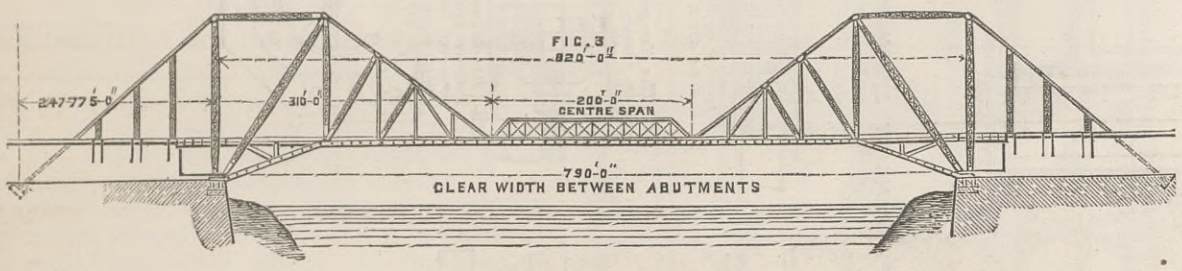
## THE SUKKUR BRIDGE.

TRAVELLERS entering or leaving the port of London during the last few months have gazed with some perplexity on a huge edifice of timber which towers about 200ft. into the air on the river bank, nearly opposite Greenwich Hospital. The curious foreigner approaching the metropolis by water might imagine that some national monument was in course of erection, and that the choice of site on the low-lying Isle of Dogs was with a view of emulating Sir Christopher Wren's noble building opposite. We fear that if that prince of architects, whose engineering skill was the true basis of his art, could return to the city he did so much to embellish he would exclaim with horror at the form and proportions of the structure about which we write—namely, the Sukkur Bridge over the Indus, now in course of manufacture in the yard of Messrs. Westwood and Bailie, who are erecting it temporarily on the lofty wooden staging above referred to.

During the last ten years the Government of India has been extending the State lines of railway to the north-west, deeming it a wise expenditure of money for military defence to connect the frontier with the whole railway system of British India. During each year of this period many thousands of tons of iron bridges, and lately of steel bridges, have been sent from this country, some of the more important, such as those over the Chenab and Nerbudda rivers, having been described in THE ENGINEER at the time of their construction. One of the natural obstacles on the British side of the mountain frontier is the Indus river, which, from the time of Alexander the Great, has hindered, more or less successfully, the advance of the invader from the north. At Attock, the point where Alexander crossed the Indus, on the direct road from Cabul, through Peshawur, the Indian Government has already built a bridge, the piers and superstructure of

FIG. 3




THE SUKKUR BRIDGE.

which formed a subject of considerable interest at the time, and it is now intended to bridge the river many miles lower down, at Sukkur. At this point the stream is about 800ft. wide, and at certain seasons the volume of water, always considerable, is greatly increased, so that serious difficulties would arise in building piers in mid-channel. Not only, therefore, was a bridge of a single span appropriate, but one easy of erection. The arch, the cantilever, the girder, and the suspension form of bridge were all available, but the skill or genius of the designer was necessary to select, elaborate, or combine the principle best suited to the site and purpose. Such skill is not wanting in the world; bridges like that lately constructed over the Douro, illustrated in THE ENGINEER and obtained by open competition, and numerous other structures designed in England and America during the last twenty years, all prove that original ideas and fertility of resource are forthcoming when sought after. The problem for the Sukkur Bridge was an interesting one to an engineer; it is now in course of solution, and, we are sorry to say, in a very unsatisfactory way, in our opinion.

Two years ago, in THE ENGINEER of 11th July, 1884, we took occasion in an article on "Suspension and Cantilever Bridges," to criticise the design of the Sukkur Bridge as then put forward by Mr. Rendel, the Consulting Engineer for Railways of the Indian Government, and to point out that the design was not only bad but gratuitously ugly. We reproduce above the elevation of the bridge, from which our readers can draw their own conclusions; and now that the erection of the structure in India is about to commence, we have again to protest against a system of management which allows so inferior a specimen of construction to be sent from this country to our greatest dependency. From each shore a cantilever is built forward 310ft., and over the middle gap, and resting on the outer ends of the cantilevers, a girder bridge of 200ft. is constructed, thus making up a total span of 820ft. The contract for the cantilevers was given out two years ago; the tenders for the girder span were sent in last week, and the contract for it will probably be arranged immediately. As we said in our article on the subject two years ago, "A derrick, the half of an English roof truss, a whipple girder, the other half of the roof truss and another derrick, are very excellent things in themselves; but to string them together upon one line and thereby make a bridge, is not engineering—nor is it architecture."

A consulting engineer to a railway company, and much more one to a Government having a variety of public works on hand, has important functions to perform, and in the routine of his duties has not only to choose, inspect, and control, but to design what may be needed for ordinary purposes. But we protest against a system that too often prevails in this country, and in no other, of allowing the consulting engineer who happens to be in office at a particular time to retain in his own hands the designing of engineering works of exceptional magnitude and importance. Even if the Council of India did not see this in the present case, their engineer should have done so for them, for there is no greater sign of wisdom than to know the limit of one's own knowledge; and we unhesitatingly assert that an engineer of Mr. Rendel's experience and standing should have been strong and candid enough to tell the Government of India that he could serve them best by advising them in a wider choice than his own office afforded. He elected not to do so, and the result will be apparent when the Sukkur Bridge is erected.

On this occasion the poverty of design is followed by an equal want of judgment or courage in carrying it out. The preliminary erection of the bridge in England is as unnecessary as it is costly, and seems to indicate a want of confidence either in the design or in the correct setting out of the various parts. The shape of pieces, the intricacy of their intersections, and the difficulties of erection are much more complicated in the Forth Bridge than in the Sukkur Bridge; but what would be thought of Sir John Fowler if he proposed to erect the former in Dalmeny Park before building it over the deep water? There are bridge builders in England as elsewhere who would undertake the responsibility of fixing the Sukkur Bridge in place as well as making it without any preliminary erection in the factory. We do not know what price the English manufacturers are being paid for the foundations and timber staging as well as for the labour in putting up and taking down the metallic structure, but we have little doubt that the bridge, when finally erected, will have cost at least £50,000 more than it might otherwise have done. We wish, at any rate, to put on record the fact that the design, though the work of a Government official engineer, is not approved by those in this country best able to judge, and in no way represents the present engineering talent of Great Britain.

## LITERATURE.

*The Rudiments of Mineralogy.* By ALEXANDER RAMSAY. Third Edition, 12mo., 359 pp. London: Crosby Lockwood and Co. 1885.

THIS volume—founded upon the small treatise by the late Miss Varley, that appeared among the earliest of Weale's series—has by successive accretions grown to more than twice the original size in the present issue. Some of the additional matter is excellent and well chosen, but the same qualification cannot be extended to the whole of it, as a considerable amount of space that might have been usefully devoted to the extension of the text on its original plan has been given up to matters that are not very intimately connected with the immediate subject of the book. For example, systematic crystallography is treated in about six pages, which contains the barest outline of the "early French" system of classification of Haüy and De Lisle by primitive forms, which though no doubt of historical interest, is of little value for rudimentary teaching at the present time, as the use of this method is practically confined to the country of its origin; and even there the use of Miller's notation at any rate conjointly with the official system, if not exclusively, is becoming general with mineralogical writers. It is certainly remarkable that no mention has been made of the crystalographic methods of Weiss and Miller, which are now in probably nine-tenths of the mineralogical literature of the present day; and the omission can scarcely be charged to want of room, as more than twenty pages of the introductory part are filled with discussions of subjects such as the properties of gases, formulæ for steam, specific heat, composition of marsh gas, and similar matters which, though no doubt interesting and useful in the study of general chemistry, have not very much to do with mineralogy proper. In fact this part of the book looks as though some pages of an elementary treatise on chemistry had wandered into the printing office and got mixed up with the text by mistake. The author has been at the trouble of recomputing the specific grades of minerals on the hydrogen scale; that is, the figures in ordinary use are multiplied by the number 11,178, representing the density of water when hydrogen is unity, and the results are given throughout the text in addition to the ordinary figures. The purpose of this addition is not at all clear; it can scarcely be to assist the memory. Probably most persons would more readily realise the density of platinum as 21·5 times that of water than as 239,327 times that of hydrogen. The latter may be more scientific, but it is decidedly more clumsy than the former While on this subject it may be pointed out that the author's figures do not tally with his statement as to the relative densities of the metals of the platinum group, for at page 100 it is stated that platinum is the heaviest substance known except osmium and iridium; while in the table of the elements, at page 25, one of these metals is said to be of the same density as platinum and the other sowewhat lighter, or in hydrogenous terms the figures given are too low by ten or twelve thousand units. The descriptive part contains notices of a large number of species, far larger indeed than there is required in a first rudimentary book; but few of them can be said to be well described. This is in great part to be attributed to the neglect of methodic nomenclature, crystals being described by vague references to shapes rather than by the terms of systematic crystallography. Thus, witherite is said to occur in hexagonal prisms and double hexagonal pyramids, although immediately before the angle of the prism is given at 118 deg. 30 sec. What is really meant is that the crystals are contractions producing six-sided prisms which resemble those of the hexagonal system, but have no structural relation to them. All the minerals of the tenstone-zircon group, although correctly figured as tetragonal, are incorrectly attributed to the rhombic system, and include prisms of twelve sides, or four that are usually supposed to be incompatible with the symmetry of the system. The description of the commoner minerals contains much information that is more curious than accurate. Thus, among other things we are told that the European silver ores are generally richer than those of South America; that all the schistic rocks contain gold; that coal beds are immense masses of moist vegetation, undergoing decomposition; that iron pyrites occur almost everywhere but never in large masses, and is seldom mined except for the sulphur and gold contained. From the latter statement we may conclude that the author has never heard of Rio Tinto, Tharsis, and the allied coppery pyrite masses in south-western Spain and Portugal. The principal lead mines in France are said to be at Poullaouen, and Huelgoal, in Brittany, which mines have, however, been abandoned for a long time, while, on the other hand, very productive mines have been worked with English management at Pontgebaud, in Auvergne, for more than a quarter of a century. Surely some notice of the latter locality might have been given. Galena is also said to have some of the lead replaced by an equivalent proportion of silver, copper, antimony, bismuth, iron, and platinum. It would be interesting to know what evidence there is for this remarkable statement. Probably many of the above blemishes upon an otherwise useful little book are to be attributed to an exaggerated respect for stereotype plates, but it is to be hoped that the work will be more thoroughly reviewed, especially as regards the localities, when it is next issued.

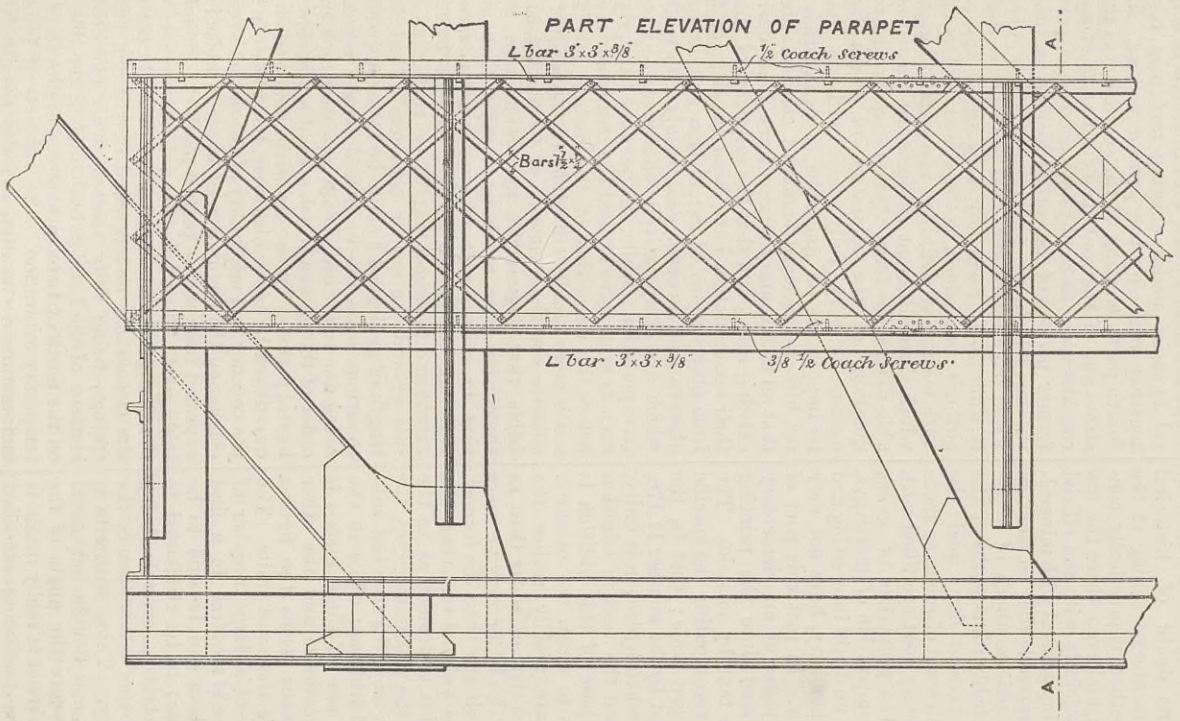
*Geology: Chemical, Physical, and Stratigraphical.* Vol. I. By JOSEPH PRESTWICH, F.R.S. Royal 8vo. pp. 472. Oxford Clarendon Press. 1886.

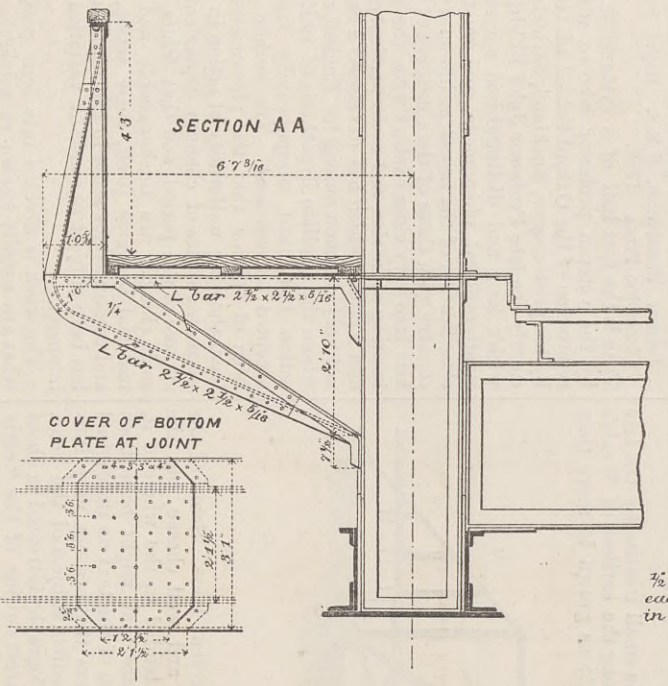
THIS is the first half of a systematic treatise on geology by the veteran professor who so worthily maintains the reputation of the Oxford School of Geologists, established by his predecessors, Buckland, Strickland, and more particularly the late Professor John Phillips. Professor Prestwich's long and distinguished career as an observer of stratigraphical phenomena, and in the comparison and classification of the newer sedimentary formations of this country with those of the continent of Europe, has brought him into very close contact with the geologists of neighbouring countries, and more particularly those of Belgium and France, which has developed a catholicity of thought not very common among his English contemporaries, with whom the Lyellian hypothesis of uniformity in geological action has until comparatively lately been generally accepted as sufficient. The author has, however, long been of opinion that the phenomena of geology, so far from showing uniformity of action in all time, present an unceasing series of changes dependent upon the circumstances of the period, and that while the laws governing such changes are unchangeable and permanent as the material universe itself, their action, as new conditions and combinations arose in the course of geological history, has been subject to constant variation both in degree and intensity.

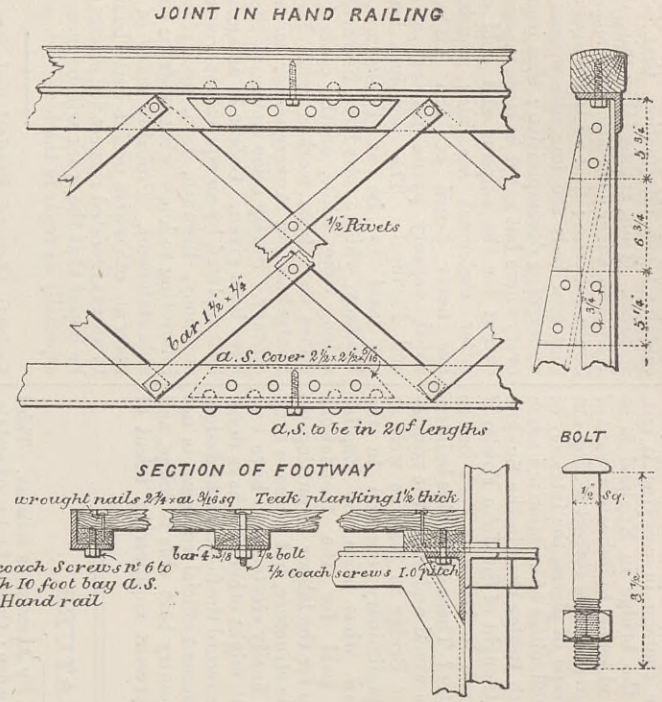
The work is divided into four parts, the first covering what are usually known as mineralogy and petrography, while the second deals with the mode of action of geological agencies under existing and past conditions, these together make up the present volume. The third and fourth parts, treating of the succession of the sedimentary strata and of the contained fossils and of some theoretical considerations as to physical conditions prevailing during former periods of the earth's history, will form the second volume, which, we understand, is now nearly completed. From the circumstance that the work is still unfinished, it is difficult to form any very exact appreciation of the author's conclusions, as the volume before us deals mainly with matters of definition and detail; but the manner in which these different subjects are treated shows considerable differences from that ordinarily adopted. Then the question of the alteration of rocks by atmospheric agency is very fully dealt with on the ground that its importance on questions of denudation and time has not hitherto received sufficient consideration. It is clear that all sedimentary stratas have been derived from pre-existing rocks, and that the estimates of time required for their accumulation have been based upon figures derived from observations of denudation as now going on. Such observations, however, deal mainly with sedimentary strata which are comparatively unchangeable except by bodily transportation; while, on the other hand, crystalline rocks, such as must have formed the entire surface of the earth before the deposition of the earliest stratified rocks, are much more rapidly altered by the removal of their alkaline silicates and the formation of China clay, so that it is probable that degradation and denudation may in earlier times have been much more rapid than at present, and that in consequence of greater abundance of available material, the earlier formations were built up of larger extent and thickness than those that have followed. On this ground the author considers all calculations of the length of geological time to be fallacious, and to have led to serious error, the unlimited length commonly assumed being due to the use of data representing a special and late order of things, and which are not applicable to earlier geological periods. These conclusions may, and no doubt will, be questioned by many observers, but there can be no doubt of the cogency and originality of the author's reasoning. The chapter on the circulation of water in rocks is, as might be expected from such a perfect master of the subject, exceedingly good. The whole of the circumstances connected with the absorption and retention of rainfall by porous strata, and the circulation, underground circulation, and delivery in springs, being fully treated, with excellent illustrative sections of the London basin and of the line of chalk hills on the north of London, showing the levels of constant and temporary saturation. The subjects of faulting, folding, and mountain elevation are also admirably treated, the latest researches, including those of Stapff in the St. Gothard tunnel, being used in illustration. Mineral veins receive much fuller consideration than is usual in geological treatises; but here the author has not been quite

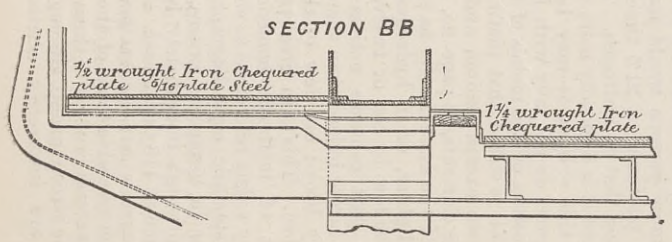
# THE SUKKUR BRIDGE.—DETAILS OF CENTRAL GIRDER.

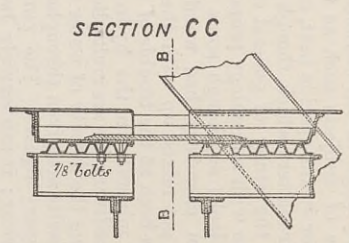
(*For description see page 28.*)

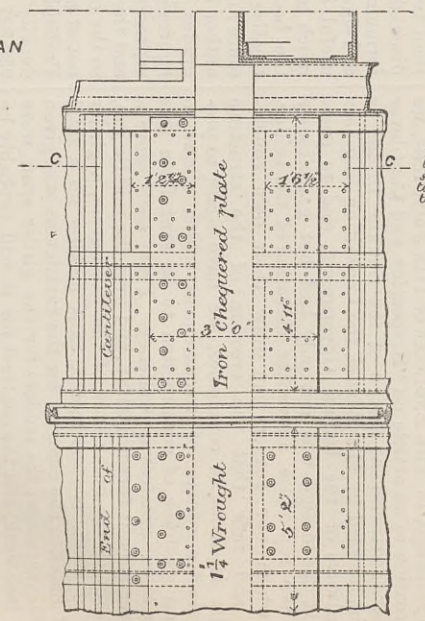


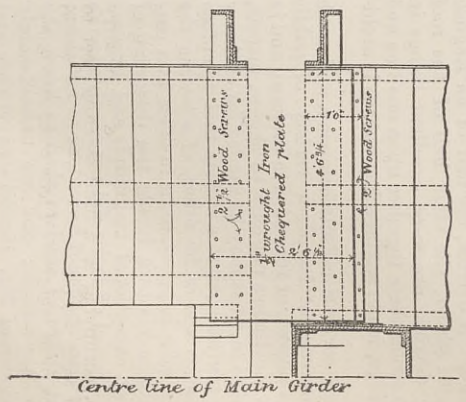



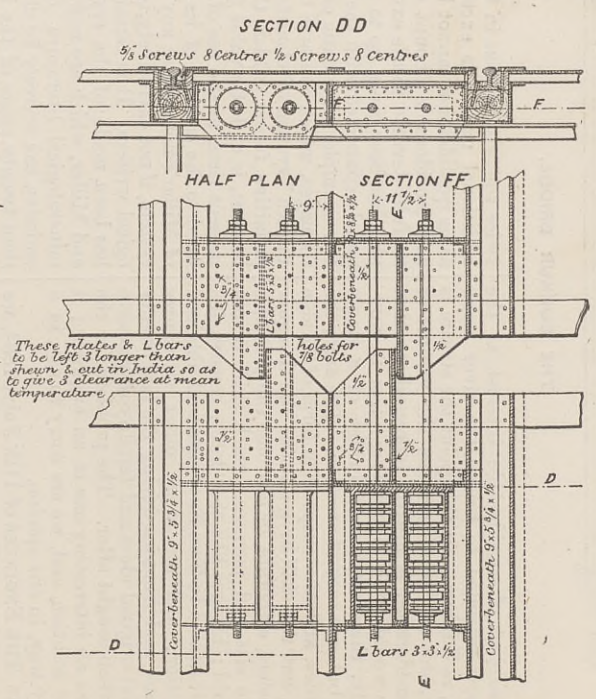



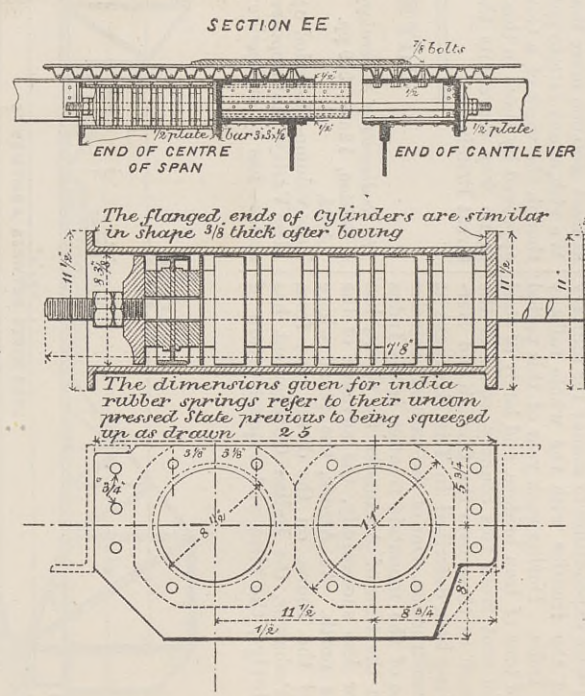




EXPANSION PLATES AT ENDS OF SPAN



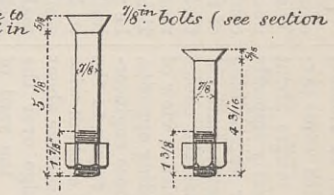

DETAILS OF EXPANSION SPRINGS

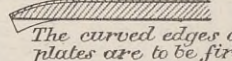


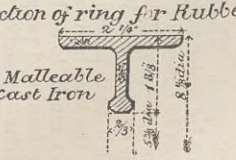

NOTES

All rivet holes in corrugated plates are to be 5/8 in diameter
All rivet holes in angle & plate covers gussets & diagonal tension bars of main girders are to be 1in diameter
Rivet holes which pass through 6/16" web plates of vertical struts & those through 5"x3" longitudinal angle bars of curbs & footways are to be 3/4in dia.
all other rivet holes in main girders are to be 7/8 in diameter




The curved edges of Chequered plates are to be first bent as shewn and the superfluous mould on smooth side planed off



fortunate in his authorities. Thus, in describing the copper region of Lake Superior, only the transverse fissure veins are noticed. The cupriferous amygdaloids are conglomerate, which are of infinitely greater importance as sources of supply being entirely ignored. It is also remarkable not to find a notice of the great lead-bearing sandstone series of Mechernich, in the Erfel, as many stratified deposits of considerably less significance are described. Mining in South America is said to have been almost entirely confined to veins containing the precious metals and mercury, thus ignoring the great copper production of Chili. The section on mineralogy and petrography would have been better if it had been subjected to an independent critical revision before publication. Such slips are, however, comparatively unimportant, having regard to the enormous amount of information contained in the volume.

Volcanic action is attributed by the author to the shrinking of the earth's crust, due to secular refrigeration, producing a pressure on the viscous or plastic molten matter below, in which he follows Cordier's hypothesis. Earthquake action is treated mainly on the lines of the late Mr. R. Mallet's investigations, and his hypothesis as to the crushing of rocks as a source of volcanic heat is fully noticed. As regards granite, the author inclines to the hypothesis of its metamorphic origin for sedimentary results, a view which has been losing ground of late, though once exceedingly popular. On such an obscure subject as this, however, considerable differences of opinion are likely to prevail for some time to come, at any rate, until more precise methods of investigation than are at present in use have been brought to bear on the question. Taken as a whole, the volume is likely to be of considerable value to students, as well as interesting to the general reader. The execution as regards type, paper, and illustration, is admirable, and reflects the highest credit on the managers of the University Press.

## THE INSTITUTION OF NAVAL ARCHITECTS.

THE Institution of Naval Architects has this year followed the example of other institutions and has met out of London. No more suitable place than Liverpool could have been selected, and the Local Committee's hospitable arrangements have left nothing to be desired.

The first meeting took place on Tuesday, the 27th inst., in the council chamber of the Town Hall—a fine apartment, well adapted to the purpose. The President, the Earl of Ravensworth, filled the chair, and there was a large attendance of members. After the transaction of formal business the President delivered a brief address. He described the arrangements for the meeting, and said it was specially appropriate that it should take place in Liverpool, which was undoubtedly the chief port of export and import for the United Kingdom. He believed that Liverpool was destined for many years to come to hold that position. Liverpool was also the port of departure for those magnificent fleets of Atlantic steamers which were alike the pride, admiration, and envy of the world. Liverpool was, further, the connecting link between the United Kingdom and that vast, powerful, and friendly nation upon the other side of the Atlantic. A paper was then read by Mr. Martell,

### ON THE CARRIAGE OF PETROLEUM IN BULK ON OVER-SEA VOYAGES.

The author began by stating that notwithstanding the fact that thirty years have now elapsed since the discovery of petroleum in America, and that its production has grown so rapidly as to cause it to occupy the fourth place on the list of exports from that country, the efforts of British shipowners have been up to the present time but little exercised in competing with foreign shipowners for the over-sea carrying trade of that commodity.

The time, however, has arrived when British shipowners can no longer afford to ignore any branch of the carrying trade in which they can successfully compete, and it is thought the trade in question is of sufficient importance to call forth their well-known enterprise and energy. The apparently unlimited supply of petroleum which, in addition to that from the American wells, exists in the Baku district of the Caucasus, and which has been so prominently brought under the notice of the public in the interesting work of Mr. C. Marvin, entitled "The Region of the Eternal Fire," together with other recently discovered supplies, would seem to show that, even if vessels are specially built for the purpose of carrying oil, no fear need arise in the minds of shipowners of the exhaustion of the supply. Nearly the whole of the petroleum shipped in America for British and European ports is carried at present either in barrels or in tin boxes cased with wood. An ordinary barrel is 33in. long and 25in. in diameter at the middle, and weighs when full about 400 lb. Such a cask holds about 42 imperial gallons, and its own weight is 64 lb., or about one-fifth of that of the oil it contains. It is estimated that in stowing this cargo, three and a-half casks take up on the average a ton of 50 cubic feet, and it would, therefore, occupy 80ft. per ton deadweight. But as most modern three-deck steamers, fitted with water ballast in the holds in the usual way, cannot be brought to their load draught with cargoes occupying more than about 50 cubic feet to the ton, it will be seen that a great loss of cargo-carrying power is sustained by shipping petroleum in such vessels in casks, through the fact that the whole of the available cargo space is occupied long before the vessel is brought down to her proper load draught. Thus, by way of illustration, if a steam vessel that could carry 2000 tons of cargo, occupying as a limit 50 cubic feet to the ton, were filled with petroleum in barrels, she would carry only 1250 tons dead weight. Of this quantity, moreover, about 16 per cent. would represent the tare of the casks, thus reducing the actual amount of petroleum to 1050 tons. From this again it is usual to deduct 2 per cent. for leakage, and if such an amount of leakage does occur in practice, the net weight of oil usefully carried becomes reduced to about 1030 tons, as against 2000 tons of ordinary deadweight cargo. As the specific gravity of American kerosine is ·80, and that of Russian about ·82, it would occupy in bulk less than 50 cubic feet to the ton, the average volume being about 45 cubic feet, and, therefore, no difficulty in carrying a full cargo would arise. The special fittings requisite for such a method, including the pumps, would, of course, have the effect of greatly reducing the above difference of 970 tons against the barrels, but there would be still left a large margin in favour of the carriage of oil in bulk. But the advantage due to a difference in carrying power, great though it be, is not the only consideration. Another important economic question which arises in connection with the barrel system is that of the cost of the barrels themselves. Their value in the United States is stated to be from 4s. 6d. to 5s. 6d. each, and, with the exception of the few that are taken back to America, they are sold in London when empty for from 3s. 6d. to 4s. each. The depreciation of from 1s. to 1s. 6d. in the value of the barrel, which amounts to as much as from £350 to £475 for one voyage in the case quoted above, is saved under the bulk system. At present it has to be borne by the consumer of the oil, and, by enhancing the cost, has an effect in restricting use of the commodity which would disappear if the employment of casks were discontinued. The

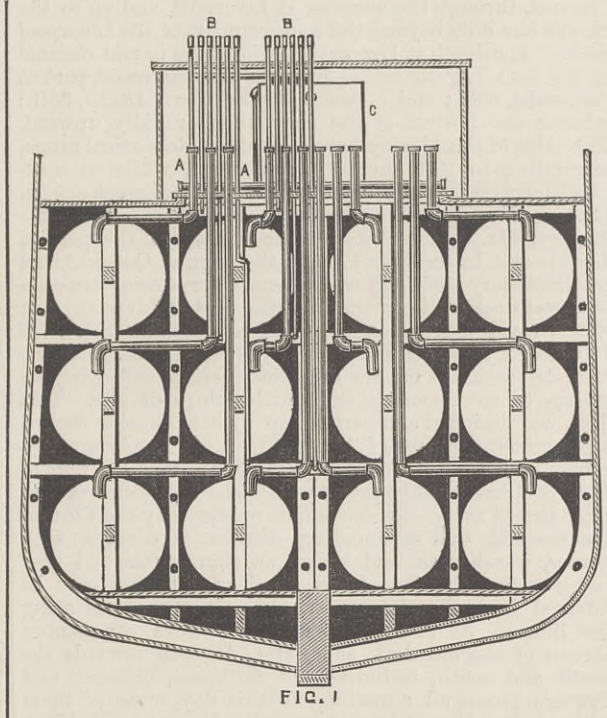


FIG. 1

loss is even greater in respect of the cases in which a large proportion of the oil is carried. The raw tin is bought in Wales, shipped to the United States, and there made into boxes protected by a wood casing. The cost of these cases is nearly equal to that of the oil they contain. On their arrival at the port of discharge they have, when emptied of their contents, no value whatever, and the full cost of their manufacture has to be charged upon the oil, at the same time some advantage is gained in carrying power, as the cases stow more closely than barrels.

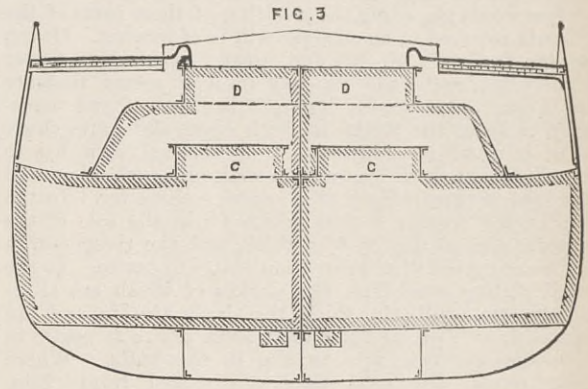
The degree of rapidity with which the cargo can be loaded or discharged under each of the systems is also of great economic importance. One steamer specially designed to carry oil in bulk, and which can take on board 1700 tons of that commodity, can load or unload in five or six hours with suitable facilities for discharge; with a cargo of barrels the operation would take nearly as many days. Whether, therefore, regard be had to the amount of cargo carried, to the loss incurred in respect of the depreciation in the value of the barrel, or to the rapidity with which loading or unloading takes place, the balance of economic advantage is clearly and overwhelmingly in favour of the carriage of petroleum in bulk.

The author then went on to state the conditions that must be fulfilled :—(1) Provision for the expansion of the oil under an increase of temperature. It may be taken that petroleum increases in bulk about one gallon in 200 for an increase of temperature of 10 deg. Fah., and as considerable variations in temperature are likely to occur on certain voyages, it is obviously necessary, if the tanks are to be saved from leakage, or even bursting, that space should be afforded to permit any probable expansion to take place. For an increase of temperature of 40 deg. Fah. the increase in volume would be about 2 per cent., and in some of the plans with which he was acquainted this degree of expansion had been allowed for. It was usual not to fill either barrels or cases completely, space being left for expansion.

(2) Provision for keeping each tank full by automatically supplying any loss due to leakage, or to contraction consequent upon a fall in the temperature of the oil. This is necessary for two reasons. In the first place, if the level of the oil in the cisterns were allowed to fall, it would be free to rush from side to side as the vessel rolled, and thus do damage which might result in the loss of the vessel. In the second place, any depreciation in the height of the oil over a space of even moderate extent seriously reduces the effective metacentric height, and renders the vessel less stable in the upright condition.

The author then sketched the history of the conveyance of petroleum in bulk, and went on to describe several systems now being tried, from which we select two. In September of last year an American merchant, Mr. L. V. Sone, of New York, patented a plan for "improvements in vessels for transporting liquid cargoes in bulk," and has fitted up the wooden barque Crusader, of 643 tons, in accordance with the patent. The vessel has made three voyages between the United States and this country with safety, and has delivered her cargoes in first-class condition. A plan of the arrangements is shown in Fig. 1. They consist of three tiers of circular cylinders placed tier above tier. The vessel carries forty-seven of these cylinders, arranged in such lengths that an end of each is located beneath a hatch, and each one is fitted so as to be independent of all the others. To each cylinder is attached a pipe A which passes up into the hatch above, to be connected with the hose for filling or emptying the cylinder. A separate pressure-pipe B attached to the top of the cylinder passes also up through the hatch and extends to some height above the deck. Its purpose is to carry away any vapour that may be given off by the oil. Each of the pressure pipes is also connected by a branch with a pressure tank or reservoir C standing on the deck. The purpose of this tank is to keep the liquid in the cylinders under constant pressure, and to supply any waste due to leakage. It also serves as an overflow tank into which the oil finds its way when an increase of volume occurs through an increase of temperature.

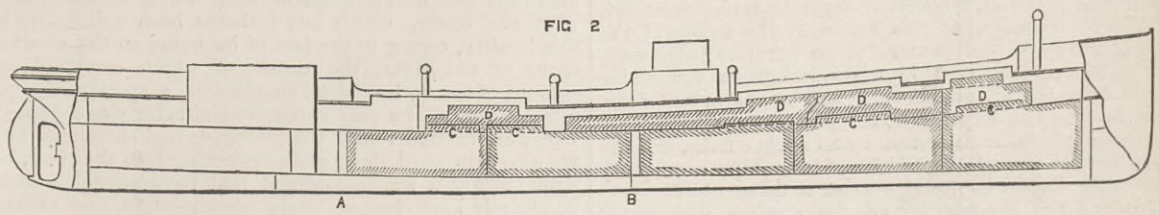
FIG. 3




The first steam vessel adapted in this country for the carriage of oil in bulk was the Fergusons, of 1551 tons gross, altered by Messrs. R. Craggs and Sons, of Middlesbrough, in the latter part of last year. Two rows of large iron tanks are fitted in the hold and two others in the 'tween decks. These tanks are specially shaped to fit the form of the vessel, and fill nearly the whole of the hold and 'tween deck space, a passage way of 2ft. being left at the middle line. They are filled by branch pipes from a 5in. main carried along under the upper deck beams in the fore and after holds, and are emptied by the same system of pipes, each tank being capable of independent connection with the pumps. To keep the tanks quite full, and at the same time to provide for the expansion of the oil, a regulating tank is fitted in the 'tween decks, and connected with each of the system of tanks arranged in the hold. A second tank, placed in the hatchway on the upper deck, is similarly connected with the 'tween deck tanks. The separate regulating tanks are fitted in this instance to obviate the great pressure that would be brought upon the lower tier if they communicated with the tank on deck. To take up any overflow from the regulating tanks, and also to furnish if necessary a reserve supply for filling those tanks in the event of leakage, an overflow cistern is fitted in the hold immediately beneath the regulating tanks.

