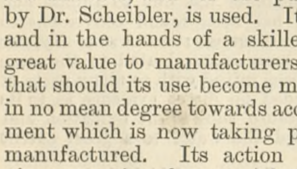
VISITS IN THE PROVINCES.

MESSRS. FRANCIS AND CO.'S CEMENT WORKS, CLIFFE, KENT.

It may be said that so many books and papers have been published on cement and cement testing during the past few years that there cannot be much more to be said on these subjects. We propose, however, to describe the practical manufacture of cement as carried on at a large works. We recently visited the extensive works of Messrs. Francis and Co. at Cliffe, over which we were conducted by Mr. V. D. de Michélé, Assoc. M.I.C.E., Westminster, the engineer of the works. A greater quantity of cement is made in Kent than in any other district in the world. The manufacture is carried on on the banks of the rivers Thames and Medway, where abundant supplies of the necessary raw materials are found in close proximity, and where the conditions for economic working are very favourable, both as regards making and distribution, communication with London and its docks by river being easy, cheap, and rapid, and where the gasworks of London afford an ample supply of coke—the fuel almost exclusively used in cement works—at a moderate cost.

Messrs. Francis and Co. possess two large works, the older of which was originally laid down by Mr. Alfred Giles, C.E., M.P., but were subsequently completed from the designs and under the superintendence of Mr. Michélé. These works are situated on the banks of the Thames, near its mouth, where they are surrounded by clay marshes, and are in close proximity to the chalk hills, with which they are connected by a short tramway. The Portland cement is manufactured from chalk and clay, which in this neighbourhood are found in a peculiarly soft, and therefore convenient form for reduction and mixture in a wet state. These materials are delivered from small contractors' tip wagons close together at a convenient point on the works, and are used in the proportion of from two to two and a-half chalk to one clay by weight; the proportions are adjusted by the regulation of the number of barrow-loads of chalk to each ten barrow-loads of clay. It is impossible to lay down any fixed rules as to the quantities to be used, as they must vary continually with the changes in density and quality of the materials. The greatest care and attention are therefore necessary on the part of the chemist who is employed to analyse and test the different mixtures from day to day, as well as on the part of the foreman whose chief duty it is closely to watch the materials and to regulate the proportions by the help of the information he receives from the chemist, and to see that the barrows are correctly filled and emptied in turn by the men. It may surprise many to learn that the apparently rough-and-ready rule-of-thumb manner of mixing together so many unweighed barrow-loads of material from constant usage in skilled hands should be capable of such nice adjustment, but it is a fact on record that after many days working in this way the samples from the resulting mixtures have not shown so much as one per cent. variation in quantity of carbonate of lime. For the purpose of, if possible, rendering the proportions still less liable to error, Mr. Michélé has lately designed and introduced an apparatus for weighing one barrow of clay against two of chalk, thus also insuring their being always delivered into the mixer in their proper turn. This apparatus is simply a scale with a scale bar of unequal length from point of suspension, and a pair of large flat scale pans, one carrying one and the other two barrows. But although this apparatus is simple in construction and works well, and is of great use as a means of insuring the amalgamation of accurate and even proportions by weight, it is quite useless unless it is adjusted frequently with reference to the constantly varying specific gravities, and compositions of the chalk and clay. In order to guide the foreman in determining the correct proportions, whether the old barrow system alone, or the new weighing apparatus be employed, daily laboratory tests are made. That which is most frequently repeated is one for ascertaining the carbonate of lime value only of the mixture in its first stage of manufacture. It can be accomplished in a few minutes, and for the purpose an apparatus, designed by Dr. Scheibler, is used. It is very simple and effective, and in the hands of a skilled operator will be found of great value to manufacturers. It may be safely predicted that should its use become more general it will contribute in no mean degree towards accelerating the general improvement which is now taking place in the quality of cement manufactured. Its action is briefly this—to cause a given quantity of a material which is partly composed of carbonate of lime, no other carbonates being present, to give off its carbonic acid, and then to measure the quantity. The exact amount of carbonic acid having been arrived at, the percentage of carbonate of lime is also known, as it is a substance of definite composition, its constituent parts being 56 per cent. lime, and 44 per cent. carbonic acid.



It consists simply of a glass horseshoe tube, graduated on one arm, and a bottle attached to it by an india-rubber pipe. A is a small pipe with a stop in it, to admit water. B is a small vessel which can be dropped in at the neck of the bottle C. D is the graduated horseshoe in air-tight connection with the bottle C. The mode of operation is simple. A small quantity of the mixed chalk and clay is thoroughly dried. A given quantity of this is weighed and put into the vessel B. A little acid is put into the bottle C. B is lowered into C in such a manner that the acid and "slurry" do not come into contact. C is corked down. The tube D is filled with water. C is then shaken so that the acid and "slurry" come into contact. As the carbonic acid gas is given off it passes into D, from which the water is let off as the gas enters, so that the heat in both arms is kept equal. The volume of gas given off is then read by the graduations on the tube. Barometrical and theomometrical corrections are then made. As the carbonic acid gas and the lime in chalk bear fixed relations to each other, when the quantity of the gas has been ascertained the quantity of lime is also known, and hence this little apparatus is exceedingly useful in enabling the cement maker to know in a very short time the quantity of carbonate of lime in his mixture.

The following table shows the usual composition of the materials and the products, and exhibits the changes which take place in the constituents after burning, grinding, and mixing with water :—

	Clay.	Slurry.	Cement.	Gauged cement, seven days old, carried 980 lb.
Sand	0·87	1·24	0·98	1·16
Silica	54·14	11·77	20·45	18·77
Peroxide of iron	7·76	2·13	4·37	3·08
Alumina	14·68	4·45	8·05	7·04
Magnesia	—	—	1·48	1·52
Carbonate of magnesia... ...	4·48	2·87	1·48	1·52
Lime	—	—	62·13	54·89
Sulphate of lime	—	—	2·13	1·73
Carbonate of lime	2·01	69·97	—	—
Water, carbonic acid	15·03	5·29	—	—
Water, organic matter	—	—	—	9·45

Besides the laboratory tests referred to, samples of the first mixtures of ingredients are carefully taken every day, and these are converted into cement by means of miniature drying floors and grinding appliances. No useful result can be obtained from such experiments, however, in less than from two to three days, and at the expiration of that time the fact of whether there is a dangerous excess of lime or not can only be judged by a further delay of, say, forty-eight hours, whilst the strength at the present usual age cannot be arrived at until nine or ten days after the mixture took place, and, therefore, errors, extending through many hundred tons of material, may have taken place before they are detected. The value of a test for carbonate of lime, which can be made in a few minutes, is therefore obvious. Excess of lime is shown by the samples cracking after immersion in water, in consequence of the expansion of the free lime when wetted. Excess of clay can be detected by the colour and low tensile strength of the cement. At the works under consideration about 75 per cent. of carbonate of lime is found to be the best proportion, this quantity being present in the dried samples of the mixture of chalk and clay as it leaves the mixing mills, or wash mills, as they are technically called. There are in the old works of which we are speaking two of these mills, which are of the usual form, each consisting of a vertical shaft driven by bevel gearing and carrying eight horizontal arms, from which depend four cast iron harrow frames, into which are inserted wrought iron "tines" or teeth, the whole revolving in a brick tank. As the "tines" are driven through the mixture of chalk, clay, and water—the latter element being admitted to the extent of about 300 per cent. of the two former by weight—the materials are disintegrated at the same time that they become thoroughly mixed; continued washing rendering the particles so fine that the motion of the mill carries them along with the water through brass wire gauze sieves containing 30 holes to the lineal or 900 holes to the square inch, these sieves being arranged in such a position at the periphery of the brick tank that the mixture which passes through them may be conveniently removed by pumping and conveyed to the settling reservoirs for precipitation by gravity. The chalk when it is put into the mill contains about 20 per cent. of water, and is nearly pure carbonate of lime, containing only about 2 per cent. of extraneous manner, principally sand. The clay contains about 40 per cent. of water, and is composed chiefly of silica and alumina. The chalk is dug from the hills in the immediate vicinity of the works, and the clay is obtained from the surrounding marshes or brought in barges from the Medway, fuel only not being procurable on the spot. The mixture of chalk, clay, and water which is now in a creamy state, has been followed to its resting place in the "backs," or large settling reservoirs, constructed on the earth with chalk walls faced with concrete, covering a considerable area and having a depth of 3ft. 6in., where it has to remain until the superfluous water can be allowed to flow away through penstocks having sills, which can be gradually lowered as the deposition of solid material takes place and level of the water in the reservoirs falls. As may be imagined, the settling process occupies many weeks, and the precipitation effected is by no means even, the coarser particles remaining close to the inlets, and the finer ones being floated to more remote regions by the water. When all the moisture, except about 50 per cent. by weight, has been removed, the "slurry," as the resulting thick mud is named, is dug out, placed in barrows, and wheeled to and spread upon—to the depth of 6in. or 7in. —the drying floors, large tiled surfaces, under which the flues from the ovens, where coke is prepared for the kilns, pass, and the remaining moisture is then evaporated. When dry the "slurry" is loaded into skips and taken to the kilns, into which it is introduced in alternate layers with the coke already mentioned as being produced in the ovens, along with a large addition of gas-coke. The proportion of dried "slurry" to coke is about three of the former to one of the latter by measure, but this ratio is constantly varied at the discretion of the "burner," who is engaged in loading the kiln, and who is responsible for its proper performance. The kilns when loaded and heaped up are lighted at the bottom by faggots, and having a capacity of about twenty-three tons yield, they take about sixty hours to burn off. When they have burnt out the fire-bars are dropped and the burnt slurry, called "clinker," is withdrawn, great care being taken by those engaged in its removal to pick out all the pieces of cinder and over-burnt material and extraneous matter. Good "clinker" should be of a greenish-black colour free from yellow or pink lumps, and although of a dense, compact nature, not too solid or hard. When it is removed from the kilns, the "clinker" is wheeled in barrows to one of Blake's crushers, where the lumps are reduced to the size of walnuts; it is then lifted to a loft above the grinding mills, where it is passed between horizontal stones, similar to those used in flour mills, 4ft. 6in. in diameter, and running at the rate of about 120 revolutions per minute. The powder coming away from the stones is of a greyish colour, and is the finished cement; it should be of such fineness that not more than 20 per cent. would be rejected by a sieve having fifty meshes to the lineal inch, or 2500 holes to the square inch. After leaving the mill the cement is taken to a large store, where it is filled into barrels or sacks after having been first carefully turned over in considerable quantities for the purpose of mixing and cooling. The packages of cement are loaded into vessels which come alongside the store.

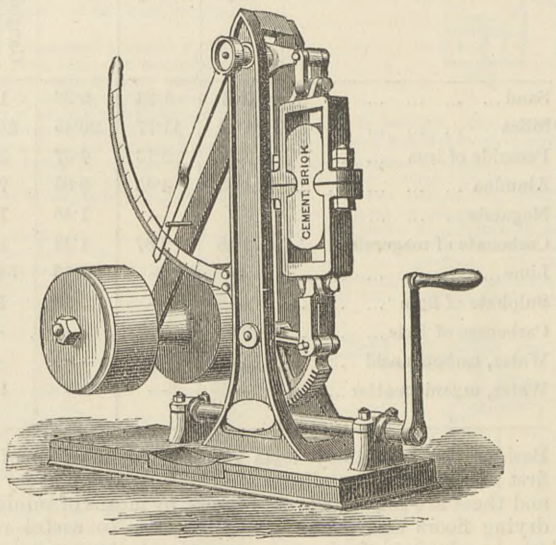
It may be mentioned that at these works there are three wash mills, two as described here and one of a newer form to be described hereafter; fourteen backs, thirty-two coke ovens with drying floors; eleven kilns, two of which are worked on the continuous burning principle; and seven grinding mills. There are four stationary and one portable engine for driving the machinery, and there are two steam cranes. The total indicated horse-power of the engines for washing, crushing, and grinding, at the Cliffe works, is about 250. The ordinary production of a pair of the 4ft. 6in. millstones is 15 to 20 tons in ten hours.

Having described the ordinary—or heretofore most commonly adopted—process, as carried on in the old works, we now come to the large new works which have been recently constructed from the designs and under the superintendence of Mr. Michélé. These embody what may be considered the latest improvements which have been successively applied. Several other schemes, some of them possessing considerable merit, were most carefully considered, and the greatest pains were taken to arrive at a sound and impartial conclusion. In these works there are sixteen kilns in one battery, each capable of turning out 25 tons of unground cement or clinker, fitted with sixteen patent drying chambers connected with a chimney 200ft. high with a clear opening at the top of 7ft. 8in. The machinery consists simply of four patent wash mills, a set of three-throw "slurry" pumps, a Blake's stone crusher, and six sets of millstones, the whole being driven by a pair of Corliss engines, which work up to 240-horse power, and are supplied with steam by four Lancashire boilers working at 75 lb. pressure. A building to receive and store the ground cement completes the works. The wash mills illustrated on page 186 of THE ENGINEER, 14th March, 1879, are constructed under Mr. Michélé's patent. The pan or tank, vertical driving shaft, harrows, and tines, are similar in their construction and action to those already described, although somewhat smaller in diameter. Instead of being fitted with fine brass wire sieves, through which the particles of chalk and clay have to be carried by the addition of about three times their weight of water, each pan supports on its upper edge a cast iron ring about 9in. wide, built up in segments and serrated on its upper surface; upon this ring, suspended tc the lengthened arms of the wash-mill, rotates a similar one which is weighted by bricks. Between the surfaces of these two rings the effluent sludge finds its way, and is by them reduced to the requisite degree of fineness. The advantage of this construction is that instead of having to add a large quantity, about 300 per cent. of water, which acts only as a carrier to pass the mixed materials through the sieves, and as soon as this is accomplished has to be removed, only a very small quantity, about 13 per cent. of water is added, which is found sufficient to insure the due amalgamation of the chalk and clay in the mill and during their passage between the plates. As has been said before, the chalk contains ordinarily about 20 per cent. of moisture and the clay about 40 per cent., so that when they are used in the proportion of 2 chalk to one clay the inherent water equals 26·66 per cent. When to this is added 13·34 per cent., the sludge upon leaving the mill will contain 40 per cent. of moisture. This quantity enables the slurry to be conveniently pumped, and is not found too large to be subsequently driven off by the waste heat from the burning process. This waste heat is utilised by the adoption of the valuable contrivance known as Johnson's patent chamber, with the improvements which have been patented by Mr. Michélé, and illustrated in our impression of the 14th March, 1879. Each kiln is fitted with one of these chambers—which is of simple construction, and is cheaply maintained. It consists of a 9in. brick arch, 15ft. wide, 5ft. high at the centre, and 65ft. long, extending over top of the kiln in a horizontal direction towards the high chimney, with which its opposite end communicates by means of a short flue. The whole is built "brick-on-end," the portion over the kiln being "fire work," the rest ordinary "stock." There are openings along the top for the admission of the slurry and coke, and for the purpose of ventilation and lighting, as well as for the ingress and egress of the workmen. The abutments of the arches are substantially built, and support two concrete walls, which, with the arches, form pockets on the outside of the chambers, and prevent the slurry intended for one kiln from passing to the next. Into these pockets the slurry is pumped direct from the wash mills, without any intermediate process, and after remaining in them a few hours, the most liquid portion is allowed to flow into the interior of the chamber, where it spreads itself over the floor to a depth of a foot or so. The stiffer portion which has remained in the pockets is then "spitted" up on to the top of the arch. The kiln, having been loaded with the previously dried material from the chamber, is lighted up in the ordinary way. The heated gases rise up, and passing through the chamber to the chimney, dry the material in the inside as well as on the top. Thus, the old drying floors with coke ovens are entirely dispensed with, and the expense of making and maintaining them is saved. The dried material being on a level with the tops of the kilns, it is conveniently wheeled to them in barrows, and loaded in the usual way. The head room of 5ft. at the centre of the arch is found to be sufficient for the men to work in without discomfort. After the kilns are burnt off, the clinker is drawn out and ground as before described. In addition to the saving effected by the abolition of coke ovens and setting backs, it is found that about 5 per cent. more carbonate of lime can be used, and that the quality of the cement produced is more uniform on account of the more even distribution through it of the coarser particles, which in the back process generally settle down near the inlets. The patent wash mills require no skilled attendant, being managed by the loaders engaged in filling the chalk and clay into them. The plates do not require touching when they have been once set to work; they will run between one and two years, when they can be cheaply replaced. The chambers are simple in construction, last well, and require but few and inexpensive repairs. By their use the large quantity of coals ordinarily used in the coke ovens is entirely saved, and the waste heat from the kilns is utilised in a practical and economic manner. From the value of the coals saved must be deducted that of the coke which would have been produced under the old system. Theoretically, a ton of good coking coal should produce a chaldron of coke, which would be superior to that obtained from gas works; but in practice, to obtain increased heat for drying purposes, the ovens are often disturbed, and too much air admitted, so that the chaldron resolves itself into half, and sometimes even less; it is therefore difficult to make any reliable comparison, but it may be accepted that the saving in fuel is appreciable, if it does not actually amount to several shillings per ton on the cement produced. We have thus described the two cement works of Messrs. Francis and Co., which may be looked upon as typical, one of the old, or system most commonly in use; and the other of the new, or that embodying the most recent improvements which have been successfully applied.

Mention has been made of the modes of testing adopted in the first stages of manufacture under the old or "back" system. Under the new system the test for carbonate of lime is applied, with the addition of a simple daily test to ascertain the percentage of water in the sludge as it leaves the wash mills. The small sample kilns are dispensed with, as they are not found to be necessary when the time occupied by the whole process of manufacture is reduced from about eight or ten weeks to very nearly as many days. Under both systems, as the ground cement issues from the millstones it should be sampled almost every hour, and pats made and immersed in water as soon as set, in order to at once detect any excess of lime. Briquettes also are made every day from this freshly-ground cement, and their tensile strength tested at two or seven days. Further, the powder is frequently sampled and tested for strength both in the store-shed and as it is loaded into vessels upon leaving the works. There is little doubt that were it practicable no cement should be allowed to quit any works until it has satisfactorily passed a seven days' test for tensile strength, but in consequence of the large masses of material dealt with, and therefore the enormous extent of warehouse room for storage required, to say nothing of the extra cost of labour for moving which would be entailed, it is not found to be possible to insist upon such a practice being always adhered to, although in some special cases it is. It is the custom in some specifications to insist that all the cement used shall be tested upon the works for which it is intended, and the manufacturers are sometimes bound to remove at their own cost any which will not withstand a given tensile strain. The result is that when the guaranteed test is a very high one it is necessary for the manufacturers to charge an unusually high price for their produce, in order to cover the exceptional risk which has to be undertaken. It would seem to be more advantageous to all concerned if the cement could be always tested, as it now sometimes is, by competent persons before it leaves the manufactory. This practice reduces the manufacturers' risk considerably, as in the case of a heavy cheap material like cement the cost of carriage to the spot where it is used often amounts to a very considerable portion of its total value, and it saves the user the expense of erecting large stores to contain the cement whilst it is being tested, as well as the risk of damage by damp, which must necessarily be greater in what are usually temporary structures than in the properly constructed permanent stores at a cement manufactory.

