information he requires in Lampe's article, "*Civilingenieur*," 1873.

Mr. Thrupp seems to have got into some confusion about the effect of temperature on flow. With stream line motion the effect of temperature is very large, and is well understood. With eddy motion the effect is less, and is less understood. But I fail to see in any case what the size of pipe has to do with it—except, indeed, so far as it determines the velocity at which the kind of motion changes. W. C. UNWIN.

February 10th.

TENDERS.

FOR the construction and erection of two purifiers and two cast iron tanks for the Borough Gasworks, Devizes.

	£	s.	d.
R. J. Dempster, Manchester	890	0	0
T. Piggott and Co., Birmingham	879	0	0
George Craik and Son, Berwick-on-Tweed	867	0	0
Jesse Tildesley, Willenhall, Staffordshire	850	0	0
W. R. Renshaw and Co., Kidsgrove	819	0	0
Willey and Co., Exeter	795	0	0
Clapham Brothers, Keighley	745	15	0
Newton, Chambers, and Co., near Sheffield	735	0	0
Hanna, Donald, and Wilson, Paisley	720	0	0
*C. and W. Walker, Midland Ironworks, Donnington	708	0	0
The engineer's estimate	629	0	0

* Accepted.

ALFRETON RURAL SEWERAGE.—A meeting of the Alfreton Parochial Committee was held at twelve o'clock on Wednesday, February 10th. Mr. Roberts was in the chair, and there were a large number of members present. Tenders were opened from contractors for executing the necessary works for a small sewage irrigation farm of 10½ acres at Swanwick, together with two outfall pipe sewers leading to the farm. The works were designed by Mr. W. H. Radford, sanitary engineer, Nottingham. The highest tender was £2250, and the lowest tender for £1230 from Messrs. R. and J. Holmes and Co., of Shirland, near Alfreton, was accepted. It was decided to advertise for a temporary clerk of the works at 35s. a week. A printed report and lithographed plans were received from Mr. W. H. Radford, C.E., showing the method in which he proposed to deal with the sewage of Greenhill-lane, Riddings, Lower Somercotes, Lower Birchwood, and Pye Bridge. Mr. Radford proposed to take 10½ acres to the south of Greenhill-lane, and construct certain outfall pipe sewers to convey the sewage of Greenhill-lane and part of Riddings to this site, where it would be dealt with by irrigation, the land being specially lightened, prepared, and drained. The cost of these works was estimated at £1850. To the south of Lower Birchwood a sewage farm of 12½ acres is proposed to be laid out, and the sewage of East Ridding, Lower Somercotes, and Lower Birchwood would be brought to this site by various pipe sewers. The sewage would be purified by irrigation as before. The cost of the whole of the works with the outfall sewers would be £2790. Mr. Radford also proposes to sewer Pye Bridge, and take certain land for a sewage osier bed, the osier plant being peculiarly suitable for sewage purification. The cost of the works would be £725. It was also proposed to efficiently ventilate the present system of sewers in the district, and construct a sewer from the Windmills to Seabrooks at a further cost of £550. It was proposed these works should be carried out as the necessity arises. The discussion of this report was deferred to a further meeting, when the members will have had time to study the report.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, January 29th.

LEADING authors and publishers from all over the country have been at Washington several days this week, testifying before the Senate Committee on Patents concerning the advisability of an international copyright. The American Copyright League is taking the lead in the movement, but there is not perfect unanimity. The Government is fully prepared to prosecute its case against the Bell telephone patent. Four cases are now pending in the Supreme Court, viz., the Molecular, the Overland, the Drawbaugh, and the Van Benthuysen.

Several foreclosures are still threatened in railway properties. First comes the Reading talked-of foreclosure, which has been gaining strength during the past few days. Next in importance is the nickel-plate default. The Central Trust Company, holding the first mortgage bonds, is seeking for a foreclosure. The Pennsylvania Company is in excellent condition. The Baltimore and Ohio has been defeated in the first round of the coming railroad fight in the New Jersey Legislature, for the erection of a bridge across a narrow waterway between Staten Island and the State of New Jersey. The Pennsylvania Company, in order to strengthen the friendly relations between itself and its several thousand employés, has completed a plan for sick or disabled benefits and death benefits. The monthly assessments range from 50c. to 2.50 dols., as wages run from 35 dols. per month to 100 dols. and over, and from 500 dols. in case of death to 2500 dols., according to the monthly earnings. The traffic prospects for the trunk lines both East and West are improving, and the industrial condition throughout the country is being daily strengthened. Notwithstanding the fact that we are in midwinter, the apprehensions are not confined to the few that a higher range of prices will be forced upon buyers by the opening of spring. This upward tendency cannot be permanent, because of the large amount of idle capacity in mills, furnaces, shops, factories, and mines.

The industries throughout the country are being run upon the idea that a restricted production will enable the managers to realise larger margins. As long as this is carried out better margins will be realised, but this advantage is seriously offset by the demand for higher wages by skilled and unskilled workmen throughout the country. The textile workers of the New England and middle States have succeeded in advancing their wages from 5 to 10 per cent. already. Further advances are probable not only in this branch but in others. Railmakers have voluntarily advanced the wages of their workmen 10 per cent. in several mills.

Railroad builders are sending in fewer orders this month than in December, evidently apprehensive that a reaction in prices will set in during the coming sixty days. This will likely prove to be a mistake. The present upward tendency, not only in rails, but in wool, textile products, machinery, and raw material, will likely continue for some time to come.

The price of coke has advanced in Eastern markets from 10 to 25 cents per ton, by reason of a general and successful strike among 10,000 cokemakers.

General strikes exist among shoemakers, cigarmakers, handloom weavers, and other branches. These facts are mentioned in order to furnish a basis for the inference that industrial activity may be checked by an advance in prices, which business sentiment may not endorse.

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

(*From our own Correspondent.*)

BUSINESS wears only a quiet aspect this week, whether at the ironworks, the manufactories, or the pits. The spring trade is opening quietly, and the inquiries are not up to the average of this time of the year.

The weekly exchanges in Wolverhampton yesterday, and in Birmingham to-day—Thursday—were well attended, and numerous inquiries were made with a view to test prices in the finished iron department; indeed, it is clear that there are some orders to come out, but that the holders are determined to place them only upon terms more favourable to themselves than those which regulated the last previous transactions. Makers were, however, generally firm, and several substantial firms declared that rather than take the prices which are being offered they would close until better times come round.

There are consumers who boast that during the week they have been so far successful in bearing the market that they have bought sheets of the doubles gauge at under £6 10s., although this is the price which a few firms of high standing declare they must have for singles. Such cases are, of course, few, but the fact that they exist shows the tendency of the market.

Strip iron is easy at £4 15s. as a minimum, and latens are not scarce at £7 2s. 6d. A few sales of bars at over £6 are occurring. Rounds for rivet iron purposes likewise fetch a good price for Admiralty and engineering needs.

Some inquiries are about for plates and angles for bridge and girder use. It is to be hoped that they will result in business. A few good orders of this class have lately come into the district, and others would be very welcome just now.

Some relief would be afforded to ironmasters by a general return in this district to the long-weight system, which means payment on a ton of 2400 lb. instead of 2240 lb. The short-weight arrangement came in with the eight hours' system at the pits, and its general removal would be hailed with satisfaction by many masters.

It is not without expressing congratulation that ironmasters learn the result of the strike at the works of Messrs. W. and J. S. Sparrow, the finished ironmasters of Bilston. The men have been out for a fortnight and have just resumed work on the short-weight system. The firm have had, however, to agree to pay the same rate of wages as were paid previous to the last award of the president of the Wages Board. Now that the thin edge of the short-weight wedge has been got in, the masters throughout the district will not be slow to drive it home.

The Bilston Iron Company, sheet iron makers, have given their men a fortnight's notice to terminate contracts, consequent upon a re-organisation of the managerial department. Business may not recommence directly the notices are up, but it is not likely that the works will remain closed long enough to cause suffering to the hands.

A personal item of local interest is that Mr. Tucker, the manager of the Lilleshall Steel Works, has resigned, and is succeeded by Mr. Ellis, who will also have charge of the Sneedshill Works.

In crude iron business continues dull. Pigs of best quality are unchanged on the week, Barrow being firm at 55s., and of the high-class sorts at from that figure up to 60s.; Derbyshires run from 37s. upwards.

Prices of forge coal are mostly 5s. into boat, which means scarcely more than 4s. over the weighing machine. Picked qualities for the mills range upwards to about 7s., whilst slack may be had at various prices from 2s. 6d. to 4s., according to quality.

There is much satisfaction that South Staffordshire continues to secure heavy contracts, the fine order recently obtained by Messrs. Bayliss, Jones, and Bayliss, of Wolverhampton, for India, being followed by the contract which has been secured by Messrs. Cochrane, of the Woodside Ironworks, Dudley, for supplying the work in connection with the bridge to be constructed in London across the Thames.

Makers of high-class hardwares report a slightly better inquiry, and it is less exceptional than for some time past to find individual manufacturers busy. The improvement, such as it is, would doubtless be much more distinct but for the prolongation of winter weather and labour disturbances.

The ironworkers of Wolverhampton and district continue to express their belief that only by strongly organising themselves can they expect to resist employers in their demands for reduced wages. A meeting to consider this question was held at Wolverhampton on Monday, but, as usual, no definite conclusion was arrived at. The men were urged to connect themselves with the Wages Board, and were recommended to form lodges at the works at which they were engaged.

Following the lead of the Wolverhampton ironworkers, those of the Oldbury district have decided to organise themselves, and it is likely that steps will be taken to secure a federation of various trades.

The chain-makers of Walsall have decided to appeal to the public to support the men locked out at Mr. Mills' works. A meeting was held on Wednesday night, when an appeal by placard was draughted, and subject to a clause being inserted that the men when working full time received only 18s. a week. The draught was approved.

The twelfth annnal meeting of the Union Rolling Stock Company was held in Birmingham on Tuesday, when Alderman Chamberlain, M.P.—chairman of the board of directors—presided. He moved the adoption of the report, and stated that the railway crisis in the United States had caused the directors considerable anxiety, but they had now successfully overcome that difficulty, and there seemed every indication of future prosperity for the company. The accounts were in a satisfactory state. The company declared a dividend of 12 per cent. per annum on ordinary and 6 per cent. on preference shares.

It was stated, during a meeting of the Coventry Chamber of Commerce held on Monday, that the bicycle and tricyle trades, which had sprung into existence since 1865, had increased 100 per cent. in volume and in the amount of capital invested and labour employed during the last five years.

The Walsall Chamber of Commerce, at a meeting on Thursday, considered the programme of business to be brought before the Associated Chambers, at their annual meeting in London. The delegates were instructed generally to support Free Trade, inquiry into railway rates, into the working of the Bankruptcy Acts, and other matters of commercial interest.