Another plan for the carriage of petroleum in bulk in steam vessels is that adopted by Messrs. W. Gray and Co., of West Hartlepool, in a new iron vessel named the Bakuin—Figs. 2 and 3—now completing for a London firm. Her registered dimensions are 260ft. × 36ft. × 17·4ft., and the gross tonnage 1527 tons. The great bulk of the oil in this vessel is carried beneath the lower deck, a novel feature of which is that the beams are given a camber in the opposite way to that usual in ships. The object of this sagging of the beams at the middle is to

FIG. 2




enable the tanks to be completely filled and efficiently ventilated. The air, while the tank is being filled, or the vapour given off at sea, collects naturally under the deck near the beam arms, from which it is led away by means of suitable ventilators. A longitudinal middle line bulkhead, extending to the height of the middle deck, divides the main hold, and transverse bulkheads further divide it into compartments of from 32ft. to 36ft. in length. As shown on the sketch of midships section, the Bakuin has a cellular bottom, the crown of which forms the floor of the oil tanks. Above the cellular bottom, to the height of the 'tween decks, the oil extends to the side, as in some other plans. In the 'tween decks, and of the shape shown on the section, are built a number of additional oil compartments. They do not extend either to the side of the vessel or to the deck above, and it is claimed for this plan that while the oil in the main hold can never reach a high temperature, owing to the immersion of the vessel, the tanks in the 'tween decks, by being so formed, are kept at a much lower temperature in hot climates than if they extended to the sides. In the event, too, of injury to the

hull at this part, by collision or otherwise, the tanks would under ordinary circumstances escape injury. As in other vessels, the machinery is placed aft, and a double bulkhead marked A is fitted before the boiler space, and another at the fore end of the foremost oil compartment. The hold is further separated into two distinct divisions by an additional pair of adjacent transverse bulkheads B, as shown on the longitudinal plan. The object of this arrangement is to allow of oils of different qualities being carried on the same voyage without any danger of their mixing. Arrangements have also been made by which, with oil in the hold, other descriptions of cargo may be carried in the 'tween decks. With this object expansion tanks C formed on the middle deck communicate with the cisterns in the hold, and are capable of being closed, air pipes being fitted to pass through the cover and above to the upper deck. Additional expansion tanks D built on the roof of the 'tween decks cisterns, within the area of the upper-deck hatchways, are for use when both the tanks in the hold and 'tween decks are filled. The whole of the valves which regulate the filling or emptying of the tanks are conveniently placed in the engine house, and by means of an arrangement of floats, connected with wires, the level of the oil in each tank can be ascertained at the same place. Great care appears to have been taken in the construction of the Bakuin to avoid all possible sources of risk from fire. She is to be lighted by electricity, the cabins are to be heated by steam instead of by fires, and the cooking will also be done by steam. It is estimated that this vessel will carry 1950 tons of oil, and the pumping arrangements are such that, with proper facilities for discharge, the cargo can be emptied in about twelve hours. A few words regarding the rivetting of those parts of the Bakuin required to be oil-tight will be of interest. Owing to the fact that oil has far greater penetrating power than water, and finds its way through seams that are quite impervious to the latter, it has been found necessary to space the rivets in both edges and butts closer than is usual in shipwork, while especial care has to be taken that the holes conform well with each other, and that the workmanship is of a superior character. In the top of the cellular bottom which forms the sole of the cisterns the plating is $\frac{6}{10}$in. thick, and the rivets $\frac{5}{8}$in. in diameter spaced 2$\frac{1}{4}$in. apart from centre to centre. In the shell plating amidships, the strakes of which are alternately $\frac{9}{10}$in. and $\frac{11}{10}$in. thick, the rivets are $\frac{7}{8}$in. and are spaced from 2$\frac{1}{2}$in. to 2$\frac{3}{4}$in. apart from centre to centre in the edges, and from 2$\frac{3}{4}$in. to 3in. in the butts. Where $\frac{3}{4}$in. rivets are used they are spaced from 2$\frac{3}{8}$in. to 2$\frac{1}{2}$in. from centre to centre. The rivets connecting the shell plating to the frames are from 6in. to 6$\frac{1}{2}$in. apart. In the transverse bulkheads the overlaps are rivetted with $\frac{5}{8}$in. rivets spaced 2$\frac{1}{4}$in. apart. This spacing of rivets is closer than in any vessel yet built in this country for oil carrying purposes, and from what has come under his notice, he questioned whether much wider spacing of rivets than this—even with the best workmanship—would ensure practical oil tightness."

This is, we believe, the first paper in which information concerning the carriage of petroleum in bulk has been collected together and made generally available. It is proportionately valuable, and we regret that we have not space for more than the abstract which we have given.

The discussion was opened by Mr. Kirk, who stated that he had some years ago a good deal of experience as an oil maker. His experience as an oil carrier was much more recent. The first attempt that had come under his notice was a failure, the oil being carried in bulk in a deep double bottom, under other cargo. Partly because of bad workmanship the oil leaked away, and the scheme failed. With good workmanship there was, however, no difficulty at all in making tanks quite oil-tight. He had made circular tanks 30ft. in diameter, and 13ft. or 14ft. deep, which did not weep in the least. They were of $\frac{5}{16}$in. and $\frac{3}{8}$in. plates; the rivets were $\frac{3}{8}$in., pitched 1$\frac{1}{2}$in. With tanks of different forms requiring angle irons to stiffen them there was more trouble, because it was easy to set such tanks leaking by springing them.

Mr. Swan said that he thought there was needless complication in some of the ships illustrated by Mr. Martell. The three things to guard against were leakage, gas, and fire. Too much subdivision provided places for gas to collect, and augmented danger instead of reducing it. He advocated the carriage of oil in the hull direct, the hull being, of course, properly subdivided by transverse and one longitudinal bulkhead. In this way great facility for repair was obtained, whereas if separate tanks are used, these must be cut out to give access to the inside of the skin of the ship. Salt water did no harm to petroleum, and if a rent occurred in a ship's bottom the water would drive the oil up above it, and no harm was done. This he knew by experience, the bottom of a petroleum ship having been actually torn by an anchor fluke, but the cargo arrived in perfect condition. If the ship was properly made there would be no bilge water to do mischief.

After a few remarks by another speaker, who stated that the Russians had their first tank steamer built for the Caspian at Motala in 1879, and that they now had 100 steamers and 300 sailing vessels, Mr. Laird called attention to the necessity for arrangements for receiving petroleum at Liverpool. Mr. Martell replied briefly. He said that although crude petroleum was not injured by sea water, refined oil was, and that to such an extent that only pure fresh water could be used for filling the tanks by way of ballast. A vote of thanks was passed, and Mr. Lyster read a paper giving a

### Description of the River Mersey and the Port of Liverpool.

This was a very long paper, containing a great deal of information of special local interest. The river Mersey first bears that name at a point in Cheshire a few miles to the east of Stockport, where it is formed by the junction of two streams, the Etherow and Goyt, which rise in the Derbyshire Hills on the borders of Yorkshire and Cheshire respectively. The entire length of the river bearing the name of Mersey to the sea is fifty-six miles. For the last six miles of its course, along which the city of Liverpool is situate on the right bank, and the town of Birkenhead on the left, with their several systems of docks, the Mersey becomes contracted, and at its narrowest point opposite the centre of Liverpool its width is only about 3000ft. From Runcorn to the sea it will thus be seen that the river is of a form which has been aptly described as that of a bottle, of which the wide expanse between Runcorn and Liverpool forms the body, and the narrows opposite Liverpool the neck. Having briefly described the course of the Mersey generally, the author went on to describe its tributaries, the outfall, and the bar. The great range of tide in Liverpool Bay, which insures a depth of at least 30ft. over the bar once every twelve hours even on the lowest neaps—which are periodically but few and far between—must be considered as affording a comparatively convenient approach for even the largest vessels; nevertheless, in such days as these, when the tendency is towards a still further increase in the size of ships, and when time forms such an important factor in successful trading, it is evident that a deeper channel to such a port as Liverpool would be desirable. The problem involved as to the best means of attaining such an end is, however, surrounded with physical and financial difficulties of no ordinary character; and though the question is prominently kept in view, no definite steps have been taken towards its solution. Within the bar ample depth of water for the largest ships is found along the Crosby Channel, through the narrows at Liverpool, and up to the Sloyne one mile beyond the southernmost of the Liverpool docks. The depth at low water spring tides in mid channel at the Rock Lighthouse is 50ft.; in the narrowest part at Seacombe, 60ft.; and opposite the Southern Docks, 35ft.; whence the bottom of the river slopes rapidly upward. The tides of the Mersey have a considerable vertical range, amounting to 10ft. on the lowest neaps, while on equinoctial springs the range opposite Liverpool is as much as 31ft. Having described the canals communicating with the Mersey, Mr. Lyster sketched the history of the port of Liverpool. In the year 1708, in the reign of Queen Anne, parliamentary authority was obtained for the construction of a wet dock at the entrance of the pool of Liverpool. It was to cover four acres, and to afford accommodation for 100 vessels, and was arranged to have not less than 14ft. of water within it on low neap tides, with a sufficiency on springs to accommodate the smaller ships of war. This dock was designed and carried out by Mr. Thomas Steers, a prominent engineer of the period, whose family are connected with Liverpool to this day. Since then the port of Liverpool has steadily progressed. The old dock has long since passed away—its site is now occupied by the Custom House—and the surrounding district is covered with houses, warehouses, and shops, no sign of the old pool being noticeable, though its previous existence may be inferred from the depression of the street surfaces along the line of its course. The earlier docks commenced abreast of the old dock, and extended both towards the north and south, including the Salthouse, George's and Prince's group, all remaining to this day, some of them without alteration, and testifying to the foresight and ability with which they were designed and carried out by Mr. John Foster and his son, who were then the surveyors to the Corporation, by whom the affairs of the dock were administered. In the year 1824 Mr. Jesse Hartley became the surveyor and engineer to the estate, and designed and carried out those vast ranges of docks, with their surroundings, between the Waterloo and the Canada in a northerly direction, and the Canning, Albert, Wapping, Coburg, and Brunswick, with other minor groups, towards the south; in fact, to his genius and practical knowledge, during the thirty-six years he occupied the position of engineer to the estate, Liverpool undoubtedly owes much of her commercial greatness, these vast undertakings having established the port as the greatest in the world. The last important Works Act was that obtained in 1873, at which time, owing to the rapid increase in the size and tonnage of steamships, it had become necessary that special dock provision should be made to meet the requirements of the port in that direction. Very comprehensive systems of docks were then designed to meet these pressing wants, and parliamentary powers were obtained to carry out the necessary works, which consisted of the development of the northern and southern ends of the estate, previously acquired and re-claimed from the foreshore for the purpose. The parliamentary estimate for these schemes was £4,100,000. In order to maintain the desideratum of deep water in connection with the docks, which has hitherto been a difficulty in this locality, owing to the fact of its being on the weather shore of the river, the waters of which carry a large amount of silt and sand in suspension, a special arrangement of sluices of a very extensive character was designed. These are carried round the pierheads and entrances, and are also continued along piers projecting into the river, by which means it was considered that the approaches could be entirely kept clear of sandy accumulation, and experience of the works has fully demonstrated their success. The estimate for this important section of the parliamentary works amounted to £2,691,360, within which sum they have been carried out to completion. The greater part of the additional dock accommodation in this position was completed in 1881, and was opened for use by their Royal Highnesses the Prince and Princess of Wales on the 8th September of that year. The works at the south end of the Dock Estate authorised by the Act of 1873 comprised the enlargement of the Herculaneum Dock, which had been built in 1868 with a special view to future extension, and the formation of a chain of docks to the northward terminating at the Brunswick Dock, and forming a complete development of the whole of the available estate in this position. The total area of the existing Dock Estate at Liverpool is 1078 acres, and the entire of this space is developed into basins, docks, quays, and premises worked in connection therewith. There are in all at Liverpool sixty docks and basins of the ordinary type, having a total water area of 368 acres, and twenty-five miles of quay berthing. In 1825 the dock authorities of that day made application to Parliament for powers to extend the dock system on the Liverpool side of the river to a point further north than it then existed, this was only partially acceded to by Parliament, and in lieu of the complete proposal it was arranged that the Birkenhead Docks, which belonged to an independent company at that time and were only partially developed, should be purchased by the dock board and finished, and brought into use for the general purposes of the trade of the port. This system, therefore, now forms an integral portion of the Liverpool estate, and is worked in complete unison therewith. The total area of docks at Birkenhead is 164$\frac{1}{2}$ acres, with 9$\frac{1}{2}$ miles of quayage. There are also three graving docks at Birkenhead, opening from the west float and capable of dealing with the largest class of vessels, their aggregate length being 2430ft. The several quays of the Birkenhead Docks are surrounded by railways which are connected with the London and North-Western, Great Western, and Cheshire lines systems, each of which have large stations upon the dock quays. The gross total area of the estate on both sides of the river amounts to 1583$\frac{3}{4}$ acres. This is subdivided into 532$\frac{3}{4}$ acres of water space in the form of docks, half-tide docks and basins, which are surrounded by thirty-four miles of quays, also sheds and warehouses having an aggregate floor area of 181$\frac{1}{2}$ acres, the remainder being laid out in streets and open quays, also in timber yards, shipbuilding yards, and other business premises necessary for the working of the port, with a small residue of partly undeveloped land. The total graving dock accommodation is comprised in twenty-four docks with an aggregate length of floor of 14,920ft. The total number of ships which entered the port and paid tonnage rates in the year ending 1st July, 1885, was 21,529, having a net tonnage of 8,571,454 tons. In this figure the capacity in or out only is represented, not both. The total revenue of the estate received from all sources during the same period was about one and a-half millions sterling. The affairs of the Dock Trust are administered by a body named the Mersey Docks and Harbour Board, with a number of members fixed by Act of Parliament at twenty-eight, twenty-four of whom are elected by the dock ratepayers, the remaining four being nominee members appointed by the Government. Special Commissioners are appointed under the authority of Parliament to guard the interests of the river, or as the Act describes, "to preserve the navigation of the Mersey from Warrington and Frodsham Bridges to the sea." This important body consists of the First Lord of the Admiralty, the Chancellor of the Duchy of Lancaster and the President of the Board of Trade, who are represented by an "Acting Conservator." That position is now and has been for some years past ably filled by Vice-Admiral Spratt, C.B., F.R.S., &c. The average tonnage turned out from the shipbuilding yards on the Mersey for the five years ending 1884 was about 42,000 tons, 11,000 tons being from the yard of Messrs. Laird. The author concluded with a sketch of the history of iron shipbuilding in Liverpool. The paper contained a full tabular statement of particulars of the docks, &c., and carefully executed maps. There was no discussion, and when the paper was concluded the members proceeded to the Grand Hotel, where luncheon had been prepared by the Local Committee.

The members of the Institute then drove to the Prince's Landing-stage, and embarked on the Dock Board tender Vigilant, in order to visit the chief points of interest in connection with the Docks. The party was conducted by Mr. G. F. Lyster. The first point visited was the entrance to the Canada Docks, where works of an interesting character had lately been constructed with the object of removing the deposit which has a tendency to collect round the entrance to the system of docks known as the North-end scheme. This development comprised the extension of the Canada basin and the lowering of the bed of its floor; the formation of the Langton half-tide dock, or the entering vestibule into the main group; two pairs of graving docks, each pair having a gross length of 1000ft.; the Langton branch dock, the three branches of the Alexandra Dock, and the Hornby Dock. The total area of the new extension is 83 acres, and the quayage 23,700ft. An excellent model of the whole of the new system of docks was exhibited by Mr. Lyster, who fully explained the nature of the arrangements which he had carried out to prevent the permanent deposit of silt in the basin of the Canada Dock. The entrance to the Canada basin was constructed in the first instance with its passage almost at right angles to the axis of the estuary; but it was found that, owing to the fact of its being on a weather shore, large deposits of silt and sand constantly formed inside the basin, and prevented vessels of deep draught from passing through the locks. This evil has been met in two ways—first, by constructing a new pier on the downstream side of the entrance, carried in the direction of the centre of the channel of the estuary, which has the effect of deflecting the tidal current from the entrance basin, and turning it out into deep water, where its strength is broken, and the suspended silt is delivered into the strongest part of the current. It was not, however, anticipated that all tendency to deposit in the basin would be prevented by this alteration of the entrance, and provision was made to wash away any silt that might be found to deposit in the basin after a flood tide. The bottom of the basin was first brought up to the level of the dock sill with concrete and rendered level. Sluices were then made all along the entrance walls to the docks, which, on being opened, deliver such a discharge that all the silt is washed away from their immediate vicinity. The influence of these sluices is necessarily limited, and the silt would only be carried a certain distance towards the river were it not that a number of pipes have been laid underneath the floor of the basin, which turn up until the discharging end of each pipe reaches the level of the concrete floor. There is to each pipe a stopper of greenheart timber, beneath which the water from the sluice escapes, producing a scour of sufficient force to wash away the whole of the silt into deep water. Besides the difficulty caused by the silting of the basin, it was found that passing vessels

into the docks during heavy weather was rendered somewhat difficult owing to the pressure of the wind from the estuary side. This was met by the engineer who erected a long row of sheds and cable rooms, which are hired by the several companies using the docks. These sheds afford ample protection to vessels from the wind. The members next passed on to view the Langton Graving Docks. These docks, which were empty at the time of the visit, are remarkably fine pieces of work. They are closed by gates. They have a cill of red sandstone, but the rest of the docks are constructed of concrete, with obvious advantage. The whole of the dock, with the exception of the cill, was perfectly dry, while the cill being constructed of porous stone was wet and slimy, and doubtless the smooth impervious concrete is found to be not only more comfortable for workmen, but more healthy for them, by reason of its being dryer and therefore warmer. These docks are filled and emptied by a pair of powerful chain pumps which are supplemented by a pair of turbines, all of which are driven by a couple of Corliss engines made by Messrs. Hick and Hargreaves, of Bolton. In the same building as the pumping machinery for the new dock extension are fixed the engines for supplying the necessary hydraulic power for the cranes and for moving the dock gates in the new extension. Both sets of engines are supplied with steam by five Lancashire boilers. The hydraulic machinery is calculated to withstand a pressure of 700 lb. to the square inch with safety. The 100-ton crane which is fixed on the margin of the Langton Branch Dock was an object of interest. This crane is powerfully framed, the operation of lifting being performed by a suspended cylinder, in which a piston is actuated by the direct action of water under pressure. After inspecting the machinery, &c., the party embarked on a steam tug-boat, and made a survey of the Alexandra and the Hornby Docks, in the last named of which was found the steamer Roman, which is one of the largest vessels in the cattle carrying trade. This vessel has brought over from America as many as 900 head of cattle, the largest number ever imported in a single ship.

The members next proceeded to the Sandon Dock to inspect the machinery. The whole of the engines, pumps, and boilers are placed below the surface of the quay, the foundations being 40ft. deep. The machinery consists of a tier of Gwynne's "Invincible" pumping engines. The engines have 21½in. cylinders and a stroke of 2ft., and with a maximum speed of 160 revolutions a minute, are capable of lifting 800 tons of water to a height of 5ft. These pumps are employed for emptying a series of six graving docks, which abut on the Sandon Wet Dock, and must be pronounced to be a fine group of machinery. It is a pity that means are not taken to ventilate the chamber in which the engines are placed, for no doubt a constantly maintained temperature of from 85 deg. to 90 deg. must be trying for the attendants who manage the engines.

After the inspection of the Sandon Dock, the members proceeded up the estuary along the Birkenhead side of the stream, making a cursory inspection of the docks in passing. They proceeded as far as the Government training ships, and passed round the Great Eastern steamship, which is moored in the Mersey opposite to Rock Ferry, and is being used as a place of entertainment by the inhabitants of Liverpool and of the adjoining towns. The members of the Institute reached the Prince's Landing Stage at 6 o'clock after a very enjoyable afternoon's work.

On Wednesday a paper was read by Professor Edgar, entitled "On Losses at Sea," after which the meeting was adjourned, the greater number of the members paying a visit to the London and North-Western Railway Company's Locomotive Works at Crewe. At 9 p.m. the Mayor, Sir David Radcliffe, gave a reception and musical entertainment at the Town Hall, which was attended by about a thousand guests.

## THE LUIZ I. BRIDGE AT OPORTO.*

THE following is an abstract of a paper by T. Seyrig, M. Inst. C.E. in the, *Memoires de la Société des Ingénieurs-civils*, Paris, 1886, p. 38.

"The river Douro would seem to constitute a fruitful site for the erection of great engineering works. After a lapse of eight years, the first celebrated bridge, with central arch of 525ft. span and of great height,† has been followed by a second example, apparently similar, but really presenting many features of difference when closely examined. Its most notable peculiarity is, that a single arch of 566ft. span provides two separate passages in the same vertical plane, of which the upper road is at a level of 164ft. above the lower one. This somewhat mars the bold effect of the work, but it serves to solve the somewhat difficult problem of intercommunication between the different levels of the town. The author, who designed both structures, gives a summary of the various plans submitted in competition for the latter bridge, insisting on the propriety of endeavouring in such works to harmonise economy and the exigencies of good construction with pleasing and even artistic aspect. This attention to artistic effect he claims as a characteristic of the French school of engineering.

"The arch of the Luiz I. Bridge is so far the largest existing, and will doubtless remain so until the completion of the Forth Bridge. It weighs with its two roadways about 20 tons per lineal metre of span—6 tons per foot. The arch rests on rollers, and its form is the opposite of that of the earlier bridge; that is to say, it is narrowest at the crown, instead of being crescent-shaped. The theoretical considerations which led to this change are discussed at length by the author, but the principal reason was the obligation of allowing the lower roadway to pass between the springings of the arch, while assuring the transmission to the masonry piers of the wind-stresses—that is to say, without interrupting the continuity of the cross-bracing. This difficult condition is asserted to have been satisfactorily met. The width of each roadway is 26ft. 3in.; the upper road is at a height of 204ft. above the river; it is paved with wood and is laid with a tramway. The lower road is macadamised. The total weight of metal in the structure is about 3200 tons, and its price will amount to nearly £100,000.

"The most important part of the paper relates to the mode of erection. The author adopted a novel system, consisting in the employment of wire cables, by which the various parts were raised from barges moored in the river below, and assembled in their proper positions by manœuvres executed entirely from the side piers. This funicular system resulted at once in safety, rapidity, and great economy. The ironwork was constructed at the works of the Société de Willebroeck, and the excellent workmanship conduced greatly to render the erection easy and economical."

* "Proceedings" Institution of Civil Engineers.

† "Minutes of Proceedings" Inst. C.E. vols. li. p. 302; and lxiii. p. 177, and THE ENGINEER.

## LETTERS TO THE EDITOR.

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

### THE FRAMING OF IRON SHIPS.

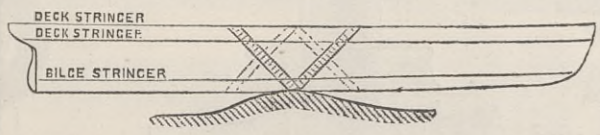
SIR,—In your journal of the 16th inst. there is an article on the framing of iron and steel ships. In that article it is stated that the hulls of the Iris and Mercury were so much lightened by the designers that the limits of safety have been passed. It is also stated that H.M.S. Calypso has been a source of trouble on a similar account. You are usually so careful in your statements in regard to such matters that I feel it to be due to you, as well as to the designers of those ships, to call your attention to these allegations. The Iris has been at sea for many years, and during that time has been badly aground in Sicily. No evidence of weakness in the ship, locally or structurally, has ever been brought to my notice, and I am confident that none can be produced. I and my late colleagues are responsible also for the Calypso, and not a word to justify your statement has reached me. On the general question, perhaps you will allow me to say that the longitudinal system has never been in competition with the transverse in merchant ships.

Materials are cheap, and the labour in transverse framing is simple. The cost per ton is therefore less in a ship framed transversely, and the saving in weight of hull in a merchant ship is not so important as in a ship of war. As competition becomes more keen the longitudinal system will undoubtedly displace the transverse to a large extent. NATHANIEL BARNABY.

London, July 23rd.

SIR,—Having read with much interest the article in your paper of the 16th inst. on the framing of iron and steel ships, and the letter of Mr. Bourne on the same subject, in your impression of the 23rd inst., advocating longitudinal frames, will you allow me a portion of your valuable space to introduce to the notice of your readers a plan differing from both perpendicular and longitudinal framing, viz., diagonally placed frames? The disadvantages of perpendicular frames are so well set forth by Mr. Bourne that I need not dilate on them, but the disadvantages of longitudinal frames may be shortly stated as follows:—That ships actually require greater strength vertically and transversely between the longitudinal frames than is given by the skin plating of the ship to prevent the plating from being crushed or bent.

On looking at the annexed sketch, where a ship is supposed to be stranded, resting on her bilges on hard ground amidships, the diagonal frames shown will take the upward pressure, and transfer it to the deck and other stringers, so that she cannot break or bend without the stringers separating longitudinally. And, of course, the adjoining frames will act in a similar way. The other frames




shown in dotted lines, running in a reverse direction, will assist by supporting the ship by taking a tensile strain; or in the case of a ship carrying heavy weights on deck or elsewhere, such as guns or cargo, they will be in compression. The frames of a diagonally built ship, if properly made, are not merely like the members of a lattice bridge, taking a strain always in one direction, but must be so made as to take strains both in compression and tension.

Of course, it will be seen that not only one pair of frames are utilised, but all the adjoining ones as well, thus distributing the strain over nearly the whole length of the ship, and in a great measure keeping the joints of the skin plating free from all strain and leakage from rupture. It will of course be obvious that in a ship thus built the skin plating may be much reduced in thickness. But a ship built with vertical frames in the position represented, the frames just over the rock would be thrust upwards, straining the joints of the plating, and bringing a transverse strain upon the deck stringers, while the adjoining frames would be of very little, if any, use. DELTA.

July 26th.

### INJECTORS AT SEA.

SIR,—The question of using injectors at sea is one that often crops up, but we hardly think that your correspondent "Aquarius" in last week's replies got quite the information he wanted. The original Giffard and all the other non-automatic injectors now made have from time to time been tried for feeding marine boilers, but only with the result of getting injectors into bad repute for this purpose, partly on account of their liability to throw off through rolling, but more especially through their moving nozzles getting fast with salt deposit. Our "Influx" being the first automatic re-starting injectors brought out in this country, were naturally the first to be tried at sea, and we have probably supplied more of them for this purpose, and certainly had them longer at work, than any other maker. Their success in facing the sediment difficulty is due simply to the fact that the "Influx" is the only automatically re-starting injector without internal moving nozzles to be set fast by the salt, while the fact of their being thoroughly automatic leaves them unaffected by rolling. "Aquarius" will no doubt thus gather that the points required in a marine injector are, the absence of internal moving parts, coupled with automatic action—points which earlier injectors do not possess. HOLDEN AND BROOKE.

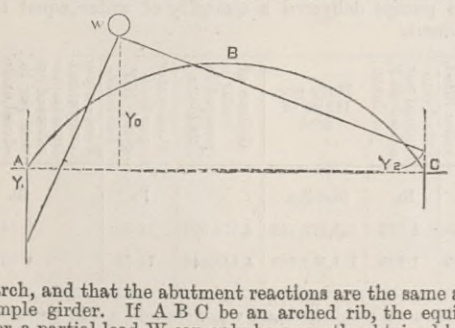
St. Simon's Works, Salford,
July 21st, 1886.

### CURVE OF EQUILIBRIUM IN MASONRY ARCHES.

SIR,—Permit me to point out what appear to be errors in the graphic treatment of masonry arches by "A. S. H.," in your issue of July 23rd.

In the first place, he averages the weight of arch ring and filling, which must be somewhat wide of the truth, as their specific gravities are very different, and their relative areas differ so much at different parts. It would be quite as easy to take the exact weights, which can be done by shortening the spandril depths above extrados in the ratio of the specific gravity of filling and arch ring. The spandril areas thus shortened will, at the weight of ring, give correct dead loads.

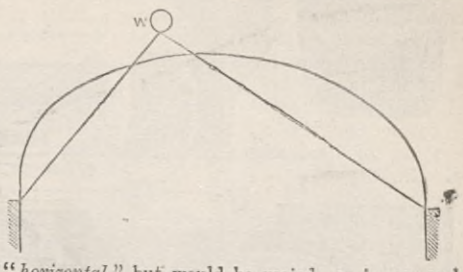
This is, perhaps, only a matter of detail, but an error in principle is also involved; for your correspondent appears to assume that the equilibrium curve must start symmetrically on both sides




of the arch, and that the abutment reactions are the same as those for a simple girder. If A B C be an arched rib, the equilibrium curve for a partial load W can only be correctly obtained by calculation of the ordinates $y_1$, $y_0$, $y_2$, and the one at the nearest abutment will generally be negative. The stress diagram from this will give the thrust and abutment reactions, which differ from those of a beam, or arch hinged at the springing. To give the whole proof of this would exceed the limits of a letter, but those interested in the subject will find it very clearly treated in Part III. —Arches—of Greene's "Graphics for Engineers." F. E. R.

July 26th.

[The difference of weight in filling and arch is a point which can be carried out in practice, but would have made the article needlessly long if gone into. With regard to the curve starting symmetrically on both sides the arch, this must be the case where the abutments are on the same level, or the thrust obtained would




not be "*horizontal*," but would be varied, as in an arch with springings at different levels, which will be treated in the next article. For a single load, with an arch with springings at the same level, the thrust would be represented thus.—A. S. H.]

### HYDRAULIC PROPULSION.

SIR,—I should be glad to know the name and address of "Go-ahead," who wrote the letter on hydraulic propulsion to THE ENGINEER of July 23rd. If "Go-ahead" can drive a 60-ton barge drawing 3ft. 10in. all round in a canal 4ft. deep, at three to four miles an hour, with 3-horse-power to 4-horse-power, and will communicate with me, I should be glad to adopt his propeller.

Castleton, Lancashire, July 26th. B. W. COOK.

## EXPORT OF BRITISH RAILS TO THE UNITED STATES.

THE recent purchases of English rails by the Michigan Central and the Chicago, Bulington, and Quincy railroads are probably the cause for the Board of Trade report showing the British exports of rails to the United States to have been larger last April than in any other April since 1882, and larger than in the whole year 1885. They cannot be called large, however, having been 6836 tons, which is not more than two days' consumption. Nevertheless, they were more than the British exports in that month to any other country except India, and more than one-fifth of the total exports, the exports to other countries being exceptionally small, and one-third less than last year. For the four months ending with April, the British exports have been:—

| Year. | To U. S. | To other countries. | To all countries. |
|---|---|---|---|
| 1879 | 1184 | 90,982 | 92,166 |
| 1880 | 62,391 | 109,451 | 171,842 |
| 1881 | 86,292 | 92,079 | 178,371 |
| 1882 | 88,921 | 159,788 | 248,709 |
| 1883 | 19,222 | 238,401 | 257,623 |
| 1884 | 8647 | 166,857 | 175,504 |
| 1885 | 3001 | 146,495 | 149,496 |
| 1886 | 8672 | 100,908 | 115,580 |

Thus the total British rail exports for the four months ending with April have been smaller this year than in any other since 1879. The activity in railroad construction, which began here in the last half of 1879, did not appear in the countries which England supplies with rails until 1882; but while we reached our maximum construction in 1882, those countries did not reach their maximum until 1883, and for three more years took more rails than in any year before 1882. These countries other than the United States, several of which are supplied exclusively from England, including the British colonies, which next to this country, are the greatest railroad builders, have this year taken 27 per cent. less rails than last year, 36 per cent. less than in 1884, and 55 per cent. less than in 1883. We must conclude, therefore, that this is a period of exceptionally little railroad construction outside of Europe and the United States, which supply themselves chiefly with rails, not depending upon English mills.—*American Manufacturer*.

## RAILWAYS IN INDIA.

THE total length of track in operation at the end of March, 1884, was 10,806 miles, and at the same period in 1885, 11,975 miles, an increase of 1169 miles, of which 989 miles were narrow gauge. The total of 11,975 miles comprised 7477 miles—of which 858 were double track—on the Indian gauge of 5ft. 6in.; 4290 miles, single track, on the metre gauge, and 208 miles, also single track, of narrower gauges. This same total is made up as follows: 4424 miles belonging to the State—3028 to the Imperial, and 1396 to the Provincial Governments—1505 miles purchased and operated by the East Indian Railway Company—468 miles double track—4517 miles owned by private companies and guaranteed by the State—390 miles double track—866 miles owned by subsidised companies, and 662 miles belonging to the native States. Of the State lines the principal are the Indus Valley Railroad, single track, 5ft. 6in. gauge, total length 651 miles; the Punjab Northern Railroad, same gauge, 446 miles, and the Rajputana Railroad, metre gauge, 1117 miles. The following is the mileage of the East Indian and guaranteed lines as given by the *Journal of Railway Appliances*:—

| Railroad. | Length. Single. | Double. | Total. |
|---|---|---|---|
| East Indian | 1038 | 467 | 1505 |
| Madras | 817 | 42 | 859 |
| South Indian* | 653 | — | 653 |
| Great Indian Peninsular | 961 | 324 | 1285 |
| Bombay, Baroda and Central India | 414 | 23 | 437 |
| Scind, Punjab and Delhi | 689 | 2 | 691 |
| Oude and Rohilkund | 594 | — | 594 |
| Total | 5165 | 858 | 6023 |

* Gauge, 1 metre—all the others 5ft. 6in.

The mileage of the narrow gauge lines is as follows:

| | 1 Metre. | 4ft. | 2ft. 6in. or less. |
|---|---|---|---|
| Guaranteed lines | 653 | — | — |
| Subsidised ,, | 661 | — | 59* |
| State ,, | 2580 | 27 | 63 |
| Native State ,, | 396 | — | 59 |
| | 4290 | 27 | 181 |

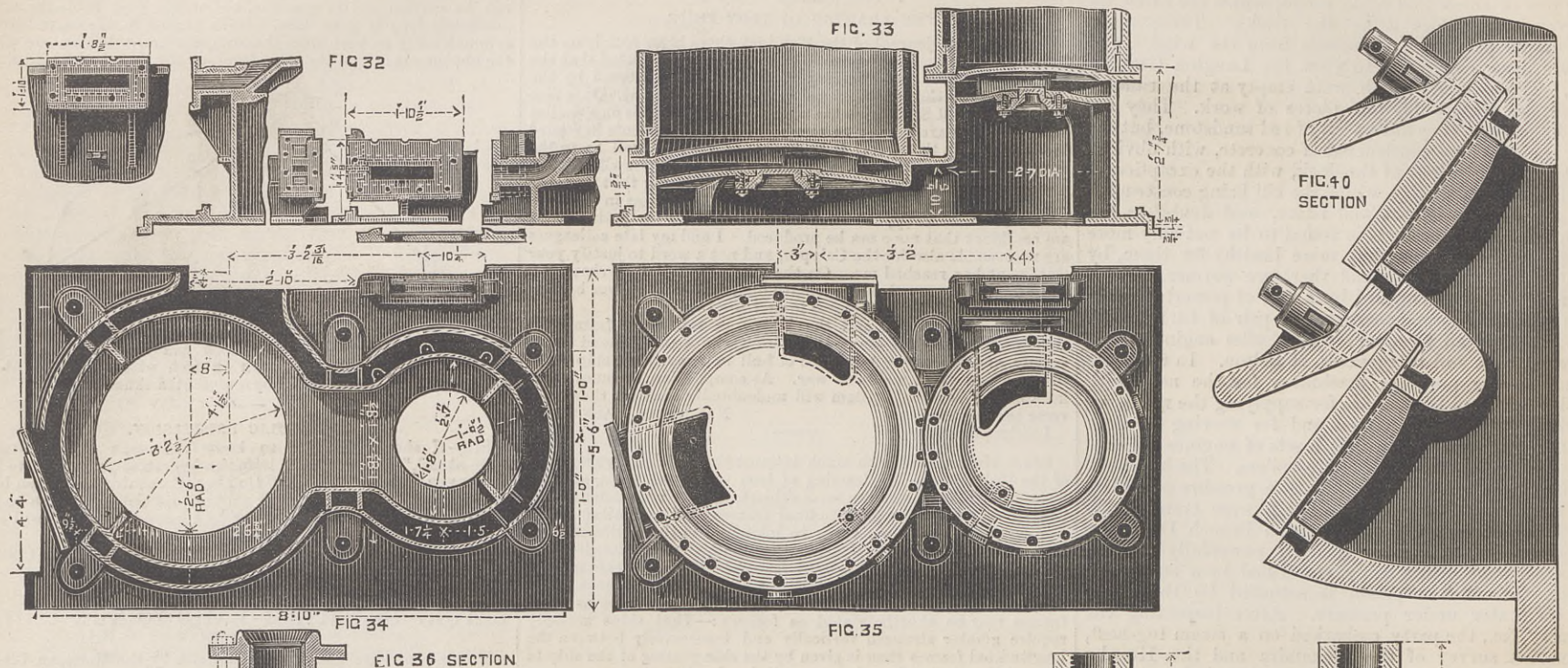
A total of 4498 miles.

* Fifty-one miles of this are on a gauge of 2ft.

There are 1448 stations and the passenger cars are of four classes. The nationality of the operating staff is as follows: Europeans, 2·66 per cent.; East Indians, 2·15 per cent.; natives, 95·79 per cent. The following is a table of the locomotives and rolling-stock at the end of 1884:

| | 5ft. 6in. Gauge. | Narrow Gauge | Total. |
|---|---|---|---|
| Locomotives | 1,943 | 811 | 2,754 |
| Passenger cars | 4,785 | 2,585 | 7,370 |
| Freight cars | 36,473 | 14,490 | 50,963 |
| Total | 41,258 | 17,075 | 58,333 |

# COMPOUND BEAM PUMPING ENGINE, MIDDLESEX WATERWORKS.—DETAILS.




## THE COMPOUND BEAM PUMPING ENGINES, MIDDLESEX WATERWORKS.

We have on several occasions called attention to the excellence of design and efficiency of the pumping engines constructed by Messrs. James Simpson and Co., and we are now able to put before our readers the designs of the large beam pumping engines constructed by them for the West Middlesex Waterworks Company at Hammersmith. Previous to ordering these, all the company's engines were of the Cornish type, but those we illustrate by the double-page engraving in our last impression, and by the engravings on pages 89 and 92 have fully justified the judgment of Mr. Thomas Hack, M.I.C.E., the engineer to the company, in departing from the past practice of that company.

In the two trials made of these engines by Mr. Hack remarkably economical results were obtained, and the working of the engines since then has realised every expectation, for we understand that they show a greater saving over the Cornish engines than was expected, besides being much better adapted to the requirements of a large district, as the speed can be varied from 12 to 22 revolutions as the demand varies throughout the day.

*Observations.*

| Date of Trial. | Duration of trial. | No. of Engine. | Revolutions from counters. | Average lift of water. | Boiler pressure. | Barometer. | Vacuum. | Temperature of Injection | Temperature of Air pump disch'rge | Coal used. |
|---|---|---|---|---|---|---|---|---|---|---|
| 1883. | hours. | | | ft. | lbs. | in. | in. | deg. | deg. | Tons. |
| Feb. 7th | 24 | 7 | 25,920 | 187·7 | 50 | 30 | 28·5 | 46 | 72 | 3·377 |
| ,, 9th | 24 | 8 | 26,325 | 187·2 | 50 | 29·6 | 28·1 | 46 | 77 | 3·425 |

*Results.*

| No. of Engine. | Actual H.P. in water lifted. | Coal consumed per actual H.P. per hour. | Duty per 112 lb. coal in million foot lbs. | Average indicated hoe-power | Coal consumed per indicated horse-power per hour. | Gallons pumped in 24 hours after deducting 5 per cent. |
|---|---|---|---|---|---|---|
| | | lb. | | | | |
| 7 | 164·35 | 1·91 | 116·1 | 206·47 | 1·53 | 4,160,913 |
| 8 | 166·46 | 1·92 | 115·5 | 206·2 | 1·55 | 4,225,926 |

In our issue of May 4th, 1883, we published the report of the official trials, but as some of our readers may not have seen it, we reproduce above the leading particulars of the engines and the results of the trials. These are compound Woolf beam engines, the high and low-pressure cylinders being on the same side of the beam and opposite to the crank. The pump, which is double-acting with four valves, is placed at the end of the beam opposite to the cylinders. The cylinders are completely steam jacketted with boiler steam; the low-pressure cylinders have separate steam and exhaust valves. The coal used was Nixon's Navigation Welsh, obtained from Messrs. William Cory and Sons, and was of very good quality. Three boilers were used on the trial, each 6ft. diameter by 28ft. long, the flues being 3ft. 6in. diameter, and each fitted with six Galloway tubes. The feed-water was taken from the hot well and pumped direct into the boilers. The leading dimensions are—diameter of small piston, 2ft. 5in.; stroke of small piston, 5ft. 5in.; diameter of large piston, 3ft. 11½in.; stroke of large piston, 8ft.; diameter of main pump, 1ft. 5$\frac{15}{16}$in.; stroke of main pump, 8ft. The engines were each to pump 3,456,000 gallons in twenty-four hours, and the duty to be done under the contract was not to be less than 96·4 million foot-pounds per 112 lb. of coal, after 5 per cent. had been deducted from the pump displacement.