It may here be well to describe in detail, for the information of those who may not have had occasion to test any cement, the usual method pursued. The powder is first filled as tightly as possible into an imperial bushel measure and weighed. It is considered that this quantity should not weigh less than 112 lb., but it often weighs more. If the weight is less than 100 lb., it will probably be found that the cement has been imperfectly burnt. After ascertaining the weight per bushel, a small quantity is again weighed, and then sifted by means of a sieve with fifty holes to the lineal or 2500 holes to the square inch. The residue obtained should not exceed 20 per cent. of the total weight of powder under trial. The cement should be ground to this degree of fineness, but Mr. Michélé considers that it should not be sifted, as by the use of a sieve the hardest and, in his opinion, the best particles are removed. The next test, for the purpose of ascertaining if there be any excess of lime, is conducted as follows:—By the use of a trowel, the powder, with the addition of as little water as possible, is mixed up to a stiff paste, with which small pats are formed, which are immersed in water on pieces of slate as soon as the cement is set. If there are no cracks visible on their surface, after immersion for forty-eight hours, it is generally considered that there is no dangerous excess of lime, although there can be no doubt that it is better to extend the time to three days, or as long as possible.

The next test applied is that for tensile strength. At the time the pats referred to are made, some of the stiff paste is carefully placed in brass moulds, which are so constructed that after forming "briquettes" with accurate breaking sections of 1½in. by 1½in. equal to 2¼ square inches in area, they can be easily removed. These "briquettes" should be made with great care, and only by those who have had considerable experience in their formation. Slight inattention or want of the requisite knowledge on the part of the operator will be the cause of perplexing and contradictory results. The briquettes are usually left in the moulds for twenty-four hours, when they are removed and immersed in water until the seventh day from that on which they were made, when they are tested in one of Mr. Michélé's machines illustrated herewith. It



has been found that the best cement so tested should be capable of withstanding a tensile strain of from 300 lb. to 350 lb. per square inch. Though briquettes having a breaking section of 2¼ square inches are used in conformity to established usage, Mr. Michélé urges the desirability of substituting an area of one square inch. No substantial arguments can be advanced in favour of the larger section, and it has many inconveniences. To revert to the tensile strength of Portland cement, although as much as 500 lb. and upwards per square inch at seven days has been obtained, it is found that with the existing appliances for manufacture these high strengths are sometimes obtained at the sacrifice of ultimate strength, on account of the high proportions of lime which must be used. The strongest and best cement is that which contains the greatest proportion of lime properly combined with the silica and alumina of the clay. If there is even a slight excess of lime—that is, free, uncombined lime—the cement will sometimes withstand a high tensile strength at seven days, but will be found to depreciate instead of improve in strength afterwards. Too much attention cannot be paid to the test for lime, for if there be any of this free, sooner or later it will make itself known, either by the work for which it has been used showing signs of cracking or crumbling, or by its total collapse. No doubt the first consideration is to obtain the strongest possible cement in order that it may form an effectual matrix for the greatest number of particles of sand or other foreign material, but it is also obvious that unless the strength is permanent or increasing it is valueless. Thus, the cement which really presents the best and most lasting qualities is not necessarily that which shows the highest tensile strength at seven days. There are many practical difficulties in the way of extending the age of briquettes before breaking from seven to fourteen or twenty-eight days, though such a practice would enable a more accurate estimate to be formed of the material tested. Mr. Michélé seems to consider that for the present the best cement may be secured by a specification which ensures an average tensile strength of 300 lb. to 350 lb. per square inch at seven days, coupled with a strictly enforced test for lime. Briquettes may be broken at four days as well to enable some opinion to be formed of the growing strength of the cement between that age and seven days, but the results so obtained must only be taken with due regard to the time the cement takes to set in the first instance. A quick-setting cement will show but little improvement in strength between four and seven days, whereas one which takes many hours to become firm will often show a very considerable increase of strength in the same period.

It is impossible to foretell what may be reached in the future. Judging by the strides which have been made during the last ten years in the direction of improving the tensile strength of Portland cement, it might be assumed that before the lapse of another similar period strengths of 500 lb. and upwards per square inch at seven days will become common. There is, however, a danger in specifying too high degrees of strength at present. The first aim of an engineer who is responsible for works constructed with Portland cement, is the production of a material for him with the highest possible tensile strength, but at the same time without containing any excess of lime which has not become properly combined in the process of manufacture, and which is therefore liable to expand and disintegrate his structure. The mode of testing above referred to when strictly adhered to will, it is believed, ensure a practically safe cement under the present mode of manufacture, but fresh means may have to be devised in the future. Before, however, any great and striking improvement in the quality of Portland cement can be expected, it would seem to be necessary that the fundamental principle involved in the setting or hardening which takes place when water is added to the powder should be understood chemically. Although several hypotheses have been enunciated to explain this remarkable property of cement, none of them seem satisfactory to chemists. This is a most important question and one which merits the attention of chemists and physicists as well as engineers, for it has an important bearing upon the stability of some of the largest engineering works in the world.

THE INSTITUTION OF CIVIL ENGINEERS.

THE ANALYSIS OF POTABLE WATER.

At the ordinary meeting on Tuesday, the 24th of January, Mr. Brunlees, vice-president, in the chair, the paper read was on "The Analysis of Potable Water, with special reference to the determination of Previous Sewage Contamination," by Mr. Chas. W. Folkard.

In the first place, the author reviewed the present state of analytical chemistry, the conclusion being that, as far as mineral substances were concerned, the existing methods were nearly perfect. But when organic analysis was considered, a different state of things was apparent, owing to the great number, complexity of structure, and unstable nature of many organic bodies, especially those contained in the secretions and tissues of plants and animals, in addition to which organic matter was present in drinking water in very small quantities, and always more or less mixed with other substances.

The subject might be divided into four parts:—(1) The various ways in which water became contaminated; (2) the methods employed by analysts to detect and determine the extent of this contamination, with an opinion as to the probable value of these methods; (3) the bearing of the results of biological and microscopical investigations on the subject; (4) the utility of irrigation, chemical treatment and filtration, for purifying purposes.

Under the first of these heads, the normal constituents of rainwater were considered, all of which were practically harmless, so that rain-water, as it fell on the earth, or on the gathering grounds of a system of water supply for a town, was unobjectionable, having contracted but an inappreciable amount of contamination. Spring water was not so pure, owing to its percolation through strata from which various mineral substances were dissolved. River water was the most objectionable, on account of the enormous quantities of animal and vegetable contamination which it acquired. Lastly, well water varied greatly in quality, in some cases being excellent where the wells were deep and surface water was excluded, or when the district was thinly peopled; in other instances well water was more contaminated than river water, as in shallow wells in towns.

Under the second heading, the author pointed out that analytical chemists had hitherto been compelled to be content with the examination of the products of decomposition, or with the determination of one or two constituent elements of the organic impurities of water. Unfortunately, the products of decomposition of the organic matter in water were the same as the normal constituents of rain, viz., carbonic acid, ammonia, and nitric acid. It was therefore impossible to ascertain whether those substances were derived from contaminating bodies or had been dissolved by the rain in falling.

The various processes of water analysis were then considered. In the first and oldest method a measured quantity of water was evaporated, and the residue was subjected to a red heat in a platinum dish. By this treatment the animal and vegetable substances were burnt away, and from the loss of weight, the amount of organic matter was inferred. One great objection to this and the following process was the evaporation of the water. With such unstable bodies it was by no means improbable that a large portion was destroyed during the process. By the second method the solid matter, left after evaporation of a known quantity of the water, was mixed with an oxidising agent and heated to redness in a glass tube. The carbon and nitrogen of the organic matters in the residue were obtained in the form of carbonic acid and nitrogen gases, from which were deduced the weight of carbon and of nitrogen present as organic matter in the residue. This ratio of carbon to nitrogen did not, however, afford the slightest clue to the identity of the organic matter. It might be intensely poisonous or dangerous, or, on the other hand, harmless.

The albumenoid-ammonia method consisted in boiling the water with an alkaline oxidising agent, by which the organic matter was decomposed, and part of its nitrogen evolved in the form of ammonia. This had the great advantage of simplicity of manipulation, and was not open to the objection that previous evaporation was required.

The last considered was the permanganate method. In this the index of impurity was the amount of oxidising agent—namely, permanganate of potash, required to destroy the organic matter in the water. Inasmuch, however, as no relation had been established between the oxidability of a body and its action on the animal economy, this method would not afford reliable evidence of the fitness of a sample of water for drinking purposes or the reverse.

Under these circumstances the conclusion seemed inevitable, that the subject was as yet beyond the power of the analytical chemist.

It was, however, possible, by the second method, to determine approximately the minimum amount of contanimation which had taken place since the water was precipitated as rain. For this purpose the whole of the nitrogen existing in the water was estimated, and the average amount in rain falling on the surface of the earth deducted. The remainder was due to animal and vegetable contamination, and it has been found convenient to express it in parts of average London sewage; that was to say, the sample was returned, as having been contaminated to the same extent as if pure rain-water had been mixed with so many parts of ordinary sewage. But this afforded no direct evidence as to its fitness for dietetic purposes, because subsequent oxidation and fermentation might have rendered the water to a great extent harmless.

The author next considered the bearing of biological research on the subject, pointing out that mere dilution had an almost inappreciable effect in disarming the germs of disease of their power. Thus, supposing a glass of water to contain but one germ, if the person taking it was sufficiently unhealthy or weakly, he would contract the disease almost as certainly as if there were hundreds of germs. In the author's opinion it would be impossible to banish zymotic disease from towns, the water supply of which contained the dejecta of persons suffering from the disease, even though present in the most minute quantity. The very weakly would contract the complaint from the water, and from them it would spread to the more robust around them. Again, these germs were endowed with such persistent vitality, that they withstood the effects of heat and cold, moisture, drought, and chemical agents to an almost incredible extent, affording what seemed, at first sight, indisputable evidence of the now exploded doctrine of spontaneous generation. From this it appeared that once-contaminated water was unsuitable for dietetic purposes.

In conclusion, the author contended that a radical change was the only remedy. Irrigation and chemical treatment were alike powerless; in addition to which, during heavy rain all existing sewerage systems were incapable of dealing with the huge volumes of water poured into them, and the sewage was allowed to flow direct into the river, to the manifest disadvantage of the towns below, who were dependent upon it for their water supply. Filtration, again, was powerless to effect real purification. The germs of disease were so minute that they could pass one hundred abreast through the interstitial spaces of ordinary sand, and dissolved substances were, of course, unacted upon. In view of the great increase in cancerous diseases of the stomach and intestines, the subject was worthy of the most careful study, and taking into consideration the unreliability of the results afforded by chemical analysis, the only way to ascertain if a sample of water was fit for drinking purposes was, in the author's opinion, to trace it to its source, and see that contaminating matter was excluded from the time that the water fell as rain till it entered the reservoir or engine-well.

RAILWAY MATTERS.

THE signalman Butler, charged with manslaughter in the Desford railway accident, was acquitted on Tuesday at the Leicester Assizes.

THE Central Metropolitan Railway Company, Limited, has lodged the necessary parliamentary deposits for its Bill for the underground railway from Westminster to King's Cross.

A SYNDICATE has been formed for surveying a line of light railway from the seashore of the Gold Coast through the gold-mining districts of Wassaw. The surveyors will leave Liverpool for the Gold Coast on the 28th inst.

THE North British Railway Company has received intimation from the Board of Trade that Mr Barlow's plans for the new Tay viaduct have been approved. The communication of Mr. Walker, manager of the company, to the authorities in Dundee that work will be at once proceeded with, has given much satisfaction.

THE long-projected railway bridge over the Hooghly, which will enable the East India Railway to be run direct into Calcutta, is, it is stated, to be taken in hand immediately. The main feature of the bridge is three wrought iron girders, each 400ft. long. The cost will be £275,000, and will be borne by the Government. The work will occupy three or four years.

EARL DELAWARR will, during the approaching session, introduce a bill, the object of which is to make the use of continuous brakes on railways compulsory. It will be proposed that after the 1st of February, 1885, every company shall have in connection with each passenger train a continuous brake, which shall be efficient in stopping the train, instantaneous in action, and applicable without difficulty. It must also be immediately self-acting in case of accident, capable of being easily removed, and be of durable material. The brake in each vehicle of a train is to be susceptible of being worked as part of one system. The Board of Trade is to have power to inspect rolling stock, especially with a view to the use of the brake.

BIRMINGHAM, our correspondent writes, is very much behind other centres of similar importance in the matter of tramway accommodation, for she is possessed of only four and a-half miles of tramways, against a considerably greater extent in other towns. The Public Works Committee of the Corporation are on the whole opposed to tramways, for they consider that many of the streets of Birmingham are too narrow, or their gradients too steep, to permit of the safe working of the lines, and they also object to them because of the obstruction incident to their construction and repair. Several applications for provisional orders for the construction of new tramway lines in the Borough have late been made to the committee, and on Tuesday the committee obtained the sanction of the council to deal with these applications "as they might deem advisable in the interests of the council."

IT is estimated that 7500 miles of new railways were constructed last year in the United States; and, according to the Philadelphia correspondent of the *Times*, no less than 18,000 miles of new railway are projected for the current year. A comparison of the new mileage of 1881 with that of each of the previous nine years shows the following result:—1872, 7340 miles; 1873, 3883 miles; 1874, 2025 miles; 1875, 1561 miles; 1876, 2460 miles; 1877, 2303 miles: 1878, 2916 miles; 1879, 4430 miles; 1880, 5839 miles; 1881, 7500 miles. Capital is thus being set fast in new railroad undertakings, with greater rapidity than during the railway mania which culminated in 1872. It is true that now the States are much better populated and far wealthier than they were nine or ten years ago; they thus need, and can afford to provide, much more ample means of communication; but it wants a lot of wealth and people too to afford and support a capital outlay of an extra £90,000,000 on railways.

A CORRESPONDENT has sent the *Times* the following table showing what may be called the maximum speed accommodation to or from London provided by nine different railway companies, and the fares per mile at which they respectively provide it. Wherever the length of the line is sufficient the run taken is considerably over 100 miles, with at least one intermediate stoppage:—

No.	Railway.	Test Station.	Miles from town.	Speed. Miles per hour.	1st Clss. Fares. Pence per mile.
1	Great Northern	York	188	48·000	1·755
2	Great Western	Bristol	118	45·384	2·652
3	London, Chatham, and Dover..	Dover	78	44·571	3·076
4	Midland	Derby	127	44·046	1·606
5	London and North-Western ..	Crewe	158	43·880	1·835
6	South-Eastern	Dover	76	42·617	3·157
7	South-Western	Sherborne	118	40·227	2·440
8	London, Brighton, & South-coast	Brighton	50	40·000	2·950
9	Great Eastern	Norwich	126	36·000	2·000

It is obvious that the shorter lines—the London and Brighton, the Chatham and Dover, and the South-Eastern—are unduly favoured on this principle and occupy a higher place than they deserve, and this is especially remarkable with respect to the Great Western, which runs distances a little over that chose, at an equal or greater speed than that given for the Great Northern. The fares of the two latter speak for themselves, and it should be remembered that the boat trains—for which credit has been given—start at very inconvenient hours for passengers, and are almost the only good trains which they run. The performance of the Great Northern and the fares charged, are astonishing. The Great Eastern now run some good trains, and the Midland trains are good and fares low.

THE recent disastrous accident at Blackburn, it need scarcely be said, has necessitated an alteration of the traffic arrangements at that station. As a result of the directors' report with regard to this matter, it is proposed to re-arrange the whole of the station, and the company purpose laying out, more in the centre of the town, a new goods station entirely, the present goods station being utilised solely as a mineral yard. At Fleetwood the company is erecting a large new passenger station for the accommodation of travellers by the Belfast and Isle of Man boats, together with extensive storage accommodation to meet the requirements of the important cattle traffic with the Irish ports. The station will consist of one central platform 250 yards in length, with a line of way on either side, and a covered in roof 516ft. in length. The station will be constructed with a complete set of apartments consisting of refreshment and waiting-rooms, in connection with which will also be dressing-rooms for the accommodation of the steamboat passengers. From the station to the boats there will also be a covered way, so that the passengers can change from the one to the other completely under shelter. Between Heaton Lodge and Dewsley Junction, about a mile on the east side of Mirfield station, the company are widening the main line for a length of about a couple of miles, and which will include the erection of a viaduct over the Calder. By this widening, its own traffic and that of the London and North-Western will be worked on separate lines. At Shawforth branch an extension of line from Facit to Bacup has just been completed, although not yet opened for traffic, whilst the station at Bacup has been rebuilt and re-arranged. This extension in connection with the recent widening of the Bacup branch, which was completed about twelve months ago, will facilitate the working of the whole of the traffic over that district, and provide additional means of communication between Bacup and the Yorkshire towns generally. Other important work, which can be only briefly summarised, consists in enlargements and improvements which are being carried out at all the stations along the Lancashire and Yorkshire Company's coast line from Liverpool to Southport.

NOTES AND MEMORANDA.

THE number of post-cards despatched in Germany during the year 1880 was 123,000,000. In the Post-office Museum at Berlin there are exhibited 418 different kinds of post-cards.

THE French census returns shows the following results:—Lyons, 332,894; Nantes, 121,965; Rouen, 104,721; Havre, 103,063; Toulon, 73,900; Alger, 64,714; Grenoble, 50,967; Bordeaux, 221,520.

ACCORDING to the *American Manufacturer*, it would seem to be easy to prepare phosphor brass. Its directions are—introduce about one-tenth of 1 per cent. of dry phosphorus into the melted metal—good red brass—in a covered crucible.

THE many earthslips that have recently taken place in Switzerland are believed to have some connection with the earthquake shocks which of late have been so frequent. Twenty-one of those phenomena were noted in different parts of the country during the month of December alone.

A GREAT mass of rock from a height of 1000ft. has fallen from the Rothrisi above Ennenda, near Glarus, swept away part of a forest, and destroyed orchards, roads, and meadows. No lives were lost; but the mass falling that distance did some work before it came to rest. Geological forces seem to be working hard just now to level Switzerland.

WATERS from shallow wells in or upon Devonian rocks are, as a rule, much more polluted than those situated in Silurian strata. Out of twenty-five samples of well waters from the Devonian rocks of Cornwall and South Devon, according to Mr. De Rance's new book on Water Supply, only eight were fit for human consumption. Of these twenty-five waters the hardness from 5·0 at Mr. Boon's well, Ivy Bridge, Devon, to 44·3 at the Fort Pump, New Quay, Cornwall.