The question of German competition has received further attention this week at the hands of Midland manufacturers, by means of an address given before the Wolverhampton Chamber of Commerce by Mr. W. W. Walker, of the firm of T. W. and J. Walker, hardware merchants, Wolverhampton. Mr. Walker said that English manufacturers were handicapped by the Factory Acts, and if they were to maintain their position the working classes would have to work longer hours and accept lower wages. The masters themselves would have to be more thrifty and less luxurious.

The report of the Bromsgrove Gas Company read at an ordinary meeting of the shareholders at Bromsgrove, on Monday, was declared to be most satisfactory. The chairman, Mr. W. Jefferies, said that considerable additions having been made to the works, great progress in the manufacture and sale of gas had been made. During the last five years the sales had increased by as much as 50 per cent. A dividend of 7½ per cent. was ordered to be paid, and it was decided to increase the capital of the company.

The foundering of the steamship Flamingo, in the Mersey, on Wednesday, is a matter of local interest. She had on board a portion of the exhibition building which is being erected in Liverpool. The purchase of the Antwerp structure and its re-erection in Liverpool was in the hands of a well-known firm in this district.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE Board of Trade Returns for January still lack any evidence of distinct vitality in our export trade. The iron and steel export for January of 1886 was £1,606,448, as compared with £1,572,178 for January, 1885, and £1,910,863 for January, 1884. In pig iron we exported a value of £135,003, which is a considerable increase on the corresponding month of 1885—£123,980—but still far short of 1884—£175,493. The increasing markets are Russia and the United States—from £22,842 to £65,363. All the others show a decrease, Germany falling from £12,871 to £5039; Holland, from £29,743 to £15,169; Belgium, from £7892 to £4832; France, from £12,692 to £11,506; Italy, from £15,945 to £10,711. In unwrought steel the figures are just about the same as in January of 1885, the respective values being £73,083 and £73,142, which show a considerable falling off from January, 1884, when we exported £98,641. The business with France has fallen from £7028 in January, 1885, to £4693 last month; the United States markets have taken a value of £22,545 against £20,443 in January, 1885; other countries make up £45,846, which is £175 more than January of 1885.

In hardware and cutlery the values for January, 1884-85-86, were respectively £283,446, £239,839, and £232,407. Comparing the opening months of 1885 with 1886, the decreasing markets are found to be Russia, Germany, France, Spain and Canaries, the United States, Argentine Republic, British Possessions in South Africa, and British East Indies; the increasing markets foreign, West Indies, Brazil, British North America, and Australasia. The United States has fallen from £29,873 to £24,618, and Australasia has increased from £49,807 to £60,356. It would be interesting to have hardware and cutlery put separately, so as to see the particular articles, and classes of these articles, in which the diminution has taken place. There should be no difficulty in giving more detail where the goods, as in the items of cutlery, represent skilled labour.

Steel rails decrease by leaps and bounds. On January of 1884, the value exported was £213,202; in January, 1885, £153,631; in January, 1866, £110,215. No business was done with Russia, Italy, or Holland in any of these periods. Sweden and Norway had £84 in January, 1884, and £60 last month. Germany took £195 in January of 1884 and then left off. Spain and Canaries had £11,838 value in the same month, and then ceased ordering till last month, when the amount taken was £2300. Egypt, Mexico, the United States, and British Possessions in South Africa had no rails last month. Brazil had £16,012, and the Argentine Republic £24,811 (values on corresponding month of 1885, £7437 and £16,396); Chili has fallen from £9863 to £846, and Peru from £700 to £141; while British North America showed a tremendous drop from £24,599 to £118. British East Indies have advanced from £26,965 to £34,674; and Australasia has decreased from £38,062 to £20,744.

I mentioned last week that the coal trade was in an unsatisfactory state. Further evidence is afforded this week, first by the Board of Trade returns, which show the exports of coal and coke during January of 1884-5-6 to show distinctly diminishing value—thus, £831,616, £762,401, and £685,728. Coming nearer home, Yorkshire collieries have sent a much reduced tonnage to Hull during January—84,872 tons as compared with 100,688 tons for the corresponding month of 1885.

The National Trades Exhibition, in co-operation with the Society of Architects, opened an exhibition on Monday, at the Norfolk Artillery Drill Hall here. The exhibition has mainly to do with the building trades, and includes a large number of articles in which the Sheffield manufacturers are interested. There are, in consequence, many Sheffield firms represented, as well as others from a distance. There is an excellent collection of gas fittings of all kinds, chimneypieces, stove-grates, heating apparatus, wall-papers, greenhouses, engineers' tools, stonemasons' tools, electric bells, &c. Mr. C. J. Beardshaw, Calypso Steel Works, shows a screw-cutting lathe, for which it is claimed that it cuts screws and taps nuts to any thread, without change of wheels, by which time is economised. It is set to work by means of a lever, which glides automatically to the right or left over a leading screw bar, and in order to obtain a given thread, it is simply necessary to move a set screw. The exhibition, which remains open three weeks, was opened by Mr. H. Roumien Gough, F.R.S., B.A., F.R.H.S., president of the Society of Architects.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Throughout all branches of the iron trade in this district there is continued extreme depression, and not only is any prospect of improvement quite as remote as ever, but in some respects the condition of trade would seem to be, if anything, even worse. A complete want of confidence in the future is one of the most noticeable features in the market, and although sellers are prepared to accept lower prices than have been known within the experience of perhaps anyone at present engaged in trade, buyers are quite indifferent; even prices that are admittedly below the actual cost of production fail to convince buyers that they have yet reached their lowest point, and consumers go on from hand-to-mouth, just covering small requirements as they arise. One very substantial reason for the indifference of buyers is, of course, that there is very little new work coming into the hands of users of iron, and low prices do not offer much inducement for buying what they do not see at present they will actually require. The condition of trade was probably never really worse than it is at present, and the depression has extended over so long a period that a feeling of utter despondency as to when any improvement may really be looked for has, to a large extent, taken possession of the market.

The ironmarkets at Manchester bring together tolerably good attendances, and on Tuesday all branches of the iron trade were well represented, both as regards buyers and sellers, but the weight of business doing continues extremely small. In pig iron an occasional moderately large sale is reported, but this is a rare exception. For the most part transactions are confined to very small parcels, and these are few in number. For local and district brands the average prices that are being taken for delivery equal to Manchester are about 37s. 6d. to 38s., less 2½, and even at these low figures there is underselling. One or two makers keep up their quotations at about 1s. per ton above the prices I have named, but except for odd special sales they are practically out of the market. In outside brands prices are being cut very low, and both Scotch and Middlesbrough iron can be bought readily at under the current quoted rates.

For hematites there is still only a very slow sale, and, if anything, prices are easier. For good foundry qualities delivered here 53s., less 2½ per cent., is about the average quotation, but buyers with orders to give out would not have much difficulty in placing them at about 6d. per ton under these figures.

In finished iron business is excessively dull, and it is becoming not so much a question of price as of an almost complete absence of orders. Delivered into the Manchester district the average prices are about £5 2s. 6d. for bars, £5 10s. for hoops, and £6 10s. for local made sheets, but for actual specifications there are sellers who are prepared to come below even these figures.

The wages' question in the engineering trades of this district may now be considered as practically settled, and as I have intimated in previous reports that it would be, this end has been arrived at without a strike. There has been some show of fight on the part of the men, and a ballot of the members of trades' union societies affected by the notices showed a large majority in favour of not accepting the reduction. This result was communicated by the representatives of the men to the Iron Trades' Employers Association at a meeting held on Monday, and if the employers persisted in enforcing the notices which had been temporarily suspended at the request of the men, a strike against the reduction seemed to be the inevitable result. On Tuesday the Employers' Association held another meeting to consider the decision arrived at by the men, and unanimously resolved not to withdraw the notices. Within a few hours of the meeting of the Employers' Association the men held a meeting and reversed the decision arrived at by ballot; under protest, they resolved to accept the reduction in wages on the condition that they do not work overtime at the reduced rates. That the men have taken a wise course in submitting to a reduction in wages which the depressed condition of trade has rendered imperative must be evident to themselves, and besides, the funds of the various trades' union societies are in too impoverished a condition to enable them to carry on a strike with any chance of success. In other districts the same wise discretion is being exercised, and on both banks of the Mersey the men engaged in every department of marine engineering and iron shipbuilding have this week accepted a reduction of 2s. per week on weekly earnings exceeding 30s., and 1s. on wages of not less than 20s. per week.

The important appeal of Sir Joseph Whitworth and Co. against the assessment of their engineering works at Openshaw, which has been taken up by the Iron Trades Employers' Association as a test case as to the liability of certain classes of machinery to be included in the valuation of engineering works for rating purposes, was for the second time before the Quarter Sessions of the Salford Hundred on Saturday, and the chairman intimated the judgment would be given at the Quarter Session to be held in April. In the meantime both sides are preparing a case which will be submitted, in the first instance, to the Court of Queen's Bench, and ultimately to the House of Lords.

The Bridgewater Navigation Company, whose undertaking the Manchester Ship Canal Company has undertaken to buy, has made a net profit on the last year's working of £59,000, and a dividend of 8 per cent. is being paid to the shareholders, besides which a bonus of 4s. per share, which will absorb £20,000, is also being divided. In compliance with the provisions of the Act under which the Ship Canal Company purchases the Bridgewater Navigation Company's undertaking, the sum of £20,000 which they are required to deposit has already been paid. The most important matter now before the Ship Canal Company is the obtaining of an Act of Parliament for the payment of interest out of capital during the construction of the canal, and this is a vital point in connection with the raising of the necessary capital. The actually subscribed capital still falls considerably short of a million, and until the promoters obtain the powers they are seeking under their new Act of Parliament further progress seems to be practically checked. The promoters are, however, sanguine that Parliament will grant them the power to pay interest out of capital, and with that power they are practically assured of raising the requisite capital for carrying out the undertaking.

In the coal trade the extra winter requirements for house fire consumption still keep up a fair demand for the better qualities of round coal, but there is not more than a moderate business doing for the time of the year, and with pits generally not working more than four to five days a week. Colliery proprietors are not doing more than move away their present output, whilst prices are already beginning to show weakness, although there is no actual reduction in the quoted rates. Other descriptions of fuel for iron-making, steam, and general trade purposes continue in very poor demand, with no prospect of improvement; and as soon as the extra winter consumption for house fire purposes drops off, the prospects are very discouraging. At the pit mouth best coal can be got at from 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common round coals, 5s. 3d. to 5s. 9d.; burgy, 4s. to 4s. 6d.; and slack, from 2s. 6d. to 3s. 6d. per ton, according to quality.

In the shipping trade there is a fair business doing in house fire coals, but for steam coals there is only a slow demand, and for good qualities not more than about 7s. 3d. per ton is being got for delivery at the high level, Liverpool, or the Garston Docks.