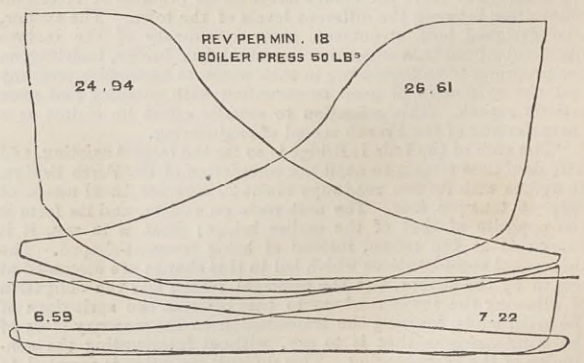
The contract for these engines was very stringent, for not only had the pump, piston, and valves to be proved quite tight to the engineer's satisfaction before the trials, but 5 per cent. was to be deducted from the pump displacement. As this is not usually done, we have given in the following table the results without deducting the 5 per cent., in order that a comparison may be made between the trials of these and other engines. The pump, pistons, and valves, were tested, and found quite tight under the full head before the trials, and there can be no doubt but that the pumps delivered a quantity of water equal to their displacement.

| No. of engine. | Actual H.P. in water lifted. | Coal consumed per actual H.P. per hour. | Duty per 112 lb. of coal. | Gallons of water pumped in 24 hours. | Feed-water per indicated H.P. per hour. | Feed-water evaporated from temperature of hot well per lb. of coal, excluding jackets which circulated back to boilers. |
|---|---|---|---|---|---|---|
| | | lb. | foot-lbs. | | lb | lb. |
| 7 | 173·00 | 1·828 | 121,779,242 | 4,379,903 | 14·56 | 9·54 |
| 8 | 175·19 | 1·825 | 121,512,329 | 4,448,343 | 14·78 | 9·53 |

The views we published last week showed a side elevation, end elevation and plan of one engine, and from them and the details in the present impression will be seen how carefully all the parts have been worked out in order that when both engines are running at full speed there may be no blow or concussion.

The indicator diagrams show a very even distribution of the power between the two cylinders, and from the results of the trials it will be seen how very efficient are the four-valve piston pumps used. The great saving effected by using these engines instead of the Cornish engines has led the directors to give Messrs. Simpson and Co. an order to construct the third engine, as space was left in the house for three of the same size, and when that is started early next year the company will have three engines of the highest efficiency.

From the drawings of the details of these engines, which have been placed at our disposal by Messrs. Simpson and Co., we have been enabled to select a number which so completely illustrate the design of all that a description would be superfluous. This is the more so as the dimensions of the parts are very fully given. Details of the condenser and air pumps are also given. Figs. 1 to 3 give plan and elevation of the beam and parallel motion not so clearly shown in the large engraving published last week.




Figs. 4 to 15 give sections of the cylinders, high and low-pressure, and of their valves, other views of these parts being given in Figs. 23 to 26, page 93, and Figs. 32 to 39 given above. Figs. 27 to 31 give elevation and section of the pumps, and from Fig. 40 is an enlarged view of the flap valves. Reference to the engraving published last week will show how these pumps are carried, and the means by which the suction roses are movably supported.

The horizontal engine to which we referred in our issue of October 17th, 1885, has now been at work some time, and is giving most satisfactory results. We hope soon to be able to give the engineer's report upon it.

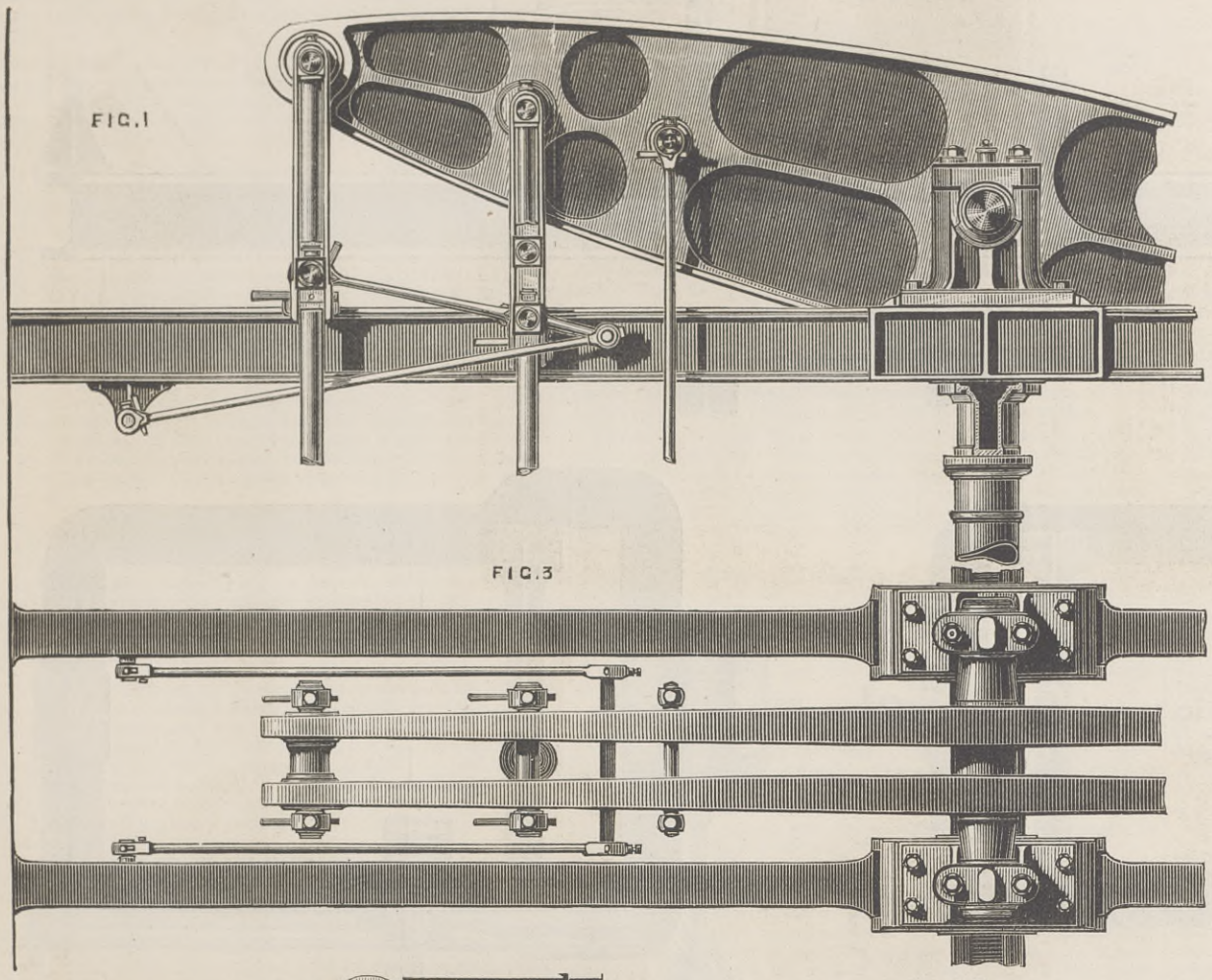
---

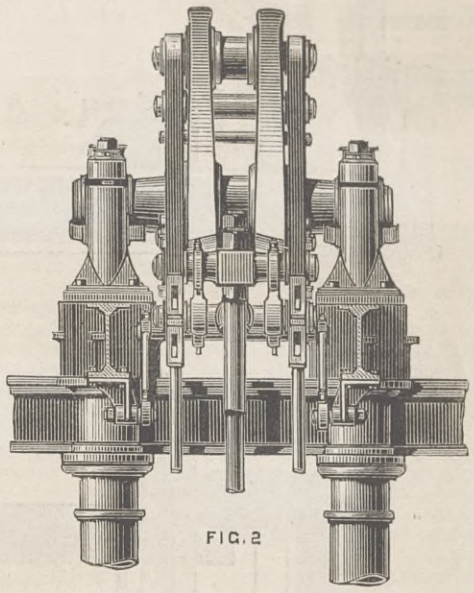
Naval Engineer Appointments.—The following appointments have been made at the Admiralty:—William J. Brown, engineer, to the Benbow; Alfred D. Watson, engineer, to the Mersey.

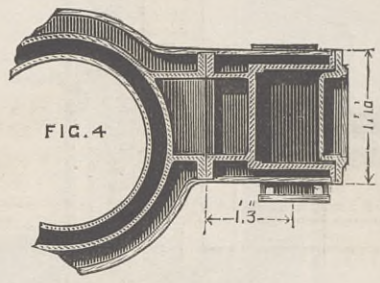
# COMPOUND BEAM PUMPING ENGINE, MIDDLESEX WATERWORKS.—DETAILS.

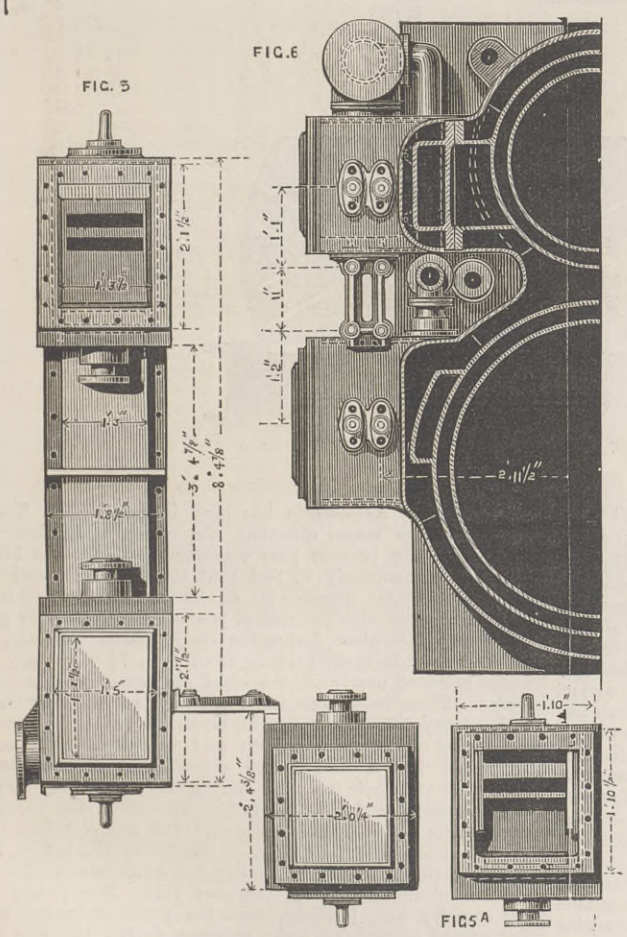
MESSRS. JAMES SIMPSON AND CO., PIMLICO, ENGINEERS

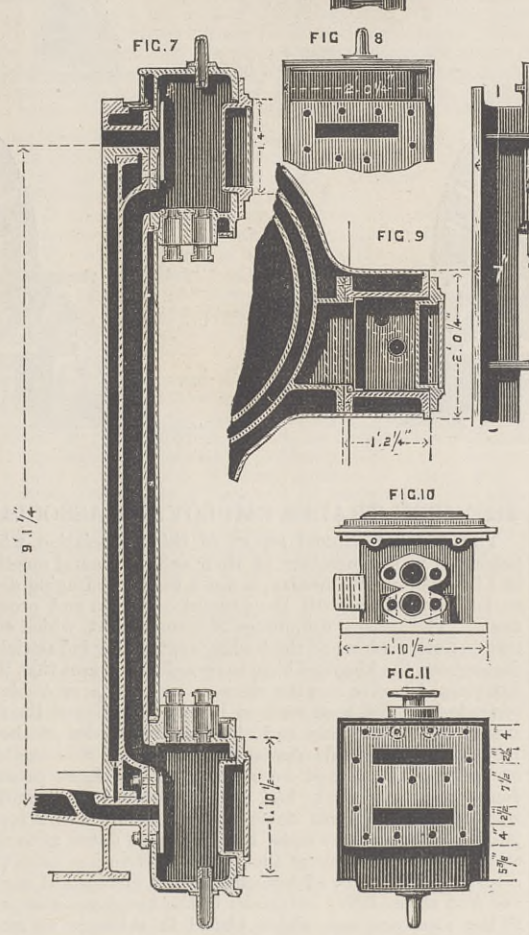
(*For description see page* 88.)

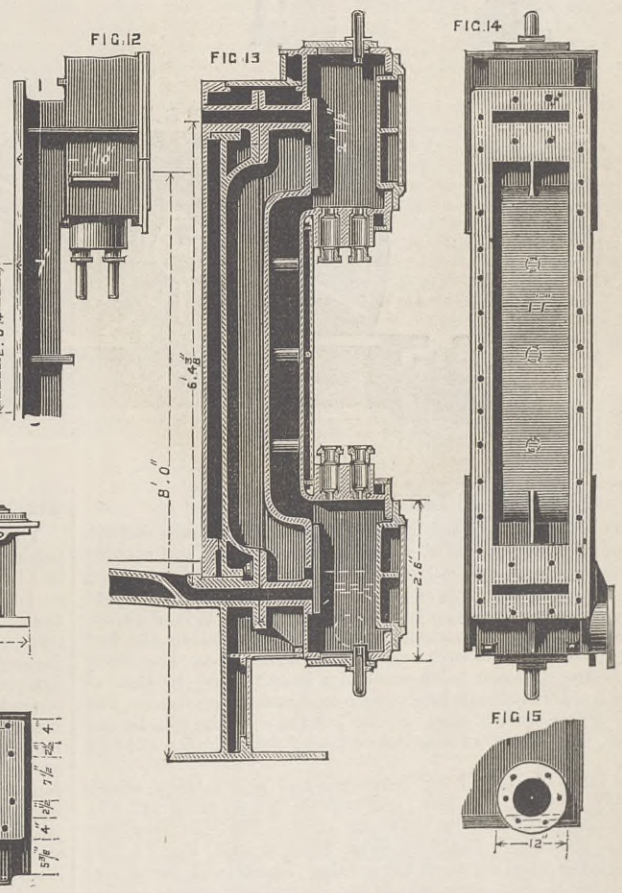


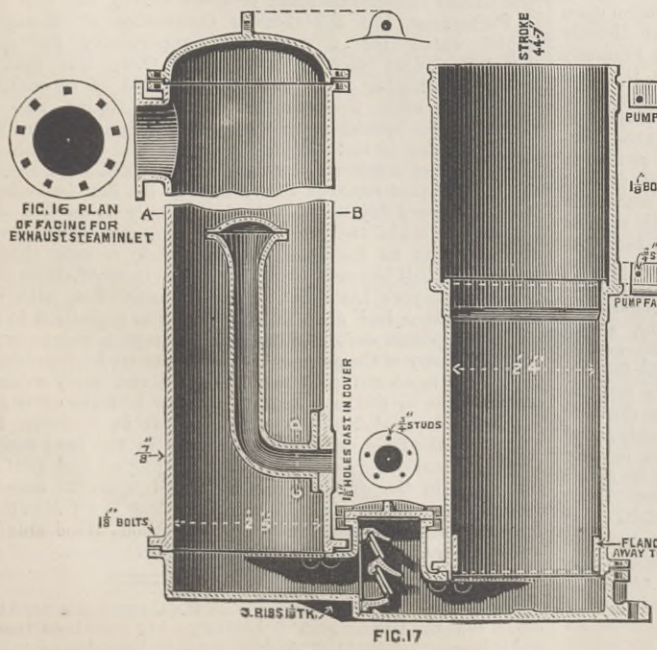



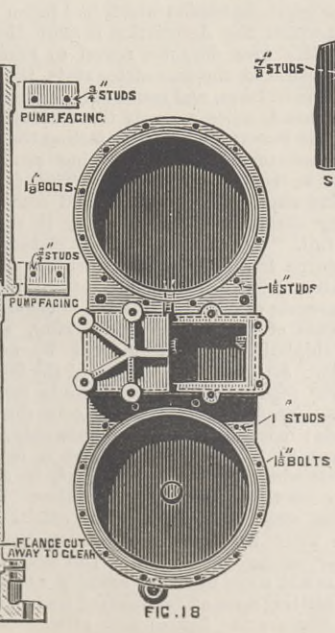



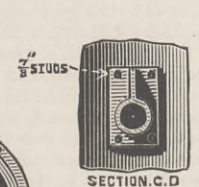



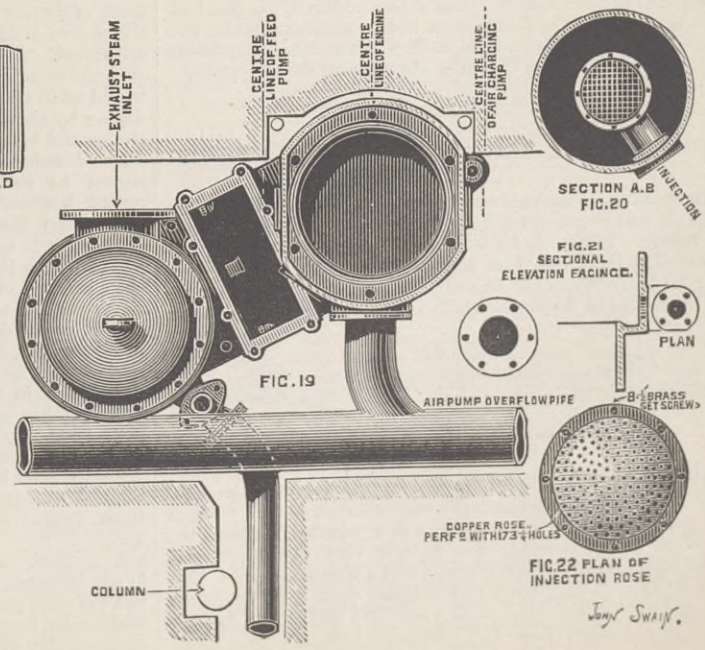









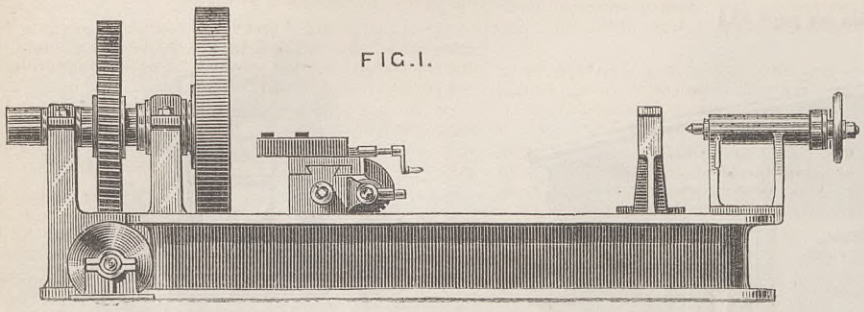


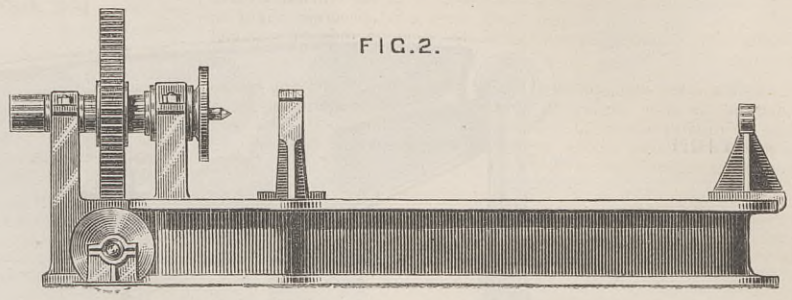


JOHN SWAIN.

# WHEEL AND SURFACING LATHE.

MESSRS. W. J. ELLIS, LONDON, ENGINEERS.



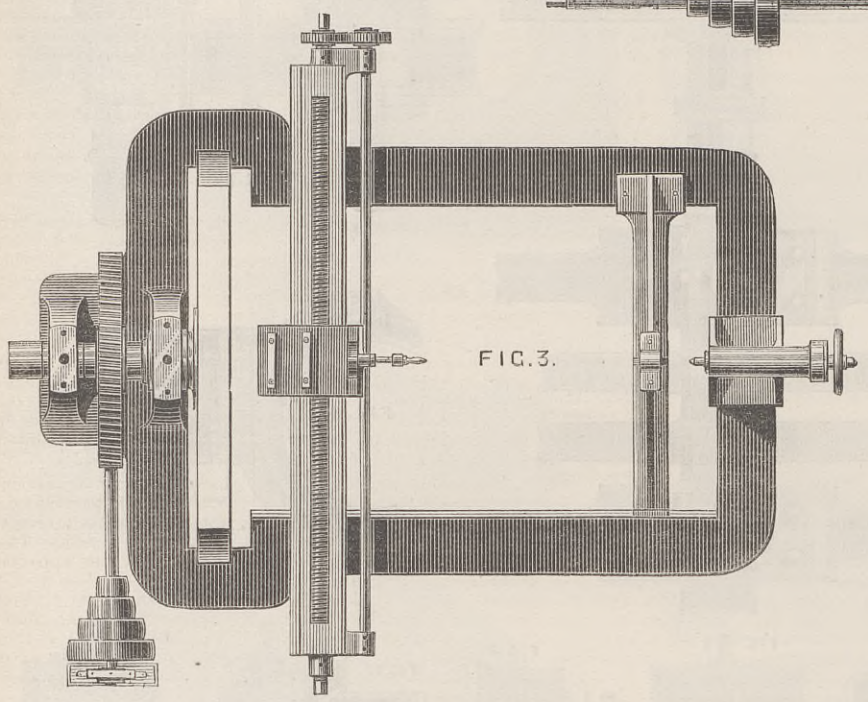




FIG.5

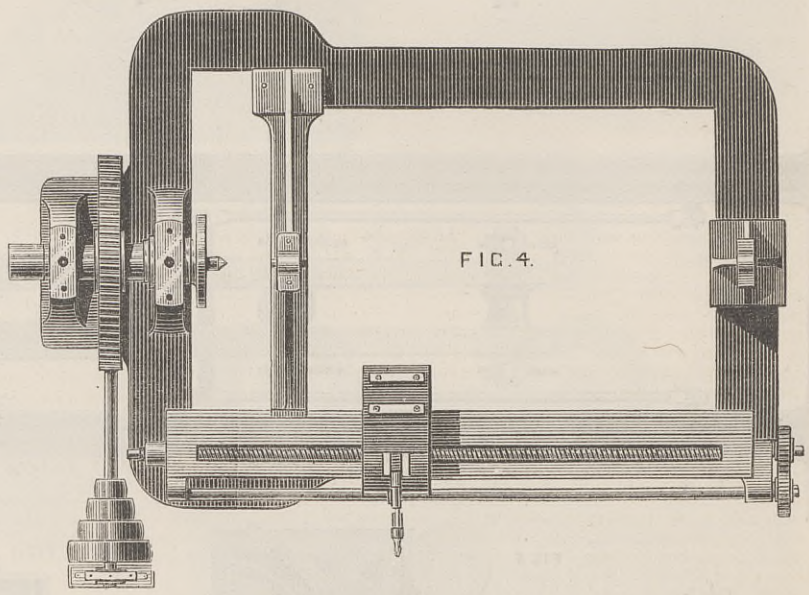



FIG.6.





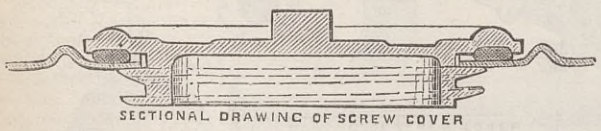

## ELLIS'S LATHE.

THIS lathe was designed by W. J. Ellis, Victoria Embankment, London, for the purpose of surfacing plates, boring and turning fly-wheels and pulleys, railway wheels and tires, and for turning large cylinders and rollers, such as are used in cotton and woollen carding engines, printing machinery, &c. It is of an unusually economical construction, which is obtained by the bed being made a large open frame of H section, and by the lower slide of the slide rest being made of a length equal to that of the bed. This rest can be slewed round into any position, and can therefore when sliding be fixed parallel with the spindle and centres, and when surfacing can be placed parallel with the face plate.

The lathe illustrated will turn cylinders and railway wheels 5ft. 4in. extreme diameter, and take in a length of 7ft. 6in. It will also surface plates, bore and turn pulleys and fly-wheels 6ft. 6in. diameter. Fig. 1 shows an elevation, and Fig. 3 a plan of the lathe when arranged for turning wheels and surfacing; Figs. 2 and 4 when prepared for turning railway wheels, sliding cylinders, &c. In the former case the slide rest is placed across the bed, and in the latter it is placed longitudinally on the bed. It will be seen that the face plate is not a complete circle, two opposite segments being omitted, so that feet or other projections cast on cylinder ends can overhang the edge of the face plate.

## KING'S PATENT HANDHOLE AND MANHOLE COVER.

THE annexed engraving illustrates a very simple and widely applicable screw cover for tight joints in tanks, drums, and even boilers. It is made by Messrs. King and Co., Reading, and consists of a light cast iron screw cover, having a rubber ring under its flange which can be easily screwed into the plain manhole by means of a spanner applied to square lug of the cover



SECTIONAL DRAWING OF SCREW COVER

and tightened down, effectually sealing the joint of the manhole. Its simplicity, and the ease with which a perfectly sound joint can be made in the space of a few minutes, makes it the best cover yet produced. The hole is very easily prepared for the reception of the screw cover, and a glance will show that it has many advantages over the ordinary cover with numerous bolts and nuts or the cover with a bolt and bridge, and saves a great deal of time in making and breaking joints.

## THE IRON TRADES EMPLOYERS' ASSOCIATION.

THE fifteenth annual report of this Association, which was presented to the members at their annual general meeting held in Liverpool on Wednesday, is not a very encouraging document so far as it deals with the present condition and prospects of trade. The general committee of management, which embraces representatives from all the leading engineering industrial centres throughout the kingdom have to record with regret that the hopes entertained twelve months since as regards a probable revival of trade have not been realised in any branches of the iron and mechanical engineering and shipbuilding trades of the United Kingdom. The trade depression, which in 1885 was declared exceptionally long and severe, had become more pronounced; competition for work had grown more acute, and prices had fallen to a degree never before known. In the report last year an extraordinary mass of evidence in detail as to the state and prospects of trade at that date—based upon more than 700 returns dealing with all branches of the mechanical engineering and iron shipbuilding industries in the kingdom—was presented to the members, and which placed in evidence an unvarying array of figures as to the great depression which had fallen upon the several industries in which the Association is most directly concerned. The report this year does not travel so minutely over the same ground, because, as the committee state, the facts would be in effect the same in form, and could only be varied in degree by showing how much more severely the employers in the several branches of the iron trades are now feeling the pressure of reduced trade, accompanied by vanishing profits in regard to such work as comes to hand. The present report, however, contains some additional data and comments bearing on the existing condition of trade which it will be interesting to quote in full. "An examination," it states, "has been made as to 680 returns from districts comprising all the chief centres of industry, in which employment in normal times is given to an aggregate of over 134,000 hands engaged in the different departments of mechanical engineering, steam boiler-making, iron shipbuilding, marine and locomotive engineering, ironfounding, &c. &c. The results of the inquiry show, that in these 680 returns the state of trade may be reliably taken as follows. Trade is declared bad over districts employing 116,000 hands; it is reported as moderate only, over areas giving employment to 16,000 hands; whilst it is only declared good in districts where the hands employed, in a fair condition of trade, may be taken at 2500 in number. From these figures it will be seen that during the official year which is now closing there has been no improvement in the outlook fer either labour or capital. The stagnation in our industrial life has not come upon the country suddenly, but has been gradually settling upon all branches of trade, and is continually increasing; because the figures now given compare unfavourably with those issued in 1885, or with any preceding year since the Association has been in existence." Touching next upon the wages question, the report adds that at the opening of the present year employers all over the kingdom seemed simultaneously to feel that the time had arrived for revising the wages question as an element of the first importance in dealing with the cost of production, and a very general movement took place during the early part of the year, which resulted in reductions varying from 5 to 7½ per cent. in the wages rates of nearly all the chief centres of the engineering trades. These reductions were generally accepted by the men without any difficulty or ill will, no strikes having been reported as growing out of the movement, and generally speaking no great difficulties had disturbed the relationship existing between employers and their workmen during the past year. In regard to legislative questions affecting the interests of the mechanical engineering and iron trades generally, the report refers to two important matters, the Rating of Machinery Bill before Parliament and the Employers' Liability Act Amendment Bills, which had been dealt with during the past year. The public life of the country had, however, been too much disturbed for the first named measure to make progress during the past session of Parliament, but the General Committee of Management would watch for a favourable opportunity for getting the Bill before the Commons, and there was reasonable ground for hoping that their efforts would be sucessful. In connection with this matter the Association also have in hand two special appeal cases—the Tyne Boiler Works and the works of Sir Joseph Whitworth and Co.—against the assessment of machinery by the overseers; and with regard to these, the report remarks that whatever the final issue may be, it became every day more evident that only by an Act of the Legislature could the law be made equitable, and clear in its definitions as to the lines within which certain classes of machinery shall be exempt from liability to be rated. With respect to the Employers' Liability Act Amendment Bills, with which the Committee had done all they could in opposition to many of the proposals embodied therein, the report points out that although many of the proposed amendments are highly objectionable, their most stringent provisions did not apply so directly to employers in the engineering trades as to some other industries, such as coalowners, builders, &c. It is, however, hoped that upon the re-opening of the question in the next session of the Legislature, the several bodies of employers and gentlemen interested in the subject may be relied upon to assist yet further in bringing their influence to bear upon Members of Parliament by whom eventually the Bills will have to be amended in Committee and passed into law.

THE divers engaged on the wreck of the Cunard steamer Oregon report that the largest part of her cargo has now been removed, and it is expected that the whole of it will be landed in a few weeks.

## RAILWAY MATTERS.

A TRAIN ran off the line on the 22nd inst. on the Saumur State Railway near Chateau La Valliere. Two persons were killed and two others injured.

GOOD progress is being made, it is said, with the Hurnai, British India, Railway. We should think very good progress ought to be made, for General Brown has 27,000 men at present engaged upon it.

THE Calcutta correspondent of the *Times* says, "a flying reconnaissance is to be made next winter by way of preparation for a line of railway across the Bikaneer desert. This will be an important strategical line as affording an alternative route for the sending of troops towards the frontier.

COAL is not yet at a very low price in Queensland. The tender of the Australasian Steam Navigation Company for the supply of 3000 tons of coal for the Queensland Central Railway recently accepted, undertakes to supply the required quantity of Queensland coal at £1 8s. 8d. per ton.

THE proposed railway tunnel between Donaghadee and Portpatrick is again receiving a good deal of attention. It has been announced that for the last three weeks Mr. Douglas, engineer to the Board of Irish Lights, has been engaged off the coast of Donaghadee in taking soundings, with the object of reporting on the subject.

SIR GEORGE STEPHEN and Vice-President Van Horne, of the Canadian Pacific Railway, recently inspected Halifax Harbour and terminal facilities. They are confident that within a very short time the Canadian Pacific Railway termini will be Hong Kong and Liverpool, with Halifax as the gateway port of the railway system going east.

AFTER conference with the Austrian manufacturers of cars and locomotives, concerning their request that orders be given now for the rolling stock which will be required next year, to enable them to keep their workmen employed, the Austrian Minister of Public Works has addressed the railroad companies of the kingdom earnestly requesting them to negotiate for supplies, not only for next year, but for a series of years, that the men in the shops may be assured employment.

THE London, Chatham, and Dover Railway accounts for the past half-year show an available balance of £77,539 0s. 9d. Out of this the Board will recommend the payment of a dividend of £1 per cent. on the Arbitration Preference Stock for the past half-year, carrying forward £15,192 6s. as against £14,367 13s. 8d. in the corresponding period of last year. Added to the dividend of £2 5s. already paid in respect of the half-year ending the 31st December 1885, the proposed payment will make a dividend of £3 5s. for the year ending 30th June last.

AT a recent meeting of the American Master Mechanics' Association, and in a discussion on the circular, "What do you consider the most economical and thorough way of cleaning tubes after they have been removed from the locomotive boiler?" Mr. J. S. Graham, of the Lake Shore and Michigan Southern, in speaking of a tumbler used by that company, said the tumbler was made of an old boiler, lengthened to suit, and is run at a speed of 30 revolutions per minute; it will clean forty-five to fifty tubes at a time in one to two hours. He thought this form of tumbler especially good, as the rivet heads on the inside of the tumbler find the poor flues by indenting or breaking through the thin spots. Mr. Jacob Johann thought a few hard clinkers should be put in with the tubes, and the tumbler speeded just fast enough to carry the tubes to the top centre, letting them drop before they pass that point; he thought that the drop did the work much more efficiently than the mere rolling of the tubes over each other.

IN the year 1885 280 kilometres of railway were opened for traffic in Sweden, of which six were State and the rest private lines. The total length of the State and private lines was, at the end of the year, 7000 kilometres, 4500 of which were owned by private companies. Of these 42, with 2673 kilometres, were subsidised or advanced loans by the State. The total value of all the lines and rolling stock is estimated at nearly thirty millions sterling. The gross receipts last year were £2,100,000, of which nearly half were taken on the State lines, the average profit of the latter being 3·46 and that of the private lines 4·21 per cent. 140 miles of new railway are now under construction. Steel rails are now becoming more and more in use in the building of railways, but as yet they have to be imported from abroad, chiefly from this country; but lately the State railways have been made two offers for delivering Swedish rails at a price slightly higher than that paid abroad. There is every prospect of one of them being accepted.

UPON the Wolverhampton and Birmingham Exchanges this week there was exhibited by the Tredegar Iron and Coal Company, South Wales, a specimen of a new steel sleeper, which, our correspondent says, the company is manufacturing mainly for tramway use underground in collieries. It was a strong, light corrugated sleeper, which is fastened with a special steel clip. It has been patented by the general manager of the company, Mr. Jas. Colquhoun. Two holes are punched in each end of the sleeper, and the steel clips are put in after it is laid, the rail being keyed up by a steel taper key. The corrugated sides of the sleeper, with the two projecting fangs at either end, enable it, when laid down, to become very firmly attached to the ballast or road, thus preventing any movement when loads are passing over sharp curves. The weight of the sleeper, with two steel keys and clips, is 16½ lb. The price complete is only about one shilling, which makes it much more economical, considering the cost of maintenance, than a timber sleeper. By increasing the size and strength, the sleeper would be equally suitable for colliery and ironworks sidings.

THE *New York World* gives the following, headed "The Fastest Time Yet:"—"The owl train to Philadelphia had just pulled out of the Jersey City station last night when a lean, long, and lank brakeman, with crushed-strawberry hair, sidled down the aisle. He noticed an acquaintance—one of the regular riders—in a rear seat, and smiling diagonally, sat down beside him. 'I see Lew Silence is a-talkin' about fast time on the York division of the P. R. R.' he began. 'He says that he run a train what made 92 mile in 93 minutes. Why, that ain't nothin'. That aint fast time for a leetle bit. I've run on trains what did make fast time, time as could be called fast, but I don't do no talkin' about it.' The lengthy brakeman closed his lips with a snap, and looked knowing. 'What time have you made?' asked the passenger. 'Oh, it don't make no difference,' replied the railroader, in a rather aggrieved tone of voice, 'an' I won't say nothin' about it, but I knew onst when time *was* made, right on this here line. We left Jersey for Phillie with a clear track. Jest as we started the telegraph operator sent a message to Phillie. We hummed through the city, an' when we reached the open air we began to travel some. I had just time to take a chew o' tobaccer before we reached Newark, an' we dusted through that town so fast that all we could see o' the place was a dark spot on the sky. There was a giddy sort of a conductor aboard what had a crazy habit o' jumpin' up in the car. He was standin' at the for'ard door o' the car when he jumped, an' before his feet touched the floor agin he was slammed up agin the rear door with a force that nearly cracked his neck. Well, we got to Phillie before the giddy conductor found out what ailed him. I told you that the operator had telegraphed to Phillie when we started from Jersey. Well, the message hadn't reached Phillie when we got there. No, sir. We made the run so fast that we beat the telegraph. But that ain't all. I had a small clock on the train that struck the hours. We left Jersey at 12 exactly, and the clock began to strike as we started. When we stopped at the Broad-street station in Phillie the clock had only got as far as ten strikes. That was somethin' like fast time, wasn't it?' And all the passengers agreed that it was."

## NOTES AND MEMORANDA.

ONE U.S. gallon standard contains 231 cubic inches: weight of water in same, 8331; one cubic foot contains 7·4805 gallons of water.

THE six healthiest places during the week ending the 17th inst. were Brighton, Huddersfield, Hull, Derby, Plymouth, and Birkenhead.

THE deaths registered during the week ending July 17th in 28 great towns of England and Wales corresponded to an annual rate of 19·7 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year.

THE American *Mechanical Engineer* observes that "English journals are accusing the bulkhead doors on the Oregon for being the cause of the loss of the ship. They would have worked first-rate in this case if a sailing vessel had not run the ship down."

IN London during the week ending the 17th inst. 2626 births and 1680 deaths were registered. The annual death-rate per 1000 from all causes, which had increased in the four preceding weeks from 14·9 to 19·4, rose to 21·1. In Greater London, 3307 births and 2018 deaths were registered, corresponding to annual rates of 32·5 and 19·9 per 1000 of the population.

A PAPER on the "Heat of Transformation for Vitreous Selenium to Metallic Selenium" was recently read before the Paris Academy by M. Ch. Fabre. Vitreous is transformed to metallic selenium by heating it to 96 deg. or 97 deg., the transformation being accompanied by a considerable development of heat, which is here directly determined by means of M. Berthelot's calorimetor.

RECENT soundings have given the following depths for the different Swiss lakes:—Constance, between Uttwyl and Friedrichshafen, 255 metres; Geneva, between Rivaz and Saint-Giugolphe, 256 metres: and between Lausanne and Evian, 330 metres; Brienne, 261; Thun, 217; Lucerne, between Gérau and Rueteren, 214 metres; Zug, 198; Neuchatel, 153; Wallenstadt, 151; and Zurich, 143 metres.

THE oldest steamer on the Hudson River is the Belle, now a tow-boat, and good for many years of active life yet. She was built by Stevens, at Greenpoint, over fifty years ago, and has been on duty ever since. The American *Mechanical Engineer* says Mr. Stevens built over one hundred noted steamers in his day, some of them famous Sound and river boats, and a good many of them are still in service.

AN American paper observes:—"A grade crossing over a railroad has a curious fascination for many people. Let a bridge and grade crossing be equally convenient, and the majority will drive over the tracks, courting death. The court of Delaware County is now hearing a demand that the Philadelphia, Wilmington, and Baltimore Railroad be ordered to take down an overhead bridge at Chester, so that people may drive across the railroad tracks at grade and run the risk of being struck by passing trains."

AT a recent meeting of the Paris Academy of Sciences a paper on the "Temperature of the Deep Waters in the Lake of Geneva" was read by M. F. A. Forel. Observations taken during the years 1879—86 show that at great depths the temperature never falls below 4 deg., and varies normally between 4·6 deg. and 5·6 deg. C. From his experiments the author also infers that the heat penetrates to the lower layers mainly through the mechanical intermingling of the upper with the deeper waters under the action of the winds. The same explanation, he argues, should be applicable to all lakes and to all seas confined by bars, notably the Mediterranean, whose deep waters have a mean temperature of 13 deg., C.

ACCORDING to Prof. Heim, of Zurich, the total number of glaciers in the Alps is 1155, of which 249 have a length of more than 7500 metres. Of this number the French Alps contain 144, those of Italy 78, of Switzerland 471, and of Austria 462. The total superficial area of these glaciers is between three and four thousand square kllometres, those of Switzerland amounting to 1839 kilometres. The greatest length is reached by the Aletsch glacier, which is 24 kilometres long. As to thickness, it will be remembered, *Nature* observes, that Agassiz, when measuring a crevasse in the Aar glacier, did not reach the bottom at 260 metres, and that he calculated the depth of the bed of ice at a certain point of this glacier at 460 metres.

CHARLES KIRCHHOF, more than twenty-five years ago, devised an apparatus which was the forerunner of the modern storage battery. A perusal of the salient points in the United States patent issued to him in 1861 shows that he drew attention, among other things, to the desirability of roughening the plates and perforating them so as to gain increased surface for action, and he recognised the great value of lead and its peroxide as the active materials, on account of their difference in the scale of electric potentials. While Kirchhof describes his battery as one in which platinum plates are used, although he suggests lead plates, the platinum is only employed as a base upon which the peroxide of lead and lead are respectively desposited.

