SHIPPING ECONOMY.

The competition under which commercial transactions are now conducted renders it necessary that greater economy should be exercised in all the departments of production and distribution than was formerly practised. The good old days to which affectionate reference is so frequently made were, in reality, times of monopoly and wastefulness, the cost of which was borne by consumers of the merchandise brought in ships. These were times in which fortunes were quickly made by men who started in the right direction, but they were not times in which the varied productions of the world were most widely and advantageously distributed. The products of foreign climes are cheaper to-day than ever they were, and, consequently, are more largely consumed by all classes of the population. But, while this is so, the inducement to carry these products across the seas is considerably diminished because of the lessened rates of freight which now prevail. Steam navigation and the Suez Canal have together operated in practically shortening the distance which separates continents, and to that extent have been the means of cheapening foreign produce. At the same time other causes have been at work in the same direction. Among these are the employment of iron, and, latterly, of steel in shipbuilding, whereby the cost of ships has been diminished, both as regards building them in the first instance, and afterwards keeping them in repair. But, over and above all, the cheapening of foreign food and other supplies has been brought about by an excess of shipping tonnage over the actual requirements of the world's present over-sea trade. It is not necessary now to analyse the causes which have led to this over-production. It will, perhaps, be sufficient to say that the state of the law which affords an encouragement to single ship limited liability companies, and sanctions the prevailing system of managing ownership is, in the opinion of many, largely responsible for the enormous inflation in our mercantile tonnage which occurred three or four years ago. But be that as it may, there can be no doubt that there are many more ships seeking employment than are being sought by merchants to carry their goods; and the consequence is that the price paid for sea carriage is so small as not to be remunerative except in exceptional cases. The cases here referred to are those in which a ship works upon a low capital and possesses the advantage of carrying a large cargo upon her tonnage, steaming economically, and meeting with good luck. Perhaps the latter condition and good management are really convertible terms. Anyhow, fair profits are still being made by shipowners who work under the favourable conditions just referred to, and, unless there is a much greater improvement in trade than so far appears probable, shipowning in the future will only be a profitable occupation in so far as it is conducted upon a system of careful economy from first to last. The ship must be economically produced, she must do her work upon economical conditions of displacement, tonnage, &c., and she must be steamed upon the minimum of cost for fuel.

It is not our purpose to advocate the production of shoddy ships. A ship may be "cheap" without being "nasty." Indeed, no ship is "cheap," in the true meaning of the word, which is not thoroughly efficient. A cheap ship is one which contains all the elements of efficiency at a minimum cost of production. It is a ship in which there is nothing incorporated that is not essential to her efficiency and safety; but at the same time it is a ship which lacks nothing that man can supply to make her what a ship should be. Now the shipping of an age just passing away did not in the majority of cases exactly fulfil those conditions—nor, indeed, do those of to-day; although the evolutionary processes now in operation are, upon the whole, tending in the desired direction. The ships of yesterday might be roughly classified as the safe and the unsafe. The former were seaworthy, but not in most cases economical ocean carriers; the latter were neither the one nor the other. The unsafe ships have practically disappeared. Restrictive and repressive legislation drove them from the British mercantile marine, and mercantile competition has at length altogether forced them from the seas. The safe ships remain, and when one considers how strongly and honestly many of them were built, it becomes a matter for deep regret that they should be handicapped by reason of their builders' thorough-going and conscientious conceptions of what a ship should be. When freights were high it mattered little if a ship were heavily constructed and of a bad form for carrying purposes; and since to err in giving excess of scantling was to err on the safe side, while the full carrying form was considered to be not so sea-kindly as that afforded by finer lines, it consequently happens that what were the crack and honestly-built ships of a few years ago now fail to give any return for the capital expended upon them, while carefully managed and economically constructed new vessels leave a satisfactory margin of profit. The truth is, that knowledge regarding the possibilities of iron and steel naval construction has been growing very rapidly of late, and it is now found that much material hitherto employed may be wholly dispensed with, while other materials should be differently arranged in order that they may operate to the greatest advantage in strengthening the structure. The substitution of steel for iron during the past eleven years has brought about a very considerable economy in weight of hull, amounting to at least 15 per cent., while more enlightened conceptions regarding the stresses to which the various parts of a ship are subjected have saved during the same period another 5 per cent. We have here a saving of one-fifth in the weight of a ship, and a consequent capability of carrying an equivalent excess of cargo; while, let it be remembered, the material of which the steel ship is built is, with all its superiority of strength and ductility, cheaper even than the iron of which ships were constructed a few years since. When to the lighter and cheaper hull we add the saving in fuel due to the employment of steam at higher pressures than formerly, and expanded in a greater number of cylinders, it will be seen that the merchant vessel just built enters upon her work with much better prospects of enriching her owners than would be possible if old modes of construction, both of hull and machinery, had been adhered to. The cellular system, with its reduced tonnage measurement, and certain modifications in the forms and types of ships, have been contributory to the same result. But many of these latter are due to conflict with the tonnage laws, and are not the consequence of absolute improvements in naval design. Attention will be given to cases of this kind hereafter. For the present we desire to limit ourselves to a consideration of those economical developments in ship construction, navigation, and control now in progress, which are not antagonistic to true efficiency, but, on the contrary, tend rather in that direction.

"Dirt" has been aptly defined as "matter in the wrong place," and it may fairly be alleged that materials in a ship which do not contribute to the strength and watertightness of her hull are as much dirt as the bilge water collected in her limbers. In both cases the ship has to carry about with her weights which are unremunerative. Now, although the process of scientifically distributing the materials of a ship has been so long in operation, it will yet appear, if we carefully examine the matter, that very much of the same kind remains to be done before the ideally perfect ship, from an economical point of view, is produced. Take, for instance, the very simple matter of reduction in scantlings towards the ends of a vessel, who will say that we have yet reached a scientific result? Can it be imagined that the reductions usually made in the transverse and longitudinal framework at those parts are proportional to the reduction in the stresses sustained by the structure thereat? Then again, considering that the stress endured by a beam increases with its span, is it reasonable to make the beams of so nearly the same scantlings at the midships, where they are, say, 40ft. long, and at the bow, where they diminish to only a few feet? In the shell plating of a ship there is not much scope for economy of this kind, as local stresses have to be provided for, and the loss of substance through corrosion, both of which considerations render necessary at least a certain thickness of plating at every part of the bottom and sides without regard to the structural stresses which may be encountered thereat. Indeed, there can be little doubt that the safe minimum in the thickness of a ship's plating has been reached, especially when the material is steel. The use of long plates results in a saving of weight in butt straps, and this form of economy is receiving due attention at the hands of our most enterprising builders. The limit in this direction will doubtless be fixed by the facilities available for bending and fairing the plates, and the difficulties experienced in handling them. But when iron or steel decks are covered with wood, it is certainly questionable whether or not a continuous surface of plating is either desirable or necessary. Many years ago Sir Nathaniel Barnaby pointed out that the weight of a ship's deck plating might be considerably diminished without loss of strength by wholly omitting butt fastenings, and leaving an appreciable space between the butts of adjacent plates in the same strakes; for as the longitudinal strength of the deck plating is determined by that of a transverse section along a line of rivet holes in the beams, no advantage was obtained by uniting the butts when the latter are properly shifted. The edge rivetting in that case should be sufficient to properly unite the plating, so that it might develope its maximum longitudinal strength. When no wood deck is laid over the plating other considerations are involved, the chief of which is that of water-tightness, making the case identical with that of the bottom and side plating. In passenger ships, however, and the many other instances in which a wood flat is laid, there certainly seems to be a good reason for saving weight in a way which has been found to yield satisfactory results in the Royal Navy. Some little time ago attention was called in these columns to the disposition evinced by one of our principal steamship companies to increase the spacing of transverse frames in large steamers. To any thoughtful mechanic who has looked upon a steamer of, say, 5000 tons, framed upon the ordinary transverse system, before her plating was put on, it must have appeared an extravagant expenditure of material to erect so many and closely spaced heavy girders to stiffen the plating and resist the comparatively unimportant transverse stresses which are endured by a long and narrow ship. When compared with the longitudinal framework of keelsons and stringers, the weight of material distributed in this way seems utterly disproportionate. The late Mr. Scott Russell saw this thirty years ago, but the force of custom and the desire for cheap and speedy construction have been a barrier to progress in the direction of economical framing which has been broken through only to a partial extent in ships with cellular bottoms. A 24in. or 26in. spacing of transverse frames might be advantageously departed from in vessels of large size, and all the desired transverse structural strength be supplied by a judicious arrangement of web frames and bulkheads. Much weight may be saved in this direction above the floor plates, and below that level the scope for economy of material is still greater. The floors of ships absorb a very large portion of the total weight of their transverse framing; and considering the proved efficiency of the bracket system in supporting the weight of cargo and enduring the stresses encountered at that part of the hull when the ship is in dry dock or otherwise resting evenly upon the ground, it becomes an important question for the naval architect and shipowner to decide whether or not solid floor plates are a necessity. At least 10 or 15 per cent. of the weight of a solid floor plate might be saved by cutting lightening holes in it without diminishing its efficiency. Machinery for punching manholes is now in use at some shipyards, and such machinery might advantageously be employed in puncturing floor plates at different places along their length with holes of various sizes, which would reduce their weight without impairing their value at the part of the structure for which they are intended.

Enough has, perhaps, been said to indicate the direction in which economy of weight might be effected in the construction of mercantile vessels without detriment to their efficiency, but rather with the result of making them better carriers of cargo, and therefore more profitable to their owners. In the matter of cement, too, there is much room for the exercise of similar precautions. Ever since the first application of Portland cement to the inside plating of ships there has been a disposition in the mercantile marine to employ that material in an extravagant manner. Cement is cheap, and on that account builders have not been sparing in its use, more especially as the sand which is incorporated with the cement is even much cheaper. It is quite true that Portland cement is essential to the preservation of the flat portion of the bottom from corrosion, and is, indeed, the "life" of the ship. But one can have too much of even a good thing, and this has been the case with cementing iron and steel ships. The cement has been heaped into the spaces between the frames to a thickness wholly exceeding that which is necessary for the due preservation of the plating and frames from corrosion. The excessive use of cement is justifiable when a vessel is intended for the West India sugar trade, as the great drainage of molasses in such cases is a source of grave danger to the frames, floors, and plating. But for other trades a thickness of an inch of good Portland cement above the rivets in butts and laps is quite sufficient, provided the ceiling hatches are lifted after every voyage and the spaces below are carefully examined. As remarked in a recent article in this journal, this course should always be taken, and indeed is, in all well managed iron and steel ships. An appreciable advantage in cargo carrying will result from a judicious reduction in the amount of Portland cement used in the bottom of a ship.

So far reference has been made only to the economies which may be advantageously effected in the hulls of ships, but over and above these the steamship owner at the present day must look to the saving in fuel consumption resulting from the use of high pressures of steam expanded in three or more cylinders. Triple and quadruple expansion engines are driving the compound engine of two cylinders out of the running, and existing steamers which fail to make a profit will have to be re-engined up to date if they are to be kept at work. "It is an ill wind which blows nobody good," and this development seems to be the only cheering prospect for marine engineers just at present. For cheapening our food supplies and opening out a field for further mercantile enterprise, the improvement now being made in the marine engine will prove a powerful factor.

Before concluding our remarks on this subject, it is desirable to call attention to one phase of modern ship evolution which is not of a satisfactory character. Just as the old tonnage laws, which were in operation prior to the year 1854, induced a type of ship which was unscientific and unsafe, so the tonnage laws of the present day are found to encourage the production of ships which pay low tonnage dues at the cost of efficiency and even sea-worthiness. By measuring all closed in spaces for tonnages, the Board of Trade are offering an inducement to shipowners to build open erections on the decks of steamers, which are in effect water traps and probable sources of disaster. A spar deck or an awning deck associated with a proper depth of immersion of the vessel is a distinct advantage, and such erections should be encouraged, subject to the proper limitations of loading as fixed by the tables of the Load Line Committee. But the present tonnage laws discourage these closed-in erections, and tempt shipowners to substitute for them the most ingenious and questionable arrangements for carrying cargo without paying corresponding dues. We find, for instance, a long poop and forecastle, without iron bulkheads at their fronts, extending to within a few feet of the central bridge house, the continuity of the deck to these superstructures being maintained by fitting portable hatches spanning the intervening spaces. Such vessels when loaded and the before-mentioned hatches are in place present the appearance of being spar or awning decked, and are immersed as such; but who will venture to describe them as safe, or at all events, so free from risk as is desirable? Other instances of what modern competition in shipowning, encouraged by defective shipping legislation, leads to, might be cited; but this example alone should be sufficient to show that a duty lies before the Government to remove all restrictions which tend to the production of badly designed ships. In the economical developments of the future it is to be hoped that ships of this kind will not have a place. The means at the hands of both shipbuilders and shipowners for legitimately reducing the cost of ships and increasing their powers of earning profits are sufficiently ample, and much may be expected in this direction before the expiration of the nineteenth century.

MECHANICAL CREAM SEPARATION.

In no department of agriculture has mechanical invention been more usefully applied during the last ten years than in that of dairying. New churns in great variety have been brought out, and if none of them have proved much more effective than the old barrel churn, most of them are a great deal easier to work. Butter workers, cheese presses, milk setting apparatus, railway milk cans, carriages for the conveyance and sale of milk, milk testers, and numerous other contrivances have been exhibited at the dairy shows, and at the meetings of all the great agricultural societies, all more or less conducive to labour saving, accuracy, cleanliness, and general efficiency in the handling of milk and its products.

By far the most important invention affecting dairying, however, is the centrifugal cream separator, which in its most recent development seems likely to cause a revolution in dairy practice. The first of these inventions was Lefeldt's separator, a machine of primitive construction, exhibited at the International Dairy Show held at Hamburgh in 1877. Several improvements upon it soon came into notice, and at the Kilburn show of the Royal Agricultural Society, in 1879, De Laval's separator was introduced, and attracted a great deal of attention. Other separators, such as

STEAM AND HAND POWER CREAM SEPARATORS.

Fig. 2

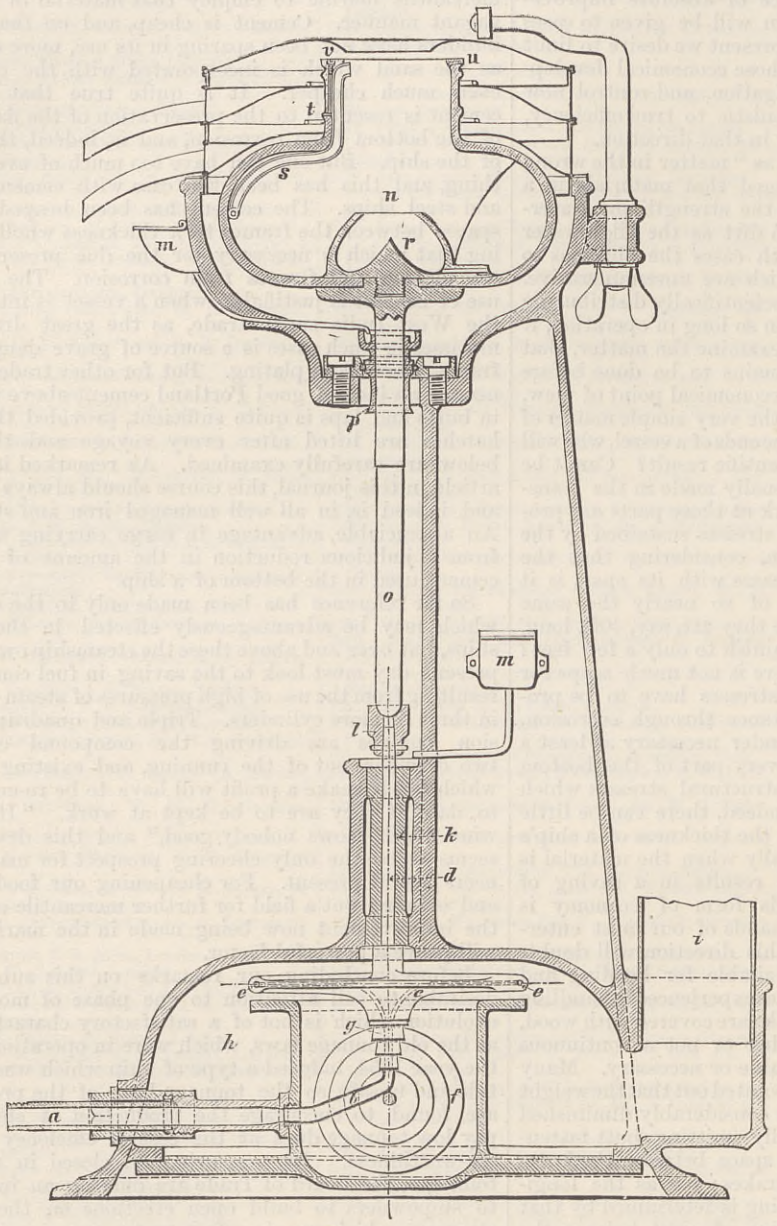


Fig. 3

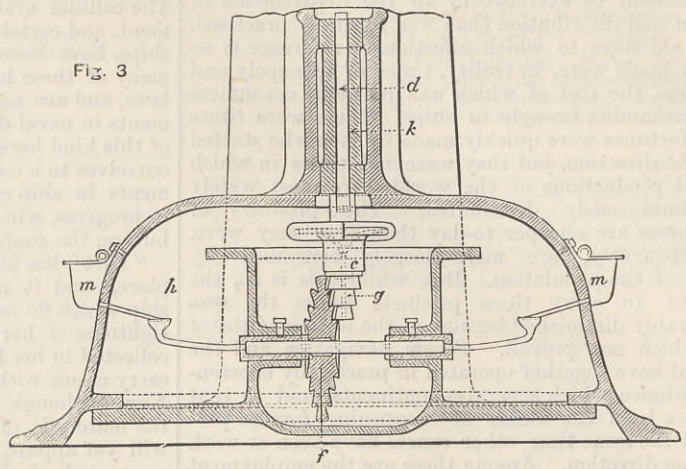
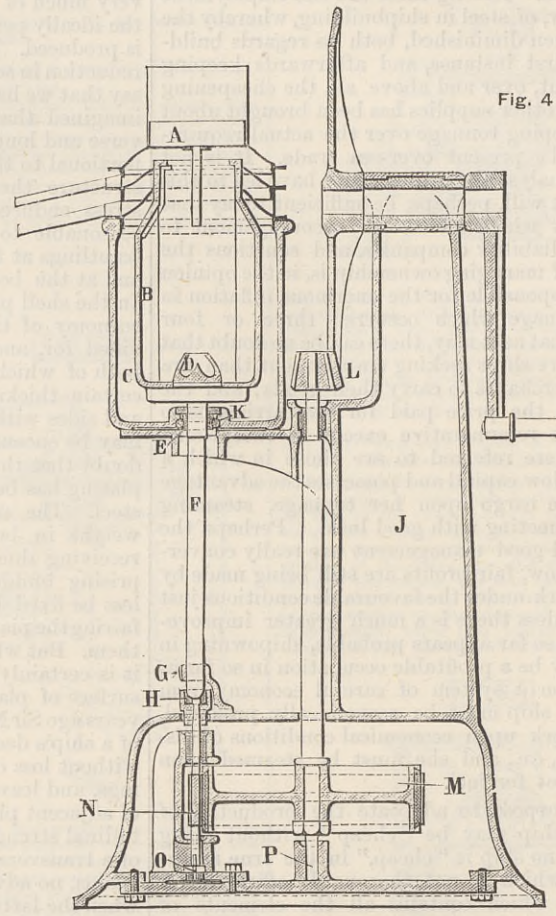


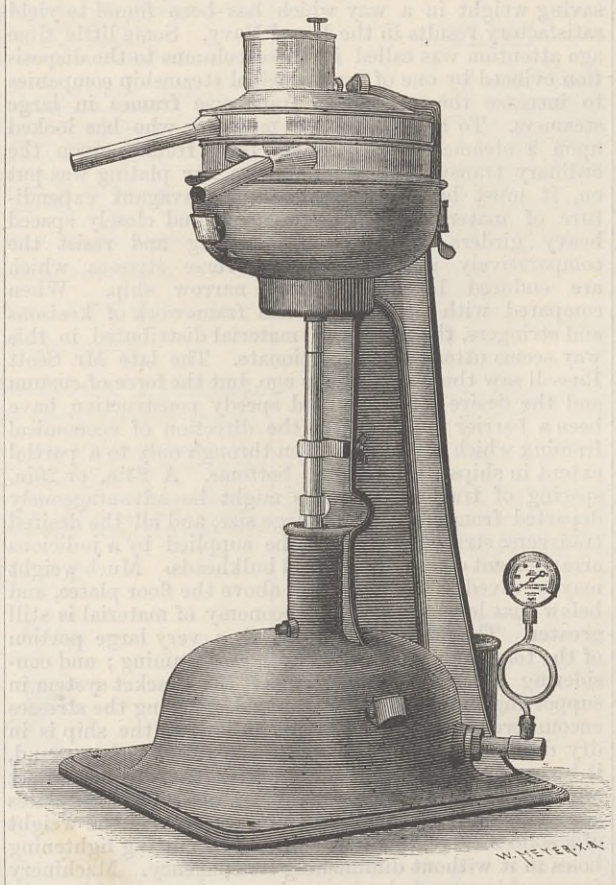
Fig. 4



Lefeldt's improved machine, and Peterson's, have since been exhibited in England, notably at the Health Exhibition; but the Laval machine, improved from time to time in detail, has held its own against all competitors, and is still the one most commonly used, in this country at any rate. It has been too long before the public to need description in these columns; but a few remarks in proof of its efficiency will not be out of place, as they will apply more or less to all modern centrifugal separators, and will show the importance of the latest adaptations of the principle upon which these contrivances are all based. A prize of £25 is offered by the Royal Agricultural Society for the best one-man power machine to be tested at Newcastle.

At the Kilburn Show the late Dr. Voelcker tested the Laval machine on behalf of the Royal Agricultural Society, and in his report he stated that by its use 93 per cent. of the butter fat of the milk had been obtained in the cream, as compared with 78½ per cent., the average result of the common system of skimming; or, in other words, that only 7 per cent. of butter fat had been left in the separated milk, against 21½ per cent. in the skimmed milk. A later test, carried out at the London Dairy Show, gave results still more strikingly in favour of the separator, nearly four times as much butter fat being found in skimmed as in separated milk. Peterson's, more commonly known as the Danish separator (Laval's being the Swedish), has given quite as good results, the most exhaustive test of all having been made, we believe, with this machine. We refer to 600 experiments carried out by Professors Fjord and Storch, of Copenhagen, extending over a whole year. The results, first published in 1882, are recorded in Long's "British Dairy Farming." When the separator was used, the quantity of milk required to make one pound of butter was 24·4 lb.; when milk was churned, 26·7 lb.; when cream raised upon the ice system in thirty-four hours, 27·5 lb.; under the same system in ten hours, 29·5 lb.; by the cold-water system in thirty-four hours, 32·4 lb. It is to be observed that this victory for the centrifugal separator was all the more triumphant because the ice and cold-water systems are improvements upon the old shallow-pan method, which was not tried at Copenhagen. It was the Danish machine too, that was used in some experiments carried out at the Munster Dairy School in 1885, from January to July. The average results of forty-three experiments were to this effect:—Taking the butter from separated cream as 100 lb., the butter from an equal quantity of milk set in open pans, skimmed after twenty-four hours, was 59 lb.; after thirty-six hours, 66 lb.; after forty-two hours, 73 lb.; and after fifty-four hours, 76 lb. At a single trial made in 1886, a quantity of new milk was divided into four equal portions, one being set for twenty-four hours in shallow tin pans, a second in Swartz cans cooled in iced water for twenty-four hours, a third portion in Cooley cans cooled in iced water for eighteen hours, and a fourth put through the separator. On the cream from each lot being separately churned, 16 per cent. more butter was obtained from the separated cream than from that raised under either of the cold-water systems, and 24 per cent. more than from cream raised under the shallow-pan system still in general use throughout the United Kingdom. The manager of the school informs us that his experience leads him to the conclusion that 24 lb. to 29 lb. of milk, according to season, will produce 1 lb. of butter when the separator is used, while 30 to 35 lb. will be required when the skimming process is followed. It is worthy of notice that two horses, instead of a steam engine, as usual, have recently been used to drive the

Fig. 1



separator at the Munster Dairy School. The most remarkable results, however, are those obtained by Colonel Curtis Hayward, of Quedgely, Gloucester, who, during a period extending from October, 1885, to February, 1886, obtained from a dairy of forty-two cows, eleven of which were of the Channel Islands breed, an average of 1 lb. of butter to 19½ lb. of milk, the Laval separator being used. Winter milk, it is to be observed, gives a higher proportion of butter than summer milk; but Colonel Hayward's proportion has seldom been equalled, and he is of opinion that the separator gives 20 to 25 per cent. more cream than any skimming system. He has found that he gets 1 lb. more butter per cow per week by using the separator than he obtained before using the machine.

Without accumulating further evidence to show the great gain of using a separator, we may state that all experts, so far as we have seen, are agreed in stating that it pays well to use one of these machines in all large dairies. Canon Bagot, a high authority on dairying, is of opinion that it pays to have a separator in a dairy of ten cows if power is already at hand. He recommends a 1½-horse power engine where water power is not available, as the boiler will give sufficient boiling water and steam for cleaning milk vessels, and will warm the dairy in winter; but he does not say how many cows are required to pay interest on cost of machinery, depreciation, and expense of working. It is to be borne in mind, when considering this question, that separated milk, being sweet, is more valuable than skim milk, which is half or quite sour. Still the outlay required to purchase a separator, engine and boiler, and intermediate motion, is more than small dairy farmers are disposed or able to disburse, and the whole form of machine is not likely to come into general use. The knowledge of this fact has stimulated manufacturers to bring out more economical machines.

During the last twelve months two makers have brought out machines which will meet the requirements of medium and small dairy farmers. De Laval has invented a separator to work on the turbine principle, with a boiler, but without engine or intermediate tackle. The cost and the space required for working are thus greatly reduced. With a 2-horse boiler this machine, it is said, will separate 90 gallons of milk per hour, and it is therefore suitable to a dairy of any size, though a less powerful machine suffices for a small dairy. Attempts have been made to make the turbine work by water power, but at present without avail. As it is, the separator is a cheap steam power machine. It appears to work well, though its durability and general efficiency have yet to be tested by lengthened experience. It is to be seen at work on the premises of the Dairy Supply Company, of Musuem-street, W.C., the sole agents of the Laval Company in England. We give above external and sectional drawings of this machine.

Fig. 1 in the next column is an elevation, and Figs. 2 and 3 are sectional drawings of the turbine separator, the upper part of which is precisely the same as the ordinary Laval, only in this case the casting is made somewhat higher, and is formed into a small dome at the base in which is encased the whole of the motive power which consists of a small steam turbine. The weight of the vertical spindle is carried by the small steel cone *g*, which rotates on the side of a larger steel wheel or disc carried on a horizontal spindle—see Fig. 3—and lubricated by the oil feeders *m m*. The steam is admitted by the tube *a*—Fig. 2—and is blown up through the centre of the cone *g*, escaping at the ends *e e* of the rotating tubes. These tubes have a very fine and smooth bore and are made slightly curved, so that if looked

at on plan, they somewhat resemble the letter S ; thus, as the steam tends to go out in a straight line, the reaction on the tubes gives the spindle its rotary motion. When the steam leaves the points *e e* it is immediately carried off by the exhaust pipe *i*. When the speed—6500 revolutions per minute—has been got up, the milk to be separated is run into the bowl *n*, so that it falls into the small cup *r*, whence it is immediately drawn through the small tube leading therefrom towards the sides of the bowl, which is filled with milk up to a point vertical with the neck piece. The skim milk, being the heavier body, is thrown the furthest outwards, and is to be found at the widest part of the bowl; whereas, the cream, being of a fatty nature, is displaced by the heavier milk, and therefore forms in a layer on the inner surface, or in a vertical line with the neck of the bowl. The skim milk is conducted to the same level as the cream by means of the tube *s*, whence it escapes through a small opening *t* into the lower tin cover, provided with an outlet spout. The cream is thrown off through a small niche in the upper rim of the bowl at *u* into the upper cover also provided with an outlet spout. These spouts can be turned round to deliver in any direction, though shown one above the other in the woodcut, and are kept in position by an adjustable arm. The bowl and spindle *o* are in one piece, simply resting in *l*. The bearing *p* is hung in rubber so as to run smoothly; *m m* being oil feeders.

Messrs. Hedges and Sons, of Littlecotes, Winslow, have a turbine separator in use, and appear to be fairly satisfied with it, though they state that whereas, with 53 lb. pressure on the old form of separator, produced by 60 lb. in the boiler, they could attain a speed of 6500 revolutions per minute, they get only 6100 to 6200 revolutions of the new machine. Probably this is ample, as we believe that anything over 6000 revolutions will suffice for the best results. Messrs. Hedges are able to separate 90 gallons of milk per hour with the turbine separator.

The other new separators to which we have alluded are hand-power machines. At the last London Dairy Show Messrs. Freeth and Pocock, of Wandsworth-road, exhibited a separator worked by two men. The manufacturers are Messrs. Watson and Laidlaw, of Glasgow. Now, the great desideratum is a hand power separator to be worked by one man. The Royal Agricultural Society offer a prize for such a machine, to be exhibited at Newcastle next July, while a gold medal is offered for the same by the Bath and West of England Society. The stipulation in each case is that the machine shall be well within the power of one man ; but we notice that in the regulations issued to exhibitors by the "Royal" it is stated that two men will be allowed to work the machine during an hour's trial, though only one at a time. Messrs. Watson and Laidlaw, we understand, have such a separator nearly ready, which is to separate 25 gals. of milk per hour. The machine which was exhibited at the Dairy Show works with a separate windlass and an intermediate motion, an unnecessarily cumbrous arrangement.

Many people are sceptical as to the possibility of any machine being produced with which the speed of 6500 revolutions a minute can be kept up for an hour at a stretch by the power of one man. The Dairy Supply Company exhibit at its warehouse two machines, invented by De Laval, which can be worked for a time with ease by one man, as we can testify from actual experience, only forty revolutions of the crank per minute being necessary for communicating the necessary speed to the cylinder. But it is one thing to turn a machine for ten minutes, and quite another to keep on turning it for an hour without stoppages, which are inconvenient for more reasons than one, as will be presently explained. The smaller of the two machines, of which we give a section in Fig. 4, is vertical in form, and separates 25 gals. of milk per hour.

By turning the handle at the back of the machine, motion is communicated to the cylinder on spindle F through the gear wheels L, and friction gear M, and N. When this handle is turned forty times to the minute the cylinder is made to rotate 6500 times. The speed having been got up, the milk is run from the feeding cistern into the small receiver A fixed on the top cover, which is provided with a loose float to maintain an even level and prevent overflowing. The milk then runs through the straight tube in the bottom of the vessel A and falls into the small cup D fixed in the bottom of the cylinder, whence it escapes through a small tube towards the sides. There it forms into a wall of milk around the sides B, the centre of the vessel being always empty, as the centrifugal force keeps the liquid against the sides. The skim milk, being heavier gravity than cream, is driven furthest outwards, and is therefore to be found nearest the sides B ; and the cream is formed in a layer on the inner surface of the milk, and in a perfectly vertical line with the neck of the revolving cylinder. A small tube is fixed inside the neck of the cylinder and reaches down to the side B, where it terminates, and this end being open, the skim milk is forced up to the same level as the cream, and escapes through a small hole pierced in this tube through the side of the neck into the lower tin tray, whence it escapes by the lower spout. The cream escapes through a small notch in the top of the cylinder into the upper tray, and thence from its spout. These trays can be moved round, so that the spouts deliver in any position. The machine is arranged on the principle of a spinning top, the cylinder and spindle F being in one piece and simply resting in the socket H. The top bearing E has an elastic ring K around it to enable the machine to be run smoothly and without vibration. G is simply a guard, and does not touch the spindle ; O and P are footsteps. The whole is mounted on a well-designed casting J.

The Laval horizontal hand-power separator separates 35 gallons of milk per hour. Its working principles are similar to those of the vertical machine ; but the cylinder is placed in a horizontal position.

The question whether either or both of these machines can be worked in ordinary practice by one man is of so much importance that we have made inquiries on the point of two dairy-farmers who are using them. One, a lady, who is using the smaller, or vertical machine, says : "One man can work it ; but we have two, one to relieve the other, so as not to be obliged to stop the machine." The meaning of this we take to be that one man cannot work the machine for the requisite time without stopping. In spite of this, our correspondent informs us that the saving in labour through using the separator is very great, and that she would be sorry to be without one. In this lady's dairy 20 gallons of milk per hour have been separated by the smaller machine, and the quantity of butter produced is said to be "greatly increased," and the quality improved, by using a separator. From 66 gallons of milk 31 lb. of butter have been produced, which is at the very satisfactory ratio of 1 lb. of butter to 17 pints of milk. The horizontal machine, though the larger of the two, appeared to us on trying it to work more easily than the other, and this impression has been confirmed by information received from a dairy-farmer in Ireland who has tried both. On being asked, however, whether one man could work it, he replied :—"I have in my service the finest and strongset man I know (well over 6ft. high), and he has often tried and failed to keep up a speed of forty revolutions (per minute) for even half-an-hour." Two hands, however, work the machine easily, the same informant states. Indeed, he says that a man or a strong lad, helped occasionally by a woman, can work the machine. After all, it appears, then, that one man will suffice if the dairymaid be at hand to relieve him for a few minutes occasionally, and the necessity of providing an occasional relief to the workman is as nothing in comparison with the great advantages derived from the use of the machine. Still it would be better if the machine could be so far improved upon that one man could manage it without help. In other respects this gentleman finds his hand-power separator entirely satisfactory. In a month's trial he found that he obtained 12 per cent. more butter than under the Cooley system without ice. With respect to the need of keeping on without stopping, we may explain why that is of importance for more reasons than one. In the first place, the milk has to be separated at the temperature at which it came from the cow, and consequently has to be worked off as fast as it is supplied by the milkers, if heating is to be avoided. Then the Laval separator has to be emptied after each stoppage before starting it again, and that is rather a tedious operation. De Laval is a very ingenious inventor, and his first hand-power machines are highly creditable. They do their work admirably, it appears from the testimony of those who have had experience in the use of them ; quite as well, they believe, as the large steam machines. Possibly the separators may be made to work with less expenditure of power. This seems all the more likely, because the larger of the two machines works more easily than the smaller. If by having the separating cylinder in a horizontal position more work can be done with less power than with the vertical machine, it is easily conceivable that some other device may be discovered for diminishing the force required. If not, we should imagine that a small turbine separator will be more economical to work in all but the smallest dairies than a hand-power machine, especially as a dairy must be heated somehow in cold weather, and at all times hot water is required for cleansing operations. In one way or another, there is but little reason to doubt, the great advantages of the mechanical cream separator will be brought within the reach of the smallest, or all but the smallest, dairy farmers, so that, ten years hence, as one writer has well put it, the use of the skimmer will be as uncommon as that of the flail is now.

PRIVATE BILLS IN PARLIAMENT.

Since the appearance of our last notes on the work in the Committee rooms, we find that the London, Hendon, and Harrow Railway—Abandonment—Bill has been passed in the Commons unopposed, and the Bexley Heath Railway Bill has been approved in the Lords after a slight resistance. The Flamborough Head Tramways Bill, for the construction of a tramway of 3ft. gauge from near Flamborough Head Station to North Sea Landing, has also been passed by a Lords' Committee; and the same Committee passed unopposed the Manchester, Middleton, and District Tramways Bill, extending by one year the time for constructing the works authorised in 1885.

In consequence of difficulties having arisen between the promoters of the proposed Harrow, Ealing, and Willesden Railway and the Board of Trade, the Select Committee of the House of Commons, which has been inquiring into the merits of the Bill, decided that they could not proceed further with the consideration of the scheme. The Bill was therefore rejected, and the Committee proceeded with the North-Western and Ealing Railway Bill, which is a competing scheme with the Harrow and Willesden Bill. This was also thrown out.

After a long deliberation the Hybrid Committee upon the Hyde Park Corner (new streets) Bill decided to pass the preamble, but to so amend the Bill as to exempt the Metropolitan Board of Works from any cost whatever, and to throw the cost of maintenance upon the parishes of St. George's, Hanover-square, and St. Martin's-in-the-Fields in the proportion of two-thirds and one-third respectively.

The Hull, Barnsley, and West Riding Railway Bill having been before a Commons Committee as an opposed measure, subsequently became unopposed, and in that form came before Mr. Courtney, the chairman of Committees. Mr. Courtney pointed out that whereas in the original Act the company were granted three years, after the purchase of lands, in which to complete the works, they were now asking for four years. He fixed the time for the completion of works at 1892, instead of 1893, as proposed. Thus altered, the Bill was ordered to be reported to the House.

The Easingwold Railway Bill also came before Mr. Courtney unopposed. The promoters sought for power to incorporate a company to make a line two and a-half miles in length, having a junction with the North-Eastern Company's main line at Alne, and terminating at Easingwold. It was proposed to pay interest at the rate of 4 per cent. out of capital during construction, but Mr. Courtney reduced the amount of interest to 3 per cent. With this alteration the preamble was passed.

The Mersey Railway Bill was likewise dealt with by Mr. Courtney as an unopposed measure. Power was sought by the Bill for extensions of the railway on both sides of the Mersey, forming a connection in Liverpool with the Lancashire and Yorkshire Railway and in Birkenhead with the joint railway of the Great Western and the London and North-Western Companies. Another provision of the Bill is that there should be a joint ownership of the Wirral Railway between Park-station and Bidston Junction and Bidston and Upton. Clauses had been inserted in the Bill which had removed the grounds of opposition by the Liverpool Corporation. A clause in the Bill proposing to authorise the payment of interest during the construction of new works, Mr. Courtney declined to decide the point himself, but presented a full report of all the circumstances to the House, and leave the House itself to determine the question. During the consideration of this clause Sir Douglas Fox, engineer to the railway, stated that at present the company could not carry goods traffic, but they would be able to do so by the proposed extensions. The company had not raised any capital under their Act of last year, but they had apart from that issued authorised capital to the extent of £1,085,000, and had practically spent about £2,000,000, the original estimate having been £866,000.

The Wakefield Corporation have promoted a Water Bill, which came before, and was passed by, the Commons Committee to whom measures dealing with police and sanitary matters are referred. Up to 1877 the town was supplied by the Wakefield Waterworks Company, the water being taken from the river Calder, which was not famous for its purity. The Corporation, when proposing to construct works of their own, were compelled to buy these waterworks, which they did in 1877. In 1880 they promoted a scheme for obtaining a supply of water from the moors by the construction of reservoirs. These reservoirs proved more costly than had been anticipated, owing to their having run into some old coal workings. A puddle trench had consequently to be constructed at a cost of £46,000, which was not provided for in the original estimate. The Corporation now applied for borrowing powers for £97,300 to enable them to complete the works. There was no formal opposition to the Bill, but the Local Government Board was represented for the purpose of securing the insertion of amendments. The only point of difficulty was the term to be allowed for the repayment of the loan. The Corporation asked for sixty years, and in the end the Committee granted fifty years, having regard to the exceptional circumstances of the case, and to the fact that they had in the similar cases of Darwen and Weston-super-Mare allowed thirty years and forty years.