ACCORDING to Mr. De Rance's new work on Water Supply, the Thames Basin includes within its area 170 square miles of lias, 931 of oolites, 5 of Hastings sands, 13 of Weald clay, 453 of greensand and gault, 2096 of chalk, and 945 of tertiary deposits. The chalk above Kingston occupies 1047 square miles, and has a storage capacity of sixteen months—according to Mr. Beardmore—who estimates the annual rainfall off at Kingston, between 1850 and 1868, to give an annual mean rate of 7·83in., while the mean rainfall of Oxford was 26·08in., the remainder being absorbed by vegetation or evaporated.

AT a recent meeting of the Academy of Sciences, New York, Professor Eggleston said he had discovered tellurium in certain copper products from Colorado. The sample examined had been found to work unsatisfactorily, and was supposed to contain arsenic and antimony, as the pig yielded dense white fumes in the furnace. After a careful examination no arsenic or antimony was found, but nearly one-half per cent. of tellurium. The fumes poisoned the furnace, and the copper manufactured cracked in the rolls was useless except for brass of poor quality, but was quite suitable for the manufacture of cupric sulphate.

THE uses of asbestos increase every year. Asbestos, in the form of a felt or tissue, is said to make a good filtering medium for the chemical laboratory, as it resists the action of corrosive acids as well as of fire. For the same reason, a pair of gloves woven from this substance is useful for handling acids. A sheet of asbestos card covering the table preserves it, and also prevents the breakage of small glass objects. Asbestos makes excellent porous cells for a galvanic battery; and kneaded with plastic clay, affords a good luting for the stoppers of bottles. Asbestos paint, used to protect objects from fire, has also been lately manufactured.

SIX THOUSAND three hundred and twenty-two vessels, with a total tonnage of 3,686,982 tons, cleared out from London with cargoes during the past year of 1881, showing the following results, compared with the previous year:—1881, number of ships 6322, tonnage 3,686,982; 1880, number of ships 6375, tonnage 3,607,952; decrease in the number of ships 53, increase in tonnage 79,030 tons. For the month of December last the result of the trade was—December, 1881, number of vessels 536, tonnage 317,858; December, 1880, number of vessels 511, tonnage 294,388; increase in the number of vessels 25; increase in tonnage, 23,470.

AS a means of making printers' ink from cotton waste, M. Bastand subjects cotton waste, in a closed vessel, to the action of bisulphate of carbon, or any other liquid having great affinity for oil and capable of evaporating at a lower temperature. It should completely saturate the cotton contained in the vessel, and run off with the oil and grease of the waste into a suitable receptacle, in which the mixture is subjected to the action of heat. The bisulphate of carbon is evaporated and condensed, to be used over again, and the oil and grease serve admirably, according to the *Journal* of the Society of Arts, for printers' ink, while the cotton waste, deprived of its grease, is as useful as before.

IN one form of secondary battery M. J. Rousse uses for the negative electrode a sheet of palladium, which during the electrolysis absorbs more than 900 times its volume of hydrogen; at the positive pole he uses a sheet of lead; the electrolyte being a 10 per cent. solution of sulphuric acid. Another form giving good results is produced by making the negative electrode of thin sheet iron, which absorbs more than 200 times its volume of hydrogen when electrolysed in a 50 per cent. solution of sulphate of ammonia. The positive pole is formed of a sheet of lead covered with a layer of litharge. Platinum and palladium are, however, too dear, unless used to platinumise or palladiumise other substances for electrodes.

FOR diminishing the danger of conflagration in theatres, Signor Giovanni Abelo Martini recommends the following formulæ for rendering materials non-inflammable in the three different cases below:—(1) Mixture suitable for light tissues: Pure sulphate of ammonia, 8 parts; pure carbonate of ammonia, 2½ parts; boracic acid, 3 parts; starch, dextrine or gelatine, 2 parts; water, 100 parts. (2) Mixture suitable for scenes already painted, timber work, furniture, doors, and windows, to be applied like paint with a brush, at a temperature of about 140 deg. Fah.: Hydrochlorate of ammonia, 15 parts; boracic acid, 5 parts; glue, 50 parts; gelatine, 1 part; water, 100 parts. (3) Mixture suitable for cloths, ropes, and straw, which should be immersed for fifteen or twenty minutes, at a temperature of 212 deg. Fah., and allowed to dry: Hydrochlorate of ammonia, 15 parts; boracic acid, 6 parts; borax, 3 parts; water, 100 parts.

SOME time since the German Society for the Promotion of Industry offered a prize of 2000 marks for the best manganese alloys, with a view to obtain samples which might be tested for their physical qualities, especially their tensile resistance, and by this means to ascertain the influence of manganese on iron. The competitors were the Gutehoffnungs Ironworks, Oberhausen, and R. Seelhof, engineer of the cast steel and arm factory, Witten. No less than 20 iron rods were required, which had all to be 50 centimetres long and 40 mm. thick. The first lot was to consist of an alloy of manganese and iron, of which the carbon did not reach 0·6 per cent., and all other substances were not allowed to exceed 0·4 per cent. The second set was to consists of carbon containing an alloy, manganese, and iron, in which all other substances were not allowed to exceed 0·6 per cent. The chemical analyses and tests show that it is very difficult to mix alloys or different sorts of iron, that manganese is very easily oxidised and disappears from the alloy, and that when the rods were worked in a lathe or with a plane, and prepared for the tearing tests, they exhibited a large number of spots, showing that the amalgamation was imperfect. Notwithstanding that the results were not in accordance with the conditions, the society agreed to award the prize to the competitors on account of the trouble they had taken. The Gutehoffnungshutte having come nearer the conditions, was awarded two-thirds and Seelhoff one-third of the prize offered.

MISCELLANEA.

THE foreign ice trade with India is disappearing, American ice being unable to compete with the ice now locally manufactured in all the large Indian towns.

WITHIN the last few days borings for ironstone, which have been attended with the greatest success, have taken place on the estate recently purchased by Mr. Bolckow on the Hambleton Plain. It is well known that ironstone exists along the chain of the Hambletons, of which the Cleveland Hills are a northern extension.

ON the 19th inst. Messrs. Robert Thompson and Sons launched from their shipbuilding yard at Southwick, Sunderland, an iron screw steamer, the Mastiff, built to the order of Messrs. R. Thomson and Co., London, of the following dimensions, viz.:—Length over all, 251ft.; breadth, 35ft.; depth of hold, 22ft. 9in. She will have engines of 130 nominal horse-power, by Messrs. S. and H. Morton and Co., of Leith.

THE *Colonies and India* draws attention to the fact that the electric light has in every sense a larger field for its operations in the colonies and India than in the old country. Here it has to invade a field already occupied by gas. There it will find itself in many cases without a rival. Even where gas is already supplied in the colonies the price is so high as to place electricity under much more favourable conditions as to comparative cost than in England.

THE quarterly return made to the Board of Arbitration for the North of England iron trade shows a remarkable increase in productive power for the quarter, amounting to 25,167 tons, the total output being for the quarter—rails, 4428 tons, at the net average price of £5 6s. 1½d.; plates, 111,525 tons, net average price £6 1s. 8¾d.; bars, 20,332 tons, net average price £5 19s. 4¼d.; angles, 34,244 tons, net average price £5 9s. 7¾d. The increased production has been almost entirely in shipbuilding iron. The production of manufactured iron for the whole year is 598,417 tons, as compared with 508,436 tons in 1880—an increase of about 90,000 tons.

OUR Sheffield correspondent writes:—"I notice the death of Mr. John Rosely, of Haverholme House, Lincolnshire, one of the leading men in the iron and coal trade of the north. He was the son of a mining enthusiast in Durham, and began life by assisting his father in tapping the great bed of Cleveland ironstone at various points long before that immense deposit was thought of by capitalists. In Lincolnshire, the scene of his greatest success, he lived to see, what twenty years ago was a barren moor, a busy hive of industry—twenty blast furnaces, consuming over 1,000,000 tons of iron ore per annum, yielding 365,000 tons of pig iron of the nominal value of £1,000,000, and affording work to 2000 hands."

THE Leeds Waterworks Committee resolved that boilers shall no longer be supplied under high pressure direct from the waterworks main pipes. The committee find by experience that it is impossible always to maintain the very high pressure in the mains that is needed, and the varying demands made for other purposes at certain periods of the day, and the occurrence from time to time of burst pipes or blown joints, render the constant maintenance of such a pressure impracticable. Some months ago a manufacturer in Leeds, whose boilers were supplied direct from the mains, gave the Waterworks Committee formal notice that he should hold them responsible for the consequences of any accident to his boilers by reason of a falling off or cessation of the pressure in the mains. The committee have resolved to put a stop to the possibility of any such claim in the future.

IT is still said that the proposal to construct a canal *viâ* Lake Nicaragua, in opposition to M. de Lesseps' Panama scheme, is taking definite form in New York. A company is being formed, and application will be made to the Legislature for a Bill incorporating the company and granting it special powers. It is proposed that the capital shall be £5,000,000 sterling, and that the United States shall guarantee the interest on the subscribed capital at a minimum of 3 per cent. for twenty years from the opening of the canal. Several Californian speculators have arrived at Panama for the purpose of erecting "villas" on the route to be taken by the Panama Canal. The first of these is to be constructed at Gatien, and will comprise fifteen distinct buildings, with accommodation for 400 men, including a separate dwelling for the engineers, lodgings for the workmen, a bakehouse, icehouse, workshops, and a hospital.

WATCH-MAKING by machinery, our Birmingham correspondent writes, is a growing industry in Birmingham. At the factory of the English Watch Company, of Villiers-street, Lozells, there is as much as 500ft. of pulley shafting. Among much delicate technical machinery there is a milling machine, a wheel-toothing machine, and a drill as fine as a human hair for the regulator holes. One valuable automatic machine, whose construction the firm keep private, is an apparatus for the cutting at one operation of a dovetail slot and a dovetail "jewel-slip" over a jewelled hole. The cutter, set by a micrometer gauge, and running at 2000 revolutions per minute, can cut a hair stretched upon a jewel without touching the stone itself. The firm claim to employ the most minute steam power lathe work in the world for turning the tiny balance-staff pivots for the jewel holes. The company report considerable success in the competition which they are carrying on with American and other machine-using watch-makers. Last year the company secured the contract for watches on the Indian State Railways.

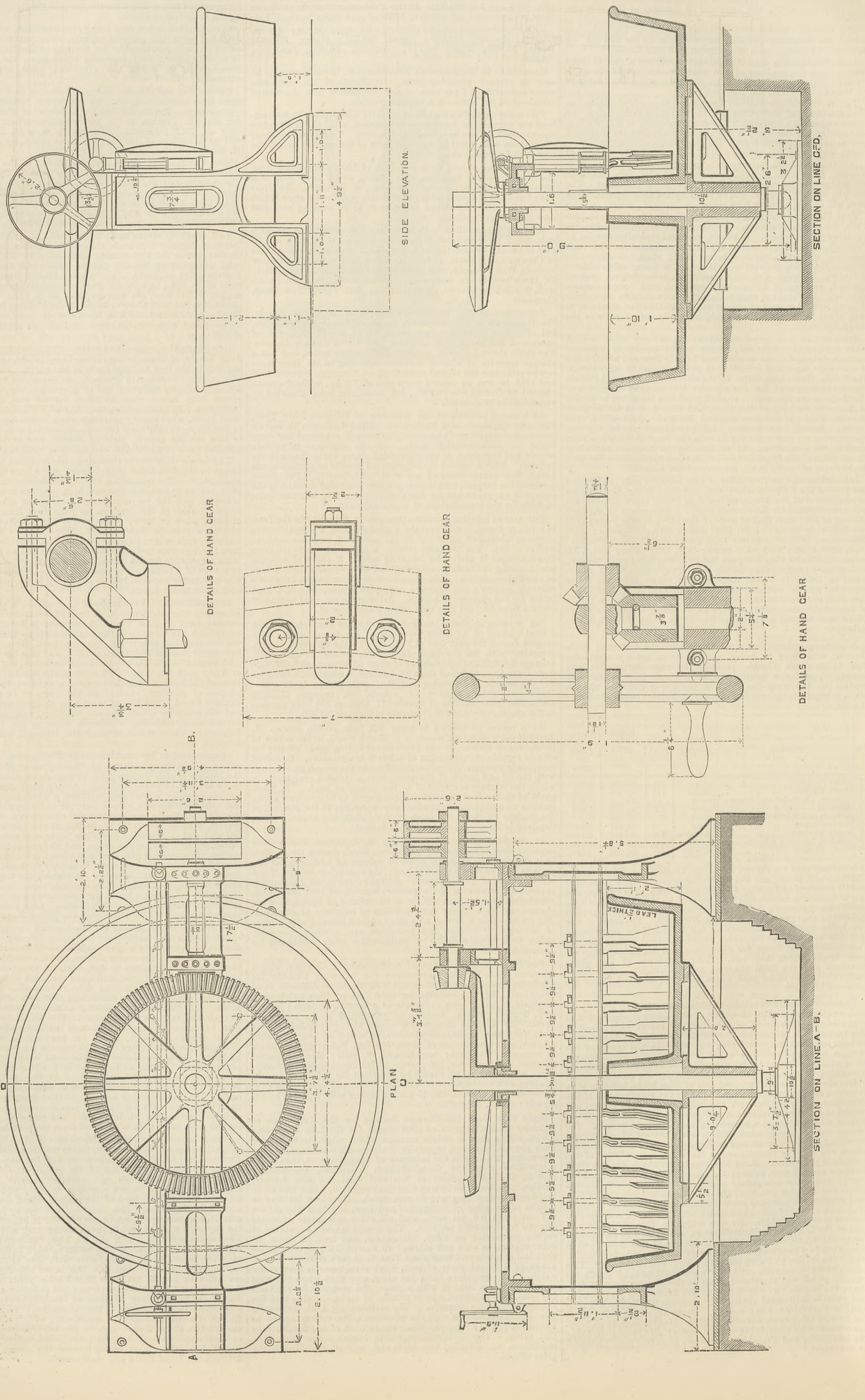
THE subsidence of land in the Cheshire salt districts continues to excite considerable alarm and increasing interest. The Dunkirk district, the scene of the great subsidence of December, 1880, has shown itself to be thoroughly shaken, and the subsidences going on there are visible from day to day, while at intervals sudden sinkings of great depth appear, and let in the fresh water to the brine pits. The amount of damage done to Ashton's works alone—which are situated close to the sinking centre—is estimated at over £2000. In Marston the sinking called "Neumann's Flash," extends and deepens continuously. The subsidence which, however, has caused most consternation to the inhabitants of the town is the one in Leftwich, which for the last three months has developed itself and every few days takes in a portion of the main highway. Since September last the local board have filled in a series of holes forming on the same spot, which in the aggregate have amounted to 50ft. in depth. At Winsford and up the Weaver the sinking continues, as also at Billinge-green and Whatcroft. The subsidence is ascribed to the brine pumping going on in all directions. During the past year there has been a scarcity of brine, particularly at Winsford. The make of salt seems to require more brine than is produced from the percolating rainfall.

GREAT improvements and additions have been recently completed in the drainage of Walthamstow, under the direction of Mr. G. B. Jerram, A.M.I.C.E. The defects in the sewerage were chiefly in the private streets. One of the principal works that have been executed consisted in providing sewers for draining Higham-hill, where before cesspools existed, which overflowed into the brook. The level of the main northern sewer was above that of the brook, and this has been got over by building a new culvert, and raising the road some 4ft. 6in. in height, thus making the approach to Higham-hill much easier and more convenient. The culvert is 8ft. in width and 4ft. high, the invert being curved and laid with Staffordshire blue bricks on edge, in cement on a bed of concrete. This is covered over with iron girders, and jack arches covered with concrete. The sewer recently laid is over six miles in length, and over 28,000 cubic yards of earth have been excavated. Junction pipes are laid at intervals of 30ft. and 40ft., so as to avoid any necessity of breaking the sewers to make any connection therewith. The works have been executed by Messrs. Currall and Lewis, contractors, of Birmingham. The construction of the surface water drains has prevented any flooding of the sewage farm during the recent extraordinary floods in the Lea Valley, thereby removing one of the causes of difference between the Local Board and their tenant.

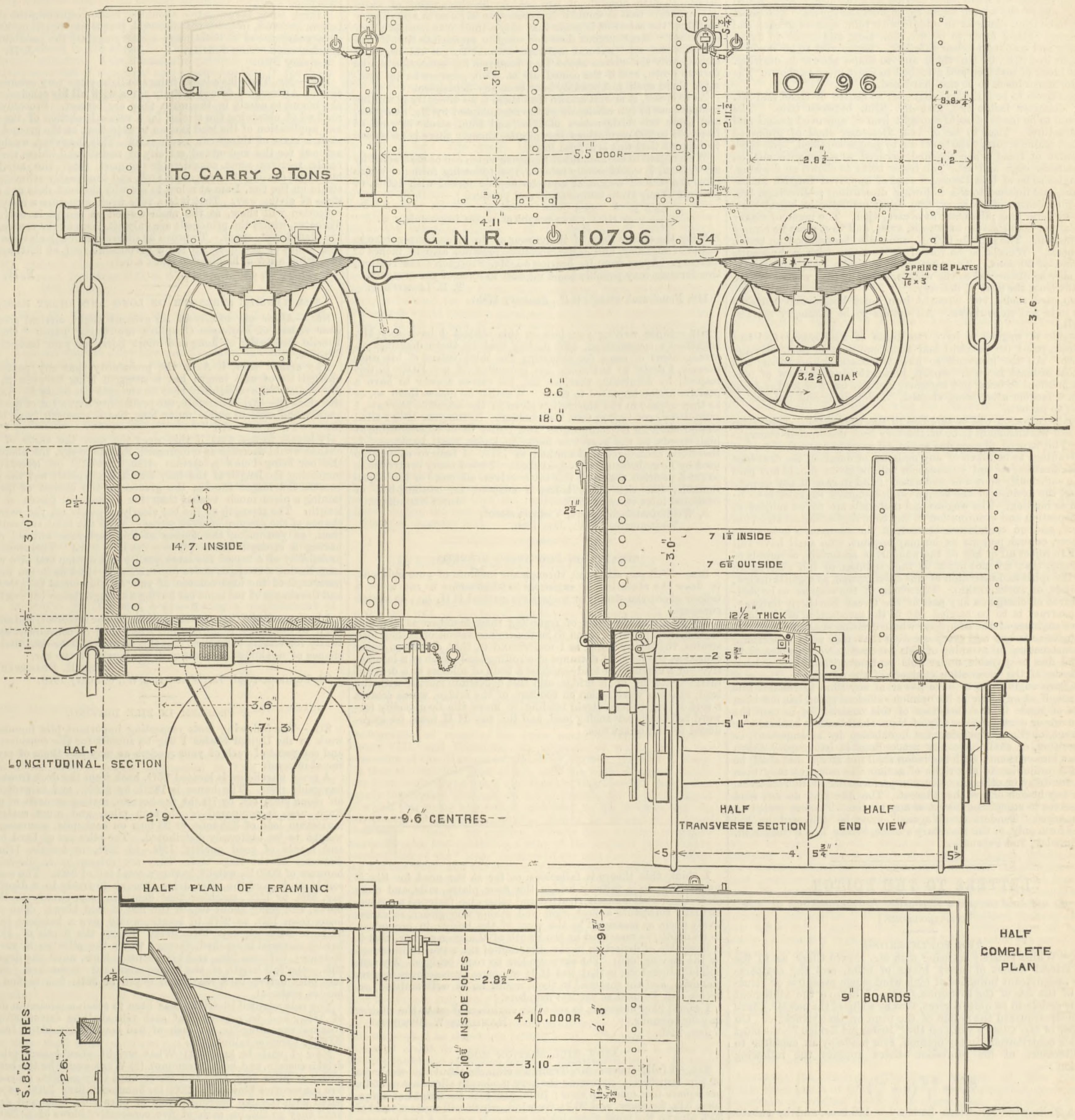
WASHING MACHINES AT THE COMPLEX ORE COMPANY'S WORKS, LLANSAMLET.