The annual report of Andrew Knowles and Sons, one of the largest colliery concerns in Lancashire, with a paid-up capital of over £700,000, besides debenture bonds of over £400,000, has been issued this week, and shows a net loss on the year's workings of £8644. This, however, is nearly all accounted for by the loss sustained by the company in consequence of the disastrous explosion at the Clifton Hall Colliery; but the directors state that the demand for coal during the past year has been very slow, in a great measure owing to the general trade in the surrounding district being far from satisfactory. In the summer months of the year the competition was keener, and lower prices had to be taken than at any other time since the formation of the company. By the accident at the Clifton Hall Colliery, and an underground fire at the Allen's Green and Green Lane Collieries, the output of coal for the year had been considerably reduced, the get having been a little over 980,000 tons, as against over 1,090,000 tons in 1884.

Barrow.—The iron trade is scarcely so firm as it has been during the past few weeks, and makers have not booked many new orders. There is a steady tone, however, and it is thought by many that the present lull will not very materially check the improving tendency of trade. It is significant, however, that the hematite has been the only trade which of late has been busy, and no other quality of iron has been in demand to any extent, except Bessemer descriptions. This has no doubt been caused by the improved tone of the steel trade, and so long as that department keeps good, there must be a large consumption of Bessemer iron from which the steel is made. The value of pig iron is steadily maintained at 45s. 6d. per ton for mixed parcels of Bessemer iron net at makers' works, and 43s. 6d. for No. 3 forge and foundry iron. Stocks are large, but are not so heavy as they have been of late. The steel trade is only comparatively busy in the heavy rail department, as only a small trade is being done in other branches of trade. The steel trade is very quiet so far as merchant qualities are concerned. A fair business is being done in steel sleepers, and a fair number of orders are held for tin bars, while a contract or two has lately been let for steel plates for shipbuilding purposes. No new contracts can be noted for ships or steamers, and work in engineering, iron-founding and boilermaking shops is very scarce. Iron ore is in better demand at firmer prices. The Manx steamers Mona's Isle and Mona's Queen are at Barrow undergoing alterations, with a view to increase their speed next season. It is anticipated that the new high-level bridge at Barrow will be opened for traffic into Duke-street in about two or three months.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The usual quiet feeling prevailed throughout the Cleveland iron market, held at Middlesbrough on Tuesday last, but no actual reduction in prices was made. Merchants offered small lots of No. 3 g.m.b. for prompt delivery at 30s. 9d. per ton, and some were willing to take 31s. for delivery over the next three months. Consumers, however, do not seem anxious to buy, believing, no doubt, that lower rates will be taken if the present rate of production is maintained and stocks continue to increase. Makers, on the other hand, look forward to an improvement so soon as the shipping season commences. The leading firms are not quoting at all, and those who are willing to do business now will sell No. 3 at less than 31s. per ton. The mills and forges being badly off for work, there is but a moderate demand for forge iron. The price, however, remains the same as quoted last week, namely, 30s. 3d. per ton.

Several holders of warrants are anxious to realise, and are willing to accept 31s. per ton, or 3d. less than they asked last week.

Not much iron is being sent into Messrs. Connal and Co.'s Middlesbrough store at present. On Monday last the stock was 160,340 tons, being an increase of 510 tons during the week. At Glasgow the stock has reached 685,198 tons, or 4118 tons more than when last reported.

The finished iron trade is as lifeless as ever. Scarcely any new work has come into the market, and no change has taken place in prices. The continued strike at the shipyards is affecting adversely the interests of the finished iron firms who have so far kept their works going, and unless it terminates soon, some of them will have to suspend operations.

A meeting of the shipbuilders of the Tyne and Wear was held at Sunderland on Friday last, in order to receive a deputation from the Boilermakers' Society and to discuss the questions in dispute. When the deputation had withdrawn the employers passed the following resolution:—"That, in the light of the explanation given by the deputation of the Boilermakers' Society, this Association is prepared to take into favourable consideration any modification which the men may propose of the reduction already notified, the amount of the reduction claimed not being a hard-and-fast line. The builders strongly recommend that deputations be empowered to treat for a settlement." The conference was then adjourned until Thursday, the 11th inst.

The ironmasters' returns for January have been issued, and show that ninety-nine furnaces are in blast. The total make of pig iron of all kinds was 214,005 tons, being a decrease of 486 tons in comparison with December. The stock of pig iron in the whole district amounts to 573,830 tons, which is an increase of 56,342 tons for the month. This enormous increase is due to a falling off in shipments, and to the strike at the shipyards.

The value of goods exported from Middlesbrough last month—exclusive of coal and coke—was £114,437, or an increase of £53,461 over the exports during January, 1885. The value of exports from Newcastle was £157,686, or £29,757 more than during January, 1885. The clearances of coal and coke from Middlesbrough show an increase of 1733 tons.

Mr. John Gunter, who for nine years has occupied the position of works manager at the Britannia and West Marsh Ironworks, Middlesbrough, belonging to Messrs. Dorman, Long, and Co., has just retired. It is understood that his place will be supplied by a re-arrangement of the existing staff. The demand has considerably fallen off for all the specialities made at these as well as for those made at all other works in the district. A large stock of rolled joists is now lying there until consumers can be found to clear it off.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

Pig iron warrants, which were very flat last week, declining to 39s. 0½d. cash, were rather more in request in the early part of the present week, with the result that there was a partial recovery in quotations. The bulk of the operations were merely speculative, however. In one case an operator purchased 30,000 tons of warrants in the forenoon, when the market rose 2d. a ton, and sold 20,000 in the afternoon, after which prices again gave way. At present transactions of this description are common, and they have little bearing upon the actual condition of the trade. Merchants and makers report that inquiries from abroad are few, and for the most part unimportant. The past week's shipments were 5621 tons, as compared with 6511 in the preceding week, and 6506 in the corresponding week of 1885. One furnace has been damped at the Eglinton Ironworks, and there are now 94 in blast against 93 in the same week last year The week's addition to stock in Messrs Connal and Co.'s Glasgow stores is 3900 tons.

Business was done in the warrant market on Friday at 29s. 3d. cash. On Monday there was more animation, while quotations advanced to 39s. 5½d., and on Tuesday there was a further increase to 39s. 9d. cash, closing at 39s. 7½d. Business was done on Wednesday at 39s. 6½d. to 39s. 4½d., afterwards improving 1d. To-day—Thursday—transactions occurred at 39s. 6½d., closing at 39s. 4½d. cash.

The current values of makers' iron are again somewhat lower. Free on board at Glasgow, Gartsherrie, No. 1, is quoted at 43s. 6d. per ton; No. 3, 42s.; Coltness, 47s. 6d. and 44s.; Langloan, 45s. 6d. and 43s. 6d.; Summerlee, 49s. 6d. and 43s. 6d.; Calder, 48s. and 42s.; Carnbroe, 43s. 6d. and 41s.; Clyde, 44s. 6d. and 41s.; Monkland, 40s. and 37s.; Quarter, 39s. 6d. and 37s.; Govan, at Broomielaw, 40s. and 37s.; Shotts, at Leith, 46s. and 45s. 6d.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. and 42s. 6d.; Glengarnock, at Ardrossan, 44s. 6d. and 41s.; Eglinton, 40s. and 37s. 6d.; Dalmellington, 42s. and 39s.

Messrs. Laidlaw and Son have secured an order to supply 400 tons of cast iron pipes to the Glasgow Corporation.

Messrs. William Baird and Co., the well-known Scotch ironmasters, have acquired an important iron ore mine in the neighbourhood of Santander in Spain. They will now be in a position, as they have long been in West Cumberland, to control the Spanish mine from which they derive their ore for the purpose of enriching the quality of their pig iron. It is also expected that the Santander mine will yield them a considerable surplus over what they will require themselves for export to America and the Continent.

In the course of the past week there was shipped from Glasgow five locomotive engines and tenders, valued at £12,250, for Kurrachee; £20,900 worth of machinery, of which the greater proportion went to Rangoon; £6200 steel goods; £4353 sewing machines, and £22,030 general iron manufactures.

The coal trade in several of its departments is in a backward state, although some more activity is expected to follow upon the disappearance of the snow. The week's shipments of coals have been at Glasgow 14,265 tons, as compared with 22,022 in the same week last year; 1101 tons, against 311, at Greenock; 10,363, against 8420 at Ayr; 2840 at Irvine, against 1119; 6467, against 4221, at Troon; 498, against 3373, at Leith; 3455, against 1339, at Grangemouth; and 3091, against 2468, at Bo'ness. For steam coals the inquiry is slow, and the prices of most descriptions are not easy to fully maintain.

The wages' question is again exercising both employers and workmen in the coal trade. A few days ago the masters in the districts of Glasgow, Carslang, and Rutherglen withdrew the 6d. a day of increase given to the colliers towards the close of the year. There is a proposal also to withdraw that amount in the Hamilton district, where the colliers, on the other hand, are expecting a second 6d. advance on the 1st of March.

Notices have been posted at all the Fife and Clackmannan collieries, intimating a reduction of 10 per cent. in the miners' wages.

A seam of ell coal, 2ft. 8in. thick, has been struck by the Bourtriehill Coal Company at Broomlands, near Irvine.

Mr. J. M. Ronaldson, who acted for about twelve years as assistant to the late Mr. Alexander, has now been appointed chief inspector of mines for the West of Scotland.

The new shipbuilding contracts placed within the past few days on the Clyde embrace a steel paddle steamer of 190ft. in length, to be built at Ayr by Messrs. M'Knight and Co., for Captain Campbell of Glasgow, for the Clyde passenger service, and a steel screw tug-boat 80ft. in length, placed with Messrs. D. J. Dunlop and Co. of Port Glasgow, for the Thames.

The present advances in the price of ammonia has given much satisfaction to the Scotch manufacturers, who now produce a very large amount.

The tonnage of the vessels arriving in the Clyde during January was 104,462, a decrease of 7886 tons as contrasted with the same month of last year, while the sailings gave a tonnage of 99,052, or 31,308 less than last year.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

The half-yearly meeting of the Taff Vale shareholders is generally looked forward to as yielding good data for trade prognostications. When it was announced that instead of a dividend of 15 per cent., 10 per cent. and 2 per cent. bonus only would be forthcoming, there were loudly expressed fears that the Taff had entered upon its decline; but I am glad to know that the directors do not share that view. There has been a falling off, it is true; the coal trade has suffered, and it simply "stands to reason" that if shipments at Cardiff show a decline of 20,000 to 30,000 tons a week, railways must suffer in proportion. But the chairman took a hopeful view of the future, and it was evident that a higher dividend might easily have been paid.