Towards the end of last year the Mersey Docks and Harbour Board took the necessary steps to promote a Bill in Parliament for the purpose of giving them power to extend the time during which they may construct a double line of overhead railway along the line of docks from north to south. They also sought additional powers for the construction of two alternative routes for short distances, namely, between Prince's Dock and Canning-place, where it is proposed to make a detour along Back Goree —four and a-half furlongs—and between Wapping and Brunswick Docks by way of Chaloner-street and Sefton-street for a length of five furlongs. The progress of the Bill through the House of Commons and the House of Lords will now be rapid, inasmuch as the threatened opposition of the Corporations of Liverpool and Bootle, the London and North-Western Railway Company, and the trustees of the Bridgwater Navigation has been withdrawn. The measure has already passed the House of Commons' Committee, and, after being read a third time, will be referred to a Committee of the Upper House, so that the whole matter will be disposed of by the month of August. The Dock Board will then have five more years to consider the question of whether they will go to an expense of £650,000 in constructing the projected line of railway.

A curious contest arose before one of the Commons' Committees over a portion of an Omnibus Bill promoted by the North-Eastern Railway Company. Certain clauses proposed to authorise the construction of a railway 3 furlongs 8 chains and 6 yards long in Hull to connect the company's line with that of the Hull and the Barnsley Company. Mr. Bidden, Q.C., who represented the promoting company, described the matter in this way:—In 1880, when the Hull and Barnsley Company were promoting their Bills, they promoted a railway which the Committee might take as identical with the railway now introduced to their notice. They promoted that line for the purpose of forming a connection between the North-Eastern system and the Hull and Barnsley system, so that traffic from the North-Eastern might flow over their system and into the Alexandra Dock. That line was sanctioned by Parliament at the same time as the rest of the Hull and Barnsley undertaking. The line was actually constructed, and the rails were laid, so that the line was a complete line with the exception of half-a-dozen rails at one end and the signals. But at the time when it was all but completed the Hull and Barnsley Company, being in financial difficulties, called in the gentleman who had been called the Sir William Gull of the railway world—Mr. Forbes—to give them the benefit of his experience in the working of the line. One of the first things Mr. Forbes said to them was—"Good gracious! Don't you see that instead of this railway being a feeder it will be a sucker? The traffic will go over the North-Eastern line instead of over your line. For heaven's sake don't finish it. Don't put another rail in." Acting upon that advice the company did not finish the line. The North-Eastern pressed them to do so, but they declined. It was not a question of money, because even the impecunious Hull and Barnsley Company could spend all the money necessary to complete the line, but it was the deliberate determination of policy in the interests of the Hull and Barnsley Company. Under the circumstances the North-Eastern had an interest in having the line completed. They were therefore asking Parliament to give them power to acquire and finish this line. Although the matter was put in the technical form of making the line, yet it was really meant compulsorily to acquire and take from the Hull and Barnsley this railway which they had so far made. Nobody would say, on behalf of the Hull and Barnsley, that they could not complete the line. They must admit that the omission to complete the line was intentional and deliberate, and that it was intended that it should not be completed. Under the circumstances the North-Eastern Company wished to say, "If you won't complete it, stand aside and let us complete it." If the Hull and Barnsley Company would say even now that they would complete it, and work and maintain it, he was willing on the part of the North-Eastern to withdraw this part of the Bill. In their petition the Hull and Barnsley Company alleged that the line had not been opened for traffic "owing to the refusal of the North-Eastern Railway Company to agree upon the terms and conditions on which the junction shall be made and worked, or to provide the sort of sidings necessary to enable the junction to be used." That allegation was absolutely untrue. The Hull and Barnsley further alleged that to acquire this line would bring the North-Eastern into unfair competition with them, but when promoting their own line they put it forward as a laudable object that traffic from the North-Eastern should have access to the Alexandra Dock. The learned counsel repeated that if the Hull and Barnsley would complete the line the North-Eastern had no wish to interfere. Evidence having been taken, the chairman of the Committee suggested that the two parties should endeavour to come to terms for allowing the North-Eastern Company to work traffic over the authorised junction between the two railways in Hull, but after a few days' adjournment it was found that no progress had been made. The North-Eastern Company suggested the following agreement :—"The coal traffic to be conveyed from collieries to which the North-Eastern have direct access by their own lines or by lines of which they are joint owners. Traffic other than coal traffic so defined to be carried only under arrangements which may be mutually agreed upon between the two companies." The North-Eastern thought that a reasonable solution of the question, but it did not meet the views of the other side. What the Hull and Barnsley proposed was this :—"The junction line and dock not to be opened (unless by special agreement) for competitive traffic of any kind, *i.e.*, for the traffic of all places on the Hull and Barnsley Railway, or to all places beyond, by and through which means of access over other lines, including the North-Eastern and Hull and Barnsley, would form a reasonable route. This junction line and dock to be opened to the North-Eastern for non-competitive traffic only, *i.e.*, for the traffic of all places on the North-Eastern Railway between which and the Alexandra Dock the North-Eastern forms the only route." To this the North-Eastern Company could not assent, and after much wrangling before the Committee, the promoters withdrew this part of their bill, thus leaving the Hull and Barnsley Company master of the position.

The Mersey Docks and Harbour Board (various powers), the Leeds Suburban Railway, the Hull Dock, the Liverpool, Southport, and Preston Junction Railway Bills have been withdrawn.

EXPLOSION OF HETEROGENEOUS MIXTURES OF COAL GAS AND AIR.

By Geo. C. Douglas.

The laws regulating the chemical combination of coal gas and air, mixed together in various proportions, have not yet been completely determined, and until we get a better understanding of these the further improvement of the gas motor as a heat engine can at best be only done by empirical experiment. At present among gas engine makers their practice evidently tends towards comparatively rich mixtures of gas and air. To this the writer does not wish to take exception so far as it applies to the cold cylinder type of engine, but it appears to him that a limit has now been reached beneath which the consumption of gas cannot be made to fall to any great extent unless some radical improvement be introduced. It seems absurd to think that in a machine intended to use as much heat as possible in a profitable manner, that about 50 per cent. of it should go to heat water for no purpose whatever, except to overcome certain mechanical imperfections of design, and which he thinks could be remedied if seriously attacked by some of our scientific engineers, and this the more easily if weaker mixtures, and therefore lower temperatures, be used. The diagrams published below will show that it is possible to get as great, if not greater, maximum temperatures in proportion from a dilute as from a rich mixture. The method by which these diagrams were obtained is as follows:—In those illustrated in Fig. 1 the gas was introduced to the eudiometer—of 380 cubic inches capacity—in known volumes, and ignited by passing an electric spark through it, care being taken that in the more dilute mixtures the richer portion was around the igniting centre. An indicator, whose barrel was moved by clockwork at a uniform speed, gave the diagram of pressures. Figs. 2 and 3 were obtained in a similar manner, with the exception that the eudiometer was divided into two equal parts by a diaphragm of paper, the one portion containing pure air and the other gas and air. The gas used was that employed for the ordinary purposes of lighting in Dundee, and is about 26-candle power, the variation of quality being not more than two candles. The results have been put in a tabulated form beneath each figure, and it only remains for the writer to point out the apparent anomaly in which the pressure of No. 9, Fig. 1, is less than Nos. 10 or 11.

Referring to Fig. 4—the maximum pressure of No. 9 = $\frac{1}{17}$th ratio is in proportion to the other curves of Fig. 1 rather lower than he would expect, and when he first observed how slowly the pressure rose he thought that the peculiarity observed by Mr. Clerk—the double explosion—had something to do with it, and that the heavier hydrocarbons remained unconsumed. Having this in view, he introduced into the eudiometer another charge in the proportion of one of gas to sixteen of the mixture partially consumed, without clearing out the eudiometer as on ordinary occasions. On passing the electric spark through this new mixture the diagram No. 9_1 was obtained, in which the maximum pressure was in proportion as much, if not more,

Fig 3.

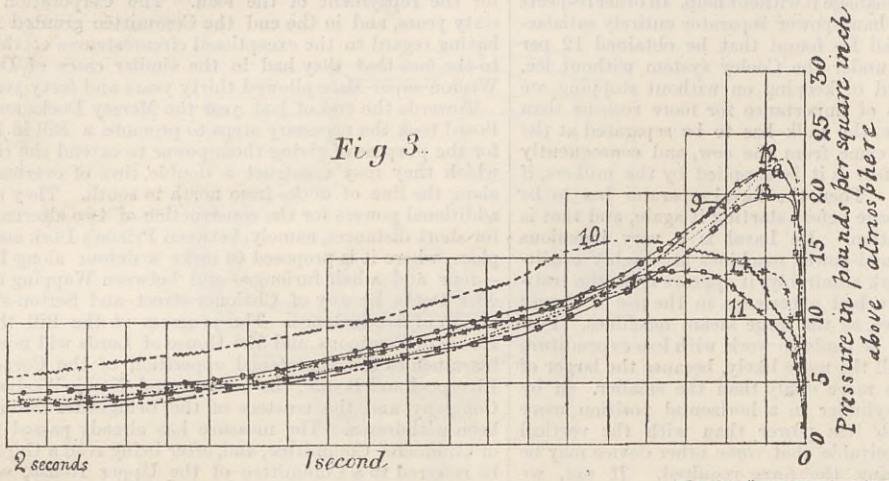


Fig 2.

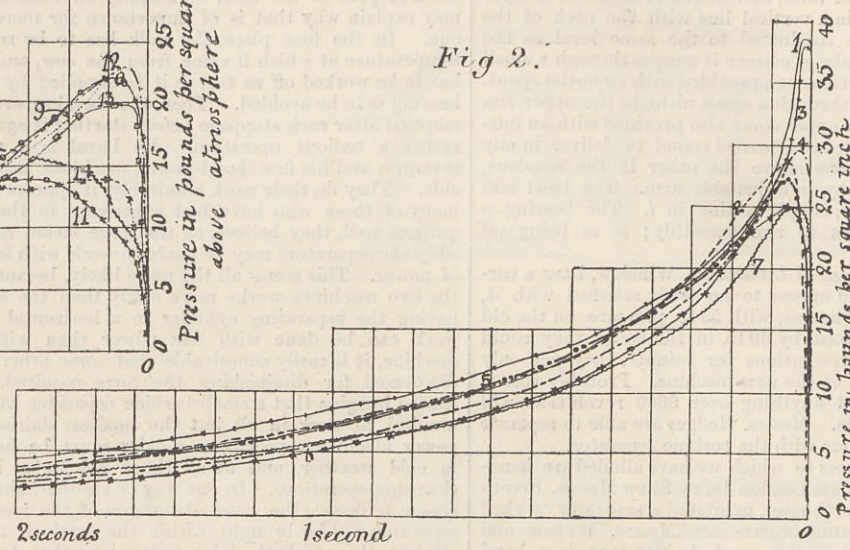


Fig 4.

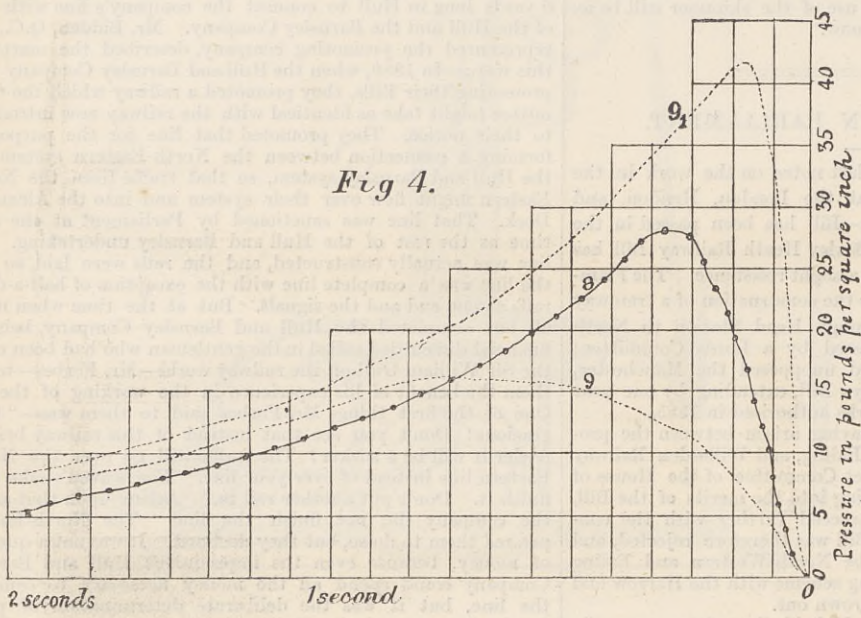


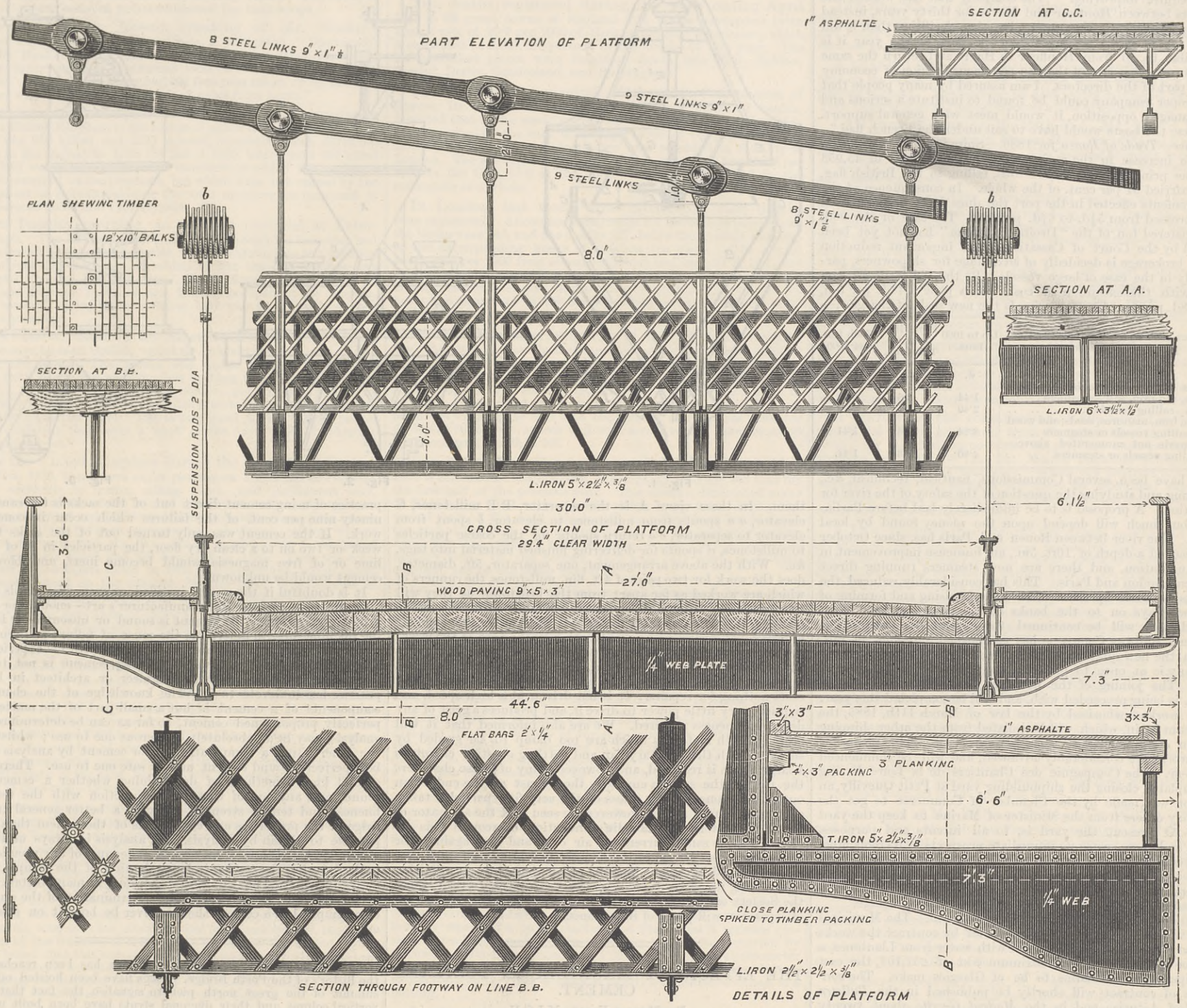
Fig 1.

	No. of diagram.	Volume, gas and air.	Kind of curved line.	Observed maximum pressure in lbs. per sq. inch above atmosphere.	Observed maximum pressure in lbs. per sq. inch absolute.	Calculated maximum pressure in lbs. per sq. inch above atmosphere. Temperature before heat is applied, 9 deg. Cent., and atmospheric pressure.	Calculated maximum pressure in lbs. per sq. inch absolute. Temperature before heat is applied, 9 deg. Cent., and atmospheric pressure.	Maximum temperature of mixture after explosion. Deg. Cent.	Calculated maximum temperature. Deg. Cent.	Range of temperature. Deg. Cent.
Table for Fig. 1.	1	$\frac{1}{9}$	———	74·6	89·3	149·3	164	1437	2878	1428
	2	$\frac{1}{10}$	— — —	65	79·7	135·3	150	1257	2618	1248
	3	$\frac{1}{11}$	–+—+—+–	55·2	69·9	124·8	139·5	1067	2400	1058
	4	$\frac{1}{12}$	—— – ——	50·2	64·9	115·5	130·2	977	2216	968
	5	$\frac{1}{13}$	— • • —	48·3	63	106·3	121	937	2058	928
	6	$\frac{1}{14}$	–×—×—×–	41	55·7	99·4	114·1	792	1922	783
	7	$\frac{1}{15}$	~~~~~~~~~~	38·2	52·9	94·8	109·5	742	1808	733
	8	$\frac{1}{16}$	–o—o—o–	27·7	42·4	87·8	102·5	541	1697	532
	9	$\frac{1}{17}$	.....	16·1	30·8	83·3	98	318	1603	309
	10	$\frac{1}{18}$	~~~ – – ~~~	22·2	36·9	78·6	93·3	434	1519	425
	11	$\frac{1}{19}$	–×—o—×–	16·5	31·2	74·9	89·6	326	1444	317
	12	$\frac{1}{20}$	— – – – —	11·6	26·3	71·3	86	231	1375	222
Table for Figs. 2 and 3.	1	$\frac{1}{17}$	———	39·2	53·9	83·3	98	760	1603	751
	2	$\frac{1}{18}$	— — — — —	28·7	43·4	78·6	93·3	559	1519	550
	3	$\frac{1}{19}$	–+—+—+–	37·5	52·2	74·9	89·6	728	1444	719
	4	$\frac{1}{20}$	—— – ——	29·1	43·8	71·3	86	568	1375	559
	5	$\frac{1}{21}$	— • • —	27·6	42·3	67·7	82·4	538	1313	529
	6	$\frac{1}{22}$	–×—×—×–	25·6	40·3	65	79·7	500	1257	491
	7	$\frac{1}{23}$	~~~~~~~~~~	25·7	40·4	62·4	77·1	502	1204	493
	8	$\frac{1}{24}$	–o—o—o–	22	36·7	59·8	74·5	432	1156	423
	9	$\frac{1}{25}$	.....	19·3	36	57·2	71·9	418	1112	409
	10	$\frac{1}{26}$	~~~ – – ~~~	16·3	31	55·2	69·9	322	1071	313
	11	$\frac{1}{27}$	–×—o—×–	13·6	28·3	53·6	68·3	270	1034	261
	12	$\frac{1}{28}$	— – – – —	22·8	37·5	51·5	66·2	446	998	437
	13	$\frac{1}{29}$	–□—□—□–	20	34·7	49·9	64·6	393	965	384
	14	$\frac{1}{30}$	-×---×---×-	13·9	28·6	48·3	63	276	935	267
Table for Fig. 4.	9	$\frac{1}{17}$	.....	16·1	30·8	83·3	98	318	1603	309*
	$9_{(1)}$	$\frac{1}{16}$	.....	42·4	57·1	87·8	102·5	822	1697	813†
	8	$\frac{1}{16}$	–o—o—o–	27·7	42·4	87·8	102·5	541	1697	532‡
	Proportional to 8	$\frac{1}{17}$		25·2	39·9	83·3	98	493	1603	484§

* Rather low. † Rather high. ‡ Normal. § Proportional to 8.

THE NEW HAMMERSMITH BRIDGE.

SIR JOSEPH BAZALGETTE AND MR. EDWARD BAZALGETTE, MM. INST. C.E., ENGINEERS.



above its proper pressure than No. 9 was below; this, we think, throws further light upon Mr. Clerk's theory of the double explosion. No. 8 is the normal diagram for $\frac{1}{11}$th ratio.

Figs. 2 and 3, obtained by using the diaphragm, only calls for the explanation that until the diaphragm was ruptured by the explosion the ratio of gas to air was twice as great as that given, *i.e.*, for mixture $\frac{1}{5\cdot5}$ there would be one of gas to fifteen of air in the one chamber, and fifteen of air in the other. On comparing No. 2, Fig. 2, with No. 10, Fig. 1—both the same ratio—it will be noticed how much greater the maximum pressure in No. 2 is than in No. 10, the only difference between the two being that in No. 2 the diaphragm kept the gas and air more intimately intermixed. The same remark holds good for all the other curves.

THE NEW HAMMERSMITH BRIDGE.

With this impression we publish a two-page supplement illustrative of the new bridge at Hammersmith. We also publish on this page the first of some engravings illustrative of the details of construction. With the exception of some parts of the pier and the abutment masonry, the bridge is a new one. The general appearance of the bridge is well shown by the general elevation on the supplement, which also contains a plan of the bridge, together with several views of the upper part of the pier and abutment masonry and the wrought iron towers, saddles, and ornamental cast iron casing. The engravings above show to a larger scale the suspension chains, part of the floor and parapet, and a transverse section near the centre of the bridge. The bridge is being constructed from the designs of Sir Joseph W. Bazalgette and Mr. Edward Bazalgette, MM. Inst. C.E., to whom we are indebted for the illustrations we now publish, and others which will appear in another issue.

ABSTRACTS OF CONSULAR AND DIPLOMATIC REPORTS.

France—Trade of Bordeaux in 1886.—Shipbuilding at Bordeaux, as in other French ports, is at a standstill, and the French shipping bounties have not had the effect of resuscitating the shipbuilding industry of the country. How far these bounties, together with the navigation bounties, may have prevented the further diminution of the importance of the French carrying trade by assisting shipowners in this country to run vessels of British or other *foreign* build on foreign voyages is difficult to estimate; but in spite of the high premiums offered, the French mercantile navy experienced during 1886 a diminution of 19,331 tons, while the British mercantile navy during the same period increased 12,721 tons. In August last a circular was sent by the French Minister of Commerce to the Custom-houses directing them to admit the consignee of the ship to perform the requisite formalities of entry and clearance unassisted by a shipbroker. Owing to the opposition of the French shipbrokers and the influential chambers of commerce, the operation of the circular was suspended after a few weeks' existence that the question might be again laid before the Council of State, and it is probable that the suspension of the circular will be permanent, and that matters will be left where they were twelve months ago. About two-fifths of British imports into Bordeaux consist of coal—a very acceptable freight even at low rates for steamers running between British ports and those of Portugal and Spain, and preferable to ballast. The importations of coal into Bordeaux in 1886 amounted to 435,150 tons, of which 434,909 tons—an increase of 15,000 tons over 1885—came from the United Kingdom. Of this coal 77 per cent. was for consumption in Bordeaux and the neighbouring district. The efforts lately made by French colliery owners towards driving the British out of the Bordeaux market have not been successful, though some large industrial establishments have used French coal on patriotic grounds. Under existing circumstances it is not probable that the French coal pits of the northern departments will be able to compete in price with British coal in spite of the French railway companies having largely reduced their rates of carriage between Bordeaux and the north. A new direct railway from Paris to Bordeaux *viâ* Chateau-du-Loire, Saumur, Niort and Saintes was opened last summer, but as the time occupied is longer, and the fare no lower than by the existing line, it is not likely that the new railway will be much used except for short intermediate stages. The works for deepening the river Garonne off the town, and for increasing the current lower down the river, were continued during the year, and, it is hoped, will soon result in providing more harbour room at Bordeaux, and also a better navigable channel between Bordeaux and Paulliac for the larger class of sea-going ships. The construction of more extensive quays at Bordeaux has been further postponed for financial reasons. The project for connecting the Atlantic with the Mediterranean, by means of a canal from Bordeaux to Narbonne, was brought before the Government, and it is stated that a commission to consider the question has been appointed. An international congress of persons interested in commercial, industrial, and technical education, and attended by delegates from various Governments, was held here in September. Among the prominent general results adopted by nearly all present were the opinions, "That the establishment and further development of commercial, industrial, and technical education is urgently necessary for the interests of the commercial and industrial classes, and that countries in which measures have not already been, or are not at once taken towards this end, will find themselves hopelessly distanced in the competitive fields of commerce and industry; that industrial and technical education should as far as practicable be left to local control and initiation, and not to the central Government; and that the plan upon which these branches of education should be organised should as far as possible consist in restricting such course of studies to a special subject."

France—Trade of Caen for 1886.—General trade has been dull and depressed, especially in the earlier part of the year, but later on importations, which are always more or less dependent upon the markets of other countries—increased in this part. There has been a considerable falling off in the number of British vessels trading to this port, amounting to a difference in number of ninety-three, and in tons of 7369. The falling off was especially apparent in the beginning of the year, but towards the end there was an increase in arrivals, and trade became brisker. Coal continues to hold the first place among imports, and there has been an increase of 1000 tons over 1885. The price of coal receded slightly in November, 1886, and freights have, with little variation, averaged from 5s. to 5s. 6d. per ton. By steadily prosecuting dredging the depth of water in the ports of Caen and Ouistreham and their approaches remains about the same average of from 15½ft. to 16½ft. The canal from Caen to Ouistreham, about nine miles in length, appears to be gradually lessening in depth from the accumulation of mud moving from the shelving banks on each side towards the centre; but some time must elapse before the navigation for vessels of large tonnage will be materially impeded, though many take the ground on the soft mud approaching the port of Caen.

Trade of Dieppe in 1886.—The imports of coal, coke, machinery, pig iron, &c., continue to be the same as usual. The amount of coal imported from the United Kingdom was 313,700 tons, and of pig iron 6562 tons. The entrance to the harbour has been considerably deepened, and the advantages of widening the channel were very apparent during the severe gale of the 26th December last. Dredging the inner and outer channel of the port and outer harbour to a depth of 8ft. is being continued, and the new channel through the quarter called "Le Pallet" is being cut, which will give direct access to the new docks, which it is expected will be formally opened shortly. The rebuilding of the quay wall where the Newhaven steam packets leave their cargoes has been completed, and the harbour improvements at Dieppe seem to be advancing more rapidly than those at Newhaven. The works at Dieppe in course of execution include the diversion of the river Arques and the establishment of shipbuilding yards and the erection of hydraulic machinery for the motive power of the harbour works.

Trade of Honfleur for 1886.—The tonnage of shipping entering Honfleur decreased from 223,779 tons for 1885 to 200,327 tons for 1886, a diminution of 11 per cent. This reduced tonnage was entirely owing to the smaller quantity of planks, timber, &c., imported, the merchants having overstocked themselves in 1885. Among the imports for 1886 was a quantity of machinery,

valued at £10,000, for a new saw mill at Honfleur. This appears to be a branch of trade eminently open to British commerce, agricultural implements and machinery of all kinds being in good demand. Although there are two lines of steamers from the United Kingdom to Honfleur, the local steam communications require improving. "The company that has worked the steamers between Honfleur and Havre for thirty years, instead of progressing with the times, gives less facilities than it did twenty years ago. For a considerable part of the year it is impossible to go from Honfleur to Havre and return the same day, for no other reason than an erroneous opinion of economy on the part of the directors. I am assured by many people that if a proper company could be found to institute a serious and well-managed opposition, it would meet with general support. Of course the boats would have to sail under the French flag."

France—Trade of Rouen for 1886.—Shipping and navigation show an increase in the registered tonnage inwards of 45,958 tons, the principal part, 34,679 tons, falling to the British flag, which carried 61 per cent. of the whole. In consequence of the improvements effected in the port the dues have been renewed and increased from 5¼d. to 6¾d. per ton. The case of the 96d. per registered ton of the "Droits d'Attache" has not yet been decided by the Court of Cassation. The important reduction in the brokerage is decidedly of advantage for shipowners, particularly in the case of large vessels. By the old tariff all cargoes, with the exception of coal, which paid 1·44d. per ton, paid 4·8d. per ton. The following is the new scale of charges :—

Cargoes entirely or nine-tenths composed of the following.	Up to 1000 tons.	From 1001 tons to 1500 tons.	Each ton over 1500.
	d.	d.	d.
1. China clay, coal, feldspath, iron ore, pig iron, salt—steamers	1·44	·96	·48
Ditto—sailing vessels	2·40	1·92	·96
2. Grain, iron, manures, seeds, and wood —sailing vessels or steamers	3·84	2·88	1·44
3. All goods not enumerated above—sailing vessels or steamers	4·80	2·88	1·44

There have been several Commissions, nautical, technical, &c., discussing and studying the question of the safety of the river for navigation. A proposal is to be immediately laid before Parliament, but much will depend upon the money found by local bodies. The river between Rouen and Paris has, since October last, reached a depth of 10ft. 5in., an immense improvement in the canalisation, and there are now steamers running direct between London and Paris. This has considerably reduced the freights to Paris by river. The macadamising and forming of the new quays on to the banks of the river has been commenced, and will be continued throughout the year. The Northern Railway Company has established four lines of railway on the new quay on the right bank; the Western Railway Company is at once to place lines on the new quay on the left bank. The joining of the new and old quays a length of 1542ft. is being proceeded with, and will be completed this year. Of the works authorised by the law of March 11th, 1885, the petroleum basin, which will be isolated from the other shipping by iron closures, will be completed in 1888. The plans for other works are considerably advanced, and will be commenced this year. The Compagnie des Chantiers de la Loire having contemplated closing the shipbuilding yard at Petit Quevilly, an attempt was made by the Chamber of Commerce to get the necessary orders from the Minister of Marine to keep the yard open. At present the yard is, to all intents and purposes, closed, and there seems no immediate prospects of its reopening. Engineering works continue almost devoid of orders, and, without exception, all are passing through a severe crisis, discharging workmen and reducing the hours of labour. The situation is as bad as possible and no apparent prospect of a change.

Spain—Construction of Waterworks at Gijon.—The Municipal authorities at Gijon have decided to let by contract the works necessary for supplying that town with water from Llantones, a distance of 4·35 miles, at a maximum cost of £31,103, the cast iron pipes and necessaries to be of Glasgow make. The conditions of contract will shortly be published in the *Bulletin Official* of Asturias, and in the *Madrid Gazette*, about twenty days previous to date for opening tenders. Conditions, plans, and specifications may be inspected at the Town Clerk's office, Gijon Asturias, North Spain. Gijon is a seaport on the Bay of Biscay, nineteen miles north north-east of Oviedo, with a population of about 6000.

MUMFORD AND MOODIE'S SEPARATOR.

The accompanying engravings illustrate a new form of separator, for use in flour and other mills, made by Messrs. Askham Brothers and Wilson, Sheffield. The separator is shown in section in Fig. 1, in which A is an outer casing of sheet iron, circular and conical in form, into which the fine dust is thrown, and terminating in a spout at the bottom for delivering into bags, casks, or to creepers, as may be desired. B is an inner casing, into which the coarse particles fall, and can be delivered to the right or left through the branch pipes *a a* by moving the valve *c*. C is a movable band encircling the top of the case B, which acts as a damper for closing the opening between the cases A and B, and is worked by the lever *f* and the rods *h h*; D is a hood against which the material is thrown; E E, blades of a fan connected by arms to the disc E^1, rotating on the fan spindle E^2; F is a standard for carrying the spindle and driving gear; G, feed cone into which the material is fed. The material to be treated is fed into the cone G, and falling on the rotating disc E^1, is thrown in a thin stream all round towards the fixed hood D. The current induced by the fan passes upwards, and carries with it the fine particles, which are thrown into the outer case A; the current of air, escaping from the fine particles separated by centrifugal force, returns through the opening O in the direction of the arrows, the same air being used over and over again. The coarser particles which are too heavy to be lifted by the current of air fall into the casing B, from whence they return by the branch pipes *a a* to the grinding machine to be further reduced. The degree of fineness of the finished material can be regulated by the speed of the fan, also by the partial closing of the aperture O by means of the damper C, which intercepts the current of air. Different forms of hood D also alter the quality of finished material. Every user of pulverising or grinding machinery has experienced difficulties in separating the fine from the coarse particles of the substance he wishes to reduce. A miller may be sometimes producing a grist to suit all requirements, but from various causes, the millstones getting blunt, or the material to be ground is extra tough and hard, and bad work and separation result, as well as a very small output when fine work has to be done. In Figs. 2 and 3 are shown the arrangement of the separator in conjunction with millstones, an arrangement which has been found in continued practical operation to increase the output from 4ft. 6in. millstones from, we are told, 60 to 70 per cent., without any increase in wear and tear or power taken to drive

MUMFORD AND MOODIE'S BLAST AND EXHAUST SEPARATOR.

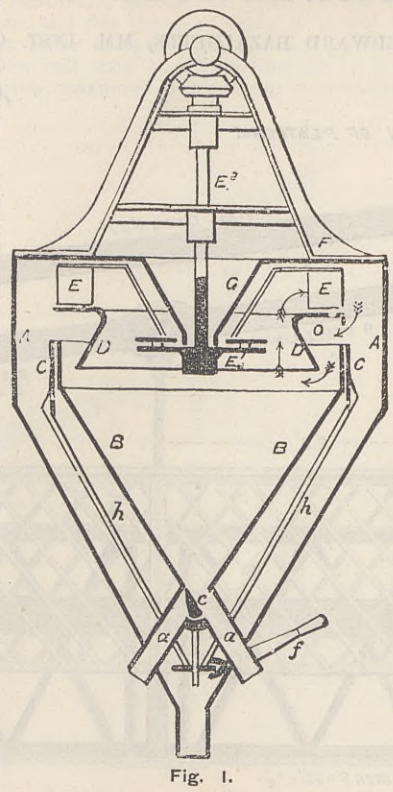


Fig. 1.

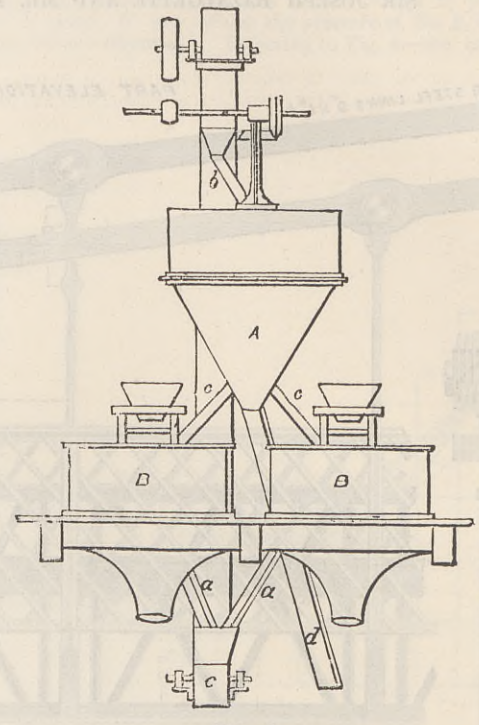


Fig. 2.

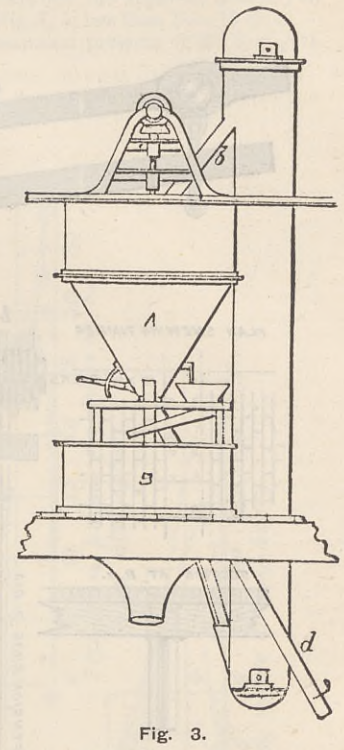


Fig. 3.

them. In these views A is the separator, B B millstones, C elevator, *a a* spouts from millstones to elevator, *b* spout from elevator to separator, *c c* return spouts for the coarse particles to millstones, *d* spouts for delivering finished material into bags, &c. With the above arrangement, one separator, 5ft. diameter, does the work for two pairs of 4ft. 6in. millstones, the runners of which are worked as far apart from the bedstones as they will run consistent with not riding on the top of the material without grinding it. The separator renders its users quite independent of occasional carelessness or inattention on the part of the workpeople. It has no working parts which can come in contact with the material operated upon, and is exceedingly simple in operation, and does not require skilled labour to work it, and costs nothing for repairs. It is not driven at a high speed, and requires very little power to drive it, and produces a grist of any degree of fineness required. We are also informed that it will also deal with materials which are too damp to be graded by sieves. With the ordinary fan and settling or stive chambers a large space is required, and however many of these chambers the user of the system employs, there must at the end be an outlet, and consequently a loss of the very fine particles taken over by the fan. It will, however, be seen that the separator of Messrs. Mumford and Moodie's invention overcomes this by employing the same current of air over and over again. For mining purposes at out-of-the-way places where sieves are now employed, and in cement manufactories where very fine division is becoming necessary (*vide* Professor Unwin's paper, read before the Society of Chemical Industry, April, 1886), this simple form of separator will prove of importance.

THE EFFECTS OF MAGNESIA IN PORTLAND CEMENT.

By Henry Faija, M.I.C.E.

The attention of engineers and users of cement has lately been drawn to the effects produced in cement by the presence of magnesia. Many have spoken and written about it until magnesia has become the *bête noir* of all users of cement. Some engineers specify that the cement they use shall contain no magnesia, though some are courageous enough to admit 1 per cent. It is curious that only a few years ago the greater excellence of the German cement over the English was thought to be due to the presence therein of a larger percentage of magnesia, and many German cements give an analysis of as much as 3 per cent. Now, of course, it is not admitted that the German cements are better than the English, and the magnesia instead of being the one thing of all others which made the cement, is tabooed altogether. It is to be presumed, therefore, that there is a fashion in the components of a cement as there is in a lady's dress, and that which is *en règle* to-day is *gauche* to-morrow.

No doubt if magnesia enters largely into the composition of a cement it produces one that is dangerous to use, but so does an excess of lime, or even a properly limed cement not having that lime wholly, or nearly wholly, in the form of a silicate is equally unsound; but the difference between one, two, or three per cent. of magnesia, or of one, two, or three per cent. of unsilicated lime, is as nothing compared to many other matters of composition and manufacture which tend to produce a good or a bad cement. While, therefore, a small percentage of magnesia is not harmful to a cement, to make a cement from a dolomite or magnesian limestone would be courting failure, and nobody with any knowledge of the manufacture would attempt it. These limestones produce some of the strongest building limes, but as an item in cement manufacture they are useless.

Magnesia is dangerous in a cement for the same reason that lime is, viz., that when in its free state, it, on the addition of water, expands, and of necessity if there is a large quantity present it will destroy the work of which it forms a part, and magnesia in a cement must be more or less in a free state, because carbonate of lime and carbonate of magnesia on calcination lose their carbonic acid and amalgamate with the silicas and aluminas with which they are mixed in the formation of a cement at different temperatures and after different intervals.

There is an old proverb which reminds one that it is impossible to make a silk purse out of a sow's ear; neither is it possible to manufacture magnesia in a cement kiln—it must be in the raw materials of which the cement is made; and but few, if any, of the cements made in England are made from raw materials which contain any appreciable or abnormal quantity of magnesia. Most English cements will be found to contain from one to two per cent. of magnesia, and there is no doubt that that amount is well within the margin of safety. The mistakes made with cement are not in its manufacture so much as in its use; the practice of using cement direct out of the sacks is the cause of ninety-nine per cent. of the failures which occur in concrete work. If the cement was only turned out of the sacks for a week or two on to a clean dry floor, the particles in it of free lime or of free magnesia would become inert, and blowing cement would be unknown.