FROM an article on "Danger of Fire from Steam Pipes," in *Glaser's Annalen*, the following account of the process of kindling wood under such circumstances is extracted:—"After wood has remained a long time in contact with steam, hot-water or hot-air pipes, the surface becomes carbonised. During the warm season the charcoal absorbs moisture. When again heated the moisture is driven off, leaving a vacuum, into which the fresh-air current; circulating around the pipes, rapidly penetrates and imparts its oxygen to the charcoal, causing a gradual heating and eventually combustion. The rusting of the pipes contributes also to this result, inasmuch as the rust formed during the hot season may be reduced by the heat of the pipes to a condition in which it will absorb oxygen to the point of red heat." The same article also notices that a building was set on fire by pitch distilled out of a pine plank placed nearly 3in. above a steam pipe, which dropped on the pipe and took fire.

M. LECHARTIER, in the *Comtes Rendus*, has called attention to a most destructive action on structures produced by the gradual hydration of the magnesia in hydraulic cements. The magnesia at the first setting of the cement acts as an inert body, and remains so sometimes for several years, but finally begins to absorb water and develope carbonic acid, with the result of expanding in volume. This action has gone so far, that in one case observed a flag of cement expanded 4 per cent. of its length. The magnesia in cements made from dolomitic marl, remains, to a certain extent, free from combination with the other components in the process of manufacture, and the amount of this free portion is in proportion to the total quantity of that base in the cement, and inversely as the hydraulic energy of the cement. M. Lechartier does not remark, what would seem to follow from the last statement, that the freedom from this destructive action is in proportion to the quick-setting quality of the cement.

THE House of Lords decided last week a question turning on the influence soft water may exercise chemically on lead pipes through which it is conveyed. After a time the influence ceases or diminishes; the pipe becomes lined with a coating not soluble in water, which no longer takes up lead. But when the pipe is new and first exposed to such an influence the chemical action may be so great as to poison water passing through it. This peculiarity has given rise to a curious action brought by a gentleman living in Huddersfield against the Corporation of that town. He made use of water supplied by the Corporation from the Blackmoorfoot reservoir. Whether or not he was peculiarly susceptible to the influence of lead poison, he no doubt suffered in health from it, and, in an action against the Corporation, a jury awarded him £2000 damages. Mr. Justice Mathew, before whom the case was tried, decided that there was no cause of action, and gave judgment for the Corporation. The Court of Appeal took the same view; and, after two arguments, a majority of the Law Lords in the House of Lords has come to the same conclusion.

## MISCELLANEA.

MESSRS. KERR AND JUBB, of Halifax, send us a sample of a water-gauge glass which has two strips of enamel upon it, making the level of the water very easy to discern as compared with the old glass, and especially at night.

PONTYPRIDD, the "great coal town," is going in for a complete drainage scheme. The estimate is 6d. to the pound, and the idea not to establish market gardens, or patent manure establishments, but connect the drainage with the sea.

ON Saturday last a monster blast of stone took place at the Loch Fyne Granite Quarries; into the mine and its chambers four tons of gunpowder were packed, and the weight of stone dislodged by the explosion is estimated at from 17,000 to 20,000 tons.

THE North British and Mercantile Insurance Company have instructed the Electrical Power Storage Company to light their premises throughout on the same system as has been successfully installed at the New South Wales and New Rio Banks.

IN the sitting of the Sofia Chamber on the 22nd inst. the special committee appointed to examine the arrangement for the purchase of the Varna-Rustchuk Railway presented its report, and the House subsequently passed the Ministerial Bill authorising the purchase of the line.

THE opening of the works of sewerage and water supply for the town of Petersfield, Hants, on the 26th inst., was inaugurated in the presence of a large number of those interested in this district. These works have been carried out by the engineer to the Board, Mr. Henry Robinson, C.E., of Westminster, and will shortly be illustrated in our pages.

THE Mayor of Manchester has already received towards the Manchester Jubilee Exhibition guarantees to the amount of £61,530, and the committee are desirous that the guarantee fund, which has been fixed at £100,000, should be completed as promptly as possible, in order that the works may be decided upon and proceeded with without delay.

WE understand that Carron Company, Carron, Stirlingshire, in the course of rebuilding and reorganising their large works, have now got their heavy foundry entirely rebuilt, in which all classes of heavy castings may be made up to 30 tons weight. They are also erecting a melting furnace of the most approved type for making steel castings which is now nearly ready.

THE Belfast Water Commissioners are about to construct an additional reservoir from the plans and under the superintendence of their engineer, Mr. L. L. Macassey. The total area of the Stoneyford reservoir will be 150 acres of water surface, with a storage of 600 to 700 million gallons. There will be a bank on two sides 1000 yards long; but the bulk of the containing capacity is made up by the natural ground.

IT is announced by the Italian Minister of Agriculture that an international competition of pumps and apparatus for the appliance of remedies against cryptogamies and insects injurious to cultivated plants will take place at Udine next month. Applications for admission, with a short description of the apparatus exhibited, must be forwarded to the executive Commission of the agrarian regional competition not later than the 31st of July—to-morrow. Inventors, constructors, and agents, national and foreign, may take part in the competition. All agents, national and foreign, taking part in the competition are considered only as representatives of the constructors, and in case of merit the prizes shall be awarded to the latter.

WRITING on the manufacture of cement in Queensland, the *Colonies and India* says:—"Recuperative industries, if slow, are sure in Queensland. Some samples of cement, prepared from fossil limestone procured from Long Island, near Broad Sound, were recently examined by the Government testing officer at the Post-office, Brisbane, in the presence of a number of gentlemen who are about to establish a cement manufacturing industry in the colony. The stone, which exists in some towering cliffs of the island from a high altitude to an unknown depth below the water, has been found capable by experienced building surveyors of producing hydraulic cement equal to the best Portland. A company is being formed to develope the industry. They will acquire 150 acres at the island, and will obtain a twenty-one years' lease from the Government for the rights of the property."

THE Great Eastern has certainly had a very curious history, but perhaps no feature in it is more remarkable than the recent success of the ship as an exhibition and entertainment. It was, as is generally known, intended that the ship should be converted into a coaling station, with every modern appliance for rapid receipt and delivery of coal; but the success of the ship as an exhibition and place of varied entertainment has resulted in the formation of a company for the purchase and working of the ship for this purpose, and subscription is now invited for the company's shares. The success of the enterprise at Liverpool, where the ship has been under charter to Messrs. Lewis and Company, has directed attention to the various advantages which attach to the easy movement of what would no doubt become ever a favourite entertainment haunt, not only round our own coasts, but on those of America and other countries.

THE bridge which spans the river Tees a little above Barnard Castle is just now undergoing certain operations with a view to strengthen it. It was originally designed by the late Sir Thomas Bouch, and has always been considered an exceedingly light and beautiful structure. Since the line of which it forms part was constructed the traffic has increased enormously, especially as regards minerals, the conveyance of coke from the Bishop Auckland district to the Cumberland blast furnaces forming one of the principal items. Recently it would appear that the bridge has been showing signs of weakness, and the engineer of the North-Eastern Railway has wisely determined to strengthen it. The work has been entrusted to the Cleveland Bridge and Engineering Company, of Darlington, and is expected to occupy about three months. The strengthening operations have to be carried on without interfering with the current traffic. This has necessitated an additional signal cabin, and the appointment of a special traffic manager by day as well as by night, until the work is completed. It is understood that the Deepdale viaduct near Lartington will also be strengthened as soon as the one at Barnard Castle is finished.

THE Queen's Low Water Landing Pier, at Ramsey, Isle of Man, was opened with ceremony last week. The pier has a length of 2248ft., the body of the pier being 2160ft. long, and the timber head fendering, overlapping the body of the pier, 88ft. The pier is supported by wrought iron screw piles, and the upper structure and decking are carried by lattice girders, of which there are 48 spans of 40ft. and 12 spans of 20ft. Its general width is 20ft., except at the strengthening bays, which are 39ft. 3in. wide, and at the pierhead, where the width is 50ft. for a length of 120ft. The timberhead fendering, alongside of which vessels will lie, is on the south side, and is 280ft. long, about 36ft. wide. It is formed of 109 greenheart timber piles, 16in. by 16in., very strongly braced and tied together, and has a flight of landing steps 10ft. wide. On the north side of the pierhead there is a flight of small boat landing steps extending to low water ordinary tides. On the surface of the pier are two toll houses, two shelter screens, and on the pierhead a large wooden building, which is divided into waiting and refreshment rooms. There is a depth of water alongside the pierhead of about 14ft. at low water ordinary spring tides, and at high water the depth alongside is 35ft. The pier was designed for the Isle of Man Harbour Commissioners by Sir John Coode, M. Inst. C.E. Mr. C. R. Walker, M. Inst. C.E., was resident engineer at the commencement of the work, and from 1883 to the present time Mr. James Walker, M. Inst. C.E., has been resident engineer. The contractors were Messrs. Head, Wrightson, and Co., of Stockton-on-Tees, and Mr. R. Routledge was their agent during the progress of the work. The total cost of the work has been about £45,000.

# COMPOUND BEAM PUMPING ENGINE, MIDDLESEX WATERWORKS.—DETAILS.

MESSRS. JAMES SIMPSON AND CO., PIMLICO, ENGINEERS.

(*For description see page* 88.)

FIG 23

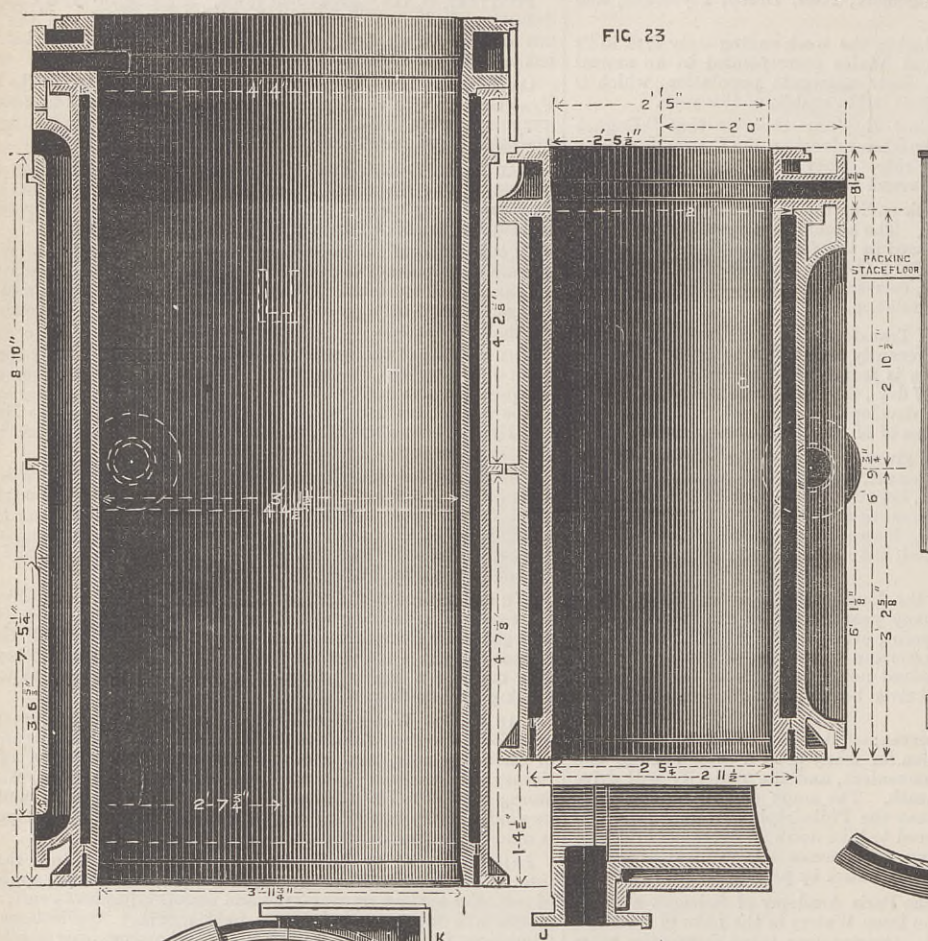
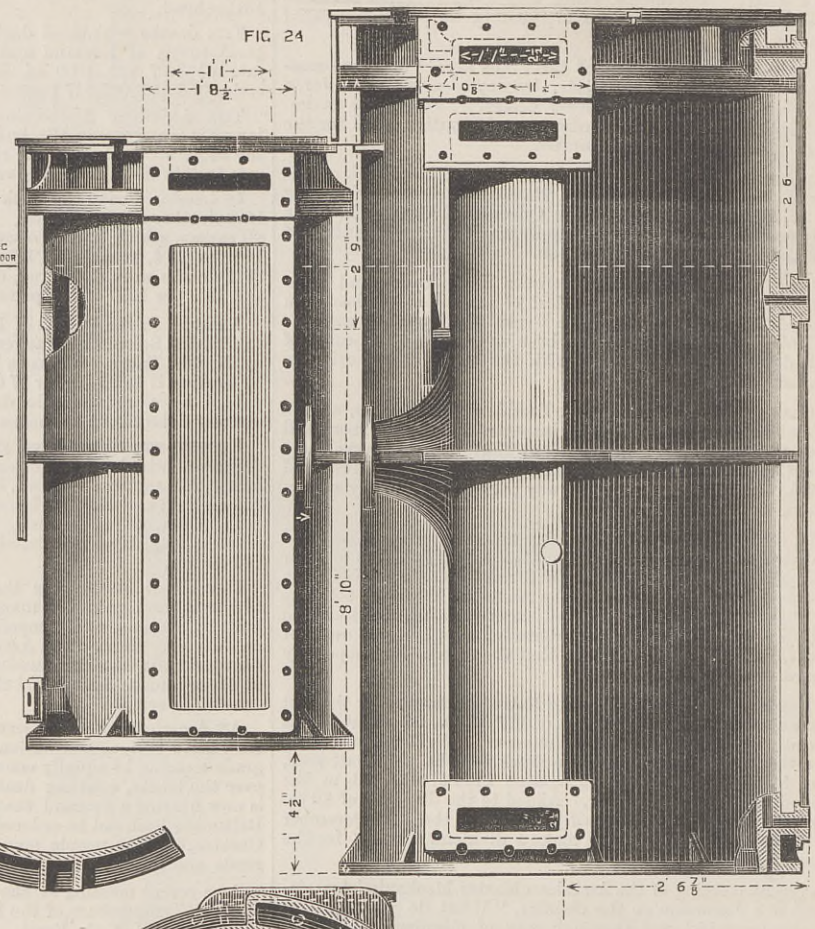



FIG 24



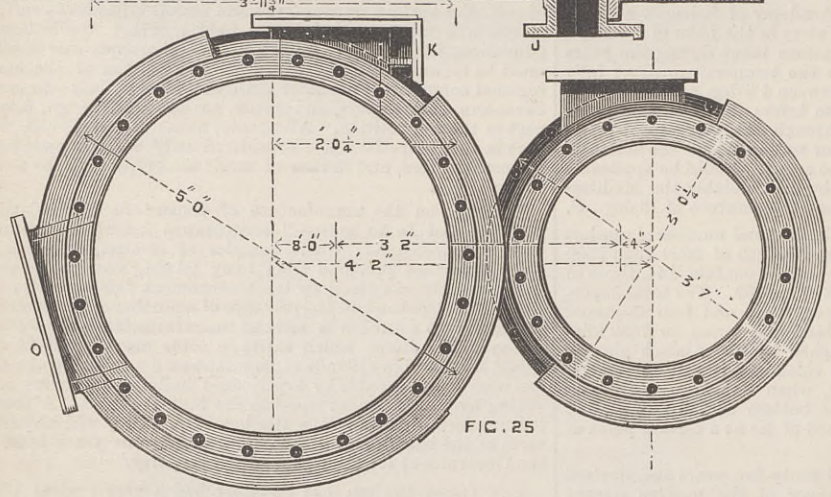


FIG. 25

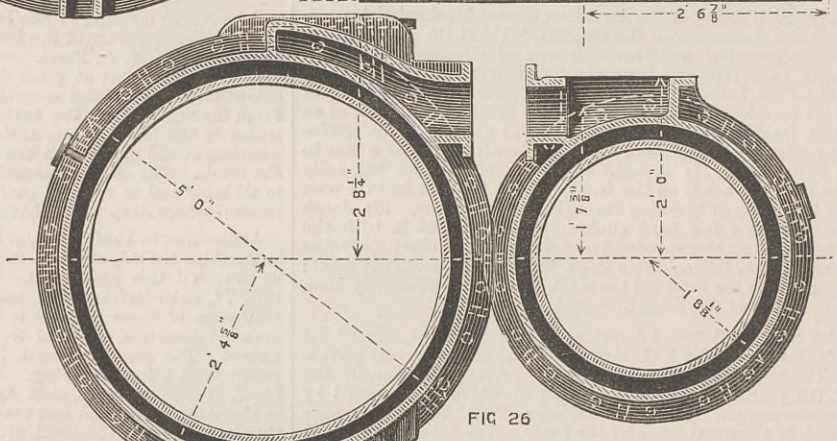


FIG 26

JOHN SWAIN

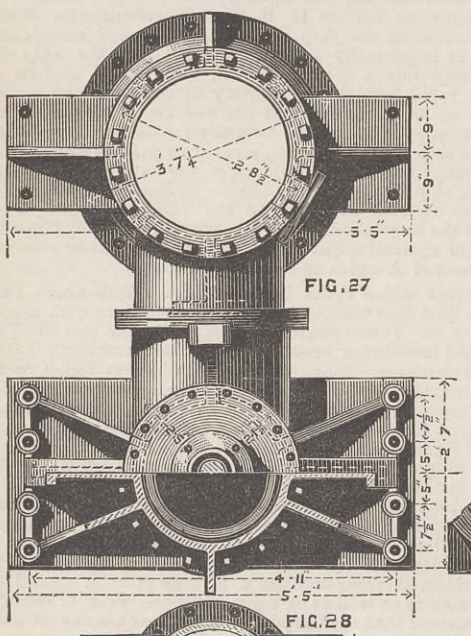


FIG. 27

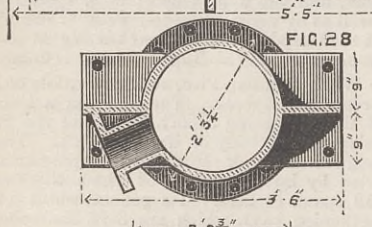


FIG. 28

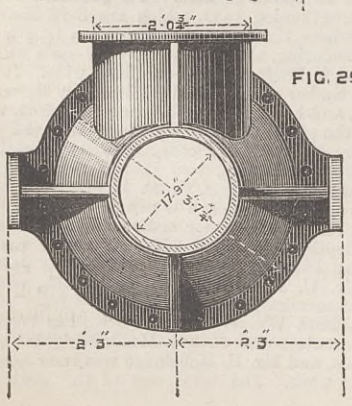


FIG. 29

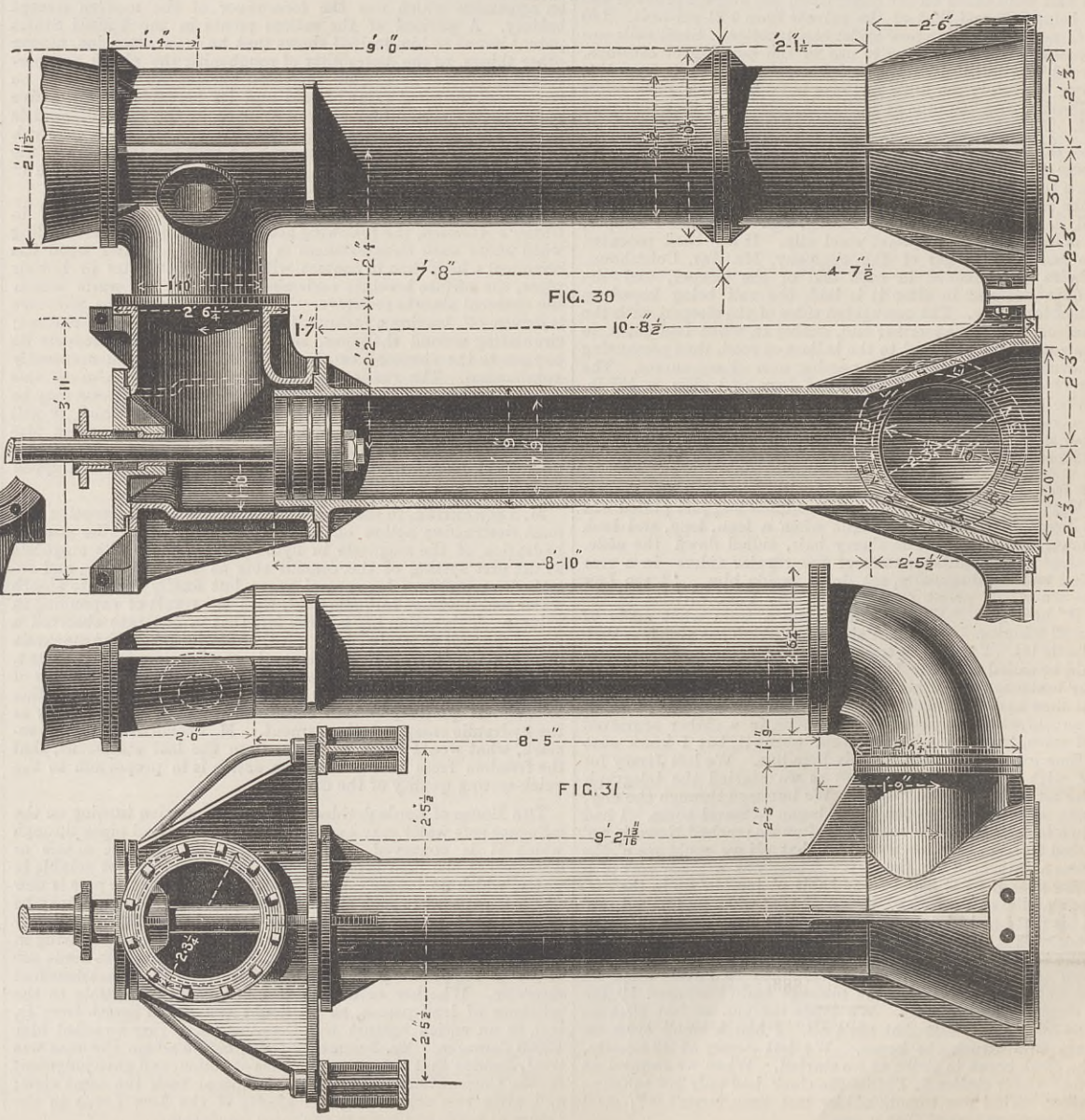


FIG. 30



FIG. 31

FOREIGN AGENTS FOR THE SALE OF THE ENGINEER.

PARIS.—Madame BOYVEAU, *Rue de la Banque.*
BERLIN.—ASHER and Co., 5, *Unter den Linden.*
VIENNA.—Messrs. GEROLD and Co., *Booksellers.*
LEIPSIC.—A. TWIETMEYER, *Bookseller.*
NEW YORK.—THE WILLMER and ROGERS NEWS COMPANY, 31, *Beekman-street.*

## CONTENTS.



## TO CORRESPONDENTS.

**Registered Telegraphic Address—"ENGINEER NEWSPAPER, LONDON."**

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

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

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

MECHANIC.—*Clark's book, published by Blackie and Son, can be obtained through any bookseller. The* 16*in. pipes,* $\frac{7}{16}$*in. thick, would by most makers be double-riveted with* $\frac{7}{8}$*in. rivets about* $1\frac{1}{4}$*in. apart.*

M. A. R.—*The greatest pressure will be that due to the greatest head,* 16*ft., or* 6·88 *lb. per square inch. The diameter of the pipe being* 24*in., the pressure tending to burst the pipe will be* 165·12 *lb. per inch of length. If, however, pressures resulting from sudden check of the flow of the water have to be considered, then the pressure may be anything from this pressure to a very heavy one, as in hydraulic rams.*

### TURNING CRANK PINS IN PLACE.

(*To the Editor of The Engineer.*)

SIR,—I have a large steam engine, in which the crank pin seems not to be parallel with the shaft, and think of turning it in its place. Could any of your readers kindly give me any information as to whether there is a machine that would do this, and where it is to be got?

Aberdeen, July 13th. AN ENGINEER.

### SUBSCRIPTIONS.

THE ENGINEER *can be had, by order, from any newsagent in town or country at the various railway stations; or it can, if preferred, be supplied direct from the office on the following terms (paid in advance):—*

*Half-yearly (including double numbers)* .. £0 14s. 6d.
*Yearly (including two double numbers)* .. £1 9s. 0d.

*If credit occur, an extra charge of two shillings and sixpence per annum will be made.* THE ENGINEER *is registered for transmission abroad.*

*Cloth cases for binding* THE ENGINEER *Volume, price* 2s. 6d. *each.*

*A complete set of* THE ENGINEER *can be had on application.*

*Foreign Subscriptions for Thin Paper Copies will, until further notice, be received at the rates given below:—Foreign Subscribers paying in advance at the published rates will receive* THE ENGINEER *weekly and post-free. Subscriptions sent by Post-office order must be accompanied by letter of advice to the Publisher. Thick Paper Copies may be had, if preferred, at increased rates.*

*Remittance by Post-office order.* — Australia, Belgium, Brazil, British Columbia, British Guiana, Canada, Cape of Good Hope, Denmark, Hawaiian Islands, Egypt, France, Germany, Gibraltar, Italy, Malta, Natal, Netherlands, Mauritius, New Brunswick, Newfoundland, New South Wales, New Zealand, Portugal, Roumania, Switzerland, Tasmania, Turkey, United States, West Coast of Africa, West Indies, Cyprus, £1 16s. China, Japan, India, £2 0s. 6d.

*Remittance by Bill on London.*—Austria, Buenos Ayres and Algeria, Greece, Ionian Islands, Norway, Panama, Peru, Russia, Spain, Sweden, Chili, £1 16s. Borneo, Ceylon, Java, and Singapore, £2 0s. 6d. Manilla, Sandwich Isles, £2 5s

### ADVERTISEMENTS.

*** *The charge for Advertisements of four lines and under is three shillings, for every two lines afterwards one shilling and sixpence; odd lines are charged one shilling. The line averages seven words. When an advertisement measures an inch or more the charge is ten shillings per inch. All single advertisements from the country must be accompanied by a Post-office order in payment. Alternate advertisements will be inserted with all practical regularity, but regularity cannot be guaranteed in any such case. All except weekly advertisements are taken subject to this condition.*

**Advertisements cannot be Inserted unless Delivered before Six o'clock on Thursday Evening in each Week.**

*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.*

### DEATH.

On the 23rd inst., suddenly, JOHN PEAKE KNIGHT, of the London, Brighton, and South Coast Railway, and Stafford House, Wickham-road, Brockley, S E., aged 58. Beloved, respected, and deeply regretted by all.

# THE ENGINEER.

*JULY* 30, 1886.

### IMPROVEMENTS IN AGRICULTURAL MACHINERY.

IT is generally assumed, and with some truth, that the field of enterprise opened up by the introduction of mechanics and steam to the operations of agriculture has now been so far filled that there is no room for anything more than improvements in small details and in the methods of manufacture. There is truth in this as far as attaches to the admission that mechanics and steam have been so far utilised that there is not an operation which is not more or less completely carried out by means of machinery. It is not, however, altogether true, and we venture, at the risk of being looked upon as visionary, to say that there are many great things yet to be done in the production of farm and field machinery and implements. As constructors of these, it is not for us to be satisfied with the idea that as machines or implements are made now they do their work very well, and that they are strong and wear well. We must create demands for agricultural engineering products, and must do as much as possible to obtain monopolies. We cannot hope to obtain monopolies if we are to become mere repetition manufacturers of the things that can be made nearly all over the world equally well, if not equally cheaply. We must make things that will effect the same objects in a more simple manner or at less cost. To this it will, of course, be answered that it is one thing to talk of departing from well-worn grooves, but it is a very difficult and different thing to do it. This is true; but the thing that is difficult is the thing that when done is deserving and generally reaps a reward, and it is questionable whether more energy and determination are necessary to make radical departures from our present designs than are needed to open up new markets and to struggle to reduce the cost of manufacture by every penny and part of a penny. One great difficulty, it must be admitted, is always met with in introducing new things, the recommendation to which is chiefly that they perform the work for which they are designed better than existing types, or new things which have, if not an objectionable feature, one which makes it necessary to overcome some prejudice. There are very few farming operations, however, which need to be performed any better than they are to-day, and there are no prejudices which would not soon find themselves taking a very rear position in any farmer's mind once he could see that the prejudice cost a good deal. It may be asked, by way of example, what is to be done in agricultural portable engines? And we may answer, to some extent, that we do not know until we try; but we do know what we think may be done. A farmer's portable engine, of good design and workmanship, might be made of about half the present weight, and sold with a good profit for little more than half the present prices, and the number sold might be trebled. The average speed of a farmer's engine is to-day about a hundred and ten revolutions per minute. This speed might be doubled. The average pressure at which portable engines are worked on a farm is about 70 lb. per square inch; 200 lb. might be used without any difficulty whatever. The boilers of portable engines might be enormously reduced in weight if a determined attempt were made to do it, and without any appeal to experiment, a boiler for the same work could be made at this day which certainly would for the same horse-power not weigh more than 50 per cent. of the weight of the ordinary portable boiler. There is not an experienced launch builder that would not at this minute offer a boiler that would not weigh more than 60 per cent. of the present boiler.

In thrashing machines we are continually making fiddle-faddling alterations, many of which are not in the least improvements. We do now as we have done for years as to the thrasher drum. We use a revolving thing weighing about 3 cwt., and running with a pheripherical velocity of about 6000ft. per minute. The grain which is taken out of the ear is removed by being knocked out by this revolving thing during a passage about one-third of its circumference, or by a process, which, to every ear of, say wheat, occupies about one-eighteen thousandth of a minute. Surely there is room for some intelligent study of what is done in this rough way to the ears of corn during their hurried passage through the concave occupying about a fifth of a second, so as to obtain some information that will lead to a method and a machine which will do this with less weight and with less power. Thrashing machine shakers use a lot of power. They ought not, and with some suitable form of rotating beater to pass the straw on to a stationary grid from the drum they need not. One of the leading makers, it may be mentioned, is now returning to rotary shakers after discarding their own good practice, and following in the ruts made by others. Addition after addition has been made to thrashing machines until they are veritable travelling machine shops, and there is not a finishing thrashing machine sent out at this day which does not weigh 30 per cent. more than it need, without appeal to any novelty in design. A finishing thrashing machine weighs 40 per cent. more than a single blast machine of, say, ten years ago. A hand power winnowing machine will do almost all the work which a single-blast machine does not do, and would weigh about $1\frac{1}{2}$ cwt.; but the difference between a finishing machine of to-day and a single-blast machine of ten years ago is over a ton.

Of ploughs we might say that, in spite of the improvements made in details, ploughs might be made to do the same work for much less than their present cost. A little more difficulty would be met with in getting radical alterations adopted, because so much more ignorant prejudice would have to be overcome; but a Royal Agricultural Society prize for the best plough to accomplish given work by the simplest means would certainly bring out something new, something cheap, and show at the same time how to use it. Much might be said on these various subjects, but we must leave them now, and only ask whether agricultural engineers intend giving up the idea that steam ploughing is impossible as a paying thing except with the very heavy and costly machinery at present in use.

### THE ELECTRIC TRANSMISSION OF ENERGY.

MANY of the readers of Monday's *Times* would naturally feel envious of M. Marcel Deprez, who is said to have so satisfied the Rothschilds of the value of his experimental researches into the electrical transmission of energy, that these celebrated bankers gave him an unlimited credit to carry out his experiments at Creil. It will be in the recollection of many that the fulsome praise of the non-technical press has often given an impetus to visionary schemes which would otherwise have obtained no monetary support. Far be it from us to say that the electrical transmission of energy deserves no such support. So many things have come to pass which theorists said could never happen, that "can't" and "impossible" should be shut out of modern vocabularies. But whatever the future may bring forth, and whatever may be ultimately done in the electrical transmission of power, we most emphatically protest against arrogating to M. Marcel Deprez any of the credit due to progress. Before discussing the problem, it will be well to consider some of the statements in the *Times*. In the first place, a Commission of thirty-eight men of science has reported favourably upon the experimentist at Criel. On the other hand, we are not told that many of the ablest of the scientific body in France have laughed to scorn the so-called success. The report, according to the *Times*, says that a difference of potential of 6290 volts "does not give rise to any danger." The Commission is of opinion that the transmitting wire may be left uncovered on poles provided it is placed beyond the reach of the hand. The cost is estimated at 5000f. for the transmission of 50-horse power round a circular line of about seventy miles. With regard to the danger, though admitting that it may possibly be minimised, we are bound to say that neither M. Marcel Deprez nor any other electrician has at the present time devised a scheme for the general use of currents of such high electro-motive force that is at once practical and safe. Further, it is stated that we can now, with only one generator and one receiver, transport a force capable of being used for industrial purposes, with a yield of 45 per cent., without using a greater current than ten ampères. This brings us to the problem which M. Marcel Deprez has been endeavouring to solve. At the present moment the world teems with natural forces which cannot well be harnessed for the use of man. Most of these forces are due to the action of gravitation—such as is presented at the Falls of Niagara and similar sources of water-power, and in tidal action. The initial cost of production is here a minimum, and if by any system of transmission such forces can be, so to speak, placed at the points where they can be utilised, and if the cost of such transmission is less than the cost of producing energy at the spot, by the combustion of coal and the generation of steam, or other artificial means, then such a system of transmission is valuable. It matters not what the loss by transmission is; the only question is the cost of the energy at the period of application. If 99 per cent. be lost, provided the cost of the remaining 1 per cent. be less than the cost of equivalent energy produced artificially at the point, the system will be used. A good deal of thought was given to the question in and about 1878. If we remember aright, Sir W. Thompson and Sir W. Siemens suggested the possibility of utilising the force generated at Niagara. Mr. Sprague, Professor Ayrton, and Professors Thomson and Houston wrote upon the subject. One sentence of an article by the latter gentlemen will bear repeating. They said:—"The burning of coal in mines, and the conveyance of power generated by the flow of rivers, may therefore be regarded as practicable, always, however, remembering that a loss of about 50 per cent. will be almost unavoidable." Quite recently Mr. Kapp, with a full knowledge of the Creil experiments, has carefully discussed the whole question, and concludes that (1) it pays to transmit cheap water power by wire rope if the distance is less than a mile, and electrically if the distance is a mile or more; this applies to all powers; (2) it pays to transmit cheap steam power if the amount of energy required at the receiving station does not exceed 10-horse power. If the distance be less than a mile, use wire rope transmission; for distances of one mile and upwards, up to two or three miles, use electric transmission. Beyond this limit a small local steam or gas engine is preferable."

Although Mr. Kapp's figures may under close examination bear some slight modification, the conclusions at which he arrives are practically unassailable. We may therefore take it for granted that the transmission of power electrically, when the power is in the first place generated by a steam engine, does not enter the domain of practice, and that so far as M. Marcel Deprez's experiments deal with this part of the problem, they only go to intensify the correctness of Mr. Kapp's result. The amount stated in the *Times* as the probable cost of transmission of 50-horse power over 70 miles—viz. 5000f.—cannot be considered, because we are not told whether this is the initial cost of apparatus or a periodic charge for maintenance. If it is an initial charge, what is the daily or the annual cost, for it is only by having these figures that we are able to compare the cost with that of other systems. So much for M. Marcel Deprez. Engineers cannot all be expected to be familiar with the nomenclature used by electricians, nor will a problem which is clear to the latter always be as clear to the former. In the particular case of the utilisation of a force of water, however, electrical nomenclature is unnecessary, and an approximately correct statement of the problems may be made without the use of technicalities. Suppose then we have a natural fall of water with a head of 100ft. The face happens to be in such a position that it cannot be utilised where nature has placed it, and if we try to use the energy at any other place some loss of energy must be expected. The aim of the hydraulic engineer would be to carry the water to the point of application with as little loss of head as possible. The hydraulic engineer cannot always accomplish the task, and the electrical engineer steps in, and says, I will use the water where nature placed it to work an electrical generator, which shall produce electricity at as high a head as possible, and by means of wires I will convey the electricity so generated to the point of application with as little loss of head as possible. The hydraulic engineer may have too great a head for his pipes or his joints

to bear, and, in fact, the greater the head the more caution he takes in these directions. Just so the electrical engineer, whose wires are somewhat analogous to the pipes. The latter, however, has the graver difficulty of danger. His wires not only leak more or burst up under the higher pressures, but contact with them becomes dangerous to life, not to mention the danger from fire. The electrical engineer does not attempt to use the water directly, but makes another head of pressure which in a certain circumstance is more amenable to discipline, and in so doing necessarily loses a portion of the natural energy, losing also some portion between the points of generation and application and a larger portion at the latter point when he reverses the preceding operation and obtains mechanical energy. It may be that the attention of engineers has not previously been so forcibly drawn to the question of the transmission of natural forces as is now the case, when, according to certain theorists, electricity is to supersede everything, but it may be doubted if such work as that experimented upon at Creil could not be carried out far more easily and at a much less cost by a system of hydraulic mains. What M. Deprez has really done is to practically use a somewhat badly-designed modification of a Gramme machine giving a very high potential. In this machine he uses between three and four yards of wire upon his armature per volt obtained, as against about half a yard of wire so used in the best English machines. By-the-bye, how is it that electricians are so wedded to copper wire for the armatures of machines intended to give a high electromotive force? Surely copper wire is not the best material for the purpose. The use of high potentials in the transmission of energy by electrical methods has long been recognised, and has, perhaps, never been more clearly put than by Professor Ayrton in his Sheffield lecture at the 1879 meeting of the British Association. One of M. Deprez's contemporaries has recently admitted his success in three directions, one of which is that he has succeeded in persuading some wealthy men that the transmission of energy is a necessity. This may be, but he has not succeeded in showing that such energy obtained by means of a prime motor requiring steam is either cheap or practical. It may be convenient and luxurious—other it is not.

### EDUCATIONAL ENGINEERING BOOKS.

The field of the engineer's labours, whether in what are usually designated civil departments, or in mechanics, yearly extends its boundaries, and the intending student of the present day has more to perplex him in selecting which departments of the profession he will study than had his predecessors of, we may say, half a generation back. With increasing knowledge comes an increase of literature professing to instruct. Much of it, however, tends rather to confuse than to teach, and ought not therefore have ever been written. While, on the one hand, the student of to-day has far more to learn than he of past times, the time available for study remains the same, and is moreover a more valuable commodity. Hence it follows that the means of instruction ought to be the best possible. Engineers are frequently asked by their friends to tell them what are the best books to get for their sons, who intend or think of adopting the profession of engineering. Solomon's remark, that "Of making books there is no end," applies perfectly to engineering literature in the present day, while as regards a great deal of it his context to the above will also apply: "Much study—of it—is a weariness of the flesh." The production of a first-rate technical treatise requires a number of qualities, rarely, if ever, found present in a single person. We will endeavour to state at least some of them. The writer must himself thoroughly understand his subject—be master of it in every ense of the phrase. He must also be endowed with the gift of lucidity and conciseness of explanation, being able to reach the understanding of his audience, his class, or his readers with the least possible number of words, figures, letters of reference, or diagrams. He should be facile and happy in power of illustration—or, in other words, be able to mould ideas already familiar to the mind of his pupil in such fashion that they will represent the new ones he desires to impart. Above all, he must be unselfish, able to sink his own personality for the time being, thinking not of displaying his own learning, but avoiding "grooviness" of method, seek to put his subjects before his pupils in the manner most readily comprehended by them; never for a moment forgetting or losing sight of the object he professes to have in view, namely, to impart knowledge, not to display it. A considerable number of engineering books are so learned as to be quite over the heads of most students. Many more are so verbose, so laden with abstruse formulæ, letters, and diagrams, that the solution of the simplest question involves hours of time that can ill be spared from other work. It is no doubt true that many engineering questions demand elaborate writing to give a precise answer with mathematical exactness; but in the majority of engineering practice absolute exactness of such a nature is not necessary, and if a useful approximation will amply suffice, and is readily obtainable in some simply written book, that is the one that will be adopted.