The amalgamation between the Rhymney and Taff Vale still hangs fire. It was suggested that if the Rhymney received a guarantee of 10 per cent., there would not be much difficulty. I should scarcely imagine there would. The Taff Vale Company is about adopting the Mardy branch, and in a few weeks I expect the Pontypridd and Newport line will carry passengers, and the Ryhmney and Great Western branch to Cyfarthfa be opened.

The coal trade generally is quiet, and the only item of note is the fact that a few leading coalowners have secured some additional Government orders. The Glamorgan Company, Rhondda Valley, has obtained a good proportion for home supplies and for Malta; Burnyeal, Brown, and Co. have secured the Ascension orders; Worms and Co., orders for Halifax; and Hickle and Co., of London, orders for Jamaica. Cardiff sent away last week 144,734 tons of coal, foreign, and Newport, Mon., 34,800 tons, both showing a slight increase. Swansea, on the contrary, exhibited a decline, there having been only a scant arrival of tonnage. Pitwood is very depressed, and quoted prices are as low as 15s. 6d.

I have no improvement to announce in connection with the iron and steel trades. Things really appear to be getting worse instead of better. At Newport, for instance, there were no shipments during the last week, and only 30 tons from Cardiff. This week one good cargo of rails to India and a small one for New York are all, and very scant consignments passes over the rails for home use. There are strong fears entertained that with a continuance of this state of things ironmasters must begin to curtail expenditure. They can never keep on making for stock. Already at Tondu and Blaenavon signs of distress are being shown, and it is only too probable will become general.

Patent fuel is looking up slightly, Newport sent two cargoes respectively to Valencia and Bordeaux; and Swansea, steadily increasing its exports, reached 8000 tons last week. This is hopeful. Swansea, too, is showing better in tin-plate, and this trade generally is better. Prices are firmer, and shipments having been large, stocks are lessening. Thus, at Swansea last week 49,771 boxes were brought down, and 53,819 boxes shipped, so that stocks now amount to 144,798 boxes, as compared with 158,271 boxes in hand last week. Anything like a spurt, it will be seen, would send prices up. At present quotations are as follows:—Coke plates, 13s. 6d. to 14s.; prices offered generally, 13s. 3d. Bessemers, 14s. to 14s. 9d.; Siemens, 13s. 9d. to 15s. It will be seen that the margin of prices is increasing. Holders of best brands in every case get 3d. more than ruling figures.

The federation of shipowners is spreading, and is being actively discussed at Cardiff.

Heusinger von Waldegg.—We regret to have to record the decease of the celebrated German railway engineer, Edmund Heusinger von Waldegg, who died at Hanover on the 2nd inst., in his sixty-ninth year, after a short illness. The funeral, which was largely attended, took place on Saturday last, the 6th of February. Herr von Waldegg, besides his official labours as Government railway engineer, contributed largely to the technical literature of his country. Perhaps the work for which he will be best remembered is "Handbuch der Ingenieurwisenschaften," a book deservedly popular in England as well as on the Continent.

Worshipful Company of Carpenters, London Wall.—A course of free lectures on matters connected with building will be delivered at Carpenters' Hall, London Wall; each lecture to commence at eight o'clock p.m. February 17th, Mr. T. Blashill, F.R.I.B.A., "Timber: its Growth, Seasoning, and Preparation for Use;" February 24th, Professor Corfield, M.A., "Water Traps;" March 3rd, Professor Kerr, F.R.I.B.A., "A Gossip on the Philosophy of Building Materials;" March 10th, Mr. T. Chatfeild Clarke, F.R.I.B.A., "Architecture of City Buildings;" March 17th, Mr. John Slater, B.A., "Concrete;" March 24th, Mr. H. H. Statham, "The Fine Art Aspect of Woodwork;" March 31st, Mr. James Doulton, "Terra Cotta;" April 7th, Mr. Banister Fletcher, M.P., F.R.I.B.A., "The Influence of Architecture upon Carpentry."

NEW COMPANIES.

THE following companies have just been registered:—

Anglo-International Patents Mart Company, Limited.

This company was registered on the 1st inst. with a capital of £2000, in £1 shares, to carry on business as agents for the commercial and industrial advancement of new inventions and discoveries. The subscribers are:—

	Shares.
Erich Meyer, 68, Buckingham Palace-road, agent	1
C. Palmer, 32, Wood-street, Chelsea, agent	1
J. Hopkins, 44, Ovington-street, Chelsea, foreman	1
Mrs. Amy Hopkins, 44, Ovington-street, Chelsea	1
R. H. Bateman, 9, Halsey-street, Chelsea, clerk..	1
Mrs. J. C. Bateman, 9, Halsey-street, Chelsea ..	1
Miss. E. L. Griffin, 9, Halsey-street, Chelsea ..	1

Registered without special articles.

Astrop Patent Company, Limited.

This company proposes to acquire and work the letters patent No. 11,901, dated 2nd September, 1884, granted to William Astrop for an improved process of deodorising, disinfecting, precipitating, drying, and pulverising the solid portion of sewage to render it a marketable manure. It was registered on the 29th ult. with a capital of £30,000, in £1 shares, with the following as first subscribers:—

	Shares.
William Wigginton, Jermaine's-road, Forest-hill	1
C. J. Fox, 61, King's-cross-road, engineer	1
R. Larchin, Devonshire-chambers, Bishopsgate, engineer	1
A. Norman, 38, Finsbury-pavement, financial agent	1
F. W. Frost, 3, Union-court, Old Broad-street, engineer	1
J. F. Williams, 34, South Island-place, Brixton-road, accountant	1
E. Marshall, 123, Shakespeare-road, Stoke Newington	1

Directors' qualification, 250 shares. Most of the articles of Table A of the Companies' Act, 1862, are adopted.

Charles Tebbitt and Co., Limited.

This company, with a capital of £5000, in £25 shares, proposes to establish and carry on in Smyrna, Asiatic Turkey, the business of manufacturing and dealing in ice in any manner whatsoever, and also to trade in fish, meat, fruit, wines, spirits, beer, or any perishable food and products. It was registered on the 29th ult., with the following as first subscribers:—

	Shares.
W. Lawrence, 14, Paulet-road, Camberwell, clerk	1
*J. Troutbeck, 4, Dean's-yard, S.W., solicitor ..	1
*Allan Field, 12, Queen-street, Cheapside, solicitor	1
*J. E. Pickering, Beulah-hill, Norwood, merchant	1
C. J. Hamilton, 89, Malpas-road, Brockley, foreman	1
E. Pronk, 8, Carisbrooke-road, Walthamstow, dye merchant	1
E. Ellison, 29, Jeffrey's-road, Clapham-rise, solicitor	1

The number of directors is not to be less than two nor more than five; qualification, four shares; the first are the subscribers denoted by an asterisk; maximum remuneration, £100 per annum, with an additional £10 for each 1 per cent. dividend beyond 10 per cent. per annum.

Indigo Company, Limited.

This company proposes to acquire and work the following letters patent for British India, viz.:—No. 97, of 1880, for the complete separation and conversion of the Indican of the Indigo Ferol, and increasing thereby in the presence of alkalies and rapid oxidation the production of indigo. No. 181, of 1882, for the complete utilisation of split-up Indican and its derivatives, and also other indigo-producing compounds in the plant, for the formation of indigo blue in the presence of ammonia and other alkalies and oxygen. It was registered on the 3rd inst. with a capital of £150,000, in £5 shares, whereof 2200 are 10 per cent. preference shares, and 8000 are deferred shares. The subscribers are:—

	Shares.
*Walter Butler, Oriental Club, Hanover-square, indigo proprietor	1
*J. Macdonald, 50, Oxford-terrace, W., indigo planter	1
*D. Norman Reid, 2, Cleveland-gardens, Ealing, indigo planter	1
M. G. Rimmer, 10 and 11, Mincing-lane, indigo broker	1
C. E. Robinson, 10 and 11, Mincing-lane, indigo broker	1
*L. Geneste, Highland House, Norwood	1
*C. J. Geneste, 14, Queen-square, W.C., indigo manufacturer	1

The number of directors is not to be less than three nor more than twelve; the first directors are the subscribers denoted by an asterisk and Messrs. W. B. Hudson, Henry Bollman Condy, and John Allen; qualification, 50 shares. Remuneration, a sum equal to £400 per annum for the chairman, and £200 per annum for each ordinary director.

James Budgett and Son, Limited.

This is the conversion to a company of the business of dealers in sugar and dried fruits now carried on by the above-named firm at 3 and 4, Laurence Pountney-lane. It was registered on the 29th ult. with a capital of £160,000, in £100 shares, with the following as first subscribers:—

	Shares.
*J. S. Budgett, Laurence Pountney-lane, merchant	1
*R. S. Budgett, Laurence Pountney-lane, merchant	1
C. Wonters, Grafton House, Forest-hill, merchant's buyer	1
G. O. Wonters, 2, Shooter's-hill-road, S.E., accountant	1
E. A. Golds, 14, Gauden-road, Clapham, merchant's buyer	1
J. Glynn, 247, Evering-road, Clapton, merchant's traveller	1
O. Page, Cavendish-road, Merton, accountant ..	1

The number of directors is not to be less than three nor more than seven; qualification, ten shares; the first are the two signatories denoted by an asterisk.

Luchana Mining Company, Limited.

On the 29th ult. this company was registered with a capital of £200,000, in £10 shares, to acquire and work mineral property in Spain or elsewhere. An unregistered agreement between Benjamin Whitworth of the first part, H. D. Pochin of the second part, Bolckow, Vaughan, and Co., Limited, of the third part, John Brown and Co., Limited, of the fourth part, and the company of the fifth part, will be adopted. The subscribers are:—

	Shares.
Benjamin Whitworth, J.P., 22, Daleham-gardens, N.W.	1
Stephen Burridge, Sheffield, iron merchant ..	1
Joseph Laing, Barnes	1
W. S. B McLaren, Bradford, worsted spinner ..	1
H. D. Pochin, J.P., Conway	1
E. W. Richards, Marton, Middlesbrough, engineer	1
J. Hart, Clairville, South Norwood, manager ..	1

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

Orlando Jones and Co., Limited.

This is the conversion to a company of the business of starch, blue, and blacklead manufacturers, millers, rice cleaners, manufacturers of germless maize, &c., carried on by the firm of Orlando Jones and Co., at York-road, Battersea. It was registered on the 30th ult. with a capital of £150,000, in £10 shares, whereof 13,600 are A or £5 per cent. cumulative preference shares, and 1400 are B or deferred shares. An agreement of the 20th ult. (unregistered) regulates the purchase. The subscribers are:—

	Shares.
*Wm. Evill, J.P., Worcester Park, Surrey	1
*Stanley Kemp Welch, 55, Cornwall-gardens, South Kensington	1
*Joseph Walton, Alleyn Park, Dulwich..	1
*C. D. Kemp Welch, Broadlands, Ascot..	1
*W. Kemp Welch, 25, Carter-lane, E.C...	1
J. Kemp Welch, Sopley, Hants..	1
J. Evill, Worcester Park, Surrey	1

The number of directors is not to be less than three nor more than eight; the first are the subscribers denoted by an asterisk and Mr. Henry Kemp Welch, of 52, Leadenhall-street; qualification, shares or stock upon which £500 has been paid up or credited as paid up; the company in general meeting will determine remuneration. Messrs. Wm. Evill, S. K. Welch, and J. Walton are appointed managing directors until the 31st of December, 1895, at salaries of £750 per annum each.