It is doubtful if the user is justified, or even wise in his own interests, to enter into the manufacturer's art—enough for him if he knows whether the cement is sound or unsound—it is for the manufacturer to determine the cause of failure and remedy and amend his manufacture in accordance with his experience. The art and science of manufacturing cement is not to be learned in the time which an engineer or architect in large practice has to devote to it. The knowledge of the chemical components of a cement is but a small part of the matter; a perfectly proportioned cement, so far as can be determined by analysis, may be an absolutely dangerous one to use; whilst, on the other hand, a comparatively poor cement by analysis may be a perfectly sound cement and a safe one to use. There are several known methods of determining whether a cement is sound, and any one of these in conjunction with the test of fineness and tensile strength, will give a better general knowledge of the properties and capabilities of the cement than it is possible to obtain by analysis. An analysis is always useful as a corroborative test, as it may explain the cause of any peculiarity noticed during the mechanical examination of the sample, and a carefully carried out analysis is therefore in many instances of very great value in assisting in the determination of the quality of a sample, but a cement should never be bought on analysis only.

The Forth Bridge.—An important stage has been reached in the history of the Forth Bridge. Flags have been hoisted on the summit of the great north pier to signalise the fact that the vertical columns and their diagonal struts have been built up to their full height of about 350ft. above the mean sea-level between high and low-water. Above this there remains only to be placed the "upper member" of lattice-work to raise the structure to its extreme height of 363ft. The south pier wants only some feet of its final height, and though the Inchgarvie, or central pier, is, by comparison, a long way behind those on the Fife and the Linlithgow sides of the Forth it is also making rapid progress. The great tubes of the main piers rise like towering clusters of masts in the middle of the Firth. What is mainly wanting now is the great cantilever spans, whose cobwebs of steel tubes and lattice bracings are to carry the railway at a height of 168ft. above high-water over two clear spaces of 1710ft. of sea and other two spaces of 690ft. This work also has begun to make visible progress, the "lower members" already projecting for a distance of from 120ft. to 150ft. from the bases of the piers.

The United States Navy.—Yesterday, April 1st, was an interesting day, says the *Army and Navy Register*, in the office of the Secretary of the Navy. It was the occasion of the opening of the plans for the armoured battle ship and armoured cruiser, for which a prize of 15,000 dols. was offered by the department last year. Nearly all the heads of staff departments were present, and a number of naval officers, including Commander Chadwick, Lieutenant R. P. Rodgers and Lieutenant Schroeder. The foreign plans that were received showed very fine workmanship. The following is a list of the names of those who submitted plans:—The Thames Iron Shipbuilding Company, London, England; the Barrow Shipbuilding Company, Barrow-in-Furness, England; Mr. Watt, of Birkenhead, England; A. H. Grandjean, marine engineer, St. Nazaire, France; Captain M. S. Clayton, Auckland, New Zealand; Lieutenant W. I. Chambers, U.S. Navy; Chief Constructor T. D. Wilson, U.S. Navy; Constructor S. H. Pook, U.S. Navy; N. L. Tonns, New York City; F. L. Norton, of Washington. Two fine models in half-sections were received from the Thames Ironworks and Shipbuilding Company, of Blackwall, England. The general description of these vessels were as follows:—

Armoured Cruiser.

Length, 350ft.	4 10in. 26½-ton guns.
Breadth, 58ft.	6 6in. 6-ton guns.
Depth, 38ft.	4 6-pds. Hotchkiss guns.
Draft (mean), 21ft. 6in.	4 3-pds. Hotchkiss guns.
Displacement in tons, 6000	2 1-pd. Hotchkiss guns.
Horse-power, 12,750	4 47mm. Hotchkiss guns
Speed, 20 knots	4 37mm. Hotchkiss guns.
	4 Gatling guns.

Armoured Battle Ship.

Length, 360ft.	2 12in. 46-ton guns.
Breadth, 60ft.	6 6in. 5-ton guns.
Depth, 42ft.	4 6-pds. Hotchkiss guns.
Draft (mean), 22ft. 6in.	6 3-pds. Hotchkiss guns.
Displacement, 6300 tons	2 1-pd. Hotchkiss guns.
Horse-power, 10,000	4 47mm. Hotchkiss guns
Speed, 18 knots	4 37mm. Hotchkiss guns.
	4 Gatling guns.

We are unable to give this week a description of the plans in detail. Chief Constructor Wilson submitted a model of an armoured cruiser of the Riachuelo type with two turrets, each containing two 12in. guns so arranged as to have a clean sweep forward and aft, as well as a full broadside range.

RAILWAY MATTERS.

Two goods trains came into collision at Palatine, Illinois, on Sunday, attracting a crowd of spectators near a large water-tank, which suddenly burst, deluging the crowd, killing six, fatally injuring four, and seriously injuring others. The shock of the collision is believed to have loosened the tank hoops.

THE *Norristown Herald*, speaking of Mr. Ruskin's recent expression of opinion, heads a paragraph "Disgusted:" "John Ruskin calls railroads 'the loathsomest form of devilry now extant, carriages of damned souls on the ridges of their own graves.' John must have had his free pass taken up by the conductor when he was several hundred miles from home."

THE total number of persons killed and injured on railways in the United Kingdom in the course of public traffic during the year 1886 was 938 killed and 3539 injured, numbers which differ but little in the aggregate from the list of 1885, which gave 957 killed and 3467 wounded. If to these numbers be added the accidents which occurred on the premises, but which were not caused by the movement of railway vehicles, the total numbers are increased to 989 persons killed and 7407 injured.

ON Tuesday morning, an accident occurred at Peterborough. The Midland train from Peterborough for Leicester had just cleared Peterborough station when it was run into at a junction by a Great Northern engine, which caught the last carriage but two and knocked it clean over. Mr. C. Everard, of the firm of Ellis and Everard, Peterborough, the sole occupant of the carriage, was rescued through the window, and was found to have been severely shaken.

"A PERSON," observes the American *Mechanical Engineer*, "who says he is an oculist, writes an article upon the care of the eyes, and says:—'The person who wishes to keep his eyesight good until late in life should allow nothing irritating to get into them. If, in travelling, dust or cinders get in, they should be carefully removed as soon as possible afterwards by the application of water along the edge.' This is very good advice. Most people leave cinders in their eyes a week or ten days, probably through thoughtlessness."

IN the United Kingdom during the year ended December 31st, 1886, there were eight passengers killed and 615 injured from accidents to trains, rolling stock, and permanent way, against six killed and 436 injured in the year before; eighty-seven passengers killed and 727 wounded by accidents from other causes—such as falling between carriages and platforms, getting into or out of carriages, and the like—which numbers may be compared with ninety-six killed and 693 wounded in 1885. Thus the total number of passengers killed in 1886 was ninety-five, which shows an improvement on the number, 102, for 1885. The number of injured, however, rose from 1129 in 1885 to 1342 last year.

ONLY four servants of railway companies or contractors were killed from accidents to trains, rolling stock, and permanent way in the United Kingdom last year, which number shows a great reduction from thirteen in the previous year, while the number injured from such causes is the same in each year—eighty-one. The list of servants killed and wounded by accidents from other causes is always heavy. In 1886 in both respects it is a little lighter than in 1885. Thus, while 438 servants were killed by such accidents in 1885, that number fell to 421 in 1886; and so with the injured—2036 and 1929 being the figures for the two years respectively. The number of persons killed by passing over railways at level crossings was eighty-one in 1886, a marked increase over the fifty-eight of the year before, while the number of injured is small in each case—twenty-five in 1886, twenty-one the year before.

IN concluding a report on the collision which occurred on February 22nd, at Quarry Gap, near Laister Dyke, on the Great Northern Railway, when a passenger train from Bradford to Shipley came into collision with one of four vehicles which a goods train had shunted across the line at Quarry Gap, and which, instead of running into a siding as intended, had stopped on the crossing foul of the main line, and outside the safety-points of the siding, Major Marindin says:—"It should be remarked that when the collision occurred, the continuous brake on the passenger train being non-automatic, was, as is too often the case with such brakes, rendered useless by the fracture of the pipe at the end of the engine. It is to be hoped that this warning will not be neglected by the directors of the company in considering the advisability of adopting a brake possessing the qualities believed by the Board of Trade to be necessary, and which have so often been proved to be so."

THE railway freightage question continues to be seriously debated by the traders and the railway authorities who conduct most of the carrying business of the Birmingham and Midland part of the kingdom. Foundry and similar heavy work is gravely prejudiced, and no branch more so than the massive pipe or iron main branch. So severe is the competition now for the few orders moving for that commodity, that unless a sensible relaxation in current rates is authorised by the carriers there is ground to fear that one or more foundries of this kind will have to close their gates. Manufacturers think that they have at least a little room to conclude that the carriers' and their own views will more nearly approximate. Under the pressure of conviction, based upon inquiries in the several localities most affected, they are admitting that gate closing at the foundries will mean a serious decline in passenger as well as in merchandise traffic. Upon all hands it is sincerely trusted that the railway authorities will soon see their way to afford the needed freightage reductions.

THE Pretoria *Volksstem* advocates the introduction into the Transvaal of cheap "portable" railways manufactured by the firm of Decauville, at Petitbourg, in France. The *Colonies and India* observes that it is said these manufacturers will deliver a line of railway of six and a-half miles, 2ft. gauge, with two locomotives of four tons, tenders, thirty passenger wagons and trucks, all implements, points, curves, spare wheels, axles, a double set of appendages—in a word, a complete, and even more than complete, set of materials for a railway, including packing, weighing 282 tons in all, free for about £8000 by rail at a French port. If the ground be pretty level, the line could be laid down fit for use at the rate of 400 yards per hour. A contemporary adds, "The question of cheap railways on this principle for up-country extension, and for cross lines throughout the colony, is well worthy of consideration." But it might be further added that there are two or three firms in England who would supply a really useful cheap line at a very little above the cost mentioned. Very cheap railway work means wasted money.

IN reporting upon the collision which occurred on January 31st, at Inniskeen Junction station, on the Dundalk and Londonderry line of the Great Northern Railway of Ireland, Major-General Hutchinson says:—"The collision was caused by a carriage having become uncoupled from the branch engine which was propelling it, at a distance of about 200 yards from the rear of the train to which the carriage was about to be attached. In consequence, the carriage—a long composite brake-carriage in which there was no guard—ran forward, and came into collision, at a speed of about six miles an hour, or perhaps more, with the rear of the train, which had just got into motion and had moved forward about two carriage lengths, a severance taking place between the first and second vehicles. It is hardly necessary to point out that had there been a brake connection between the engine and carriage, and had the brake in use been an automatic one, the carriage would have been stopped at once had it become detached from the engine, and the collision would have been prevented. To prevent couplings jumping off draw-bar hooks, a very simple contrivance is adopted by some companies in the shape of a small weighted lever attached to the top of the hook. There seems to be no good reason why this should not be more generally employed."

NOTES AND MEMORANDA.

THE imports of iron ore into France in 1886 amounted to a total of 1,158,581 tons, as compared with 1,419,521 tons in 1885, and 1,412,724 tons in 1884.

THE deaths registered during the week ending April 16th in 28 great towns of England and Wales correspond to an annual rate of 20·9 per 1000 of their aggregate population, which is estimated at 9,245,099 persons in the middle of this year. The six healthiest places were Brighton—death rate 10·6—Halifax, Cardiff, Derby, Sunderland, and Birmingham.

ON Tuesday, at a meeting of the City Commission of Sewers, Dr. Sedgwick Saunders, the medical officer of health, reported that in the week ending on Saturday last the deaths in the City were at the rate of 3·03 per 1000 of the population per annum, being the lowest death-rate ever recorded in the City of London. The average rate for the last two years had been 14·5 per 1000 in the City, 18·9 in the United Kingdom, and 19·7 in the metropolis as a whole.

IN London, last week, 2626 births and 1558 deaths were registered. Allowance being made for increase of population, the births were 146, and the deaths 277, below the average numbers in the corresponding weeks of the last ten years. The annual death-rate per 1000 from all causes, which had been 21·3, 19·7, and 17·8 in the three preceding weeks, rose again last week to 19·3. During last quarter the death-rate averaged 20·7, and was 3·3 below the mean rate in the corresponding period of the ten years 1877-86.

IN the older determinations of the physical constant "v" the ratio of the electro-magnetic and electro-static units of electricity differences amounting to as much as 4 per cent. appear, while the newest determinations of Exner, $29{,}20 \cdot 10^9$, Klemencic, $30{,}18 \cdot 10^9$ and J. J. Thomson $29{,}63 \cdot 10^9$ are not very much more in accord. A short time ago Herr F. Himstedt determined five sets of values which agree well with each other, and his final value for $v = 30{,}074 \cdot 10^9$ cm/sec agrees well with a very recent determination by Klemencic, $v = 30{,}15 \cdot 10^9$.

THE make of pig iron in France during the first half of 1886 is returned at 763,225 tons, as compared with 829,366 tons for the first half of the previous year. This shows a diminished make of 66,141 tons; but as trade was rather more brisk during the second half of the year, this decline may have been made up by the end of the year. Of the production for the half-year ending June 30th last, 604,517 tons were forge and 158,708 tons were foundry iron. Of the former, 4179 tons only were made with charcoal, and of the latter 2424 tons.

IN a "general list of Italian earthquakes," 280 serious earthquakes are noted which have befallen the Italian Peninsula since the year 1400. The most disastrous ones on record occurred in the years 1169 at the foot of Mount Etna, with 15,000 victims; 1456 in the Neapolitan Provinces, 30,000 victims; 1627 in the Province of Puglia, 4000 victims; 1638 in Calabria, 9600 victims; 1693 in Sicily, 93,000 victims; 1703 in Central Italy, 15,000 victims; 1783 in Calabria, 60,000 victims; 1805 in Terre di Lavoro, 6000 victims; 1857 in Basilicata, 12,300 victims; 1885 in Ischia, 2515.

ACCORDING to Ryland's blast furnace returns to March 31st last, the total number of furnaces built March 31st, 1887, was 853; total number of furnaces in blast March 31st, 1887, 405; decrease in the number of furnaces built since December 31st, 1886, 4; increase in the number of furnaces in blast since December 31st, 1886, 28; furnaces blown out since December 31st, 1886, 5; furnaces blown in since December 31st, 1886, 33; furnaces built since December 31st, 1886, 0; furnaces pulled down since December 31st, 1886, 4; furnaces being built at present time 8; furnaces being re-built at present time, 7.

IT is well known that the fall in electromotive force of a cell when the circuit is closed, due to alterations in the layers of liquid in contact with the plates, may be prevented by keeping the liquid in motion. Mr. A. P. Laurie has measured the electromotive force of cadmium and platinum immersed in iodine solution, by means of a galvanometer, and finds that it remains constant for a long time when the cadmium plate is kept moving by clockwork. Its initial value was 1·084 volts—by the electrometer 1·076 volts. After two hours it fell to 1·067 volts—by the electrometer 1·072 volts. But a clock is hardly a desirable addition to a battery.

A NEW method of purification of illuminating gas and other fluids is described in a patent, somewhat curiously, it may be mentioned, taken out by Herr F. Lux. It is based upon the principle of alternately contracting and expanding the gaseous current, and is carried out by dividing the current into several streams, and passing these through series of chambers, the enclosing walls of which, being convoluted, continually change the sectional area in the direction of the current. It is claimed that the sudden changes of velocity produced in the gaseous current by this alternate expansion and contraction of its channel cause a most complete deposition of the mechanically carried solid or liquid matters, which may be aided by the insertion of baffle plates where the channel is widest.

THERE is little or no reason, says the *Millstone*, for the grading of middlings on a reel, and every reason why they should be graded on a sieve. Yet most millers use a reel, and few have sieve graders in their mills. The reel makes the middlings more difficult of purification, in that it pulverises the impurities, mixes them with the middlings and makes dust. A sieve does not make dust, does not pulverise the impurities, and does help materially in the separation of the impurities from the middlings, and grades them most perfectly. A sieve 18ft. long and 30in. wide will grade all of the middlings from a 250-barrel mill, if operated at a speed of from 250 to 300 revolutions per minute. The throw should be about 1in. This machine is simple in construction, cheap as to cost, and effective in the work it does.

AS is now generally known, that which in Germany is known as the Thomas slag is coming very much into use for manure. Herr L. Blum. in "Chem. Zeit.," proposes to avoid grinding the slag by acting on it, as it runs out of the converter, with a jet of steam under a pressure of 2—4 atmospheres. Slag wool is made in this way, but Thomas slag always contains a large excess of lime, so that the slag is reduced to a fibrous and powdery mass, which needs no further disintegration for manuring purposes. Should the slag be very fusible—when fluorspar or alkalis have been added—it can be run off into a wagon, and then treated with steam. With regard to the chemical action of the aqueous vapour, it is found that the metallic granules are oxidised, and some of the sulphur is eliminated as H_2S.

INTERESTING experiments have recently been made by MM. Ormond and Werth, of the Creusot Works, on the inner structure of cast steel. A very thin rolled plate was placed on a pane of glass and carefully treated with nitric acid until the iron was all dissolved, in such a way as to leave the carbon in its normal condition. When this skeleton was examined with the microscope, it was discovered that the carbon is not at all distributed evenly throughout the mass, but that the steel consists in its inner structure of tiny particles of soft iron enclosed in cells formed by the carbon. These cells are again distributed in the iron, either combined or as a collection of cells, having considerable open spaces between them, so that such a plate or sheet of steel may be rolled until it becomes transparent. These spaces are irregular in shape, and may in the raw material be almost noticeable, but they are reduced in proportion to the treatment to which the steel is subjected either by rolling or hammering, as naturally the homogeneity is increased.

MISCELLANEA.

IT is announced that the offices of the Union Electrical Power and Light Company have been removed from Cannon-street to Palace-chambers, Westminster.

THE English and Scottish Boiler Insurance Company is now publishing an eight-page monthly periodical entitled "Steam and Boiler Insurance Monthly" and dealing chiefly with boiler insurance matters.

A LEAKING oil pipe on Saturday last caused the oil to float on the water of New York Harbour, which caught fire from a passing tugboat. The burning oil field partly destroyed two New York Central Railway piers, causing a loss of 100,000 dols.

ON Thursday evening, the 28th inst., Mr. Eric S. Bruce will give a popular lecture in Princes Hall, Piccadilly, at 8 o'clock, on "Science and the Jubilee." The leading scientific inventions of the fifty years will be described and illustrated by experiment and dissolving views.

THE Royal Counties Agricultural Society will hold its meeting at Reading this year during four days, from the 20th to the 23rd June inclusive. It is intended that it shall be an unusually large meeting, and £2300 are to be given in prizes—of course for cattle and live stock.

MESSRS. F. SILVESTER AND CO., of the Castle Hill Works, Newcastle, Staffordshire, have just shipped a considerable consignment of mining machinery to Australia. Messrs. Silvester and Co. shipped a consignment last year to the same place, and are now engaged on orders for similar work for India.

THE Essex Agricultural Society will hold its annual meeting on the 7th and 8th of June, and is offering four medals for award by the judges in case of merit in new implements, or substantial improvements in implements now in use for agricultural or estate purposes. Competitors must enter exhibits before May 10th.

A TENDER for the construction of the second section of the Watts River Aqueduct, from Kangaroo Grounds to Long Gully, for the Melbourne water supply, has been provisionally accepted for £204,786 12s. 2d., Messrs. Johnston and Shaw, of Melbourne, being the tenderers. When the contract is finished, Melbourne and the suburbs will have an additional supply of 25,000,000 gallons of water daily. The work is expected to occupy about two and a-half years.

A LANCASHIRE paper records the death, on the 4th inst., of Richard Rogerson, of St. Helens, remarking that on September 14th, 1886, he completed his 74th year of servitude chiefly as turner and cylinder borer to Messrs. Daglish and Co., St. Helens Foundry. At the time of his death he was over 85 years of age, and up to a few years ago enjoyed excellent health. He was much appreciated by Messrs. Daglish. He was married twice, and had fourteen children, and, some years ago, as many as forty-two grandchildren and twelve great grandchildren living.

THE annual Sportsman's Exhibition, which opened at Olympia on the 20th inst., eclipses all its predecessors. Some idea of the magnitude of the undertaking, of which Mr. H. Etherington is manager, may be gathered from the fact that the whole of the seating in the vast building at South Kensington has had to be removed, and that from wall to wall every inch of space has been let to exhibitors. The collection of sporting accessories is on a very comprehensive scale, and includes every possible article from a fish-hook to a billiard table, a drag, or a steam launch. In the annexe will be found from the 26th to 29th inst. the show of sporting dogs—the first confined to the sporting dogs.

THE report of Mr. William Crookes, Dr. William Odling, and Dr. C. Meymott Tidy, on the water supply to London, during March, states that altogether, the water supply during the past month has been most satisfactory. In the case of one company's supply, a few of the samples have to be recorded as "slightly turbid," but this turbidity was entirely local, and due to an interference with the mains in the locality from which the samples were taken. The matters in suspension were, moreover, constituted entirely of mineral matter. The remaining samples, including the whole of those supplied from the Thames, were well filtered, clear and bright. The proportion of organic matter in the water was appreciably below that of the preceding month's supply.

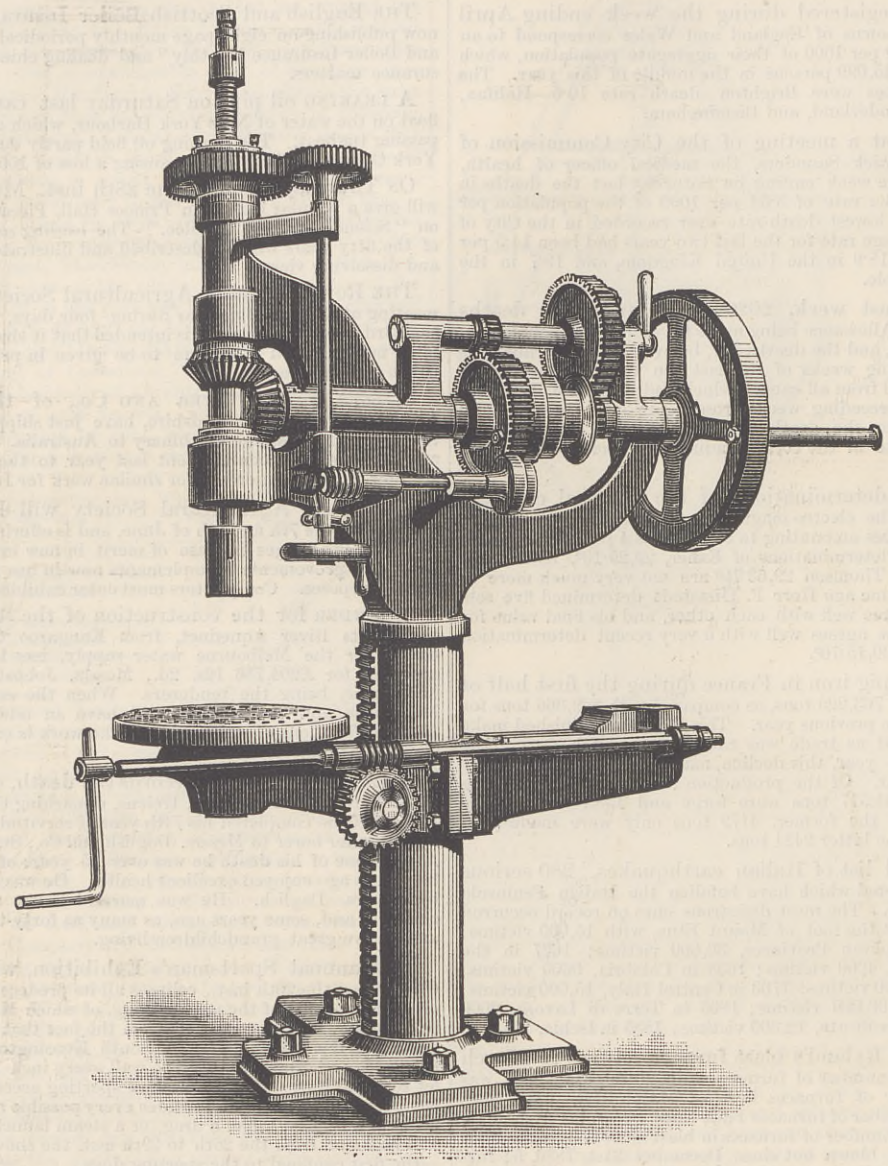
WE have received a copy of "May's British and Irish Press Guide" for 1887, which contains not only the particulars of all newspapers and periodicals published in the United Kingdom arranged alphabetically and also under their counties, but it contains a great deal of statistical and other information concerning these, and the newspapers and periodicals of the Colonies, America, and the Continent, and the organs of various societies. Amongst the miscellaneous information is a list of about 190 publications which have ceased to exist or are suspended since last year. There are now it appears 2538 newspapers and class journals published in the United Kingdom. There are 83 daily newspapers 14 of which are published in London, 45 in England, 9 in Scotland, 4 in Wales, and 11 in Ireland.

CONNECTION between the Manchester Post-office, in Brown-street, and the offices of the *Sunday Chronicle* and the *Sporting Chronicle*, in Withy-grove, has been made by pneumatic tubes. The apparatus, which is now in full working order, has been constructed by Messrs. Francis B. Welch and Co., of Manchester. The connection is made by means of a 1½in. lead pipe, inclosed in an outer casing of iron, laid beneath the intervening roadways for a distance of 420 yards. The messages, when received and written out by the telegraph clerks, are placed in cylindrical "carriers" of felt, which fit the pipe easily and perfectly. These are fed into the Post-office end of the tube and drawn thence to the office of the paper by suction. A vacuum is produced in a steel chamber by means of a compact set of 8in. air pumps, with cylinder—12in. stroke—erected on a vertical engine bed with a 6in. cylinder and 12in. stroke, and running in direct line. A vacuum, varying from 15in. to 25in. is produced in the steel chamber referred to. The signal that a carrier is on its way is given from the Post-office by an electric bell to the attendant at the other end of the system. He turns on the suction, and in an average of ten seconds the message is on the office table.

AT the last meeting of the Liverpool Engineering Society a paper was read by Mr. J. J. Campbell, entitled, 'Compound Engines for Atlantic Navigation." The author, after alluding to the interest that attaches to the question of the best type of engines for Atlantic steamers, referred to the remark made by Mr. John, of Barrow, in his paper read at the Liverpool meeting of the Institution of Naval Architects last summer, that the large Atlantic lines had been rather behindhand in not having adopted the most recent types of machinery. Having described the principal types of engine hitherto employed in Atlantic steamers, he then spoke of the large consumption of coal in these vessels as compared with others, proceeded to express his opinions on the chief causes of it, especially insufficient expansion from the engines being too small for their power, and pointed out that the increase in pressure and piston speed adopted of late years had been utilised almost exclusively in obtaining more power in proportion to size, and not in producing economy of fuel. Having indicated some of the defects in existing types of engines, the author exhibited several combined diagrams from the engines of Atlantic and other steamers. He then described a type of six-cylinder three-crank quadruple expansion engine which he had spoken of at the summer meeting of the Institution of Naval Architects, as being in his opinion the best for large Atlantic steamers, and exhibited drawings showing their special features, indicating the various points in which he considered it to possess advantages over the types of engines now in use or proposed.

DRILLING MACHINE, B. B. AND C. I. RAILWAY.

MESSRS. G. BOOTH AND CO., HALIFAX, ENGINEERS.



BOOTH'S DRILLING MACHINE.

The annexed illustration shows a novel and compact drilling machine, which has been designed and constructed by Messrs. George Booth and Co., Halifax, for the Bombay, Baroda, and Central India Railway Company. The machine has a steel spindle 1½in. diameter, which is carried in a long cast iron socket with a conical neck running in gun-metal bearings, the adjustment being secured by lock nuts placed beneath the mitre wheels. The spindle is driven by mitre and double-purchase gearing, with a three-speed cone for power, and fly-wheel and handle for working by hand when required. The feed is of ordinary construction and made to give a traverse of one inch in ninety revolutions of spindle; the feed nut is of gun metal, with an adjustable gun-metal nut for taking up the wear of the feed nut and to prevent backlash. The machine is fitted with an arm which has a vertical adjustment by hand by rack and pinion, worm gearing, and handle. Upon one end of the arm is carried a circular table, with bolt holes for securing work, and on the other end is a vice with a swivelling jaw for receiving various shapes of work. The machine is capable of drilling holes from $\frac{1}{8}$in. to $1\frac{3}{16}$in. diameter, and is executed in the usual manner.

STABILITY OF WALLS AT OPENINGS.

The following article has been written by M. Emile Trélat, architect-in-chief for the Department of the Seine, director of the especial School of Architecture, and has appeared in *Le Genie Civil*. It contains matter of some interest, although some of the defects of which the writer complains do not

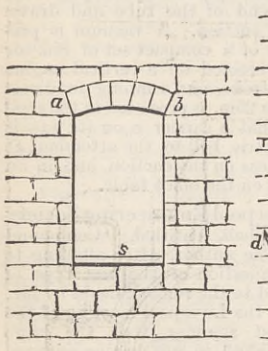


FIG. 1

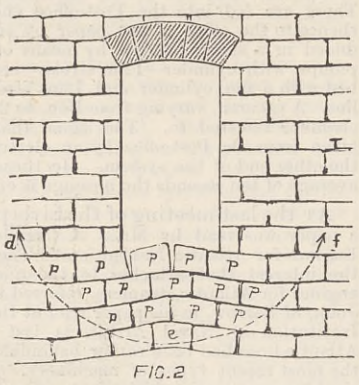


FIG. 2

obtain with English work, as English methods are not always those to which objection is taken.

Fig. 1 shows the manner in which openings in the walls are generally constructed. It will be seen that the courses are simply discontinued at the place where the opening is required, except at the top, where an especial support is added, capable of sustaining the weight which surmounts the bay. This has been the method always pursued, and it is singular that its imperfections have not been recognised. On looking at a nearly finished new building, it may be observed that the stones of the masonry below the bays are displaced and raised up. This deformation gradually developes as the work proceeds. When the edifice is built of hewn stone, the displacement is scarcely perceptible, especially if the blocks are large; but if smaller materials are used, it becomes very considerable. Beyond a certain point the disorder ceases to progress, because under the upheaved layers—Fig. 2—the stones press against each other in one direction, *d e f*, forming an inverted arch, and the foundations from whence at first arose the dislocation of the stones *p p p* bring a resisting force to bear upon the piers T T. It is on account of these disorders, limited though not avoided, that the following rule is to be found in all treatises:—"The supports and sills of the bays should never be fastened into the masonry of the jambs, and should not be placed until the sinkings have ceased." Economy requires that the sills, Fig. 1, should be reduced in thickness, which if they were fixed at their extremities would render them liable to break when what is shown at Fig. 2 occurs. Experience shows therefore that it is

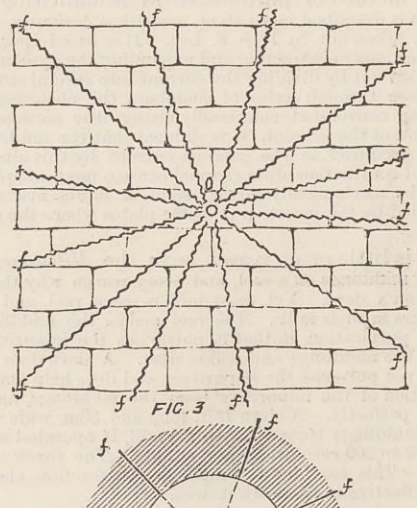


FIG. 3

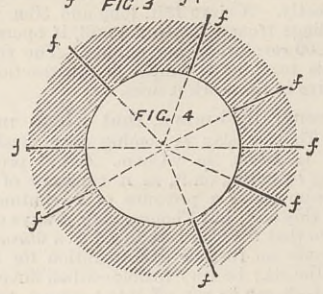


FIG. 4

best simply to place the supports and sills between the jambs. Why should not these displacements be avoided by some appliance fixed under the bays? The question is better understood when treated mechanically. Fig. 3 shows a well-made wall composed of resistant materials. It is stable and solid, because round any point *o* all the forces *fff* are equal and opposite, balanced in *o*. If the field of resistance immediately round were partially removed, the displacement of materials would follow until the forces were again balanced by new conditions set up under a new form. For instance, in Fig. 4, the forces *fff*, or those derived from them, would continue to act on the remaining part of the wall, but the material road by which they joined the meeting point being removed, their direct reactions would be interrupted. Two results may then follow—the materials which border the hole, not being fitted to maintain the place from which the forces *fff* tend to remove them are dislocated, compressed on one side, separated on the other side as in Fig. 5, so that the material path of the direct reaction of the forces becomes in a way reconstituted; but the work is then ruined, as seen by Fig. 5, by the sinking of the piers T T, which causes the lower stones to rise and the upper ones to sink towards the aperture. The arrows show the direction taken by the derivative forces to accommodate and balance themselves in the new arrangement of the materials unless the opening is bordered by a frame of a material sufficiently resistant to preserve its form and to set up an opposition to the course of the forces *fff*, &c., as in Fig. 6. If instead of a circular hole, the bay be rectangular, as is generally the case in edifices Fig. 7, it will be remarked that the forces *fff* are all vertical and horizontal, and that the actions and reactions of those that are horizontal are so slight

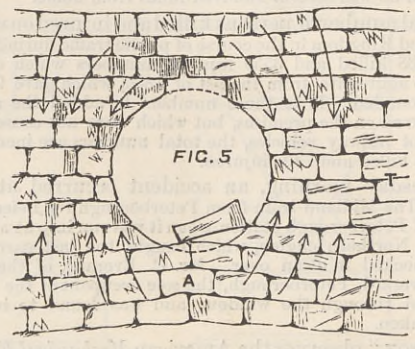


FIG. 5

and accidental that it is scarcely necessary to provide against them, while those which act vertically are considerable. Under such circumstances, strength should be exclusively given at the top and at the bottom of the bay, Figs. 8 and 9. In summing up these remarks the author insists that every bay should be well protected at the bottom as well as at the top, enabling the jambs to sustain and distribute the vertical changes in pressure and its line of action He concludes by pointing out the greater

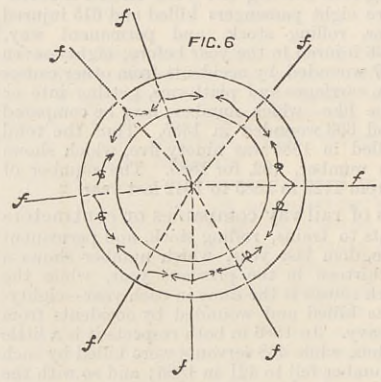


FIG. 6

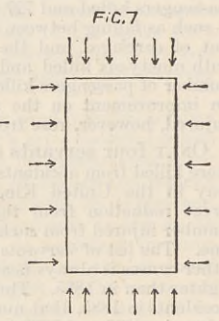


FIG. 7

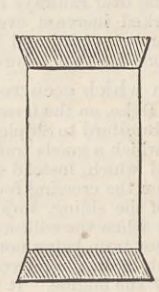


FIG. 8

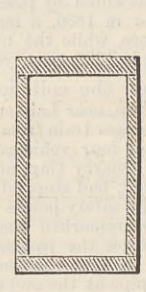


FIG. 9

FIG. 10

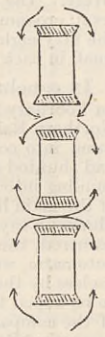


FIG. 11

advantages of iron frames for stability and capacity to maintaining the form of the bay. In many storied edifices where the bays are above one another, it may be thought sufficient to strongly cill the bottom of the lowest bay only, as in Fig. 10. But it is far better to do so to the upper and lower parts of every bay, as all materials can thus be better adjusted, and the regularity of the lines maintained.

A HIGH SPEED TORPEDO BOAT.

A torpedo boat for the Imperial Chinese Navy, by Messrs. Yarrow and Co., had her official trial on March 31st, and attained the remarkable speed of nearly 24 knots per hour, as a mean of six runs over the measured mile in the Lower Hope, three with and three against tide. To be exact, the speed was 23·882 knots; and a subsequent run of two hours' duration gave a mean speed of 22·94 knots, with the engines running easy. She had on board her torpedo armament complete and ballast to represent four torpedoes, also a fair quantity of coal and twenty-four persons. This boat is 128ft. long, and constructed on Messrs. Yarrow and Co.'s. rapid-steering principle, which enabled her afterwards to make circles to both sides, having diameters of about 230ft.

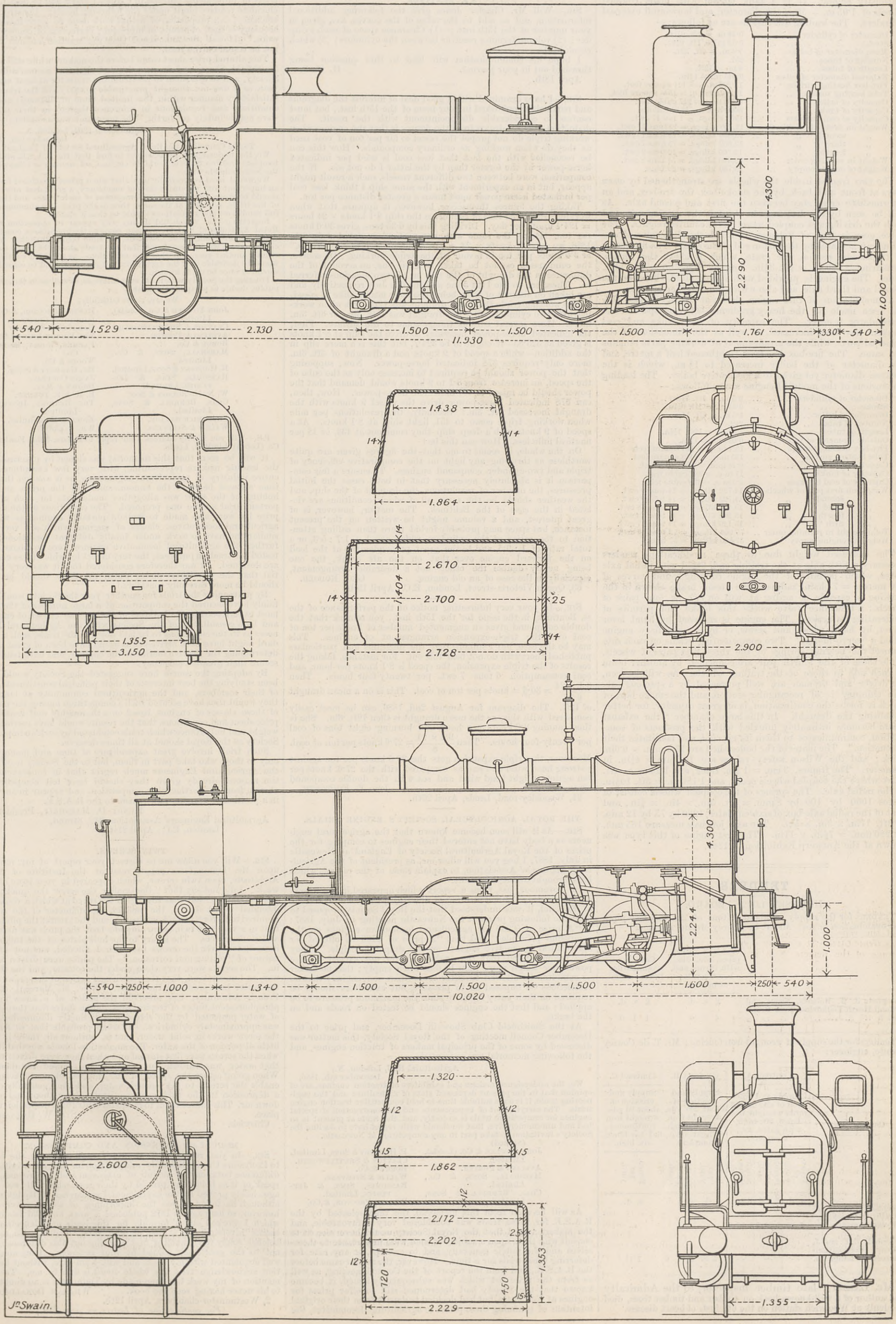
The Chinese Government possess in this vessel a torpedo boat which, for her size, is decidedly the fastest in the world at the present time, and, moreover, has manœuvring powers almost unique, probably only equalled by the celebrated No. 79, of the British Navy, constructed last year by the same firm.