There is too much paste and scissors work, too much book-making and padding now-a-days. German scientific literature is often so overladen with mathematics as to render it useless for any purpose outside the philosopher's study. On the other hand, again, we have seen treatises on certain mechanical subjects but little, if at all, better than trade catalogues. Professing to explain the construction and action of certain machines, nothing but elevations, evidently taken from catalogues, were used as illustrations; and author and publisher only damage their own reputation by producing such rubbish. If a man wants to acquaint himself with the nature and construction of any particular machine, he has but to go either to the reading room at the Patent-office, or to any provincial free library, and refer to the patent list and specification, and he will almost certainly find working drawings fully, and, as a rule, concisely described. Why, then, should he throw money away on such books? In many treatises trigonometry and algebra are simply done to death. Scientific writers would do well to take example from the modern novelists. They go with the times, and condense much matter into a small space. Sir Walter Scott and others are often relegated to the top shelf now-a-days. Unfortunately many have neither time nor inclination to read long stories, however good. The same applies to technical books. Why must we have grinders as well as schoolmasters? Why cannot the two be combined? A successful grinder, as we understand him, is a well-informed man who possesses in an eminent degree the ability to impart his knowledge quickly and clearly to others. There is, of course, this difference between the schoolmaster and the grinder—that the former has to teach a greater variety of subjects, and having only the same time each day as has the grinder, the progress of his pupils must consequently be slower. The latter works in a more contracted sphere. His subjects are few; and this fact, coupled with his own special ability, enables him to teach particular subjects well and quickly. The fault with some engineering books is that there is too much of the schoolmaster and not enough of the grinder about them. On the other hand, there are most excellent treatises on many technical subjects to be had, simply and clearly written, fairly free from—to the student—perplexing abstract formulæ, and such books are welcomed by all except pedants. Under the Education Act pupils are regularly trained to become teachers, by which we presume is meant that their native ability to impart their ideas quickly and well is tested and developed. It would be well for students, of no matter what age, if intending bookwriters were also taught that art beforehand.

Two things militate against the production of first-rate engineering literature. One of these lies in the fact that those who are in the daily and hourly practice of some given engineering work have seldom either the time to write or the conviction that anything they know is worth writing, or likely to interest any reader; and, secondly, very many men of conspicuous ability in other ways really do not know how to write. Coming now from generalities to particulars, we must say a few words about publishers. As a rule, their part of the work is done admirably, so far as what we may call the equipage of books is concerned. Whether as regards size, quality of paper, or letterpress, there is hardly any room for improvement, but the engravings are not always good. Much carelessness is often noticeable in the printing of letters of reference. These, which are as a rule of first-rate importance, are sometimes misplaced, and frequently some are altogether omitted, with the consequence that the student has to pass the said illustration by, not having time at his disposal to hunt up the meaning of the reference himself. We are convinced that all the instruction contained in a great number of the engineering books already published could be printed much more simply and concisely, and also much more lucidly, if authors sought only to impart their knowledge with the greatest brevity, without thinking at all of displaying their own learning or seeking to make a thick volume. Some of our universities, technical schools, or scientific bodies would, we fancy, do good work by extending the essay system a little—by offering prizes for the best treatises on given subjects; brevity, simplicity, and clearness should be the three essential conditions of success.

### THE MANCHESTER SHIP CANAL.

It is much to be regretted that so great an engineering project as the Manchester Ship Canal should have received so discouraging a check as that which has been given it by the total failure of the appeal to the public for money support. Not only has the London Stock Exchange refused to take up the project—a refusal which is, of course, followed by apathy on the part of the British investor generally; but Lancashire, the county which was expected to have eagerly subscribed, has equally shown no faith in the project. The cause of this may be difficult to assign, but the explanations which at present gain most ready credence are of the simplest kind, the basis of all being, of course, the fear that the Canal will not pay. Whether the reasons for this fear have any satisfactory foundation or not, it has been sufficient to prevent the county, which has already spent about £150,000 on the preliminary work and parliamentary contest, from risking any more; and if the district to be more immediately served by the Canal is not ready to back the project, it is hardly a matter for surprise if investors in other parts refuse to make up the £5,000,000 which must be subscribed before the constructive work can, under the Act, be commenced. The permission to pay interest out of capital during construction has not proved a bait, and could not have been expected to attract the most important section of English investors. The reasons for and against the probable success of the Canal as a money-earning concern are being everywhere re-examined; and as a result, the estimated tonnage of the Canal is freely spoken of as excessive, the cost of working is supposed to be under-estimated, the extras on the contract price for the work are prophesied to be great, the number of places served by the Canal without the assistance of the railways—and therefore of breaking bulk—is said to be small, the total freight for all places not immediately upon the Canal is expected to be as great as by rail and not so quick; the railway companies would, it is feared or expected, so reduce the rates to places on the Canal as to make profitable working of the Canal impossible; and the railway rates to many places not on the Canal would be correspondingly large, in order to recoup the losses on traffic to places on the Canal. The great bulk of the shipping will, it is urged, prefer to unload at Liverpool, where good return freights are to be had without the risks and loss of time involved in pushing through a canal. All these reasons, and more, are given as explanations of the reluctance of the public to take the matter up, and it may be that time has enabled people to comprehend more fully the nature of the obstacles to be overcome, and the amount of credence to be placed in the estimates of traffic, working expenses, and cost. These matters were, however, very fully discussed in the Parliamentary stage of the project, and the discussion failed to check the ardour of the promoters and the leaders in Manchester and Salford. The subsequent lapse of time has, however, cooled the enthusiasm, real or feigned, that led supporters on, and now even Manchester does not seem ready to pay for the Canal which proposed to make Manchester a port. Another attempt will probably be made to obtain the money necessary to make a start. The time allowed by Messrs. Rothschild was undoubtedly very short, but some very tempting promises will have to be made to make the investing public change its mind so much as the difference between practically no support and the subscription of seven or eight millions sterling will necessitate.

### THE STEEL SLEEPER TRADE.

Steelmasters are manifesting a good deal of vigour at the present time in seeking new outlets for the products of their rolling mills. Herein we mean not so much new markets as new uses to which steel may be applied. The domains now occupied by wood are steadily but surely being encroached upon, and there are immense fields which may be gained by the steelmaster in this direction. All that is needed to bring about the much-desired change is energy coupled with some amount of patience on the part of our metal producers, and of our mechanical and civil engineers and architects. Railway construction and the provision of improved railway rolling stock might afford great scope for the steelmaker for developing his industry if engineers were a little less conservative. Happily the steel sleeper is at last beginning to make progress in this country in a manner which indicates that by-and-bye its adoption will be as general as for some time past it has been upon continental lines. The London and North-Western, the Midland, and the Metropolitan Companies deserve the thanks of the steel industry for leading in this matter. That the Midland should have determined to lay a further section of its line close to Derby with the metal sleeper is full of promise. The steadily increasing number of orders which are being executed at our English works for sleepers for the Indian lines are a peculiarly satisfactory indication, and the fashion is already extending in the direction of the Colonies. Wisely, steelmasters recognise that colliery and ironworks' tramways below and above ground offer a favourable outlet for the employment of the metal sleeper, and they are devoting increased attention to bringing the article under the notice of proprietors of such works. Our Birmingham correspondent records this week what the Tredegar Iron and Steel Company is just now doing in this connection. The Tredegar Company has given great attention to the sleeper business, and seems determined to push it. Other steel companies in the Principality and the North of England are also rolling colliery sleepers, and the future of the industry is bright.

### STEEL GUN CASTING AT WOOLWICH.

It seems that the incorrect report of the accident at Woolwich has caused considerable excitement in Sheffield, and our Sheffield correspondent writes that our ordnance firms at Sheffield breathe again. Mr. Stuart Wortley, M.P. for the Hallam division of the borough, keeps a vigilant eye on the steel plant at Woolwich. When Mr. Wortley saw it stated in the *Times* that there had been an accident at the steel works at the Arsenal, and that the accident occurred while the men were casting an ingot for a 68-ton gun, he naturally came to the conclusion that the Government were making further experiments in a direction which would be detrimental to his constituents, as well as in direct violation of an understanding arrived at in 1884, when it was arranged that if the Sheffield firms would put themselves in a position to meet all possible requirements, there would be no Government competition in huge gun productions. As a matter of fact, the Sheffield firms have stoutly persisted all along that they have never yet been unable to make anything the Government required; but, falling in with the official way of putting it, the local firm complied—or are now complying—with the conditions, the shareholders having sanctioned an enormous expenditure for the purpose. It was therefore an unpleasant surprise, almost in the nature of a shock, to read that the Woolwich authorities had been casting an ingot for a 68-ton gun. Explanation was required, and it is forthcoming. The Surveyor-General of Ordnance writes that the *Times* report of the accident was inaccurate, because "the steel ingot which was being cast was only eight tons instead of 68 tons in weight." Mr. Woodall adds that nothing has been done to depart from the understanding arrived at in 1884, which is exceedingly satisfactory to all concerned.

## THE ORWELL WORKS OF MESSRS. RANSOMES, SIMS, AND JEFFERIES.

On Friday last a large party of the Indian and Colonial representatives to the Exhibition were taken by special train to Ipswich. to visit the Orwell Works of Messrs. Ransomes, Sims, and Jefferies, one of the oldest agricultural engineering works in the world, and one from which a larger number of important agricultural engineering inventions have sprung than from any other. The business was established in 1789, or nearly a hundred years ago, by Robert Ransome, then at Norwich. He invented several improvements in ploughs, but the most noteworthy invention was the chilled cast iron share, made everywhere to this day. This invention was the leading element in the foundation of the business removed from Norwich to Ipswich, where, after existing on a small but rapidly growing scale for a good many years, the site of the Orwell Works was acquired, now nearly fifty years ago. At that time the land was outside the town, and consisted chiefly of low-lying meadows near the river, and built upon only by a malting. With a full belief in the future growth of the business, this land bordered by a river was taken, and the malting had its two floors taken out and a central floor put in, and became the first part of the now great Orwell Works. The Ransomes had in their employ several men of unusual ability and energy; and the Orwell Works soon grew to be not only the largest agricultural engineering works, but, in the time of the great railway growth in England and elsewhere, railway stock and permanent way work was taken in hand and turned out in enormous quantities. Sixty wagons were sometimes turned out in a week, over 50 tons of iron melted in the cupolas, and nearly sixty loads of timber cut up per day. For some years Messrs. Ransomes and Sims had the monopoly of compressed tree-nail and wedge manufacture, and they were in possession of special tools for heavy and long-point and crossing work. This business is now carried on at the waterside works of Messrs. Ransome and Rapier. Out of Ransome's works came the first agricultural traction engine and the first steam threshing machine. The greatest inventions in the construction of ploughs came from these works; and the steam plough generally known as Fowler's had its invention and experimental days there.

The visitors of last Friday were thus in works of much historic interest, as well as of great extent and modern development; in fact, the modern extension of the works and changes have so much changed their general appearance that one well acquainted with them a dozen years ago would find difficulty in recognising them if no intermediate visit had been paid. The number of men employed is about the same as formerly, but the methods of production have improved, and the system of business makes larger stores necessary.

Amongst the recent improvements in the works is a splendid

new foundry, formed of a succession of very well lighted bays of 40ft. span, on columns 24ft. in height, several of the bays being provided with travelling cranes worked by constantly running high speed ropes, and operated by one attendant who is placed in a convenient position for seeing every necessary movement of ladle, pattern, or box, and who has every handle within a few inches of him.

The new foundry covers an area of 4500 square yards. On entering one is immediately struck with the general cleanliness of the shop, and arrangements giving evidence of order, system, and method, and the absence of scrap and extraneous dirt so apparent in the ordinary foundry is very noticeable. Ample accommodation is provided for heavy work by the overhead travelling cranes supplemented by ordinary foundry cranes on the columns. The first bay is partly occupied by machinery for preparing the sand for the moulders, including loam mill, a sand-sifter, machinery for dressing the charcoal used in mixing the sand, and two rows of bins 8ft. high by 5ft. wide, and of various capacities, to suit the sands used in foundry operations. Tramways are laid through the foundry both longitudinally and transversely. In No 2 bay are a series of six new cupolas with drop-bottoms, through which the refuse, after casting, may be dropped into trucks for removal. The metal is run into ladles which are carried on trucks to the moulds throughout the foundry. One stage serves for all the cupolas, and will accommodate sufficient iron and coke for one day's consumption, which is raised to the platform by the "travellers." The stores and core ovens are also situated in No. 2 bay, which is further utilised for share moulding. In bays 3 and 4 the heavier moulding operations are conducted, the spans being consequently traversed by more powerful travelling cranes than the others, but having two-ton cranes fixed to each supporting column.

In the smiths' shop are more than one hundred fires, giving employment to about two hundred smiths and strikers. A 30-ton Nasmyth steam hammer is employed in working up scrap in large masses for cranks, axles, &c., whilst several smaller hammers and stamps are used in stamp forging and in working up the numerous forgings required in agricultural machinery.

In the plough shop, where more than 10,000 ploughs are manufactured in the course of a year, comprising single, double, and multiple furrow ploughs, and embracing every variety of construction, from the highly finished and perfected Newcastle Prize Plough for high-class English work to the simple implement used by Indian natives and capable of being carried on their shoulders from place to place, there is much to be seen though nothing strikingly novel.

The engine house for this portion of the factory contains two large locomotive boilers and a pair of 25-H.P. nominal horizontal stationary engines, manufactured by the firm, which are employed for driving the blast fans of the smiths' shop, tools in the boiler shop and foundry, and also for driving the grindery and the tools in the plough shop. These engines give off about 100-horse-power.

The boiler shop contains a number of hydraulic, flanging, bending and rivetting machines, also machines for cutting, punching, drilling, and other purposes, whilst a powerful overhead travelling crane runs along the whole length of the shop. The furnaces for heating and the rolls for bending the boiler plates are so arranged in the shop that the plates entering in the rough state are gradually worked and past on stage by stage until they reach that part of the shop where the actual boiler making takes place. The rivetting is done by hydraulic rivetters, the boilers being lifted to the press by power cranes.

The largest separate shop in the works is that devoted to engine erecting. The erecting is done in the centre of the shop. The machinery and tools in this department are driven by a pair of horizontal engines similar to those already described. The heavier work is done on the ground floor, and the lighter in the galleries on each side of the building. This shop contains a very large number of machines, including lathes of all sizes and descriptions, radial and multiple drills, planing machines, slotting, shaping, screwing, and cylinder-boring machines. An overhead traveller, driven by high-speed rope, is employed for placing the boilers in position and lifting them again after the engines have been erected upon them. In the heavy turnery is a couple of 20ft. planers for bed-plates and similar work, and also a 10ft. boring lathe for wheels. There are also convenient fitting and brass finishing shops for small work, as well as large stores for the finished parts. All the various parts of the engines are accurately bored, turned, and fitted to standard gauges; so that no matter when an engine may have been supplied, there cannot be at any time any difficulty about extra wearing parts. It may be remarked that the value of standard measures and first-rate tools was very fully understood at the Orwell works many years ago, a staff of special tool fitters having for many years been employed in a separate shop. Adjoining this department are large and convenient shops for trying and testing every engine before being sent away, not only by hydraulic pressure, but also under steam. Near the engine-erecting shop is a building devoted to the manufacture of corn-grinding mills, a large warehouse used for the storage of complete engines and thrashers of various descriptions and sizes. A separate yard is devoted to horse rake and haymaker construction, and it may also be remarked that a separate factory has recently been acquired, and fresh buildings erected, a few minutes' walk from the Orwell Works, and fitted complete with every modern appliance exclusively for the manufacture of lawn mowers, which have long been one of the specialities of the firm, several thousands being annually manufactured by them. The Orwell Works produced some of the earliest lawn mowers.

In the thrashing machine department, which contains some fine machinery, the round and square logs are sawn up into scantlings and boards, and then proceed to the steam drying rooms, whence, after remaining for periods varying from one to two months, they are next taken to the storing sheds, where they remain to season as long as may be necessary. Beyond the drying ovens are extensive stores for converted timber, *i.e.*, timber cut to the standard sizes required in the threshing machinery. Outside these sheds is a large yard for stacking converted timber, the total stock of which on hand at any one time is necessarily very large. Among the few old machines still left in this department is one of the earliest wood-shaping machines with revolving discs carrying gouge cutters. It was made in the works, and was the forerunner of the modern machines. A small shop is devoted to the production of wheels for threshing machines and engines. A horizontal Corliss engine capable of developing 150 horse-power drives the machinery in the wood-works. The furnace for heating these boilers is of special construction, and is fed mainly with the chips, sawdust, and other refuse.

After inspecting the works the visitors were conveyed to the grounds of Mr. Cobbold's Holy Wells farm, and there, after an excellent lunch (at which local visitors did not take back seats), portable traction engines, thrashing machines, ploughs, and haymaking implements were shown at work, the visitors were taken by steamer to Parkeston, and thence by train to London.

## THE DECAZEVILLE COAL MINES AND THE COAL MINES OF FRANCE IN GENERAL.

THE following is taken from the report of the Imperial Austrian Consul at Paris, forwarded to the Austrian Government. The disastrous strike at Decazeville, which broke out amongst the miners there at the beginning of the year, shows with what difficulties the French coal industry—and, indeed, others as well—have to contend with. The coal mines of Decazeville together with the ironworks of Firmy, situated close by, were acquired by the Société Nouvelle des Houillières et Fonderies de l'Aveyron, in 1873, for six and a half million francs, in 13,000 shares at 500f. the share, which stood at 380f. when the strike broke out. The company raises 350,000 to 400,000 tons of coal per annum from the pits Bourran, Combes, Paylereu, and Firmy, the first-named producing nearly the half of the whole quantity brought to bank. Three thousand four hundred workmen were employed by the company, of which 2200 were miners; almost all have a house and a small plot of ground, and have had twenty-six days' work per month, and therefore have worked full time, whilst the men in the northern and other parts of France—where the iron industry has been so depressed—in most cases have only had work a few days per week. The miners' wages were 4f. 21c. per day, therefore no less than elsewhere. But besides, the company expended 12,000f. yearly for keeping up the Workmen's Hospital, which it also built to start with. Then it paid a subvention to the sick club of 15,000f., and again 50,000f. in the shape of coals and pensions to widows and workpeople at the rate of 300f. to 450f. per annum, according to length of service. For a number of years besides all this the company has laid out 600,000f. to 800,000f., by far the largest portion of which was spent in the immediate neighbourhood for improvements in machinery and appliances, and for the purpose of studying appliances in other parts of the world, with the object of reducing the charges of winning the coal, which at prices as now sold leaves nearly nothing as profit, costing only 3½f. to 4f. per ton to the buyers. The principal purchaser at present is the Railway Company d'Orleans, which takes 300,000 tons yearly, the remainder being used at the ironworks of Firmy. Of other sales there are scarcely any, as in that neighhourhood there are neither works nor factories, nor on the banks of the Lot, which flows past the works, although the Government recently spent twenty-three million of frances in making it navigable between Penchot and Aiguillon because the mines cannot utilise it, as only boats holding 80 tons and drawing 80 c. m. of water can pass it. Although the seams are very thick they bring but little profit, as only 60 per cent. of them deliver saleable coal, the other 40 per cent. being waste, whilst in the coal field of the north 95 to 97 per cent. of the seam is of saleable quality. But besides this, the coal of Decazeville contains very much gas, and the lower seams are in a continual state of incandescence, the spreading of which is only hindered by damming up the roads with walling, which evil of course demands a continual watching on the part of all concerned. Things standing in this somewhat precarious position, the shareholders have only received the following yearly dividends:—In 1874, 35f.; 1875, 25f.; 1876, *nil.*; 1877, 15f.; 1878, 17½f.; 1879, 20f.; 1880, 1881, and 1882, 25f. each year; 1883, 12½f. per share, and in 1884 nothing. For the rest, the position of the rich coal mines in the Department of the North and Pas de Calais is not much better, for in 1844, in comparison with the year before, 620,957 tons less of coal was raised; whilst for the last thirty years there was a continual increase in the production from year to year. In 1884 the North Department Mines of Anzin produced 1,797,385 tons; Aniche, 621,541 tons; Escarpelle, 442,721 tons; Douchi, 255,697 tons; formerly 284,031 tons, or altogether 3,401,375 tons metric. The mines of the Pas de Calais produced in the same year:—Lens and Donoviu, 1,135,355 tons; Liévin, 480,397 tons; Nœux, 774,644 tons; Bruay, 607,277 tons; Marles, 482,988 tons; Bully-Grénay, 677,217 tons; formerly 1,821,251 tons, altogether 6,029,129 tons metric. In consequence of the strike at Auzan the sales fell off 498,844 tons; in Bully-Grénay, 98,135 tons; in Aniche, 53,494 tons; and in Marles, 43,393 tons metric. On the other hand, in Nœux, 38,803 tons; in Bruay, 37,797 tons; and in Liévin, 27,626 tons, there was an increase. In the year 1875 the shares of the mine Auzin stood at 9404f.; in 1876, at 7857f.; in 1883, at 2645f.; in 1884, at 2104f. The shares of the mine Lens stood in 1875 at 39,720f.; in 1876, at 29,580f.; in 1883, at 20,663f.; in 1884, at 20,994f. The shares of the mine Bully-Grénay in 1875, at 3785f.; in 1876, at 2250f.; in 1883, at 1438f.; in 1884, at 1842f. Those of Liéven stood in 1875 at 12,935f.; in 1876, at 8000f.; in 1883, at 5749f.; in 1884, at 5385f. Those of Dourges in 1875, at 17,404f. in 1883, at 4900f.; and in 1884, at 4500f. Those of Courières in 1875 at 46,000f.; in 1879, at 24,000f.; and in 1884, at 27,000f. The official *Annuaire de Bourse* authenticates the fact that, besides the shareholders many years receiving none, that they have only enjoyed very small dividends at any time, and that many of the shares in these richer mines of the North Department and Pas de Calais are now to be bought for a quarter and, in fact, some at a tenth part of their original value. The position of the shareholders in mines in the centre of France is still more unfortunate, for the mines of the Largon et Loire Company, established in 1847, paid nothing whatever in 1872 and 1873, and those in Haute-Loire during the last ten years only 20f. to 80f. each year, and from 1849 to 1871 only 5 per cent. interest yearly. The mines of Epinac pay better now; but from 1829 to 1853 they could only pay their shareholders interest twice. Those in Montieux and St. Etienne gave from 1849 to 1872, and also since 1875, no profit. The shares in the mines of Grandes-Flaches have borne 6f., 8f., and 10f., and those of Rive-le-Gier paid 3f., 4f., to 5f., but for some years nothing at all, and the shares now stand at 11f. 75c. The mines in Campagnac, which were opened up in 1862, pay every five years each 3f. to 4f. per share, and the same is the case with those of Anne. On the whole it may be said that with the exception of a few favoured shareholders in good mines, they do not get more than 3 per cent. for their capital, which certainly cannot be called an extravagant profit. Under no circumstances therefore can it be maintained that they have enriched themselves at the expense of their workmen; for, as has been shown in the case of the Decazeville mines, the men were well paid, and the company besides that spent large sums for purely humanitarian purposes. Of what importance the mining industry is to France the following newest data shows. Out of 580 concessioned mines in 1882, 252 coal mines were being worked, and they gave employment to 104,995 workpeople whose wages amounted to 115,831,352f., which equals 1103f. per head. There were in operation 1407 machines exerting 73,683 horse-power, which consumed 1,206,711 tons of coal and produced 20,046,796 tons metric of saleable coal, which fetched 12f. 43c. per ton, or a total value of 249,210,833f. But even this production is insufficient for the requirements of the country, which consumes eight to nine million tons in excess of that raised.

In the year 1883 were imported 92,581,125 metric cwts.; exported, 4,725,546 metric cwts.; difference, 87,855,579 metric cwts. In 1884 were imported, 93,856,698 metric cwts.; exported, 4,519,494 metric cwts.; difference, 89,337,204 metric cwts. In 1885 were imported, 88,113.396 metric cwts.; exported, 4,775,798 metric cwts.; difference, 83,337,600 metric cwts.

This shows that France paid in 1883 150,747,000f. for imported coal above what it produced itself; in 1884, 160,438,000f.; and in 1884, 149,283,000f.

## SIR J. ANDERSON.

SIR JOHN ANDERSON, LL.D., F.R.S.E., died at his residence at St. Leonard's-on-Sea on Wednesday. For some time he had suffered from a bronchial affection, and a sudden aggravation of the illness caused his death. Sir John was born at Woodside, near Aberdeen, in 1814. As a boy he was employed for ten years in the engineering department of a local cotton mill, and such was the esteem in which he was held that on leaving he was presented with a testimonial by the inhabitants. In 1839 he left Woodside for Greenwich, and followed his profession in various establishments. In 1842 he was appointed to take charge of the brass gun-foundry at Woolwich Arsenal. In that capacity Mr. Anderson set himself to introduce much-needed reforms, revolutionising the system of working, and inventing new machines to be used in the construction of cannon and in the casting of rifle bullets. One bullet machine invented by him turned out 40,000 bullets an hour, at a cost of 5½d. per thousand, whereas by the old method of casting they cost 5s. per thousand. Another of his inventions was a machine for grinding, which was a great success. Mr. Anderson's guiding motive was an enthusiastic love of his profession backed by a spirit of real patriotism and sense of duty. He had by this time become known not only to his superiors, but widely in other quarters as a first-rate mechanician, a man of great resources and untiring energy, and accordingly he had had offers to accept other well paid situations—one foreign Government offering him a high salary to enter their arsenal. All these offers and handsome profits from patents he refused. In 1853 the Lords Commissioner of the Treasury made a substantial addition to Mr. Anderson's salary expressly on the ground that "the valuable services which had been rendered by him in several branches of the ordnance service by his inventions and adaptations of machinery" entitled him to special consideration. But more important services were still to come. In the year 1853 Mr. Anderson was requested to report on the capabilities of the Government Rifle Factory at Enfield for manufacturing bayonets by machinery. His report was to the effect that, while bayonets were turned out in limited numbers at a cost of 7s. 6d. each, they could be made by proper machinery far more rapidly at a cost of 2s. 6d. each. In a subsequent report he expressed his belief that all the separate parts of a rifle could be made by machinery at the rate of 500 a day if required. His proposal in this matter roused the strong opposition of the gun trade generally in London and Birmingham. These private manufacturers declared Mr. Anderson's statements that he could make any part of a rifle by machinery more perfectly and at a much cheaper rate than they were made by hand to be entirely illusory. A Select Committee of the House of Commons was appointed to inquire into the subject, before which Mr. Anderson was severely cross-examined. But he stuck to his point, declaring himself prepared to undertake to carry out what he had said he could do, while Lord Raglan, Sir Thomas Hastings, and General Tulloch expressed their strong confidence in his ability to accomplish what he said. A small arms factory was established by the Government at Enfield, entirely according to his plans. After the first few years this factory produced annually 100,000 muskets with bayonets complete, and at a cost of less than £2 for each. The entire sum spent on lands, buildings, machinery, gasworks, &c., amounted to £315,000, and this sum, together with a depreciation of £48,000, had been entirely repaid, and in 1862, there was a surplus of £14,000 from the profit as compared with the prices paid to contractors. In 1859 the Government took up the manufacture of Armstrong guns, and Mr. Anderson was chosen to superintend the work. He had now conferred upon him the office of Inspector of Machinery, with a salary of £1000 and £200 in lieu of house or quarters, at which salary he continued till 1872, when, on finally retiring, he was paid a handsome allowance. In 1870 Mr. Anderson had the degree of LL.D. conferred upon him by the University of St. Andrew. He served as a juror at the International Exhibitions at London, Paris, and Vienna in 1862, 1867, and 1873 respectively, and was at the head of the British jurors at the Philadelphia Exhibition of 1876, and in Paris in 1878. In recognition of his services at the Exhibitions he was nominated a Companion of the Order of Francis Joseph of Austria, and was made an officer of the Legion of Honour. He received the honour of knighthood in 1878. Sir John Anderson married, in 1840, Eliza, daughter of Mr. William Norrie, of London. In 1881 Sir J. Anderson presented to his native village a free library, which cost £6000, and was subsequently presented with his portrait by the inhabitants.—*Times.*

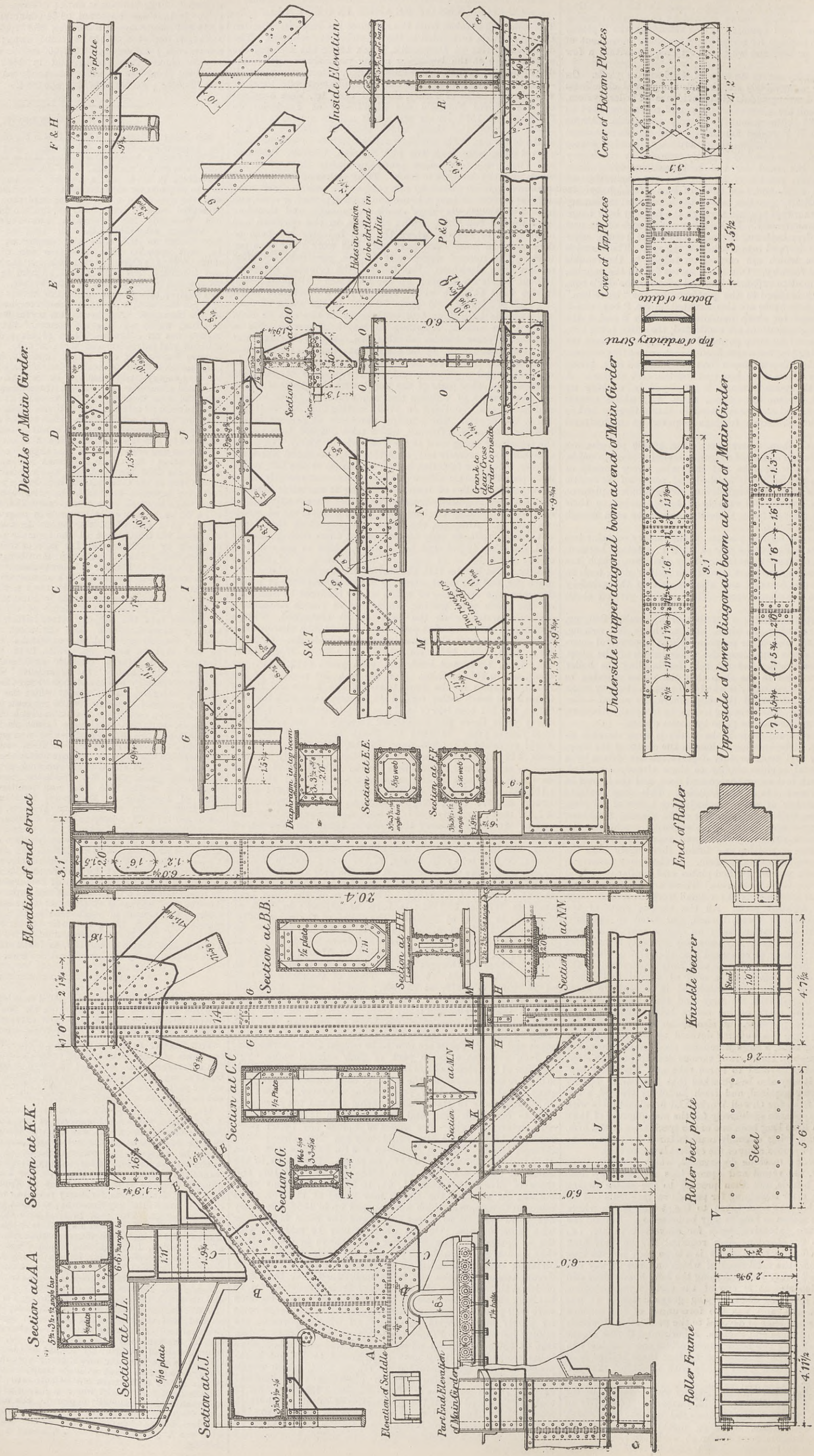
THE Royal Society have determined to substitute a direct-acting dynamo and a set of accumulators for the present alternating current plant. The work has been entrusted to the Electrical Power Storage Company, 4, Great Winchester-street, E.C.

THE RECENT ACCIDENT AT WOOLWICH.—We are informed that the mass of steel in which are imbedded some of the remains of the unfortunate man who met his death so tragically at the Royal Gun Factory will be buried within the Arsenal. This is a resolution on the part of the authorities which will commend itself to every one on the score of decency and right feeling.

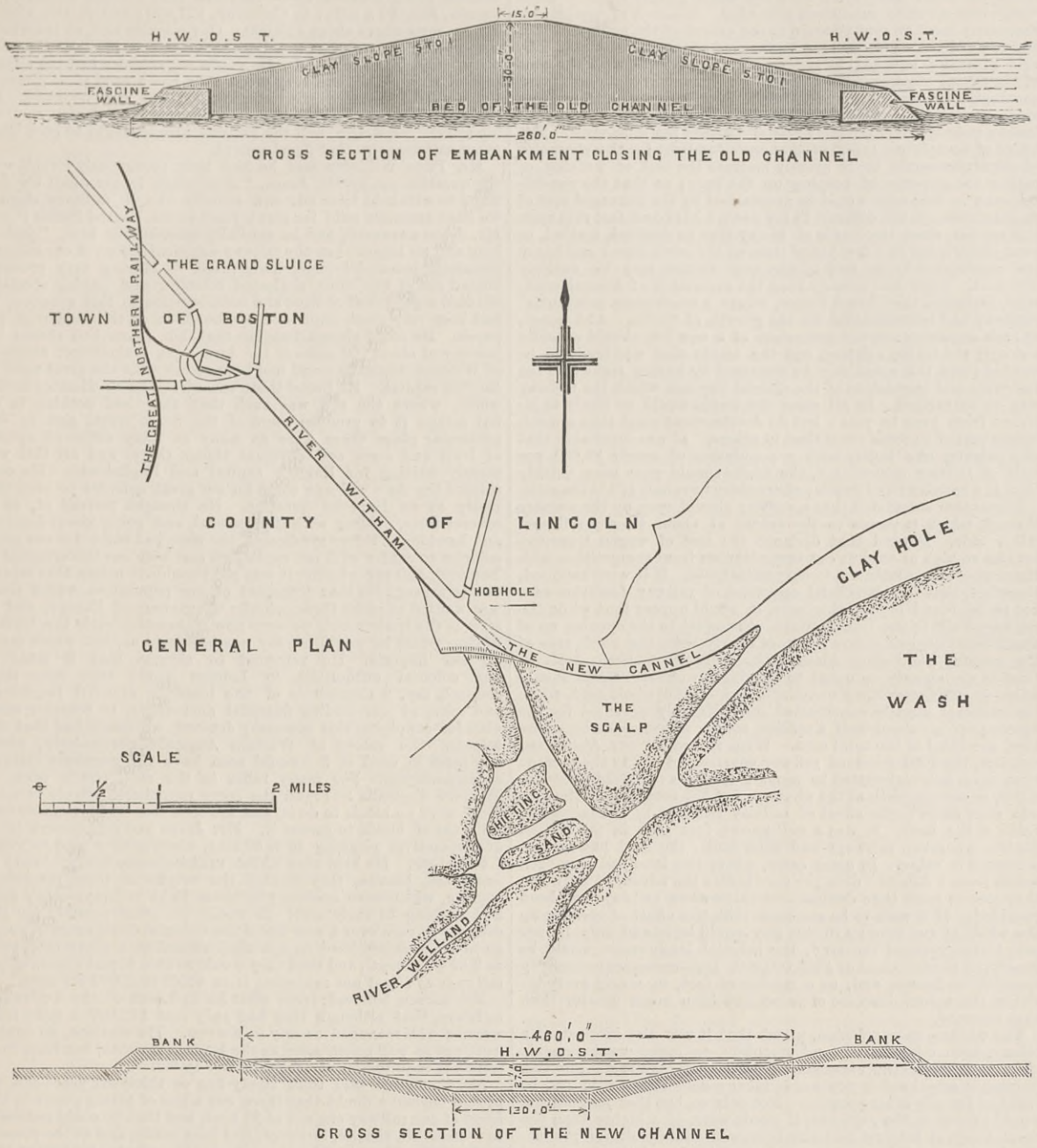
MR. J. P. KNIGHT.—We regret to announce the death of Mr. J. P. Knight, the general manager of the London, Brighton, and South Coast Railway. It was only on Wednesday of last week that he was present at the half-yearly meeting of the company, when he received the congratulations of the chairman and numerous shareholders on his recovery from his recent illness. He transacted business on Thursday with Sir Philip Rose, and subsequently went to visit some friends at Epping, Essex, where he died. Mr. Knight was for many years in the employment of the South-Eastern Railway Company, and was eventually appointed superintendent. This post he filled with satisfaction until 1869. In that year he relinquished his position on the South-Eastern Railway in order to undertake the responsible office of general manager of the London, Brighton, and South Coast Railway Company's system, in succession to Mr. George Hawkins. During his tenure of office, Mr. Knight had seen many changes, and had superintended numerous improvements tending to the safety and comfort of travellers. He proved himself one of the most able, systematic, and thorough managers. It was during his administration that the Westinghouse brake was generally adopted, the electric light applied, and the interlocking system of signalling brought into practical use. He always took special interest in the ornamentation of stations and other minor matters, all tending to the improvement of the line. Mr. Knight held the rank of Lieutenant-Colonel in the Engineer and Railway Volunteer Staff Corps, and his services in connection with the transport of troops at the time of the Easter manœuvres are well known. Though firm in his management, Mr. Knight was considerate to all under him, and his death will be generally deplored. His valuable services have been frequently acknowledged by the chairman and board of directors, and as often endorsed by the shareholders. The deceased, who was fifty-eight years of age, leaves a widow and several children.

# THE SUKKUR BRIDGE.—DETAILS OF CENTRAL GIRDER.

(For description see page 28.)



# THE WITHAM NEW SEA CHANNEL.

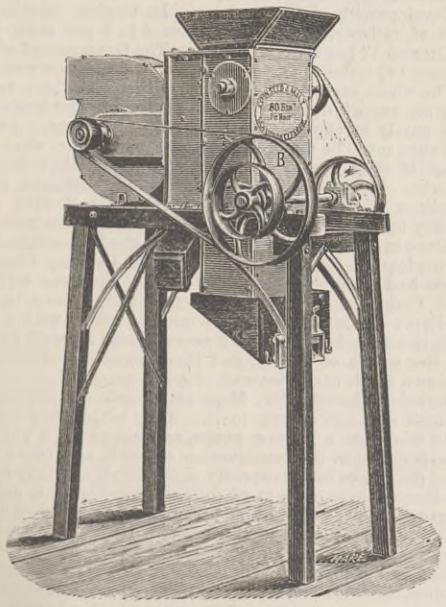



## THE WITHAM NEW SEA CHANNEL.

THE accompanying engraving illustrates the Witham New Sea Channel recently completed into the estuary of the Wash, a description of which we gave a few weeks ago. The new channel s three miles in length, and compared with the Suez Canal, the Amsterdam Canal, and the proposed Manchester Canal, the width and depth is as follows:—Suez Canal—depth, 26ft.; bottom width, 72ft. Amsterdam Canal—depth, 23ft.; bottom width, 89ft. Manchester Canal—depth, 26ft.; bottom width, 120ft. Witham Channel—depth, 27ft.; bottom width, 130ft. The largest class of vessels can navigate the new channel with ease, and compared with the old circuitous shifting channel, the work has already proved of immense advantage to a vast area of low-lying land during periods of heavy rainfall.

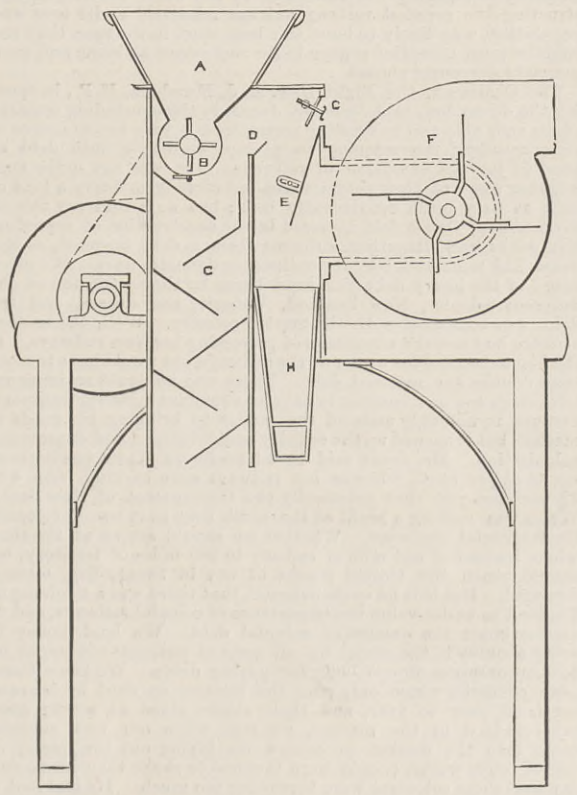
## ROBSON'S GRAIN AND SEED CLEANING MACHINE.