(PARNELL'S PROCESS.)

(*For description see page 67.*)



CONTRACTS OPEN.—GOODS WAGONS, GREAT NORTHERN RAILWAY.



CONTRACTS OPEN.

550 NINE-TON GOODS WAGONS—GREAT NORTHERN RAILWAY.

THE Great Northern Railway Company invites tenders for 550 goods wagons. The accompanying engraving illustrates their construction. The following is a copy of the specification. The general arrangement of the wagon is shown in the engravings above. The body to be 15ft. long by 7ft. $6\frac{5}{8}$in. wide outside, and 3ft. deep inside, exclusive of $\frac{1}{2}$in. coping iron; to be carried on four wheels, 3ft. $2\frac{1}{2}$in. diameter at centre of tread, placed 9ft. 6in. centre to centre; the whole of the underframe to be of St. Clair white oak; the floor, sides, and end boarding of best St. Petersburg deals; the whole to be of the best quality, dry, sound, and free from knots and shakes. All the wrought ironwork where not otherwise specified to be of the best hammered scrap iron, cleanly forged, and where fitted to woodwork to be bedded on white lead; the draw chains to be made of best Yorkshire chain iron; axles and tires to be of best Bessemer steel of approved English manufacture; springs to be made of the best spring steel; all the bolts and nuts to be screwed to Whitworth's standard, and all the nuts hexagonal; all the bolt heads inside of wagon to be countersunk flush, and corners well rounded off washer plates.

Underframe.—Underframe 15ft. long by 6ft. $10\frac{5}{8}$in. wide outside, and made to the following dimensions:—Sole bars, 11in. deep by $4\frac{1}{2}$in. thick, and to have a plate $\frac{5}{16}$in. thick on outside, making total thickness $4\frac{13}{16}$in.; to be tenoned at ends into headstocks, and secured on inside with knee iron 10in. deep by 8in. by $4\frac{1}{2}$in. and on outside by knee iron 10in. deep by $4\frac{1}{2}$in. by 3in. The headstocks to be $13\frac{1}{2}$in. deep by $4\frac{1}{2}$in. thick by 7ft. $6\frac{1}{8}$in. long morticed to receive soles, spring bed stretchers and diagonals. The crossbearers to be 11in. by 5in., tenoned into soles, and morticed for longitudinal, diagonals, and spring bed. The longitudinal to be 10in. by 5in., tenoned into crossbearers; to be flush on bottom side, and on top to have a saddle piece bolted on with three $\frac{5}{8}$in. bolts, 5ft. 9in. long by 11in. wide by $3\frac{1}{2}$in., bevelled on edges as shown to $2\frac{1}{2}$in. The diagonals to be 5in. by 4in., tenoned into headstock and crossbearers. The spring bed to be formed by longitudinal pieces 4in. square, tenoned into headstock and crossbearer, and further secured to the crossbearers by a wrought iron palm plate $\frac{1}{2}$in. thick, bolted underneath as shown; also to be firmly secured with four longitudinal tie bolts, $\frac{3}{4}$in. diameter from headstock to crossbearer as shown, these bolts to have square heads inside and nuts on outside of headstock; a striking or washer plate on outside of headstock $14\frac{1}{2}$in. by 9in. by $\frac{1}{2}$in., and one on crossbearer. Pieces of oak to form spring stop to be put in as shown; and on top of spring beds between headstocks and crossbearers, two pieces of oak $3\frac{1}{2}$in. by $3\frac{1}{2}$in. to be put in to support floor boards, boxed at each end $\frac{3}{4}$in. deep. The crib rails to be 5in. by 4in., the full length of wagon, half lapped on to headstocks and secured to sole with four $\frac{5}{8}$in. bolts; two pieces of oak $4\frac{1}{2}$in. wide by 4in. thick by 8in. deep to be bolted on sole bars on outside, to form side door stops. The tie bolts to be two cross tie bolts $\frac{7}{8}$in. diameter, four bolts $\frac{3}{4}$in. diameter in each spring bed, and two between crossbearers as shown. The tenons on soles, crossbearers and longitudinals to be $1\frac{1}{2}$in. by $1\frac{1}{2}$in. by $3\frac{1}{2}$in. between where double tenons are used; all the other tenons to be $1\frac{1}{4}$in. by $1\frac{1}{4}$in. deep. Rope rings to be three on each side of wagon and two on each headstock as shown. Striking plates $\frac{3}{8}$in. thick to be fastened to sole behind the buffing spring as shown.

Boards.—Sides and ends of the body to be $2\frac{1}{2}$in. thick planed on the outside with plain edges, having outer edges slightly chamfered; the corners to have corner plates $\frac{1}{4}$in. thick, 3ft. 5in. long, 8in. by 8in. wide, and bolted with eighteen $\frac{1}{2}$in. bolts in each; great care must be taken to have all the heads of the inside bolts flush, and heads made to pattern, the edges of inside washer plates must also be well rounded off. The sides to be strengthened by two wrought iron knees to each, of the strength shown on drawing, and bolted to the sides with $\frac{1}{2}$in. bolts, two in each board with a long washer plate inside, $2\frac{1}{4}$in. by $\frac{1}{4}$in. thick, rounded off on edges as shown. The side doors to be 5ft. 5in. wide in the clear, with three strong hinges bolted to them with $\frac{1}{2}$in. bolts as shown, the two outer hinges to have lugs forged on to form the fastening, which must be made in all respects to detail drawing; the lower part of hinges to be bolted to crib rails and soles. The ends to be strengthened by two oak stanchions 4in. by $4\frac{1}{2}$in. at bottom, tapered to $2\frac{1}{4}$in. by $3\frac{1}{2}$in. at top, bevelled as shown, fastened to headstocks by a wrought iron plate 1ft. 6in. long by 3in. wide by $\frac{3}{4}$in. thick, and bolted up with one $\frac{3}{4}$in., one $\frac{5}{8}$in., and one $\frac{1}{2}$in. bolt in each end board as shown. Body to be fastened to crib rails and headstock by twelve $\frac{1}{2}$in. bolts, cup head bolts on coping, and nuts and washers underneath. Coping to be $2\frac{1}{4}$in. by $\frac{1}{2}$in. thick carried all round, welded up at corners and fastened down with twenty-eight screws $2\frac{1}{2}$in. long No. 18, besides bolts as shown on drawing. The floor boards to be $2\frac{1}{2}$in. thick, placed across the wagon spiked to underframe with 5in. spike nails. The bottom doors to be 4ft. 10in. long by 2ft. 3in. wide in the clear, 11in. apart as shown, each door to be supported by two strong wrought iron hinges, and opened by two levers. The brackets for carrying the hinges to have two eyes, and are let in flush with top of longitudinal bearer at 3ft. 10in. cr. to cr.; through each hinge and bracket passes a long bolt $1\frac{1}{4}$in. diameter, and held in place with a $\frac{5}{16}$in. split pin at each end. Each door to have a strap plate on underside 3in. wide by $\frac{1}{4}$in. thick. The levers for opening the doors to be 1ft. $10\frac{1}{2}$in. long, fixed to studs bolted through sole, and so fixed that when the $\frac{3}{4}$in. pin shown is taken out and both levers pulled outwards the door will fall down. Hinges and levers to be made to detail drawing. Six bolts in each hinge.

The Springs are to be of the best spring steel, properly tempered so as to retain their original camber after being forced straight; buckles of the best hammered scrap iron well shrunk on to spring and secured with $\frac{7}{16}$in. rivet. Bearing springs to have twelve $\frac{7}{16}$in. by 3in. plates, 3ft. $8\frac{1}{4}$in. long, with $5\frac{1}{4}$in. camber unloaded. Buffing springs to have nineteen $\frac{3}{8}$in. by 3in. plates 5ft. $3\frac{1}{2}$in. long. with 14in. camber unloaded; all plates spear pointed and made to detail drawing. Each plate to be well painted before the spring is put together, and stamped with maker's name and date of manufacture.

Axle-boxes and Guards.—Axle-boxes of the best cast iron with gun metal steps, cast in the proportion of $2\frac{3}{4}$oz. of tin to 1 lb. of copper, accurately fitted in boxes and made in every respect same as detail drawing. Axle guards of the best hammered scrap iron $\frac{3}{4}$in. thick, of the exact form shown in detail, forged perfectly parallel between the legs; each guard to be secured to sole by seven $\frac{3}{4}$in. bolts with nuts on outside; a clip strap to be provided at bottom of guard as shown.

Buffers and Drag Hooks.—Buffer heads and rods to be forged solid from the best hammered scrap iron, the rod to be $2\frac{1}{2}$in. diameter and made $1\frac{7}{8}$in. square at ends to receive buffer shoes. Buffer shoes of cast iron to be accurately fitted to rods and secured with best Yorkshire iron cotter as shown. Sockets of best cast iron $9\frac{1}{2}$in. long, bolted to headstock with three $\frac{5}{8}$in. bolts in each, and placed 5ft. 8in. apart cr. to cr. Draw-bars and hooks of the best hammered scrap iron, links 1⅜ diameter of the best Yorkshire chain iron neatly forged and secured to draw spring by a 1¼in. pin. A striking plate to be bolted to headstock on outside 14½in. long by 9in. by ½in. which also forms a washer plate for the longitudinal tie bolts; the nuts to be on outside of plate.

Hand Brake.—A hand brake carried on a cast iron bracket which forms one of the spring shoes to be made as shown. The short shaft to be 2½in. diameter in middle with 1⅛in. squares at each end for levers. Hand lever to be 9ft. 6in. long, and made to detail drawing and cranked to clear axle-box. Brake rest to be made of wrought iron 2¼in. by ½in. thick and to shape shown on drawing. Brake block of cast iron and attached to short lever as shown. The bolt for brake block to be case hardened.

The wheels to be 3ft. 2½in. diameter at centre of tread and 2ft. 10in. diameter inside tire, and 4ft. 5⅝in. between tires. The skeleton to be made of solid wrought iron of approved design and manufacture. Tires to be of best Bessemer steel of approved English manufacture, to be bored out to gauges supplied, 2⅛in. thick at centre of tread when finished, secured to wheel with clip on the outside edge and four ⅝in. screw bolts as shown on drawing. The axles to be of best Bessemer steel of approved English manufacture, and finished to the following dimensions:—Bearings, 8in. by 3⅜in.; centre of bearings, 6ft. 4⅜in.; diameter in wheel seat, 5⅛in. by 7⅞in. long; diameter at centre, 4⅜in. The name of maker and date of manufacture of wheels, axles, and tires must be clearly stamped on. The initials G.N.R. must also be stamped on bosses of wheels. Wheels to be forced on to axles with a hydraulic pressure of 60 tons. The contractor to make good any defects that may be discovered in the wheels, axles, or tires within twelve months from the date of delivery.

Two card racks, two wrought iron horse hooks, and ten rope rings to be put on as shown. All details to be distinctly marked G.N.R.

Outside of wagons to have two coats of lead colour and two of brown paint (to pattern) and then one coat of good carriage varnish. All the ironwork to have two coats of lead colour and one coat of black lacquer. Spring plates to have one coat of lead paint previous to being put together, and two coats of lead and one of black lacquer after being erected. The writing and number on wagon to pattern.

A pattern wagon will be supplied to the contractor. The materials and workmanship to be of the very best description throughout. The figured dimensions are in all cases to be worked to, but no advantage to be taken of any omission of detail in the drawings or specification, as full explanation will be given should any part not be sufficiently shown or understood; and in case of any dispute arising, the decision of the company's locomotive engineer is to be taken as binding. The wagons and materials are to be subject to the inspection and examination at any time during the construction thereof, and on completion thereof, of the company's locomotive engineer, or such persons as he may appoint, who shall have full power to reject all or any of the wagons, or materials, or details of the same, that are not in his or their opinion in full accordance with the spirit and intention of this specification, as regards design, materials, or workmanship. The whole of the wagons to be delivered free of charge on any part of the Great Northern Railway. The contract is to be carried out to the satisfaction of the locomotive engineer of the company, whose decision shall be final and conclusive as to any and every question that may arise concerning the construction or meaning of this contract. No payment is to become due or payable under this contract without the written certificate of the locomotive engineer of the company. The said locomotive engineer is to have power at any time to rescind this contract, if at any time in his opinion sufficient speed has not been shown or made in the execution of this contract or in case the contractor or contractors or any of them shall become bankrupt or insolvent, or file any petition for liquidation by arrangement, or composition, or shall have any proceedings in bankruptcy taken against him or them; such rescission shall not affect, and shall be without prejudice to any right of action the company may then have for delay or otherwise, for non-performance of this contract, or for any breach or breaches thereof. The directors do not bind themselves to accept the lowest or any tender. Tenders sealed up and marked "Tenders for Wagons," must be delivered on the official form only, at the Secretary's office, before Ten o'clock a.m. on Thursday, 2nd February.

LETTERS TO THE EDITOR.

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

THE FORTH BRIDGE.

SIR,—Whilst entirely agreeing with Mr. Edwin Clark as to the small lateral extent of heavy blasts of wind, and the comparatively insignificant influence of high wind gauge pressures on structures of the size of the Britannia Bridge, I believe the statement in your article to be quite correct, that by a slip of the pen Mr. Clark has underestimated the action of the wind on that structure. On page 787 of Mr. Clark's work on the "Britannia Bridge"—the most valuable contribution, in my opinion, ever made by an engineer to the literature of his profession—there appears the following equation:—

$$\frac{\mu\, l}{f} = \frac{8\, d}{l}\left(a + \frac{a^1}{6}\right)$$

With a 20 lb. wind Mr. Clark finds $\mu\, l = 120$ tons, and by substitution he obtains $\frac{\mu\, l}{f} = \cdot 621$, whence, he remarks, $f = 74\cdot 5$ tons per square foot, or but the "insignificant" stress of half a ton per square inch. He has clearly multiplied by ·621 when he ought to have divided, and the stress under a 20 lb. wind would, therefore, be $\frac{1}{\cdot 621^2} = 2\cdot 6$ times greater than that calculated by him. As the loss by rivet holes would reduce the sectional area of metal by about one-third, the actual tensile stress would be $\frac{2\cdot 6}{\cdot 66}$ or, say, four times that stated by Mr. Clark. In other words, considered as an independent beam, the stress upon the Britannia tube from wind pressure would be 1 ton per square inch for every 10 lb. per square foot pressure instead of ½ ton for 20 lb. as given in the work cited above.

B. B.

Westminster, Jan. 24th.

COLD-AIR MACHINES.

SIR,—I have read Mr. Sturgeon's letter on this subject in last week's ENGINEER. Though disagreeing with most of that gentleman's remarks, in so far as they deal with the communication I had the honour of sending you on the 26th ult., yet I do not feel that the subjects at issue are of sufficient general interest to warrant my encroaching on your space with any detailed exposition of the fact. To give this fully, and without running the risk of being further misunderstood, would occupy considerable time. I must, however, ask you to permit me to correct the statement that the inlet valves in my compressors—as illustrated in the scientific papers—are not positive in their action, but depend for their lift on the creation of a partial vacuum. In all illustrations with any pretence to detail, the gear for lifting these valves is very distinctly shown, and it must be in the recollection of many of your readers that I have always advocated the importance of positive action.

Mr. Sturgeon seems to think he has a monopoly of the method of abstracting what he calls the "natural moisture" from the air when under compression, as well as of high speeds in relation to air compressors. I need hardly say this is not the case. When fresh air containing the usual amount of moisture in solution is compressed and cooled, a portion of the vapour is condensed according to a natural law, which is fortunately at the service of all makers and users of air refrigerators, and Mr. Sturgeon does not even attempt to get rid of the further amount of water dealt with in my own and other drying apparatus.

It is curious that though in order to defend himself from the accusation that because the air in his refrigerators is only compressed to 30 lb. absolute, it will hold double the amount of water in suspension that it would if compressed to 60 lb. as in an ordinary machine, the assertion is made that only a limited amount of water is present. Mr. Sturgeon does not seem to appreciate that if this were the case no "natural moisture" would be got rid of, as, of course, only the excess above that required for saturation can be thrown down, and if the cooled air at 30 lb. pressure be not saturated there could not possibly have been any deposition.

As to speed, it is well known that there is no difficulty in making compressors to run efficiently at the rate adopted by Mr. Sturgeon, and there are refrigerators of 12in. and 15in. stroke in work at from 150 to 200 revolutions per minute, though there is no reason to suppose that this is a final limit.

With regard to the amount of moisture which can be abstracted by my system, I would simply refer to the following formula, which gives the pounds weight of aqueous vapour mixed with 100 lb. of pure air at any given temperature and pressure:—

$$\frac{62\cdot 3\ \text{E}}{29\cdot 9 - \text{E}} \times \frac{29\cdot 9}{p} = \text{weight of water in pounds,}$$

E being the elastic force of the vapour at the given temperature in inches of mercury, and p the absolute pressure also in inches of mercury. Apart from its bearing on Mr. Sturgeon's observation, this formula may possibly be of interest to some of your readers.

T. B. LIGHTFOOT.

116, Fenchurch-street, E.C., January 17th.

SIR,—Since writing you last on this subject I have seen Mr. Lightfoot's specification, and finding that he there describes an arrangement of cams for actuating the inlet valves of his compressor, I desire to anticipate his correction of my letter in this respect, by admitting that, so far, his valves appear to have a positive action imparted to them. Whether he makes them so, or as they appear in the illustration given in the scientific journals, I cannot say, not having seen his machine. In the year 1869 I tried similar cams for air compressors and found them objectionable at high speeds, as the gear was liable to knock itself to pieces. I, therefore, abandoned that method in 1873. I believe cams were used by Lowe before I employed them. I tried many contrivances to get a positive action of the inlet valves, all more or less objectionable, like the cams, before I adopted the stuffing-box or frictional inlet valve in 1873.