The engines are on the triple expansion principle. The Chinese Government were represented on board by Admiral Lang, I.C.N., accompanied by Messrs. J. Birch and Co., of Liverpool, who were the direct contractors with the Chinese Government for this vessel; and the English Admiralty by Mr. Shapcott, all of whom were much pleased with the results obtained.

The Forth Bridge.—At a meeting of the Civil and Mechanica Engineers' Society on April 13th, a paper was read by Mr. R. E. Middleton, M.I.C.E., on the foundation of the Forth Bridge, in which the writer gave a description of the general site of the bridge, the nature of the foundation, the dimensions and form of construction of the piers, the arrangement of the wrought iron caissons 70ft. in diameter, and in the case of the largest, 74ft. high, which, when filled with concrete, support the main piers, and the means used for excavating the hard clay and rock which forms the foundation for the piers and caissons. In describing the caissons the writer explained their construction, both in the ways *in situ* and the arrangements of the air tubes and locks for the removal of the material excavated, and the ingress and egress of the workmen, and gave an account of the sinking of the North-West Queensferry caisson at its moorings, and the means employed successfully to raise it and replace it in its proper position. The paper was illustrated by a diagram showing the general arrangement of the bridge.

TYPES OF BELGIAN STATE RAILWAY LOCOMOTIVES.

(*For description see page* 314.)



BELGIAN STATE RAILWAY LOCOMOTIVES.

The engine shown at the bottom of page 313 was built for the 1 in 33 incline near Liége, which was originally worked by a stationary engine. It is a tank engine with eight coupled wheels of 1·05 m. = 3ft. 5⅜in. diameter, and horizontal external cylinders. The leading dimensions are as follows:—

Diameter of cylinder	0·48 m. = 1ft. 6⅞in.
Stroke	0·55 m. = 1ft. 9⅝in.
Mean diameter of boiler	1·4 m. = 4ft. 7in.
Number of tubes	251.
Length of tubes	4 m. = 13ft.
External diameter of tubes	0·045 m. = 1¾in.
Fire-box heating surface	11·293 m.q. = 121 square feet.
Tube heating surface	124·8103 m.q. = 1345 square feet.
Capacity of boiler	6·892 m.c. = 247 cubic feet.
Capacity of tanks	6600 litres = 1452 gallons.
Capacity of coal bunkers	1900 kilogs. = 1 ton 17 cwt.
Weight on first pair of wheels	13,100 kilogs. = 12 tons 17 cwt.
,, second ,,	13,000 kilogs. = 12 tons 1 cwt.
,, third ,,	13,600 kilogs. = 13 tons 7 cwt.
,, fourth ,,	12,700 kilogs. = 12 tons 9 cwt.
Weight in running order	52,400 kilogs. = 51 tons 8 cwt.
Weight of engine empty	39,700 kilogs. = 39 tons.

The two frames inside the wheels are strengthened by cross stays at front and back, by the smoke-box, the fire-box, and an intermediate cross stay between the first and second axle. As will be seen by the drawing, the third is the driving axle, and both the driving and coupled wheels have counterweights. The valve gear is that of Belpaire, in which the slide valve of one cylinder is actuated by the piston rod of the other. The fire-box is of trapezoidal section, the grate, which is above the wheels, measuring 2·229 m. = 7ft. 3⅜in. long by 1·862 m. = 6ft. 1½in. wide. The engine is provided with a sledge brake between the second and third axle, and also with a Lechatellier injector.

A modification of this engine, shown at the top of page 313, has been made for the heavy gradients between Spa and the Luxemburg frontier. The capacity of the tanks and coal bunkers has been increased, as well as the dimensions of the principal parts, while the arrangement of working parts remains the same. The fire-box has been lengthened half a metre, and the diameter of the boiler increased to 1½ m., which is the greatest diameter yet given to a locomotive boiler. The leading dimensions of the modified engine are as follows:—

Diameter of cylinders	0·5 m. = 1ft. 7⅝in.
Stroke	0·55 m. = 1ft. 9⅝in.
Diameter of boiler	1·5 m. = 4ft. 11in.
Number of tubes	242.
Length of tubes	4·01 m. = 13ft. 1⅜in.
Outside diameter of tubes	0·045 m. = 1¾in.
Fire-box heating surface	13·1 m.q. = 140 square feet.
Tube heating surface	135 m.q. = 1453 square feet.
Capacity of boiler	9·18 m.c. = 318 cubic feet.
Capacity of tanks	11 m c. = 388 cubic feet.
Capacity of coal bunkers	4·5 m c. = 159 cubic feet.
Weight on first pair of wheels	14,722 kilogs. = 14 tons 9 cwt.
,, second ,,	14,722 kilogs. = 14 tons 9 cwt.
,, third ,,	15,136 kilogs. = 14 tons 18 cwt.
,, fourth ,,	15,300 kilogs. = 15 tons 1 cwt.
,, fifth ,,	15,120 kilogs. = 14 tons 17 cwt.
Total weight in running order	75,000 kilogs. = 73 tons 16 cwt.
Weight of engine empty	57,800 kilogs. = 57 tons.

The increased weight due to these modifications renders necessary a fifth axle at the trailing end, fitted with radial axle boxes, which permits of the engine running round curves of 150 metres = 7 chains radius. The steam brake shown in the drawing is capable of acting at will on two or four pairs of wheels; a Dewrance valve works this brake and permits of moderating its action. The engine is reversed by hand lever direct, by hand wheel and screw, or by a subsidiary engine called a "servo-motor." Two compensating beams on each side connect the bearing springs of the three first pairs of wheels, while those of the fourth pair are connected by another beam on each side to those of the trailing wheels. As will be seen, the driver and fireman are well protected by a spacious cab. The chimney is of rectangular section, and the smoke-box, of which it forms the continuation, is of great capacity, for better equalising the draught. In this large chamber "the exhaust steam becomes intimately mingled with the products of combustion, communicates to them its *vis viva*, and facilitates their evacuation." The plates of the boiler shell are 15·5 mm. = 0·6in. thick; and the Wilson safety valves are 107 mm. = 4¼in. in diameter. The frames, 3 cm. = 1·1in. thick, are 1·23 m. = 4ft. apart where the coupled wheels occur, and 1·186 m. = 3ft. 10½in. at the radial axle. The springs of the coupled wheels consist of plates 1000 by 100 by 8 mm. = 3ft. 3in. × 4in. × ⅝in., and that of the radial axle-box of sixteen plates, 1200 by 75 by 12 mm. = 3ft. 11in. × 3in. × ½in. The axle journals measure 185 mm. by 280 mm. = 7¼in. × 11in. The first engine of this type was shown at the Antwerp Exhibition of 1885.

TENDERS.

HORNSEY LOCAL BOARD.

Tenders for the supply of about 76 tons of 2in. cast iron pipes and examination boxes; Mr. T. de Courcy Meade, engineer:—

	Cast iron socket pipes, 2in. dia., with turned and bored joints; at per ton.	Cast iron examination boxes—each.
Accepted: J. T. Roberts, Swan and Small Heath Foundries, West Bromwich	£ s. d. 4 8 9	£ s. d. 1 1 0

Tenders for the supply of wrought iron fencing; Mr. T. de Courcy Meade, engineer:—

Contractors.	Contract A. Supply and erection of about 1270 yards wrought iron fence, 5ft. high, with gates, &c., complete.			Contract B. Supply and erection of about 200 yds. wrought iron fence, 4ft. high, with gates, &c., complete.		Contract C. Supply and erection of about 90 yds. wrought iron continuous flat bar fence, 4ft. high.
	Fence, per yard.	Double gates, each.	Single gates, each.	Fence, per yard.	Double gates, each.	Fence, per yard.
	s. d.	£ s. d.	£ s. d.	s. d.	£ s. d.	s. d.
Accepted: Brookes and Co., "Priestfield," Wolverhampton	5 10	6 0 0	5 15 0	—	—	—
Accepted: E. C. and J. Keay, Corporation-street, Birmingham.	—	—	—	4 10	3 10 0	1 11

Mr. Laslett, late timber inspector, to the Admiralty and author of a well-known book on timber and timber trees, died suddenly at Woolwich station on the 6th inst. of heart disease.

LETTERS TO THE EDITOR.

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

S.S. BENTINCK.

Sir,—Will Mr. Charles Jones give the following additional information, and so add to the value of the curves, &c., given in your number of the 15th inst.:—(1) Clearance space of each cylinder; (2) volume forming receiver between the cylinders; (3) which crank leads.

I hope his communication will lead to this question being thrashed out in your journal. H. C. P.

April 18th.

Sir,—I have examined with a good deal of interest the diagrams and particulars published in your issue of the 15th inst., but must confess to considerable disappointment with the result. The deduction which is drawn from the figures is that the engines when working triple do not propel the vessel so far per ton of coal used as they do when working as ordinary compounds. How this can be reconciled with the fact that less coal is used per indicated horse-power by the former than by the latter I do not see. If the comparison were between two different vessels, such a result might appear, but in an experiment with the same ship I think less coal per indicated horse-power must mean a greater distance per ton.

Taking the figures themselves, however, it appears that when working triple 6·35 tons of coal drive the ship 8·1 knots × 24 hours = 194·4 knots per day. Dividing this by 6·35 tons, gives 30·6 knots per ton. Doing the same with the particulars dated July 6th, 1886, we have 9 knots × 24 = 216 ÷ 8 tons = 27·0 "ton-knots," or 3·6 knots per ton in favour of the triple working. Of course, the comparison cannot be taken as a fair one, on account of the difference in the draught of the ship on the two occasions referred to. These are on the 14th June and the 6th July respectively, and are taken on account of their being the most nearly alike in speed. While working triple the mean draught was 12ft., but when working with two cylinders only, the draught was 15ft. 3in., or 3ft. 3in. more. Here several curious things come to the surface. First, the indicated horse-power necessary to drive the ship at 8·1 knots is given at 325·85—it ought to be 324·7, but this is a mere slip in the addition—while a speed of 9 knots and a draught of 3ft. 3in. more only requires 378 indicated horse-power. Now, supposing that the power should be required to increase only as the cube of the speed, an increase from 8·1 to 9 knots would demand that the power should be raised to 400 indicated horse-power. How, then, can 378 indicated horse-power drive the vessel 9 knots with the draught increased 3ft. 3in.? Secondly, the revolutions per mile when working triple come to 451, light ship, at 8·1 knots. At a speed of 9 knots with a deep ship they come out at 433, or 18 per nautical mile less. How can this be?

On the whole, it seems to me that the figures given are quite worthless as throwing any light on the comparative efficiency of triple and two-cylinder compound engines. To ensure a fair comparison it is absolutely necessary that in both cases the initial pressures, the number of revolutions, the draught of the ship, and the weather should be the same, all of which conditions are violated in the case of the Bentinck. The matter, however, is of great interest, and a volume might be written on the present instance, but space may probably forbid more than calling attention to the ratios of the cylinders, which are 1 + 1·7 : 5·3, or a total ratio of 1 : 9·5, and to the great preponderance of the load on the forward engine over that on the aft crank, the one being nearly double the other—not a desirable arrangement, especially in the case of an old engine. Geo. Rodger.

63, Queen Victoria-street, London, E.C., April 19th.

Sir,—In your very interesting notice of the performance of the ss. Bentinck, in the issue for the 15th inst., you remark that the double compound gives an augmented number of knots per ton of coal over the triple-expansion arrangement of engines. This may be the case, but I submit that the diagrams and particulars published therewith do not bear this out. For instance, taking the results of the triple expansion, the speed is 8·1 knots per hour, and coal consumption 6 tons 7 cwt. per twenty-four hours. Then $\frac{8{\cdot}1 \times 24}{6{\cdot}35} = 30{\cdot}6$ = knots per ton of coal. This is on a mean draught of 12ft. The diagram for August 2nd, 1886, can be most easily compared with this, as the mean draught is then 12ft. 6in. She is then running 9·2 knots per hour, and burning eight tons of coal per twenty-four hours. Then $\frac{9{\cdot}2 \times 24}{8} = 27{\cdot}6$ knots per ton of coal. Moreover, the triple expansion gets the 30·6 knots per ton against a strong head wind and sea, as compared with the 27·6 knots per ton against a light head wind and sea with the double compound arrangement. Jno. F. Elsworth.

21, Woodsley-road, Leeds, April 20th.

THE ROYAL AGRICULTURAL SOCIETY'S ENGINE TRIALS.

Sir,—As it will soon become known that the agricultural engineers as a body have not entered their engines to compete for the prizes of the Royal Agricultural Society of England at Newcastle in July, 1887, I beg you will allow me, as president of the Agricultural Engineers' Association, to explain some of the reasons which have brought about this result.

In November last, from a report which appeared in the papers of the monthly Council meeting of the Royal Agricultural Society of England, it was understood that the Royal Society proposed to offer the following prizes at the Newcastle meeting in July, 1887:—"A prize of £200 for agricultural locomotive engines on the compound principle;" and that "A prize of £100 be offered for agricultural locomotive engines on the simple principle." They also recommended that the engines should not exceed 8-horse power, nor weigh more than 10 tons when empty; that no maker or exhibitor be allowed to enter more than one engine; that no restrictions be imposed as to pressure, but exhibitors should be required on their entry forms to state the maximum pressure to be applied; and that the engines should be tested on roads and on the brake.

At the Smithfield Club Show in December, and prior to the December Council meeting of the Royal Society, this matter was discussed by some of the principal makers of traction engines, and the following memorial was presented:—

Agricultural Hall, London, N.,
December 6th, 1886.

We, the undersigned makers and exhibitors of traction engines, are of opinion that in the present depressed state of agriculture and the engineering trade, it is not a suitable time to hold competitive traction engine trials. The carrying out of experiments and the construction of special engines for competitive trials is so costly, and the trade at present is so bad and unremunerative, that we should with regret have to decline the Society's invitation to take part in any competition at Newcastle.

(Signed)

John Fowler & Co. (Leeds), Limited.	P. Hornsby & Sons, Limited.
Aveling & Porter.	Clayton & Shuttleworth.
Marshall, Sons, & Co., Limited.	Robey & Co.
Chas. Burrell & Sons, Limited.	Wallis & Steevens.
	Ransomes, Sims, & Jefferies, Limited.
	Ruston, Proctor, & Co.

As will be seen from this memorial, the time selected by the R.A.S.E. for these trials was considered very unfavourable, and the makers hoped that the Royal Society would have seen fit to consult with them upon a subject of such wide importance to themselves and the public generally, and to arrange, at any rate, for deferring these trials for a time. However, the matter came before the R.A.S.E., and from the report of the Council meeting, as well as from the prize list which was subsequently issued, it became known that the Society had determined still to offer prizes for engines at Newcastle, but had decided to depart from their original intention of confining these prizes to agricultural locomotives, the revised prize sheet issued in December being as follows:—"Class 1: Portable agricultural engines, self-moving or otherwise, on the compound principle, not exceeding 8-horse power, £200. Class 2: Portable agricultural engines, self-moving or otherwise, on the simple principle, not exceeding 8-horse power, £100. The brake trials of implements entered in Classes 1 and 2 will be designed to elucidate relative merit under the following heads:—Construction; efficiency, *i.e.*, proportion of actual work done to work indicated; economy of fuel, of steam, of lubricant; perfection of combustion; price." It was also announced that the traction engines would not be tested on the road.

This altered prize sheet came before the makers while still at the Smithfield Show, and it was decided again to memorialise the Society, and to ask them to postpone the trials for at least another year, as it was not thought practicable to carry out the trials in a satisfactory manner within the limited time at dispesal; and the conditions and regulations in reference thereto in their opinion were not definitely set forth. The memorial was as under:—

Agricultural Hall, London, N.,
December 9th, 1886.

To the Council of the Royal Agricultural Society of England.

We, the undersigned firms, regret to find that the R.A.S.E. still contemplate holding trials of portable engines, self-moving or otherwise, at the Newcastle Show.

We would most respectfully urge that when prizes are offered for such an important and extensive class of machinery, a great deal more time should be given between the announcement of such prizes and the date of the trials, and that at the same time as the prizes are announced the full conditions and regulations should be clearly stated.

Regretting that we should in any way appear in opposition to the Royal Agricultural Society, we have come to the unanimous conclusion that we cannot compete at Newcastle, the time being altogether insufficient, and we would recommend that the trials should be postponed for at least another year, and that the conditions—as to which we think it would be desirable that the agricultural engineers should be consulted—should at once be made known.

Trusting the Society will, in its own interests, as well as in those of the public, decide to postpone the trials,

We are, yours faithfully,

John Fowler & Co. (Leeds), Limited.	Ruston, Proctor, & Co.
Clayton & Shuttleworth.	Gibbons & Robinson.
Aveling & Porter.	Barrows & Stewart.
Robey & Co.	Wm. Foster & Co., Limited.
Marshall, Sons, & Co., Limited.	Farmer, Robey, Brown, & Co.
R. Hornsby & Sons, Limited.	Woods & Co.
Ransomes, Sims, & Jefferies, Limited.	Rd. Garrett & Sons.
W. N. Nicholson & Son.	James Coultas.
Chas. Burrell & Sons, Limited.	Brown & May.
Frederick Savage.	E. R. & F. Turner.
Wallis & Steevens.	The Reading Ironworks, Limited.
	Edward Humphries.
	Wm. Allchin.

P.S.—Will you kindly address your reply to Messrs. John Fowler and Co. (Leeds), Limited, Leeds.

It will be seen that this memorial was signed by practically all the leading makers representing, with very few exceptions, the entire industry of agricultural engineering, as it was felt that the time allowed between the announcement of the prizes and the holding of the show was altogether inadequate for such an important trial as the one proposed. The conditions of the second prize list were also made to include portable engines as well as agricultural locomotives, classes of engines which are very dissimilar and have to work under totally different conditions; and further, the agricultural locomotive engines were no longer to be tested for traction purposes, the very object for which these engines are designed. It was therefore considered that it was very essential that the conditions under which the trials should be held should be more carefully considered.

By postponing the trials for another year the Society would certainly have secured the competition of a large number of the firms most experienced in the building of both these classes of engines, and by a consultation of the Society with the Agricultural Engineers as to the conditions to be laid down at the trials, such a standard might have been arrived at as would have been of great use in determining the relative merits of the engines, and have tended to secure their greatest efficiency.

By adopting the course here suggested the Society would have been studying the best interests of their principal constituents, viz., of their members, and the agricultural community at large, as they would thus have secured such a competition among the makers of these classes of engines, based on a thoroughly well considered prize-sheet and conditions, that the results would have carried that weight and importance which trials conducted by such an important Society as the Royal should at all times deserve.

Such trials involve great expenditure of time and money, not only to those who take part in them, but to the Society itself, and the Agricultural Engineers much regret that in consequence of the reasons already given they should have felt compelled to abstain from the forthcoming competition, and appear in any way in a position of seeming antagonism to the R.A.S.E.

Henry D. Marshall, President.

Agricultural Engineers' Association, 342, Strand,
London, E.C., April 21st.

TWIN SCREWS.

Sir,—Will you allow me to correct your report of my remarks upon Mr. Linnington's paper, read at the Institute of Naval Architects, upon twin screws, which appeared in your issue of last week. I did not say that "the smaller the screw the quicker the pitch might be," but that the higher the speed at which a vessel was intended to be driven, the smaller the diameter of the screws required to be for a given horse-power, and the greater the pitch, and that in a very fast twin-screw torpedo boat the pitch was as much as 1·82 diameters. The injury to the hull plates of the Inflexible, immediately over the screws to which I alluded, was not of the nature of "pitting and corrosion." The plates were driven bodily in. The screws were very close under the counter, and the theory was, as I understood, that the centrifugal action of the screws upon the water had produced the effect. Now, M. Marchal, of the French Admiralty, has observed the action of a screw in the phosphorescent water of tropical seas, and he states that the column of water projected by the screw was distinctly illuminated, and was approximately cylindrical. It seems probable that so long as the screw works in solid water, that is, without air, there is very little dispersion of the water. The suggestion I made was that it was when the screws were first started and when they were driven astern that water was thrown out radially and caused the damage. When going astern the speed of the ship is seldom sufficient to enable the screws to get enough water, and they generally cause a depression in the surface immediately above them and draw down air. This causes them to race, and centrifugal dispersion takes place. Syd. W. Barnaby.

Chiswick.

MODULI OF EXTENSION AND COMPRESSION.

Sir,—In your review of Todhunter's work you give the credit to Professors Unwin, Kennedy, and Pearson for first discovering the difference between the moduli of extension and compression, and speak of it as being now proved by their researches. It was long ago clearly proved by the experimental researches of Hodgkinson, although he failed to see the importance of the discovery. I, however, so long ago as 1872 published a work on solid beams, in which I worked out a formula for the loads and deflections of beams involving the values of both these moduli. To myself belongs solely the honour of first pointing out this difference, and not to the gentlemen named by your reviewer. They must be well acquainted with my book, and will, I am sure, without hesitation acknowledge that the whole credit is due to me. That no mention of my work has been made by Todhunter is no doubt due to his never having seen the book. William Donaldson.

2, Westminster-chambers, April 12th.

(*For continuation of Letters see page* 319.)

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame Boyveau, *Rue de la Banque.*
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*** *With this week's number is issued as a Supplement a Two-page Engraving of the New Hammersmith Bridge. Every copy as issued by the Publisher contains this Supplement, and subscribers are requested to notify the fact should they not receive it.*

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TO CORRESPONDENTS.

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G. S.—*The book you want is "Fuel and Water," published by Charles Griffin and Sons, Exeter-street, Strand.*

Manganese.—*We must refer you to Dr. Percy's "Metallurgy." We can publish your question, if you wish.*

Valley.—*Divide the total coal burned per hour by the indicated horse-power. The quotient is the coal per horse per hour.*

Refrigerator.—*There are numerous freezing powders, which can be obtained of any chemist. If these are not what you require, send more particulars.*

Sailor.—*You must serve an apprenticeship for three years in some works before you would be eligible. You are too old to enter the Navy as a pupil.*

T. W. H.—*There is no general rule for the length of connecting-rods, except that the longer they are the better. See any of our sectional engravings of locomotives.*

E. W. H.—*No special article on gas-fired steam boilers has appeared in* The Engineer. *If you will say what information you require we will endeavour to supply it.*

RAIL TOPS OR SPEAR HEADS.

(To the Editor of The Engineer.)

Sir,—Would any of your readers kindly give us the address of a foreign maker of rail tops or spear heads? M. I. S. C.
Manchester, March 31st.

MACHINES FOR DRILLING BICYCLE HUBS AND TRUEING WHEELS.

(To the Editor of The Engineer.)

Sir,—Kindly allow me to inquire through the medium of your columns the name of the makers of machines for trueing wheels and drilling hubs of bicycles. A. S.
Italy, April 17th.

STEEL RUST.

(To the Editor of The Engineer.)

Sir,—In reply to "Anti-Corrosion," let him get the rust scraped and well rubbed off; give a coat of "turps;" before coat is dry give a coat of best sand and finest Portland cement, mixed with lime water—not whitewash, but lime in solution, in which is mixed a teaspoonful of chloride of lime to a bucket of the wash. When set, water may be boiled in vessel. Of course, the first quantity may have the effects of the "turps," &c. The portion of the vessel not exposed to the fire may get other coats of the wash without the use of the "turps." The wash must be applied as quickly as possible, so as not to be setting before completion.
Cork, April 20th. R. Hartland.

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

MEETINGS NEXT WEEK.

The Institution of Civil Engineers, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, April 26th, at 8 p.m.: Ordinary meeting. Paper to be further discussed:—"Water Supply from Wells," in the London Basin, at Bushey (Herts), in Leicestershire, and at Southampton, by Messrs. Grover, Fox, Stooke, and Matthews respectively. Friday, April 29th, at 7.30 p.m.: Students' meeting. Paper to be read:—"Flour Mills and their Machinery," by Alfred Chatterton, B.Sc., Stud. Inst. C.E.

Society of Arts, John-street, Adelphi, London, W.C. — Tuesday, April 26th, at 8 p.m. Applied Art Section: "Ornamental Glass," by J. Hungerford Pollen; Colonel Donnelly, R.E., C.B., vice-president of the Society, will preside. Wednesday, April 27th, at 8 p.m.: Ordinary meeting. "Appliances for Saving Life from Fire," by Arthur W. C. Shean. Friday, April 29th, at 8 p.m. Indian Section: "Village Communities in India," by J. F. Hewitt.

Civil and Mechanical Engineers' Society.—Wednesday, 27th inst., at 7 p.m.: Ordinary meeting. Paper to be read:—"The Use and Care of Chains for Lifting and Hauling," by Henry Adams, M.I.C.E., F.S.I.

The Society of Telegraph Engineers and Electricians.—Thursday, April 28th, at 25, Great George-street, S.W., at 8 p.m.: I. "Measuring the Coefficients of Self and of Mutual Induction;" II. "Driving a Dynamo with a very Short Belt," by Professors W. E. Ayrton, F.R.S., and John Perry, F.R.S., Members.

THE ENGINEER.

APRIL 22, 1887.

HARBOURS OF REFUGE.

It is a favourite doctrine with many persons that there is no evil in existence for which there is not a remedy, and that the remedy is not applied simply because some individual, or party, or government, will not, out of sheer perversity, or stupidity, or ignorance, apply it. The holders of these tenets have no broad or comprehensive grasp of matters. They never realise the truth that, to use an old adage, the remedy may be worse than the disease, or that its application may bring about other evils of still greater importance and moment. We recollect being told at the time of the Plimsoll agitation that it was better that the whole carrying trade of Great Britain should be transferred to France, Germany, and America, than that the life of one British sailor should be lost; and we have no doubt that the proposition was put forward with perfect sincerity and conviction of heart. This may be regarded as an extreme case, but it is only so because the absurdity of it is so glaring. Things quite as absurd occur daily, but they do not attract attention because the absurdity is, to a certain extent, veiled. One of the most recent examples is supplied by the demand made in certain quarters for the construction of harbours of refuge round our coasts. We are told that for lack of such harbours "thousands" of lives are lost, and that the nation in general and the English Government in particular are guilty of something little short of murder because they will not spend some five or six millions of pounds sterling on the construction of such harbours. The demand has at last been heard in Parliament, and the answer to the demand is complete.

On Tuesday evening Mr. Yeo moved:—"That having regard to the recent fearful sacrifice of life in the Bristol Channel, and to the constantly recurring losses of life and property around the coasts of the United Kingdom, it is, in the opinion of this House, urgent that her Majesty's Government should immediately take action to diminish these losses by the construction of suitable harbours of refuge." The debate, or rather the discussion, which followed, served to make certain points clear which have long been obscured. Indeed, it was only necessary to state the case clearly, as it was stated by Mr. Yeo, to render its weakness apparent. The broad contention is very simple. If a ship is caught in a gale of wind, she wants a harbour in which to seek for shelter at once. Failing such a harbour, she will be cast on a lee shore and wrecked. Mr. Yeo said that proposals had been made for the construction of harbours of refuge in all sorts of places, but "it was to the Bristol Channel that he wished to call the attention of the House. The trade of the Bristol Channel had increased enormously in recent years, and this was, no doubt, largely due to the great development of the coal trade of Cardiff and Newport. The Bristol Channel was, no doubt, very dangerous. The coasts were iron bound, and vessels caught in a storm had no harbour to run for. He wished briefly to call attention to recent disasters in this channel. The loss of life was above the average. There had been more than fifty vessels lost in three months, the loss of life being from 350 to 400. It must not be supposed that the vessels lost were old or badly found ships. They were of the highest class, and were well equipped. They were caught in a storm, were unable to weather it, and foundered for want of a harbour of refuge. He did not think they had a right to fold their arms when they knew that this loss of life might be prevented." He then proceeded to state the cost, which he took at £6,000,000, the repayment of which, if spread over ninety-nine years, would be met by a yearly sum of a quarter of a million, which would be sufficient to provide for interest, the repayment of capital, and for maintenance. On the other hand, the sum expected to be received in the way of tolls each year would amount to something like £300,000, leaving an annual balance in favour of the undertaking of £50,000. This reads almost like the prospectus of a new limited company. Mr. Yeo did not say where the harbours in question were to be placed, but we gather that he intended they should be constructed in the Bristol Channel. There is, however, no reason why the Bristol Channel should be exceptionally favoured, and it is easy to see that if other places round our coast were to be provided with harbours of refuge on the same munificent scale, not six millions, but over one hundred millions of pounds sterling would be needed.

There are two principal answers to Mr. Yeo's proposal; the first is that harbours of refuge would not secure total immunity from shipwrecks; the second is, that the amount of additional security which they could provide would not be worth the expenditure demanded. As regards the first point, some interesting particulars were produced by Baron de Worms. He showed that in one sense harbours were more likely to bring about shipwrecks than to prevent them; and it is not difficult to understand the reason. If a captain knows that a storm is brewing, and that if he is caught on a lee shore there is no harbour to run for, then he will take good care to keep away from land as far as he can. If, on the contrary, he knows there is a harbour to which he may run, he will not take proper precautions, and will chance being able to make the harbour. We have only to look at the reports which appear in the daily press after any heavy gale to learn that by far the greater proportion of ships come ashore at or near some harbour or port, to the shelter of which they were running. Furthermore, the number of lives lost altogether by ships being wrecked on the coast of England is very small. Baron de Worms brought forward very interesting statistics on this subject. He had a return prepared which threw a great deal of light on the question as to how far harbours affected the amount of loss of life at sea. This return was a statement showing the number of sea casualties attending with loss of life during the five years ending June 30th, 1885. It showed the whole of the life lost from British ships in that period, both exclusive and inclusive of collisions. Exclusive of collisions, 14,188 lives were lost, of which only 3751 were lost on or near the coast of the United Kingdom; and deducting from this 1158 lives lost in 210 vessels missing near the coast of the United Kingdom, there were 1993 lives lost on or near the coast from stranding, foundering, and all other causes, except collisions, during five years. Examining the facts as they bore on that portion of the coast referred to by Mr. Yeo, it appears that, taking a wide margin—namely, a line from St. David's Head to the Land's End and half way across St. George's Channel, including, as it does, part of the highway to Liverpool, without including collisions or missing vessels, 289 lives were known to have been lost in that district in five years, or about fifty-eight yearly. For the purposes of comparison he then cited a contiguous district, namely, the quadrilateral bounded on the south by a line from St. David's Head to Carnsore Point, county Wexford, and on the north by a line from Fair Head, county Antrim, to the Mull of Cantire. This would include all the traffic from Holyhead to Dublin, all the traffic in and out of Liverpool, Fleetwood, Barrow, &c., and all the traffic in and out of Belfast, Stranraer, and the ports along the west coast of Scotland, including the Clyde. Excluding lives lost by collisions and missing vessels in this vast area, with its capacious ports on both sides of the Channel, with their great facilities for refuge, 390 lives were lost in five years. From this it appears to be tolerably plain that an abundance of harbours of refuge would really do very little for the reasons we have stated, to prevent wrecks. Indeed, it is well known that some of the most disastrous wrecks which have taken place on the coast of Great Britain could not have been prevented by harbours. Take, for example, the loss of the Royal Charter, on the north coast of Anglesea. It certainly was not the want of a harbour which wrought her destruction. She had just passed one—Holyhead—and was making for another—Liverpool. That there are instances in which the presence of a harbour might have saved life we do not for a moment dispute, but the proportion which such cases bear to those in which safety could be equally secured by keeping away from a lee shore are very small. That the full value of a harbour of refuge may be realised, it will be necessary for each ship to carry one with her, say, as part of her cargo.

The second objection to the construction of harbours of refuge is their cost. It was pointed out by Baron de Worms that as seventeen British harbours had cost £23,000,000, it was not improbable that £6,000,000 was far too low an estimate. It was, however, pointed out that this outlay included the sum spent on the construction of docks, &c. That, in short, the seventeen harbours were commercial harbours, not harbours of refuge pure and simple. But there is no difficulty in seeing that a harbour without docks, &c., would be very little used. It is just as likely that a pecuniary profit could be made out of a lifeboat station as out of a harbour of refuge. Consequently, Mr. Yeo is in this dilemma, that if his harbours are to cost but £6,000,000, they cannot have docks and warehouses, and therefore will earn no money; while if they have these things they will no longer be harbours of refuge pure and simple, but commercial harbours, which must cost a great deal more than £6,000,000, and which would without doubt prove very bad investments.

There is something very taking and benevolent in the idea of constructing refuge harbours round our coasts, but hard facts tell heavily against the scheme, which was further weighted by the circumstance that Mr. Yeo had no definite scheme to suggest. After all his was little more than an abstract resolution. It is very easy to think and to say that it would be a good thing to have plenty of harbours all round our coasts. It does not compromise anyone to utter this benevolent wish, and we are not surprised to find that about eighty members of Parliament voted with Mr. Yeo, while eighty-six voted against him. If he wishes to have the subject fully handled, his proper course is to prepare a definite detailed scheme for the construction of a harbour of refuge in some special place, and then ask the House to grant money for its construction. The scheme can then be discussed on its merits, and we venture to think that the majority against such a proposal will be very large. We need scarcely say

that the whole question has been discussed over and over again, with results unfavourable to the construction of such harbours. Thus, for example, it has been shown that an expenditure of a million sterling on Filey would perhaps have saved fifteen lives in a considerable period. The facts always come out the same way. The value of harbours of refuge as a means of saving life is very much exaggerated. Their powers of earning money would be of the very smallest, and if it could be shown that they would earn money, private enterprise and capital would at once provide them. The benefits they would confer on the nation would not be nearly worth the sum which they would cost, and which, if available at all, might be spent to far greater advantage on other national objects.

THE SANITARY REGISTRATION OF BUILDINGS.

The extent to which Government ought to interfere with private action, where such action affects the well-being of any section of the public, partly or wholly unable to protect itself is and probably must remain, a debateable question. Control by the State in supercession of individual management under such conditions, has both its advocates and its opponents, and weighty arguments can be and often are adduced on both sides. In a free country what is commonly designated as paternal government is usually deprecated; but instances have arisen in the past history of this country wherein compulsion by law has had to be applied to remove domestic evils and check abuses. What may be called sanitary legislation is of necessity to some extent an assumption by the State of duties that properly belong to individuals. The house-owner who lets out a house, or a block of houses as tenements, ought presumably in one sense to be the best judge of how to manage his property. The law, however, calls on him to comply with certain sanitary rules, not only for the sake of his tenants' health, but also, inferentially, for the protection of the health of the community at large; and that this legislation has done good is shown by the Registrar-General's statistics of death rates. State intervention in matters of this sort has two grounds of justification ; one of these is that a proper knowledge of sanitary work can only be acquired by a special study of the subject, involving time and labour, such as the general body of householders cannot be expected to devote to it; and secondly, that sanitation to be of use must be systematically carried out, and therefore cannot be entrusted to mere individual action.

A Bill was introduced into the House of Commons during its last session, and was read a first time, which marks an advance on all existing sanitary legislation. Its title is, the Sanitary Registration of Buildings Bill. It was introduced by Mr. Lacaita, the member for Dundee, and supported by Sir Henry Roscoe, Sir Guyer Hunter, and Dr. Farquharson. It provides for the compulsory sanitary registration and inspection of every building intended to be used as an asylum, college, hospital, hotel, or lodging-house, and also to give opportunities for voluntary registration and inspection in the case of all other buildings whatever. At its first reading the Bill provided that the administrative staff should include sanitary registration authorities generally, identical with existing local sanitary authorities, and also of a new body of "licentiates in sanitary practice." The first were to receive and register the reports of the second, who were to perform the duties of inspection and to issue the certificates which in the case of the specified buildings are, after the passing of the Act, to be compulsory. As at first drawn the Bill excluded Members of the Institution of Civil Engineers, of the Institute of British Architects, and of the Royal Institute of Architects in Ireland. So obvious a defect had of course to be amended; and all members of these bodies who shall have passed an examination conducted by their own governing bodies; civil engineers and architects of three years' standing, who shall prove to the satisfaction of the Local Government Board that their work has been *bonâ fide*, and has included sanitary construction; medical practitioners, registered as qualified in sanitary science, medical officers of health, and persons otherwise qualified, as the Local Government Board shall direct are now included. From one or another of the foregoing classes the owners of the buildings in question must get their sanitary certificates, and these cannot be given till the buildings satisfy the tests laid down and stipulated for in the Bill, and recognised as elementary by every sanitary authority. Penalties can be inflicted for the occupation of uncertified buildings, and for the issue of false certificates. The 1st of January, 1888, is proposed as the date after which it shall be unlawful to occupy an uncertified hotel, school, &c., and after every five years the building must be re-examined and a fresh certificate issued. Such is the essence of Mr. Lacaita's Bill.

It was fortunate for the promoters of this Bill that it never reached the second reading last session. Its introduction seemed to have been characterised by undue haste; its provisions had not apparently been laid before the great legalised urban or other duly authorised sanitary authorities, as, for example, the Association of Municipal and Sanitary Engineers and Surveyors, which issued a circular calling attention to the prominent defect referred to above, and directing attention to the evils attending on spasmodic attempts on the part of private societies and individuals to vary the Public Health Act without consulting the legally constituted authorities. We have received a copy of the Bill as now being promoted, and also a report of a meeting of a Sanitary Registration Conference held recently at Argyll-place, Regent-street. The principle of the proposed Bill was approved by the conference, which then adjourned, on the understanding that at a subsequent meeting the details of the Bill will be discussed. We are glad that before again introducing a Bill of so advanced a legislative nature, opportunity is being afforded to those best fitted and most competent to aid in its formation to discuss its provisions. The Bill as at present draughted seems moderate, and not likely to prove vexatious in its administration; and if it appears to interfere too much with freedom of private action, such interference is more apparent than real, and is not inconsistent with powers already vested in governing bodies for the protection of public health and safety of public life and limb. As we have only the Bill before us as a first draught, it is perhaps premature to criticise it closely. We may, however, suggest that a clause might be introduced bringing buildings about to be erected within its operation, somewhat on the basis of Lloyd's registration of ships built under their supervision, with the difference, of course, that sanitary provisions alone would come under its operation. We would also suggest the omission of Clause 10, which is, in fact, a specification, and therefore too inelastic to constitute practical legislation. Circumstances alter cases in architecture as well as in other matters. It is also a discourteous reflection upon the competence of the professional experts who will have to administer the Bill should it become law. The principle of the Bill has our approval, but as a matter of course, before its principle can be made law the Bill itself must be thoroughly discussed and its provisions scrutinised. It is a very paternal legislative proposal indeed, and is open to the same objections that are common to all laws empowering the State to interfere with private action; and we question whether sanitary engineers will be especially eager to support it. The primary objection is the removal, to a considerable extent, of that responsibility which of right should be borne by the individual, and undertaken by the State. The granting of certificates for a term of five years is too long a period. To be at all effective the certificate should rather take the form of a license, or else be put on the basis of, say, a pilot's or ship captain's certificate, and the building in question ought to be inspected at least once a year; and where such inspection detected defects, the owner should be notified thereof, and if they were not made good, then the certificate ought to be suspended until they were. It by no means follows that because a building is in a sanitary state to-day that it will continue so for any specific time. Frost often bursts water-pipes; floods burst sewers; careless servants choke drains and sink pipes; foreign matter finds entrance into water-tanks, decays there, and poisons water supply. Of course, it is impossible effectually to guard against these things, but yearly or half-yearly inspection will do much more service than that at quinquennial periods.