THE grain scouring and cleaning machine illustrated by the accompanying engravings is made by Messrs. J. Robson and Sons, Dover, and is used in breweries to clean malt, and elsewhere for cleaning oats and other grain and seeds. It is a simple



machine, and is one which has been designed to effect a cleaning and separating process which may be efficiently done without sieves or shakers.

In our engraving A is the feed hopper, B the scouring cylinder, C separating trunk, D tailing regulator, E tailing plate, F exhaust fan, G air valve, and H the tailing spout. The malt or grain enters the hopper A, passing to the scouring cylinder B, which is lined with slotted, perforated, or smooth plates according to the grain to be operated on, and is fitted with a fast running spiked roll. It then passes in a thin stream through the bottom of the cylinder, and falling from guide to guide in the separating trunk C, it meets a strong current of air, drawn upwards by the exhaust fan F, when it loses its light grain, the quantity of which is regulated by the position of tailing regulator D, and passing under the plate E, the light grain drops to the tailing spout, and the dust is blown into a




place by itself. The air valve is set so that it is always partly open, and can be adjusted to admit more or less air from outside, and so reduce or increase the volume of air passing through the separating trunk.

## COMPRESSED WOOD FOR TOOTH-GEARING AND SHUTTLES.

WE have received a number of samples of beech and other woods compressed by hydraulic presses under the patent of Mr. Robert Pickles, of Bromley, who makes this material a speciality for shuttles and for gearing. The compression of the wood improves its wear-resisting capacity in an unexpected degree. The wood is sawn into sizes necessary for making shuttles or cogs and naturally dried. It is then compressed under a pressure of about 15 tons per square inch in a rectangular space in the press holding six shuttle blocks, packed three side by side and two deep; above is a metal block which is made so as to fit the space in the ram. The depth of the blocks before compression is 2¼in., and it is reduced to 1¼in. The kinds of compressed wood sent us are beech, persimmon, and cornel. The grain is very close, and the weight of the compressed beech is greater than that of box-wood, and remarkably heavier than uncompressed beech. We have no figures as to the wear of the wood as cogs, but should expect it to last a very long time and to run very easily. It may be mentioned that the samples sent us are 1·25in. by 1·437in. by 4·625in. Of the beech, the uncompressed piece weighs 3·24 oz., and the compressed piece no less than 4·91 oz., or 1·66 oz. heavier.

## RAILWAY EXTENSION IN THE COLONIES.

THE following paper on this subject was read by Mr. J. S. Jeans, at the Conference at the Colonial and Indian Exhibition, on Tuesday, July 27th, and is of great interest to those concerned in railway enterprise.

The author opened his paper by remarking that the railway development of the colonies was a subject of great importance, not only to the inhabitants of the colonies themselves, but equally so to the mother country. The most obvious reason for this was that the mother country had hitherto been, and was likely to continue for a long time to come, the chief source whence the colonies draw the material necessary for the construction and working of the railways. But besides this it was manifest that every increase to the railway resources of the colonies provided them with additional facilities for opening up their immense virgin lands, exporting their own produce, and importing that which European, and especially the mother country, sent them in return, and finally for supplying the people of the United Kingdom with the food which they were compelled to import in increasing quantities. If they took the fifteen principal colonies belonging to the British Crown, including India, Canada, and the Australias, they possessed a total of about 30,000 miles of railway, being one mile to every 269 square miles of area, and every 7300 inhabitants. In order to show how this relation of railway mileage to area of population compared with other countries, the author stated that in the United States there was one mile of railway to every 25 square miles of area, and every 2300 inhabitants. In the United Kingdom there was one mile of railway to every six miles of area, and every 2000 inhabitants; whereas if they took the United States, Europe, and the British Colonies together, there was one mile of railway to every 57 square miles of area, and every 2500 of inhabitants. It was impossible to furnish a standard of adequate colonial railroad service based on European data, the circumstances of our colonies being as unlike as possible to those of our own country in respect both to area and to population. The area of the British Islands was about 75 million acres, of which 50 millions were cultivated or cultivable. But the area of our Australasian empire was 2000 millions of acres, the greater part of which was believed to be capable of yielding excellent crops, alike of cereals and of tubers. In the Canadian North-West there were 384 million acres of valuable agricultural land, the whole of which was well adapted for settlement and cultivation, and in British India there were close on 600 millions of acres of land under cultivation or capable of being cultivated, and much of it under judicious irrigation might be made to yield two and even three crops in the year. These were the territories that we should wish to see become the wheat fields, grazing lands, orchards, and market gardens of the mother country. At the present time England imports foreign food supplies of the value of 125 millions per annum, of which the United States furnished 30 millions worth, or about 25 per cent. of the whole. But the United States were in fiscal affairs a hostile country, endeavouring as far as they could to exclude British produce by unfriendly tariffs. In the colonies, however, we have an empire that was not only ready but eager to trade with us on reciprocal terms, and every necessary resource for meeting our requirements as regards food supplies, excepting only the means of bringing those suplies to market, or, in other words, adequate transportation facilities.

The author believed that with those facilities furnished to the fullest extent, England might expect to draw from our own colonies a very large proportion of the produce now contributed by the United States, and remarked that if Canada and India had to-day solved the railway problem as effectually as the United States had long since done, if railway facilities were as abundant between the producers and the ports, and if the rates of freight were as cheap and as well adapted to the development of the trade, there would be no need for the dependence upon American supplies that now exists. The strides that the colonies had already made within recent years in furnishing the food supplies of Europe were such as to put the fabled achievement of the seven leagued boots entirely into the shade. Between 1868 and 1882 the imports of wheat alone into Great Britain increased from less than 1 million to over 3 million cwts. as regards the Dominion, from less than 200,000 to 8½ million cwts. as regards British India, and from less than 500,000 to nearly 5 million as regards Australasia. The question whether our own colonies could compete with the United States and Russia, in supplying the food requirements of the mother country, might be regarded as settled by these figures.

Mr. Jeans next referred to the experience of the United States with reference to the assistance that railway facilities had rendered in developing this foreign trade. In 1885 there were 20,000 miles of railroad built in America, as compared with a total foreign trade, including both exports and imports, of 536 million dols. In 1870 there were 49,000 miles of railroad constructed, and the foreign trade amounted to 913 million dols. In 1883 there were 120,000 miles of railroad constructed, and the foreign trade amounted to 1600 million dols. There had therefore been a great correspondence between the railroad mileage constructed in America and the development of the American foreign trade. This relation was not exactly continuous, but it was sufficiently so to establish the argument that railways were the main factor in facilitating the extension of foreign trade. The case of the United States likewise confirmed the economic theory of the concurrent development of exports and imports, and proved that there could not be any large development of exports without an almost, if not quite, exactly corresponding development of imports. Not only, however, had the United States been able enormously to develope their foreign trade by the aid of increased railway facilities, but they had been able, by the low rates of freight which the increasing volume of traffic brought upon the line enabled them to charge, to compete with other countries, where that would otherwise have been impossible, at any rate to the same extent. Between 1870 and 1884 the freight rates charged on American railways had been reduced on an average by fully one-half, which meant that if the same average rates of freight prevailed at the present time as in the year 1870, the agriculturists and traders of that country would now have been paying 100 millions sterling more than they actually are for railway transportation. In India the same phenomena had been witnessed, the goods traffic carried on Indian railways having increased between 1880 and 1884 by 60 per cent., while the exports had increased from 51 millions to 88 millions. The colonies had many things in common, but in nothing were they more alike than in the fact that agricultural produce in one form or another was the staple of the railway traffic. More than 70 million tons of agricultural produce were carried on American railways in 1880. On the transport of this traffic the agriculturists were paying now about 30 millions a year less than they would have required to pay at the rates of twelve years ago; and the effect of this had been that the agricultural exports of America had more than doubled in value, and greatly more than doubled in volume, since 1870. The fact was that this reduction of the American railway rates had been the controlling factor.

Our colonists, almost without exception, had an enormous amount of produce to dispose of, and although that surplus was now mainly agricultural, it would take other forms by-and-bye, so that we might expect before long to draw from those sources the great bulk of the raw materials of our widely ramified manufacturing industry. We might depend upon it that, as this development of exports proceeded, the import of commodities would follow; so that the more the colonies sent to us, the more we should be able to send to them.

The author pointed out, as a result of these facts and considerations, that it was a matter of vital concern to our colonies that they should be furnished as speedily as possible and on the greatest attainable scale with the means of transporting their produce to the markets of Europe and especially to our own. As it was at present, the prices of wheat, beef, mutton, and other produce grown in our colonies was mainly affected by merely local considerations, but when agriculturists were furnished with adequate railway facilities the price of their produce would be determined by the quotations ruling in Mark-lane and Smithfield, plus the cost of reaching those markets.

The author next considered the different methods of financing the railways constructed in the colonies, showing that in all cases their development had been limited from the outset by the exigencies of capital. The various methods of raising capital in the principal colonies were described, together with the character and extent of the aid furnished by the general and municipal Governments. One remarkable feature of the railway finance of the colonies was the ready acquiescence of the inhabitants in taxing themselves for transportation facilities. In Canada the Governments and municipalities unitedly had contributed 178 millions of dollars out of 557 millions of dollars expended in railways up to the present time. In Australia the several Governments had also very largely contributed the necessary capital for railway construction, and it was referred to as a source of satisfaction to the colonies to reflect that they were just providing a heritage as years rolled on which would enable them at an earlier stage of their career to dispense with that crushing burden of taxation which a dynastic and other wars had maintained upon European countries without any similar set-off. A number of details were given of the cost of constructing railways in different colonies, and the question was considered whether it might not be advisable in the case of new and sparsely populated countries to endeavour to economise first cost by one or other of the several expedients that were so well-known to railway promoters and engineers. In some countries narrow gauge railways had been found to fulfil this condition, although the break of gauge was not a thing to be recommended where it could be avoided. In India there was in 1884 10,700 miles of railway constructed, of which 7300 miles were built on the broad and 3400 on the narrow gauge; the cost of the former amounted to an average of £16,700, while the latter only cost £6800, the average cost per mile for the whole country being £13,600. In Canada it had been deemed advisable, with the view of opening up the back country beyond Toronto, to construct some hundred miles of narrow gauge railways, which cost an average of only £4000 per mile, as compared with an average of only about £8000 per mile on the broad gauge railways in the same province. In this case the narrow gauge railways, with an average net income of £113 per mile, had yielded 4 per cent. on the cost of construction, whereas the broad gauge railways, with an average net income of £250 per mile, had only yielded 3 per cent. on their capital cost. Some authorities maintained that the narrow gauge railways involved a greater cost of working, had much less capacity for traffic, and led to a much heavier expense for maintenance. Others again held that the narrow gauge railways of India were equal to carrying any traffic that they might be called upon to bear. The opinion of the Select Committee on Indian Railways of 1884 was that the narrow gauge railways should generally be confined to tracks of country where that system was already in successful operation, and to local lines where the traffic was likely to be so light that cheapness of construction more than counterbalanced the undoubted disadvantage of break of gauge. The author thought it probable that this recommendation was, on the whole, a wise one. It was certain that on the great majority of lines the ultimate traffic had largely exceeded the most sanguine expectations of promoters and builders. In proof of this we were now using forty to fifty-ton engines, and the seven to ten-ton engines were deemed sufficient not so many years ago, and in some cases 90 lb. rails, when 56 lb. and 72 lb. rails were regarded as adequate within the last few years. So it was with all the other conditions of railway working.

The author next noticed the differences as between the several colonies in respect of their area, population, and probable traffic, as well as in the cost of working. These differences were so striking that it was impossible to frame any rules or suggestions that would equally apply to all. The cost of working Indian railways was considerably under that of working European or Colonial railways in general. Both in India and in Canada the freight rates were exceptionally low. In India this was mainly the result of the low cost of working; in Canada it was mainly the result of the competition that existed between the principal Canadian lines, especially the Grand Trunk and Canadian Pacific for the trans-continental traffic.

Engineers held that the cost of a railway should not exceed ten times the amount of its gross annual revenue. Measured by this rough-and-ready test, the railways of the colonies were found wanting. This was especially the case in Canada, where 125 millions had been expended against 67 millions, which they ought to have cost on the principle stated. In India, however, this theoretical limit of expenditure was 163 millions for the railways already constructed, being 20 millions more than the actual outlay. Taking our eight principal colonies together, the sum actually expended in railway construction up to the end of 1884 was 347 millions sterling, or 46 millions more than the theoretical limit stated. But this, after all, was not an exceptional state of affairs seeing that in the mother country the railways built up to the end of 1883 had cost 103 millions more than the figures at which they ought to stand as determined by their annual revenue. One of the most important principles in railway working was that of securing a high range of gross earnings per train mile, or, in other words, run full train loads. Another was that of keeping the working expenditure low relative to the gross receipts. With regard to the former, the colonies generally showed satisfactory results; but with regard to the latter, in consequence of the comparatively limited volume of traffic, the working expenses took a considerably higher range than the European average.

In view of the importance of making every possible effort to extend colonial railways, and so accelerate the development of colonial resources, the author considered some of the limitations imposed upon the prospects of railways as investments by the extent of traffic available. The net earnings of colonial railways varied from a minimum of £163 per mile in the case of Canada to a maximum of £804 per mile in the case of India. Queensland was able to pay an average dividend of rather over 4 per cent., with a net income of only £268 per mile. But in New South Wales it required an average net income of £485 per mile to return a dividend of 4·2 per cent. In the case of the British railways it required a net return of about £1800 per mile, or more than six times the average of the Queensland railways, to pay approximately the same amount of dividend. These and other figures set forth by the author sufficiently showed that colonial railway property was a very different thing from English, and that the two must not be tested by the same criteria.

The average cost of the railways built in our nine principal colonies, including India and Canada, amounted, to the end of 1883, to £11,900 per mile, as compared with upwards of £42,000 expended on British railways, and £12,000 on the railways of the United States. The lowest average cost has been incurred in Queensland, and the highest in Victoria and in India.

It was not always within the power of an engineer to determine the cost at which a railway should be made. If the alignment and gradients were easy, the number of bridges and viaducts few, and the cost of the land nominal or *nil*, the expenditure would necessarily be much less, even with the same gauge, than in cases where the opposite conditions prevailed. The cost of equipment, moreover, must be proportioned to the extent of the traffic. If the traffic was light so also should be the cost of the rolling stock. The rule generally adopted by railway engineers was that the cost of the rolling stock should represent the equivalent of a year's gross earnings. On this basis India should have fully twice the rolling stock for the same mileage as Canada, since the gross earnings of Indian railways were double those of Canada per mile open. The effect of completing railways that were too light for the character of the traffic would be to greatly increase the cost of working, or rather the expense of keeping up the lines; so that the possible economy in first cost would be neutralised by the increased cost of maintenance. It was difficult to lay down a hard-and-fast rule upon this matter, since the traffic of to-day may be doubled, trebled, or even quadrupled in a few years' time on the same lines; and hence the conditions to be met in the near future may be entirely different. Such had already been the experience of several countries, including the United States, where a much more substantial roadway had been entailed by the growth of traffic. And hence, in each separate case, the promoters of a new line should consider not only the traffic existing, but the traffic that was likely to be created; and this could only be measured by having regard to the resources and population of the district through which the railway was to be carried. In all cases the traffic would be likely to increase from year to year; but its development must take a much longer period in some cases than in others. It was inevitable that in a country like India, with a population of nearly 20,000 per mile of railway constructed, the traffic should grow more quickly than in a country like Canada, where there were only 470 to the mile.

The author calculated that a railway should open up the country through which it passes to the extent of about twenty miles on either side. Beyond that distance the cost of wagon transport became so high as to shut out agriculturists from competition with those who were within the twenty miles limit. If it were assumed, therefore, that the beneficial operation of railway facilities were not to be found beyond this area, it would appear that while the railways built in the United States were equal to the opening up of about 5½ millions of square miles, or nearly twice the whole area of the country, excluding Alaska, the railways hitherto built in Canada would only be equal to opening up about 400,000 square miles, or little more than one-ninth part of the whole area, while the railways already constructed in India only provided for the opening up of about half a million square miles, or rather more than one-third of the total area. With regard to our Australian colonies, the 7000 miles of railway constructed up to the present time were only calculated to provide facilities for 280,000 square miles, or one-eleventh of the whole area of the country. Reference was next made to the effect of railway facilities in increasing the value of the land. It was a well-known fact that in the United States, wherever railways had been built, the land had greatly increased in value. In many cases, where the land had only been worth from 1 dol. to 5 dols. per acre before the advent of railways, they rose to more than double that value when railways had been provided. If it were to be assumed that the effect of opening up the whole of our colonies in this way would be to add only 1s. per acre to the value of the land, the colonial landowners would be benefitted to the extent of £256,000,000. But these were necessarily speculative figures, and, as a matter of fact, in nearly every instance the actual increase of value had been much greater than that assumed.

The author, in conclusion, urged that it was the interest of a colony, both immediately and remotely, to make every possible effort to promote the extension of its railway facilities. For this purpose it might safely venture to incur a debt that would not be justified for any other purpose. Not only so, but that justification would extend to the payment, if needs were, of a higher than the normal rate of interest on loans borrowed exclusively for productive works. It did not seem to be quite beyond the bounds of possibility that our colonies would yet come up to the standard of the United States in having one mile of railway to twenty-five square miles of territory. If that standard should ultimately be attained, our colonial railway mileage would not be the paltry 30,000 miles at which it now stands, but 320,000 miles, or about eleven times as much. Population and capital appear to be the only desiderata necessary to this result, and these would be ultimately forthcoming. Meanwhile, the colony that succeeded, by taxing itself, by mortgaging the future, or by any other process, in constructing the greatest railway mileage relatively to its area and population, was likely to have the best start in the race that our colonies must hereafter engage in for supremacy at home and commercial intercourse abroad.

The Chairman, the Right Hon. A. J. Mundella, M.P., in opening the discussion, said that Mr. Jeans, in the concluding remarks of his very able and interesting paper, took a very heroic course in recommending the colonies to plunge as deeply into debt as possible for the extension of railways. He was not quite sure whether some of their colonies had not already as heavy a load of debt as they could conveniently bear; but he would say this in extenuation, that a debt incurred in the construction of reproductive works was altogether different from a debt incurred, as Mr. Jeans had remarked, for international or dynastic wars. We often heard of the heavy debt per head borne by the population of our different colonies, New Zealand, Victoria, and others, and the debt was compared with the mother country. Well, the mother country had not the advantage of possessing her own railways. If she had to become the owner of the railways, she would have to more than double her national debt. There was no doubt an immense advantage to a new country to have an abundant means of transport, because it not only assisted the settler in bringing his goods to market, but it opened up the country and developed and encouraged colonisation. Mr. Jeans said that New South Wales was borrowing at 3½ per cent., whereas her railways were earning from 4 to 4¼ per cent.; so that practically the Government of New South Wales was making a profit at the same time as it was developing its territorial resources. Whether we should arrive at the time when, instead of one mile of railway to 260 miles of territory, we should reach the United States of one in twenty-five, seemed doubtful. But this he quite believed, that there was a tendency in England to under-value the importance of colonial railways, and to over-estimate the danger of colonial debt. We lend money to every country in the world for all sorts of purposes—it might be for purposes of war or merely for paying debts. We knew European countries which only paid the interest on debt by borrowing from year to year, and their stocks stood at a very good price indeed in the market, whereas when our own colonies came into the market to borrow for laying out the money in reproductive works, people were inclined to shake their heads and say that these colonists were borrowing too much. He had had a good deal of experience of colonists. He had the greatest faith in Englishmen as colonists, and in the territories that they were assisting to develope, and he believed with moderate prudence the money lent to our colonies was safely lent, and was as a rule well laid out. There was only one danger that occurred to him, that whenever a Government made railways and undertook their management, there was always a danger of jobbery. There were such things known in the colonies as "political railways;" that was to say, railways that were hardly necessary, which were made to some particular district in order to satisfy the demand of some importunate legislators, and to secure their votes in the local Parliament. We all agreed that that was a very bad state of things. But taking it all in all, it was wonderful how well the colonies had managed their affairs, not only the construction of their railways, but also the executive department of them. They were fairly getting up the rates of interest now until the debt actually, as in the case of New Zealand, had reached a point where the interest covered the amount of the borrowed money. Mr. Jeans had told them that in our colonies the railways had cost £12,000 a mile. That was not an extravagant estimate. He believed in India they had cost £13,000 a mile. Well, in France—the next dearest country to our own—they had cost £28,000 per mile; in Russia, £15,000 a mile; in Germany, £21,000; and in the United States, somewhere about £13,000. Our colonies had, on the whole, constructed our railways at a lower average rate per mile than any other country in the world. No doubt our colonies had the advantage of cheap land, and very often they had a good piece given on either side of the railway in order to encourage it to be made. He believed it was very good policy to encourage the colonists to develope their territories, and the English people ought to give them every assistance in that development.

Mr. Price Williams said he had been particularly struck with the question put by Mr. Jeans, "How much longer shall we continue to withhold from our own colonies the 30 millions sterling we have annually paid for many years to the United States?" and Mr. Jeans answered, and he cordially agreed with him, "just so long and no longer than the railway communications of our colonies remained incomplete and inadequate." Having very recently visited one of our most neglected colonies, and having specially devoted a good deal of time and consideration to this question, he had been very much impressed by the views of the author of the paper. He could almost imagine that Mr. Jeans had shared his journey of about 700 miles of the bush—the magnificent territory of Western Australia—and had been struck with the great need of English capital. He found there one of the finest climates in the world, where the soil was such that they had nothing to do but scrape it to produce some of the finest crops, and in one particular place there were as many as forty different species of fruit and corn, and different things there, and all this was merely waiting for English capital and Englishmen. He considered the time had now come for our great colonies to view this really as an Imperial question. He thought instead of, as in several cases, dealing with it piecemeal, and going about London, and hawking it before syndicates, the time had come for our great colonies to confer with our capitalists and with our Government in England, and say whether it was not possible to attain that capital and to arrange for that transport of our population, which alone was wanted to make those colonies the granary of Europe, and to give us the trade which we were now transacting with the United States, which he would not say was hostile to us, but which taxed all our imports. He ventured to suggest that if some of our colonial authorities in London would take into their counsel, say, a Committee of the Institute of Civil Engineers, and some of our leading financial authorities, to consider some plan for supplying this necessary demand, we would find that the colonies—the colony of Western Australia particularly, which was most in need of it—would soon have the necessary railway accommodation. For many miles in the most fertile parts of Western Australia he found the crops ungathered simply because there were no hands to do it, and the corn was trodden under foot for want of hands to garner it. Mr. Jeans had spoken very truly of locomotives weighing 40 to 50 tons, whereas they used to weigh 7 to 10 tons. He held that whilst utilising more heavy—heavy in one sense, because they wanted the weight of those ponderous engines, which were necessary in those light railways—they need add nothing to their cost! It would be quite possible for the colonies to turn over a new leaf if the Colonial Governments would go to the fountain-head to get their capital at a cheap rate, such as 3 or 4 per cent., and then they would be able to make these cheap railways at a cost not exceeding from £4000 to £5000 per mile.

Mr. Larsen believed, from what he had seen of the Australian railways, that although they had only cost £12,000 a mile, they were as well managed as any in Europe. The stations, no doubt, were not so well constructed as the English stations, but then they were not required for the same sort of traffic.

Mr. Crampton said that, thirty-five or thirty-six years ago, he proved beyond a doubt that there was a loss of lifting power in the front of our railway engines of 25 tons, and that he could reduce it to 5 tons. No change, however, had been made, and at the present moment there was hardly an engine in this country that went at a high speed that did not lift four tons up and down at every stroke of the piston. That meant a greater wear and tear, and therefore a greater cost in the working. At this very moment, on all our big railways, the working action of the engines of from 16 to 18 tons gave three to four hundred strokes a minute, which was destroying both the engine and the road.

Mr. J. R. Moss said he had been constructing railways in the colonies for the last thirty years. Railways were made in different countries, of course, according to the peculiar wants of each country. In the sparsely settled parts of the United States the railways were made to develope the country, and were therefore made as cheaply as possible; but the costs of the railways in parts of the States at all similar to that of England was really equal to that of England. There were many items of expense in England which there were not in other countries—such as parliamentary expenses. He had just finished a railway in Ceylon which went up 5300ft., and they had to steer for that enormous summit for many miles with a gradient of 120ft. to the mile. They could not use any ordinary level country, because they had to steer for that enormous summit. The railways he had been engaged upon had been all Government railways. For the colonies that was by far the best system, because the Governments there worked the railways for the public benefit irrespective of remuneration. Of course they tried to make the railway fairly remunerative, but still the commercial element was not the chief point. The fares were put down as low as they could possibly be, and everything was worked for the development of the country. In Ceylon they had made 180 miles of railway, paying now from 4 to 5 per cent. in some parts to 10 and 12 per cent. in others. The Government of Ceylon owned some 140 miles of the railway, and did not now owe a penny for it. The whole capital of nearly two millions had been recouped, partly by an export duty on coffee, partly by dividends on the line, and partly by the surplus balances of revenue. As he had said, railways must be made to meet the particular wants of the localities. If they had a mountainous district they must have heavy works. The grip of the engine was not sufficient to go up steep inclines unless it was a heavy engine, and with a heavy engine they must have heavy works. In India the metre gauge was a failure in some cases. For instance, the Rajpootana Railway was so inadequate to the traffic that the Bombay Chamber of Commerce had petitioned not only to the governor but to the House of Commons in order to have it turned into the broad gauge. Every single line of railway must be made with a view to the traffic it would have to carry years hence, as well as with a view to the traffic of to-day, and there was no real economy in putting down a 3ft. gauge instead of a 5ft. gauge.

Mr. Berkeley thought Mr. Moss attributed an importance to gauge which did not belong to it. They could do an immense amount of work on a narrow gauge, as well as on a wide gauge. He had experience in the construction of both, and there was not that great difference in the capacity of the two that many assumed. Nor was there a large amount of difference in the cost, unless the narrow gauge was made light and comparatively inefficient. The difference which people spoke of as "narrow" and "wide" was really between "heavy" and "light." In a country which was very broken and difficult to engineer, they must have curves of short radius, and for such curves there was a considerable advantage in having a narrow gauge. Robert Stephenson—whose pupil and personal assistant he had been—always advocated the 4ft. 8½in. gauge. If that gauge had been adopted in India, it would have prevented the introduction of the diversity of gauge which had been so mischievous. He would impress upon those who were connected with the Colonial and Indian railways the great desirability of adopting duplicates wherever possible. When they were being supplied from this country, which was so many miles away, the advantage of adopting a system where almost everything was duplicated was immense.

Mr. Carbutt said that having been one of those who were suc-

cessful in obtaining the appointment of the Committee on Indian Railways which sat in 1884, he was very glad to find that the conclusion arrived at then was verified by Mr. Jeans. That conclusion was that the Indian Government should spend more money than it had hitherto done upon making railways in India. He believed that India was the only country which built a large proportion of its railways out of the revenue of the country, instead of adding to the debt of the country. They had utilised the Famine Insurance Fund. At the present time the Indian Government was spending between five and six millions to further increase their railways. He hoped that the time would come when the iron manufacturers of this country would reap the reward of Mr. Jeans' paper, because he might tell their colonial friends that they never could construct the railways cheaper than at the present time, when steel rails were being made at £3 12s. 6d. per ton. The colonists should take advantage of that, because that price would not be long continued.

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

*(From our own Correspondent.)*

THE improvement in trade which was looked for in some directions after the quarterly meetings, stocktaking, and election excitement were over, is slow in making its appearance. At present it is pretty much confined to the sheet branch. Inquiries in this department from galvanisers and from merchants are certainly more numerous, and the orders actually booked also show up better. Orders are arriving not only from galvanisers in this part of the kingdom, but likewise from firms in London and Liverpool, and the south-west of England. It is questionable whether merchants' inquiries represent in all cases genuine orders in hand, or whether they are not in much part put forward as feelers.

The sheet works generally are getting a little more active, and some few are very busy. Prices have a slight tendency towards more firmness, but no advance has yet been established. Doubles are still selling at £6, and lattens at £7, with singles in proportion.

Galvanised corrugated sheet makers express confidence that the improvement which is appearing in the condition of colonial and South American buyers will continue and steadily become more marked, and must before long result in a steadily increased demand for the iron of this district. It is gratifying that the advance in wool continues to progress, and in River Plate qualities the rise has been already as much as 25 per cent. It is not easy to secure the advance of 5s. per ton which has been declared on galvanised sheets, particularly in face of the severe competition from galvanisers whose works are located much nearer the ports. Still prices are decidedly firmer than before the quarterly meetings.

The marked bar firms have not much to do, their order books showing but a small influx of new business. Messrs. Noah Hingley and Sons and one or two other favoured firms, however, keep active. Prices are retained at £7, with the extra 12s. 6d. for Lord Dudley's make, and common unmarked bars are going off at about £4 15s. up to £5 10s., a few firms being still able to obtain £6 for good branded merchant qualities. Hoops and strips will find rather more work in the mills during the ensuing month at £5 5s. upwards for coopers' hoops, and £5 to £5 10s. for export hoops, tube strips being £4 15s. to £5.

The list of John Bagnall and Sons is:—Bars, 1in. to 6in., £7; 6½in. to 9in. flat bars, and 3½in. to 4in. round bars, £7 10s.; 4¼in. to 4½in., £8; 4⅝in. and 4¾in., £8 10s.; 4⅞in. to 4⅞in., £9; 4⅞in. and 5in., £9 10s. As to rounds only, the large sizes are:—5⅛in. and 5¼in., £10; 5⅜in. to 5½in., £10 10s.; 5⅝in. and 5⅞in., £11; 5⅞in. and 6in., £11 10s.; 6¼in. and 6½in., £12 10s. Hoops and angles are quoted £7 10s.; and rivet iron, £8 10s. to £9 10s., according to quality. Sheet quotations are: 20 g., £8 10s.; 24 g., £10; and 27 g., £11 10s.; but these quotations are hardly more than nominal. Boiler plates are £8 10s., £9 10s., £10 10s., and £11 10s., according to quality.

The Lilleshall Iron and Steel Company, Shropshire, is doing an enlarged business in special Bessemer basic steel, which is being rolled down in a manufactured form at the adjoining works of the Snedshill Iron Company. Blooms and billets of the general run of sizes the Lilleshall Company quotes at £4 10s., delivered to consumers in the Birmingham district, large sizes being somewhat less, and small sizes advancing in price according to gauge.

Best sheets and tin plates command favourable inquiry on export and home account, some manufacturers' books being fuller than for a month past. Deliveries have to be made without delay, and prices are maintained on a firm basis. In heavy plates there is but little doing. Tank sorts are abundant at £6 15s., and boiler sorts at well under £8 for ordinary qualities.

Sales of pig appear to have become more contracted. The tendency throughout the district is to diminish the make, and it is stated that selling prices in the face of the keen competition by outside makers barely cover cost of production. The best qualities are but little wanted, and most of the business doing is in part-mine and cinder iron, though that is not saying a good deal. All-mines are quiet at 50s. to 52s. 6d. for hot blast sorts. Part-mines are 35s. to 40s.; and common, 27s. 6d. to 32s. 6d.

Although the strike in the Shropshire iron trade is at an end, work has not been found for the whole of the men, two-thirds of them being yet idle. The terms which have ended the strife are understood to be that all the men in the mills and forges have been conceded the old terms with the exception of the shinglers, and the heaters and bundlers in the mills who have made a slight concession in their wages. As I indicated last week, the men would certainly seem therefore to have scored a point. The employers had attempted a large reduction.

Certain of the electric machinery engineers keep very well supplied with orders. This is the case, for example, with the Elwell-Parker Engineering Company, Wolverhampton, who have almost more work on hand than they can execute, some of it being of an important experimental description.

Some of the engineering firms in North Staffordshire are fairly employed. Messrs. Fred. Silvester and Co., Castle Hill Foundry, Newcastle-under-Lyne, are meeting with a steady call for winding engines, of which they make a specialité, and in which they claim to be able to compete successfully with any district. They have recently shipped to Brisbane a pair of high-class coupled horizontal high-pressure winding engines of 50-H.P. They were throughout of strong massive construction, and were built specially to order with link reversing motion and drum on first motion shaft. The engines were fitted up complete with winding indicator, steam and exhaust pipes, and starting valve. I may add that they were got up bright before being shipped, and presented a very serviceable and altogether attractive appearance.

Quietude continues in the wrought iron tube trade, and negotiations are still going forward relative to joint-stock enterprise in this industry at Wolverhampton. It is not understood that anything definite in the matter has yet been arrived at.

The chainmakers of Cradley have determined to take a decided course. Notices for an increase in wages have been served upon their employers, and if by the 7th of August their demands are ignored a general strike will be declared.

Attention is being this week drawn to the deplorable poverty which exists amongst the wrought nail makers in the Sedgley district. The absence of work has reduced them to such a condition that they are said to be "just left alive." Able-bodied workmen who in days of prosperity earned £2 a week, now earn on an average 5s. a week. This depression is said to be due chiefly to their industry having been superseded by mechanical processes, and to the destructive influence of the middleman.

The summer meeting of the Institution of Permanent Way Inspectors, held at Birmingham on Saturday, under the presidency of Mr. W. C. Keeling, C.E., developed some very interesting matter. The President, in his address, remarked that it would be very desirable when the institution had become formally established that it should be recognised by the Institute of Civil Engineers, and, if possible, attached to it in some way, which he thought might be a benefit to both institutions. A good test examination in practical knowledge for admission would identify a member as being eligible for any permanent-way post, and would promote self-improvement. After speaking of the forms of permanent way in existence in different parts of the country, he mentioned that the home railways were now nearly 19,000 miles in length. The rails, originally about 40 lb. per yard, were now nearly 90 lb. per yard, but the increase was due to the locomotive engines employed, which at first were very light, but now, with tenders, weighed 60 to 70 tons. The best kind of permanent way was that which, while being of sufficient strength, possessed the greatest degree of elasticity. He suggested that a special subject to which the members might address themselves with advantage was to ascertain the best manner of preventing the creeping of the rails on single lines, which was one of the greatest evils from which home railways had suffered since the introduction of steel rails of double head or bull head section.

In a paper read last week at the meeting of the Institution of Permanent Way Inspectors, "Upon the Wear of Wheels and Rails by the Action of Skidding Wheels," Mr. W. C. Meredith stated that the adoption of continuous brakes had already been found to have effected considerable economy in the wear of wheels and rails and other parts of the permanent way; and, he was inclined to think, a not inconsiderable economy in the wear of wheels and rolling stock generally.

A paper was read at the same meeting "On the Comparative Efficiency and Economy of Steel Fish Bolts, with Nut Locks and Nut Washers, and ordinary Steel or Iron Fish Bolts, with or without Spring Washers," by Mr. W. J. Meredith, who pointed out that the fish bolt, although one of the most simple articles of railway requirements, was yet one of the most important members of the numbers required in permanent-way construction, and particularly its subsequent maintenance. Within recent years, he continued, competition for the supply of railway material had been carried to such an extent that it seemed scarcely wise to entrust the manufacture of any important article to any but those having the highest reputation for their excellency of material and workmanship; and so keenly did competition press on those having the most perfect and powerful means of production, that with their high and undoubted reputation, the greatest responsibility was placed on railway engineers. Mr. Meredith concluded by a reference to the comparative merits of a few of the most modern and improved designs and systems of fish-bolts. Other papers followed.

The Birmingham Town Council on Tuesday accepted the designs of Messrs. Webb and Bell, of Queen Anne's-gate, Westminster, for the erection of the new Assize Courts, at a cost of £78,000. There were 126 competitors.

## NOTES FROM LANCASHIRE.

*(From our own Correspondent.)*

*Manchester.*—Reports as to the condition of the iron trade are still little more than a repetition of the discouraging outlook which I have for so long had to record in my "Notes" from this district. Continued absence of inquiry and miserably low prices is still on all sides the general complaint so far as the pig iron trade is concerned; in fact, the present position and prospects of trade are so unsatisfactory that the only alternative resource which makers have before them is apparently the gradual blowing out of their furnaces, and notwithstanding the already abnormally restricted output, negotiations are now in progress between some of the district makers for a still further restriction rather than go on making iron for which it is impossible to find a market even at prices which not only are unremunerative, but which do not cover the cost of actual production. In the finished iron trade manufacturers are seemingly also in quite as bad a position; from the representatives of the largest works in the district I gather the most gloomy accounts, although business certainly is being got which keeps some of the works fairly engaged, I am assured that at present prices makers are losing on every ton of iron they sell, and that they have no immediate prospect of improvement before them. It is of course difficult to see how such a state of things, if it truly represents the actual position into which producers and manufacturers of iron have been brought, can go on for any very lengthened period, and the matter of most surprise is that what would seem to be inevitable has been staved off so long.

At the Manchester iron market on Tuesday business was again as flat as it was possible to be. Actual sales were extremely small in weight, and these were only practicable at the lowest cut prices. Lancashire makers of pig iron still quote 37s. to 37s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester; these, however, are only nominal quotations, as there is practically nothing being done at them, and where buyers have actual orders to place local makers are open to entertain offers. In district brands the minimum prices in the market do not go below those I quoted last week, viz., 33s. 6d. for forge and 34s. 6d. for foundry, less 2½, delivered equal to Manchester, but the impossibility of getting very much above these figures, even for the best reported brands, is in some instances tending to break down the prices for which one or two of the makers have been holding out, and good foundry brands of Lincolnshire are being sold at 35s. 6d., less 2½, delivered here, which is quite 1s. per ton under what the makers have recently been asking. Notwithstanding the firm tone which has recently been reported in Glasgow warrants, outside brands, so far as makers' iron is concerned, show a tendency to weakness rather than firmness. Scotch makers' iron can be bought at quite as low prices as ever, and in Middlesbrough iron makers show a disposition to give way a little upon the full prices they have been asking of late where sales can be effected.

Hematites still meet with only a slow sale. In some quarters a slightly better tone is reported, but there are still sellers at very low prices, and good foundry qualities can be got at 50s. 6d. to 51s., less 2½, delivered here, with about 1s. per ton less taken for forge numbers.

In the manufactured iron trade there is a little more business stirring for shipment, chiefly in hoops and sheets; but home trade requirements show no appreciable increase, and no better prices are being got. In some instances, on the strength of increased shipping orders, attempts have been made to get slight advances, but these have failed, and for delivery into the Manchester district prices do not average more than £4 17s. 6d. per ton for bars, £5 7s. 6d. for hoops, and £6 10s. per ton for sheets.

There is no material change to notice in the condition of the engineering trades as compared with what I reported in my previous "Notes." Where there is any little improvement it is of no marked or definite character; and generally it may be said the prospects of trade are no better than they have been.

The sanguine anticipations of the promoters of the Manchester Ship Canal as to the assured success of the financial operation for raising the required capital for carrying out the scheme, to which I made reference in my last week's "Notes," unfortunately have not been realised, and the failure of the subscription put forward by the Messrs. Rothschild has been a great disappointment in this district. Last week I called attention to the surprise which was felt at the shortness of the period allowed for the share applications to be sent in, and this is now generally considered to have been a serious mistake, which will not be repeated when the raising of the capital is again placed upon the market. The promoters do not appear to be daunted by their unfortunate failure in the first instance of the financial portion of their scheme. On Tuesday a numerously attended meeting of the directors was held at the company's offices in Manchester, to take into consideration the further course of action to be adopted. In the unavoidable absence of Mr. Daniel Adamson, the chair was occupied by Mr. W. H. Houldsworth, M.P., and after the present situation had been fully discussed, it was decided to go on with the scheme, and board meetings of the directors are to be held daily to consider and decide upon the line of action to be adopted for the successful carrying out of the project.

I understand that Mr. Robert Austin, who for twenty-two years has occupied an official position in connection with the Manchester branch of the Amalgamated Society of Engineers, and has very ably and energetically discharged the duties of local resident secretary, is seeking appointment to the post of general secretary of the Society, which will be rendered vacant by Mr. John Burnett's acceptance of an official post under Government.