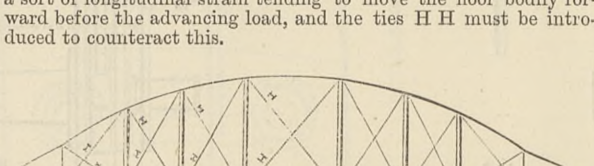
JOHN STURGEON.

3, Westminster-chambers, Victoria-street, Westminster, S.W., Jan. 18th.

STRAINS ON BOWSTRING GIRDERS.

SIR,—Will you allow me, through the medium of your columns, to draw the attention of engineers to what seems to me to be a fallacy about the strains on some parts marked H H, &c., on sketch enclosed.

We all are in the habit of regarding these members as ties, and their more especial function to be the counteraction of rolling load strains, the theory being, as I understand it, that deflection being caused at the point of entrance of a rolling load—such as a locomotive—or a moving live load—such as a body of soldiers or a drove of cattle—entering on a bridge, and this deflection moving with the load, causes a wave action on the floor of the bridge, which creates a sort of longitudinal strain tending to move the floor bodily forward before the advancing load, and the ties H H must be introduced to counteract this.



I think this theory is fallacious, so far as the need for ties is concerned. In a railway bridge the floor plates, rails, and cross girders being all securely rivetted and otherwise fastened together, virtually constitute a most rigid and strong web girder, so excessively deep, as measured by the span of the bridge, in proportion to its depth, as measured by the length of the cross girders, that it is incapable of deflection in the direction of the wave strain caused by the moving load. The same applies to road bridges. My own opinion, therefore, is that ties H H are mere excrescences, useless members, and the material in them would be as well omitted, or, better still, be used as vertical members.

I would like, however, to see other engineers discuss the matter in your columns.

HAMILTON W. PENDRED.

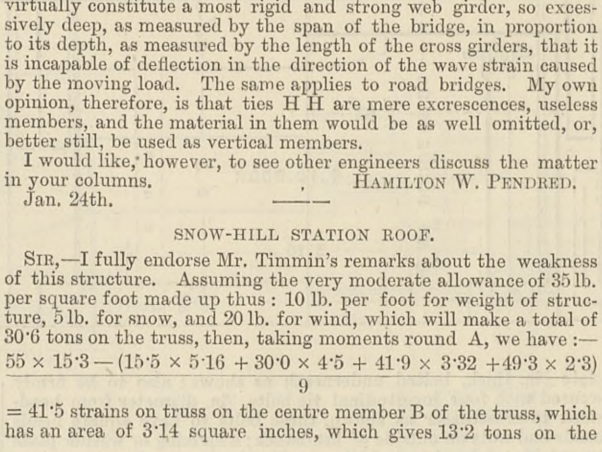
Jan. 24th.

SNOW-HILL STATION ROOF.

SIR,—I fully endorse Mr. Timmin's remarks about the weakness of this structure. Assuming the very moderate allowance of 35 lb. per square foot made up thus: 10 lb. per foot for weight of structure, 5 lb. for snow, and 20 lb. for wind, which will make a total of 30·6 tons on the truss, then, taking moments round A, we have:—

$$\frac{55 \times 15\cdot 3 - (15\cdot 5 \times 5\cdot 16 + 30\cdot 0 \times 4\cdot 5 + 41\cdot 9 \times 3\cdot 32 + 49\cdot 3 \times 2\cdot 3)}{9}$$

= 41·5 strains on truss on the centre member B of the truss, which has an area of 3·14 square inches, which gives 13·2 tons on the



square inch, which is an excessive amount, and that too exposed to the sulphurous fumes and vapour from the locomotives. There can be no doubt whatever that the structure is a very unsafe one, and the Great Western Company will incur grave responsibility if it is not immediately strengthened. It is surprising that such a weak and faulty structure could have been erected so late as 1873, the date, I believe, the station was renewed.

C. E. BAINES.

Victoria Cottage, Harrow, January 21st.

SIR,—I think many of your readers are indebted to Mr. Timmins for his diagram of strains and description of the errors of construction of the Snow-hill Station roof. I have no doubt the matter stands just as he has described. If the theory is correct that iron roofs of this description should have a rise of one-third their span, this roof must be defective on this score also. One-third of a span of 92ft. 2in. would give a fraction over 30ft. 8in., whereas the rise is only 27ft. 6in.

I do not know the rule for determining the usual distance between top of a principal rafter and tie-rod, but I presume, if the rise were increased, the distance between the rafter and tie-rod would also have to be increased, and the ties made a trifle stronger in proportion to their increased length. Perhaps Mr. Timmins will enlighten us a little further as to these particulars of roof construction.

I think some investigation should be made respecting the structure in question, in order that the weak points may be strengthened, as a guarantee of a little more security against the possibility of another engineering disaster.

J. H. A.

January 24th.

SIR,—Mr. Timmins's letter brings to light some very astonishing facts. Although I do not entirely agree with all his conclusions, I am bound to admit in the main they are correct. Probably, the method of obtaining the strains for a vertical reaction of the piers and application of the load is open to objection, on the ground that such a state of things can never exist. This, however, would not account for the undoubted scarcity of metal; and unless the roof really receives some considerable support from the adjoining buildings, causing it to act as an arch, and thus partly relieving the strain on the ties, I am at a loss to see why the roof does not show signs of giving way. That it is a very weak structure a moment's reflection will show, as the main tie-rod at centre is only 2in. diameter, whilst the principals are only 8ft. deep at the centre, and are placed 20ft. apart. To prove by diagram and calculations that this is out of the question for a permanent roof of 92ft. span is like using a steam hammer to crack a nut.

Camberwell, January 25th.

F. H. C.

THE TENSILE STRENGTH OF LONG AND SHORT BARS.

SIR,—Allow me to correct an evident slight clerical error in your report of Professor Chaplin's interesting paper "On the Tensile Strengths of Long and Short Bars," in your issue of the 6th inst.

The article says, if A_x is the probability that any particular untried bit of unit length has a strength lying between S, and $(S_1 - xP_1)$ "the probability that its strength lies below $S_1 - xP_1$ is therefore $(\frac{1}{2} - A_x)$. Therefore, the probability that a bar of the same quality and section, and n units long, has a strength lying below $(S_1 - x P_1)$ is $(\frac{1}{2} - A_x)^n$"

It is easy to see that if this were the case the value of this chance would decrease as n increased, that is to say, the chance of the bar being below a certain strength would be lessened by increasing the length of the bar, which is obviously not the case, because the longer the bar the greater is the chance of its containing a piece much weaker than the average of pieces of unit length. The strength of the bar clearly depends on the negative chance of the absence of weak pieces. With the same supposition, then, as you make, the chance of this particular untried piece having a strength above $(S_1 - x P_1)$ is $\frac{1}{2} + A_x$. Therefore the probability of a bar of the same quality and section and of n units long having a strength above $(S_1 - x P_1)$ is—just as in the fourth paragraph of the first column of your article—equal to $(\frac{1}{2} + A_x)^n$, and the chance of the same bar having a strength below $(S_1 - x P_1)$ is

$$1 - (\tfrac{1}{2} + A_x)^n$$

I have no doubt that this formula is the one intended, and adapts itself to the tables required; but I have had no convenient opportunity for testing it further. In this form it will be seen that the chance of weakness increases with the length of the bar.

JOHN H. BLAKESLEY.

23, Fopstone-road, Earls'-court, S.W., January 19th.

A PROBLEM IN PILE DRIVING.

SIR,—The following facts respecting important pile foundation work in the United States I beg to submit for the consideration and comment of such of your readers as may find them of professional interest.

A grain warehouse is located 25ft. back from the dock front of a navigable river. The house is 142ft. by 213ft., and is supported on stone piers 4ft. by 7ft. at the bottom, resting on nests of piles. Each nest is composed of thirteen piles, and must sustain a maximum load of 325 tons, or 25 tons on each pile, assuming the weight to be uniformly distributed. The piles are of hard beech and maple of good quality, 18ft. to 25ft. in length, 14in. in diameter at the large end. They are driven by a pile-driving hammer of 2000 lb. weight, having a total fall of 34ft. The surface soil is sandy, and the piles drive through it freely to a depth of, say, 13ft. to 15ft., reaching that depth in, say, twenty to thirty blows, and going about 4in. in the last of said blows. The piles, being from 18ft. to 25ft. in length, would give a hammer fall of 31ft. to 24ft. at, say, 15ft. deep. Below the depth of 15ft. a harder material is reached, through which the piles go at varying distances, between 3½in. and 1¼in. at each blow, until the depth of 25ft.—the full length of the longer piles used—is reached. Single test piles driven to a maximum depth of 38ft. fail to find any harder material.

The rule adopted in driving has been to reach a minimum depth of 18ft., and to require that each pile shall be driven until it goes not exceeding 2in. on each of five consecutive blows from a 2000 lb. hammer falling 30ft.

Now I wish to know (1) What weight should such piles so driven sustain, and how determine? (2) What would be the bearing power of piles 18ft. long and driven until they go 2½in. on each of five consecutive blows of a 2000 lb. hammer falling 24ft., as compared with the like bearing power of piles 25ft. long and driven until they go 2in. on each of five consecutive blows of a 2000 lb. hammer falling 32ft.—how are the results determined in each case? (3) What would a 2000 lb. hammer falling 32ft. be equivalent to in dead load placed on the top of a pile, and how determined?

January 14th.

PHILADELPHIA.

WATER SUPPLY IN INDIA.

SIR,—In the *Lancet* I see a long letter by Dr. Cookson on the great percentage of deaths among the European soldiers in India. Dr. Cookson attributes this to the dirty water supplied to the troops. It is to be hoped that water supply forms part of the curriculum at Cooper's Hill. The wells made in India are mere surface wells made in the middle of the cantonments; the water is the mere surface soakings which go down in the rains to the sand-bed underlying the surface soil. As there are no drains or sewers, either open or closed, in Indian cantonments, it is obvious that after twenty or thirty years the soil must lose its power of oxidising animal matter, and that this water will be very nasty. I quite agree with Dr. Cookson that this dirty water carried in dirty leather bags is most objectionable. Besides cholera and dysentery, all sorts of skin diseases are propagated in this way.

There is, as a rule, no want of water in India; the fault lies with the obstructive routine of the department. All that is needed is to sink a deep well or wells two or three miles out of the cantonments, and pump the water by steam power to a covered-in reservoir, where it will be kept clean and cool. The land round the well should be kept under grass, and will cause no expense, as grass is needed for the cavalry and artillery horses.

A. G. MURRAY.

141, George-street, Edinburgh.

STRAINS ON CRANE POSTS.

SIR,—In addressing you again I do not propose to add one word to the controversy upon the central point at issue, but in a letter appearing in your journal to-day, Mr. Stokes makes a personal charge, which I am compelled to refute. He accuses me first of changing my ground surreptitiously; and secondly, of doing so after "Mr. Coventry has kindly called his (my) attention," &c.

Taking the second statement first: Mr. Coventry's first letter was published on December 16th. Mr. Stokes admits that my letter, published on December 23rd, took up what we will for the moment call my final position. If he will look again at that letter, he will see that it was written on November 26th, *i.e.*, three weeks before the appearance of Mr. Coventry's first. Such a charge based on such careless reading is most unjustifiable, and I hope Mr. Stokes will see his way to an unqualified withdrawal, and as promptly made as that of his equally erroneous formulæ for "the neutral axis theory."

Now, as to the charge of changing front. Mr. Pendred said, October 7th, "I took the neutral axis as gradually being eliminated till it disappeared in the breast." This view was the object of all my adverse criticism. I considered the question as one purely of the existence or not of a neutral axis; assuming that if the existence were proved, the position would be calculated with due regard to mechanical laws. My letters of October 21st and November 11th were written with this idea in view, and a reference to the conclusion of the former will show that a general contention for a neutral axis was the central point of the letter.

But as the correspondence proceeded, I found writers who admitted the existence of the axis placing it in unheard of and absurd positions, and to such I hoped my two letters appearing December 9th and 23rd might be useful, and therefore wrote them, the one treating of the simple girder, the other of the crane post; and here it became necessary for the first time to allude to the excess stress in the breast. Until then I had contended only for a neutral axis, and had nowhere said a word as to the amount of stress which might exist on either side of such axis in a crane post. If, therefore, I had previously taken up no ground upon this question, Mr. Stokes's accusation of changing ground is unfounded.

34, Freke-road, Lavender Hill, S.W., 20th January. C. G. MAJOR.

SIR,—Will Mr. Coventry, or Mr. Major, or Mr. Stokes, or Mr. Ward, or any of your correspondents, tell me whether the breast of a bent crane ought to be thicker than the back or not, in one word? I do not want to know how much thicker, but only whether it ought to be thicker at all. Sometimes I think it ought to be; then I read over your correspondents' letters again, and I think it ought not to be, because the neutral axis shifts about so. Then I find that it is not a neutral axis, but a "neutral line," or an "axis of rotation" that is talked of; and so my brains get all in a muddle. Surely this must be the fault to a large extent of your correspondents. I do not find any such muddling of brains take place when I read Clerk Maxwell on "Heat," or Goodeve on the "Steam Engine." May I ask for a clue—is the breast to be thicker than the back or not? Yes or no.

Hoxton, January 24th. A PUZZLED STUDENT.

POWER AND SPEED OF TORPEDO BOATS.

SIR,—In your last issue you drew attention to the fact that the proportion between the powers required to propel boats of different sizes is far from constant at all speeds. It so happens that we have recently had under trial two torpedo boats of different sizes which illustrate the above very clearly, and as it may be of interest to your readers we annex the following facts. The larger boat was 100ft. in length by 12ft. 6in. beam, having a displacement of 40 tons. The smaller one was 86ft. in length by 11ft. beam, having a displacement of 33 tons:—

To drive the	40	ton boat	15	knots	required	248	I.H.P.
,,	33	,,	15	,,	,,	277	,,
,,	40	,,	18	,,	,,	394	,,
,,	33	,,	18	,,	,,	390	,,
,,	40	,,	21	,,	,,	540	,,
,,	33	,,	21	,,	,,	510	,,

Poplar, January 24th. YARROW AND CO.

THE EFFICIENCY OF TURBINES.

SIR,—Those of your readers who are interested in the discussion on the above subject, which commenced in THE ENGINEER of January 23rd, 1880, and to which Messrs. McKenzie refer in their letter of last week, will remember that at the outset difficulties relating to weir measurements put an end to the correspondence.

If those who have now opened up the question, and other practical men who have had experience in turbine work—and there must be many such—will give the public the benefit of their opinions, there will be no fear of a collapse on account of the difficulties above-mentioned.

There is, no doubt, a necessity for reliable information as to the efficiency of many of the turbines now in the market, but in the majority of instances a difference of 5 or 6 per cent. is of little consequence, and those wheels which are the best known are, I believe, about on a par for efficiency; such is the case, probably, with the Vortex, the Girard, the Leffel, and McAdam's. Now while in these turbines there may not be much difference of efficiency, there is a considerable difference in construction; and if the discussion which has commenced is to be of much value, it seems to me that the design of the details of these wheels must be examined, besides fighting over weir measurements and the best angle for the vanes. It is very important that a turbine shall not be liable to choke easily; it is also of importance that the buckets shall not work loose, and that the gates for regulating the flow of water shall move easily and not be liable to stick, especially when a governor is to be applied to the turbine; these and other such practical questions should often decide between rival wheels rather than a matter of 4 or 5 per cent. in efficiency.

Of the three varieties of turbines, viz., inward flow, outward flow, and parallel or downward flow, the first appears to be the most popular. With respect to parallel flow wheels, such as Girard's or Fontaine's, it would be interesting to hear the experience of any who are acquainted with the practical working of this kind of wheel. The experiments made by M. Girard and other eminent continental engineers are, no doubt, reliable, but many of your readers who are interested in this matter have not the time nor the opportunity to search up records of turbine tests. If there are wheels of this class working near home, and those who know would communicate, their information would, I am sure, be very acceptable.

Of outward flow turbines there are few; one on Fourneyron's principle, which has met with some favour, is that made by Messrs. McAdam Brothers. It appears to give a fair percentage of power, but the small apertures in the guide chamber must be very liable to choke, and when the gate is open for full water the friction in these passages must be considerable. To come to inward flow turbines, their name is legion, so also are their characters. In this country the Vortex has had a large sale, and it is, no doubt, a good wheel, although there is no reason to believe that its efficiency is greater than some other turbines which are now being offered to the public. My experience is that there are less expensive wheels giving quite as much percentage of power. I should like to notice here the remarks made by Mr. Hett on the Vortex. From the manner in which he refers to Mr. Donaldson's work on turbines; those who have not read the book will think the Vortex nowhere for efficiency, but it is only fair to state that in Mr. Donaldson's opinion no turbine can give more than 50 to 60 per cent., and probabiy not more than 40 per cent.; so that if the Leffel, which Mr. Hett sells, had fallen into Mr. Donaldson's hands it would have fared no better than the other.

The internal construction of the Vortex turbine is objectionable on account of the long narrow passages which the vanes make, and which are as liable to choke as those in McAdam's wheel. Perhaps it is not possible to make a turbine which is perfect in theory, and which will prove to be everything it should be in practice; but if as good efficiency can be obtained with short and large passages as with long narrow apertures, then the former is preferable, as not being likely to choke, and what is often of importance, a much coarser trash rack can be used in the head race. A fine rack—which is indispensable with the Vortex in many localities—is sometimes the cause of annoyance in more ways than one. Where the head race runs under overhanging trees, as is often the case, a great mass of leaves and small wood will accumulate on the rack, and unless it is constantly cleared the free flow of water will be interfered with. In the case of some turbines leaves and sticks will pass through without injuring the buckets of the wheel in any way, and other things being equal, it is certainly an advantage to have such a wheel.

The Leffel turbine is one which gives a good percentage, and one which has very few defects in its construction; such at least has been my experience. It is not easily choked up, even when a very coarse rack is used. In one case no trash rack whatever is used, and in a locality surrounded with trees. The buckets of the wheel, and the body of the wheel itself, are very strong indeed. The footstep is seldom worn down sufficiently to need replacing, the discharge of water being downwards, favouring the toe very considerably, three or four years' work under ordinary circumstances causing only about $\frac{1}{4}$in. wear. In the Vortex there is an arrangement for raising the toe, as the wear is more severe than in the Leffel. The guide blades of the Vortex are well suited to their work, and would probably be easily operated by a governor. The gates in the Leffel are also easily moved, and those in this country which have governors are, I believe, giving great satisfaction. I have compared the Vortex with the Leffel because of the reputation both have achieved in this country and in America. I agree with Mr. Hett as to his remarks about the Hercules turbine. In the majority of cases where turbines are erected, there is abundance of room for them; and I do not therefore see any great advantage in making a wheel deeper. When I took part in the discussion of this subject two years ago, I suggested the desirability of a public competition of turbines; and it seems to me that just now, when water-power is likely to be used for electric lighting machinery, a thorough trial of turbines would render a great service to future purchasers, and, indeed, to all owners of water-power. The usual objections to turbine tests could not be urged if the wheels were tested, not only for efficiency, but also for those points in construction which have been above referred to as essential to a useful turbine.