Another defect in the Bill as now draughted is that it does not fix responsibility with sufficient accuracy. It says,—"Any owner, lessee, sub-lessee, or occupier" shall be liable if the building is not certified. It does not, however, state which of these four partics is to be prosecuted in the first instance. This will have to be amended. It almost seems a piece of irony to include hospitals in an Act of this kind ; but the law has not, or ought not to have, any terrors for the innocent, and the hospital authorities therefore need not fear, though at the same time the discoveries made concerning the foundations of a certain hospital at a not very remote date point to the possibility that even temples of healing are not necessarily or invariably what they might be well presumed to be. There does not seem any very apparent reason either why the actual operation of the Act should, if it become law, be postponed for three years as in Clause 11. Does it imply that all the buildings now existent which it will affect are so bad that not less than three years' notice is required to set them in order? A power of appeal is included in the Bill. We foresee one good likely to accrue from the Act if it become law, and that is that probably it will have the effect of strengthening the hands of sanitary engineers in their dealings with jerry builders, and among other powers compel them to so arrange their pipes and drains as to facilitate inspection. Builders sadly need a little of the training that mechanical engineers have to get before they are fit to design machines—namely, to make the various parts as accessible as possible. Engineers are more humble-minded than builders; they recognise that the best laid of their plans "gang agee" at times, and must be put right, and the means of doing so are provided for as much as circumstances will admit. The builder appears to think that his work will outlive the Pyramids, and pays no thought to possible repairs. Hence, in most cases the fracture of a pipe, the repair, however trivial, of a drain, almost always involves an amount of incidental work in searching out, first, the pipe or drain, then the place where it is damaged; and a subsequent replacement of bricks, plaster, earth, wood, paper, and paint wholly out of proportion to the actual damage needing repair. It is one thing to find the basement of a house flooded with sewage or other water; how to find the source of damage is in most cases quite another, and as difficult as the discovery of the North-West passage. There is no reason why this should be so, and if sanitary engineers had adequate powers matters would not remain in so objectionable a condition. If Mr. Laicata can contrive to introduce a clause into his Bill to provide means to compel an accessible method of fitting pipes and tanks within houses generally, and also to compel builders to supply the owners of every house built by them with a proper drawing, showing clearly the exact position of every drain and pipe pertaining to, but outside it, such clause will, we venture to believe, receive the hearty support of every engineer and householder.

SIR J. BAZALGETTE AND MR. BAILEY-DENTON.

In another column we publish a letter from Lieutenant-Colonel Jones referring to a passage in our article of last week on "Metropolitan Sewage Disposal." The question at issue has reference to the opinion expressed by Sir Joseph Bazalgette concerning the chemical treatment of sewage, when giving evidence last year before the Select Committee of the House of Commons on the pollution of the river Lea. In his recent lecture at the Parkes Museum of Hygiene, Mr. Bailey-Denton described Sir J. Bazalgette as making certain statements to the Committee indicating a want of faith in the chemical treatment which the Metropolitan Board proposed to adopt at the main drainage outfalls. On the contrary, we made quotations from the evidence showing that Sir Joseph declared himself perfectly satisfied with that mode of treatment, so far as concerned the London sewage, in relation to the Thames. But it was another matter when Sir Joseph was questioned as to the discharge of a sewage effluent into the scant and sluggish stream of the river Lea. We pointed out that Mr. Bailey-Denton had failed to distinguish between that part of Sir Joseph's evidence which had reference to the Lea and that which dealt with the Thames. Lieutenant-Colonel Jones now says that we have ourselves misunderstood the evidence given by Sir J. Bazalgette, and have overlooked the fact that Sir Joseph proposed an enlarged dose of chemicals for the treatment of the Lea Valley sewage, even though he designed to discharge it into the Thames about one mile from the Metropolitan outfall at Barking. But the explanation of this is given by Lieutenant-Colonel Jones himself in his quotation from Question 1446, where Sir Joseph is asked, concerning the sewage of the Lea Valley: —"Will it be sufficient to deal with it chemically, in the same way as the sub-committee recommended as to the sewage of London?" Sir Joseph is quoted as saying:—"My opinion is that it will." This alone sufficientiy proves our point—namely, that it was wrong to cite Sir Joseph as condemning the precipitation plan of the Metropolitan Board. But why did Sir Joseph propose to apply more chemicals to the Lea Valley sewage, even though it went into the Thames, than he considered necessary for the London sewage? He went on to explain that the chemical treatment he had proposed in the case of the Lea Valley sewage was in deference to the views of other people who might differ from him. He therefore adopted the higher estimate, in view of the possibility that a smaller expenditure would afterwards be found sufficient. What Sir Joseph proposed to do with the Lea Valley sewage is one thing, and what he approved in the case of the London sewage is another thing, for the simple reason that different considerations governed the two questions. In the former instance he was conciliating opposition. In the latter he was forming his own conclusion, which we still contend was favourable to the plan which is being adopted, whereas Mr. Bailey-Denton inadvertently made it appear otherwise. Sir J. Bazalgette objected to any chemically prepared effluent going into the Lea; but with regard to the Thames he declared the results arising out of the treatment of 9,000,000 gallons of London sewage daily by Mr. Dibdin's plan to be "very satisfactory;" and his reply to Question 1446 shows that if left to himself he would be prepared to adopt the same plan for the treatment of the Lea Valley sewage, providing it went into the Thames, and not into the Lea. We acquit Mr. Bailey-Denton of all intentional misrepresentation. It is not always easy to get at the real meaning of evidence recorded in a Blue Book, and the controversy which has arisen may in this instance be of some service in the way of elucidation.

SPEED EXPERIMENTS WITH SHIPS' MODELS.

A proposal has recently been made by Professor Philip Jen kins, who now occupies the John-Elder Chair of Naval Archi tecture in Glasgow University, to the effect that the shipbuilders and marine engineers of the Clyde should unite together to construct a tank where the models of vessels proposed to be built by the subscribers might have their curves of resistance and other qualities determined. The proposal has already been publicly made several times—amongst others by Mr. William Pearce, of the Fairfield Works, when delivering the opening lecture of the course in connection with the Naval Exhibition held in Glasgow in 1881 ; but notwithstanding a pretty wide concensus of opinion as to the desirability of some such tank being established, the matter seems never to have been carried any further. The revival of the subject now by Professor Jenkins will perhaps lead to its being more fully and satisfactorily discussed, if not to practical steps towards a realisation of the scheme. It is unnecessary to refer at any length at this time to the value of model experiments as exemplified in the case of the Admiralty tank established and conducted at Torquay by the late Dr. William Froude, and now under the management of his son, Mr. R. E. Froude. A recent and very sufficient proof of the importance which the Admiralty attach to this work, and the practical uses to which the investigations and results may be applied, is the construction of a new tank and the re-organising of the existing apparatus and staff at Haslar, near Portsmouth. The dimensions of the old tank were 280ft. long, 36ft. wide, and 10ft. deep. The new one is some 400ft. in length, 20ft. in width, and 9ft. deep. Indirectly the merchant service has derived much benefit from the tank worked under the auspices of the Admiralty, but being carried on primarily for investigation with Government vessels, and as the types of merchant vessels differ in so many essential respects from vessels of war, it is obvious that the benefits of such an establishment cannot to any great extent be taken advantage of in the interests of the mercantile marine. A set of conditions obtains in merchant ship design, concerned with changes of loading and draught and economical working, which are almost or altogether foreign to war ships, and renders the determination of the most suitable form and the most efficient propelling machinery for the former class of vessels a matter of greater intricacy, and perhaps of greater consequence, than for the latter class. Much useful information is undoubtedly derived from the system of trying vessels progressively on the measured mile, but to take the full benefit which such trials are calculated to yield, they should be supplemented by experiments with models. By such means the combined efficiency of ship, engines, and propellers, as ascertained by measured mile speed trials, can be dissected and pretty accurately apportioned to the respective elements constituting the total efficiency. One of the first private firms of shipbuilders to recognise the important aid which experiments with models may be made to yield in ship design and in the economical application of motive power was, as is well known, Messrs. Denny, of Dumbarton. The establishment of a tank similar to the one at Torquay in connection with their shipyard was effected in 1882, and the work of experiment has been carried on ever since with results which it is understood are gratifying to Messrs. Denny. It would certainly be a satisfactory state of things, and one from which incalculable benefit would accrue to naval architecture and marine engineering, if every firm of importance were similarly equipped ; but on economical grounds this may be considered quite out of the question. The alternative therefore of having a tank supported by the general body of shipbuilders and engineers, of which they might all avail themselves in common, is a project more

likely of realisation. The difficulty, however, of instituting and carrying on a tank which would at once afford general benefit to the subscribers as a body, and secure for individual firms the exclusive advantages due to their own especial experience, skill, and enterprise, is very formidable. Another fruitful source of difficulty would be the adjustment of the administration, &c., so that the interests of competing firms could be equally attended to in times of great hurry with proposed vessels. Until some probable method of satisfactorily reconciling these apparently contradictory conditions can be pointed to we are afraid no substantial progress will be made in the matter.

HYDRAULIC MINING AND THE CALIFORNIAN RIVER BEDS.

The hydraulic system of mining is the cause of a great deal of contradictory statement in the *Mining and Industrial Advocate* of San Francisco and other journals, and a very interesting series of articles on "Mining Débris in Californian Rivers," by Mr. A. J. Bowie, jun., and others, by Mr. P. M. Randall, has been published by the journal mentioned. Some of those who have entered the controversy contend that the water level in the Sacramento, Yuba, and other rivers, for instance, has been materially raised by the mining débris, and beneficially so from the farmers' point of view. Others contend that the change of level is due to natural land washings very little affected by the hydraulic mining operations. From an estimate made by one mining engineer, it appears that the sediment carried into the rivers by deep placer or hydraulic mining is not more than 5 per cent. of the mass of material worked; but as the quantity of hydraulic material washed per year in the Yuba basin, for instance, is 22,326,500 cubic yards, the 5 per cent. represents 1,116,320 cubic yards of sediment carried into the Yuba River. This sort of thing, coupled with the denudation of forest lands, must, if continued, produce effects on the rainfall and floods of the Californian rivers which will some day be disastrous.

LITERATURE.

The Portable Engine: its Construction and Management. By William Dyson Wansborough. London: Crosby Lockwood and Co. 1887.

There is an unmistakeable vacancy in engineering literature for a good work on the portable engine. At present all we have are a work by H. Weber, "Der Bau der Locomobilen," and an article in "Perel's Handbuch des Landwirthshaftlichen Maschinenwesens." But these, besides being not all that could be desired, are inaccessible to the majority of English readers. The work now before us does but little to meet the existing want, but it must be admitted that this is not its primary object. The author states that it is designed for the use of buyers and users of steam engines generally, as well as for those more directly engaged in the construction and management of the portable engine. As might be expected, the attempt to unite the requirements of buyers and constructors has not been attended with the most satisfactory results, at any rate from the constructor's point of view.

Chapters I., II., III., IV., and VI., give an elementary description of the high-pressure steam engine and the locomotive boiler, units of connection, construction of the engine and boiler, and hints to purchasers. Instructions for the management and maintenance of the engine in working order appear to be well adapted for the service of users, but are not likely to be of very much use to constructors. On the other hand, chapters V. and VI., on the slide valve and the indicator diagram, would probably be of service to the latter class, but appear to be of too high an order of difficulty for the former.

Exception must also be taken to many of the statements made, and to a general want of breadth of view. For instance, we are told with regard to rivet joints that a common proportion in portable engine boilers for 80 lb. pressure and under, is to use for $\frac{3}{8}$ plate $\frac{5}{8}$ rivets at 2in. pitch. Now, as a matter of fact, several eminent firms are using far better designed joints than this. In one case $\frac{3}{8}$ plates have $\frac{3}{4}$ rivets at $1\frac{7}{8}$in. pitch. Again, as to boiler tubes, sizes $\frac{1}{4}$in. and $\frac{1}{2}$in. smaller in diameter than those given as a standard are now largely used with the best results. Presumably, in neglecting the weight of the valve, &c., in the calculation for the leverage of a safety valve, the author had in view the object of making the matter as clear as possible to the non-professional reader. It can hardly be that this practice is followed by any leading firm. With regard to the statement that most of the best engines are now constructed with a separate box for the stop, throttle, and safety valves, of course there is room for a diversity of opinion as to whose the best engines are, but certainly this is the practice of very few of the firms who can be considered to lead the trade. The use of the separate box very much simplifies the cylinder casting, and is doubtless in some respects an advantage in working. But, on the other hand, the consequent increase in the number of steam joints and of holes in the boiler are highly objectionable, more especially, of course, with high pressures. While agreeing with the author as to the use of separate liners in cylinders, it should be pointed out that a large number of really good engines are made without. No doubt the saddle construction for crank shaft brackets makes a good stiff job, but it is heavy and cumbersome, and not in our opinion equal to the wrought iron brackets used by Messrs. Marshall and others.

With regard to exhaust pipes inside the boiler, it may be remarked that, in spite of the objections thereto, one firm, Hornsby's, has consistently adhered to this construction, as well as to their steam dome and enclosed cylinders for many years, and with good results. It must of course be borne in mind that comparatively little heat is transmitted through a surface having steam on both sides of it, and the quantity that does in this case pass, and is imparted to the exhaust, is not altogether wasted, as it beyond doubt serves to reduce the back pressure in the cylinder by giving a freer exhaust.

In the brief historical sketch some reference to the labours of Howden of Boston, Dean of Birmingham, and Cambridge of Market Lavington, might, with advantage, have been incorporated. The work is illustrated by wood-cuts of typical details, and by two plates representing a portable engine in side and end elevation and plan.

Topographical Drawing and Sketching. By Lieutenant Henry A. Reed, U.S. Army. 4to., pp. 129. New York: Wiley, 1886. London: Trübner and Co.

The author, who holds the position of assistant professor of drawing in the United States Military Academy at West Point, has been induced to write this work to supply American students with a complete and fully illustrated treatise of native origin, in rapid methods of hill shading, which shall present the subject of topographical sketching in a form suited to the requirements of a beginner. This he has done by searching every available source, both native and foreign, for new information, and such as the publications of the United States Coast Survey, and the different manuals in use in the military schools of France and England. The result is a very useful volume containing full details of the routine of map making and drawing (apart from surveying) carefully described and illustrated, but which, as might be expected from the nature of the case, contains but few novelties calling for notice here. The author speaks, apparently with some favour, of a labour-saving contrivance, which consists in electrotyping a tasteful arrangement of signs on thin copper, which is then mounted on a roller and when inked is passed over the surface of the plan that it is desired to ornament, when the result is obtained in at most one-tenth part of the time spent in drawing by hand. The typographical execution is exceedingly good, except as regards the plates, which are mostly printed on sheets from $\frac{3}{4}$in to 1in. smaller than the height of the page, giving them a shabby appearance quite out of keeping with the text. All the leading problems in contouring and hill shading by different methods are fully illustrated, but finished maps are restricted to a single example, taken from the French African Survey, which is so overloaded with heavily printed contour lines in colour as to be almost useless for ordinary itinerary purposes. There are some useful hints in the latter part of the volume, as sketching in mountain countries, which are likely to be of value to many besides military students. Oddly enough, the only example given of eye-sketching without instruments is one of a reconnaissance sketch made by an officer on the Duke of Wellington's staff in 1812, before the Battle of Salamanca.

MODERN FLOUR MILL MACHINERY.

In an article in The Engineer of the 17th December last we described the modern flour mill, and it will be remembered that we stated that an enormous amount of capital had been sunk within the last six years in equipping the British and Irish mills with the roller or gradual reduction system. In this article we propose pointing out how an expenditure of something like £9,000,000, in the very short period of six years, has been distributed among the British, German, and American flour mill engineers.

The importance and extent of our flour mill industry appears to have been very imperfectly realised by the flour mill and general engineers, and the result has been that the recent extensive requirements in flour mill machinery have to a very large extent been met by foreign manufacturers. It is matter for serious thought that while Great Britain has been for over half a century the world's workshop, very few of the new industries that have ripened into such splendid maturity upon our soil have had their birth in this country. The industrial genius of Great Britain is known to be sluggish in the earlier stages of the development of any complete revolution in the method of manufacturing any special product, but when the minds of those interested are at last awake to the importance of the matter, in a few strides our manufactures out-distance those of the country who may have given them the lead. Numerous instances of this description will at once suggest themselves to the reader who possesses a knowledge of the history of industrial progress. There is no more striking case in this connection than the recent development in roller milling. It is true that the use of rollers in doing the work of millstones dates as far back as 1820, when Collier, of Paris, erected a flour mill fitted with rolls instead of stones. A few years later roller mills were erected at Venice and in Switzerland, but all of these mills failed, and reverted to the old millstone system. The first complete successful roller mill plant was the Pesth mill erected in 1867. This was a very large concern, as it was fitted with 210 pairs of rolls. Roller milling from that date spread on the Continent, and from 1870 to 1880 all the high-class brands of flour used in this country were imported from Hungary. This is perhaps as good a place as any to dispel the very general opinion that America gave the British millwrights the lead in roller milling machinery. The Americans by the loudness of their claims to many improvements succeeded for a time in gaining some credit as the pioneers of all useful inventions, and particularly of all inventions in milling machines and mill systems. It is a fact nevertheless that complete roller mill plants were at work in England before they were introduced into America, and British millers and milling engineers are little indebted to their American brethren, as, in addition to our home engineers being before the Americans in roller milling, the gradual reduction system is to be found carried out in a much more elaborate and scientific manner in British than it is in the American mills.

In the early days of roller milling in this country some of the American firms made strenuous efforts to get a large share of the orders for milling machines; but the home millers never took kindly to the machines of American construction. There was no denying that the principle of many of the American machines was good, but the design and construction were not such as to command the confidence of those accustomed to British-made machines. The German-made machines met with a more extensive patronage from British buyers, as the figures in this article demonstrate.

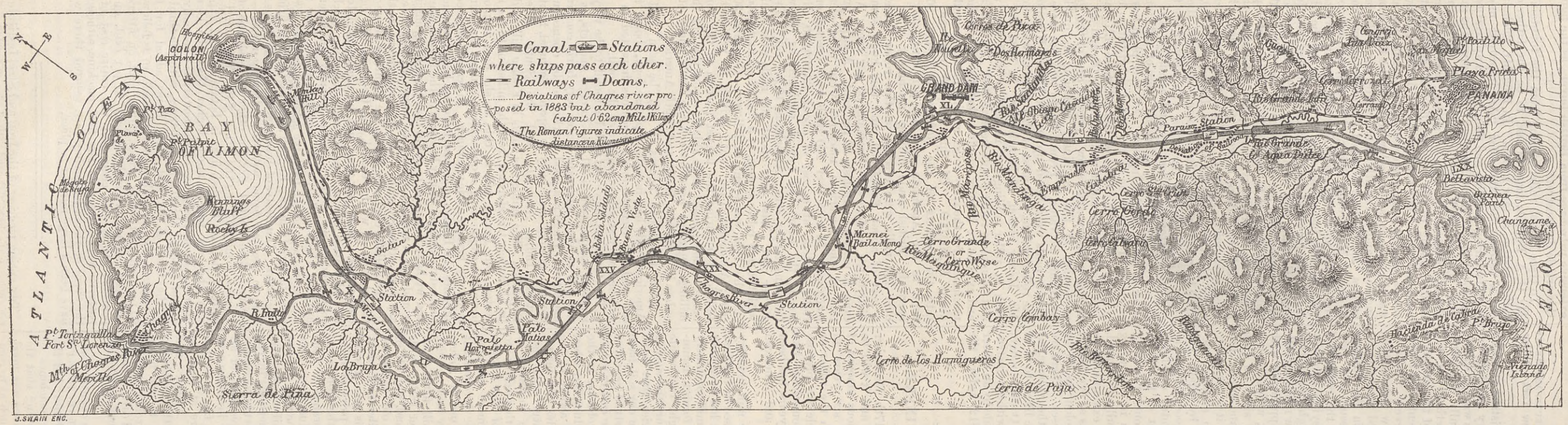
To trace British roller milling from the fountain-head, Mr. G. A. Bucholz may be said to be the father of the roller system, as now known. In 1862 Mr. Bucholz took out a patent—No. 3113—for "An improved mode of manufacturing semolina and flour, and in apparatus to be employed in such manufactures." The apparatus in these early days of high grinding were very crude, and the Bucholz system, like Collier's system, was pretty much a failure, owing to the impossibility of getting suitable machines made; but there is no doubt that the Bucholz *modus operandi* or flow sheet of gradual reduction milling was the same as is now followed by all the British milling engineers, and, as recently remarked by one of the leading millers, "Mr. Bucholz laboured, and others entered into his labour." Mr. Proctor Baker, of Bristol, who is known as one of the ablest millers in England, recently wrote that "Mr. Bucholz just missed a big thing." It may be interesting to state here that a son of Mr. Bucholz designed the first automatic roller mill plant in the world, and carried out his invention with perfect success at the mills of Messrs. Barlow and Sons, of Bilston, in 1879. This great improvement made the roller system popular in Great Britain, as it enabled the millers to work the roller plants in the most economical manner. When this first automatic roller plant was started by Mr. Bucholz in 1879, very little interest was taken in the new system, and the millstone kept its place in the mills. To convert the thirty million quarters of wheat ground annually into flour, there were about twenty thousand pairs of millstones at work in the United Kingdom. All this plant has been rendered of little value by the rapid substitution of the roller system. The value of the millstone mill plants in 1880 could not be much under £6,000,000, and no other British industry could show a parallel case of the greater proportion of the machinery becoming so quickly of practically no value. From 1878 to 1882 not more than twenty mills were fitted up in the United Kingdom on the roller system, and most of that number were done by Mr. Henry Simon, of Manchester. In 1883 the great rush in roller milling set in, and in that year about sixty complete roller plants were erected. From a careful and exhaustive inquiry we find that the cost of the new machinery for the sixty roller milling plants amounted to about £1,000,000. Of this sum, 65 per cent. went into the pockets of the German engineers, 20 per cent. to the American, and 15 per cent. only was spent in British-made milling machinery. In 1884, over 130 mills were erected on the roller system at a cost of about £2,500,000, and this huge sum was distributed as follows:—Germans, 60 per cent.; Americans, 20 per cent.; British, 20 per cent. A large proportion of the American machines were wheat-cleaning machines. In 1885 over 200 mills were erected on the roller system, at a cost of about £3,500,000, divided among the home and foreign engineers as follows:—Germans, 50 per cent.; Americans, 10 per cent.; British, 40 per cent. Last year about 160 mills were equipped with the new roller system, at a cost of about £2,500,000, and this sum was spent as follows:—Germans, 30 per cent.; Americans, 5 per cent.; British, 65 per cent. In addition to securing the largest portion of the work at home, we are pleased to be able to report that the British milling engineers have booked the lion's share of the orders in Australia, India, and South America.

From the above figures it will be seen that the American trade has, in milling phraseology, about "tailed off," and the German-made machines imported in 1887 will be a very small percentage of the total.

The Germans, however, will be found to be very formidable competitors in all the foreign markets, as they can sell at very moderate prices very fairly constructed machines. There is a good market to be opened up for modern milling machinery in Spain, Portugal, Southern Russia, India, Australia, and the South American Republics. The numerous mills in France will no doubt be ultimately transformed from the millstone to the roller system, but France will in this, as she does in most of her other engineering requirements, confine the demand to purely French-made machines. In general engineering supplies the British engineers have not been very successful in developing a steady business in the French markets, and we have no reason to doubt that the milling engineers would find it not less difficult to secure French orders on any very extensive scale. The future therefore, we think, for the milling engineers lies in the countries above mentioned, and, as we have said, the Germans will be the only rivals. That they must not be under-estimated in the calculation will be clear from the following which has come under our notice:—Quite recently an ingenious machine which is likely to be largely used in flour mills was invented, and the patentee asked quotations for the manufacture from two English and two German firms of engineers. Duplicates of drawings and specifications were sent to the four firms with the following result:—One German firm quoted £22, the other £25, and one of the English firms £37, and the other £42. The detail estimate of the first English firm is before us, and explains why the cost was so much higher than the German figures. First, the price of the materials; secondly, the cost of labour; thirdly, shop charges, with one-third part of the total of the first three items added for trade expenses. The shop charges were made up as follows:—60 per cent. on turners' wages, 30 per cent. on fitters', 15 per cent. on pattern-makers', and 20 per cent. on carpenters'. It is also clear that the entire cost of the patterns were charged on the first machine, although in the event of the order having been secured there would have been a large number to place.

The spring meeting of the Iron and Steel Institute will take place on the 26th, 27th, and 28th of May, in London.

MAP OF THE ISTHMUS OF PANAMA AND PANAMA CANAL ROUTE.



NOTES ON THE PANAMA CANAL.[1]

By R. Nelson Boyd, M. Inst. C.E.

(*Concluded from page* 293.)

After Tavernilla comes San Pablo, where the canal crosses the railway and a turning bridge will have to be constructed. A few kilometres beyond this point comes Gamboa, where the proposed reservoir was to be, and then the immense cutting of Culevra across the watershed. This is the most important work to be done on the canal. The length of the cutting is 1800 metres, and the deepest point of the cutting is 140 metres. The average for the total length is 88 metres. The height of 140 metres is not that of the centre line, but the height of the summit of one of the slopes. The latter are 1 to 1, and the width at top of cutting will be from 200 to 300 metres. The quantity of earth to be moved is 20,000,000 cubic metres. At the time of my visit little work was being done, because a new firm of contractors had just taken over the cutting, and were making arrangements to suit their views. The previous contractors worked in steps, and used the small gauge Decauville railway and the steam navvy. Of the latter they had seventeen at work. Up to date about one-twentieth of the quantity has been moved, so that about 16,000,000 cubic metres remained to be excavated. This has been the work of six years. Of course much had to be done in preparatory work, such as laying roads for tipping and getting the material together. However, as it now stands, it is estimated that it will require at the very least six years to finish it. The difficulties of this immense cutting are greatly enhanced by the nature of the ground, which is in great part composed of basalt rocks—dolomite—with bands of sand intervening. Several slips have occurred and occasioned much trouble. This point is the watershed between the Atlantic and Pacific Oceans, and from this on to Panama the canal is cut through comparatively easy ground. The only difficulties are the deviation of the Panama Railroad and of the river Grande.

When the canal was commenced the necessity of locks and gates was suggested owing to the difference of tide between the two oceans. The Atlantic tide at Colon rises 2ft., whereas the Pacific at Panama rises 20ft., and it has been ascertained that at low water the level of the Pacific Ocean is 3·25 metres—10½ft.—below the Atlantic. The last proposal to obviate the ebb and flow of the Pacific tide was to construct a basin near the Pacific end 4000 metres long by 500 metres wide, lined with strong quay walls and gates on the Colon side which would be opened at high water. The cost of this work was estimated at 50,000,000f. This as well as all other projects of a similar kind have been shelved for the time, and the present intention is to construct an open canal from end to end. The canal ends at or near the mouth of the river Grande, and a channel has to be dredged for a distance of 5 kilos. into deep water through a bed of sand. This is proceeding at present, and three powerful dredges are at work. These are of the Gouro model, and able to raise 150 tons per hour. I was informed that it was intended to use Gwynne's Invincible elevator on other parts of the canal, mixing two-thirds water to one-third earth, and forcing to a distance of 80 metres.

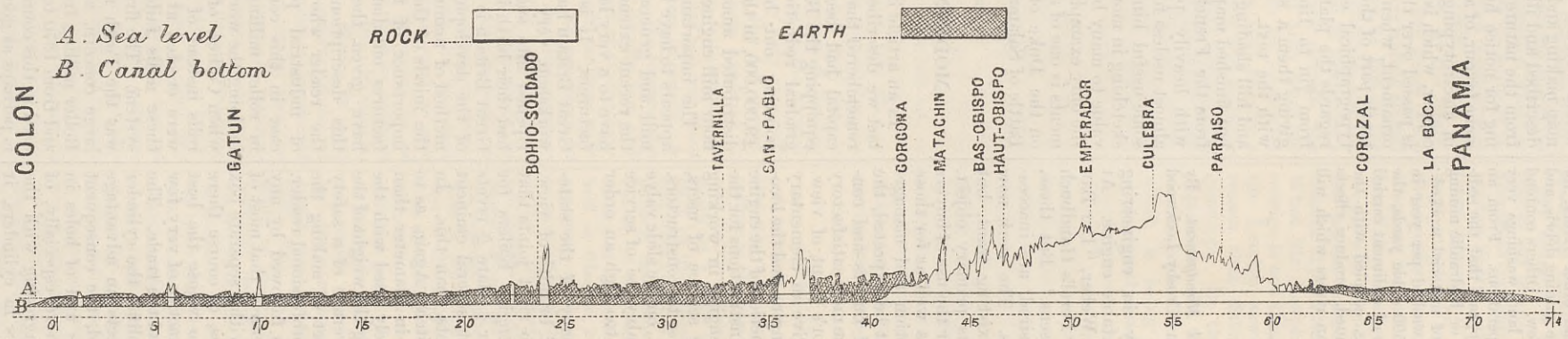
The work done on the canal is not in proportion to the time spent. Up to the end of 1886 the total cube extracted, according to the figures of the company, was under 30,000,000 cubic metres. This gives an average of 6,000,000 per year. At present the work is progressing more rapidly, and in the year 1886 the quantity moved was 11,727,000 cubic metres, or about 1,000,000 a month. During the early years of course much preliminary work had to be and was done.

Three large fitting and repairing shops have been erected, one at Colon, a second at Matachin, about the centre of the canal, and a third at Boca on the Pacific. These shops are amply fitted for repairing locomotives, dredges, engines of all kinds, and, in fact, all the machinery employed on the work. At La Boca iron barges are built as well as repaired. A good idea of the importance of these establishments may be formed from the cost, namely, over 20,000,000f., or nearly £1,000,000 sterling. These shops were intended to repair the immense quantity of machinery accumulated by the company along the railroad and the canal. In this department more waste has occurred than in any other. It is impossible to get at the value of all the machinery imported, but it has been far in excess of the requirements. Numbers of machines of all kinds are to be seen rusting along the line, and the loss is something abominable. The locomotive engines alone have been estimated at something over 57,000-horse power. I have seen a dozen locomotives, apparently in good order, shunted on a siding and left to rust away in the hot, damp climate. The rich tropical vegetation had settled on them, and green leaves were growing out of the fire doors and funnels. The waste in material is a matter of common, I may say public comment. Thousands of barrows, wagons of all kinds and sizes, rails, and even locomotives have been tipped over the banks and buried. Lots of new and expensive machinery from Europe has been left lying along the railroad, and may still be seen gradually rusting away into valueless dross. A good deal of this material was found unsuitable when it reached the Isthmus, but it had all to be paid for.

It was soon found that in such an unhealthy climate some provision had to be made for the many cases of sickness. Accordingly two hospitals have been erected, one at Colon and the other at Panama. The former has 100 and the latter 500 beds, and this hospital consists of twenty-seven isolated wooden buildings, constructed on brick pillars rising about 10ft. from the ground. In these hospitals the company's employés are gratuitously cared for. Those of the contractors are admitted on payment of 1 dol. per day. In addition to these hospitals, a sanatorium has been erected on the island of Taboga, in the Bay of Panama, about ten miles from the shore.

Again, as there are no towns or villages on the Isthmus, and, in fact, no inhabitants except a few black men, who live in miserable huts, provision had to be made for housing the thousands of workmen employed. By a rough calculation made on the ground I estimate the number of houses and barracks for employés and men at over three thousand. These houses are all of wood, and were imported straight from the United States ready to put up. Lastly, the Panama railroad had to be bought up to secure the means of transport, and nine-tenths of the shares were purchased by the company, who thus have the control of the working. The railroad remains, however, an independent American company, in order to comply with the terms of the concession. All the works are under the management of a director at Panama—invariably a French Government engineer. A large number of clerks are employed at the central office in Panama; the canal is divided into five sections under the control of two chief engineers, and each section has a resident, or *chef de section*, and the necessary complement of technical and office assistants; then come about 10,000 workmen collected from different parts of the world. I have a list of the different nationalities employed in 1885, as follows:—

From Jamaica	.. ..	9006
,, Carthagena	.. ..	141
,, Barbadoes	.. ..	1344
,, Saint Lucia	.. ..	495
,, Venezuela	.. ..	272
From Cuba	.. ..	275
,, New Orleans	.. ..	542
,, Martinique	.. ..	800
		12,875



SECTION ALONG THE LINE OF THE PANAMA CANAL.

These proportions are fairly accurate up to the present time. It will be noticed that the great majority of the workpeople come from Jamaica and other English islands. Of course, they are all black men or mulattos. No white men can stand the climate of the Isthmus and work in the cuttings of the canal. The ten or twelve thousand men employed along the forty-five miles of cuttings make a very small show, yet they are moving earth at the rate of a million cubic metres per month.

Now comes the question as to how long it will take to complete the canal at that rate. It will certainly take longer than the three years allotted. The quantities estimated and admitted as correct for the main ship canal are 120,000,000 cubic metres, to this must be added for deviating and other works at least 30,000,000 cubic metres, which gives a total of 150,000,000 cubic metres. The quantity already moved is about 30,000,000, so that 120,000,000 cubic metres remain to be excavated. Taking the present rate, namely, 12,000,000 per annum, it will take ten years to complete the work. During the first few years little excavation was done; not only had the buildings, hospitals, houses, workshops, &c. &c., to be erected, but miles of rails had to be got on the ground and laid for tipping. The latter question, though a minor one, is in many cases a serious difficulty, as the cutting is made at the bottom of a narrow valley, where the only tip-room is a swamp lying above the level of the canal. All this preliminary work is now complete, or at any rate is supposed to be so, and the engineers consider that one-third of the actual work of the canal is accomplished. But if it has taken five years to do this, it will take another ten to complete the remaining two-thirds. The sanguine calculators reckon on a much larger excavation during the next few years, estimating 24,000,000 for this year and 36,000,000 for 1888, and so on. I do not think this will or can be realised. Even assuming the preparatory arrangements to be all that can be desired, an unavoidable delay will occur at the Culevra cutting. This

[1] Read before the Civil and Mechanical Engineers' Society, March 30th, 1887.

immense and difficult work cannot be accomplished under six years, as estimated by men acquainted with the circumstances and competent to judge.

Then, again, taking the first or present rate of excavation, we are not allowing for the greater difficulties of the work as the depth increases. Up to the present time all earth moved has been close to the surface, and most of it has been moved by level roads. Later it will be necessary to raise the earth 29½ft., and the tips will be further away, so that as time goes on we ought to reckon on a smaller and not a larger rate of excavation. It appears clearly impossible to complete the canal under six years from 1st January, 1887; and judging from all I have seen and heard, I am inclined to think that it will take nearer twelve than six years.

With regard to the cost some figures will be interesting. First as to wages. These vary for labourers from 1½ dols. to 2 dols., say 6s. to 8s.; and for artisans, from 3 dols. to 4 dols., or 12s. to 16s., so that work of any kind is most expensive. The cost of blasting and moving a cubic metre of rock may be fairly taken at 16s., and a cubic metre of earth at 8s. Now, taking the remaining 120,000,000 cubic metres to be excavated at one-third rock and two-thirds earth, the total cost of moving this will come to 1,280,000,000f. To this must be added the office and general expenses of Paris and Panama, the cost of repairs, and the interest on capital during construction, and these cannot be taken at less than 1,000,000,000f. for ten years; so that the money still required, roughly calculated, will amount to about 2,200,000,000f. This estimate, founded on data independently collected, is corroborated by others, and some even put the amount above this.

The money already spent can only be surmised, but it must be very considerable. It is generally believed that more than the original capital has been already spent. Assuming that 1,000,000,000f. have been absorbed by the existing works, interest on capital, &c., the amount of capital eventually required will be over 3,000,000,000f., say £120,000,000 sterling.

Of course it is quite possible that in less time and at less cost a ditch from end to end with water flowing from the Pacific to the Atlantic may be made, but not the canal as designed, 29½ft. deep. The impression made on the mind by a visit to the canal is a sad one. It seems as if the success of Suez was to be tarnished by the failure of Panama, and the brilliant reputation earned in the East lost in the West.

The Suez Canal has been followed too closely for a work constructed under very different circumstances. The engineers at the head of Panama have been those of the Suez Canal. The section is much the same, and a great deal of the early machinery was similar to that used at Suez, though quite useless at Panama. The difficulties were underrated by the early surveyors, and the rate of wages miscalculated. Now there is uncertainty and hesitation about the plans to be adopted, and an eager but tardy straining after economy.

It is quite evident that more capital than had ever been contemplated will be required, and if this is not subscribed by the shareholders, it is very possible that this great work, organised by the master mind of Suez, will be completed by other hands.

LETTERS TO THE EDITOR.

(*Continued from page* 314.)

METROPOLITAN SEWAGE DISPOSAL.

Sir,—In your article on the above, in The Engineer of 15th inst., you make "a very serious point" of what you describe as the result of Mr. Bailey-Denton having overlooked certain parts of Sir Joseph Bazalgette's evidence, which you quote from "Proceedings" of the Select Committee on the Lea; and I therefore lose no time in drawing your attention to a fact which you appear to have overlooked, and upon which my partner's statement was justly based, in order that you may have the opportunity of putting the matter right in your next issue.

It will, I think, be admitted that the question, whether an engineer is "satisfied" or not with a proposed remedy for an admitted evil, can best be determined by his future carefully prepared plans and estimates in a very similar case, because second thoughts would hardly induce him to introduce a much more expensive remedy if he were satisfied—of course, taking the word to mean belief that the remedy would practically suffice—with the cheaper one previously proposed; and Mr. Denton stands on solid ground in drawing his conclusion from such data in preference to regarding the engineer's explanation of his views while undergoing cross-examination as quoted by you. Sir Joseph Bazalgette will hardly thank you for drawing attention to the "singular contradiction," for overlooking which you charge Mr. Denton with a "lack of discrimination in dealing with his evidence."

Now, the fact which you appear to have overlooked is that Sir Joseph Bazalgette's proposed outfall for effluent of the Lea sewage, after treatment with ten grains of lime and eight grains of sulphate of alumina, and with land treatment to follow, is not into the Lea, as your remarks imply, but into the river Thames, "about one mile from the metropolitan outfall at Barking." The true explanation of the "singular contradiction" is, I think, to be made as follows:—(1) That Sir Joseph's well-known and often expressed opinion is that the discharge of crude sewage into such a river as the Thames, heretofore at Barking, and in future at Thames Haven, is the right and only necessary measure for his own Board to adopt; but that he is in duty bound to uphold as "satisfactory" any palliative form of treatment which may happen to be favoured by his employers until they see fit to change their minds. (2) That in preparing his plans for the Lea Valley Sewage Sir Joseph Bazalgette did not think it likely that an independent body charged with the duty of dealing with sewage at Barking would be satisfied with what must appear to anyone holding his views—the harmless chemical delusion of his colleague, Mr. Dibdin.