In the coal trade there is no material change to report. For all descriptions of round coal the demand continues extremely dull, and colliery proprietors have great difficulty in keeping their pits going more than half time without putting largely into stock, and engine classes of fuel move off very indifferently considering the limited production at this season of the year. Late rates still remain the basis of quotations, but although there is no actual reduction, the tendency of prices is in favour of buyers, and where anything like quantities can be moved promptly sellers are not very firm in adhering to their list rates. At the pit mouth best coal averages 8s. to 8s. 6d.; seconds, 6s. 6d. to 7s.; common coal, 4s. 9d. to 5s. 3d.; burgy, 4s. 3d. to 4s. 9d.; best slack, 3s. 9d. to 4s., with common sorts to be got at as low as 2s. 6d. per ton.

The shipping trade is only moderate, with prices very low, 6s. 6d. to 7s. per ton being still the average figures for steam coal delivered at the high-level, Liverpool, or at the Garston Docks.

*Barrow.*—There is a steady trade in hematite pig iron, and the demand from all sources is fairly maintained. This is more particularly the fact in regard to Bessemer qualities of pig iron, which are in full demand, for steel-making and general purposes. The output of the furnaces throughout the district is large considering the furnaces in blast, and deliveries of late have been bulky. The engagements for future deliveries are large, and it is reasonable to expect that the present production of the furnaces will have to be maintained during the remainder of the season, while the prospects for the winter are such as to give hope of a much better state of things than was experienced in the corresponding period of last year. The value of pig iron is steadily maintained, and 42s. per ton is still the value of mixed parcels of Bessemer iron net at makers' works. Nothing much is doing in other specimens of pig iron, as the uses to which forge and foundry iron are now applied precludes the chance of sale on large dimensions. The stocks of iron on hand, though large, have of late been comparatively well kept down. Steel makers are busy only on the heavy classes of steel. There is a good demand for rails at low prices, and orders are already well held for America and for home railway companies. There is not much trade doing except at the steel rail mills and at the tinplate mills; the only other department of the works at which any trade is doing is in fish-plates, which have to be produced incidental to the contracts for rails. The demand for steel wire is dull, and very little is doing in billets, forgings, or hoops. Boiler makers are exceptionally quiet, and in the minor trades generally the market is dull. Shipbuilders are very short of work, and not only is the number of hands employed limited, but short time is being worked. There is, however, some prospect of ships of good useful size being built for sale, in order to keep the men employed. Iron ore is exceedingly quiet, and prices are unchanged at from 8s. 6d. to 11s. per ton at makers' works. Coal and coke in steady though limited request. Shipping better employed.

## THE NORTH OF ENGLAND.

*(From our own Correspondent.)*

THE long-continued depression still prevails in the Cleveland pig iron trade. The market held at Middlesbrough on Tuesday last was well attended, but there were no signs of the long-talked-of revival. Buyers continue to purchase only small lots for immediate use; and consequently prices are still gradually falling. Merchants generally offer No. 3 g.m.b., for prompt delivery, at 29s. 1½d. per ton, and some of them do not refuse 29s. Most makers quote 29s. 6d. per ton for No. 3, and in two or three cases 29s. 3d. has been accepted for small quantities. Forge iron is not so scarce as it was, and can easily be obtained at 28s. per ton, or 3d. per ton less than was taken two or three weeks since.

Transactions in warrants are quite insignificant. The price nominally remains at 29s. 6d. per ton.

It is generally expected that there will be a considerable increase in stocks at the end of the month. Messrs. Connal and Co.'s Middlesbrough stock has grown during the past week to the extent of 3340 tons, the quantity held on Monday last being 268,673 tons.

The shipments of pig iron from the Tees have been worse this month than during any previous month since January. Up to Monday last, only 46,651 tons had left the port. In the corresponding portion of June, and also of July, 1885, the exports were over 55,000 tons.

The accountant to the Board of Arbitration for the North of England Manufactured Iron Trade has issued his report for the two months ending June 30th. It shows the average net selling price of iron rails, plates, bars, and angles, taken together, to have been £4 12s. 3d. per ton. The corresponding figures for the previous two months were £4 13s. 7d. per ton. The fall in the price of iron rails has been 2s. 8d. per ton, or 3 per cent. In plates it has been 1s. 5d. per ton, or 1½ per cent. In bars it has been 3s. per ton, or 3 per cent.; and in angles 9d. per ton, or 1 per cent. As regards volume, there has been a diminution in the total output of 1401 tons, or 3 per cent. The deliveries of plates have decreased 2749 tons, or 9 per cent. Of bars, they have increased 1367 tons, or 11 per cent.; and of angles, they have increased 32 tons, or about ½ per cent. The quantities of bars and angles which are required by the market appear to be rather on the increase; but this hopeful sign is far more than counterbalanced by the continued falling off in the quantity of iron plates which seem to be needed, notwithstanding the temptation of unprecedentedly low prices.

The directors of the Consett Iron Company will, at the general meeting of shareholders to be held on August 21st, advise the payment of a dividend of 10s. per share. A dividend of 4s. 6d. per share will be recommended in respect of the share capital of the Consett Spanish Ore Company.

The depression of trade still continues to operate in the way of forcing all who are responsible for the conduct of industrial enterprises—to use every legitimate means to get down cost of production. The coal trades of the North of England have just sent a deputation, consisting of some of the leading coalowners, to interview the directors of the North Eastern Railway Company, and induce them if possible to lower their charges for conveyance of coal. Mr. J. Dent Dent, chairman of the railway company, supported by several of his colleagues, received the deputation. The case for the coalowners was opened by Mr. L. Adamson, of Newcastle, who asked for a substantial reduction of dues. He pleaded that the coal trade has long been in a state of great depression, and urged that unless relief be given in the way demanded, several of the collieries now at work, and contributing largely to the railway company's revenue, would have to suspend operations. Mr. J. Thompson, of the firm of J. Joicey and Co., Mr. Straker, and Mr. Marley supported the application, drawing attention to the increase of competition both from foreigners and from the coalowners of other districts. The deputation received no definite reply, but Mr. Dent Dent, on behalf of the directors, said that the request which had been preferred would receive, as it deserved, their fullest and most attentive consideration.

Mr. Robert Wyllie, manager of the marine engine works of Messrs. T. Richardson and Sons, West Hartlepool, died on the 21st inst. It will be remembered that he met with an accident a short time since. A boiler, weighing about 50 tons, was being lifted

from a lighter on to the adjoining quay, when the shear legs used for the purpose suddenly broke down. A chain connecting them to certain rails close by tore up the latter. A foreman, named Leffrage, was killed on the spot, and Mr. Wyllie had his left thigh broken by the rails, or timber connected therewith. Mr. Wyllie's injuries were not at first considered serious, and recovery was confidently anticipated. It appears, however, that the heart was affected by the shock, and death by syncope suddenly took place. The deceased gentleman leaves a widow and four children. The burial has taken place at Ardrossan, on the west coast of Scotland, from whence he came to Hartlepool. Mr. Wyllie took a prominent part in the development of the triple-expansion marine engine; and a paper written by him on this subject is upon the programme prepared for the ensuing meeting of the Institution of Mechanical Engineers to be held in London next month. His predecessor, Mr. Charles Smith, was drowned while bathing in Lake Lucerne three or four years since.

## THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Steel gun casting at Woolwich is a subject which always excites interest at Sheffield. The Surveyor-General of Ordnance, Mr. Woodall, writing on the steel ingot accident at Woolwich to Mr. Charles Stuart Wortley, M.P., Hallam Division, states: "You may rest assured that nothing has been done in deviation from the understanding arrived at in 1884, or contrary to the explanations which have from time to time been given to yourself and Mr. Mundella on this subject." At the inquest on the man who was killed, the principal person concerned in the casting operation said the ingot was about 6ft. long and 34in. in diameter. The charge in the furnace was 10 tons, but he had made castings as heavy as 20 tons. The main point for Sheffield is that the Government authorities were not engaged in any large casting, though it is not quite satisfactory to local firms to know that the authorities keep experimenting in steel castings after the immense expenditure made here to supply everything the Government may need at present and at any future time.

A large party of "Colonials" visited the Spittlegate Ironworks, Grantham, on the 21st inst., and spent about two hours inspecting the premises and processes carried on by Messrs. R. Hornsby and Sons. During their progress through the works, which cover about 16 acres and employ 1400 hands, the visitors saw in operation the latest improvements in agricultural machinery particularly adapted for colonial use. Special interest was excited by the sheaf-binding harvester, to which was awarded the Royal Agricultural Society's first prize; and by a threshing machine fitted with patent straw trusser, tying the straw into bundles as it left the machine. Several of the "Colonials" took note of these contrivances, and spoke to me in warm terms of their adaptability for farming purposes. The visitors were entertained to luncheon at the Guild-hall, and afterwards on the invitation of the Duke of Rutland, proceeded to Belvoir Castle, where they spent a pleasant afternoon.

The check given to the Manchester Ship Canal by the temporary failure to find the eight millions required for its construction is not regarded as likely to stop the ultimate result. Orders placed here for tools and special machinery for the undertaking are being proceeded with all the same. Manchester has made her mind if she cannot get the sea to her she will go to the sea, and the battle has gone too far for the victors to be baulked on the point of reaping the reward of their labours. Sheffield has suffered seriously for the lack of water-way communication, and various schemes have been projected, but none have ever been vigorously tackled by Sheffield people, mainly because many of the leading capitalists are largely concerned in the railway companies that draw their revenues from the district.

It is stated that the "hitch" in regard to the adoption of a sliding scale for the regulation of miners' wages in Yorkshire is likely to be amicably arranged. The "hitch" was regarded as serious enough to imperil the success of the scheme, though the chairman of the Associated Coalowners expressed his belief that the negotiations had brought about such a friendly feeling that he did not think the relations of coalowners and colliers would again be imperilled by a strike or lock-out. At the same time he did not seem to have any great faith in the ultimate adoption of the scheme. Broadly stated, the proposals provided that a number of coalowners and their representatives, with an equal number of miners and their representatives should form a board to deal with all disputed questions affecting the wages of miners and other colliery workmen's remuneration. It further provided for a basis from which the wages should rise and fall according to the fluctuating value of coal, and determined how that basis should be ascertained, dealing also with the duties and powers of the board in relation to the disputed questions. A sliding scale which would really meet the relations of capital and labour, and continue a permanent institution, would be hailed by the most sensible of colliers and owners alike.

Meanwhile the colliery undertakings in this district continue in a very unsatisfactory state. The Rockley Colliery, Worsborough, near Barnsley, is announced as to be closed forthwith; but this is really more a matter of arrangement, under new ownership, than of positive depression. The colliery, which has been worked for some years past by Mr. T. A. Mann, has been acquired by the Strafford Main Colliery Company, whose workings have been extending in the direction of Rockley, and further ventilation has become necessary. When they acquired the Rockley pit, a pit-head notice was given to the men, stating that the "lamp money" —about 4d. per score—would be taken off their wages; and on their failing to start work at the reduction on Thursday morning, they were told the pit would be closed. It is understood that the Strafford Company will utilise the Rockley shaft in sinking a ventilating shaft to the Silkstone seam.

The ivory sales at Liverpool have resulted in a rise of £5 per cwt. on the sorts used in the Sheffield trades. This advance is not sufficient to justify the ivory cutlers in raising their prices, and ivory-handled cutlery, consequently, will remain according to previous lists.

## NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The iron market has been comparatively steady in the past week. There are several facts, such as the improved demand for hematite for abroad, and the larger shipments for the week, which have imparted a rather more cheerful aspect to business. The past week's shipments of Scotch pigs amounted to 11,120 tons, as compared with 6016 in the preceding week, and 9571 in the same week of 1885. Italy and the United States are at present our best customers. The stocks in Messrs. Connal and Co.'s Glasgow stores have increased by about 4000 tons in the course of the week. There are 85 furnaces in blast, as compared with 90 at this date last year.

Business was done in the warrant market on Friday at 39s. cash. On Monday and Tuesday the tone was firm, with business at 38s. 11½d. to 39s. 1½d. cash. Transactions occurred on Wednesday at 39s. 1½d. to 39s. 2d. cash. To-day—Thursday—the market was depressed, with quotations at 39s. 2d. to 39s. 0½d. cash.

The current values of makers' pigs are as follow:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s.; No. 3, 40s. 6d.; Coltness, 46s. 6d. and 43s.; Langloan, 43s. and 41s.; Summerlee, 45s. and 41s.; Calder, 45s. 6d. and 40s. 6d.; Carnbroe, 41s. and 39s.; Clyde, 42s. 6d. and 39s. 6d.; Monkland, 40s. and 36s. 3d.; Govan, at Broomielaw, 40s. and 36s. 3d.; Shotts, at Leith, 43s. 6d. and 43s.; Carron, at Grangemouth, 47s. 6d. and 44s. 6d.; Glengarnock, at Ardrossan, 41s. 6d. and 39s.; Eglinton, 39s. 6d. and 36s. 6d.; Dalmellington, 40s. and 37s. 6d.

In consequence of the stoppage of work for the holidays, comparatively little has been done in the past week in the export of iron and steel manufactured goods from the Clyde. The prospects at a number of the works are the reverse of encouraging, and unless fresh orders are soon available, there may possibly be some distress in the iron districts.

Coalmasters report that they have been obtaining firmer rates for coals within the past few days, but they attribute this not to any improvement in trade generally, but to a scarcity of coals at some of the pits for the moment, on account of the miners being absent on holiday. The quotations, although somewhat fuller in reality, are therefore left nominally without change. The shipments of the past week embraced at Glasgow, 24,002 tons; Greenock, 5237; Ayr, 9927; Irvine, 2571; Troon, 7668; Leith, 2553; Grangemouth, 14,001; and Bo'ness, 7162 tons.

A serious dispute has arisen between the managers and the colliers at the large pits of Messrs. William Dixon at High Blantyre. The miners, considering that certain of their number, who were dismissed, had been made victims of the agitation of the others against the reduced wages, left their work in a body two weeks ago. Messengers-at-arms served summonses for the ejectment of eleven leading miners from the company's dwellings at Stonefield. The men have been addressed on the subject by representatives of the Socialist Society, and they threaten to resist in a body the ejection of their fellows from their houses. The dispute has thus assumed a very bitter and threatening aspect.

In the Irvine district the miners have been served with notices that their wages will be reduced from 3s. to 2s. 6d. per day. The men allege that the present prices of coals to the consumers warrants an increase rather than a reduction of wages, but they consider resistance useless, as they have no combination to support them in opposing the decrease.

## WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

There is not much animation in the steel rail trade. Fortunately, Bombay, Canada, and New Orleans have put in a few orders, and one consignment of 2000 tons to the last-named place occurred on Saturday.

I am assured by railway authorities that rail prospects are not quite so bad as represented in some quarters, and extensive home renewals are certain. Steel sleepers will unquestionably give a stimulus. Toon, and another large works in the district, may shortly be expected to enter into competition.

New inventions suggest other new inventions. The steel sleeper has brought a steel chair to the front, by Mr. Thomas, C.E., "Brecon and Merthyr" Railway. Its merit is extreme simplicity. Railway men of eminence speak highly of it, and as steel sleepers are certain to become general, it comes to the front in the nick of time.

Coalowners are complaining that troubles are not coming singly. The impost on Welsh coal to Russia has already told, and is certain to tell still more seriously for a time. I am told that a large firm in Cardiff used to load twenty steamers a month for Russia, and now this has dwindled down to three per month. Cardiff coalowners have, however, the consolation of knowing that their coal is infinitely superior to the bulk of Russian coal, and the industries and authorities of that country are certain to get to loggerheads. Russia can no more do without our coal than she could without our men in her ironworks. Hughesoffski, in Southern Russia, is ruled by an old Cyfarthfa workman named Hughes, and he has fully a hundred Welsh workmen with him.

Russian tactics in taxing our coal were sought to be imitated by the Bristol Town Council last week. It appears that they proposed to tax all coal coming coastwise to Bristol from Newport, Cardiff, and Lydney 1d. per ton. Mr. Sibley presented, on the part of numerous traders in Newport and elsewhere, a strong protest against this; and, for the present, the Bristol Council have deferred the matter.

The coal export totals were low all round last week, and a good deal of uneasiness naturally prevails. The Rhondda coalowners appear to be suffering the most, and for No. 2 the demand is quite out of keeping with capacity of output. Prices are weak for house and steam coal, and prospects of lessened wages are getting certain. In this matter the Ocean sliding scale opened the ball this week, as the first of the scales that come into operation, by announcing a reduction of 6d. in the pound for the next three months. The others, Ferndale and Associated masters, will be certain to follow the same, and if the reduction in each does not exceed this, the men must be thankful.

Other industries are suffering in consequence of the general depression. The sale of coke may be instanced as conspicuous in this list, and railway returns show a great falling off in coke transit to Midlands and elsewhere. A local contemporary states that a Staffordshire ironmaster has lessened his supply of Welsh coke by one-third, having to blow out several of his furnaces.

Tin-plate continues alone the only industry with any vitality about it, and thanks to the steadiness of business, a large make comparatively of steel bars is going on at several of the steel works, Swansea alone received over 3000 tons of steel bars and pig iron last week. Middlesbrough pig holds its own in the estimation of some tin-plate workers.

Close upon 60,000 boxes of tin-plates were shipped from Swansea last week. The decrease in stock in the week alone amounts to 12,000 boxes, a good augury; and it is wanted, as prices are still too low considering the excellence of the quality turned out.

The question is under consideration again of trying to improve prices by restricting make, but as stocks are falling, makers can afford to wait a little.

Bessemer and Seimen's plates are in request. Three thousand tons were shipped last week to America alone.

In Monmouthshire a fair trade is being done, and quotations are firm.

Several fatal colliery accidents occurred last week. There is an impression abroad that coal pits abound with unskilled labour, and this may account for some of them. In former days the collier was a distinct being, so to state, who had graduated from a door-boy and become a veteran, singed by explosions and asthmatic by draughts and puddles. Now it is nothing unusual to find a man labouring in a pit who a short time ago was in the full glare of the steel works.

A colliery manager calls my attention to the constant increase of candidates for vacancies as colliery managers. Last week at the South-Western Mining Board seven passed, and the greatest number of marks was gained by Mr. C. J. N. Gray, Mountain Ash. In the present state of the coal trade, when several large collieries are to be closed, and the export has fallen off 50,000 to 70,000 tons a week from Wales alone, prospects for young colliery managers are bad. I am glad, however, to find that Cyfarthfa collieries, which have had a long period of stagnation, worked all last week. The colliers were quite jubilant at having a full week, and especially when they found that they could begin again on Monday.

A new foundry has been opened at Garth Anchor Works. Taff Vale stock is down to 216.

Newport, Mon., has been rather busy with Bilbao ore, and Ebbw Vale and Tredegar companies are getting in consignments. Some good coal shipments, too, took place at Newport last week.

Welsh colliers in the Brymbo district, North Wales, have accepted a reduction of 5 per cent.

## NOTES FROM GERMANY.

(*From our own Correspondent.*)

From the Silesian district the news is somewhat more encouraging. For the moment it is not intended to blow out more furnaces, but to endeavour by economical working, and making arrangements to utilise the bye-products, to keep them in blast for a few months longer. There are still large stocks of forge pig on hand, and the price is M. 41 to 42 p.m.t.; and the best sorts rise to M. 50, and even M. 52. Foundry pig remains at its low level, although the pipe and other foundries cannot complain of want of work. Also there are considerable orders on hand for rails, fish-plates, and the like smaller railway requirements. In bars the trade is still very dull, but plates and sheets are in request at M. 135 to 140, and even 145; whilst the best qualities fetch M. 150 to 155 p.m.t. Bars are M. 95 to 97·50 p.t.

The Rhenish-Westphalian iron and coal market is still in an unsatisfactory condition. The demand is limited, and only the best situated works can look the future in the face. The restriction of output is not yet in proportion to the small demand, and therefore there is no hope of better prices for the present. The news from France and Belgium, on the other hand, is quite favourable, and there are few complaints. To return to the Rhenish-Westphalia district, ores, in consequence of the diminished demand caused by restricted output of pig iron, have receded somewhat, and steelstone is now M. 7·50 to 7·90—last quotation, M. 7·50 to 8·00; roasted M. 9·80 to 10·30—9·90 to 10·40; iron glance, M. 8·90 to 9·10 (M. 8·9 to 9·20) p.t. at mine station. Pig iron cannot maintain its quoted price on account of the small demand. Spiegeleisen, thanks to the convention, keeps up its price best, and for 10 to 12 per cent. Mn. quality the average price is M. 46 to 47; better qualities, half to two marks higher. Forge pig has more to contend with and is difficult of sale. Siegen, best quality, M. 39 to 40; inferior quality, M. 37 to 38; Westphalia, M. 41 to 42; inferior quality, M. 39; foundry pig, No. 1, 52 to 53; No. 2, 50 to 51; No. 3, M. 45 to 48, on which concessions would be made. Siegen Bessemer pig, M. 43 to 44; Westphalia, M. 42 to 43 p.t. at works; basic pig, M. 38; Luxemburg forge pig, M. 29·60 to 30·40 p.t. at works, and has occasionally been sold cheaper. Bar iron has not gone back in price, but it is difficult to dispose of; good common range, M. 93 to 98; and for large lots M. 1 to 2 abate would be given. Angle iron, M. 100 to 105; girders, M. 94 to 98. hoop iron, M. 102 to 105; Bessemer bars, M. 105 to 115, according to the brand; steel rails, M. 121 to 130; transverse and longitudinal steel sleepers, M. 122 to 135. The fear expressed by makers here, and mentioned in a former letter, of the English competition, has speedily been realised at Altona on the 12th inst., when an English firm carried off the order for rails at M. 124 p.t., inclusive of freight and duty, against the German firm—Krupp—who tendered at M. 121 at works. But to the latter price M. 6 to 7 had to be added for freight; so in future any German firm will have to come down in price by just this amount in order to compete in those regions. Boiler plates I. quality, M. 139 to 143; and in special cases M. 145; inferior sorts, M. 130 to 133 p.t.; steel plates, M. 145; iron sheets, M. 142 to 145; steel sheets considerably higher. In wire rods the export is almost nil, and the sale all round dull. In iron, M. 102 to 106; in steel, M. 105 to 110; rivet iron, M. 115 to 130; wire nails, M. 130 to 140; rivets, M. 155 to 162; drawn iron and steel wire about M. 115, and higher; complete wheels and axles, M. 315 to 320; steel tires, M. 220 to 235; steel mine rails, M. 90 to 95, all p.m.t. The railway wagon building works are badly off, as no new orders are coming in as old ones are worked off, and the position of the machine factories is precisely similar, with the exception of a few special cases, where demand and sales are satisfactory. By working short time the orders still keep them going, but at the poorest prices. It is reported here that through the intercession of Prince Bismarck the Japanese Government has been induced to give to a German firm the manufacture of the whole of the rails which it will require for the next eight years! If this statement prove true, the question may be reasonably asked, what our railmakers and our diplomacy have been about all the time this has been taking place? The profit to be derived from the transaction is estimated at £200,000.

The present price of coal is, for gas, M. 6·60 to 7·80; long-flame coal, M. 5·60 to 6·20; lumps, M. 7·60 to 8·40; slack, M. 3·50 to 4; washed for coking, M. 4 to 4·50; anthracite slack, M. 4·50 to 5·40; lumps, M. 8 to 10·50; cokes, patent, M. 8·50 to 9·50; other sorts, M. 7; smalls, M. 6·80 to 7·50, all p.m.t. at mines.

The Pommerische Maschinenbau Gesellschaft, in Stralsund—Pomerania—has acquired a patent for a manure distributing machine, and in consequence of the great demand for their machines, is about to raise its capital from M. 450,000 to M. 900,000, in order to enlarge its works and increase its output.

A probably unique but melancholy incident occurred in connection with the terrible smash which recently took place near Würtzburg on the Bavarian Railway, when two express trains ran full tilt into one another, namely: a guard, who had been on the line twenty-two years, on passing over it the following day, was so affected at the sight of the immense heap of wreckage, that on arriving two hours later at his destination he was seized with a stroke, which necessitated his conveyance to the hospital, where he now lies in a precarious state, and will very likely not recover.

The dividends which will be paid this year and those paid in the last by the works, companies, and firms, some of which are the wealthiest, oldest, best known and most celebrated concerns in the country—given below—will enable your readers to form a judgment from an economic point of view concerning the present situation of industrial undertakings in Germany. Annen Steel Works pay this year 0, paid last year 0; Bismarck Iron Rolling Mills, 6 p.c.—8 p.c.; Bochum Steel Works, 7 p.c.—10 p.c.; Dortmund Mining Company, A shares, 0 p.c.—0 p.c.; Dortmund Mines Steel and Ironworks, priority shares, 0 p.c.—0 p.c.; Eschweiler Coal Mines, in Aix-la-Chapelle, 1 p.c.—1 p.c.; George Marian Company Iron and Steel Works and Mines, 1·2 p.c.—2 p.c.; Haginer Steel Works, 2 to 3 p.c.—3 p.c.; Harcourt Mining Company, 0 p.c.—0 p.c.; Harpener Mining Company, 0 p.c.—0 p.c.; Harzer Ironworks, 0 p.c.—0 p.c.; Hoerder Union Mines Iron and Steel Works, 0 p.c.—0 p.c.; Hochdahl Blast Furnaces, 0 p.c.—0 p.c.; Cologne-Musen Company Steelstone Mines and Spiegeleisen Furnaces 0 p.c. — 0 p.c., Koenigs and Laure-Hutte, Silesia, 0 to 1 p.c.—4 p.c.; Lauchhammer Company, Saxony, 2 to 4 p.c.—4 p.c; Lothringer Ironworks, 0 p.c.—0 p.c.; Louisa Coal Mines, Westphalia, 0 p.c.—0 p.c.; Markisch-Westphalian Coal Mines, 4 p.c.—0 p.c.; Menden and Schwerte Wine Mills, 0 p.c.—0 p.c.; Phœnix Iron and Steel Works and Mines, A shares 2 p.c.—2½ p.c., B shares 0 p.c.—0p.c.; Rhenish Steel Works, 15 to 16 p.c.—20 p.c.; Sachsische Steel Works, 7 p.c.—7 p.c.; Silesian Coal Mines Company, 0 p.c—0 p.c.; Stadtberger Zinc Works, 2 p.c.—2¾ p.c.; Vulcan Company, 0 p.c—0 p.c.; Wesphalian Union, original shares 8 p.c.—8 p.c.; Wissen Ironworks and Mines, 0 p.c.—0 p.c.; Wurm Revier, Aix-la-Chapelle, House Coal, 4 p.c.—4 p.c.; Berlin-Anhalt Maschine Factory, 7 p.c—7½ p.c.; Berlin Maschine Works, Schwartzkoff, 33 p.c.—27 p.c.; Berlin Maschine Factory, Freund, 5 to 6 p.c.—8½ p.c.; Brunswick Jute Factory, 7 p.c.—11 p.c.; Bradower Sugar Factory, 1 to 2 p.c.—1½ p.c.; Central Bazar Transport Company, 2½ p.c.—2¾ p.c.; Chemnitz Workshop Tool Factory, 1½ to 2 p.c.—3 p.c.; Grollwitz Paper Mills, 15 p.c.—15 p.c.; Gorlitz Fabrik for Railway materials, 5 p.c.—8 p.c.; Gorlitz Maschine Fabrik, 0 p.c—0 p.c.; Hamburgh Dynamite Factory, 12 to 13 p.c.—6½ p.c.; Hannover Maschinen Fabrik, Orig. Priority Shares, 2 p.c.—2 p.c.; Harburg-Vienna India-Rubber Factory, 15 to 18 p.c.—20 p.c.; Leopoldshall Chemical Works, 5 to 6 p.c.—5 p.c.; Menberger Iron Foundry, 2½ to 3 p.c.—0; Rostock Shipbuilding Company, 0 p.c.—0 p.c.; Westphalian Wire Rolling and Drawing Mills, 2 to 3 p.c.—4 p.c. The dividend for this year—always the first figure—is not to be taken in every case as absolute, because some firms are chary of giving the exact figures prematurely; but they may all be taken as within the slightest shade of being the amounts which will be paid—*i.e.* where any at all is paid—and then it frequently comes out of reserve funds.

The firm of Wilhelm Hartmann and Co., Fulda, Hessia, has introduced a new steel saw for cutting metals, the teeth of which are as hard as diamond, whilst the blade remains as flexible as if of unhardened steel. It is reported favourably upon by the metal workers of Remscheid—the Birmingham of Germany. It not only cuts cast and wrought iron and steel, but glass, and, as is claimed for it, keeps its edge infinitely longer than the very best saws ever yet produced. The firm is now turning its attention to making band saws for cutting out articles in iron, steel, &c.

## AMERICAN NOTES.

*(From our own Correspondent.)*

NEW YORK, July 17th.

THIS week's trade and commercial returns up to last night show a 12 per cent. increase over the report of the same week last year. Jobbers are full of confidence. Textile manufacturers are better pleased with the autumn outlook than they have been for some time. Orders for new machinery show it. One Connecticut concern carried off orders through city agencies for 40,000 dols. worth of machinery, and a Philadelphia agent has just closed a contract for 50,000 dols. worth. Prices are surprisingly firm in all channels. Mills and factories are resuming after a week or two's suspension. Orders are arriving early. In the heavier branches of trade and industry, such as iron and steel, coal and lumber, there is a slight apathy, not due, however, to any curtailment of demand, but to a conservative policy pursued by large buyers, who have on more than one occasion recently pushed prices up on themselves. The feeling here is that we are on the eve of an active building and manufacturing season. The best posted architects and builders are all of one opinion in reference to building enterprises, and estimate that our average weekly investments will be for the year 1,500,000 dols. One great drawback is the enormous taxation and high assessments. The manufacturing interests complain a good deal, and more are preparing to follow the example of the electrician, Edison, who removed eighty miles from the city to avoid annoyances of one sort or another. The month of July is usually a dull one in the metropolis, and this month is no exception. The habit of spending the summer months in summer resorts leaves the city comparatively bare, but an enormous business will be done nevertheless. The crop reports are favourable. Commercial reports are satisfactory. Advices from Pennsylvania and from the Western iron centres are bright. The heavy railroad building going on in so many States is helping the smaller industries. The ironstone pool has just been reorganised at Pittsburgh for the purpose of strengthening railroad rates on ores from the West. The wrought iron pipe makers have more orders offered for the next ninety days than they can execute, and cast pipe contracts are also driving the mills. Nails have advanced 10c. per keg. Old rails are in liberal supply, both home and foreign. Up to date receipts this year from abroad have been 16,000 tons. Total receipts of tin-plates at all points, 2,200,000 boxes. The syndicate seeking higher tin-plate tariff duties will make their best effort next winter. The tin-plate interests here will meet their opponents with vigour. The tin developments in Dakota are marvellous, and encouraging additional expenditures. Copper production is restricted. Exports since January 1st, 8,340,000 lb., against 19,000,000 lb. at the same time last year. Pig iron is 17 dols. 75c. for Eglinton, 18 dols. 50c. for Dalmellington, 19 dols. 75c. for Coltness, and 18 dols. 75c. for Glengarnock. American forge is 16 dols.; No. 2 foundry, 17 dols.; No. 1, 18 dols. to 19 dols.; nails, 1 dol. 90c. to 2 dols.; spiegel, 25 dols.; English Bessemer, 18 dols. 50c. to 19 dols.; steel rails at mill, 34 dols. to 36 dols.; T rails, old, 19 dols. 50c.

## NEW COMPANIES.

THE following companies have just been registered:—

*Sherman Iron and Steel Trading Company (Foreign Patents) Limited.*

Upon terms of an agreement of the 10th ult. this company proposes to purchase from John Edwin Sherman, of New York, at present residing at the First Avenue Hotel, Holborn, the patent rights for the whole world (except the United Kingdom) granted for certain improvements in the manufacture of iron and steel. It was registered on the 16th inst. with a capital of £100,000, in £1 shares. The purchase consideration is £95,000 in fully-paid shares; 50,000 of these shares are to be allotted to Mr. John Trehane, of 28 and 29, St. Swithin's-lane, in consideration of advances made and services rendered. The subscribers are:—

| | Shares. |
|---|---|
| J. M. Alprovidge, 72, Lenthall-road, Dalston | 1 |
| W. Powter, 21, Gotha-street, South Hackney, clerk | 1 |
| G. H. Newman, 47, Walterton-road, Westbourne Park | 1 |
| Arthur Cohen, 49, Buckingham-place, Brighton | 1 |
| A. Martin, 28, Bellefield-road, Brixton, clerk | 1 |
| J. L. Cooper, 144, St. Paul's-road, Camden-square, accountant | 1 |
| J. H. M Freshwater, 37, Marsden-road, West Dulwich, clerk | 1 |

The number of directors is not to be less than three nor more than nine; the subscribers are empowered to appoint the first directors and to fix their qualification, to determine the remuneration of the board, and are to act as directors *ad interim*; these gentlemen may also appoint a managing director, solicitor, secretary, and auditors.

*Simond's Steel and Iron Forging Company, Limited.*

This company was registered on the 20th inst. with a capital of £150,000, in £5 shares, to purchase the patent rights, undertaking, and business of the Simond's Round Forging Company, Limited. The subscribers are:—

| | Shares. |
|---|---|
| *W. R. Lake, 45, Southampton-buildings, consulting engineer | 1 |
| C. F. Gardner, 1, Worship-street, managing director of the English and American Machinery Company, Limited | 1 |
| *C. T. Cayley, Brackley-street, Golden-lane, mechanical engineer | 1 |
| J. W. Burton, 13, Sherborne-lane, timber merchant | 1 |
| J. Tolley, 66, Cannon-street, architect | 1 |
| G. W. Shinn, 12, Brockfield-road, South Hackney | 1 |
| J. Hansford, 18, Angel-road, Hammersmith | 1 |

The number of directors is not to be less than three nor more than nine; qualification, 100 shares; the first are Lord Thurlow (chairman), Admiral Sir Astley Cooper Key, G.C.B. (vice-chairman), R. Copley Christie, C. H. Firth, W. R. Lake, and C. T. Cayley. Mr. W. R. Lake will not be removable except by a requisition in writing of four-fifths of the members of the company. The chairman will be entitled to a remuneration of £500 per annum, the vice-chairman to £400 per annum, and each other director (except Mr. Cayley) to £300 per annum; the board will be further entitled to 10 per cent. of the net profits in excess of 10 per cent. per annum. Mr. Claude Thornton Cayley is appointed managing director for seven years at a salary of £1000 per annum unless the same be increased by the board; he will also be paid reasonable travelling expenses.

*General Construction Company, Limited.*

This company was registered on the 16th inst. with a capital of £50,000, in £10 shares, to act as contractors for the construction, equipment, and maintenance of railways, canals, tramways, or other kindred works in Great Britain or elsewhere. The subscribers are:—

| | Shares. |
|---|---|
| R. W. Welford, 78, Queen's-road, Bayswater, dairy farmer | 2 |
| W. Jallings, 68, Queen's-road, Bayswater, grocer | 1 |
| W. Schofield, 20, Bucklersbury, builder | 1 |
| G. R. Sampson, 80, Lombard-street, merchant | 1 |
| H. H. Knight, Strood, Kent, clerk | 1 |
| J. Smith, 1, Cornwall-road, Bayswater, grocer | 1 |
| Henry Jackson, 14, Clyston-street, Wandsworth, builder | 1 |

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first and act *ad interim*; the company in general meeting will determine remuneration.

*John Bowes and Partners, Limited.*

This company proposes to acquire and work the collieries and property belonging to the firm lately carried on by John Bowes (deceased) and Charles Mark Palmer, under the style of John Bowes and Partners. It was registered on the 21st inst. with a capital of £600,000, in £10 shares. The subscribers are:—

| | Shares. |
|---|---|
| *C. M. Palmer, Newcastle-on-Tyne, coalowner | 1 |
| *E. Y. Western, 35, Essex-street, Strand, solicitor | 1 |
| *G. A. Jamieson, 24, St. Andrew-square, Edinburgh, accountant | 1 |
| *A. M. Palmer, Newcastle, glass manufacturer | 1 |
| *G. A. Western, 35, Essex-street, Strand, solicitor | 1 |
| R. W. Cooper, Newcastle, solicitor | 1 |
| J. V. Gregory, Newcastle, coal fitter | 1 |

The number of directors is not to be less than three nor more than five; the first are the subscribers denoted by an asterisk. Mr. C. M. Palmer is appointed chairman and managing director for life at a salary of £3000 per annum, and will also be entitled to a commission of one-fourth of the net profits after payment of debenture interest, such commission to cease on the 1st July, 1896, or when the aggregate of the same shall amount to £100,000.

*Leeds and North of England Boiler and Accident Insurance Company, Limited.*

This company was registered on the 21st inst. with a capital of £50,000, in £5 shares, to insure steam boilers against injury, damage, or loss by explosion, and to insure other property against boiler explosions or collapse of flues; also to effect insurances under the Employers' Liability Act, 1880. The subscribers are:—

| | Shares. |
|---|---|
| Robert Addyman, Leeds, merchant | 50 |
| W. Holton, Morley, York, woollen manufacturer | 50 |
| A. Law, Cleckheaton, card manufacturer | 50 |
| T. Addyman, Levenshulme, engineer | 50 |
| W. Brown, Bramley, Leeds, tanner | 50 |
| J. T. Horsfall, Morley, woollen manufacturer | 50 |
| J. W. Addyman, 15, East-parade, Leeds, solicitor | 50 |

The number of directors is not to be less than three nor more than twenty-three; qualification, £250 in shares or stock; the subscribers are to appoint the first; the company in general meeting will determine remuneration. The managing director will be required to hold £50 in shares or stock.

*Power Pulley Company, Limited.*

This company proposes to purchase the patent rights of James Shepherd and Peter Goodwin, together with the business carried on by them at Manchester under the style of the Patent Power Pulley Company, Limited. It was registered on the 20th inst. with a capital of £20,000, in £10 shares, with the following as first subscribers:—

| | Shares. |
|---|---|
| *James Shepherd, 18 and 19, Arcade, St. Mary's-gate, Manchester, engineer and pulley manufacturer | 1 |
| *Peter Goodwin, 18 and 19, Arcade, St. Mary's-gate, Manchester, engineer and pulley manufacturer | 1 |
| *J. Walthew, Reddish, Stockport, cotton spinner | 1 |
| *G. Walthew, Heaton Norris, Stockport, cotton spinner | 1 |
| W. R. Lawrence, Cheadle, Cheshire, lathe merchant | 1 |
| G. W. Goodwin, Old Trafford, Manchester, soap manufacturer | 1 |
| J. McQueen, Ardwick, Manchester, engineer | 1 |

The number of directors is not to be less than four nor more than seven; the first are the subscribers denoted by an asterisk.

*Smoke Consuming and Fuel Saving Appliances Company, Limited.*

This company was registered on the 21st inst. with a capital of £5000, in £1 shares, to acquire and work patents relating to smoke consuming and fuel saving appliances. The subscribers are:—

| | Shares. |
|---|---|
| Colonel H. C. Glass, Bentley Lodge, Upper Norwood | 1 |
| W. Strapp, Redhill, Surrey | 1 |
| A. B. Wall, Junior Army and Navy Club | 1 |
| J. E Mortimer, 160, Kensington Park-road, merchant | 1 |
| H. C. Paterson, 5, Camden-gardens, Uxbridge-road, engineer | 1 |
| W. Dunn, B.A., Woodlands, Upper Norwood | 1 |
| A. Marsden, 20, Bucklersbury, secretary to a company | 1 |

Registered without special articles.

*Thomas Carr and Son, Limited.*

This is a reconstruction of a company registered on the 8th of April, for the purpose of complying with the requirements of the Stock Exchange. It proposes to take over and carry on the business of T. Carr and Son, of Scotswood-on-Tyne, brick and tile manufacturers, &c. It was registered on the 21st inst. with a capital of £100,000, in £5 shares. The subscribers are:—

| | Shares. |
|---|---|
| J. D. Hill, Osbaldiston-road, Clapton | 20 |
| G. H. Furmedge, 10, New Broad-street, engineer | 20 |
| H. Copeland, 10, New Broad-street, contractor | 20 |
| H. W. Adams, 10, New Broad-street, secretary | 5 |
| W. Coogan, 44, Manaton-road, Peckham | 5 |
| J. A. Jarrett, 141, Ramsden-road, Balham | 5 |
| W. R. Carrff, Scotswood-on-Tyne, manufacturer | 600 |

The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first and are to determine remuneration; qualification for subsequent directors, 200 shares. The subscribers are empowered to appoint the first managing director and secretary, and to determine their remuneration.