PRODUCTION OF SALT IN THE UNITED STATES.—The production in 1884 was 6,514,937 barrels of 280 lb., equivalent to 1,824,182,360 lb., or 32,574,685 bushels, or 912,091 short tons, according to the unit used. The total value, computed on average wholesale prices at the point of production, was 4,197,734 dols. The apparent output was 322,706 barrels greater than in 1883, while the value was 13,308 dols. less; but the production figures do not include a considerable stock on hand in the Onondaga district, not officially reported because not inspected.

CANAL PROJECTS IN THE UNITED STATES.—Several important waterways are projected in the north-western States of America. One of these is a proposed artificial river 200ft. wide, to run from Chicago south-west to the Illinois river. This would practically unite the Mississippi and Lake Michigan. It has further been suggested to turn the trade of the Canadian North-West southward to the United States by constructing a canal to connect Lake Winnipeg with their lake system. The Red River of the north, which forms the boundary between Minnesota and Dakota, and which runs north into Lake Winnipeg, is navigable from Fargo, if not from Breckenridge. A vessel would go west from Lake Superior by the St. Louis river, cross over the divide to the Mississippi river, follow that river up stream 150 miles, cross over to Red Lake river, and go west on that to the Red River at Grand Forks. On this route, observes *Demorest's Monthly*, a waterway requiring less than fifty miles of artificial canal could be constructed. This would make a channel with 6ft. of water, which would connect the Mississippi with the lake system, and connect both the lake systems with Lake Winnipeg and the whole of the Saskatchewan and Hudson Bay country. This scheme contemplates the uniting of three basins, that of Lake Superior, of the Upper Mississippi, and of the Winnipeg river and lake. It is estimated that it will cost about 300,000 dols. to construct the canal, which would be about as long as the Erie Canal in New York.

KING'S COLLEGE ENGINEERING SOCIETY.—At a general meeting held on Tuesday, February 2nd, Mr. C. W. Atkinson read a paper "On Hydraulics," in which he described the theoretical considerations involved in the designing of water motors. The author commenced by enumerating the various sources of loss from "skin friction" and "eddies," and the ways in which these losses might be reduced. He then proceeded to the consideration of water motors, which he divided into three main classes—weight machines, pressure engines, and impulse or reaction machines. After briefly describing the action of weight machines, he pointed out the great differences which existed between the use of high-pressure water and high-pressure steam. First, the loss from friction in the pipes and passages being enormously greater in the former case, owing to the much greater density of water compared with steam; secondly, the great waste of energy arising from the incompressibility of water, necessitating the expenditure of the same volume, and consequently of the same amount of energy each stroke, whether the work done was large or small; and, thirdly, the much greater effect of the inertia of the fluid in the pipes and reservoir, which reduces the pressure on the vane at the commencement of the stroke, while at the end the pressure may rise very considerably above that in the accumulator. The author then referred to the inefficiency of reaction wheels, and showed the way in which this had been remedied in turbines by giving the water a forward motion before the wheel. The paper concluded with a detailed description of the designing of the guide-blades and vanes in both impulse and impulse-pressure turbines.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

2nd February, 1886.

1480. Coupling, &c., Railway Wagons, G. Gaskell, Poolstock.
1481. Carriage Lamps, J. Westaway, Coryton.
1482. Hawking Machines for Indigo Dyeing, J. Coulter, Halifax.
1483. Making Hearth Rugs, F. Wilkinson, Halifax.
1484. Closing the Mouths of Bottles Containing Ale, &c., J. Buckland and W. Medley, Halifax.
1485. Producing Looped Fabric whilst Weaving, A. Lister and W. Carter, Halifax.
1486. Construction of Bagatelle Appliances, D. Clarke, Birmingham.
1487. Anti-vibrating Automatic Steering Arrangement for Velocipedes, J. and H. J. Brookes and W. R. Kettle, Smethwick.
1488. Pins for Brooches, J. Killin, Aston.
1489. Whistles, F. Sunderland, Birmingham.
1490. Separation of Smoke from Gases Evolved During the Combustion of Fuel, W. Mills, T. Pickup, and G. Procter, London.
1491. Enamelled Coloured Plaster for Walls, R. Jenkins and J. Cox, Bexley Heath.
1492. Fitting on of Shirt Collars, W. Husband, Edinburgh.
1493. Dynamo-electric Machines, H. J. Allison.—(*W. L. Voelker, United States.*)
1494. Roast Jack and Meat Hastener, W. Foxcroft, Birmingham.
1495. Sketch-books, W. Duppa-Crotch, Richmond.
1496. Electric Bells, T. P. C. Crampton, London.
1497. Lavender Smelling Salts, T. C. Lovewell, Brighton.
1498. Mounting Hobby-horses, A. Porter and W. Wilkinson, Halifax.
1499. Knitted Ribbed Fabrics, G. F. Sturgess, Leicester.
1500. Reception of Coin, C. H. Russell, London.
1501. Coupling and Uncoupling Railway Engines, W. Gilmore, London.
1502. Folding and other Chairs, W. Bendall, Aston.
1503. Skiving, &c., Leather, J. and A. Hall, Leeds.
1504. Combined Match-box and Cigar Cutter, A. E. Ragg and A. Smith, Chester.
1505. Tin Cases, G. Tomkins, London.
1506. Permanently Facing with Metal Hard Rubber Surfaces, M. G. Cunningham, London.
1507. Bags or Packets for Tea, &c., J. M. Bames and S. Washington, Hulme.
1508. Fastenings for Articles of Dress, S. Alford, London.
1509. Lubricators, F. Trier, London.
1510. Knotting Plyers for Carpets, B. Neubauer, London.
1511. Distilling Turpentine, &c., E. W. McClave, London.
1512. Vapour Inhalers, P. M. Justice.—(*R. M. Kennedy, United States.*)
1513. Joiner's Bench Hooks, T. M. Speight, Halifax.
1514. Metallic Knobs, W. Mayon, Birmingham.
1515. Metallic Sleepers, &c., W. H. Beck.—(*F. Cantero, Spain.*)
1516. Rotary Engines, J. A. Wade and J. Cherry, London.
1517. Generating Gases, J. S. Badia, London.
1518. Smelling-bottle Mount, S. E. Culver, London.
1519. Steering, &c., Velocipedes, C. W. R. Duerre, London.
1520. Car Couplings, C. B. C. and S. O. C. Coles, London.
1521. Regulating Gas Supply, L. A. Groth.—(*A. Silbermann, Germany.*)
1522. Winding Apparatus, J. Lysaght and J. B. Hollom, London.
1523. Applying Boot Protectors, J. L. Thomson, London.
1524. Making Dies, A. J. Boult.—(*J. Brady, United States.*)
1525. Lubricating Compounds, C. Fink, London.
1526. Night Commodes or Pans, V. C. Browne-Cave, London.
1527. Brooms, &c., T. R. Donnelly, London.
1528. Establishing Line of Communication, C. E. Thompson, Liverpool.
1529. Devices for Holding and Cutting Paper, W. P. Thompson.—(*The Morgan Envelope Company, United States.*)
1530. Nail Plates, &c., G. Macaulay-Cruickshank.—(*J. O. J. and A. B. J. Kollén, Sweden.*)
1531. Furnace-doors, J. Parker, Glasgow.
1532. Three-way Valve, J. R. Thomson, Glasgow.
1533. Apparatus for Expanding the Ends of Tubes, J. R. Thomson, Glasgow.
1534. Combination Locks, A. M. Clark.—(*A. J. Calhoun, United States.*)
1535. Sleeve Holder, A. M. Clark.—(*L. N. Loeb, United States.*)
1536. Scarves and Neckties, A. M. Clark.—(*La Compagnie Française du Celluloid, France.*)
1537. Tobacco Pipes, A. Hird and G. Saunders, London.
1538. Materials for Roads, &c., J. W. Butler, London.
1539. Electric Circuit Breaker, F. F. Yeatman, London.
1540. Metallic Fastenings for Trouser Fronts, C. Bathias, London.
1541. Portable Fire-escape, J. Wall and H. Rundeill, London.
1542. Extinguishing the Flame of Oil Lamps, A. E. Seear, London.
1543. Electric Candles, G. Ignatiev, London.
1544. Valves for Producing Reciprocating Motion, J. A. Clarke, Glasgow.
1545. Fastenings for Corsets, T. R. Rossiter and C. W. Allen, London.
1546. Pipes for Sewers, A. C. Trew, London.
1547. Apparatus for Lamps and Burners, G. F. Redfern.—(*F. Fevekenne and G. Swevers, Belgium.*)
1548. Travelling Bags, J. E. Ransome, London.
1549. Marking Aerated Liquid Bottles, H. Codd, London.
1550. Alarms, R. Frost, London.
1551. Manufacture of Ginger, &c., O. Imray.—(*J. G. Smith, Hong Kong.*)
1552. Horseshoes, W. R. Lake.—(*H. M. Whitney, United States.*)
1553. Rock Drilling Tools, W. R. Lake.—(*E. Moreau, United States.*)
1554. Putting-out and Striking-out Machines, W. R. Lake.—(*W. M. Hoffman, United States*)
1555. Sewing Machines, W. R. Lake.—(*T. Lamb, United States.*)
1556. Manufacture of Gas, C. Pilla, London.
1557. Door Latches, W. R. Lake.—(*O. H. Gilbert, United States.*)
1558. Grinding and Polishing Metals, J. Hampton and S. Partridge, London.
1559. Combination of a Wick Tube Cleaner and Wick Inserter, A. Rettich, London.