Question 1446, however, clears up all doubt, as follows, from "Proceedings" of the Select Committee:—"1446. Will it be sufficient to deal with it chemically in the same way as the subcommittee recommended as to the sewage of London? My opinion is that it will;" [why not? when he, Sir Joseph Bazalgette, has so often stated his opinion that the discharge of crude sewage would suffice] "but as other people may differ from me in that respect, I thought it better, in laying the estimates before the committee, to put before them the most comprehensive and expensive system, so that the cost may not be susceptible of being increased, but possibly of being decreased."

It is true that this great subject of metropolitan sewage disposal has been complicated by many misunderstandings, which must try the patience of any one who wishes to unravel the truth; but when you recognise the fact that Sir Joseph Bazalgette laid formal plans and estimates before different authorities for two distinct systems of treating sewage before discharge of effluent into the Thames at points only about a mile apart, you will surely hasten to remove the stigma of misrepresentation implied against Mr. Denton by your remarks, evidently made under the impression that the Lea sewage was proposed to be discharged after the more costly treatment into the Lea, and not into the river Thames.

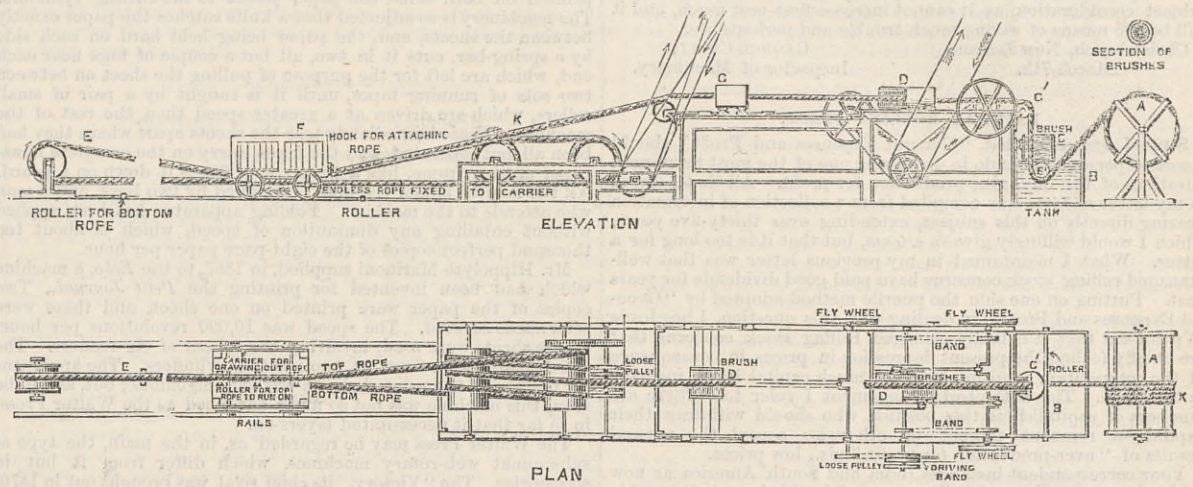
Alfred S. Jones, Assoc. M. Inst. C.E.
Havod-y-Wern Farm, Wrexham, April 16th.

PAINTED AND TARRED ROPES.

Sir,—It is a well known fact amongst ropemakers, though not to the majority of users of ropes, that a rope which is tarred is not so strong as an untarred rope, for the strands in passing through the boiling tar lose at least a third of their strength, whilst a third is added to their weight. Now as tarred ropes are bought by users with the idea that they wear longer than untarred, and keep out the wet, it occurred to me as a practical ropemaker to try and devise a means of coating ropes with a substance that should be impervious to water, without detracting from the strength of the rope, or adding perceptibly to its weight, and I have invented and patented a machine as per specification and drawing sent you herewith, and which does its work perfectly.

The rope K is first drawn around a coiling wheel A and then down under a roller B^1 situated in a tank B containing the preserving solution; it then passes up through a pair of brushes C over another roller C^1, thence along through a pair of reciprocating painting brushes D; it then passes along through another pair of brushes G. In such ropes which it is found advantageous to coat whilst in strands, and before being completely made, that part of the machine marked F, and described as a drawing-out frame from the painting machine, may be converted into a rope-making machine as now in general use.

The substance which I use is a preparation of boiled oil and other ingredients, and I maintain that a hemp or manilla rope coated with this and left in water for twelve months would, at the end of that time, be as strong as when first placed there, and would be no heavier. Enclosed is a copy of a certificate received



from Messrs. Lloyd's Proving House Company, giving particulars of a test made there on the 8th inst. The rope tested was of the same quality and make throughout, and the broken pieces can be inspected by anyone interested in the matter. This coating will not wear off, but will last as long as the rope itself, and is inexpensive.

The advantage to large users is obvious—such as shipowners, railway companies, and for ropes used in the fishing trade. As the preservative can be produced in any colour, any one firm or company could have all their ropes made one particular colour. For yachts a perfectly white rope would have a very pretty effect, and when the rope got dirty it would only require wiping with a wet cloth to bring it back to its original colour. I send you also a small sample of white and yellow hemp rope, which has been so coated, and shall be pleased to supply any further particulars if you require them. I may say that the coating always keeps the rope soft and pliable.

Copy of a certificate received from Lloyd's Proving House Company, Limited, Tipton.

Lloyd's Proving House,
Tipton, Staffordshire.
8th April, 1887.

This is to certify that the ropes tested to destruction for Thomas Oliver and Co. as per particulars herewith, were delivered to us in one piece, one end of which was tarred, and the other end coated with paint or similar material. That the piece of rope was cut in our presence and each end tested separately with the following results:—

Painted end broke at 4¼ tons
Tarred end ,, under 2 tons.

Erastus R. Isitt, Supt.

The rope was 3¼in. cir. bare, and was made from Russian hemp, and was hand spun. This test was thrice repeated, with exactly the same results, and the bits of rope sent you are pieces cut off that which was tested on the 8th inst. Thomas W. Oliver.
West Bromwich, April 9th.

PROFESSORS AND ENGINEERS.

Sir,—It would be easy to reply at considerable length, if you would accord the space, to "J. T. N.'s" letter, but it would not be expedient to adopt such a course. Your correspondent is obviously a young man, and has, I fancy, passed an examination or two with credit to himself. Possibly he is a Whitworth scholar. He is a favourable specimen of a type with which I am quite familiar. At present he knows very little apart from that kind of knowledge necessary to pass examinations—that is to say, he has read very little. If, for example, his reading had been at all extended, he would have known that the proposition that all energy is due to motion did not originate with me, but that it is at least as old as the days of Descartes, and that it is held as an article of faith by some of the ablest and most advanced thinkers of the age; were I to quote their names it would but occupy space, and convey little information to your correspondent. I gather from his letter that he holds that there are sources of energy with which motion has nothing to do. This may be possible, just as there is no inherent impossibility involved in the proposition that somewhere in space, space is curved; but it is certain that we have no evidence of energy apart from motion, and I have explicitly stated that we have no knowledge of anything which we are not, or have not been, told by our senses. It is a very old proposition that motion can be caused only by motion. This has often been stated in your columns by various correspondents, and I think that "J. T. N." will have no difficulty in seeing that, if this be true, energy can have no existence apart from motion. Lest "J. T. N." should once more, through lack of reading, fall into the error that these views are mine alone, I would refer him to Mr. G. T. Romanes' Rede Lecture for 1885, where he will find the following passage:—"The fundamental axiom is that energy can neither be created nor destroyed; that just as motion can produce nothing but motion, so conversely motion can be produced by nothing but motion." I fancy that he will admit that Mr. Romanes is a man who is capable of thinking lucidly and of selecting his subjects of belief.

The proposition I started with is that natural philosophy, using the word in a very extended sense, is not properly taught, and that it is not properly taught because the teachers adopt certain propositions and statements as true in substance and fact, the truth of which sometimes does not admit of demonstration, while in other cases they are manifestly untrue, or simply metaphysical propositions or abstractions. I could name many examples; one must suffice. I do not know whether "J. T. N." has read optics. I take it for granted, however, that he has. Now, the undulatory theory is taught as being true in substance and fact; yet every prism, nay, every drop of water in a rainbow, gives it the lie. In other words, the undulatory theory can on no existing assumption explain the dispersion of light.

It would be waste of space to discuss such questions as these at large, even if you, Sir, placed the whole Engineer week after week at the disposal of your correspondents. If, however, "J. T. N." will narrow the discussion to a single point in the teaching of science, I shall be happy to discuss that point with him; he maintaining that the teaching is sound, I maintaining that it is unsound. It may be that he will hit on a subject about which there can be no discussion. If so, he must try again. It is not for me to suggest.

As I have no doubt he has seen by this time the mistake into which he has fallen concerning "rate of acceleration," I shall say nothing about it. If not, then I would refer him to Professor Tait. Finally, I would observe that the tone of his letter might have been better. Youth, however, excuses much. J.
London, April 19th.

ENGINE DRIVERS' EYESIGHT AND COLOUR BLINDNESS.

Sir,—As this subject is being discussed in your columns, I beg leave to offer a few remarks upon it. Mr. Stretton, in his letter published in your issue of April 15th, speaks of the absurdity of the theoretical test. I think he is somewhat rash in using such an expression, and it looks as though he wrote it without forethought or in ignorance. I do not intend to go into the distance tests at any length, but may mention that in Germany a most varied and thorough test is applied, actual semaphores and signal lights being used, and the examination is conducted by day and by night. The point I wish to touch upon is the colour test. Mr. Stretton seems to wish—if I construe his letter rightly—for a more lax test as regards the examination of locomotive drivers' eyesight. Now I don't think any test, if properly carried out, too severe for colour, when trying a man for such a post, especially in England. Men may pass many tests now applied, and still fail at the critical moment. It is well that, to prevent this, such a test as Prof. Holmgren's wool test, though theoretical, be resorted to. The part of this test where the person being examined must arrange the different shades of the several colours, is sure to bring out the truth as to whether he be colour-blind or not. To a man with abnormal colour vision the different colours or lights appear white or grey, as the case may be, and such a man may, by education and use, call the colours by their right names, and until accident reveals his defeat, is looked upon as one possessing normal vision. It would be quite possible for him to pass the "flag" or "lantern" test satisfactorily. Dr. Keyser mentions a case where a man could name a red light at 3ft. distance but at 30ft. called it green. A colour-blind person may pass all right for a time, and if a driver, may treat his signals in the proper way for years before his defective vision is detected. He sees all lights as white or grey, and only distinguishes them by their intensity. It can be easily understood how a brighter reflector, a clean spectacle, a smoked glass, or sudden change in the atmosphere may, lead to a serious mistake. Dr. Coher, of Breslau, mentions a case of a locomotive driver running for thirty years before being found to be colour-blind.

In 1880 the Minister of Public Works in Belgium ordered a most thorough test for colour-blindness to be made on the State Railways at a cost of 32,000f.—each man had to pass three distinct tests. By the above remarks I hope I have shown that there is more in the question of testing drivers for normal vision than Mr. Stretton seems to think; and though he may have only met one man during twenty years who could not distinguish various coloured flags and railway signals, I fully believe that had he gone more minutely into other cases and used such means as doctors and professors, who have made colour-blindness their life study recommend, he would doubtless have made some discoveries, as the North-Eastern Railway officials have done during the last few weeks.

In 1879 the German Railway Union examined 11,066 drivers and firemen, and found eighty colour-blind, or at the rate of ·72 per cent. the total number of men examined was 85,996 of which ·62 per cent. were found colour-blind. John Place.
London, April 16th.

Sir,—In your impression of the 8th inst. is an interesting letter from "M. Inst. M. E.," relative to the testing of engine drivers' eyesight. It would I think be thankfully received if "M. Inst. M. E." would kindly state the size of the cards containing the black spots ¼in. square; also what test he uses for night blindness—hemeralopia—which, as is well-known, occurs very frequently amongst railway officials. H. C.
Riga, Russia, April 13th.

DOMESTIC DRAINAGE.

Sir,—In your leading article of April 15th, on "Recent Advances in Domestic Drainage," I see you mention my "drain plug," which was patented for the purpose set forth, but it was never at the time thought the pressure would be applied from the second or first floor of a house to the drain by charging the rising pipe as well as the drain, as this pressure could never occur in practice, as the water would first come out of the lower outlets, such as gulleys in areas or water-closets in basements; but the usual and full test is to apply the plug and fill to the lowest outlet, and any drain above that outlet tested separately.

I quite endorse the reason for iron and the use of it below a house, but not in every case for long stretches in outer courts, for this reason—the house drain, on account of fatty matter, does not rust, but drains with water only, such as rain water, will quickly rust; and again, I think iron manholes a stretch too far when any contractor will guarantee to build brick to hold the pressure needed. Having an iron drain under this house and seen its action, I make it a point to show it to any one who is interested, and will be happy to afford any information in my power. J. Botting.
6, Baker-street, Portman-square, London, W., April 19th.

WHAT IS A FITTER?

Sir,—It appears that the ideas of many of the metropolitan magistrates on trade nomenclature are very vague. We read that John Jones or Michael O'Rourke, of "Sweep's-walk, Chelsea," "an engineer," was brought up as drunk and disorderly or for an assault. The proper trade designation would probably be engineer's labourer, foundry labourer, gasfitter, &c.; in no case engineer. Men employed in erecting engines are "engine fitters" and "erectors," not engineers in the proper sense of the word at all.

The recent case brought before Mr. Bennett, of the Hammersmith Police-court, illustrates this system of brevet rank in a delightful manner. Some labourers employed on the American Exhibition building claimed fitter's wages of the manager, and very nearly got their claim recognised, as the magistrate called for a dictionary, and found that a "fitter" is "one employed to

adjust or make right." The manager, however, urged the "magistrate would not be guided by Johnson," so the summonses were adjourned for technical evidence. S. H. T.

Surbiton, April 20th.

INSPECTING TRACTION ENGINES.

Sir,—In The Engineer of the 7th of January, just to hand, there is an account of an accident to a traction engine made by J. Fowler and Co., caused, as stated in your paper, by the fire-box stays giving way, and the pressure was then too great for the boiler to stand. This subject has caused me much thought lately, for in this colony there are a great many of these engines at work, and with the exception of one maker, none of the others have made any provision for the inspection of these stays. As all boilers are under Government inspection in New Zealand, the trouble is how can inspectors see through half an inch of boiler plate and know the condition of the inside of the boilers, more especially fire-box stays? Sounding may reveal a broken stay, but certainly not a wasted stay. The only way I can see out of the difficulty is to have holes cut in convenient places for inspection and afterwards closed with screwed plugs or doors; and if my recommendation is of any weight, I would strongly urge all makers to give this subject consideration, as it cannot increase first cost much, and it will be the means of saving much trouble and perhaps life.

Christchurch, New Zealand, March 7th. George Croll, Inspector of Machinery.

RAILWAY ROLLING STOCK.

Sir,—I am sorry that "General Expenses and Profit" should resort to personal inuendo in discussing one of the most prominent questions of the day, viz., production for profit. All that I stated in my letter as facts was compiled from a collection of information bearing directly on this subject, extending over thirty-five years, which I would willingly give *in extenso*, but that it is too long for a letter. What I maintained in my previous letter was that well-managed rolling stock concerns have paid good dividends for years past. Putting on one side the puerile method adopted by "General Expenses and Profit" in dealing with this question, I beg leave to point out that it is badly-managed rolling stock concerns that are chiefly feeling the present depression in prices in consequence of the competition resulting from too much capital being invested in the trade. This is the bad management I refer to. There are numbers of capitalists in this position who should withdraw their capital—or remnant thereof—or otherwise accept the natural results of "over-production for profit," viz., low prices.

Your correspondent instances India and South America as now taking large quantities of railway material; this is an indisputable fact, but the question that "General Expenses and Profit" raised in his first letter remains unaffected by this fact. He deplored the want of a sufficiently large margin for general expenses and profit, and I pointed out in my reply the chief cause for this, which your correspondent generally accepts. Railway rolling stock concerns should, if it be possible, at once make any sacrifice to remove what your correspondent calls "the millstone" from their necks; this is the chief portion of good management. If the rolling stock trade is not in a failing condition, why does your correspondent complain about lowness or absence of profit? If it is temporary, why complain? If it is permanent throughout the trade, it must be failing. It is absurd to propose self-evident facts that "people must always have carriages to ride in," for the point is brought forward as to who shall build the carriages as well as the wagons, which your correspondent seems to have passed over.

The "survival of the fittest" means nothing more than the words represent, viz., the fittest to survive the commercial war now carried on under the flag of competition, whereas I would desire to see the trading community not fighting, but working upon universal co-operative lines.

I do not accept the novel and quixotic definition given by your correspondent regarding the "Phœnix-like" action of his profit gleaners. The whole process of competition as carried out in trade is immoral, judging from a standard of high ethical policy, and I beg leave to traverse "the live-and-let-live" statement of "General Expenses and Profit," for the general experience of myself and many other engineers with whom I have discussed the subject is that the "live-and-let-live" spirit is entirely absent in operations of bartering or in dealing with the absolute producers of all wealth.

Your correspondent refers to certain general managers who could, as I prefer putting it, form a ring for the increase of prices, and they might be "counted on one's fingers." There are over forty wagon and carriage builders in this country, and there is none of the "live-and-let-live" policy in their business, the whole being based upon strict "commercial" principles.

I beg leave of your kindness to allow me the space to recommend to such of your readers who may take any interest in the subject to read "Communal and Commercial Economy," by John Carruthers, M.I.C.E., late chief engineer for New Zealand Government. It is published by Stanford, Charing-cross. I was fortunate in seeing it recommended by a correspondent in your columns. It is a thoroughly good guide, and I advise "General Expenses and Profit" to study it carefully, and to leave literature dated 220 B.C. alone when dealing with practical difficulties of the competitive system. Fabian.

Birmingham, April 20th.

THE INSTITUTION OF CIVIL ENGINEERS.

PRINTING MACHINERY.

(*Concluded from page* 300.)

In 1816 the late Professor Edward Cowper patented a method of printing from curved or bent stereotype-plates, which were fixed upon the impression cylinder of the machine. The cylinder revolved under inking rollers, which alternately ran on the naked cylinder, and on the stereo-plates fixed on a part of it. The machine was intended for continuous sheets. Sir Rowland Hill in 1835 patented improvements in the same direction. He proposed, however, to use tapering types to be fixed on a cylinder, an expedient which was essentially impracticable. The first rotary machine, actually available and put in operation for printing newspapers, was invented and patented in 1848, and is known as Applegath's vertical machine. It may be pointed out that all the essential principles of rotary printing were discovered before the year 1850—the printing, the inking, the bending of the plates, the folding and taking-off, the web of paper, the means of cutting it and of damping it.

In 1857 the *Times* adopted the "type revolving printing machine," manufactured by Hoe and Co., of New York. It was not unlike Applegath's machine, but the cylinders were horizontal. Single sheets were taken in by grippers, conveyed out after printing by tapes, and deposited by self-acting "flyers" upon boards. The distributing surface of the main type cylinder being lower, or less in diameter than the forme of types, passed by the impression-cylinder without touching. The manner of fixing the type on the cylinder was by means of wedge-shaped column rules, something like the keystone of a bridge. This expedient had been patented as far back as 1847. The speed was limited by the ability of the feeders to supply the sheets; complication was caused by having ten different feeders.

It was now felt, at the *Times* office, that until the printing-press was simplified, so as to be available for printing on both sides at one operation a roll of paper which would require no laying on, the most important results derivable from stereo-plates had not been secured. Mr. J. A. Wilkinson, of New York, had a rotary web machine at work as far back as 1840; and the Bullock Press, patented in 1863, was put into operation soon after in Philadelphia. But neither of these exactly solved the problem. Hence, in 1862, the construction of the Walter web-printing press was undertaken by Mr. John Cameron Macdonald, the present manager of the *Times*, aided by Mr. Joseph Calverly, the chief engineer. It is about 19ft. long, 6ft. wide, and 7ft. high. Each roll used in printing the *Times* is about 8000 yards in length, and weighs 800 lb. The paper is passed from the roll over hollow damping cylinders perforated with small holes, through which steam condenses on the blanket covering, by which it becomes thoroughly wetted on both sides. The paper is then squeezed, and goes to the printing appliances, consisting of four large cylinders, arranged one above the other. The two outside carry the stereotype-plates, while the two in the middle are the pressing cylinders. The paper, after passing between the rollers, is led between the upper printing and pressing cylinders, when one side of it is printed upon; it is then passed between the two pressing cylinders, and afterwards between the lower pressing and lower printing cylinders, when it receives an impression upon the other side. Provision is made for taking up the set-off by means of a metal cylinder pressing against the lower impression cylinder, and licking up the superfluous ink on the covering thereof, while any accumulation of set-off is prevented by a rubbing-bar affixed to its circumference. After having been printed on both sides, the paper passes to the cutting cylinders. The machinery is so adjusted that a knife catches the paper exactly between the sheets, and, the paper being held hard on each side by a spring-bar, cuts it in two, all but a couple of tags near each end, which are left for the purpose of pulling the sheet on between two sets of running tapes, until it is caught by a pair of small rollers, which are driven at a greater speed than the rest of the machine. These immediately tear the sheets apart where they had been all but separated, and the tapes hurry on the complete newspaper until a frame, like a huge comb, flings it down on a board. All the manual labour required is supplied by two boys, and a man who attends to the machine. Folding apparatus has been applied without entailing any diminution of speed, which is about ten thousand perfect copies of the eight-page paper per hour.

Mr. Hippolyte Marinoni supplied, in 1867, to the *Echo*, a machine which had been invented for printing the *Petit Journal*. Two copies of the paper were printed on one sheet, and these were afterwards severed. The speed was 10,000 revolutions per hour. Single sheets were used, involving the labour of six feeders. The stereo-plates were fixed on two rotating cylinders. The apparatus for delivering the printed sheets was very ingenious; but, as will be seen, this machine was not so much advanced as the Walter Press, in so far that it necessitated layers-on.

The Walter Press may be regarded as, in the main, the type of subsequent web-rotary machines, which differ from it but in accessories. The "Victory," its chief rival, was brought out in 1870. It gained favour among country newspaper proprietors for its being cheaper in price, and possessing folding arrangements, an important feature in places where the newsvendors require to receive their copies ready folded. In 1871, Messrs. Foster, of Preston, introduced a machine, also adapted, from its comparative cheapness, to the circumstances of provincial journals. It printed from movable type, and obviated the necessity of a stereo plant and staff. The type was held on the type-beds, as in Hoe's type-revolving machine. In 1872, Messrs. Pardoe and Davies brought out a rotary machine—called the "Whitefriars"—for printing periodicals from type or type and cuts combined. Four cylinders are arranged round a semicircular frame, the two in the centre being used for the impression, while the two outside receive plates, which are not cast to a curvilinear form but bent. This machine is also built to print from a continuous roll. In 1873, Messrs. Hoe, of New York, introduced a rotary machine, which claimed a speed of fourteen thousand perfect sheets per hour. The roll of paper was above the type cylinders, which were fitted on a horizontal frame. The second impression cylinder was of three times the diameter of the first, and was placed underneath. The object of making this cylinder larger was to obviate the set-off, the impression being given on three different portions. The sheet having been printed by the inner forme, passed under the cylinder to the outer, and thence between two cutting cylinders, which were of the same diameter as the type cylinders. In the same year Marinoni also brought out a rotary machine. Both of the makers of the fastest machines had thus abandoned their former principles and adopted that of the *Times* rotary web. Marinoni's is simple in design. Four cylinders are arranged one above each other. The two centre ones are the impressing cylinders, the stereo-plates being fixed on the cylinders at the top and bottom. The inking appliances are at the top and bottom.

The excellence of the work done by rotary machines is patent to every reader of a daily paper. Mention should be made, however, of two machines specially designed for printing cuts or engravings requiring extra care in working, and abundance of inking. One of these is the "Ingram" machine, introduced by the proprietor of the *Illustrated London News* in 1876. In order to obviate the disadvantages of bending the stereo-plates of the cuts to the sharp curve corresponding to that of the ordinary rotary machine, in the "Ingram" the diameter of the printing cylinder is largely increased, even rendering it capable of containing two, three, or more copies of the cuts. The inking apparatus includes an increased number of inking and distributing rollers. The other is a German machine, which prints an illustrated serial at Stuttgart. The paper is not damped before printing; instead of that, super-calendered, half-sized dry paper is used. To prevent "set-off," there is a web of "set-off" paper wound on a spindle like the printing paper. After being used, it is dried and sent through the machine again and again.

The culminating point in regard to speed, has, so far, been attained by Messrs. Hoe, of New York, the most recent of whose machines seem altogether fabulous in the extent of their output. One prints and delivers folded an eight-page paper like the *Standard* at the speed of twenty-five thousand per hour. Another prints eight-, ten-, or twelve-page papers, delivering them folded, to either half-page or quarter-page size, at the rate of twenty-four thousand per hour. For ten-page and twelve-page papers, the inset of two or four pages is printed on a supplementary machine inside, and is then directed to and folded with the main web of paper. And another prints eight-page newspapers, delivering them folded to either half- or quarter-page size, at the rate of eleven thousand per hour. It also delivers two-, four-, eight-, or sixteen-page sheets unfolded. A four-page paper like the *Echo* would be turned out, completely printed on both sides, at the rate of nearly fifty thousand per hour by this apparatus. If it were imagined possible to print an edition of such a paper on the Columbian press of the year 1817, it is a simple matter of calculation that this one hour's production would entail the labour of two men for no less than four hundred hours, or forty working days. Machinery has, it must be admitted, undoubtedly debased certain industries. The machine-laces of Nottingham are vastly inferior to the patient hand-work of the Irish or Belgian lace-weaver. Machine-made furniture cannot be compared to mediæval examples, created by the chisel, hammer, and saw of the cunning craftsman. But in regard to printing, the conditions are about the reverse. The newspaper of to-day is incontestably better printed than that of a century ago, worked off by the laborious process of the hand press. In all technical requirements popular literature is superior to that of the last century. The impression is clearer, the inking more uniform. Whatever some people may say, in their adulation of the productions of the mediæval printers, there are books now issued from the press which surpass in nearly every valuable characteristic the most belauded achievements of the Aldi, the Estiennes, or, coming down later, of Baskerville, Bulmer, Bodoni, and the Didots. Improvements in style have gone hand in hand with improvements in methods, and the development of printing machinery has been as satisfactory in its results from an æsthetic as from an engineering point of view. The wonderful progress made during the past seventy or eighty years has promoted, to a degree which it would be impossible to realise, the freedom and prosperity, the intelligence, and the happiness of the nation.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

The lake shipbuilding trade.—The lake shipbuilding yards are very busy and are crowded with orders. At Buffalo, N.Y., the Union Dry Dock Company is building two of the largest boats in the lake marine; they are the Owego and Chemung, for the Union Steamship Company, and were designed by Geo. B. Mallory, the naval architect, of New York. They will cost 300,000 dols. each, carry 2800 tons of freight, and are to have a speed of 16 miles per hour. The average speed of the fastest boat now on the water is 13 miles per hour. The Owego will have a double bottom, forming a water ballast compartment the entire length of the vessel. She will have a triple expansion marine engine of 3000-H.P.; cylinders, 28in., 42·5in., and 72in. diameter, stroke 54in. She will have six steel boilers, steam labour saving apparatus of every kind, and will be the best appointed vessel of her kind. She is entirely of steel, 351ft. long, 41ft. beam, 25·5ft. deep. R. Mills and Co. are building a steamer with a freight capacity of 2000 tons. At Cleveland, O., sixteen new vessels are in hand, six are built of steel and fifteen are steamers; the steel boats are being built by the Globe Shipbuilding Company. The largest is the Cambria, for the Mutual Transportation Company, 297ft. long, 39ft. beam, 24ft. moulded depth. She has a sectional wheel 13ft. in diameter driven by a triple expansion engine with cylinders 24in., 38in., and 61in. diameter and 42in. stroke, and 1500-I.H.P. She has seven hatches and several steam hoists, &c., to facilitate the rapid handling of ore. At Detroit, Mich., the Detroit Dry Dock Company is building eight vessels, one is of steel with a freight capacity of 2650 tons, 304ft. long, 40·5ft. beam, 26ft. deep, draft 15·5ft.; two of the ships will have triple expansion engines. There are several vessels of less importance, and all the yards are busy. The following is an estimate of the work now in hand:—Cleveland, O., 16 vessels, 36,500 tons, 2,340,000 dols.; Bay City, Mich., 9, 18,600, 1,060,000 dols.; Detroit, Mich., 9, 16,200, 1,301,000 dols.; Buffalo, N.Y., 3, 7600, 735,000 dols.; Trenton, Mich., 3, 5800, 315,000 dols.; Milwaukee, Wis., 2, 4500, 270,000 dols.; Grand Haven, Mich., 1, 2500, 130,000 dols.; St. Clair, Mich., 1, 2400, 130,000 dols.; Marine City, Mich., 1230, 120,000 dols.; Baraga, Mich., 1, 1600, 35,000 dols.; Mt. Clemens, 1, 200, 4000 dols.; totals, 47 vessels; aggregate tonnage, 98,200 tons; total estimated cost, 6,460,000 dols.

An express train safely lighted and heated.—The Boston and Albany Railroad Company on March 30th ran the first thoroughly safe train. The train was the regular express from Boston to New York, leaving Boston at 4.30 p.m. The cars were lighted by incandescent electric lamps, the Julien storage battery being used, one in each car, with sixty cells, weighing about a ton, and giving a twelve-hours' supply; the lights are 16-candle power each. The heating was effected on the Martin system. Steam is taken from the boiler of the locomotive and is led through the train by a main pipe running the entire length of each car. From pipes running along the sides of the car a double return pipe extends under each seat, the water caused by condensation passing down to a trap. The steam can be shut off from any one car without affecting the rest of the train, and there is no appreciable effect on the performance of the engine. The cost of equipping a car with this heating apparatus is 200 dols.

New York Underground Railroad.—This company has formulated an immense project for making New York a great railroad centre and for facilitating its large freight traffic. Under this project the existing Grand Central Depôt at Forty-second-street will be abandoned, and an immense union depôt, for passengers and freight, erected at Morrisania with extensive yards, sheds, &c.; this will be the terminus of the New York Central and Hudson River Railroad, the New York, New Haven, and Hartford Railroad, the New York City and Northern Railroad, and the New York and Harlem Railroad, which now run to the Grand Central Depôt. The Suburban Rapid Transit Railroad, which is the extension, north of the Harlem river, of the New York Elevated Railroad—Second Avenue line—will also connect with the new depôt. An eight track line is to be built along the New Jersey shore to connect with all the trunk lines centreing there, and crossing the Hudson river by a cantilever bridge at Fort Lee will form a direct route to the new depôt, crossing the Harlem river by a large steel bridge. To facilitate the freight traffic of the city an elevated railroad will be built along the water front streets on both sides of the city, with sidings and switches into the warehouses of all the large railroad, ship, and transport companies, as well as into all the large factories, warehouses, &c. The underground railroad, which is the ostensible purpose of the company, will be a double track line, for passenger traffic only, from the Battery to Forty-second-street, with branches to the most important railroad ferry houses at which street it will connect with the present tracks from the Grand Central Depôt, over which the trains will run to the new Morrisania depôt.

Coast defences.—General Henry L. Abbott has been lecturing on the necessity of increasing the coast defences of this country, and in many quarters it is being urged that immediate steps should be taken.

Government ordnance foundry.—Plans are being considered by the Secretary of the Navy for the equipment of the Washington Navy-yard as an ordnance foundry. Most of the large machine tools must be procured from abroad, so that it will be two years before large guns can be turned out, but in the meantime guns up to 6in. calibre can be made. Captain Rush R. Wallace will be the commandant. Commander McCormick will be inspector of ordnance, and A. G. Menocal, civil engineer.

Locomotive cylinder proportions.—The Master Mechanics' Association has issued a circular to railroad master mechanics asking what rules they recommend for calculating the dimensions o cylinders for passenger locomotives when the boiler pressure diameter of and weight on drivers are given, with recommendations as to departures from these rules in the case of freight and switch engines. The circular asks the reasons for the adoption of these rules, demonstrations of their correctness by results, whether the diameter of drivers is taken when new or half worn, and what percentage of boiler pressure is assumed for average cylinder pressure.

A railroad for Santo Domingo.—The Government of Santo Domingo has granted to an American company, composed of New York capitalists, and headed by General Horatio C. King as president, a concession for a railroad, with land grants amounting to about 500,000 acres and exemption from taxes. The company has been organised as the Santo Domingo Central Railroad Company. The main line will be from Barahona on the south side to a port on the north side, a distance of 150 miles. Branches will be built, making a total length of about 250 miles.

German Shipbuilding.—In the "Germania" shipbuilding works at Kiel work is being actively proceeded with on the large contract booked by the company some time ago for the Turkish Government. This is for torpedo-boats and "catchers" of the types now most in favour by our own Government. The order includes nine torpedo-boats of about 128ft. long by 13ft. 9in. beam and 3ft. 3in. deep, one 140ft. long by 15ft. 6in. beam, and two chasers of considerable size—one 230ft. long, and the other 180ft. long. Recently the company has turned out a first-class cruiser, preliminary speed trials with which have yielded the gratifying result of 21½ knots per hour, and that with very inferior coal. This vessel is 318ft. long by 32ft. broad, a remarkably narrow beam for the length, when compared with our new cruisers of the "Orlando" type. Her midship section is fine, but the water-lines are straight, and tending to fulness rather than otherwise. The speed attained is certainly noteworthy, and reflects credit on the firm producing the vessel. The "Germania" Shipbuilding Company, whose engine works are in Berlin are certainly pressing forward in the competition for the supply o war ships for the Great Powers.

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

(*From our own Correspondent.*)

Few ironworks began the week after the holidays with a large accumulation of orders. Mostly, the mills and forges have been deficient of enough specifications to afford full employment to the hands. Those which have resulted from the sales effected at the quarterly meetings have proved to be under the average; but as some buyers who usually attend the Wolverhampton and Birmingham meetings were last week absent in connection with their Easter holidays, it is hoped that now that these customers know what were the prices determined upon, they will not continue the waiting policy which they had begun to adopt before the meetings came off.

The suspension of buying on account of the United States is the chief feature of current business. Indents are conspicuous by their absence, and speculative offers are at much too low a figure to arrest the attention of makers. Home customers, availing themselves of the position, are likewise seeking to buy at impossible figures. Reasonable terms receive prompt attention; and on such terms valid requirements are promptly satisfied. And certain of the orders which have this week been received demonstrate the narrowness of stocks in the possession of both merchants and manipulators alike of iron and of steel.

Few commodities have been quicker to respond to the demand for easier rates than certain brands of high-class hematite pigs. These were easy to buy to-day—Thursday—at a good half-crown under the prices confidently asked at the quarterly meeting in Wolverhampton. This week 52s. 6d. easy would buy such iron. Nevertheless there were firms who make a medium quality of such iron who neither yesterday in Wolverhampton, or to-day in Birmingham, would accept any less money than they were before asking. In such case earlier sales embrace their total output for some few months to come, though all their available furnaces should be kept going.

As before, so also now, these makers when forced to quote, asked prices that it was known would be rejected. By the time the orders now in hand are worked off, "the Yankee—they intimate in the phrase of the market—will come on again."

There is an active enquiry this week for double-sawn crop ends of steel rails. These are ends of rails freed of their fangs and suitable for reheating and slitting up into numerous oblong sections which the cutlers and the rest in Sheffield and Birmingham display much ingenuity in adapting to requirements before discharged by steel made for the purpose.

This article has lately been selling at 60s. a ton, and the demand has been so considerable that the market is practically bare of it, yet consumers decline to give a price 5s. under that figure.

Though at their meeting in Birmingham last week the galvanisers resolved to make no alteration in prices, there is yet a somewhat severe competition going on, and the makers of the black sheets find it imposible to realise the prices of a fortnight ago. Doubles have this week rarely realised £6 7s. 6d., galvanisers protesting that £6 5s. is too high a rate, while for trebles they are even less inclined to give £7 5s.

Medium iron bars are less pressed at the moment by steel bars. These last are somewhat stronger this week, £6 5s. being now firmly demanded. But soft steel bars, on the contrary, are somewhat lower, and are to be occasionally bought at a little over £5, the price of common iron bars, which in their turn are a shade weaker.

The demand for common tin-plates for export is scarcely so brisk in this district as before the termination of the strike in Wales. Inasmuch as 12s. 6d. easy per box is now being accepted free on board in Swansea, Staffordshire, and Worcestershire, tin-plate firms are out of the competition for sheets for the United States required in such services as petroleum cans and meat and fruit tins. The same applies also to the Russian and a portion of the Australian trade in the same article. Yet a fair business is at the same time under execution for Australia in the higher qualities, and in sheets for stamping and for working-up purposes of the quality usually rolled by the tin-plate firms.

Tinned sheets of the "Cookley K," brand are 26s.; Cookley SS," 24s.; "Cookley," 23s.; black "Dibdale," 8s.; "K.B.C.," 9s.; "Crown," 10s. 10d.; "C.SS charcoal," 14s. 10d.; "Knight's charcoal," 18s. 10d.—all per box at the works.

Knight's Crown bars are £7; plough bars, £9; and charcoal bars £15—also at the works.

The quotations of Messrs. E. P. and W. Baldwin at date are:—Severn singles, £10; Wilden B., £11; BB., £12; singles, £11. Upon doubles an extra 20s. to 30s. per ton is quoted, and upon lattens a further 20s. to 30s. Charcoal sheets are £15; best charcoal £18, and extra qualities £21.

Local iron and steelmasters are encouraged to hope for a better export demand as the year advances by the nature of the Board of Trade returns for March. These manifest that the iron and steel trades still show a steady and improving advance, the total quantity exported for the month being 342,934 tons, against 255,210 tons for the corresponding month of last year, an increase of 87,724 tons, or 34 per cent. The value was £2,115,050, an increase of £320,387, or 15 per cent.; but the prices have not proportionately improved. In pig and puddled there was an increase of £87,795, or 62 per cent.; in bar and angle, &c., £14,337, or 13 per cent.; in wire, £1723, or 3½ per cent.; telegraphic wire, £37,135, or 103 per cent.; cast and wrought, £45,644, or 13 per cent.; old iron, £63,672, or 141 per cent.; and unwrought steel, £82,101, or 65 per cent. Railroad iron, on the other hand, shows a decrease of £35,746, or 11·6 per cent. The following are the figures relating to values:—

Iron.	Month of March. 1886. £	1887. £
Pig and puddled	141,878	229,673
Bar, angle, &c.	109,121	123,458
Railroad	307,868	272,122
Wire	48,592	50,316
Telegraphic ditto	36,165	73,300
Cast and wrought	347,868	393,512
Hoops, sheets, &c.	313,256	246,211
Old iron	45,007	108,679
Steel, unwrought	125,476	207,577
Hardware and cutlery	248,632	257,180
Machinery	564,252	651,631
Steam engines	268,580	255,084

The following are the figures showing the tonnage of iron shipped:—

Iron.	Month of March. 1886. Tons.	1887. Tons.
Pig	65,845	94,849
Bar, angle, &c.	18,154	22,196
Railroad	53,776	57,745
Wire	3,572	3,479
Hoops, sheets, &c.	25,592	27,516
Tin-plates	28,150	33,593
Cast and wrought	31,830	34,699
Old	15,529	36,190
Steel.		
Unwrought	10,625	31,457
Steel and iron combined	2,137	1,210

The iron main business is at a low ebb, and prices are sadly cut up. Not a little of the quietude is traceable to the indisposition of the Board of Trade to permit free expenditure by the metropolitan water companies at a time when there is every prospect of the several concerns being taken over by the municipalities or by the Government; and pressure has had occasionally to be put upon the Board of Trade. That authority has had to be told that unless they relax their restrictions the companies will be in the position of men who will be subjected to pains and penalties for not doing that which such restrictions preclude them from doing. Orders are now under execution for mains which could not have been bought if the water companies had not taken this action, and the Board of Trade had not judiciously yielded.