Borough-road, Ipswich, January 25th. A. M. BROWN.

PHOTOMETRIC TESTS OF INCANDESCENT LAMPS.

SIR,—Mr. Ormiston's letter of the 18th inst. has drawn my attention to a cause of error in my tests. I am therefore now re-testing, under improved conditions, all the lamps mentioned in Table IV., and hope to send you the results.

The tests of Maxim lamps—Table III.—are, I believe, correct, a separate exciter having been used. Also those of Table I., where the fixed German silver resistance and the lamp under test were joined up together, so that the resistance of the circuit was not altered during the test of each lamp. ANDREW JAMIESON.

Glasgow, January 25th.

LIVERPOOL ENGINEERING SOCIETY.

PLYMOUTH WATERWORKS.

THE first meeting of the eighth session of this Society was held on the 18th inst. at the Royal Institution, Colquitt-street, the president, Mr. F. Salmon, M.I. and S. Inst., in the chair. After the usual business, Mr. H. F. Bellamy read a paper on "The Plymouth Corporation Waterworks."

The author, having called attention to the fact that the antiquity of the present supply of water to the town of Plymouth rendered the subject more than usually interesting, pointed out, on a bird's-eye view of the town, the geographical position of the district supplied with water by the Plymouth Corporation, proceeded to review in detail the history of the present source of supply—passing round photographs of maps of the town made during the reigns of Henry VIII. and Elizabeth, the originals of which are in the possession of the Marquis of Salisbury, in the Hatfield Library. He then showed that prior to A.D. 1590 the chief source of supply was from wells in the town, and that the Corporation, finding this supply inadequate, obtained an Act of Parliament—a brief extract of which was given, and which continues to the present day—to introduce a supply from the river Meavy, by means of an open channel or "leat." By quoting extracts from ancient corporate account books, and exhibiting a copy of the original plan for the construction of the "leat," he showed the cost and mode of carrying out the work, and the system of distribution, and charges made after the introduction of the water. In describing the present condition of the works, he stated that the original "leat," in a repaired condition amounting almost to reconstruction, was still used for twelve miles of its course, discharging the stream into a service reservoir three miles from the town, from which the water is conveyed by two lines of pipes, 12in. and 24in., to the distributing reservoirs two and three miles distant, thereby cutting off seven miles of the old course. He described, by a working drawing, the settling tanks, through which the water passes before entering the reservoirs. With reference to proposed improvements, he stated that the supply still being inadequate, a storage reservoir of about 350 million gallons capacity is to be constructed within the watershed of the river Meavy, above the head weir. The resources of this water-shed he showed to be very great. The pipe line is to be extended about five miles to Roborough Down, and a series of settling tanks and an intake reservoir constructed there. In conclusion, he gave details of consumption and quantity of water available, the rules and regulations, rates for domestic and other supplies, and analyses of water.

After the paper, which was illustrated by plans, photographs, and drawings, had been read, a discussion took place, and a vote of thanks to Mr. Bellamy for his interesting paper was given. The president announced that the next meeting of the Society would be held on the 1st of February, when Mr. Wm. Goldshaw would read a paper "On Municipal Control of Streets and Buildings."

THE ROYAL INSTITUTION.

DR. HUGGINS ON COMETS.

LAST Friday night Dr. William Huggins, F.R.S., lectured at the Royal Institution on "Comets." He said that in ancient times comets were supposed to presage war, pestilence, and woe, and that as during last year no less than seven comets had been seen, the events of 1881 might in the minds of some seem to give some justification to the idea. The subject of comets was one on which there was no general concensus of opinion even among the masters of science, although of late the spectroscope had done much to give clear knowledge. Some comets, he said, are permanent members of our own solar system; others visit us but once, and will probably never return. When the flight of a comet is more than twenty-six miles per second at the distance from the sun of the orbit of the earth it will go away never to return. A comet leads a humdrum life except when it gets near the sun; then it undergoes violent changes, but at other times it consists of little more than its nucleus. It is probable that the nuclei of some comets contains solid matter, and that the collision of one of these with the earth would have serious effects indeed. By means of the electric light he projected on the screen some magnified drawings of comets as seen through large telescopes, showing that as they neared the sun a kind of cap was thrown out from the nucleus on the one side, from which streamed a long tail on the other. Few photographs of comets had been taken because of their feeble light, the long exposure necessary, and the too great insensitiveness of photographic films; but Dr. Janssen, Dr. Draper of New York, and an astronomer residing near Ealing had taken a few. When they gave sufficient exposure to secure a representation of the tail they lost all the details in the head, and *vice versâ*.

Many years ago, when he and the late Professor W. Allen Miller applied the spectroscope to comets, they saw luminous bands like those produced in the spectrum by olefiant gas, and by observing the spectrum of the latter gas simultaneously, and with the same apparatus brought to bear on the light from the comet, their identity was manifest. Most comets gave this spectrum, indicating the presence of some hydrocarbon. But the nucleus of the bright comet of 1881 gave a continuous spectrum, proving beyond doubt the presence of solar rays reflected by cometary matter; the bright lines due to the presence of hydrocarbons were also present, as well as some indications which had been proved by Professor Dewar to invariably accompany the presence of nitrogen. The effects seen in 1881 might have been due to the presence of cyanogen. The light-giving stuff in comets is essentially the same.

Another branch of science, that relating to shooting stars, threw light on the subject. The November meteors go round the sun in rather more than thirty years, and Schiaparelli, of Milan, discovered that they move in the same orbit as the comet of 1861; thus there is a probable identity between the nature of the meteors and the comet. These meteors are very small pieces of matter, which usually ignite by friction and burn away in the earth's atmosphere; at other times some of them come through to the earth. The meteorites which came through contain a long range of chemical constituents, from the iron and nickel, of which some are chiefly composed, to the stony matter of others, rich in silicates; some of them contain carbon, hydrogen, and nitrogen. Probably the light of comets is not due to chemical decomposition, but to the setting free of the gases previously occluded in the metals. Dr. Odling, he said, once at the Royal Institution lit up the theatre with hydrogen brought down from interstellar space by a meteorite; he (Dr. Huggins) did not intend to attempt anything so sensational, but he might state that hydrocarbons, carbonic oxide, and nitrogen had been obtained from meteorites of both the metallic and stony type.

So far he had been walking on solid ground; beyond, all was speculation in relation to comets. The primary disturbing cause in comets is the action of the sun, and Mr. Crookes thinks that in high vacua the loss of the sun's heat by radiation is very small; so that there may be considerable heat in comets. Professor Tait, of Edinburgh, thinks that the luminous phenomena of the nuclei of comets may be due to stones knocking against each other. He (Dr. Huggins) thought that, in such case, a more complete spectrum would be given, showing the composition of the ignited substances. A feeling is growing among physicists, especially in America, that the light of comets may be due to electrical conditions; but in this direction speculation should advance cautiously, because at present it is supported by no known facts. Professor Zöllner says that, if certain data be granted, the action of electricity is sufficient to explain the phenomena of comets.

Dr. Huggins closed by hoping that throughout the lecture the listeners had not felt themselves to have been under the influence of the malign characteristics of comets.

LARGE ENGINES FOR THE NAVY.—The new twin-screw cruiser now in course of construction at Pembroke is to be fitted with compound engines to indicate 5000 indicated horse-power, by Messrs. Maudslay, Sons, and Field. The same firm has received orders to fit the troopship Tamar with new compound engines of 2500 indicated horse-power.

BRITISH COAL SHIPMENTS.—During the past year the coal shipments of the kingdom have been on the highest scale, the exports especially reaching the maximum quantity known. From many of the Welsh ports there has been an enormous increase in the exports, whilst the additions to the shipments from the north-east ports to other British ports have been large. Newcastle-on-Tyne still stands at the head of the coal-shipping ports, the large quantity of 7,139,197 tons having been sent thence. Cardiff, however, follows close, and is increasing its shipments much more rapidly than the Tyne port, the shipments last year having been 6,429,947 tons. Sunderland sent out last year 3,398,885 tons; and Newport, the fourth port, shipped 2,058,975 tons; Swansea sent 1,455,417 tons. West Hartlepool is the only other port shipping more than a million tons, its quantity last year being 1,137,620 tons. South Shields shipped 675,720 tons; Seaham—where the disastrous colliery explosion reduced the exports—shipped 502,060 tons; and North Shields, 319,065 tons. None of the other ports on the north-eastern or Welsh coal-shipping coast contribute largely to the export of coals or to the shipments to other ports. The largest increases in the exports are from Cardiff, Newport, Sunderland, and Shields; whilst in the coastwise shipments, the additions are most prominent at Sunderland, Swansea, Cardiff, West Hartlepool, Newport, and Newcastle-on-Tyne. But in the coastwise shipments, so far as those for London are concerned, there is increased competition with railways. The Midland Railway alone now takes into London more than two million tons of coals yearly—a quantity in excess of that of the largest of the ports that send coal to London by sea. It is possible, however, that in this respect there may be changes in the future, for the coalowners are now endeavouring to cheapen the cost of sea-borne coal as delivered to London consumers, and in other modes to increase the sales. It remains to be seen how far they will be successful in this respect, and how far they will meet the increased and increasing demand for fuel. Of this there can be little doubt—that, from time to time, it is tolerably certain the shipments of coal at our ports will grow, and that especially in the foreign part of the trade during periods of low price of coal.

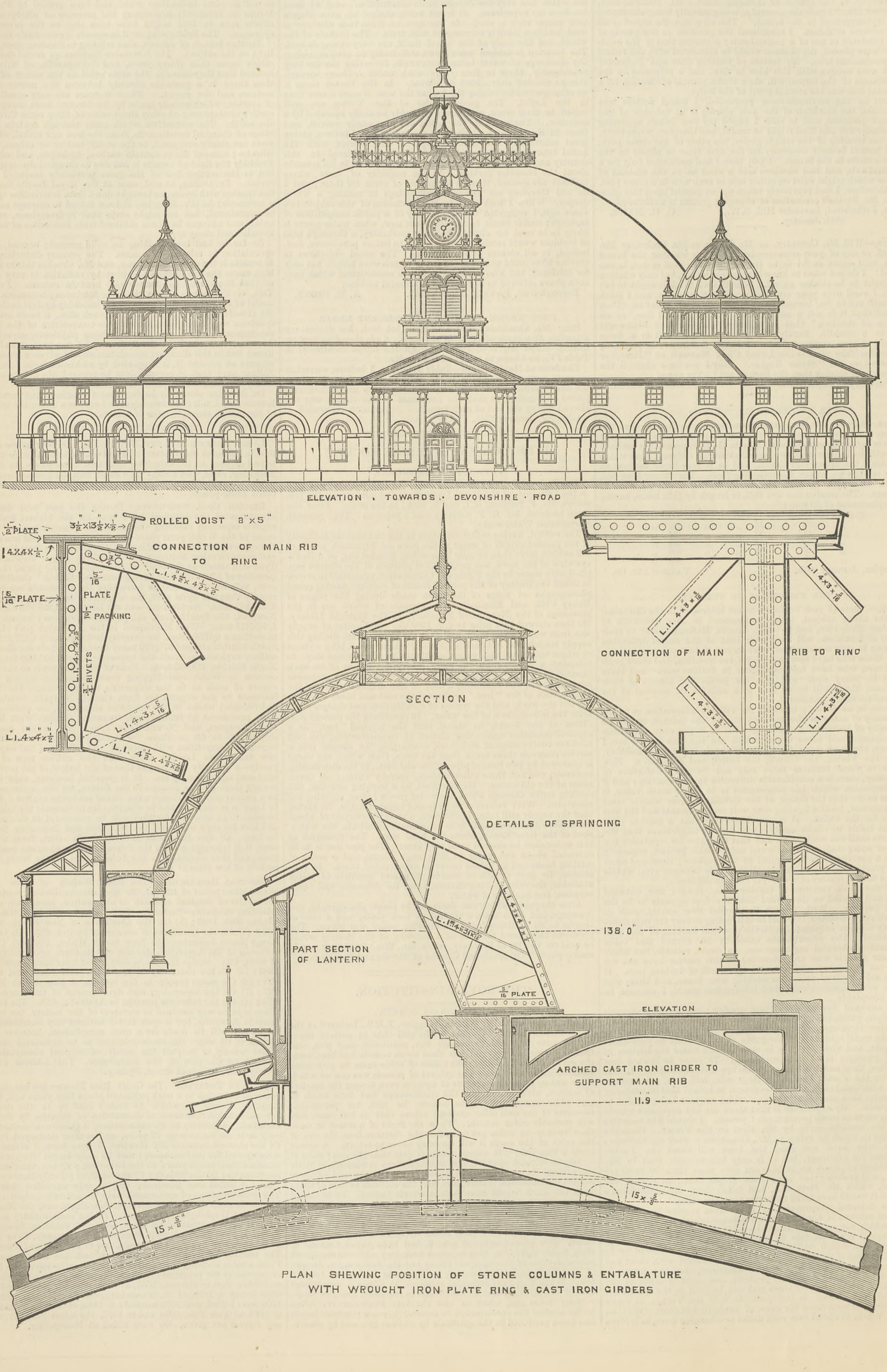
ORIGINAL RESEARCHES.—The Royal Society of New South Wales offers prizes of £25 for the best communication, containing the results of original research or observation, upon each of the following subjects:—Series I.—To be sent in not later than September 30th, 1882: (1) On the aborigines of New South Wales, £25; (2) On the treatment of auriferous pyrites, £25; (3) On the forage plants indigenous to New South Wales, £25; (4) On the influence of the Australian climates and pastures upon the growth of wool, £25. Series II.—To be sent in not later than August 31st, 1883: (5) On the chemistry of the Australian gums and resins, £25; (6) On water supply in the interior of New South Wales, £25; (7) On the embryology and development of the marsupials, £25; (8) On the infusoria peculiar to Australia, £25. The competition is in no way confined to members of the society, nor to residents in Australia, but is open to all without any restriction, but no award will be made for a mere compilation, however meritorious in its way—the communication to be successful must be either wholly or in part the result of original observation or research on the part of the contributor. The address of the society is 37, Elizabeth-street, Sydney.

FIRES IN THEATRES.—The Great Ring Theatre fire has directed renewed attention to a work published about four years ago, by M. Auguste Felsch, in which he stated that up to the date of his publication 252 cases of destruction of theatres by fire had occurred. According to his calculations, a theatre or concert-hall only lasts on an average 22 years, and is then destroyed by fire. Of the above-mentioned 252 theatres, 5 were burned before they were opened for performances; and 70 only lasted five years; 38 attained their tenth year; 45 the twentieth; 27 the thirtieth; 12 the fortieth; 20 the fiftieth; 17 the sixtieth; 7 only lasted eighty years; 8 lasted one hundred; and 3 only exceeded that age. Thirty-seven places of amusement were burned twice, eight of the largest theatres three times, and four four times, one, the National Theatre at Washington, five times. Taking each country separately, it appears that there have been 176 theatres burned in America, 68 in England, 63 in France, 49 in Germany, 45 in Italy, 26 in Austro-Hungary, 24 in Russia, and 17 in Spain and Portugal. The number of lives which have been lost has been enormous. From a table showing the number of persons who have been killed or injured at the principal fires, it appears, taking an example here and there, that in the year 1794, at Capo d'Istria, 1000 people lost their lives; in 1836, at St. Petersburg, 800; in 1845, at Canton, 1700 were killed, and 1670 injured; in 1846, at Quebec, 200 killed; in 1872, at Tien Tsin, 600; and in 1877, the latest year for which any figures are given, 400 were killed at Montpellier.

DOME OF THE DEVONSHIRE HOSPITAL EXTENSION, BUXTON.

MR. R. R. DUKE, BUXTON, ARCHITECT.

(*For description see page* 67.)



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PUBLISHER'S NOTICE.

*** *This week we publish a Double Number of* THE ENGINEER *containing the Index to the Fifty-second Volume. The Index includes a Complete Classified List of Applications for and Grants of Patents during the past six months. Price of the Double Number,* 1s.

*** *Acceding to a reasonable request made by several of our friends, we have commenced the publication of an Index to the Advertisements which appear weekly in* THE ENGINEER. *The Index will always be found upon the last but one of our advertisement pages.*

TO CORRESPONDENTS.

*** *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.*

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

*** *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.*

R. P. (South-hill-road, Liverpool).—*The address is the Woodlands, Hayes, Middlesex.*

H. R.—*Stoney "On Strains," Cargill "On Strains in Bridge Girders and Roof Trusses," published by Spon, Charing-cross.*

J. P. J.—*Most modern works on the steam engine contain descriptions and engravings of Corliss valve gear. You can obtain copies of the Corliss specifications from the Great Seal Patent-office, which explain the gear fully.*

M. P.—*The proposal has been made before, and in a measure tried. The difficulty is not only in the manufacture of the carbons, but when heated they expand and spring differently, and the consequence is that their arc ends cannot be kept opposite each other.*

WROUGHT IRON PULLEYS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your correspondents give me particulars of the strength and adaptability of wrought iron pulleys; are they capable of transmitting power equal to cast iron? G. J. C.

Birmingham.

ARTIFICIAL MANURE.

(*To the Editor of The Engineer.*)

SIR,—May I ask for some information as to the most approved methods of treating the flesh and other matters from a horseslaughtering establishment for the production of artificial manure and the collecting and refining the fat therefrom, or are there any good books on the subject?

Bridgefoot, January 24th. ISLA.

FISH GRINDING MACHINE.

(*To the Editor of The Engineer.*)

SIR,—On behalf of a joint-stock company, I am looking for a machine which will dry and grind fish—after the oil has been pressed out of them—for shipment on long voyages. Allow me to ask through your columns the names of the makers of a machine which is now successfully working as above, and where, the probability being that we shall want machines of a similar nature here. But before buying I should wish to inspect, if possible, and satisfy myself as to the capability of the machinery for the work required. E. M. J.

Victoria, British Columbia, December 28th.