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1560. Couplings, R. S. Wood, Manchester.
1561. Spinning &c., Machinery, S. and T. Newton, Manchester.
1562. Cigarette Boxes, H. Moon and P. Gallimore, Birmingham.
1563. Producing Metallic Designs on Glass, &c., W. Cotterell, Glasgow.
1564. Working of Reversible Desks, R. Smith, Padiham.
1565. Removing Hot Air from Meal, &c., J. P. Fielden and T. N. Robinson, Liverpool.
1566. Dolly for Washing Clothes, A. R. Strachan and W. Byers, Gateshead-on-Tyne.
1567. Attaching Porcelain Knobs to Metal Utensils, J. Robinson, Birmingham.
1568. Locks, C. Mohr, Birmingham.
1569. Securing Colliers' Tickets, W. Beatson and J. Moore, Rotherham.
1570. Codes for Signalling, T. Workman, Belfast.
1571. Bolts and Nuts, G. H. Wells, London.
1572. Gas Taps, Messrs. Samuel Greatrix, jun., and Brother, Manchester.
1573. Ships, Sir N. Barnaby, C.B., Lee.
1574. Making Taper Pipes, J. Campbell and P. Hattan, Glasgow.
1575. Handles for Self-feeding Brushes, T. Cox, Leeds.
1576. Carding Engines, J. Thompson and T. Barker, Manchester.
1577. Printing Cotton Fabrics, &c., F. A. and V. H. Gatty, Manchester.
1578. Head Covering for Treating Neuralgia, &c., G. S. Hazlehurst, Liverpool.
1579. Gloves, Cuffs, Collars, &c., R. Bach, Birmingham.
1580. Taps, G. F. Thomson, Manchester.
1581. Velveteens and Velvets, T. Emmott and W. Hurst, Manchester.
1582. Fastening Boots, E. M. Minns, London.
1583. Parts of Music Stools, &c., C. Wadman, London.
1584. Combed Wool Fine Spinning, P. L. Klein, London.
1585. Torpedo Launches, &c., H. Harford and C. F. Sutcliffe, London.
1586. Electrical Commutators and Switches, F. R. de Wolski, Kew.
1587. Working Points and Signals, G. P. Dineen and A. Rowe, London.
1588. Sovereign Purses, I. Brager.—(*Feldmeier and Bock, Germany.*)
1589. Button-hole Attachments for Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
1590. Button-hole Attachments for Sewing Machines, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
1591. Telephonic Switching Apparatus, A. R. Bennett, Glasgow.
1592. Boots and Shoes, J. Cutlan, London.
1593. Umbrella Frames, A. MacMillan, London.
1594. Locking the Screw Nuts of Screw Bolts, &c., W. Barwell, London.
1595. Fixing Rails in Railway Chairs, W. Barwel and B. S. Roberts, London.
1596. Hydraulic Controlling Gear for Gun Mountings, J. Vavasseur, London.
1597. Glass, A. Luraschi, London.
1598. Regulating the Flow of Fluids, A. J. Boult.—(*J. G. Richert, Sweden.*)
1599. Shafts of Screw Propellers, J. Sutton, Liverpool.
1600 Mica Flap Ventilators, &c., J. W. Gibbs, Liverpool.
1601. Lithography, R. Gutheil, London.
1602. Regenerative Gas Lamps, H. J. Haddan.—(*C. Westphal, Germany.*)
1603. Roughing for Horseshoes, F. S. Lepinte, London.
1604. Cement Kilns, E. and A. Ashby, London.
1605. Lamps, T. M. Harvey.—(*T. W. Shaw, Natal.*)
1606. Railway Buffers, R. E. Proudlock, London.
1607. Keyless or Self-winding Watches, E. Spencer, London.

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1608. Wooden Boot and Shoe Finishing Last, J. H. Gainsford, London.
1609. Gas Engine Cranks, W. Ainsworth, Accrington.
1610. Secondary or Storage Batteries, G. E. Dorman, Stafford.
1611. Travelling Bands, N. Greening, Manchester.
1612. Horseshoes, J. and J. B. Meeson, Sheffield.
1613. Hafting Table Knives, &c., F. Evans and W. Jennings, Heeley.
1614. Untwisting Waste Rope, &c., J., R., and J. Greenhalgh, Manchester.
1615. Wheel Guard for Preventing Accident, G. W. Cramond, Belfast.
1616. Braces for Trousers, J. Moynan, Dublin.
1617. Lubricators, R. Arrol and J. McAnelly, Gateshead.
1618. Coupling for Railway Vehicles, R. C. Sayer, Newport.
1619. Banding, Cord, Twine, &c., T. Unsworth, Manchester.
1620. Registering Fares in Tramcars, &c., G. F. Hampson, Manchester.
1621. Blowing-off Boilers, W. Hemingway, Bradford.
1622. Oil-cans, J. Kaye, Bradford.
1623. Heels for Boots, Slippers, &c., J. C. Edwards, Manchester.
1624. Scouring Wool or Fibrous Substances, J. Aimers, Galashiels.
1625. Gas Cooking Ovens, A. Hill, Birmingham.
1626. Spray Lamps, J. Lyle and J. B. Hannay, Glasgow.
1627. Printing Designs on Both Sides of Cloth, &c., P. B. Wilson, Glasgow.
1628. Lubricators for Bicycles, &c., E. H. Baxter, Birmingham.
1629. Candle Holder, G. Rockliffe and T. Sanders, Bishopwearmouth.
1630. Tubular Metal Frame Lawn Tennis Raquet, T. B. Burns, Camelford.
1631. Shaving Brushes, J. H. Smith, Birmingham.
1632. Raising Letters on Press-made Bracelets, J. Baker, Birmingham.
1633. Fastening for Window Curtains, A. J. and H. A. K. Davis, East Dulwich.
1634. Weighing, S. Russell, Stanwell.
1635. Castrating Animals, J. A. Nunn, London.
1636. Telephones, R. H. Ridout, London.
1637. Converting Rotary Motion into Continuous Rotary Motion, J. Radcliffe, East Retford.
1638. Cash Tills, W. H. Blakeney, Dundee.
1639. Fastenings to Solitaires, J. Finch, London.
1640. Locking Bolts and Nuts, R. Simpson, H. Simpson, and B. G. Simpson, London.
1641. Self-regulating Springs, F. A. Richardson, London.
1642. Plastic Composition, O. Brach, Liverpool.
1643. Cooling and Heating Air, &c., B. W. Maughan and S. F. Sloper, London.
1644. Smokers' Pipe Plugs, W. E. J. Turner, London.
1645. Fastening Handles to Brooms, &c., J. Drewitt, London.
1646. Lock Nuts, W. Ward, London.
1647. Converting Rifles into Arms of Smaller Calibre, E. Sèches, London.
1648. Couplings of Railway Wagons, J. W. Hancock, London.
1649. Canisters, &c , H. T. Bond, London.
1650. Nails, E. Cameron, Bristol.
1651. Coupling Railway Trucks, &c., H. Eustace Leyton.
1652. Cutting Machines, W. Crosland, London.
1653. Return Steam Traps, J. J. Royle, London.
1654. Hinges, A. Gold, London.
1655. Connecting together Soft Metal Pipes, &c., N. Thompson, London.
1656. Cure of Curbs, &c., in Horses, H. Mason, London.
1657. Gear Wheel for Bicycles, &c., J. E. Holloway London.
1658. Mechanical Navvies, C. L. Smith, London.
1659. Drawing Beer, &c., A. Stierlin, London.
1660. Damping Paper, A. Stierlin, London.
1661. Coupling Railway Wagons, &c., W. Burnell, London.
1662. Railway Brakes, T. Sloan and E. Hawks, Glasgow.
1663. Floor-cloths and Tiles, T. J. Melvin.—(*D. N. Melvin, United States.*)

1664. SOCKET COUPLING for PIPES, T. Wright, London.
1665. GAS METERS, W. Cowan, Westminster.
1666. DELIVERING CIGARETTES or CIGARS, J. Breeden, London.
1667. STORAGE of AERATED BEVERAGES, F. Walter, London.
1668. GAS LAMPS, J. Bartlett, London.
1669. CASES for PENCILS, &c., J. Spear, London.
1670. PRESSURE VALVES, W. W. Fyfe, London.
1671. "PREVENTS" for the JOINTS of UMBRELLAS, &c., W. Carter, London.
1672. RELEASING the BOLTS of DOORS, E. Edwards.—(*L. Radi, France.*)
1673. VELOCIPEDES, A. Hunnable, London.
1674. SUPPORTS to DRAPERS' and other BUSTS, A. W. Child and G. B. Childs, London.
1675. FOLDING PHOTOGRAPHIC CAMERAS, A. Rayment, London.
1676. BOILERS, C. Wells, London.
1677. PORTABLE GAS PILLAR, C. Wells, London.
1678. TOBACCO PIPES, C. G. Robertson, London.
1679. DOUBLING and WINDING MACHINES, J. Horrocks, Manchester.
1680. PERMITTING the USE of TELEGRAPHIC and TELEPHONIC APPARATUS upon the SAME LINE, H. H. Lake.—(*La Société des Téléphones à Grande Distance, France.*)
1681. RELAY APPARATUS for TELEGRAPHIC PURPOSES, H. H. Lake.—(*La Société des Téléphones à Grande Distance, France.*)
1682. VELOCIPEDES, W. Scantlebury, London.
1683. COVERED WHALEBONE, &c., W. L. Wise.—(*E. Leroux, France.*)
1684. SECONDARY BATTERIES, B. Weiss, London.
1685. CRANKS for VELOCIPEDES, J. Harrison, London.
1686. BETANAPHTHOLMONOSULPHO-ACID, &c., A. M. Clark.—(*The Farbfabrik vormals Brünner, Germany.*)