A large quantity of wrought and cast ironwork is being required by the Huddersfield Corporation in connection with a contemplated wholesale market, which is to cover an area of 2655 square yards.

It is anticipated that next week a general strike in all branches of the Cradley Heath chain trade will be declared.

The Birmingham, Tame, and Rea District Drainage Board are being congratulated upon a new development which is just now occurring of their system. It has long been felt by the Works Committee that when the success of the system of irrigation by the effluent sewage had been demonstrated on the farm of the board, other agriculturists in the neighbourhood would be desirous of sharing in the advantage, and that by that means a wider area would be available for the final filtration of the effluent through the soil, A commencement has now been made in this direction by an arrangement with an agriculturist whose lands adjoin those of the board to irrigate fifty acres of such land.

A meeting of the Walsall Chamber of Commerce was held on Monday, when a communication was announced from the War-office requesting the Chamber to ascertain whether the publication of prices in tenders accepted by them would be of advantage to the contractors themselves and to the community at large. It was decided that before a reply was sent the secretary should communicate with the chief manufacturers in the district, and obtain their opinion upon the matter.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The depression in the iron trade of this district seems to increase rather than decrease, and the second quarter of the year has opened with only a very discouraging outlook. There is a continued absence of new work of any weight coming forward, and makers and users of iron seem to be each waiting to see which will have to give way the first. So far as the market in its present inanimate condition affords any means of judging, it is unquestionably in the favour of buyers. Makers are, of course, expecting that very shortly consumers will be compelled to come into the market to renew their contracts, and they are holding on as firmly as possible to present rates; but these keep them out of the market, and in the meantime their position is being weakened by the underselling of merchants and speculative operators, who are prepared to entertain any business that is offering at considerably under current rates, whilst consumers, seeing the downward course that prices are taking, simply buy from hand to mouth. The chief source of weakness is, no doubt, the excessively low figures at which warrants are now being quoted, and which are so far below the prices asked by makers, that speculators are encouraged to "bear" the market; and makers, as they have to seek for orders, are being forced down in their prices, which seem to be gradually getting back to pretty near the low rates that were ruling prior to the close of last year.

The Manchester iron market on Tuesday brought together about an average attendance, but business was extremely slow, and where sales were made lower prices had to be taken. For pig iron there was little or no inquiry of any weight. Lancashire makers, although they have come down slightly on their quoted rates, are still quite out of the market. For forge and foundry qualities they are quoting about 38s. to 39s., less 2½, as their minimum for delivery equal to Manchester, but there are Lancashire brands to be bought from makers at about 37s. to 37s. 6d., less 2½, and there are some sellers at even 6d. per ton under these figures. For outside brands makers' quoted prices remain much about the same as last week, but in most cases they are prepared to entertain offers at about 6d. under the list rates, and there is keen underselling both in Scotch and Middlesbrough iron where business can be done.

Makers of hematites are still holding on to about late rates, but they are being undersold by merchants and dealers to the extent of quite 2s. to 3s. per ton.

In the manufactured iron trade business is still very slow, and makers generally have great difficulty in finding sufficient work to keep their forges going. Quoted prices remain on the basis of £5 per ton for good qualities of bars delivered into the Manchester district, but where there are anything like favourable specifications for prompt delivery to be got makers are not very firm in holding out for their full prices, and in a good many cases £4 17s. 6d. per ton is being taken rather than allow orders to pass.

From some of the machine tool makers I receive reports of an improvement in trade, and here and there firms are getting decidedly busier, but this is not at all general, and the prevailing reports are still anything but encouraging. There are very few engineering works that are what may be termed fully employed, in most cases they are but very indifferently supplied with work, and any orders that are got are competed for quite as keenly as ever, with the result that work is frequently taken at unremunerative prices, simply to keep the shops going.

The engineering section of the Manchester Exhibition is now in so forward a state that a very fair opinion can be formed as to how this important branch of industry will be represented, and a brief outline of the general characteristics of the exhibit will be of interest. The superficial area covered by this section of the Exhibition is about 150,000 square feet, independent of the large boiler-house, in which ten 30ft. by 8ft. Galloway boilers have been laid down, whilst the number of exhibitors is about 400. The boilers are already under steam, and they will supply motive power to four separate engines, which have been put down respectively by Messrs. Hick, Hargreaves and Co., Musgrave and Co., Woods and Co., of Bolton, and Messrs. Daniel Adamson and Co., of Hyde; and these engines, which are capable of transmitting upwards of 1000-horse power, will furnish the power for the machinery in motion. The whole of the main driving is by rope, the power in several instances being transmitted from shaft to shaft by means of double belts, and there are six ranges of shafting running the whole length of the building, 510ft., to give motion to the exhibits along their respective lines. To prevent radiation of heat, the steam pipes in this section are carried in a culvert outside the building, and at every 30ft. there are branch connections. The chief feature of this section of the Exhibition will, of course, be the display of textile machinery, and this occupies a bay 50ft. wide, running from end to end of the building. Here the various manufacturing processes in connection with almost every description of fibre will be shown, and cotton will be treated from the scutcher to the loom, with all the most modern improvements in the various intermediary processes of manufacture. After the cloth leaves the loom, the several processes of sizing and finishing will be shown, with the most recent improvements in calico-printing machinery, one machine printing simultaneously in ten different colours. Gas engines will form a very important section, and amongst them there will be several new inventions which have never been seen before, whilst in the grounds outside will be seen apparatus for making the Dowson economic gas, the paraffin patent gas, the Mansfield gas, and other interesting processes. Pumps will form a prominent class in this section, the chief makers evidently endeavouring to outvie each other in the size and quality of their respective exhibits. In heavy machine tools there will be some of the finest examples that have ever been brought together, and which will illustrate the enormous progress that has been made in the development of speed and accuracy of work; whilst in the lighter class of tools quite a number of novelties are being shown. Steam hammers are being shown by the best known makers, and there will also be a good display of the most approved types of fuel economisers. Confectionery and jam-making machinery, the manufacture of hats, brush making, gutta-percha shoe making, and other manufacturing processes will be shown in operation; and in corn grinding there will be illustrations both of roller milling and stone dressing. In the still machinery section there will be a number of very fine exhibits, some of them partaking of an educational character, and such as have not been seen in any previous Exhibition. Amongst the most interesting will be a series of exhibits showing the process of iron and steel manufacture from the ore to various descriptions of finished goods, and there will be a magnificent display of six splendid locomotives supplied by the principal makers in the country, showing the most recent progress in this branch of railway engineering, and in contrast to these will be a model of the old Rocket, made by Mr. Webb, of Crewe. The very forward condition of this portion of the exhibition, which is probably in a more complete state than any other section, is an evidence of the energy with which the exhibitors have set themselves to work to bring together what will be the finest display of engineering appliances and machinery that has ever been collected in one Exhibition, and is very creditable to the management, which has been in the hands of Mr. R. H. Jackson, who held the position of assistant-superintendent at the Inventions Exhibition, and had the entire charge of the machinery section at the recent Liverpool Exhibition. In no previous Exhibition has so important a section been so far advanced a fortnight before the formal opening; and I may add that the work of getting the various exhibits into position has been greatly facilitated by the portable railway, about a mile and a-half in extent, which, with turntable, points, crossings, &c., has been laid down in the Exhibition by De Cauville, of Paris, and which, when any particular road has been temporarily blocked, has enabled exhibits to be carried without difficulty by other routes to their destination, and thus prevented numerous delays which would otherwise have been inevitable.

In the coal trade there is a steady business doing, and with the exception that in the better classes of house-fire coal there is a little giving way, prices generally are being well maintained. At the pit mouth, best house-fire coal averages 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common house coal, 5s. 9d. to 6s. 3d.; steam and forge coals, 5s. 3d. to 5s. 6d.; burgy, 4s. 6d. to 4s. 9d.; best slack, 3s. 6d. up to 4s.; and common, 2s. 6d. to 3s. per ton.

For shipments the demand continues fairly good, and delivered at the high level, Liverpool, or the Garston Docks, prices average 7s. to 7s. 3d. per ton.

The question of miners' wages is again coming to the front, and it is not impossible that with the close of the present month some reduction on the rates now being paid may be put in force.

Barrow.—There is again a weaker tone to note in the hematite pig iron trade. The demand has fallen off, especially from American sources, and there is not so much doing on home account, but makers are well placed for orders, and it is probable that activity in an industrial sense will be maintained at the iron works in the district for several months to come, notwithstanding the fact that large stocks are held at makers' works and elsewhere. But the great weight of iron in hand is for the most part held by second-hand dealers and speculators who are disposed to clear out at lower prices on a falling market. This is one of the most unfortunate features of speculative sales. They help a market up, certainly, but they do a great injury to trade when prices are declining, and when negotiations with producers are necessarily cut off by the lower rates at which holders of stock are inclined to sell. Prices are now quoted at 45s. per ton for mixed numbers of Bessemer iron, net f.o.b., or at makers' works. But holders of iron are asking 42s. 6d. upwards. Of course special brands are fetching the full figure, and some of the largest makers who are well employed, and have plenty of orders in hand, are still quoting 47s. 6d. per ton. At present makers, generally speaking, are doing no business at all. The question is whether the iron market is declining to the low position it held last autumn before the advance in prices, consequent on an improved demand, set in. There are many reasons to believe that for at least six months this will not be the case, as makers are independent of orders, and buyers can only deal with large holders at present prices, while stocks altogether do not represent more than the deliveries of three months. The steel trade is briskly employed on heavy goods, but a weak trade is shown in merchant qualities of metal. Rails, however, have declined in price, and makers' quotations for heavy sections, which a month ago were £4 6s. per ton net f.o.b., are now £4 1s. 3d. net f.o.b. Billets, which are in good demand, are quoted at £4 per ton. Shipbuilders still occupy a very inactive position, and not only are the yards practically bare, and next to no work proceeding, but the prospect of new orders is very poor, while the engineering, boiler making, and kindred branches are in an equally unsatisfactory position. The iron ore trade is quite firm, although prices show a slight decline. Speculative sales are quoted at 9s. 9d. to 10s. 9d. per ton net at mines, but some of the largest raisers are not in a position to quote at all. The coal and coke trades are fairly employed, and there is a general good demand for steam qualities. Shipping is much more busily employed, and large shipments of metal are to be made during the season. A new line of steamers under the management of Messrs. Tapscott is about to ply between Barrow and Montreal, chiefly with rails and other classes of steel.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Is it generally known that under former patent laws Government claimed the right of adopting anything they chose, of British invention, without acknowledgment or reward? Eleven years ago a Sheffield manufacturer, who has made himself a name in the manipulation of steel, secured a patent for the production of common and shrapnel shell and other similar projectiles, which were cast the shape and thickness required, and were not liable to be over-heated. Forging was dispensed with, and the walls were greatly reduced in thickness. They were subjected to most severe tests, some of them indeed being fired three times over without bursting or breaking up, and nearly double the charges could be inserted therein. Years passed, and nothing further was heard until two years ago, when the patentee discovered that the Service had adopted the principle. Since that date, the inventor assures me, the common and shrapnel shells have been almost, if not entirely, manufactured of steel, and are made so to-day to the extent of probably 2000 tons per year. He never received the slightest acknowledgment for his pains, and when, with a view of attempting legally to enforce his claims, he consulted counsel he was referred to the fact that Government under former patent laws claimed the right to take what they chose without paying anything for it. Inventors are more fortunately fixed now. The Palliser projectile, which was made in cast iron—soft iron body with a chilled point—obtained for its inventor considerable honours and some £25,000 in cash. For many years it was regarded as an admirable projectile, but it is now unavailing against compound plates. Originally, the common shell was also cast in a softer cast iron, as well as the shrapnel shell. The increased power of the guns, and the increased powder charges forced into the common and shrapnel shell burst them, and it was impossible to increase the thickness to fit in the guns, for they were already too thick by half internally to get strength, and the thicker they were made the less charge they carried. Various schemes were devised to overcome this difficulty. Some shells were forged and made out of sheets and plates, and built up; but none succeeded until the Sheffield steel manufacturer hit upon his scheme, for which, as I have said, he did not even receive thanks. So far as known, prior to the date of this invention, none were ever supplied cast hollow in steel. When supplied as forged the hollow chamber and plug-holes for charging had to be drilled out of the solid, and all the forged and built-up shells had to pass through various forging and mechanical processes. They were practically useless. If made sufficiently hard to penetrate they were too brittle, and broke up; if made softer, they failed to penetrate and "set up," like a dumpling. All these difficulties were overcome, after great cost and

much thought; and steel armour-piercing projectiles were also made hollow and lighter, and could be supplied more cheaply and quickly than other steel shells. Being cast in steel they possessed greater penetrative and cohesive power, and were no doubt the best steel projectiles known until the advent of the French projectiles. The inventor complains that his services have passed unrecognised in any way; and to add to the unkindness, the Government, instead of encouraging English firms who could make steel shells, gave an order to French manufacturers—Firminy and Holtzer—for 200 each. Still, he has continued to give close attention to the subject, with the result that he has again come to the front with a steel shell, for which he claims very distinct advantages. A trial of his new shell has been made, and I have already given you the broad results in The Engineer. Briefly, this 6in. steel shell of Sheffield manufacture passed through a 9in. compound plate on the same day as a 9in. French shell, four times the weight, failed against a 12in. plate. A steel shot weighing 400 lb., a chilled shot and a cast steel shell of similar weights, were recently fired against a 10½in. compound plate on board the Nettle gunship at Portsmouth. Locally, manufacturers complain that these experiments are unfair. One of them, "A Steelmaker, who is also an Engineer," puts the case thus in the *Sheffield Telegraph*:—"A 6in. Sheffield shell, 100 lb., is expected to go through a 9in. compound plate, whilst these three other, foreigners', shells, weighing 400 lb., each, cannot penetrate a 10½in. compound plate. There is no sense, as you have previously mentioned, in such experiments. Why does the Government ask an English maker to do with a 100 lb. shot what a foreign maker cannot do with a 400 lb.? Any one will perceive the unfairness of this test to the maker of the smaller shell."

Speaking in Brightside, last week, the Right Hon. A. J. Mundella, M.P., made a vigorous protest against the Government production of steel at Woolwich on a large scale. He stated pretty distinctly that an arrangement had been come to whereby the Sheffield manufacturers by making extensions to their productive powers, were not to have the Woolwich authorities as rivals; and yet, unknown to their superior officers (Mr. Mundella declared) very large extensions had been made at Woolwich. This is a question which is not likely to rest here. Our Sheffield firms are now completing the extensions they undertook to make, with the result that they are rapidly approaching a proficiency for producing large steel castings unequalled by any foreign firms. They will naturally expect the Government to carry out their part of the contract, and not deprive them of work with which to keep these large appliances in operation.

During the first quarter of the year the Yorkshire collieries have largely increased their tonnage to Hull, as well as their export business from Hull. For the quarter, the Yorkshire collieries sent to Hull 361,352 tons, being an increase of no less than 91,736 tons on the corresponding quarter of 1886. The coal exported during the same period was 150,431 tons, as compared with 71,689 tons in the quarter ending March, 1886. The largest increases are shown by France, Germany, Italy, and Sweden and Norway.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

Although the shipping season has fairly commenced, and exports are increasing satisfactorily, the Cleveland pig iron trade is in no better condition. The outlook is in fact exceedingly gloomy, and prices are still tending downwards.

The market held at Middlesbrough on Tuesday last was thinly attended, and only a few unimportant transactions took place. Certain speculators who bought in January, and are unable to hold any longer, are selling at the best price they can obtain, and this tends to weaken the market. The value of No. 3 g.m.b., which on the 12th inst. was 34s. 6d. per ton, fell towards the end of last week to 34s. 3d.; and on Tuesday 34s. was accepted for prompt delivery. Neither buyers nor sellers are operating for forward delivery, and it is difficult to say what price would be taken. Makers are still able keep out of the market, and in view of the fact that they are reducing their stocks, their position does not seem a very bad one. Forge iron is still quoted at 33s. per ton, but slightly less has been taken.

Stevenson, Jaques, and Co.'s current quotations are:—"Acklam hematite," mixed Nos., 45s. per ton; "Acklam Yorkshire"—Cleveland—No. 3, 36s.; "Acklam basic," 36s.; refined iron, 48s. to 63s.

Warrants are weaker than makers' iron. The price current on Tuesday, both at Middlesbrough and Glasgow, was 33s. 10½d. per ton, but buyers were scarce even at that low figure.

For the first time for several months the stock of pig iron in Messrs. Connal and Co.'s Middlesbrough stores has begun to decrease. The quantity held on Monday last was 329,669 tons, which represents a reduction of fifty tons during the preceding week.

Shipments are increasing satisfactorily. Between the 1st and 18th inclusive of the present month, 45,769 tons of pig iron were shipped at Middlesbrough, which compares favourably with the 38,015 tons shipped in the corresponding portion of the previous month.

The finished iron trade is still in a discouraging condition. Fresh orders are scarce and prices are no better. On Tuesday the quotations given were as follows, viz.:—Ship plates, £4 10s. per ton; common bars, £4 12s. 6d.; and angles, £4 7s. 6d. All free on trucks at makers' works, less 2½ per cent. discount.

The demand for steel is quiet and prices are as follows, viz.:—rails, £4 2s. 6d. per ton; ship plates, £6 5s.; and angles, £5 15s.; subject to the usual terms and conditions.

The Cleveland district has just lost one of its ablest engineers by the death of Mr. Samuel Godfrey. He had been somewhat delicate for years, and in 1880 made a voyage to New Zealand for the benefit of his health, with encouraging results. The long-continued east winds which have recently prevailed proved too much for him, and he died of pneumonia on the 18th inst. Mr. Godfrey came originally from South Wales, his father and grandfather having both belonged to the same profession as himself. It is said that the latter was the inventor of the cataract which is so important a detail of the Cornish engine. At the age of twenty-four, Mr. Godfrey was selected by the late Mr. John Vaughan as his chief mechanical engineer, and the field of his operations was thenceforward Middlesbrough, Witton Park, and the neighbouring colliery districts. When Messrs. Bolckow and Vaughan handed over their business to the limited company which still bears their name, Mr. Godfrey remained as chief engineer under the late Mr. Edward Williams; and it was then that he had to bear the chief responsibility of the arrangement and construction of the Eston Steelworks. Altogether, he was in the service of Messrs. Bolckow, Vaughan, and Co., for twenty-six years; and when he left, a handsome service of silver plate and 200 guineas were presented to him, as a testimonial from the other members of the staff and the workmen. Mr. Godfrey died at the age of 54, and leaves a wife and nine children to mourn his loss.

The great strike in the Northumberland coal trade seems gradually approaching an end. Last week the employers sent a formal communication to the workmen's executive, declining to submit the question to arbitration. Fresh ballot papers were then issued, to ascertain whether the strike should be continued, or whether the executive should be empowered to make the best terms they could for a settlement. The result of this ballot was a decided majority in favour of a no-surrender policy. This decision was come to in spite of the fact that eleven weeks have already been lost. The subscriptions received from various quarters have proved totally inadequate, and the sufferings of the colliers are now intense. The ballot showed that although a majority were in favour of continuing the strike, a very respectable minority would be glad to go to work again on the best terms obtainable. This want of unanimity among the men has been naturally regarded as a proof of weakness by the employers. They held a meeting on Tuesday last, and decided to reopen the pits forthwith to all in favour of recommencing work at the reduction originally demanded. It was further agreed that a proportionate reduction should be made in the wages of deputies and off-hand men, and that a sliding scale should be formulated for the future regulation of wages. The executive committee of the colliers have also met to consider the situation. The wages committee have resigned their positions, and new ballot papers have been issued to ascertain whether the men desire to elect a new wages committee, or whether they are still in an uncompromising mood. Outside and disinterested observers are of opinion that the strike is on its last legs, and that a week or two at the furthest will be sufficient to terminate it, and that on the employers' terms. Had the colliers left their case in the hands of their officials at the beginning, they would have obtained much better terms, and would have avoided all the loss and suffering which have occurred since through their unreasoning obstinacy.

The shipbuilding trade on the north-east coast seems in a somewhat uncertain and variable condition. At Stockton-on-Tees, six steamers are in course of construction. There are, however, many idle berths, and not sufficient orders on the books to replace the vessels in hand, when the time comes for them to leave the port. At Whitby a number of shares in local steamers have just been sold by auction. One-sixty-fourth share in the Everilda, a steamer of 1950 tons carrying capacity, was sold for £132. A similar share in the Matthew Bedlington, built five years ago, and having a capacity of 3100 tons, was sold for £251. Several other shares which were offered were not sold, but the reserve prices were very nearly reached.

Among the various exhibits which are now arriving day by day at the Jubilee Exhibition at Newcastle-on-Tyne is a magnificent compound express locomotive from the Gateshead railway shops. It has been made under the superintendence of Mr. Worsdell, and to the design patented by himself and Herr von Borries. The high-pressure cylinder is 18in. in diameter and the low-pressure one 26in., the stroke common to both being 24in. The driving wheels are 6ft. 8in. in diameter. The valve gear is arranged on David Joy's patent system. The engine is magnificently painted and decorated, and is altogether a fine specimen of modern English mechanical engineering. Messrs. John Fowler and Co., of Leeds, have sent a special compound locomotive fitted with a crane. The latter is worked independently of the propelling power, and is capable of lifting three or five tons, according to the gearing used. The same firm have also sent two compound semi-portable engines, with automatic expansion gear; and a narrow gauge locomotive suitable for miniature railways with light traffic. A large road locomotive from the works of Messrs. Richard Garrett and Sons, of Leiston, Suffolk, has just been placed in the West Court.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron trade of Scotland is fairly active as far as the deliveries and shipments are concerned. The past week's shipments were comparatively good, amounting to 9160 tons, as compared with 7683 in the same week of last year. It is also noteworthy that the export season to Canada has begun, a shipment of 607 tons having been despatched to the Dominion in the course of the past week, while 2150 tons were sent to Russia. It is hoped that the navigation now being open to these countries, that we shall see an increase in the exports. During the week two furnaces were put in blast at Eglinton and one at Langloan; while one was put out at Quarter Ironworks, which are now completely idle, and it is not expected that smelting of ordinary pig iron will be resumed there. The total number of furnaces blowing is 79, as against 77 in the preceding week and 97 at the same date last year. Considerable additions continue to be made to the stock of pig iron in Messrs. Connal and Co.'s Glasgow stores.

Business was very depressed in the speculative warrant market, the quotations declining to 41s. cash, from which some recovery took place.

The current market values of makers' pigs are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 48s., No. 3, 43s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. 6d. to 46s.; Summerlee, 52s. and 43s.; Calder, 51s. and 42s. 6d.; Carnbroe, 44s. and 40s. 6d.; Clyde, 47s. and 42s.; Monkland, 42s. 9d. and 39s.; Govan, at Broomielaw, 42s. 9d. and 39s.; Shotts, at Leith, 48s. 6d. and 45s.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 48s. and 42s.; Eglinton, 42s. 9d. and 38s. 9d.; Dalmellington, 44s. 6d. and 40s. 6d.

The malleable iron makers of Lanarkshire complain that business is getting slack, and that orders come to hand slowly. On the other hand the activity is well sustained in the steel trade.

The Mining Institute of Scotland has had under consideration the Mines Bill, and has resolved to signify approval of it, subject to certain modifications.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

With the ending of the holidays, a little better tone has prevailed in the coal trade, and exports generally are looking up. Some collieries are doing well, and making large outputs. In the Rhondda valley this week the Clydach Vale has been totalling closely up to 1800 tons a day, and the manager thinks in a short time to bring it up to 2000 tons. In the face of such enormous results from one colliery it is no wonder that trade flags now and then. The coal there is 7ft. 6in. thick, and resembles a quarry.

Great improvements are being carried out in the Plymouth collieries, and a great increase may be expected soon from the South pit.

The coal trade seems improving in respect of quantity, but prices are stationary, quotations prevailing in respect of best steam from 8s. 3d. to 8s. 9d. f.o.b. Cardiff. In some instances sales have been effected at 8s. House coal is slightly drooping in price. No. 3 is quoted 8s. 6d. f.o.b. Small steam from 4s., with a trifling improvement in demand for best samples.

In the case of the Abercarn colliers a strike has been brought about. The pit has been worked at night every alternate week, and the day shift men complain that by this their wages have been lessened, and the pit too much crowded. Unless an arrangement is brought about, the hands will be brought up forthwith. Some are up already.

Newport coal trade has been slacker, on account of the holidays, the coasting total being only 17,000 tons. Swansea, on the other hand, has been busier; total last week, coal exports, close upon 23,000 tons.

A mass meeting of colliers has been held at Tredegar, addressed by Mr. Abraham, M.P. The subjects discussed were the Mines Regulation Amendment Bill, some clauses of which were approved, and some, as Mr. Abraham pointed out, objectionable, as they interfered with the vital interests of collieries, such as in check weighing. The meeting passed resolutions approving of short pay. In the Merthyr district a mass meeting of colliers has also been held, with the object of promoting unionism amongst the colliers of England and Wales. There is some degree of significance in the movement, but so far it cannot be stated that paid agitators are at work.

The iron trade is moderately good; demand for steel rails not so good; for bars, tin and merchant, better. Swansea imported 1100 tons of iron and steel this week. Steel rail quotations are from £4 5s. Prospects would appear tolerably good, seeing the briskness which has taken place in the foreign ore trade. This week Ebbw Vale, Tredegar, Cyfarthfa, and Dowlais imported large quantities. Treforest steel works are being repaired. I regret to hear that Mr. Godfrey, engineer, of Middlesbrough, who had a good deal to do in the fitting up of Treforest, and was consulting engineer at Cyfarthfa, is dead.

The character of the tin-plate trade may be regarded as rather perplexing, the make increases steadily and the sales increase, but prices have a tendency to droop. This is due to the needy portion on the list of makers who cannot afford to make for stock, and thus accept reduced figures. Prices for ordinary cokes are anything above 12s. 3d. Few advances are had by 3d., the general course is by 1½d., and 12s. 4½d. to 12s. 10½d. includes pretty well the business done. Best brands by the principal makers command 13s.; Bessemers' sell at this, and in some few cases at 13s. 3d.; Siemens' command 13s. 6d. to 13s. 9d., and even 14s. Over 47,000 boxes were shipped from Swansea last week, and the stocks there now are nearly 30,000 boxes less than at the beginning of the year. Swansea imported 650 tons of pig last week, and 137 tons of scrap steel.

Preparations are active in Cardiff for the season in improving the route to Weston and putting on new lines of steamers.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

There is little change to note this broken week as regards the iron markets of Rheinland-Westphalia. If anything, the demand has somewhat slackened, but it has been possible to keep up the prices pretty well, and to all present appearance they seem likely to remain stationary for some time to come, unless the share companies, to force business, begin again to sell at any price. This is a danger, and working with other people's capital, with facilities for creating fresh funds as the original ones are exhausted, which is now being freely done, makes it very difficult for private works to hold their own, which if they do not see their way to do, will ultimately determine many of them to cease working altogether. This is not the case yet, but judging from the past might well happen, if by any chance the trade instead of improving should take a downward tendency. It is questionable if prices are even now paying.

The ore trade here is not so brisk as it was, and on the Spanish market there is the same dull tendency. Rubios superiores cost at Bilbao 6s. 9d. to 7s.; and Campanil 7s. to 7s. 3d. p.t. The pig iron market is quiet, nearly the whole of the output for the second quarter being now sold, and no alteration in prices has been made known.

The prices of rolled iron have generally been maintained at M. 115 for girders, 110 for bars, and 120 p.t. for angle iron, quoted notations be it remembered, which are not always realised in practice, and there seems now no prospect in the immediate future of any rise taking place, although the works are still well employed. Thin black sheets have not been so much called for, and the prices, as last noted, rather tend to weakness. The non-arrival of American and the tardiness in giving out domestic orders causes dulness to prevail in the wire rod branch, but still the mill owners cannot yet complain of want of work. The steel works are moderately busy, one or two of them so much so as to be obliged to work overtime to complete orders.

A new trade is springing into life here, namely, the importation from abroad of puddle cinder in great quantities. It is stated that some of the basic steel makers have already contracted for it over the year 1888. The machine and boiler shops and foundries have secured a few fresh orders, but as a whole they are only partially employed. The reports from Silesia are still very favourable. There as well as in the West the consumption of pig iron seems to have outstripped the production, necessitating the near blowing in of fresh furnaces. The rolling mills as also the iron foundries have constant and full work for some time ahead.

The Belgian market is momentarily quiet. The works have still sufficient orders in hand to keep on with regularly. The demand from America has slackened materially of late, and is beginning to be felt; nevertheless, a brisk business is prophesied for the coming months. With few exceptions the foundries and constructive ironworks are well employed. Forty-seven tables have just fallen to their lot, but a large order for plates has been carried off by Krupp, which is causing considerable vexation in industrial circles.

In France, with the exception of Paris, the iron market is looking up a little. In Paris, prices, which have been moderately well sustained for some time, are now weakening through competition amongst the merchants themselves. Girders are offered at 122·50f. and merchant bars at 127·50f. p.t. The ironworks maintain their quotations rigidly, and orders, if moderate in extent, are coming regularly to hand in the three chief iron districts of Nord, Ardennes, and Haute Marne. Prices have risen 5f. since last month, and wire rods are noted—for No. 20 mixed 150f.; thin coke sheets, 150f.; and mixed, 155f. to 160f. p.t.

It may quiet alarmists who live in dread of German rivalry if the exports of iron goods for the month of February last are given. They were—pig iron, scrap, blooms, puddled bars, and ingots, 5233⅓ t.; iron and steel goods of all sorts, with the exception of machinery, 14,921 t.; and machinery, 1064½ t.; in all 21,219 t., against 20,025 t. for the same month last year. It must also be remembered that a good portion of this goes to Austria and that part of Russia where England does not come into competition.

An old project of constructing a bridge over the Danube at Presburg seems about to be realised. It will probably be financed by the Länderbank.

Italy is making industrial efforts just now. The first iron rolling mill established is close to the gates of Milan at Rogerado. Up to this it has rolled rounds and squares from 4 mm. to 110 mm., out of old foreign rails. There are five furnaces and 120 men at work. All the machinery is of Italian origin.

Lighting Omnibuses with Gas.—The Metropolitan Railway Company is now running one of its three-horse omnibuses between Portland-road and Charing Cross lighted by means of the Pintsch's Patent Lighting Company's apparatus, like that employed on a larger scale in the Metropolitan and other railway carriages. The experiment has been a complete succcess; a fine steady light is obtained, and the application of the system will probably be greatly extended in a short time.

Launch of a Steamship at Goole. — On the 13th inst. the ss. Emden, which has been constructed for the Yorkshire Coal and Steamship Company, of Goole, for their continental trade, was launched from the yard of Earle's Shipbuilding and Engineering Company, at Hull. She is designed to embody all the requirements of the service for which she is intended, as well as the most modern improvements, and the dimensions are as follow:—Length, 220ft.; breadth, 32ft.; and depth, 13ft. 6in. She is built to Lloyd's highest class for iron, and has topgallant forecastle bridge and poop, a considerable portion of the two latter being available as shelter for deck cargo and cattle, and water ballast is provided in main and after holds. A comfortable saloon, ladies' cabin, and state rooms are fitted amidships under the bridge for the passengers, the entrance to which accommodation, together with steering house, are in a house overhead; and the captain and officers are berthed aft under the poop, and the crew forward. The ship will be schooner rigged, with two pole masts, and when completed will have a smart appearance. The hatches, winches, &c., are carefully arranged to afford the utmost available dispatch in working cargo, and she has powerful steam steering gear of Harrison's make. The engines, which have also been made by the builders, are on the triple-compound, three-crank system, and have cylinders 21½in., 34in., and 52in. diameter, by 36in. stroke, supplied with steam of 150 lb. pressure from a steel boiler of large size.

AMERICAN NOTES.

(From our own Correspondent.)

New York, April 8th.

Brokers representing large purchasing interests have recently been furnished with estimates of quantities of material that will be wanted for engineering and railroad building requirements for the summer season. It is probable that within the next six weeks contracts for about 50,000 tons of steel rails will be placed for south-western delivery. It is also probable that the steel makers of Penna. and Ohio will be in the market for large lots of steel to be delivered at New York and Philadelphia. The placing of these orders will be delayed a week or two longer, and perhaps a month. The new freight rates have gone into effect throughout the country. Wages have been advanced in several branches of the iron trade. Labour agitations are threatened for a further advance to be made in June.

American manufacturers are alarmed at the remarkable increase in British iron and iron ore importations. The figures for January and February foot up 464,869 tons, against 268,828 tons for a like period last year—an increase of about 73 per cent. Of this year's importations 546,108 tons were ingots, blooms, &c., 48,640 tons pig iron, 40,204 tons of scrap, 20,517 tons steel rails, 3003 tons of hoop steel, 39,169 tons tin-plate, and 22,011 tons iron rods. The March importations will also be heavy, but the greatest rush will come in during this and next month. Just at present comparatively few orders are going abroad; but a careful study of the situation shows that the foreign demand will continue heavy, unless prices abroad should reach prohibited limits. American steel rail makers would not be sorry to see prices advance abroad, and are already anticipating such a result by increasing the cost of steel rails in small lots for summer and fall delivery.

Last year's copper production throughout the United States was 156,373,421 lb. A very heavy part of this came from Lake Superior, namely, 79,728,838 lb. From Montana and Arizona 73,000,000 were produced. From the Southern States the shipments were 29,811 lb. Railroad building is being vigorously pushed in all sections of the country. The mileage so far this year foots up 700 against 300 miles last year, and 165 miles for same time in 1885. The year of the greatest construction was in 1882, when up to this time 11,088 miles had been constructed. The increase in the production of pig iron last year over 1885 in this country was 1,640,017 gross tons, and the increase this year will in all probability exceed these figures. The demand for all iron and steel products is sufficient to preserve prices at the present rates, which are 21 dols. to 22 dols. for best foundry at tide water, 19 dols. to 19·50 dols. for best forge. Steel rails are difficult to obtain for summer delivery at 40 dols. Old rails have dropped to 22 dols. for shipment.

NEW COMPANIES.

The following companies have just been registered:—

Dixon and Corbitt and R. S. Newall and Co., Limited.

This company proposes to trade as manufacturers of rope, cord, and twine from metallic, fibrous, and other materials, wire workers and drawers, telegraph, telephone, and electric light cable manufacturers, lightning conductor and electrical appliance manufacturers, and for such purposes will take over the businesses and assets of the partnership firms of Dixon and Corbitt and R. S. Newall and Co., the Teams, Gateshead. It was registered on the 6th instant, with a capital of £120,000, in £10 shares, 6000 of which are preference shares. The subscribers are:—

	Shares.
*F. Dixon, Gateshead, hemp and wire rope manufacturer	1
*J. Corbitt, Gateshead, hemp and wire rope manufacturer	1
R. Dixon, Newcastle, hemp and wire rope manufacturer	1
M. Corbitt, Gateshead, hemp and wire rope manufacturer	1
*C. Leddell, C.E., 24, Abingdon-street, S.W.	1
*J. G. Gordon, Lindore, Glamorgan, steel manufacturer	1
J. Simpson, M.E., Heworth, Durham	1

The number of directors is not to be less than three, nor more than seven; qualification, 300 shares; the first are the subscribers denoted by an asterisk; remuneration, £100 per annum each.

Eclipse Portland Cement Company, Limited.

This company proposes to acquire letters patent and foreign concessions granted to Mr. Robert Stone for improvements in the manufacture of plaster and cement. It was registered on the 7th inst., with a capital of £10,000, in £10 shares. The subscribers are:—

	Shares.
*R. Stone, Lewin-road, Streatham, merchant	1
E. J. Bayley, Ferne Park-road, Hornsey, shipping clerk	1
*S. J. Barrell Prior, 5, Lawrence Pountney-hill, merchant	1
E. Appleton, 2, Warwick-villas, Wood-green, book-keeper	1
Mrs. S. Stone, Lewin-road, Streatham	1
R. Stone, jun., Little Hunock, Grays, clerk of works	1
Henry Peat, 9, Russell-square, Brighton	1

The subscribers denoted by an asterisk are appointed the first directors, at a salary of £200 per annum each, to be increased to £300 per annum when the net profits exceed £3000.

Newcastle-on-Tyne Machinist Company, Limited.

This company was registered on the 9th inst., with a capital of £3000, in £1 shares, to trade as cycle manufacturers and repairers. The subscribers are:—

	Shares.
J. Bowie, Newcastle, engineer	500
F. N. Tait, Newcastle, agent	100
R. S. Holme, Newcastle, merchant	10
S. R. Heenan, Newcastle, journalist	10
J. J. Simpson, Newcastle, clerk	10
D. Lumsden, Newcastle, confectioner	5
H. Dale, Gateshead, clerk	5
G. Hall, Newcastle, agent	2

Registered without special articles.

Economic Fuel Company, Limited.

This company was registered on the 6th inst., with a capital of £25,000, in £1 shares, to acquire the goodwill of the business of importers from Belgium of patent fuel, now carried on by Arthur Coombs, at 5, Crosby-square, and the business of manufacturing the "Economic" fire-lighter and fire reviver, now carried on by Arthur Coombs, at Copperfield-row, Bow. The subscribers are:—

	Shares.
J. Allen, Kingston-crescent, Portsmouth	1
J. Dakin, 27, Iffley-road, Hammersmith, clerk	1
Captain C. Howard, West Horsley, Surrey	1
A. B. Gasson, 32, Folkestone-road, Dover, clerk	1
R. O. R. Russell, 5, Ballarat-terrace, Richmond, 3rd Lancashire Fusiliers	1
J. Munro, 47, Ossian-road, Stroud-green, accountant	1
J. Marshall, Kingston-on-Thames	1

The number of directors is not to be less than three, nor more than five; qualification, £100 in shares or stock; the first are Messrs. P. E. Beachcroft, Gustave Hubert Weltzmann, and Henry de Grelle; remuneration, 10 per cent. of the net profits.

Exeter Patent Steam Carpet Beating Company, Limited.

Registered on the 6th inst., with a capital of £1000, in £5 shares, to provide gas, steam or other power for driving a carpet beating machine or machines. The subscribers are:—

	Shares.
F. Pollard, Exeter, public accountant	65
J. S. Lawdon, Plymouth, marble merchant	65
S. Simmons, Pleasant-grove, York-road, King's-cross, dyer and cleaner	32
J. Tulledge, Pleasant-grove, York-road, King's-cross, dyer and cleaner	32
W. Harvey, Pleasant-grove, York-road, King's-cross, clerk	2
E. Mitchell, Plymouth, commission agent	2
F. Sanders, clerk of the Devon County Orphan Asylum	2

Registered without special articles.

Kimberley, Potchefstroom, and Pretoria Railway Limited.

This company was registered on the 6th inst., with a capital of £1,800,000, in £10 shares, to apply for such legislative powers as may be necessary for the construction, maintenance, and working of a railway or railways in Cape Colony, the South African Republic, the Orange Free States, or other parts of Africa, and to apply for and obtain Government subsidies, grants, guarantees, aids or other assistance in furtherance of such objects. The subscribers are:—

	Shares.
J. Cass, Claremont, Bradford, stuff manufacturer	1
G. Reed, 79, Queen-street, Cheapside, merchant	1
E. Haslehurst, 11, Billiter-square, shipbroker	1
H. Byron Reed, M.P., 15, Collingham-place, S.W.	1
Lord R. H. Brown, Reigate, Surrey	1
Sir John Brown, Endcliffe Hall, Sheffield	1
R. C. Grant, C.E., 32, Walbrook	1

Registered without special articles.

Lumsdon and Company, Limited.