GUN-METAL CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—There is no difficulty in getting a sound casting of the form and size that "Pneumatic" has been pestered with if the simple requirements have been brought into use, *i.e.*, bringing away the air, running it in the proper place, neither too hot nor too cold. I may say that the mixture of the metal will have nothing to do with it, so far as the solidity of the casting goes—that is, if the proper proportions are used, for either gun-metal, yellow or red. Also there is no need for it to be cast mouth upwards, as the core would have to be bolted to the top box, and would require a crane to lift it, whereas it could be made in a box, and cast either skin dried, or thoroughly dried in the stove. I have cast similar articles successfully frequently. Of course any practical man knows that there is more certainty in a dry sand cast than in green sand. If "Pneumatic" experiences any more difficulty in this, if he will communicate with me, I may possibly set him right.

J. E. TAYLOR.

7, Ribston-street, Hulme, Manchester, January 14th.

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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.*

MEETING NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 31st, at 8 p.m.: Paper to be discussed, "The Analysis of Potable Water; with Special Reference to the Determination of Previous Sewage Contamination," by Charles W. Folkard, Associate Royal School of Mines.

DEATH.

On the 16th inst., at Antwerp, after two days' illness, in his 53rd year, WILLIAM BURLS, for 34 years one of the Chief Engineers of the Imperial Continental Gas Association.

THE ENGINEER.

JANUARY 27, 1882.

THE CHANNEL TUNNEL.

ON Friday, the 20th inst., a meeting of the Submarine Continental Railway Company was held at the Charing-cross Hotel, to consider a proposed agreement with the South-Eastern Railway Company concerning the Channel tunnel. Sir Edward Watkin presided, and made a speech of some length. This speech contains a certain amount of information, but it leaves a great deal to conjecture. On Tuesday the money article of the *Times* contained a letter from Sir John Hawkshaw, written on the 30th of December, 1881, resigning his position as engineer to the South-Eastern Railway Company, because a document issued by the directors of that company to the shareholders contained the following statement:—"The works of experiment which you have authorised were commenced after the failure of those who proposed to make St. Margaret's Bay, to the North-east of Dover, the point of departure, so as to exclude your railway from a connection with the tunnel." As Sir John Hawkshaw was engineer to the Channel Tunnel Railway Company, this was a direct charge that he had neglected the interests of the South-Eastern Railway Company. This, we need hardly add, he indignantly denies. "On the contrary," he writes, "they—that is, the Channel Tunnel Railway Company—have always proposed that the Channel tunnel railway should start from Dover, so as to admit of a good connection there with both the railways." The publication of Sir John Hawkshaw's letter, following immediately after Sir Edward Watkin's speech, may be regarded as a comment on it. Sir John virtually warns the investing public, through the money article of the *Times*, that he is not responsible for any statements made by Sir Edward. We have no intention of following Sir Edward Watkin through his speech. The principal feature in it was the statement that the Submarine Continental Company purchases from the South-Eastern Railway Company, for the sum of £30,000 in cash and £20,000 worth of fully paid-up shares, the tunnel work and plant, the property of the South-Eastern Railway Company. The sum named is large. Let us see what the purchasers have acquired. In order to do this we must explain certain matters concerning which not much is generally known.

Into the town of Dover run two railways, namely, the South-Eastern, and the London, Chatham, and Dover. The South-Eastern line passes under Shakespeare's Cliff from Folkestone; both lines run branches on to the Admiralty Pier, and thus have similar advantages for carrying on their traffic with the Continent *viâ* Calais, Boulogne, and Ostend. Now, Sir John Hawkshaw proposed to construct a railway, part of which would be in tunnel, commencing at a point not far from The Priory station, and running at the back or land side of the Castle to a point near the shore of Fan Bay, close to the South Foreland. The length of this railway would be approximately $2\frac{3}{4}$ miles. It was so laid out that junctions by easy curves and gradients could be made between it and both the existing railway systems. From Fan Bay the Channel tunnel was to start, but nothing definite was ever arranged as to the precise direction which it was to take after it had left British soil. Its route from Fan Bay would lead it a little eastward of the Dover Pier. Nothing more was settled or could be settled. Thus it will be seen that Sir John Hawkshaw never proposed to start from St. Margaret's Bay and exclude the South-Eastern Railway. The story that he did, seems to have arisen in the fact that he anticipated that water would be found in the chalk, and to get rid of this he proposed that a drainage heading should be driven from some point in the tunnel off the pier head and Fan Bay to St. Margaret's Bay, which is about $1\frac{1}{2}$ miles north-east of Fan Bay. No Act of Parliament was ever got for this scheme, nor was the consent of either the French or English Governments obtained. The South-Eastern scheme is of a different character. Leaving Dover the railway passes in a tunnel under Shakespeare's Cliff. It then runs along the shore for a short distance, and enters the Abbot's Cliff tunnel, and so on to Folkestone. The South-Eastern Channel tunnel starts from a point near the Dover end of the Abbot's Cliff tunnel, and runs under the seashore, and parallel with it, nearly to Shakespeare's Cliff. Thence it diverges seawards, passing the head of the Admiralty Pier. Thus it will be understood that while Sir John Hawkshaw takes what may be termed the eastern leg of a Y, Sir Edward Watkin has selected the other leg; but both routes coalesce at or about some point southward of the pier. Sir Edward Watkin totally excludes the London, Chatham, and Dover Company from all participation in the advantages to be conferred by the tunnel. It will be understood that no works have been carried out by the original Tunnel Company on shore, with the exception of certain borings; but a very important series of soundings and auger borings have been made on its behalf by Sir John Hawkshaw, and we have not the least hesitation in saying that his scheme is in every way better, if for no other reason than because it is less selfish, than Sir Edward Watkin's. Sir John would give both railway companies access to the tunnel; but Sir Edward wishes to reserve it entirely for the line of which he is chairman. This fact alone would be certain to condemn the scheme the moment it came before Parliament. Such a work as the Channel Tunnel must be cosmopolitan, and it will never receive Government favour on any other basis. It will thus be seen that Sir E. Watkin's scheme involves a long parallel shore boring under land and under water which will count as nothing in the true cross-channel tunnel, and that though his tunnel ostensibly starts at a point nearer the French coast than Fan Bay, it in reality involves a longer sea tunnel than Sir J. Hawkshaw's scheme. Not only is this so, but the Watkin scheme renders a considerable length of the South-Eastern Railway useless, and all for the purpose of making the tunnel, as he has said, a South-Eastern Railway tunnel.

We are now in a position to understand what it is that the South-Eastern Railway Company has sold for £50,000. It has not sold a concession in the sense of an Act of Parliament, for none has been obtained; nor one in the sense of a permission from the French and English Governments to make the tunnel, for neither has that been got, although it is understood that Mr. Gladstone is or was not opposed to the work. What Sir Edward has sold is the permission to begin a tunnel on the three miles of sea-shore which the South-Eastern Company possesses at this place, and a heading about 7ft. in diameter driven for a distance of 1·1 mile in chalk *parallel with and within the sea-shore*, and not in any sense or way under the sea. For all the service this heading is, it might just as well have been bored at Broadstairs or Canterbury. If the tunnel is not proceeded with, the South-Eastern Railway Company will find itself more than recouped for the sums it has expended; but the new company will be just £30,000 out of pocket, and this will also be its fate if any other than Sir Edward Watkin's scheme is adopted. It denotes enormous faith in that gentleman that he should have succeeded in carrying out the sale under the conditions. In his speech at the Charing-cross Hotel, he made several statements which are at least rash, if not wholly opposed to the experience and teaching of the best engineers of the day. In the first place, the route he has selected is not regarded with favour by either Sir John Hawkshaw or Mr. Brunlees. Again, he stated that "a great fallacy which had been cherished by engineers was that in order to get to the gray chalk they must go through the upper chalk; but the South-Eastern had taken the other plan—they had found the gray chalk and followed it." This is true; but Sir Edward forgot to explain to his hearers that it has only been followed along the shore, and that neither he nor anyone else can tell with certainty how soon it will be lost after the work tends seawards. On nearly every important problem connected with the tunnel he was silent. Col. Beaumont asserted that while the works were in progress the air required for driving the boring machines would suffice for ventilation; but he did not stop to explain how compressed air is to be carried ten miles, or what would be the power required to get it through the mains. Concerning a scheme such as this, demanding for its construction on the most moderate estimates very large sums of money, it is essential that full information should be supplied. No one would think of constructing a railway twenty miles long on land, unless they knew perfectly well how it was to be worked, and that its working presented no insuperable difficulties. But the most competent mechanical engineers alive assert that the Channel tunnel cannot be worked by locomotive steam engines, and yet not a hint is dropped by Sir Edward Watkin, or any one else connected with the scheme, as to what is to be used instead. The idea appears to be that if the tunnel is constructed some means of working it is sure to turn up. Paraphrasing the words of a great general, we say that this may be financing, but it is certainly not engineering. A good deal has been said in continually appearing paragraphs in the daily newspapers about the borings on the French shore. These, in fact, until recently consisted of one shaft in the chalk ending in a chamber and two short headings normal to each other—mere hole-making to see what there is below, giving an appearance of reality to the scheme, which is said now to have been sold.

GAS ENGINES AND THE ELECTRIC LIGHT.

AT present there is a demand for something other than the steam engine to drive dynamo-electric machines. With the progress of the Swan or Edison incandescent system, this demand will probably increase. It is true that in cities electricity may be supplied from great central stations, as it is now about to be supplied from a station in Holborn throughout a district of considerable extent; but when all that can be done in this way has been done, there will still remain a good demand for small sets of apparatus, especially in country districts or provincial towns. There are beyond question objections to the use of the steam engine for driving dynamo-electric machines under such circumstances. These objections are so well understood that it is really hardly necessary to say that they refer to the risk incurred, and to the need for employing more or less skilled attendants to look after the machinery. No such objections apply to gas engines, and they enjoy considerable favour in consequence. The arguments against their use are that they do not drive regularly—at least, none of these engines which, like the Otto, make two revolutions for one impulse, can be said to do so—and that the cost of the fuel consumed is high. The first of these objections is, however, in a fair way to be removed. Thus, Clerk's new gas engine, now being manufactured by Messrs. Thomson, Sterne, and Co., does twice as regular driving as Messrs. Crossley's Otto engine, because there is an impulse given at every revolution. One impulse to every revolution is also given by Turner's engine, but this engine has not yet, we believe, been exhibited of more than 3-horse power, though larger powers are being made. We do not refer here to the Bischoff engine because, although an extremely useful machine where little power is needed, it is unsuitable for running a dynamo-electric machine, although, like Clerk's, it gets one impulse every revolution. There is every reason to think that Clerk's new engine will turn with sufficient regularity to give a current steady enough for all practical purposes. The question which remains for solution is, therefore, simply one of cost. When 20 indicated horse-power are required to drive a dynamo-electric machine, which will require least fuel, a gas engine or a steam engine?

Various attempts have been made to answer this question, and hitherto they have all led to the same result, namely, that the gas engine costs more to work it than the steam engine. The latest utterance on the subject is that of Professor Ayrton, who delivered a lecture in French, on the "Economical Use of Gas Engines for the Production of Electricity," during the Electrical Exhibition, held last autumn in Paris. Professor Ayrton shows that so long as gas at 3s. per 1000 cubic feet is used, so long must the steam engine be the cheaper motive power; but he goes on to explain that if a gas manufactured on Dowson's system be used, instead of ordinary coal gas, the result is different, and the gas engine becomes the more economical motor. Professor Ayrton's lecture contains several statements which demand notice, and we are by no means satisfied by his reasoning that the gas engine can, under any circumstances, compete with the steam engine on the basis of fuel consumption alone. But this statement is really not an argument against the use of gas engines, because they possess so many admirable qualities, when used under special conditions, that the cost of fuel becomes of secondary importance; still it is of sufficient importance to claim accurate statement. Now Professor Ayrton begins with a proposition which is true only in a sense, and can be, and often has been, perverted from its true meaning. He states that the steam engine wastes nine-tenths of all the heat evolved during the combustion of the fuel burned to put it in motion. "At present," said Professor Ayrton, "steam engines are chiefly used to drive dynamo machines, but even with the best engines and boilers it is well known that the fuel consumption is excessive compared with the actual work done. So good an authority as Sir William Armstrong has recently said that with a good condensing engine one-tenth of the whole heat energy of the fuel is realised in useful work, and this is no exaggeration of facts." To those not well acquainted with the subject this statement will appear to mean that the steam engine wastes, as we have said, nine-tenths of all the heat generated; but, as a matter of fact, it does nothing of the kind. The efficiency of any heat engine, no matter what, depends on the limits of temperature. T and t between which it works, and what we may term its coefficient of useful effect is found by the well-known formula, $\frac{T-t}{T}=E$, where E is the practical efficiency of the engine. Now, with the steam engine, when well made, E, as determined by practice—that is to say, as measured by the work done—compares very favourably indeed with E as obtained by theory; and the steam engine is not at all a wasteful machine. That it rejects a large quantity of heat is certain, but this heat has been first used in making the working fluid—steam. The loss lies in the fact that the whole, or nearly the whole, of this fluid, after being made, is lost; while it is retained very good use indeed is made of it by the best engines, and Professor Ayrton's statement is hardly fair to the steam engine, although it is, no doubt, true in a sense; but the sense is so readily mistaken that Professor Ayrton would have done well to explain in which of the two he used his words. We regret, indeed, to find that throughout he appeared to manifest a spirit of hostility to the steam engine. Thus, for instance, he says, "Engines and boilers of the portable type are those generally used now for electrical purposes, and in a competition in England of several of the best engines of this class the fuel consumption was about 4 lb. per indicated horse-power per hour; but in daily practical work it may be assumed at 6 lb. to 7 lb., more nearly representing the usual fuel consumption. This gives an efficiency of only about $\frac{1}{30}$th." We do not know to what competition Professor Ayrton refers—the last held in Great Britain was at Cardiff, when Messrs. Clayton and Shuttleworth's engine burned only 2·8 lb. per indicated horse-power per hour—but we do know that Messrs. Fowler, of Leeds, claim that their compound, electric light, engines work with less than 3 lb. of coal per indicated horse-power per hour; and we know that Messrs. Ransomes, Head, and Jefferies' engine on the Thames Embankment works up to 42-horse power with but a fraction over 3 lb. per indicated horse-power per hour. In any competition between the gas engine and the steam engine, the latter will have to reckon with a consumption of not more than 3·5 lb. of coal per horse per hour, or about one-half the quantity stated by Professor Ayrton.

The best performance of a gas engine of large power, say 40-horses, is one horse-power indicated for 20 cubic feet of gas. We have only to divide the price of gas per thousand cubic feet by fifty to get at the cost of fuel in this case. Thus, with gas at 3s., the cost is 0·72d.; with gas at 4s. the cost is 0·96d.; with gas at 1s. it is ·24d., and so on. The price of 3·5 lb. of coal, at 1s. per ton, is 0·01872d., consequently, with coal at 10s. per ton, the cost in fuel of 1-horse power per hour is 0·1872d.; with coal at 20s. per ton the cost rises to 0·375d., or little more than one-half that of a gas engine worked with gas at 3s. per thousand. It appears to be quite clear, therefore, that so long as ordinary coal gas is used, there does not appear to be the least chance that the gas engine can rival the steam engine, and Professor Ayrton ought to see that the reason why, is just the same as that which leads to the species of so-called waste with which he charges the steam engine. It is the cost of the working fluid with which we have to contend in each case. An explosive mixture of coal-gas and air is more expensive than the quantity of steam required to develope the same power, and the gas is as much wasted and lost as is the steam. That, however, the gas engine makes better use of its working fluid than the steam engine does of its working fluid is not impossible. All future attempts at the improvement of the gas engine, apart, of course, from structural ameliorations, must be directed to the production of a cheaper working fluid than ordinary coal-gas. With gas at 1s. per 1000 cubic feet, the cost of a horse-power would be, as we have said, 0·24d. per hour, or about the same as that of a steam engine burning coal costing 13s. per ton. Now, Professor Ayrton states that this cheap working fluid is supplied by Dowson's gas. About this little or nothing has been heard as yet—in this country, at all events. It appears, however, to be our old acquaintance, water-gas, in a new guise. Steam mixed with air is passed through a column of burning fuel. The steam is decomposed, and we have a mixture of hydrogen and carbon monoxide given off. Professor Ayrton gives its analysis as hydrogen, 20 per cent.; carbon monoxide, 30 per cent.; carbon dioxide, 3 per cent.; and nitrogen, 47 per cent. Its calorific value is therefore much less than that of coal gas. Indeed, it appears that coal gas has 3·4 times as much energy as the Dowson gas, which must therefore be 3·4 times cheaper in order that it may be used to the same advantage. As to the cost we know very little. Professor Ayrton exhibited a table, however, during his lecture, in which were set forth all the working expenses of an Otto engine indicating 30-H.P., and working with Dowson gas for 300 days of nine hours each. The figures showed that the engine cost about 45½ per cent. less, power for power, when worked with Dowson gas than when worked with coal gas at 3s. per 1000 cubic feet. It does not appear, however, that these figures were obtained by actual experiment. A smaller engine driven with Dowson's gas has, it was stated, in practice given results showing that one indicated horse-power was obtained from 1·46 lb. of coal, a performance rather better than that of the best modern marine engines. But it is estimated by Professor Ayrton that an engine working to 40 lb. would require but 90ft. of gas per horse per hour, and would give one horse-power for every 1·2 lb. of coal burned.

Should these statements be verified on further trial, the result will be very important. It is quite true that pipes cannot be laid down and the gas supplied from a central station, but each engine might be provided with its own producing apparatus to take the place of a steam boiler. The question would of course then arise whether the boiler or the gas producer would be the greatest nuisance. The enormous advantage possessed by the coal gas engine would still keep it in use. The only advantage to be derived from a resort to the Dowson gas engine instead of steam would be a small saving in cost of coal. The necessity for skilled labour and the risk from fire would remain about as before. Upon the whole we are disposed to think that the steam engine will find a more dangerous rival in the ordinary gas engine, such as Clerk's, than it will in the Dowson gas engine, which only appears to advantage when compared with engines burning an unnecessary quantity of fuel. We suppose, too, that such a thing as a wasteful or badly kept Dowson gas engine might also exist, when the comparison would assume another aspect.

THERMOMETERS FOR LOW TEMPERATURES.