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1687. RAISING, &c., PULLEY BLOCKS, &c., C. A. Jones, Gloucester.
1688. FASTENING HANDLES to TABLE CUTLERY, &c., J. S. B. Baker, Sheffield.
1689. MATTRESSES, I. Chorlton and G. L. Scott, Manchester.
1690. KNITTED RIBBED FABRICS, W. F. Baines and S. C. Baines, Leicester.
1691. ZINC ROOFING, T. W. Helliwell, Halifax.
1692. WINDOW BLIND ROLLERS, W. Starley, Coventry.
1693. FEEDING MACHINES, A. Haigh, Huddersfield.
1694. TAD-POLE LOCK BOLTS, S. Houghton and W. Hardwick, near Wolverhampton.
1695. FIRE-LIGHTERS, D. Yates, Halifax.
1696. GAS ENGINES, M. Welch and F. Rook, Southsea.
1697. SELF-ACTING ENGINES, G. E. Dorman, Stafford.
1698. COLLECTING WASTE STEAM, A. Marshall, London.
1699. ROTARY SCREENS, J. Hornsby and H. Palmer, Grantham.
1700. AUTOMATIC COMPENSATOR for RAILWAY SIGNAL WIRES, J. Eccles, Warrington.
1701. OIL CHANDELIERS, &c., J. Phillips, Leicester.
1702. RINSING BOTTLES, J. Alabaster, Barnsley.
1703. LUGGAGE CARRIER, F. W. Lambert, Birmingham.
1704. RAILWAY CARRIAGE ROOF LAMPS, E. H. Griffiths, Birmingham.
1705. HORIZONTAL TURNIP SLICERS, W. Dewar, near Dundee.
1706. SYPHON CISTERNS, J. C. Cooke and A. W. Cooke, Birmingham.
1707. RACKET BATS, T. C. Attreed, Glasgow.
1708. SNOW PLOUGHS, J. Ireland, Glasgow.
1709. MINERS' SAFETY LAMPS, A. Howat, Manchester.
1710. CLEARING TOP ROLLERS of SPINNING MACHINERY, B. A. Dobson, R. Hardman, and E. Gillow, Manchester.
1711. EXHAUST for the BETTER CONSUMPTION of FUEL, R. W. Hewett, Birmingham.
1712. STEAM ENGINES, T. Hunt, Manchester.
1713. FIRE-EXTINCTEURS, T. F. P. M. Kavanagh, London.
1714. AXE BLANK, H. Hammond, United States.
1715. ORGANS, W. Drechsler and E. Specht, London.
1716. SAFETY BICYCLES, J. K. Starley, London.
1717. FEED APPARATUS for CHAFF-CUTTING MACHINES, R. Maynard, London.
1718. FIXING BLINDS to ROLLERS, F. J. Clarke, London.
1719. PENHOLDERS, &c., A. Vogel, London.
1720. STOVES, J. A. Gottereau, London.
1721. HAND BAGS, E. G. Brewer.—(*H. Scheidemandel, Germany.*)
1722. CHALK-HOLDER for BILLIARDS, H. J. Haddan.—(*A. Labre, France.*)
1723. ATTACHING the PRESSER-FEET of SEWING MACHINES, J. Mehlich, London.
1724. BOTTLES, T. Herb, London.
1725. TRAVELLING TRUNKS, R. Challenor, London.
1726. INCANDESCENT ELECTRIC LAMPS, L. S. Powell and R. P. Sellon, London.
1727. PURIFYING SEWAGE, W. H. Hartland, Glasgow.
1728. SEA ANCHOR, J. Waters, London.
1729. RAILWAY SLEEPERS, A. Little and W. Percy, London.
1730. BALANCED SPRING BLINDS, M. H. Robottom and J. H. Brough, Liverpool.
1731. SWINGING CHURNS, W. J. Temple, London.
1732. TIGHTENING WIRE FENCES, &c., J. Westgarth, Liverpool.
1733. DRYING GRAIN, &c., T. Parkinson and J. G. Walker, London.
1734. BARBED WIRE for FENCES, J. Westgarth, Liverpool.
1735. WATER GAUGE, C. Wells, London.
1736. SIGNALLING the OUTBREAK of FIRES, C. Wells, London.
1737. CLOSET-SEAT GUARD and TOILETTE PAPER, C. Wells, London.
1738. SPORTING HAWK, C. Wells, London.
1739. WING COMPASSES or DIVIDERS, C. B. C. and S. O. C. Coles, London.
1740. WATER-CLOSETS for SHIPS, H. E. Newton.—(*J. J. De Rycke, United States.*)
1741. SHARPENING the KNIVES of CHAFF-CUTTING MACHINES, R. Maynard, London.
1742. PIPE CUTTER, J. C. Bauer, London.
1743. VALVE, G. F. Redfern.—(*La Compagnie Générale Transatlantique, France.*)
1744. FLOORINGS and SUPPORTS for BRIDGES, &c., T. L. M. Hare.—(*G. F. Horbury, India.*)
1745. FIRE EXTINGUISHING APPARATUS, R. Leigh, Oldham.
1746. SLATES, &c., O. Schwenck, London.
1747. ELECTRIC SPONGE, G. Epstein, London.
1748. CONVEYING PARCELS, &c., from PLACE to PLACE, E. H. Fosbery, London.
1749. TUBULAR ELASTIC SUPPORTS for VARICOSE VEINS, &c., J. H. Cooper, London.
1750. DYEING FABRICS, W. G. White, London.
1751. GUN MOUNTINGS, T. Nordenfelt, London.
1752. LOCK-UP BOTTLE STANDS, W. H. Brand, London.
1753. SANITARY or TOILET VESSEL with OUTER PAIL, M. A. Law, London.
1754. AUTOMATIC TELEGRAPHIC APPARATUS, A. M. Clark.—(*M. V. Meyer, neé G. Decharme, France.*)

6th February, 1886.

1755. MOULDING COUNTERS of BOOTS and SHOES, S. H. Hodges, Street.
1756. LAYING DISSOLVED GLUE or PASTE upon SHEETS of PAPER, &c., S. H. Hodges, Street.
1757. MEDICAL PLASTER, E. L. Sheldon, London.
1758. CARDING ENGINES, W. Lord and J. Stocks, Manchester.
1759. PIPE for SMOKERS, W. Lewis, Sheffield.
1760. STEAM GENERATORS, W. Garner, Liverpool.
1761. DISTRIBUTING OIL, &c., upon FIBROUS SUBSTANCES, A. Benn and P. Firth, Bradford.
1762. BREAKWATERS, J. D. Wilson, A. Ambler, and J. C. Marshall, Sowerby Bridge.
1763. ATTACHMENTS for RETAINING NECKTIES, &c., in POSITION, H. C. Miller, London.
1764. HOLDER for CANDLES, F. Ashwell, Truro.
1765. WEATHERPROOF TILE, J. Chapman, Milverton.
1766. CARTRIDGE CLIPS for AMMUNITION BELTS, W. J. Cross, Birmingham.
1767. FERMENTING TEA, H. H. N. Martin, London.
1768. ROTATING PISTONS, G. M. Park, London.
1769. WASHING, MIXING, and BLENDING BUTTER, &c., J. Llewellin, London.
1770. SPINNING and DOUBLING FRAMES, H. Ashworth and E. Eaves, London.
1771. FORCING SEWAGE, &c., by PUMPS driven by ELECTRIC MOTORS, H. de Grousilliers, London.
1772. BULLETS or PROJECTILES, A. C. MacLeod, London.
1773. LAMP STATIONS and HARBOURS of REFUGE for MINES, H. Kirkhouse, London.
1774. BALL VALVES, H. H. Sporton, jun., London.
1775. VELOCIPEDES, W. Hillman, W. H. Herbert, and G. B. Cooper, London.
1776. SHIPS' and MOORING ANCHORS, W. H. Gales, London.
1777. WHEELS for VELOCIPEDES, &c., A. T. Andrews, London.
1778. AUTOMATIC STARTING GEAR for LOCOMOTIVES, W. H. Nisbet, Glasgow.
1779. DRAWING OFF OIL from BARRELS, &c., G. A. J. Schott, London.
1780. WATCHES, S. E. Gunyon.—(*E. Belzon, France.*)
1781. SECURING the INNER BANDS to HATS, F. W. Durham, London.
1782. REGULATING the HEAT in GAS COOKERS, H. T. Kirby, London.
1783. LIGHTING CIGARS, &c., E. J. Wimshurst, London.
1784. SEWING MACHINES, A. J. Boult.—(*A. Jeslein, Belgium.*)
1785. PERMANENT WAY, L. Somzée, Liverpool.
1786. PRINTERS' GALLEYS, A. J. Boult.—(*D. W. Whitaker and J. E. Lyon, United States.*)
1787. SCREW-THREADED NAILS or SCREWS, W. R. Lake.—(*The Russell and Erwin Manufacturing Company, United States.*)
1788. LIGHTING DOMESTIC FIREPLACES, &c., W. Abbott, London.
1789. COUPLINGS for SCREW-PROPELLER SHAFTS, J. F. Hall and J. Verity, London.
1790. COUPLER, T. V. Riordan, London.
1791. AUTOMATIC WEIGHING MACHINES, C. C. Clawson, London.
1792. MATERIALS for USE in the TREATMENT of SEWAGE, F. Candy, London.
1793. FILTERING MEDIA for PURIFICATION of LIQUIDS, F. Candy, London.
1794. MIXING SOLID MATTERS, &c., W. B. G. Bennett, London.
1795. EXTRACTING MOISTURE from PULP, J. T. and J. McDougall, London.
1796. PURIFICATION of IRON, T. Twynam, London.
1797. COOLING the CYLINDERS of GAS MOTORS, T. R. Shillito.—(*E. Capitaine, Germany.*)
1798. APPARATUS for RELIEVING SEWERS from PRESSURE of GASES, W. Greenhill, London.

8th February, 1886.

1799. APPARATUS for SYRUPING ARTIFICIAL BEVERAGES, J. H. and J. W. Galloway, London.
1800. AUTOMATICALLY COUPLING RAILWAY TRUCKS, W. Gilmore, London.
1801. GLASS COPING for the PROTECTION of TREES, H. C. Board, Bristol.
1802. BICYCLES, W. E. Hart, jun., and C. Lee, Wolverhampton.
1803. APPARATUS for PRODUCING LINES of PAINT, T. Heighway and J. Smithies, Manchester.
1804. WINDOWS, W. Howie and R. Henderson, Ecclefechan.
1805. DISPLAYING ADVERTISEMENTS on VEHICLES, J. Whitehead and C. F. and E. D. Tanner, Birmingham.
1806. BRUSHING MACHINES, G. Thomas, Halifax.
1807. REMOVING MATERIALS USED in GAS PURIFIERS, W. S. Morland, Hempstead.
1808. CONVEYING BISCUITS THROUGH OVENS, J., T., and J. Vicars, jun., Liverpool.
1809. STOPPING the RATTLING of CARRIAGE WINDOWS, W. Johnstone, Edinburgh.
1810. SPINNING COTTON on a RING FRAME, C. Butterworth, Oldham.
1811. NECKS of INTERNALLY STOPPERED BOTTLES, D. Rylands, Barnsley.
1812. LOCKING NUTS and BOLTS, J. B. Meeson, Sheffield.
1813. PERFORATED HOLLOW BALLS, A. S. King, Norwich.
1814. PICKING MOTION of LOOMS, J. and E. Horrocks, Bradford.
1815. SOUP PLATES, W. F. Drew, London.
1816. CHARGING CEMENT KILNS, W. Joy, London.
1817. SEATS for ANGLERS, A. George, London.
1818. SUCTION PIPES for PUMPS, A. Tozer, Manchester.
1819. BAKERS' OVENS, A. Gates, London.
1820. DIASTASIC SACCHARINE, L. Cuisinier, Liverpool.
1821. AERIAL NAVIGATION, F. M. é Ybargoitia, London.
1822. APPLYING SEALING WAX, C. T. Mackley, London.
1823. ONE-WAY PLOUGHS, J. Huxtable, London.
1824. SHOW GLASSES, E. W. Searle, London.
1825. STEAM ENGINE GOVERNORS, J. D. Churchill, London.
1826. LAMPS, G. F. B. Lukin, London.
1827. FOUNDRY LADLES, G. A. Goodwin and W. F. How, London.
1828. DRIVING GEAR for BICYCLES, &c., J. Truffault, London.
1829. STRAINERS for PULP for PAPER MAKING, J. Woodley, London.
1830. FLYING MACHINE, J. Wäelde, London.
1831. MANUFACTURING SULPHATES of METALS from their OXIDES, A. M. Graham, London.
1832. PRODUCING LEAD SALTS, A. M. Clark.—(*O. Eyckens, France.*)
1833. COUPLINGS for RAILWAY CARRIAGES, J. Friborg, London.