This company was registered on the 9th inst., with a capital of £5000, in £10 shares, to acquire the business of chain and anchor manufacturers and ironmasters, carried on at the Strand Ironworks, Monkwearmouth, Durham. The subscribers are:—

	Shares.
J. Lumsdon, Sunderland, chain and anchor manufacturer	5
C. Lilburn, Sunderland, shipowner	5
J. Y. Short, Sunderland, shipowner	5
C. Hutchinson, Roper, Sunderland, shipowner	5
J. W. Taylor, Sunderland	5
R. Thompson, Sunderland, shipowner	5
*J. S. Barwick, Sunderland, shipowner	5

The first directors are Messrs. Samuel Story, M.P., Colonel E. T. Gourley, M.P., J. S. Barwick, J. Sanderson, M. Hudson, jun., W. S. Byers, and J. Lumsdon. The company in general meeting will determine remuneration.

Mercadillo Copper Mining Company, Limited.

Upon terms of an agreement of the 30th ult., this company proposes to purchase from Senor Don Juan Macveigh the Pitan mining property situate in the village Mercadillo of Sopuerta district, two miles from the railway to Portugalete Harbour and the Bilbao River, Spain. It was registered on the 9th inst., with a capital of £30,000, in £1 shares. The purchase consideration is £20,000 in fully-paid shares, and £3000 in cash. The subscribers are:—

	Shares.
W. G. White, 34, Leadenhall-street, merchant	1
J. Ouseley, 12, Bishopsgate-street	1
W. Cook Scott, Farmers' Club, Inns of Court Hotel, land agent	1
J. Price, 101, Leadenhall-street, accountant	1
J. Martin, 58, Lombard-street, merchant	1
A. Martin, 72, Bishopsgate-street	1
S. Matthews, 72, Bishopsgate-street, clerk	1

The number of directors is not to be less than four, nor more than eight; qualification, 50 shares; the subscribers are the first; remuneration, £52 10s. per annum each.

Vacuum Furnace Company, Limited.

This company proposes to acquire the patent rights of Orel Dighton Orvis, for improvements in means of consuming smoke and gases in steam boilers and other furnaces. It was registered on the 7th inst., with a capital of £50,000, in £10 shares, with the following as first subscribers:—

	Shares.
Hon. R. Brougham, 15, Hans-place, S.W., engineer	1
A. Castle, The Grove, Weybridge, wine merchant	1
*J. Leach, Haverhill House, Bolton	1
Kenneth Powles, 5, Guildhall-chambers, solicitor	1
G. Lund, 5, Hanover-square, secretary to a club	1
J. Railton, Woking, railway agent	1
T. J. Chalmers, 91, Isledon-road, N., accountant	1

The number of directors is not to be less than three, nor more than seven; the first are the subscribers denoted by an asterisk, and Captain J. Harcourt Ivory, and Orel Dighton Orvis; qualification for subsequent directors, 50 shares; remuneration, £500 per annum, and in addition thereto, one-fifth of all profits in excess of sufficient for £10 per cent. dividend.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

12th April, 1887.

5271. Electrical Type Setter, J. D. Dallas, London.
5272. Couplings for Tramway Engines, J. Darbyshire, Bradford.
5273. Compound Expansion Engines, R. Montgomery, Greenock.
5274. Electric Clock, R. Rendell.—(*A. B. Jones, United States.*)
5275. Manufacture of Rugs, Mats, &c., E. A. Packer, London.
5276. Improvements in Cyclometers, C. V. Boys, London.
5277. Holding the Rudders of Vessels, D. W. Porteous, Paisley.
5278. Gordon Type Setter, W. Gordon, Banffshire.
5279. Axle-box, R. Hodgson, Denaby.
5280. Fixing Sheets for Roofing, C. J. Latter, London.
5281. Propelling Boats, F. W. Allchin, Northampton.
5282. Rings, W. Farquhar, Norfolk.
5283. Frames for Bottles, J. E. Bingham, Sheffield
5284. Springs for Pistons, W. E. Frith, Sheffield.
5285. Window-Blind Racks, W. H. Dalby, Birmingham.
5286. Fire-escape, C. Ward, Londonderry.
5287. Obtaining Warmth, H. J. Newcome, Shenley.
5288. Attaching Knobs to Spindles, G. Woolliscroft, London.
5289. Indicating Signals, P. Williams and W. Powles, London.
5290. Wringing Machine Rollers, E. Malbon and R. Slater, Longton.
5291. Velocipedes, H. J. Lawson, Coventry.
5292. Electric Motors, H. J. Allison.—(*The Baxter Electric Manufacturing and Motor Co., United States.*)
5293. Electric Motors, H. J. Allison.—(*The Baxter Electric Manufacturing and Motor Co., United States.*)
5294. Journal Boxes, H. J. Allison.—(*T. McGrath, United States.*)
5295. Washing Machines, J. Collet, London.
5296. Fire-proof Paper, L. Bastet, Middlesex.
5297. Breech-loading Ordnance, A. J. Boult.—(*T. Yates, United States.*)
5298. Valve Gear, W. Wright, London.
5299. Embossing Machines, G. Valiant and J. Nesbitt, London.
5300. Lamps, W. Fox, Cheshire.
5301. Plugs, G. M. Marchant, Huddersfield.
5302. Powder, J. B. Fabre and L. Bergel, Lawrence Pountney-hill.
5303. Dynamo-electric Machines, H. W. Ravenshaw, W. T. Goolden, and A. P. Trotter, London.
5304. Cylinders, A. Hitchin, Accrington.
5305. Paring Candles, H. J. Garnham, Middlesex.
5306. Step Ladders, C. Fenwick, London.
5307. Geological Stratification J. T. B. Ives, Toronto.
5308. Photographic Films, S. H. Fry, Surrey.
5309. Electric Conductors, H. Flad, Middlesex.
5310. Locks, &c., E. E. Deacon, London.
5311. Artificial Bait for Catching Fish, A. Dudgeon, London.
5312. Rotary Motors actuated by Elastic Fluid Pressure, C. A. Parsons, London.
5313. Gas Washers, H. and F. C. Cockey, London.
5314. Carrying &c., Candles in Candlesticks, E. Edwards.—(*H. Laurent, France.*)
5315. Rendering Woven Fabrics Waterproof, N. Dubois-Mauduit, London.
5316. Feeding Water into Steam Boilers, T. White and W. Shedden, Glasgow.
5317. Breech-loading Ordnance, W. H. Driggs and S. Schroeder, London.
5318. Utilising Electric Currents, &c., J. E. Watson, London.
5319. Paper Bottles, G. A. Wilkins, London.
5320. Paper Boxes, &c., G. A. Wilkins.—(*L. H. Thomas, United States.*)
5321. Wheel-tires, H. H. Lake.—(*La Société des Forges et Laminoirs D'Epinay, France.*)
5322. Gas Burners, J. Mactear, London.
5323. Brakes, D. H. W. J. N. O'N. Neale and P. Everitt, London.
5324. Mixing Tap, E. Delaroche, London.
5325. Camp Stool, F. Alff, London.
5326. Spring Mattresses, A. McFarland, London.
5327. Speed Indicators, R. Willis, London.
5328. Electric and other Clocks, A. L. Parcelle, London.
5329. Waterproof Garments, J. F. Carter, London.
5330. Gas-burners, P. Haddan.—(*W. M. Jackson, United States.*)
5331. Saw-cutting Apparatus, R. Haddan.—(*C. C. Harris, United States.*)
5332. Engraving Buttons, R. Haddan.—(*C. R. Bannihr, United States.*)
5333. Date Indicators, C. Lütgens, London.
5334. Bottling Machines, J. Walch, London.
5335. Closing Bung-holes, L. V. Dumesnil and J. B. Zerre, London.
5336. Regulating Apparatus for Gas Motor Engines, W. Bernhardt, London.
5337. Purifying Crude Spirit, I. A. F. Bang and M. C. A. Ruffin, London.
5338. Learning to Play on the Piano, V. Wedelstaedt, London.
5339. Working Rotating Slide-valves, J. Southall, London.
5340. Writing Table, Work Table, &c., L. Anidjah, London.
5341. Electric Bells, F. L. Rawson and C. S. Snell, London.
5342. Coating the Interiors of Boxes, G. A. Wilkins.—(*L. H. Thomas, United States.*)
5343. Mechanical Musical Instruments, H. H. Lake.—(*O. H. Arno and A. E. Pailliard. United States.*)

13th April, 1887.

5344. Bath Gloves, J. Fox, Harpurhey.
5345. Storing Packets of Sweets, J. D. Churchill and D. J. Callard, London.
5346. Window Fastener, G. Gregory, Dundee.
5347. Buttons, E. Brill, Manchester.
5348. Velocipedes, W. Schröter, Manchester.
5349. Window Fastenings, W. Macvitie, Sutton Coldfield.
5350. Corn Grinding Mills, A. E. F. Chattaway, Birmingham.
5351. Window-sash Fastener, G. F. Williamson, Wellingborough.
5352. Spindles and Bearings used in Ring Spinning, &c., T. Ashworth, Manchester.
5353. Steam Generator, Steam Superheater, and Steam Heat Protector Combined, S. Elson, Oldham.
5354. Incandescence Gas Lamps, B. H. Thwaite, Liverpool.
5355. Corsets or Stays, M. W. Utting, Liverpool.
5356. Opening and Closing Railway and other Carriage Windows, S. Henshaw, Ashton-under-Lyne.
5357. Indicating or Recording Pressure, G. Smith, Glasgow.
5358. Cock for Charging Air and Liquor into Stills, J. Harvey, Glasgow.
5359. Bleaching Fibrous Materials, J. and F. M. Gibson, Edinburgh.
5360. Stopping and Starting Tramcars, &c., H. Booth, Edinburgh.
5361. Microscopic Slide Holders, T. H. Simmonds, London.
5362. Utilising the Vibration of a Train to Produce Movement in an Advertisement, H. C. Aldom, Leyton.
5363. Sashes of Railway Doors, &c., W. Farquahar, Norfolk.
5364. Bars for Furnaces, &c., A. E. Scott, London.
5365. Acoustic or Tone Telegraphy, W. T. Barnard, London.
5366. Ammunition for Rifles, &c., G. A. Farini, London.
5367. Guns, G. A. Farini, London.
5368. Sealing Packing Cases, A. D. Penfold, London.
5369. Lamps, W. W. Harverson, London.
5370. Scoring Pork, W. H. Edwards, London.
5371. Metallic Boxes, W. B. Williamson, London.
5372. Axles, G. Harrison, London.
5373. Smoke Preventing Apparatus, S. Proctor and G. A. Maltster, London.
5374. Water-tight Doors, J. W. Shepherd, Glasgow.
5375. Lock-stitch Sewing Machines, D. Jones, London.
5376. Metallic Pigeon-hole Cases, A. J. Boult.—(*J. F. Lash, Canada.*)
5377. Separating Ashes, R. Clague, Liverpool.
5378. Treatment of Yeast, F. J. von der Ropp, London.
5379. Triturating Cylinders, J. R. Alsing, London
5380. Fastening Neckties, J. Winter, sen., London.
5381. Coin Tester, T. J. Walsh and L. Wild, London.
5382. Combined Velocipede and Rest for Guns, &c., H. J. Watts, London.
5383. Accordeons, &c., J. O. Herold, London.
5384. Steam Cooking Apparatus, J. Beck, London.
5385. Lubricators for Steam Engines, R. Haddan.—(*W. H. Craig, United States.*)
5386. Fastenings for Collars and Cuffs, J. Carter, London.
5387. New Game or Pastime, R. Crawford, Brighton.
5388. Automatic Delivery of Prepaid Goods, G. Jeffery, London.
5389. Knitting Machines, H. H. Lake.—(*E. Boessneck, Germany.*)
5390. Match-making Machines, C. J. Donnelly London.
5391. Tool for Manufacturing the Mail in Weaving, J. Stevenson.—(*E. Absous, France.*)
5392. Locks and Latches, W. A. Brailey, London.
5393. Bleaching and Disinfecting Liquor, E. Hermite, London.

14th April, 1887.

5394. Racket Presses, C. Hunt, Westminster.
5395. Mechanical Horses, F. H. Ayres, London.
5396. Signalling Apparatus for Street Tramways, W. S. Thompson, Dundee.
5397. Telescopic Spout, Whillock Brothers, Birmingham.
5398. Match-boxes, J. W. Nasmith, Manchester.
5399. Wedge for Winning Coal, &c., G. W. Elliott, Sheffield.
5400. Snake Chain Pump, J. Bartlett and J. Bartlett, Shipton Gorge, near Bridport.
5401. Securing Rows of Hooks to Frames, B. Shaw, Halifax.
5402. Velocipedes, J. L. Garsed, Halifax.
5403. Velocipede Saddle Springs, H. J. Lawson, Coventry.
5404. Fog Signalling for Railways, T. H. Richardson, Brasted.
5405. Mechanical or other Telephones, J. M. Porter and J. Blakey, Leeds.
5406. Drying Paper, W. Bertram, Glasgow.
5407. Looms for Weaving, J. Mathieson, Manchester.
5408. Beer Engines, R. Machin, Chesterfield.
5409. Winding, &c., Machines, W. Gallimore, Manchester.
5410. Coach or Carriage Tubular Spoke Wheel, J. Williams, Wigan.
5411. Bessemer and other Ingot Moulds, F. Herbert and C. G. Jordan, Newport, Mon.
5412. Treating Provender for Horses, &c., J. Hamilton and T. Hamilton, Wishaw.
5413. Facing for the Keys of Pianofortes, &c., W. Spencer and S. Spencer, Longport.
5414. Blind Cord Adjustment, H. W. Bean, Wellingborough.
5415. Indicating the Motions of Looms, J. Fletcher, Ashton-under-Lyne.
5416. Carding Engines, W. Knowles, London.
5417. Condensing Steam, F. Hocking, Liverpool.
5418. Lawn Tennis, W. C. Owston, London.
5419. Admixture of Ferrous Sulphate, T. Thompson, Edinburgh.
5420. Printing on Glass, &c., T. W. Hogg and P. J. Jackson, Newcastle-on-Tyne.
5421. Cutting Keyways, J. L. Stewart, S. Greenwood, and J. Overend, Bradford.
5422. Tricycles, H. Pipe, London.
5423. Vegetable Shedder, J. W. Thompson, London.
5424. Miner's Pick, S. S. Bromhead.—(*D. McL. Wallace and J. Mace, New Zealand.*)
5425. Drying Paper, W. Bertram, Glasgow.
5426. Ornamentation for Buildings, W. R. Maloney, London.
5427. Points for Tramways, J. Kincaid, London.
5428. Bale Ties, J. B. Bradshaw, Sheffield.
5429. Bricks, &c., F. Wallbrecht, London.
5430. Conveying Medicinal Matter, A. J. Boult.—(*A. J. Spinner, United States.*)
5431. Velocipedes, J. W. Radford and A. Litchfield, London.
5432. Continuous Distillation of Fatty Bodies, W. P. Thompson.—(*La Société Industrielle de Glycerine et Acides Gras, Paris.*)
5433. Treating Cotton-seed Oil, W. P. Thompson, Liverpool.
5434. Couplings for Hose and other Pipes, W. Mullan, Liverpool.
5435. Trawling Nets, J. Bolton, Liverpool.
5436. Pictorial Toys, H. J. Graham, London.
5437. Velocipedes, V. P. Fevez, London.
5438. Overhead Railways, W. P. English, London.
5439. Safety Valve, C. Bendy and F. J. Giblett, London.
5440. Preventing Animals from Running away, W. C. Niblett and G. E. Hesse, London.
5441. Removal of Scale, W. D. Player and T. Instone, London.
5442. Reception of Coin Counters, &c., J. S. Wallace, London.
5443. Steam Engines, J. Bremner, London.
5444. Tires and Fixing Tires to Vehicles, J. Thom, London.
5445. The Richmond Landing Brow, A. Sullivan and J. T. Beckett, Richmond.
5446. Stoppers for Bottles, J. Munro and J. Thom, London.
5447. Regulating the Tension of the Warp Threads of Lace Machines, J. Jardine, London.
5448. Roasting Coffee, &c., H Maddocks, London.
5449. Self-acting Motor, G. Jeffries, London.
5450. Spinning Textile Materials, &c., J. Fayollet, E. Dervieu, and J. Van der Zee, London.
5451. Quick-firing Guns, T. Nordenfelt, London.
5452. Spinning and Doubling Cotton, &c, W. Bodden, F. Ashton, and A. Kay, Manchester.
5453. Substitute for Corsets, A. Leffler-Arnim, London.
5454. Opening Corked or other Bottles, J. S. Garlick, London.
5455. Perambulator Brake, C. Kranz, London.
5456. Lamp Burners, R. Haddan.—(*Messrs. Schuster and Baer, Germany.*)
5457. Measuring, &c., Liquids, H. C. W. Emery and G. A. Collum, London.
5458. Vice Jaws and Face Plate, R. G. Fiege, London.
5459. Non-fermentible Cementitious Body, A. Schuhmann, London.
5460. Dextrine or Soluble Starch, A. Schuhmann, London.
5461. Land Torpedo, W. J. Brewer, London.
5462. Dynamo-electric Machines, W. H. Scott and E. A. Paris, London.
5463. Sewing Machines, H. H. Lake.—(*G. H. Wilkins, United States.*)

5464. Lithographic Pictures, &c., L. Bertling, London.
5465. Penholders, H. Pound, London.
5466. Incandescence Electric Lamps, W. Clark, London.
5467. Wind Musical Instruments, F. W. Rawstron, London.
14,983a. Mechanical Devices Started by Electricity, E. W. Serrell, jun., Paris.—*18th November*, 1886. [Received 15th April, 1887. This application having been originally included in No. 14,983, 1886, takes, under Patents Rule 23, that date.]
17,046a. Food for Horses, &c., J. P. Larieux and H. Gregoire, London.—*29th December*, 1886. [Received 15th April, 1887. This application having been originally included in No. 17,046, 1886, takes, under Patents Rule 23, that date.]

15th April, 1887.

5468. Arc Lamps, T. Crabb, London.
5469. Condensers, A. Dickinson, Birmingham
5470. Determination of the Dip of Rocks, P. F. Kendall, Manchester.
5471. Fasteners for Window Sashes, &c., J. R. Dedicoat, Birmingham.
5472. Alignment of Shaft Bearings, E. Stinton, Ipswich.
5473. Compressed Fuel, J. Laidler, Sunderland.
5474. Compressed Fuel, J. Laidler, Sunderland.
5475. Guiding Bicycle-steered Tricycles, A. J. Lewis, London.
5476. Utilisation of Waste Products, &c., D. Burns, Carlisle.
5477. Cooking Ranges, &c., D. Cowan, Glasgow.
4478. Protecting Screw Propellers from Corrosion, D. A. Cormack, Leith.
5479. Flushing by Water, G. Haslilow, London.
5480. Communicating Motion to Straw Elevators, &c., W. T. Carter and J. Keeble, Bury St. Edmunds.
5481. Bearings for the Legs of Billiard Tables, &c., J. Ashworth, Manchester.
5482. Waist Belts or Bands, D. B. Harris and W. H. Walker, Birmingham.
5483. Fastening Neckties, J. H. Kenny, London.
5484. Media of Globes, R. Scott, Newcastle-on-Tyne.
5485. Thermodynamic Engines, J. Hargreaves, Liverpool.
5486. Digging, &c , Potatoes, &c., J. Hope and R. A. Clark, Liverpool.
5487. Screw Balance Brake, J. H. Waite, Crigglestone, near Wakefield.
5488. Holders, &c., for Photographs, &c., H. Whitfield, Birmingham.
5489. Self-closing India-rubber Valves, G. Chapman, Warrington.
5490. Hand Grenades, S. W. Wilkins, Edinburgh.
5491. Machine for Making Covered Buttons, G. Heidmann, E. Höttges, and C. Egen, London.
5492. Converting Reciprocating Motion into Rotary Motion, G. F. Lütticke, London.
5493. Type-writers, R. W. Anderson, Liverpool
5494. Instrument for Killing Birds, &c., W. Moffatt, Glasgow.
5495. Shuttles, D. McGregor, Glasgow.
5496. Making "Caprophore" Flower-pots, J. H. Witty, London.
5497. Cases for Displaying Provisions, &c., G. French, London.
5498. Metallic Handles for Cutlery, &c., E. Brown, Sheffield.
5499. Fastenings of Bracelets, J. Cook, Birmingham.
5500. Coke and other Forks, &c., W. Slater and J. Trippett, Sheffield.
5501. Portable Hurdles, W. Snaydon, London.
5502. Feeding Mechanism for Sawing Machines, J. R. Jex-Long, Glasgow.
5503. Writing Desks, &c., A. C. Thomson, Glasgow.
5504. Obtaining the Oxides of Metals, A. L. Keeport, London.
5505. Dynamo-electric Machines, H. W. Ravenshaw, W. T. Goolden, and A. P. Trotter, London.
5506. Extinguishing Flames of Oil Stoves, W. G. Cloke, London.
5507. Beetle Trap Cover, H. Beare, London.
5508. Ventilated Boots and Shoes, E. Irons, Northampton.
5509. Electric Arc Lamps, A. J. Boult.—(*P. J. V. Létang, France.*)
5510. Pegs for Joining Woodwork, H. and E. Rielle, Liverpool.
5511. Pins and Joints for Brooches, &c., F. Taylor, Liverpool.
5512. Holders for Sacks and Bags, D. W. Kinghorn, Liverpool.
5513. Syphons, G. W. Arper, Liverpool.
3514. Rein-holders, L. S. Tambling, Liverpool.
3515. Celluloid Attachment for Glasses, J. Steele, Liverpool.
5516. Flying Target Traps, J. B. Bennett and F. W. Samuels, Liverpool.
5517. Safety Receptacle for Money, T. Ekroth, Liverpool.
5518. Collecting and Removing Ashes, J. W. Wood, Liverpool.
5519. Gas Apparatus for the Carbonisation of Coal, J. Elliott, London.
5520. Hydraulic Lifts, W. R. Green, London.
5521. Sewing Machines, W. Webster, London.
5522. Beating or Stamping Flax, S. Kidner, London.
5523. Hardening Surfaces Durable for Soles of Boots, &c., L. and A. H. O. Otto, London.
5524. Oily Chemical Preparation for Russian Leather, G. Delfos, London.
5525. Stays and Corsets, M. G. Totterdell, London.
5526. Elevators or Lifts, F. L. Edoux, London.
5527. Projectiles or Shells, C. T. Cayley and R. S. Courtman, London.
5528. Straining Pulp, T. Goodall and T. Webster, London.
5529. Syphon Bottles, F. Foster, London.
5530. Gas Producers, A. Harris, London.
5531. Tills, R. K. Day and R. H. Ward, London.
5532. Disinfectant, E. Edwards.—(*J. Jeger, Poland.*)
5533. Vibrating Electric Motors, A. L. Parcelle, London.
5534. Electric Synchronous Movements, A. L. Parcelle, London.
5535. Preserving Animal, &c., Substances, A. P. Wire, London.
5536. Facilitating the Conveyance of Parcels, E. H. Fosbery, Brighton.
5537. Telephones, H. J. Maclure and R. D. Bowman, London.
5538. Torpedoes, W. J. Brewer, London.
5539. Game of Dominoes, G. Freytag and Berndt, London.
5540. Attaching Helical Bars to an Axial Shaft, J. Harper, London.

16th April, 1887.

5541. Axles, &c., W. M. Riddell, London.
5542. Shelling Peas and Beans, A. J. Boult.—(*C. P. and J. A. Chisholm, Canada.*)
5543. Castor Rings, &c., F. and H. Matchett, Birmingham.
5544. Solitaires, Sleeve Links, &c., F. R. Baker, Birmingham.
5545. Heating Cements, &c., S. Snell and A. W. Sanderson, Birmingham.
5546. Lamps for Velocipedes, S. Snell and A. W. Sanderson, Birmingham.
5547. Spanner and Pliers, S. Snell and A. W. Sanderson, Birmingham.
5548. Sewing Machines, Holloway Brothers and J. Carter, Stroud.
5549. Ordnance, E. Maitland, London.
5550. Knee Cap, H. Fisher, London.
5551. Hooks for Lowering Boats, W. Kennett, Hyth
5552. Adjustable Reamers, J. W. Newall, London.
5553. Regulators for Feeding Bottles, J. B. Hickley, Southampton.
5554. Driving Gear of Washing, &c., Machines, J. P. Binns, Halifax.
5555. Band for Driving Spindles, &c., W. Taylor, Halifax.
5556. Heating Water, A. Hill, Birmingham.
5557. Fish Landing Apparatus, G. Durham, Stockport.
5558. Shuttle Tips, J. Sellers, Manchester.
5559. Steam Washing Machines, W. Gordon, Edinburgh.
5560. Producing Patterns on Glass, A. D. Brogan and A. M. Malloch, Glasgow.
5561. Washing and Starching Machines, J. Bowie, London.
5562. Generating, Distributing, &c., Electricity, W. Maxwell, London.
5563. Motor, C. Martin, London.
5564. Straw-lined Tobacco Pipes, J. H. Dale, London.
5565. Umbrella Frames, J. Weeks, London.
5566. Gas Heating Apparatus, H. P. Miller, London.
5567. Inhaler, J. Gibbs, London.
5568. Securing Music on Music Rests, J. H. Richards, Birmingham.
5569. Fitting Seats to Lamp-posts, J. Palmer, Liverpool.
5570. Table-tops, &c., S. B. Sutcliffe, London.
5571. Rollers of Grinding and Crushing Mills, W. N. Nicholson and W. Mather, London.
5572. Raising, &c., Roller Blinds, G. Furness, London.
5573. Friction Clutch, W. W. Horn.—(*J. C. Potts, United States.*)
5574. Gas, W. W. Horn.—(*A. L. Allen, United States.*)
5575. Kitchen Cabinet, W. W. Horn.—(*A. E. Irwin, United States.*)
5576. Drilling Chuck Plate, J. Charlesworth and G. H. Batley, London.
5577. Fabric, H. H. Lake.—(*E. Brown, United States.*)
5578. Signals, H. B. Berdoe, London.
5579. Gutta-percha, W. H. Hope, London.
5580. Sewing Machines, S. Hahn, London.
5581. Musical Instruments, W. Cluse, London.
5582. Decoration in Glass, J. W. Scott, London.
5583. Batteries, H. Liepmann, London.
5584. Pumping-engines, J. D. Wardale, London.
5585. Position of Bodies, J. S. Warburton and H. J. Sanderson, London.
5586. Varnish, F. Crane.—(*J. Hale, United States.*)
5587. Sawing Machines, J. Hamilton, Derby.
5588. Valve, J. C. Simpson, Hull.
5589. Boots, H. H. Lake.—(*C. D. Wood and A. Seaver, United States.*)
5590. Naphthalol, E. Merck, London.
5591. Lifts, F. L. Edoux, London.

18th April, 1887.

5592. Looms, T. Valentine and J. Hunter, Belfast.
5593. Yarn Presses, T. Coleby, Manchester.
5594. Slide Valves, J. Magee, Glasgow.
5595. Flats, J. Macqueen, Manchester.
5596. Colouring Paper, J. Bromley and T. Harrison, Leeds.
5597. Weighing Machines, J. Jackson and P. A. Martin, Birmingham.
5598. Locomotives, R. W. Mewes, Newcastle-on-Tyne.
5599. Case for Butter, T. Bartle.—(*L. K. Bryant, United States.*)
5600. Ice Machines, J. Dauber, Germany.
5601. Heel Protector, H. Urmson, Oldham.
5602. Cutlery, W. B. Hatfield and C. Wingfield, Sheffield.
5603. Wheels, E. and A. E. Dearden, Sheffield.
5604. Swings, H. Tipper, Birmingham.
5605. Stays, M. Ehrenfeldt, Sheffield.
5606. Lifts, B. Jones, North Devon.
5607. Distributing Trade Cards through the Agency of an Automatic Model, J. E. Kingsford and A. T. Hope, London.
5608. Tea-pots, &c., W. H. Pike, West Newcastle.
5607. Anchor Dog Leader, W. G. Clarke, Limehouse.
5610. Feeding Bottles, &c., M. Flurscheim and T. Bergmann, London.
5611. Gasaliers, &c., J. Eaton and J. Huband, Birmingham.
5612. Plant Protector against Frosts, S. Fusenot, Paris.
5613. Flexible Pipe or Hose Coupling, F. M. Hale, London.
5614 Automatic Indicating Lights for Ships, F. R. Francis, London.
5615. Combined Umbrella, Walking-stick, and Billiard Cue, H. Maffert, London.
5616. Safety Tap for Gas, &c., A. Watt, Manchester.
5617. Spinning, &c., Cotton, &c., J. Lisle and E. Hazlehurst, London.
5618. Figured Cloth, D. Greenhalgh, London.
5619. Watering Cans, &c., J. Ludlow, Birmingham.
5620. Indicating Muscular Power and Delivering Goods in Exchange for a Coin, F. Mosser, London.
5621. Silent Ball Valve, J. Davies, Croydon.
5622. Coating Plates with Tin, &c., W. H. and T J. Rickard, London.
5623. Wheels for Railway Carriages, W. M. Riddell, London.
5624. Tables, C. Bradbury.—(*Grimme, Natalis, and Co., Commandit-Gesellschaft auf Actien, Germany.*)
5625. Clocks, H. Halvorsen, Liverpool.
5626. Hoisting Machines, R. Schultz, London.
5627. Amalgamation of Gold, A. Woodhouse, London.
5628. Oil Lamps, M. Moska, London.
5629. Partitioned Boxes, M. H. Glover, London.
5630. Keeping Plates, &c., Warm, H. de la Rue, London.
5631. Safety Pins, F. Savory, London.
5632. Preventing the Slipping of Locomotive Driving Wheels, J. Gresham, London.
5633. Elastic Seats, &c., for Chairs, C. Wittkowsky, London.
5634. Furnaces of Steam Boilers, T. Hollings, London.
5635. Steam Vessels, G. A. de Penning, London.
5636. Furnace Grates, P. F. Oddie, London.
5637. Electrical Controlling Apparatus, A. Siemens and E. F. H. H. Lauckert, London.
5638. Thermo-piles Heated Directly, G. E. Dorman, Stafford.
5639. Castors, F. T. Heath, London.
5640. Dog Slips, E. W. Edwards, London.
5641. Night-lights, J., J. W., G. P., and H. J. Broad, and G. C. Fowler, London.
5642. Electrical Switch, W. J. Ormston, London.
5643. Electrical Switch, W. J. Ormston, London.
5644. Navigation of Aerial Vessels, W. N. Hutchinson, London.
5645. Cuff Buttons, H. H. Lake.—(*F. F. Campbell, United States.*)
5646. Elevators for Grain, J. Schlesinger, London.
5647. Extinguisher Mechanism for Oil Lamps, A. Gray, London.
5648. Breaking Electric Circuits, J. H. Holmes, London.
5649. Reducing Material for Making Paper, C. Barataud, London.
5650. Softening the Muscles of Pianists, C. Magnus, London.

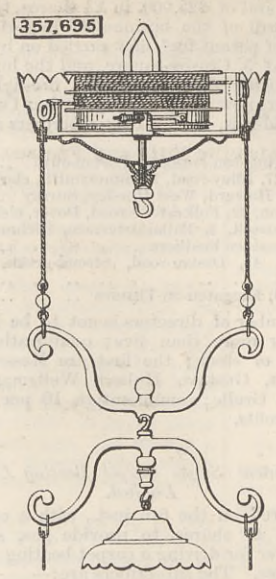
SELECTED AMERICAN PATENTS.

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

357,695. Suspension Device, *G. W. Woodward, Brooklyn.—Filed May 8th*, 1885.

Claim.—(1) A self-balancing lamp support for spring suspension devices, consisting of two bars or plates having their adjacent edges pivotally connected together at the centre of their lengths, whereby the upper bar or plate may assume an inclined position without changing the horizontal position of the lower bar or plate, substantially as specified. (2) The com-

357,695

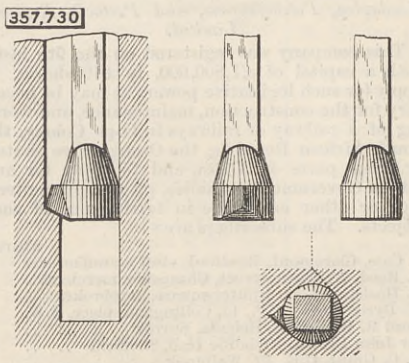


bination, with a drum of the counterbalance spring acting in conjunction therewith.

357,730. Method of and Means for Blasting out Rock Corners, *T. Murdock, Middleton, Conn., and J. L. L. Knox, Allegheny, Pa.—Filed July 22nd*, 1886.

Claim.—(1) A drill body of less diameter than its lower working end, provided at that lower end with a mainly round lateral expansion and with a V-shaped cutter projecting laterally from this rounded expansion, all substantially as described, and for the purpose set forth. (2) The process of blasting out the

357,730

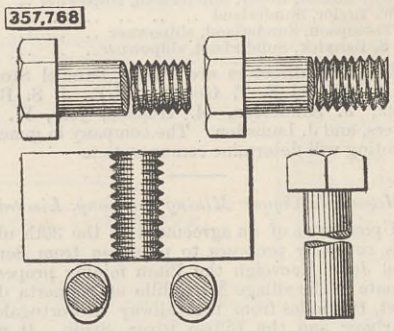


corner of a piece of rock, which consists, First, in drilling a round hole in the rock at the proposed corner; Secondly, with a drill having an expanded foot fitting to the hole and a lateral cutting wing cutting a V-shaped groove in the wall of the hole; Thirdly, with a like drill cutting a like groove less than half the circle distant from the first groove; and Fourthly, exploding a blast in the hole, all substantially as described, and for the purpose set forth.

357,768. Manufacture of Screw Bolts, *C. Furbish, Brooklyn, N.Y.—Filed July 30th*, 1886.

Claim.—The method of producing a screw or bolt which is adapted to receive a nut having either a right or a left-hand screw-thread, consisting in forming a

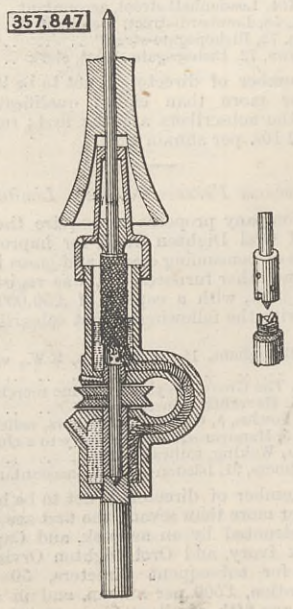
357,768



blank having two opposite arc-shaped portions and intermediate flattened portions, in cutting a thread upon such blank, and in subsequently chamfering portions of the thread by means of dies, substantially as specified.

357,847. Spindle and Bearing Therefor, *O. H. McKelvin, Louisville, Ky.—Filed May 1st*, 1886.

357,847

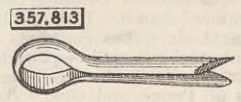


Brief.—The upper and lower bearing portions, formed with oil reservoirs, are connected by a hollow arm containing a wick, so that when oil is exhausted in one reservoir it may be supplied from the other.

357,813. Cotter Key, *W. P. Brown, Zanesville, Ohio.—Filed June 16th*, 1886.

Claim.—(1) A cotter key having its two ends bevelled in opposite directions, whereby the point of one end

357,813

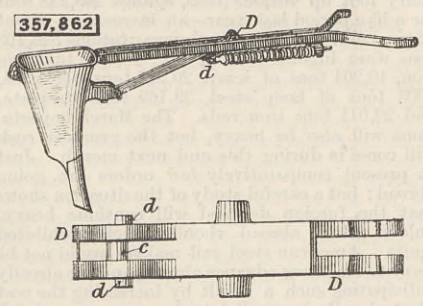


will overlap the bevel of the other end, as described and shown. (2) A divided key, the ends of which present, when closed together, projecting points extending past each other to permit the insertion of a spreading tool between them.

357,862. Spring Hoe for Grain Drills, Seeders, &c., *R. B. Sheldon, Shortsville, N.Y.—Filed September 3rd*, 1886.

Claim.—(1) The herein-described lever D, having the pivot *c* and studs *d* formed integral therein. (2) As a

357,862

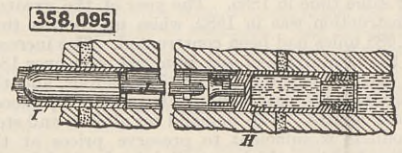


new article of manufacture, the herein-described link D, cast complete in one piece with the grooved body, the central trunnions, the notched arms at one end, and the pivot *c* and stud *d* at the opposite end.

358,095. Manner of Making and Cooling Joints for Electrical Conduits, *B. Williams, Chicago, Ill.—Filed November 2nd*, 1886.

Claim.—(1) The method of cooling the cement used in making the joints of electrical conduits by the introduction of water into the passages, substantially as specified. (2) A device for forming and cooling

358,095

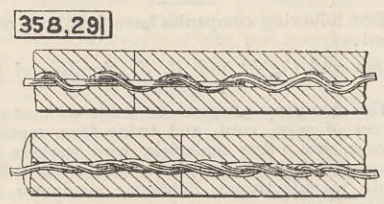


joints of electrical conduits, consisting of the plug H, provided with a packing at one end and at the other end adapted to engage with a rod, in combination with a tube I, and rod J, adapted to engage with the plug H, substantially as and for the purpose specified.

358,291. Elastic Tire for Wheels, *E. C. F. Otto, Peckham, London.—Filed July 14th*, 1886.

Claim.—An elastic wheel tire composed of a tubular rubber, a corrugated or wavy spring wire drawn

358,291

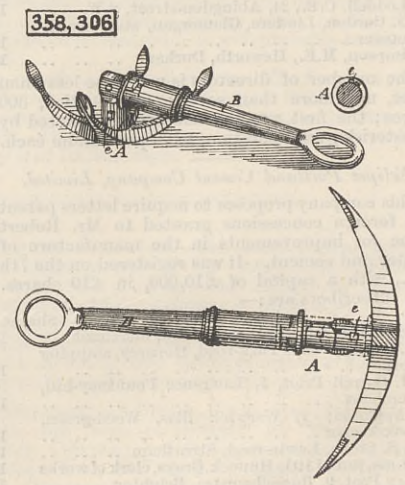


through the rubber tube and the ends of said wire joined, the rubber being under compression lengthwise upon the wire, substantially as specified.

358,306. Anchor, *J. Tiebout, Brooklyn, N.Y.—Filed December 23rd*, 1886.

Claim.—(1) In a grapnel or anchor, a shank consisting of two sections united by a pivotal connection, in combination with a sleeve encompassing said shank and movable thereon, substantially as shown and described. (2) In a grapnel having two or more flukes, the combination of a shank composed of two sections joined by a pivotal connection, a sliding sleeve encom-

358,306



passing the shank and movable thereon, and means, such as described, for securing said sleeve, substantially as shown and described. (3) The combination, with the shank-sections A B, of a pivotal connection whereby one section A can be turned about the other in one direction, three or more fluke-arms carried by the section A, a pin *e* on said section, and a sleeve movable on the shank and provided with a groove adapted to engage with the pin, substantially as shown and described.

Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—James M. C. Bennett, chief engineer, to the Rattlesnake, to date April 1st; Henry S. Rashbrooke, engineer, to the Undaunted; Richard T. Serle, engineer, to the Black Prince; William L. Wishart, engineer, to the Indus, additional; William Castle, inspector of machinery, to the President, additional, for service at the Admiralty, to date May 1st; Alfred Wood, inspector of machinery, to the Hibernia, additional, as chief engineer of Malta Dockyard, to date May 1st; and David J. Bennett, engineer, to the Defiance, addition