*Tyne Plate Glass Company, Limited.*

This company was registered on the 16th inst. with a capital of £150,000, in £100 shares, to take over the Tyne Plate Glass Works at South Shields, belonging to Charles Mark Palmer, trading as the Tyne Plate Glass Company. The subscribers are:—

| | Shares. |
|---|---|
| C. M. Palmer, Newcastle, coalowner | 1 |
| A. M. Palmer, Newcastle, glass manufacturer | 1 |
| J. Gregory, Newcastle, coal fitter | 1 |
| R. Watson Cape, Newcastle, solicitor | 1 |
| Edmund Brown, South Shields, glass manufacturer | 1 |
| J. Price, Newcastle, engineer | 1 |
| J. Hall, Newcastle, merchant | 1 |

The subscribers are to nominate the first directors; qualification, 20 shares; the company in general meeting will determine remuneration.

## MECHANICAL HAULAGE AT THE BILBAO IRONSTONE MINES.[1]

THE following is from a paper by Mallizard-Taza in the *Bulletin de la Société de l'Industrie Minérale.*

The ironstone beds of Somorrostro are situated on the summits of a steep chain of hills, some 650ft. to 1000ft. high, situated between Bilbao and the sea. At their foot runs the river Nervion, navigable for vessels of considerable tonnage, and flowing into the sea at Portugalete, a few miles away. From the foot of the hills to the loading jetties transport is effected by railways, usually straight, and with no serious gradients. For the descent of the hill-side wire ropeways, either on the Bleichert system with two ropes, one for carrying, the other for traction, or on the Hodgson system, with a single rope travelling with the tubs, are in some cases used, but these are only capable of dealing with comparatively small quantities of material. The—Lancashire—"endless chain" system is not suitable, as the gradients are almost always in the same direction and not undulating.

For the transport of larger quantities, self-acting jibs or inclines are used, of which the following may be taken as typical examples:—The MacLean inclined plane is about 330 yards long, with a gradient of 1 in 2. The full and empty wagons are attached to either end of a single rope passing round two horizontal pulleys at the head of the incline, and controlled by a brake. The useful load for each trip is about six tons, contained in two wagons.

The Orconera plane is about 1300 yards long, with an average gradient of 1 in 7. It has two parallel lines of rail, and about one-half the length is on a curve, necessitating inclined guide-sheaves for the ropes, which are coiled in reverse directions on two drums, about 16ft. 6in. diameter, keyed on the same axle. Each drum is furnished with two brake sheaves, the whole controlled by four strap brakes shod with cast iron brake blocks, and operated simultaneously by the brakesman. A train consists of seven or eight 4-ton wagons, or a net load of from 30 to 32 tons, and about 2000 tons of ore per day can be dealt with.

The Cadegal plane is about 660 yards long, with a total fall of about 175 yards, the gradients varying from 1 in 2 9, 1 in 3 3, and 1 in 4, on the upper, middle, and lower sections respectively. It is laid with a double track of 3ft. 3⅜in. gauge. The drums, about 16ft. 6in. diameter, are of slightly conical outline, and are formed of wrought iron plates ⅜in. thick, carried on three cast iron frames, the two outer ones being formed to receive brake straps, while the centre one is cogged, and gears into a pinion in the ratio of 8 to 1. The shaft of this pinion carries a large "fly," with four straight wings, about 6ft. 6in. wide, and 16ft. 6in. outside diameter, formed of wood planks on iron frames. By adding or removing one or more planks the speed can be regulated to a nicety, and with 90 revolutions per minute of the fly a train speed of 200 yards per minute is permitted and never exceeded. The run of 660 yards takes about three and a-half minutes, and as six or seven minutes are occupied in making up the trains at each end, they can be despatched at intervals of ten minutes. A train consists of eight 2-ton wagons, so that about 1000 tons can be dealt with in a day of ten hours, and by increasing the number of wagons in each train this might easily be brought up to 1500 tons. The ropes are of steel, 1½in. diameter. The drums are mounted at a sufficient height above the rails to allow the wagons to pass beneath them, and by means of two short inclines in opposite directions between the drums and the head of the plane the trains are made up with a minimum of labour.

The paper is illustrated with drawings and sections of the Cadegal incline and machinery.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending July 24th, 1886:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p m., Museum, 8355; mercantile marine, Indian section, and other collections, 3545. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m., Museum, 1717; mercantile marine, Indian section, and other collections, 292. Total, 13,909. Average of corresponding week in former years, 17.499. Total from the opening of the Museum, 24,983,764.

[1] "Proceedings," Institution Civil Engineers.

## THE PATENT JOURNAL.

*Condensed from the Journal of the Commissioners of Patents.*

### Applications for Letters Patent.

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

*20th July*, 1886.

9374. RESEATING and REFRONTING TROUSERS, &c., S. Barnes, Matlock Bath
9375. FIRE-ESCAPES, E. T. Ward, Newmarket.
9376. TOYS for PROJECTING EXPLOSIVE MISSILES resembling TORPEDOES, F. R. Baker, Birmingham.
9377. ATTACHING KNOBS or HANDLES to SPINDLES, A. Moore, Birmingham.
9378. COMBINED EDGING TILE and GUTTER, R. Guest, Manchester.
9379. FEEDING-BOX for PIGEONS, &c., J. Neal, Ashton-under-Lyne.
9380. SCREW BOSSES for WATER SUPPLY, G. Cooper, Redland.
9381. AUTOMATICALLY OPERATING RAILWAY BRAKES, H. J. Allison.—(——*Kinsman*,——.)
9382. STRAIGHTENING, &c., METAL BARS, B. C. Tilghman, London.
9383. RAPIDLY CHANGING the PICTURES in a MAGIC-LANTERN, W. C. Hughes, London.
9384. SEWING MACHINERY, H. W. Hadley and W. L. Grout, London.
9385. THERMOMETERS, P. Ward, London.
9386. CUTTING MOTION of LOOMS, W. Smith, Manchester.
9387. BUTTER REFRIGERATOR, E. Walker, Scarborough.
9388. SUPPLY and DISCHARGE of HOT and COLD WATER to and from BATHS, H. Sutcliffe, Halifax.
9389. A SELF-REGISTERING BALLOT-BOX, G. Baker, Aldershot.
9390. CASING for IRON and other METALS, W. B. Ash, Birmingham.
9391. The MONOPHONE ORGAN REGISTER, P. R. Harrison, London.
9392. MANUFACTURE of STEEL, &c., PENS, G. H. Manton, Liverpool.
9393. The NEW EXCELSIOR DRAG, S. Luck and W. H. Bannister, Eastbourne.
9294. INDIA-RUBBER COVERING for BLOW-OFF PITS, W. S. Mackie, London.
9395. HOISTING MACHINERY, J. D. Churchill, London.
9396. OPENING and SHUTTING DOORS, T. P. Wood, London.
9397. ROAD CARRIAGES, R. Glover, Stratford.
9398. CLOTHIERS', &c., PATTERNS for GARMENT MARKING, C. S. Bore, Millwall.
9399. ADMINISTERING FARADIC or GALVANIC ELECTRICITY, W. Oliver, Canonbury.
9400. APPARATUS for PACKING or STORING CARTRIDGES, &c., J. R. Cunnington, London.
9401. COATING, &c., METALS, E. Tuteur, London.
9402. CABINET for STATIONERY, &c., W. Abbott, London.
9403. GALVANIC BATTERIES, A. J. Boult.—(*O. Lugo, United States.*)
9404. NAIL DRIVING MACHINES, T. Fowler and T. B. de Forest, London.
9405. TRAPS for PREVENTING the RETURN of GASES, &c., J. P. Jones, Liverpool.
9406. APPARATUS for MIXING DOUGH, J. A. Baker and W. K. Baker, London.
9407. MANUFACTURE of HYGIENIC and SANITARY BED-COVERS, &c., R. Thornton, London.
9408. CONSTRUCTING ORNAMENTAL MASONRY COLUMNS, H. H. Leigh.—(*B. Dubois, France.*)
9409. DOVETAILING APPARATUS, P. L. Martinier, London.
9410. SELF-ADJUSTING GOVERNORS, C. J. Galloway and J. H. Beckwith, London.
9411. FIRE-ARMS, H. H. Lake.—(*The Winchester Repeating Arms Company, United States.*)
9412. AWNINGS for OMNIBUSES, &c., G. A. C. Brooker, London.
9413. PHOTOGRAPHIC PRINTING, H. H. Lake.—(*R. B. and B. C. West, United States.*)
9414. FIRE-ARMS, H. H. Lake.—(*The Winchester Repeating Arms Company, United States.*)
9415. BLEACHING FATS and OILS, H. H. Lake.—(*W. B. Allbright, United States*)
9416. STEERING PROPELLERS, W. W. Popplewell.—(*J. J. Künstadter, United States.*)
9417. CORK FASTENERS, W. W. Popplewell.—(*W. M. Fischer, United States.*)
9418. MILK CAN FITTINGS, W. Bruce, Glasgow.
9419. GRAIN BINDERS, B. E. Huntley.—(*The Johnston Harvester Company, United States.*)
9420. PIPES or TUBES of LEAD, &c., H. H. Lake.—(*A. K. Eaton, United States.*)
9421. TYPE-WRITING MACHINES, E. Fitch, London.
9422. JOINTING RAILWAY RAILS, J. Glanz, London.
9423. SEPARATING DUST from AIR, H. H. Lake.—(*The Knickerbocker Company, United States*)
9424. AUTOMATICALLY PLAYING TUNES on CONCERTINAS, E. Parr, London.
9425. SAFETY SOUP PLATE, C. L. Newell, London.
9426. COLLAR BUTTONS, P. A. Newton.—(*A. J. Wilson and J. P. Delany, United States.*)
9427. BRACES, E. G. Sim and R. H. Bishop, London.
9428. POISING BALANCE SPRINGS of WATCHES, P. A. Newton.—(*T. Gribi, United States.*)
9429. THROWING SILK, L. Camel, London.
9430. STUDS, &c., W. W. Jones, Manchester.
9431. UTILISING the REFUSE of BREWERIES, H. W. Lafferty, London.
9432. TREATING AURIFEROUS SUBSTANCES by ELECTROLYSIS, H. Liepmann, London.
9433. ROTARY PUMP ENGINES, A. M. Clark.—(*L. Neubur, France.*)
9434. CONVEYING PARCELS, E. H. Fosbery, Brighton.
9435. ASBESTOS BOILERS, J. Garner, Kent.
9436. COMPOSITION for PAVING ROADS, J. A. Parker, London.
9437. AUTOMATIC SPILE, J. Smith and W. Simkins, London.

*21st July*, 1886.

9438. COMBUSTION of STEAM BOILERS, &c., J. Bremner, Hull.
9439. TESTING PIPES, T. Kennedy, Glasgow.
9440. PISTON PACKING, H. M. Walker, Glasgow.
9441. ROLLED IRON for HORSESHOES, E. Smith, Birmingham.
9442. SCREW-EYES and PLATE-EYES for HANDLES, E. Phillips, Birmingham.
9443. STOPPERING of BOTTLES, J. Greaves, Oldham.
9444. DOOR KNOBS, T. Taylor, Birmingham.
9445. FIXING NON-CONDUCTING COMPOSITIONS to METAL SURFACES, R. Hilson, Newcastle-on-Tyne.
9446. WORKING the "DOLLY" in WASHING MACHINES, J. Summerscales and J. Crossley, Halifax.
9447. OBTAINING MOTIVE-POWER, S. Rivett, London.
9448. STOPPERS and CORKS for BOTTLES, A. J. Johnson, Birmingham.
9449. SPRING SAFETY VALVES, W. L. Bone, Manchester.
9450. ATTACHING LEATHER BUTTONS to BOOTS, H. Sexton, Norwich.
9451. PREVENTING PIECES of HAIR from PASSING BETWEEN the NECK and CLOTHES of PERSONS, H. S. Prior, London.
9452. AERIAL NAVIGATION, A. M. Clark.—(*A. M. G. Sebill, France.*)
9453. SPLITTING FIREWOOD, H. Wostear, London.
9454. BOXES, W. Stubbs, London.
9455. VELOCIPEDES, J. M. Taylor, London.
9456. AUTOMATICALLY LIGHTING, &c., GAS LAMPS, J. H. Wüster, Liverpool.
9457. SHUTTLE SPRINGS and PINS, J. Haydock, Halifax.
9458. APPLYING INFLAMMABLE FLUIDS to MATERIALS REQUIRING HIGH TEMPERATURES in their MANUFACTURE, R. Stone, London.
9459. DYNAMO-ELECTRIC MOTORS, F. Wynne, London.
9460. DRY PLATES for PHOTOGRAPHIC PURPOSES, J. Brown, Norbiton.
9461. BAG FASTENERS, W. B. Thomson, London.

9462. SPINDLES and WIRES of WINDING, &c., MACHINES, E. Reavill, London.
9463. INKSTANDS, D. L. Tower, Brooklyn.
9464. MOUNTING DIAMONDS and other GEMS, R. Hemsley, London.
9465. FURNACES, J. and R. B. Bonthrone, Glasgow.
9466. ARTIFICIAL AERATED or GASEOUS WATER, R. P. y Pedret, London
9467. MAGNESIUM LAMPS. H. Süss, Liverpool.
9468. LAMPS, A. J. Boult.—(*Messrs. Moreau Brothers, Belgium.*)
9469. ROLLING CURTAIN EFFECT for LANTERNS, W. C. Hughes, London.
9470. STOPPERING BOTTLES for CONTAINING MILK, &c., A. Kempson, London.
9471. LOCK-NUTS, J. Scattergood, London.
9472. RACK and PINION LOCOMOTIVES, H. L. Lange and H. Livesey, London.
9473. ENRICHING GAS by admixture of HYDROCARBON VAPOUR, J. Livesey and W. Whitehouse, London.
9474. STOPPING HOLES in VESSELS, O. Imray.—(*J. N. L. Tuck, London*)
9475. SCREW BOLTS for RAILWAY RAILS, H. H. Lake. (*J. L. Pope, United States.*)
9476. VENTILATING APPARATUS, H. H. Lake.—(*A. Kosemund, Germany.*)
9477. CLOSING BOTTLES and JARS, W. W. Macnay, R. Sykes, and H. Codd, London.
9478. DYNAMO-ELECTRIC MACHINES, J. A. Fleming, London.
9479. BEDSTEADS, &c., A. D. Brown, London.
9480. TRICYCLES and VELOCIPEDES, W. J. Lloyd and W. Priest, London.
9481. ASCERTAINING LEAKAGE in WATER PIPES, H. J. Haddan.—(*A Paris, Germany.*)
9482. CARPET LOOMS for CUTTING the PILE in any required PATTERN, H. J. Haddan.—(*C. Boll, Germany.*)
9483. ATTACHING RAILWAY CHAIRS to METAL SLEEPERS, W. Davison, London.
9484. PETROLEUM BURNERS, E. H. Haeckel, London.

*22nd July*, 1886.

9485. OPEN BROUGHAMS, &c., W. J. and R. H. Ridges, Wolverhampton.
9486. ALUMINIUM and ALLOYS thereof, L. Grabau, London.
9487. METALLIC BEDSTEADS, J. Middleton and F. Harker, Birmingham.
9488. FILTERS, F. W. Brownlow, Manchester.
9489. TREATING COLOURED POWDERS, J. and J. Crawford, Glasgow.
9490. CHAIN CABLES, J. J. Laffitte, Paris.
9491. CAP and RING SPINNING and TWISTING FRAMES, W. T. Garnett, Bradford.
9492. PICKLE FORK, L. R. C. Hamber, London.
9493. FILLING BOTTLES with AERATED BEVERAGES, D. Rylands, Barnsley.
9494. TRICYCLES, C. Grant, Bedford.
9495. STOPPER for BOTTLES, J. A. Marshall, Dewsbury.
9496. PLUMBERS' BLOW PIPES, C. Bellamy, Streatham.
9497. SUPPLYING ATMOSPHERIC AIR to COMBUSTION CHAMBERS, &c., R. Johnson, Manchester.
9498. ELECTRIC ALARM CLOCKS, F. T. Brown, Liverpool.
9499. DRILLING HOLES in BOILER SHELLS, &c., F. Butterfield, London.
9500. SECURING WOOD FLOORING without NAILS or SCREWS, C. E. Oliver, J. G. Burrell, and J. L. Oliver, London.
9501. SEWING and BINDING LETTER COPYING BOOKS, T. H. Hicks, London.
9502. FILE-CUTTING MACHINES, A. Shardlow, Sheffield.
9503. BUFFERS for RAILWAY ROLLING STOCK, A. B. Ibbotson and I. Widdop, Sheffield.
9504. SMOKERS' MATCH BOXES, W. Bullard, Manchester.
9505. DAMPER MECHANISM for PIANOFORTES, J. Nicklin, London.
9506. KETTLES, W. G. Richardson, Sheffield.
9507. WOOD MOULDING MACHINES, J. E. Evans, London.
9508. MUTES for VIOLINS, &c., A. N. Mezzetti, London.
9509. WATERPROOF ARM-HOLE LININGS, &c., A. M. Clark.—(*La Société A. Hutchinson et Cie., France.*)
9510. PACKINGS for STUFFING-BOXES of STEAM ENGINES, E. B. Petrie, Manchester.
9511. STAY BUSKS and FASTENING for SAME, H. J. Haddan.—(*G. Moulinet, France.*)
9512. DOUGH KNEADING MACHINES, M. G. Strachwitz, London.
9513. ADVERTISING PHOTO FRAME, F. W. K. Tarte, London.
9514. GALVANIC BATTERIES, E. H. Desolu, London.
9515. MOVING INGOTS into POSITION for passing through the ROLLS of ROLLING MILLS, D. Davy, London.
9516. TRACTION ENGINES, J. and H. McLaren, London.
9517. RECEIVING PAYMENT for and for DELIVERING PREPAID GOODS, P. Everitt, London.
9518. CARBON ELECTRODES, R. Applegarth, London.

*23rd July*, 1886.

9519. FACILITATING DRILL with HEAVY ORDNANCE, T. Nordenfelt, London.
9520. TAKING the SHAVINGS from PLANING MACHINES, J. Rawlings, London.
9521. BOTTLES, J. R. Shearer, London.
9522. INSTANTANEOUS PHOTOGRAPHIC CAMERA SHUTTERS, W. J. Lancaster, Birmingham.
9523. FURNITURE CASTORS, R. G. V. van Avezathe, Birmingham.
9524. SHOT MAKING, T. Cordes, Gateshead-on-Tyne.
9525. WEAVERS' SHUTTLE TONGUES, J. Waddington, Bradford.
9526. BUST IMPROVER, J. S. Williams, Birmingham.
9527. FILTERS for DOMESTIC PURPOSES, C. A. Clapham, Bradford.
9528. SPRING BEDSTEAD, J. M. Meech, Hove.
9529. CORRUGATED IRON for ROOFS, W. Snaydon, Corscombe.
9530. LOCK-UP STRAP BUCKLE, &c., H. R. Maynard, Brandon.
9531. BOOTS, W. W. Popplewell.—(*L. Smadbeck and B. Natham, United States*)
9532. CARRYING TOOLS in BUILDING SHIPS, F. J. Rowan, Glasgow.
9533. HAMMERING MACHINERY, &c., F. J. Rowan, Glasgow.
9534. VALVE ACTUATING ARRANGEMENTS for ENGINES, D. Donald, Penryn.
9535. PREVENTING a ROPE from LEAVING a PULLEY, W. P. Bayliss, London.
9536. HARDENING PLASTER-OF-PARIS, E. T. L. Clark, London.
9537. APPLICATION of ELECTRIC LIGHT, V. Blumberg, London.
9538. BICYCLES, &c., T. W. Robinson, Coventry.
9539. PHOTOGRAPH FRAME, H. Johnson, London.
9540. RAIN-WATER PIPING, S. R. Alexander, Chiswick.
9541. LAYING ASPHALTE, C. Dunscombe, London.
9542. WOOD SCREW MACHINERY, H. D. Cunningham, London.
9543. CLOTHES PEG or CLIP, J. Fleming, Halifax.
9544. SHOP WINDOW FITTINGS, W. H. Blakeney, Dundee.
9545. STANDS for PHOTOGRAPHS, &c., A. Arbenz and E. Kuhn, London.
9546. FIRING or HEATING STAVES for MAKING CASKS, &c., A. Dunbar, London.
9547. REFRIGERATING and ICE MACHINES, W. H. Wood, New York.
9548. DESICCATING COCOA NUT, C. Millen, London.
9549. LAMP for STREET LIGHTING, J. Duffield, Slough.
9550. DISTILLATION of COAL SHALE, &c., O. Rose, London.
9551. HYDRAULIC CEMENT, W. F. Reid, London.
9552. LADDERS, E. and H. W. Lanaway, London.
9553. RECLAIMING OIL, &c., for CLEANING CLOTHES, S. Schofield, Bradford.
9554. TREATING DISTILLERS WORTS, A. G. Fraser and G. Epstein, London.
9555. MACHINES for DRILLING or BORING ROCK, P. Bianchetti, London.
9556. EXTRACTING IODINE, &c., from SEA-WEED, H. J. Haddan.—(*J. Rousseau, France.*)
9557. PRESS for STAMPING METAL SEALS, &c., H. J. Haddan.—(*Messrs. Rast and Gasser and H. Zwanziger, Austria*)
9558. CONNECTING RAILWAYS separated by STRAITS, &c., Sir E. J. Reed, London.
9559. CONSTRUCTION of BILGE KEELS, &c., A. M. Wood, London.
9560. SUB-DIVISION of SHIPS into WATER-TIGHT COMPARTMENTS, A. M. Wood, London.
9561. SHEARS for CUTTING UP BLOOMS, D. Davy, London.
9562. ELIMINATING AIR from FEED WATER, E. Bohlig and G. O. Heyne, London.
9563. IGNITION APPARATUS for GAS MOTOR, J. Fielding, London.
9564. LACE FABRIC, J. H. Johnson.—(*La Société Smith frères et Cie., France.*)

*24th July*, 1886.

9565. PREVENTING FALLS from BICYCLES, E. Redman, London.
9566. REGULATING SUPPLY of OIL to LAMPS, J. B. Fenby, Sutton Coldfield.
9567. OBTAINING FRESH WATER from SALT WATER, J. Weir, Glasgow.
9568. CONVERTIBLE CRADLE-PERAMBULATOR, J. Hartley, Oakworth.
9569. DEPURATING CHARCOAL for PURIFYING SEWAGE, W. Burns, Leith.
9570. ASCERTAINING the QUANTITIES of LIQUIDS in CASKS, R. Hill, Newcastle-upon-Tyne.
9571. PRESSES for PRESSING the JOINTS of the LEATHERS for COVERING ROLLERS, J. S. Dronsfield, Oldham.
9572. LOADING and DISCHARGING and PROPELLING VESSELS, O. E. Pohl, Liverpool.
9573. PORTABLE WINDOW SAFETY FIRE-ESCAPE, W. T. Noakes, Tunbridge Wells.
9574. LOOSE REED and WARP LETTING-OFF MOTIONS, C. and S. Catlow, Halifax.
9575. ELECTRICAL MOTOR and FAN, The Ross' Patent Lighting Company, Dublin.
9576. STEAM ROAD ROLLERS, F. J. Burrell, Thetford, and R. Coles, Coventry.
9577. CONSTRUCTING, &c., DRAIN or SEWERAGE PIPES, J. Potts, Glasgow.
9578. COMPOUND ENGINES, E. Matthews, Newport.
9579. CARDING ENGINES, J. M. Hetherington, Manchester.
9580. BLIND FURNITURE, H. P. Hoghton, Manchester.
9581. MAKING WHITE PAINT, J. B. Hannay and E. J. Pape, Glasgow.
9582. DYNAMO-ELECTRIC MACHINES, J. P. Hall, Manchester.
9583. SPINDLES and FLYERS for SPINNING, W. A. Beney.—(*C. Krauss, Austria.*)
9584. VENTILATORS, &c., A. Sweet, London.
9585. BEARINGS for SUPPORTING the SPINDLES of SPINNING, &c., MACHINERY, P. Knowles, London.
9586. CLASP KNIVES, A. J. Beal, Sheffield.
9587. OINTMENT BOXES, &c., F. J. Mackinlay, London.
9588. SHEAF CARRIERS for GRAIN BINDERS, W. P. Thompson.—(*C. H. McCormick, jun., United States.*)
9589. SHEAF BINDING MACHINERY, W. McI. Cranston. —(*The W. A. Wood Mowing and Reaping Machine Company, United States.*)
9590. PLATES for the TABLE, J. Southall, London.
9591. ANTISEPTIC SOAP, J. Thomson, London.
9592. BREAD-MAKING, H. Crane, London.
9593. TOOL HOLDERS for LATHES, &c., F. Strickland, London.
9594. BATTERY SOLUTION, H. Weymersch and J. Whittall, London.
9595. ANTIFRICTION BEARINGS G. Buchholz, Liverpool.
9596. COUPLING and UNCOUPLING RAILWAY ROLLING STOCK, A. R. Schade.—(*J. Dadswell, Mexico.*)
9597. MEDICINAL PREPARATION for the CURE of SWINE-FEVER, T. Johnston, Bradford.
9598. CARBURETTING AIR, J. H. Johnson.—(*E. Delamare-Debouteville and L. P. C. Malandin, France.*)
9599. PENDULUM COMPENSATION, J. Gerhardt, London.
9600. PLOUGH, A. Owschisowitz, London.
9601. MEANS of ADVERTISING, F. Stanfield, London.
9602. DRILL STOCK, J. Blaiberg, J. Marson, and B. J. S. Roberts, jun., London.
9603. DELIVERING CIGARETTES, &c., from RECEPTACLES CONTAINING THEM, J. Breeden, London.
9604. NOVEL APPLICATIONS produced by TREATMENT of WASTE LEATHER, W. Ross, London.
9605. GAS BURNERS, O. E. Woodhouse, F. L. Rawon, and C. S. Snell, London.
9606. PRINTING TELEGRAPHS, A. M. Clark.—(*S. B. van Nortwick, A. P. Haldane, J. V. Ackerman, and B. K. Van Nortwick, United States.*)

*26th July*, 1886.

9607. DUPLEX STAMP AFFIXER, D. Gilmore, Belfast.
9608. PNEUMATIC DOOR CHECKS, G. F. Newman, Birmingham.
9609. PROPELLING FISHING BOATS when BECALMED, J. Coulson, Buckie.
9610. MACHINES for GRINDING CUTTERS, D. Sagar, Halifax.
9611. DYEING COTTON in the SLIVER, G. E. Sutcliffe, Halifax.
9612. ELECTRIC BELLS, F. H. Royce, Manchester.
9613. MAKING LEATHER, &c., FLEXIBLE, T. Laycock, Northampton.
9614. SHAFTS of HANSOM CABS, C. Clarke, F. Selby, and E. T. Phipson, Birmingham.
9615. CASES or CANISTERS for CONTAINING EXPLOSIVES, J. R. Linsley and J. H. Proctor, Newcastle-upon-Tyne.
9616. BURNING LIQUID FUEL for STEAM BOILERS, &c., T. Smith, Newcastle-upon-Tyne.
9617. AUXILIARY PHOTOGRAPH FOCUSSER, &c., S. D. McKellen, Manchester.
9618. LIGHTING, &c., GAS LAMPS AUTOMATICALLY, J. J. Butcher, Newcastle-on-Tyne.
9619. CENTRE-BOARDS for SAILING VESSELS, D. McFall, London.
9620. CHEMICAL FIRE-EXTINGUISHERS, J. H. and J. W. Galloway, London.
9621. GENERATORS, J. H. and J. W. Galloway, London.
9622. STEERING VELOCIPEDES, &c., C. W. R. Duerre, London.
9623. CHALK-HOLDER for BILLIARD ROOMS, J. C. Baxter, London.
9624. OBTAINING MOTIVE POWER by AIR, WEIGHT, and WATER, C. J. Eyre, London.
9625. MATERIAL for COVERING FLOORS, &c., Sir F. Bolton, London.
9626. ADJUSTABLE PORTABLE POCKET HAT PEG and CLIP, H. F. Brion, London.
9627. SIDE COUPLINGS for RAILWAY CARRIAGES, A. J. Boult.—(*T. Suchland, Germany.*)
9628. COATING SHEETING METALS with a FABRIC so as to attach it to other SURFACES with GLUE, &c., T. H. Rees, London.
9629. METAL ADVERTISING TABLETS, T. H. Rees, London.
9630. DISTILLATION of ALCOHOLIC LIQUIDS, L. Béchaux, London.
9631. PUMPS, J. and W. Evans, London.
9632. PERMANENT WAY of RAILWAYS, R. J. Jones and J. C. Lee, London.
9633. DIAPERS, H. J. Haddan.—(*R. Hicks, U.S.*)
9634. SAUSAGE MACHINES, H. Spühl, London.
9635. LIFTING RAKE for MACHINES for WASHING WOOL, &c., A. Deletombe and A. Prouvost, London.
9636. NEUTRAL PHOSPHO-GUANO, L. A. Chevalet, London.
9637. HEATING CURLING TONGS, &c., L. de Liendendorff. London.
9638. WATERPROOF GLOVE, S. W. Silver, London.
9639. TREATING BLACK PLATES PREVIOUS to TINNING or TERNING, G. Nurse, London.
9640. LUBRICATING CAP for AXLES and SHAFTS, F. Moore, London.
9641. LACE MACHINES, J. Jardine, London.
9642. EXHAUST STEAM HEATING APPARATUS, S. Pitt.—(*J. T. King, United States.*)
9643. WALLS, CEILINGS, &c., H. H. Lake.—(*E. C. Morris, United States.*)
9644. WALLS, CEILINGS, &c., H. H. Lake.—(*E. C. Morris, United States.*)
9645. PHOTOGRAPHIC CAMERAS, T. Samuels, London.
9646. PAPER BAGS, L. Elias, Berlin.
9647. GRINDING APPARATUS, A. F. Roth, Berlin.
9648. FLOUR-SHAKING MACHINES, E. Weiss and L. Fraenkel, Berlin.

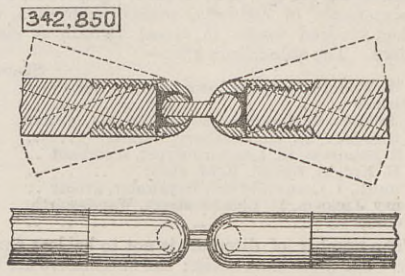
## SELECTED AMERICAN PATENTS.

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

342,850. COUPLING for ROUND BELTING, *Daniel C. Smith, Albany, N.Y.—Filed September 28th*, 1885.

*Claim.*—In a coupling for round belting, the combination, with the end sockets, of the connecting bar

342,850

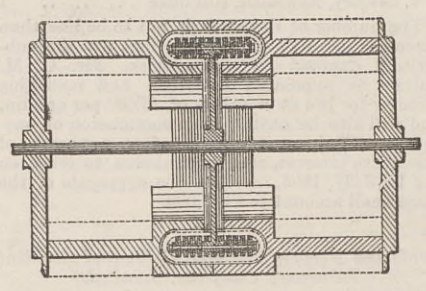


and socket balls, one of which is removable, substantially as set forth.

343,129. DYNAMO-ELECTRIC MACHINE, *Arthur G. Ketchum, Winchendon, Mass.—Filed February 10th*, 1886.

*Claim.*—(1) In a dynamo-electric machine, an armature frame consisting, essentially, of a central hub having radial spokes all lying in approximately the same plane, enlarged cylindrical heads upon the outer ends of said spokes, holes in said heads, a first set of incomplete rings having notches which fit upon said heads and secured to said heads, and a second set of incomplete flat metallic rings secured to said first set, substantially as and for the purpose set forth. (2) In a dynamo-electric machine, an armature frame consisting of a central hub having spokes, enlarged heads at the outer ends of said spokes, a first set of rings secured to said heads and provided

343,129

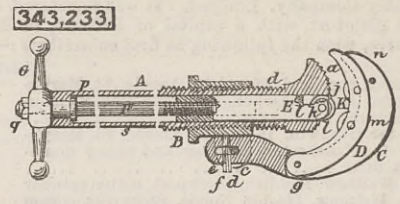


with notches which fit upon said heads, and a second set of rings secured to said first set of rings, all in combination, substantially as described. (3) In a dynamo-electric machine, an armature frame consisting, substantially, of a central hub, and radial spokes to said hub, enlarged ends to the outer ends of said spokes, rings of sheet metal containing slots which fit upon said heads, additional rings, also of sheet metal, upon each side of said first-mentioned rings, holes in all of said rings and in said heads, and bolts passing through said holes, in combination with field-magnets and pole-pieces thereto, said pole-pieces each having branches, one branch of each extending within the armature to the said spokes and the other of each extending outside the armature and secured to a similar branch of an opposite pole-piece, essentially as and for the purpose set forth.

343,233. PIPE CUTTER, *Albert H. Esten, Amesbury, Mass.—Filed February 23rd*, 1886.

*Claim.*—(1) The combination of hollow stock A, formed with serrated head *a*, cutter *j*, pivotted in bar E, arranged in the passage in stock A, and rod F, provided with a handle for rotating it, and screw-threaded in bar E, toothed in hook C, cutters K K, mounted in hooks D, pivotted in hook C, and an adjusting pin *n*, to secure hook D when adjusted, substantially as specified. (2) The combination, with bar A, having serrated head *a*, and adjustable cutter *j*, of cutters K, pivotted in hook D, supported by hook C, and said latter hook having elongated passage *c* to receive pivot *d*, and provided with locking pin *f*, substantially as

343,233

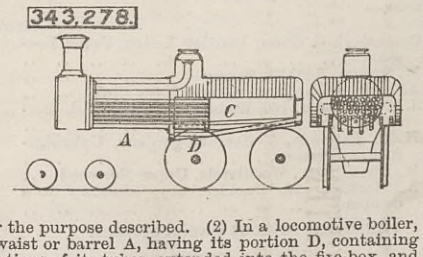


specified. (3) The combination, with bar A, having head *a* and cutter *j*, of bifurcated toothed hook C, and hook D, pivotted in hook C, and having cutters K, pivotted therein, substantially as specified. (4) The combination of bar A, formed with serrated head *a*, sleeve B, threaded on bar A, bars E F, threaded together and provided with means for actuating them, cutter *j*, pivotted in rod E, bifurcated and toothed hook C, pivotted in sleeve B, hook D, pivotted in hook C, and cutters K, pivotted in hook D, all substantially as specified.

343,278. LOCOMOTIVE BOILER, *Townsend Poore, Scranton, Pa.—Filed April 2nd*, 1886.

*Claim.*—(1) In a locomotive boiler a waist or barrel A, having its portion D, containing portions of its flues or tubes, extended into the fire-box C, in combination with a fire-box above and extended laterally beyond the locomotive wheels, substantially as and

343,278

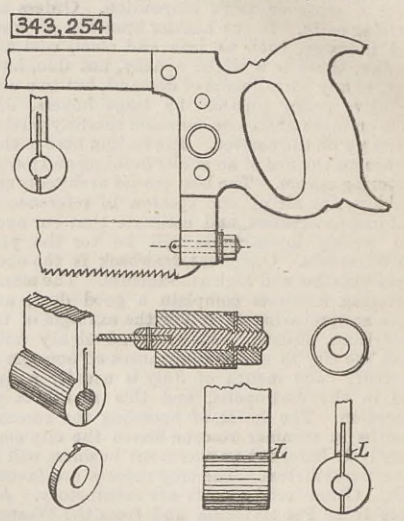


for the purpose described. (2) In a locomotive boiler, a waist or barrel A, having its portion D, containing portions of its tubes, extended into the fire-box, and said portion D rivetted directly to crown and front sheets of the fire-box, in combination with a fire-box extended laterally over and beyond the wheels of the locomotive, substantially as and for the purpose described. (3) In a locomotive boiler, a waist or barrel A, having its portion D, containing portions of its tubes, extended into the fire-box, in combination with a grate extended laterally beyond the locomotive wheels, and having the intermediate portion of its bars inclined to a greater extent than those on the sides thereof, substantially as and for the purpose described. (4) In a locomotive boiler, the combination, with a fire box having a perforated crown sheet, of a waist or barrel A, having its portion D, containing portions of the flues or tubes, extended into the fire-box C, and said portion D rivetted directly to the crown sheet of the fire-box, substantially as and for the purpose described.

343,254. HANDSAW, *Christopher Richardson, Newark, N.J.—Filed March 18th*, 1886.

*Claim.*—(1) In a saw buckle constructed with a hub slitted to receive the saw blade, and provided with a bolt and nut for tightening the blade, as described, the combination, with the slitted hub, of a washer

343,254

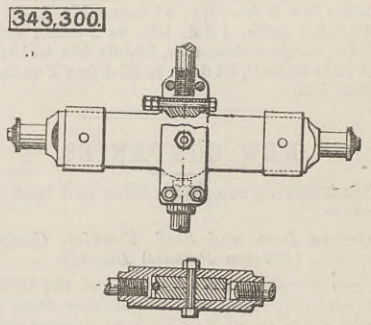



applied to the bolt, and provided with a collar to embrace the end of the hub, substantially as herein set forth. (2) In a saw buckle constructed with a hub slitted to receive the saw blade, and having a bolt inserted through the hub, and provided with a nut for tightening the blade, as described, the combination, with the slitted hub and the shank by which it is attached to the saw frame, the shank having the notch L formed therein, of the collared washer applied to the hub and embracing the same with its collar, substantially as shown and described.

343,300. CROSS-HEAD, *George R. Cullingworth, New York, N.Y.—Filed October 28th*, 1885.

*Claim.*—(1) The combination, with the cross-head and piston rod, of a clamp embracing the cross-head, and with which the piston rod is connected, and a central pivot bolt passing through the clamp and cross-head, whereby provision is afforded for the self-adjustment of the clamp and cross-head relatively to each other, substantially as herein described. (2) The combination, with a cross-head having at opposite sides convex projections, of a clamp embracing the cross-head, and with which the piston rod is connected, the clamp at one end of its opening being concave to fit the convex projection on one side

343,300

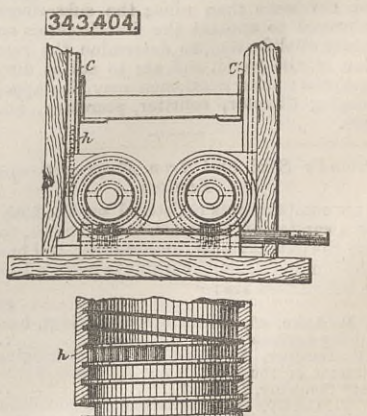


of the cross-head, and wedge blocks having concave faces inserted in the clamp between the opposite end of its opening and the cross-head, substantially as herein described. (3) The combination, with the cross-head A, having at opposite sides convex projections A′, of a two-part or divided clamp D, and the bolt *b*, for securing its sections togethes, one end wall of the clamp being concave to fit the convex projection at one side of the cross-head, the wedge blocks *e*, having concave faces, inserted from opposite sides of the clamp, between the opposite end of its opening and the cross-head, and the bolts *f*, whereby the wedge blocks may be adjusted, substantially as herein described.

343,404. ELEVATOR, *R. Smith, Sherbrooke, Quebec, Canada.—Filed November 17th*, 1885.

*Claim.*—(1) In combination with an elevator, a solid extensible support on which it rests, and mechanism for forcing said support upward to raise said elevator, said support consisting of a series of separate rolls, substantially as set forth. (2) The combination of the rotary cylinders and stationary nuts having screw-threaded connection therewith, the threads of the former having abutments *i*, with the rolls *h h* interposed between said cylinders and nuts, the boxes

343,404



C C1, into which said rolls pass tangentially, and the elevator provided with rigid parts *m*, which extend into said boxes and rest on said rolls, in order that they and said elevator may be raised and lowered by the latter, substantially as set forth. (3) A solid support for an elevator, said support consisting of a column of unconnected parts, and a box or guideway within which they may rise and descend, substantially as set forth.