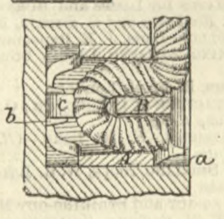
SELECTED AMERICAN PATENTS.

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

332,773. SASH CORD FASTENER, *William Altick, Dayton, Ohio.—Filed June 26th*, 1885.

Claim.—The combination, in a sash cord iron, of a shell A, with tapering bore, outer recesses *a*, and

332,773



inner slots *b*, and an anchor or stay piece B, provided with a rear slot *e*, retaining shoulder *c*, concavities *f*, notches *g*, and retaining points *h*, the whole constructed and adapted to be applied in connection with a sash cord, substantially as described.

332,909. NAIL EXTRACTOR, *Isaac H. Kiser, Riverside, Cal.—Filed September 23rd*, 1885.

Claim.—(1) A nail extractor having a bearing surface and a notch in one of its sides, said notch having inclined faces, the surfaces of which intercept the bearing surface of the extractor and form edges b^1 b^{11}, for grasping the nail, substantially as described. (2) A nail extractor having a bearing surface and a notch in one of its sides, said notch having inclined faces, the surfaces of which intercept the bearing surface of the extractor and form edges b^1 b^{11}, one of said edges being at substantially right angles to a line drawn lengthwise through the extractor, and the other being inclined thereto, substantially as described. (3) A nail extractor having a notch in one of its sides, said notch having inclined faces, which intercept each other at the inner limit of the notch, substantially as described. (4) A nail extractor having a bearing surface and a series of notches of various dimensions in its sides, each of said notches having inclined faces, which intercept the bearing surface of the extractor and form edges b^1 b^{11}, for grasping the nail, substantially as described. (5) A device for pulling nails

332,909

having a nail-extracting notch at one side thereof, a hole for the insertion of a handle, a collar surrounding said hole, and a brace or fin extending from said collar to or near the end of the device, substantially as described.

332,929. ELECTRICAL RAILWAY, *James F. McLaughlin, Philadelphia, Pa.—Filed October 7th*, 1885.

Claim.—(1) The herein described method of operating a series of electrical railway cars with motors in multiple arc, said method consisting in intermitting the current in the derived circuits between the line conductors, some of the motors being thrown out of

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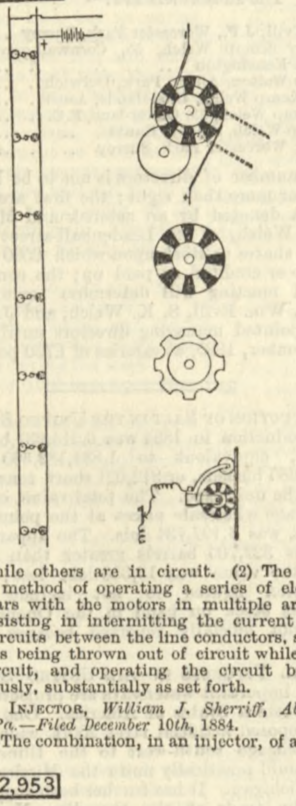
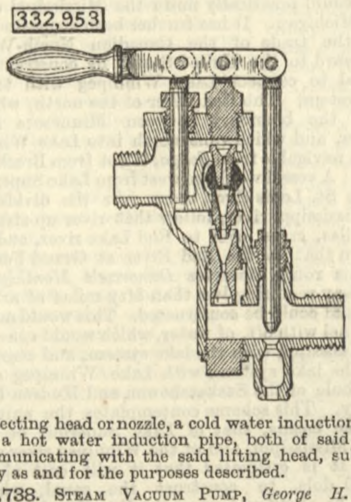


circuit while others are in circuit. (2) The herein described method of operating a series of electrical railway cars with the motors in multiple arc, said mode consisting in intermitting the current in the derived circuits between the line conductors, some of the motors being thrown out of circuit while others are in circuit, and operating the circuit breakers synchronously, substantially as set forth.

332,953. INJECTOR, *William J. Sherriff, Allegheny City, Pa.—Filed December 10th*, 1884.

Claim.—The combination, in an injector, of a lifting

332,953

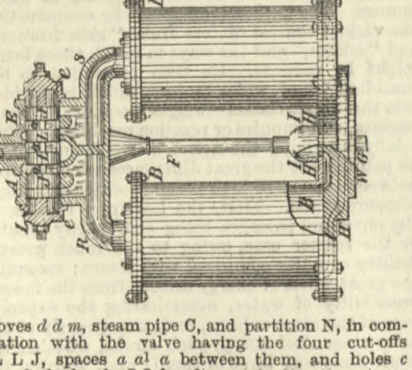


or ejecting head or nozzle, a cold water induction pipe, and a hot water induction pipe, both of said pipes communicating with the said lifting head, substantially as and for the purposes described.

332,738. STEAM VACUUM PUMP, *George H. Nye, Chicago, Ill.—Filed April 20th*, 1885.

Claim.—In steam vacuum pumps for elevating water, the valve case A L^1 K, constructed with the pipe attachment R S, openings 1 4 communicating with the valve chamber and pipes R S, the annular

332,738

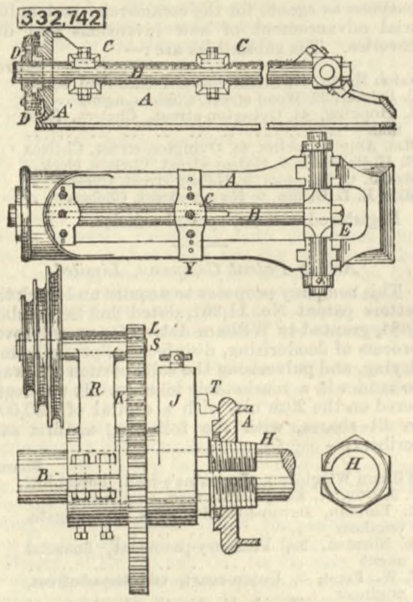


grooves *d d m*, steam pipe C, and partition N, in combination with the valve having the four cut-offs J L L J, spaces a a^1 a between them, and holes *c* through the heads J J for alternately directing steam into the cylinders B D, as specified.

332,742. MECHANISM FOR FINISHING ENGINE BED-FRAMES, *Wm. F. Parish, Minneapolis, Minn.—Filed June 22nd*, 1885.

Claim.—(1) The combination, with the arbor, of the plates C C^1, means for securing said plates to the arbor, and the adjusting screws *f*, all substantially as described, and for the purpose set forth. (2) The combination, with the arbor B E, having the two parts at right angles to each other, of means for centreing said arbor in an engine bed-frame, revolving tools, as described, mounted on said arbor for truing the end of the bed, the plates C C^1, secured to said arbor for preparing the supporting projections to receive the crosshead guides, all substantially as described. (3) The combination, with the arbor B E, having the two parts at right angles to each other, of means, as described, for centreing said arbor in an engine bed-frame, and revolving tools mounted on said arbor for truing the end of the bed-frame, all substantially as described. (4) The combination with the arbor B E, having the two parts at right angles to each other, of means for centreing said

332,742



arbor in an engine bed-frame, and the plates C C^1, secured to the arbour for preparing the supporting projections for the crosshead guides, all substantially as described. (5) The combination, with the arbor having the longitudinal grooves b^2, of the plates C, having a corresponding groove, the key *c*, bolts *b*, bolt *d*, and screws *f*, all substantially as described. (6) The combination with the arbor B, of means for centreing said arbor in an engine bed-frame, the cutter head J, mounted on the arbor and carrying the tool T, and means for revolving said cutter-head, as and for the purpose set forth. (7) The combination, with the arbor B E, of means for centreing said arbor in an engine bed-frame, and means mounted on said arbor for truing the end of the bed, said means consisting of the part R, clamped to the arbor and carrying the shaft S, pulley M, and gear L, and the cutter-head J, adapted to revolve freely on said arbor and provided with a gear K, and cutter T, all substantially as described. (8) The combination with the bed-frame A, having the projections *n n*, of the arbor B, centrer D, the plates C, having recesses fitting the arbor, means for securing said plates to the arbor, the bolts *b*, and screws *f*, as and for the purpose set forth. (9) The combination, with the bed-frame A, of the arbor B, the tapering threaded split sleeve H, the cutter-head J, mounted on the arbor and carrying the tool T, and means for revolving said slide-rest, as and for the purpose set forth.

333,371. PROCESS OF FUSING METALLIC PLATE JOINTS, *Chas. H. Wilson and J. Steuart, Detroit, Mich.—Filed October 29th*, 1885.

Claim.—The herein-described method of fusing metallic joints together, which consists in bevelling

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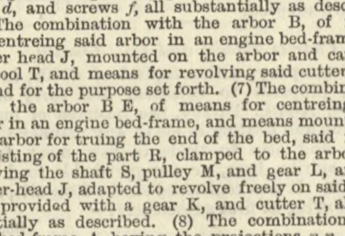

off to an edge the interior faces of two plates, then bringing together the points formed by such bevelling, leaving a space between the inclined faces of the plates, and then filling in said space with molten metal, substantially as and for the purpose specified.

333,261. ADJUSTABLE VICE JAW, *Edgar Shaw, Lynn, Mass.—Filed March 19th*, 1885.

Claim.—(1) An adjustable support composed of two pivotally-connected and independently rotatable wedge-shaped sections in contact with each other, as set forth. (2) An adjustable support composed of an inner wedge-shaped section having means, substantially as described, for attachment to a vice jaw or other support, and an outer wedge-shaped section pivotted

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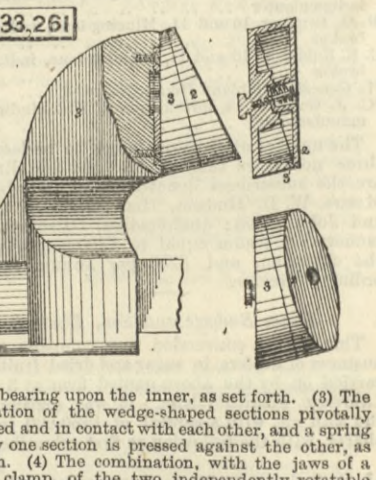

to and bearing upon the inner, as set forth. (3) The combination of the wedge-shaped sections pivotally connected and in contact with each other, and a spring whereby one section is pressed against the other, as set forth. (4) The combination, with the jaws of a vice or clamp, of the two independently rotatable wedge-shaped sections 2 3, as set forth.