Experiments at the Meteorological Observatory at Kew have proved that ordinary thermometers are "very wild" below the freezing point of water, and that the low temperatures announced as having been produced by apparatus for freezing meat on board ocean-going steamers are liable in some cases to serious questioning. Some of the thermometers used for the indications have been found to be inaccurate to the extent of more than 50 deg. Fah., and one was 100 deg. out. A thermometer, a relic of one of the earlier Arctic expeditions, was recently tested at Kew. At —40 deg. Fah. it was 15 deg. out, and at —100 deg. Fah. it was 30 deg. wrong. The demand for trustworthy thermometers for circumpolar and northern meteorological stations, as well as for meat-freezing machines and various scientific purposes, has induced the authorities at Kew to test the instruments at the temperature of melting mercury, the air thermometer being used for lower temperatures should exceptional circumstances require it. The freezing point of mercury —37·9 Fah., was first determined by Dr. Balfour Stewart, and his observations were subsequently confirmed by other observers. Between the freezing points of water and mercury no intermediate fixed point is known, although methyl chloride is supposed to furnish one. It is difficult to get this chloride in a solid state. On Thursday, last week, for the testing of a thermometer to be used with meat-freezing apparatus, also a thermometer for a meteorological station in Norway, about a pint of mercury was poured into a wooden cup, which cup was surrounded with a covering of boiler-felt, which again had an outside wooden cover. Solid carbonic acid was made in the usual way, by the evaporation of some of the liquid carbonic acid from an iron bottle, into which 200 gallons of the gas had been compressed. Lumps of the solid acid were then placed on the surface of the mercury, a little sulphuric ether was poured over them, then the lumps were pressed down into the mercury with a wooden spoon. This produced a hissing and a bubbling from the escape of carbonic acid gas. After the operation had been several times repeated, lumps of solid quicksilver began to form; some of them, rich in gas-bubbles, floated at the top; others sank to the bottom, for mercury, unlike ice, is heavier than the liquid in which it is formed. The lumps, some of them hard and some soft, were constantly broken up as much as possible with the wooden spoon, the great object being to get a thick layer of soft mercurial paste at the bottom of the vessel, in which to plunge the thermometers during the observations. The whole operation appeared to the onlookers to be simple and easy enough, although in the last generation the freezing of even a small piece of mercury was considered such a wonderful feat. Four standard Kew thermometers were then placed in the mercurial paste, and those to be tested were inserted alongside, their errors in indication being written down on paper. The possibility of all four of the Kew thermometers going wrong at once is not to be supposed, consequently the values of the indications of the thermometers on trial are well tested.

THE PETER THE GREAT.

The alterations made by Messrs. John Elder and Co., of Glasgow, in the Russian warship Peter the Great being now completed, the vessel was taken out of their dock on the 21st inst. during a high tide, and towed to Greenock by six tug boats, preparatory to taking in stores and undergoing her trials before leaving the Clyde. The Peter the Great arrived at Messrs. Elder's Fairfield Works on the 13th July last, after a rather stormy passage round the north and west coasts of Scotland, and the alterations made in her have thus occupied fully six months. A description of the vessel was published in The Engineer at the time of her arrival in the Clyde, and it is therefore unnecessary to give her dimensions now; but it may be of interest to state briefly the nature of the work which has been done in connection with her by Messrs. Elder and Co. The workmen of that firm were engaged from the 25th July to the 13th August in removing her old machinery and boilers, which consisted of three sets of engines and twelve boilers. This task being accomplished, the Peter the Great was towed up the harbour and placed in the Clyde Trustees' Graving Dock at Salterscroft on the 26th August. Here very extensive repairs were executed upon her. Built of iron, she is sheathed with wood, and covered with armour-plates to about 4ft. under water mark. In Salterscroft dock the vessel was thoroughly caulked, and the wood sheathing coppered over. Two new propeller shafts were put in, two brass propellers, and a brass rudder post, and also two complete sets of gearing for working torpedoes and firing them under water. This part of the work was finished on the 8th October, when the vessel was brought out of the graving dock and taken back to Messrs. Elder's dock at Fairfield, for the purpose of having her new machinery put in. While preparations were being made for this purpose it was discovered that the Peter the Great was not quite so strong a ship as had been believed, and it was found necessary to strengthen her considerably for the reception of machinery. This being done, the new machinery, consisting of six boilers and two sets of engines, *fac similes* of those placed on board the Czar's yacht Livadia, were put in. The engines indicate 8000-horse power, and are expected to give a speed of about 12 knots. The boilers are designed for a working pressure of 75 lb., whereas those taken out worked at 30 lb. when new, and considerably less when they arrived in the Clyde. During the stay of the vessel in Glasgow the officers visited a great many of the public works there, and appeared desirous of picking up all the information they could regarding them.

THE EXPLOSION OF A LOCOMOTIVE ON THE NORTH-EASTERN RAILWAY.

The coroner's jury which sat at South Stockton to inquire into the deaths of three of the victims of the recent locomotive boiler explosion near the Erimus Ironworks, has come to a totally different verdict from that come to at the North Stockton inquest, held a fortnight since upon the bodies of two other of the victims who resided at the latter town. It will be remembered that the previous verdict was founded upon the evidence of Mr. Lavington Fletcher, given in our last impression, and attributed the accident to shortness of water, and not to any defect of construction. The new verdict finds "that the explosion was caused by defective screw stays above the fire door, allowing the fire-box front plate to bulge, and ultimately rupture, when the fire-box top was crushed down by the pressure upon it." The jury were further of opinion that "a number of vertical stays connecting the crown of the fire-box to the top of the outer casing were totally insufficient to take the stress coming upon them," and they think that "additional stays of a more efficient character should have been adopted." These conflicting verdicts seem to show that the decisions of ordinary coroners' juries are liable to be matters of chance or impulse, and are not the deliberate judgments of competent persons. The public are puzzled rather than assisted by such decisions, which are likely to lead to litigation and other complications. Surely this is a case where a searching Board of Trade inquiry would be most appropriate and useful, if, indeed, it be not absolutely necessary.

LITERATURE.

The Book of Scales: Principally designed for the use of Students preparing for the Royal Military Academies at Sandhurst and Woolwich. By Ambrose Wheeler Holohan. London: Longmans, Green, and Co. 1881.

The contents of this little work are fairly indicated by its title. Besides, however, the description and explanation of various scales, it contains a table of lineal measures, a table of the continental units of lineal measure in terms of English measure, and a series of exercises in scales. There is very little to say about a work of this kind; but in this instance the book is excellently printed and bound, and the paper of more than ordinary quality—rendering it a rather artistic production. The scales are simply described, with examples of their use given, the illustrations being carefully and accurately drawn. The book will not only be useful to those preparing for Sandhurst and Woolwich, but for any students of geometrical or mechanical drawing.

Lightning-rod Conference: Report of the Delegates. Edited by the Secretary, G. J. Symonds, F.R.S. London: E. and F. N. Spon. 1881.

In 1878, the Council of the Meteorological Society, considering there were no authoritative directions in England to guard the public in their dealings with those who profess to protect buildings by means of lightning-rods—although official sanction is given in other countries to the best means of protecting—decided to ask the co-operation of certain societies for the formation of a committee to consider the subject. The committee was ultimately formed, and the result of its labours is the volume before us. The Report occupies about nineteen pages, the remaining portion of the book being filled with abstracts of papers, reports, correspondence, lists of books, &c., the information, in fact, upon which the conclusions of the committee seem to have been based. The work is useful as containing such abstracts, the original papers not being easily obtained. There is nothing in the Report itself to object to. It simply states that the conclusions of the committee are the conclusions advocated a hundred times before. So far as we are aware, their code of rules is that ordinarily followed by all who profess to know anything of the work. The value of the Report has been very highly appreciated by reviewers—such as he who suggested that, as lightning took a zig-zag path, the natural arrangement of the lightning-rod should be also zig-zag—we suppose in order to show his knowledge of the subject, and freedom from bias. But this does not necessarily make the Report complete or authoritative. The Report, in our estimation, lacks several essentials. The value of a lightning-rod depends (1) upon its being the nearest conductor to the discharging cloud; (2) upon its sectional area and material being suited for the work it has to perform; (3) upon thorough metallic continuity; and (4) upon perfect earth connection. Instead of a mass of abstracts good for the student, useless for the practical man, we should have preferred the discussion of earth connection under various conditions, and simple descriptions of visual and electrical testing, such as men far away from the smoke of towns and unacquainted with electrical science might comprehend and use. We do not agree with the advice to connect to the gas or water mains. Such connections may or may not be good; but of this we are sure that just as the householder needs good contact the mains may be under repair and his contact broken, &c. We would make a suggestion to the authorities moving in this matter, viz., print the Report without the appendices, adding to the former a few paragraphs stating the various causes which tend to decrease the efficiency of conductors—we do not notice vegetation, for example, mentioned—and also to add one or two of the simpler tests, such as that in use at Paris, and to give a few more suggestions as to good earth.

THE WATER SUPPLY OF COLCHESTER.

AN important addition has been made to the water supply of Colchester, a garrison town of about 30,000 inhabitants. The work has been carried out by Mr. Charles Clegg, Assoc. Memb. Inst. C.E., and borough surveyor to Colchester, for the Urban Sanitary Authority.

In the early part of last year, this Authority having recently purchased the works and plant, together with all the powers and liabilities of the Colchester Waterworks Company, appointed Mr. Clegg its engineer, and almost the first duty required of him was to report upon the then existing supply, and suggest the best mode of augmenting it. This he accordingly did, and was directed by the Authority to prepare the necessary plans and specifications for carrying the same into effect.

The works are now practically complete, and the supply obtained considerably in excess of the most sanguine anticipations. It may be well to state the general character of the works when purchased, and source and amount of supply. The water was obtained from an 8in. bore hole into the chalk, about 410ft. in depth from the surface, and starting from the bottom of a well, 10ft. in diameter and 37ft. deep, into which led the suction pipes from two pairs of three-throw 12in. pumps, actuated by a pair of 25-horse—nominal—horizontal condensing engines, by Messrs. E. R. and F. Turner, of Ipswich. These engines drive the pumps by gearing, have expansion valves, and are very good engines of the type. The supply was augmented by the water from some springs cropping up in the adjacent watershed, and till the new well was sunk did not exceed 18,000 to 20,000 gallons per hour.

Mr. Clegg's plan consisted in the construction of a well 9ft. in diameter, about 30ft. distant from the then existing well, and carried down to a depth of about 46ft. from the surface, and connected with it by a subway, having a 5ft. penstock to close communication if necessary with the old well. The suction pipes from the pumps are carried along the subway, and by an arrangement of valves and gearing, the water from either well can be used at will independently of the other. From the bottom of this new well, a cast iron pipe, 18in. internal diameter, is driven down a few feet into the chalk stratum about 143ft. from the surface, a 13in. hole being then bored about 268ft. through the chalk. In Colchester the water is pumped directly into a main, and there is no reservoir of any kind, therefore the supply is constant while the engines are at work. As the first water obtained from the new well was sure to be chalky, it was necessary to pump to waste, but to do this it was necessary to fit on a tail piece to the end of the existing main to carry the waste water to the river. This work was accomplished on Saturday night and Sunday morning during the few hours the engines could be stopped. On Sunday forenoon the engines worked as usual to supply the town, but about 4 p.m. the sluice to the old well was closed, and the pumps were put on to the new well, the water pumped, which was as white as milk, running to waste in the river. The engines will be kept working on the new well, pumping to waste at every opportunity until the water clears, which it will do in a few days. The results of Sunday's and Monday's pumping were, that after about an hour's work, both engines going full speed, the head was found to be lowered about 3ft.; but although the pumps continued for seven hours to throw from 75,000 to 80,000 gallons per hour, no further lowering of the head could be detected. This we cannot help thinking is an extraordinary supply, and is greatly due to the careful and thorough manner in which the work has been done by Mr. Thomas Tilley, of 12, Walbrook, the contractor. The whole cost did not exceed £1500.

The Colchester Authority contemplates some further works for the improvement of the distribution of the water, including a fine water tower, much needed, about which we shall have more to say at a future time. The whole work of obtaining the new supply reflects much credit on Mr. Clegg.

LARGE DOME ROOF—DEVONSHIRE HOSPITAL, BUXTON.

WE illustrate by the engravings on page 64 one of the largest dome-shaped roofs in this country or abroad. It forms part of the recent large extension of the Devonshire Hospital at Buxton, which has been carried out from the designs of Mr. R. R. Duke, architect of the building. In making the alterations and extensions it was found that the area required for the reception of 300 patients could not be obtained without the removal of two inner walls and a passage between them, which gave access to the different parts of the interior; and this removal necessitated another means of access, and required a covered communication on the ground floor and communication by a gallery on the chamber floor; and these could not be obtained satisfactorily by other means than covering the interior area. The construction of the dome was therefore determined upon, as it not only supplies the means of communication, but enables every room to be detached, and gives an unequalled hall for the recreation and protection of the patients from all inclemencies of season or weather. As shown by the drawings the dome is second only to the Royal Albert Hall oval roof in dimensions. This however is not a dome, but a series of covered roof principals of the truss type, having spans varying from 219ft. 4in. to 185ft. 4in. The Buxton dome is about 150ft. in diameter, while the dimensions of some of the principal domes elsewhere are as follows:—Pantheon, Rome, 142ft.; St. Peter's, Rome, 139ft.; Duomo, Florence, 139ft.; St. Sophia, Constantinople, 115ft.; St. Paul's, London, 112ft.; Baths of Caracalla, Rome, 112ft.; Temple of Apollo, 120ft. The outer form of the hospital is an irregular octagon, with an inner circular area of 164ft. diameter; within this there is a circle of forty-four columns, 138ft. diameter, forming a colonnade, 13ft. wide, all round this inner area. These columns, 2ft. 4in. in diameter, with their entablature, rise 25ft. above the floor, and from this point springs the dome, covering the whole of this area. The dome is a segment of a sphere, the diameter of which is 156ft. 6in., and is formed of wrought iron ribs, twenty-two principal ones, and twenty-two intermediate ones, secured at the foot to a wrought iron plate rim and heavy cast iron girders, connecting the inner area wall and the colonnade, and thus securing a perfectly firm base for the dome, as shown in elevation and plan at page 64. The lower ring or polygonal bracing rests on the stone entablature, each bay between the main ribs being composed of two wrought iron plates, each 15in. by ⅝in., interlacing each other at the centre, and the ends being strongly rivetted to a third plate, which is combined with and forms part of the foot of the rib itself. The horizontal thrust of every rib is thus received by this polygonal ring, there being no thrust whatever on the masonry. The ribs rise to a height of 50ft. from the base, or 75ft. from the floor line, and are there secured to a wrought iron ring, 40ft. diameter, from which springs a lantern light, also having 40ft. diameter, and being 18ft. high. On the apex of this there is an ornamental finial, 25ft. high, thus giving a total height from floor to roof of lantern of 93ft., and to top of finial of 118ft. In addition to the lantern light abovenamed there are eight other skylights on the roof at the base of the dome; and together they give 4500ft. superficial of light to the central hall. The purline framing is of rolled girder iron, 8in. by 5in. by 5in.; and, in addition to the attachment direct to the main ribs at the upper surface, is braced diagonally thereto by means of T-iron, extending from the lower flange of ribs to a point on the purline 3ft. 6in. from its junction on the rib. This bracing also adds to the rigidity of the arched ribs. There is also a framework of light rolled girder intermediate ribs, intersecting and attached to the several tiers of purlines, and to the upper central ring. A gallery surmounts the exterior at the summit of the dome and foot of the lantern, with suitable guard railing, to which access is provided. When the dome was completely covered in it was found that the deflection was not more than ½in. The superficial area of this hall is just half an acre; and it is capable of holding 6000 people. Its cubic contents is about one million of feet.

Our illustration shows the main front of the extensions with the dome in the rear. The heating of the wards, day rooms, central hall, and building generally, is by hot-water pipes passing under the floor, and coils of pipes placed in the large wards and day rooms; the smaller rooms, lavatories, &c., having pipes placed above the floor, and the hall having six rows of pipes around its whole circuit, four rows above the floor, and two rows under the gallery. The ventilation, in addition to that obtained through the windows, is supplied by 12in. glazed earthenware pipes, starting from areas outside the building, passing under the floor, and having branches into each ward and round the colonnade, carried up 8ft. above each floor level, in specially constructed wooden tubes; thus giving a perfect and constant supply of fresh air throughout the hospital. This description of the ventilation applies equally to the chamber floor. In the centre of the roof of the lantern is a large Boyle's patent ventilator, 3ft. in diameter. The principal entrance is on the east side of the building. The building contractor for the work was Mr. S. Warburton, of Cheetham Hill, Manchester; the ironwork being by Messrs. Rankin of Liverpool. Mr. Allen Vickars was the clerk of the works.

WASHING MACHINES AT THE COMPLEX ORE COMPANY'S WORKS, LLANSAMLET.

THE process patented by Mr. Edward Andrew Parnell is for the treatment of ores containing zinc, lead, copper, silver, and gold, from which the zinc cannot be eleminated by the ordinary method of "dressing." The presence of zinc in such ores renders them ill adapted for the dry smelting operations as commonly practised at lead, copper, and silver works; in such cases the whole of the zinc is lost, together with some of the lead and silver, and the cost of extracting the metals is considerably increased by the presence of zinc. By Mr. Parnell's process all the metals are utilised, the ore being treated in the following manner:—

(1) The ore is ground to a coarse powder; (2) It is then calcined in muffle furnaces, at a moderate heat, to oxidise the sulphur and metals and form sulphates and oxides; the sulphurous fumes which are disengaged may be collected when desirable in leaden chambers and towers, for the manufacture of sulphuric acid, in the usual way; (3) The calcined ore is then placed in a large revolving pan—see page 60—and there agitated with sulphuric acid diluted with hot water. The sulphuric acid at once takes into solution nearly all the zinc and most of the copper, leaving all the lead, silver and gold in the undissolved portion. The latter is now in a suitable condition for smelting in the usual manner in cupolas or reverbatory furnaces; (4) the solution of zinc and copper is then drawn off into tanks, and the copper is next precipitated therefrom in the customary way, affording a copper precipitate at once suitable for the copper smelters; (5) The liquor, which contains the sulphate of zinc, is then drawn off into pans and evaporated until it commences to thicken, when a small quantity of raw or uncalcined blende—native sulphide of zinc, is added. The desiccation is carried still further with occasional stirring until a nearly dry mixture is obtained of sulphate of zinc and raw blende. The blende is added to decompose the sulphate of zinc in the next operation; (6) the mixture thus obtained is placed in close ovens, and there heated to redness. The sulphate of zinc is thereby decomposed, sulphurous acid is disengaged—derived from the sulphate of zinc and the added blende—and conveyed to leaden chambers, for production of sulphuric acid, while the zinc remains in the state of oxide, well suited for the production of metallic zinc in the usual manner. The following are examples of the ores referred to above:—(1) Cavalo ore containing 15 per cent. lead, 17 per cent. zinc, and 20 oz. of silver per ton. (2) Spanish ore containing 4 per cent. copper, 30 per cent. zinc, 12 per cent. lead, and 18 oz. of silver per ton. (3) Constantine ore containing 1¾ per cent. copper—wet assay—10 per cent. zinc, 4 per cent. lead, 11 oz. of silver, and 3 dwt. of gold per ton. (4) British ore containing about 2 per cent. copper, 30 per cent. zinc, 10 per cent. lead, 8 oz. of silver and 4 to 5 dwt. of gold per ton. (5) French ore containing on the average 25 per cent. zinc, 30 per cent. lead, and 15 oz. of silver per ton.

TENDERS.

CONSTRUCTION of storm-water sewers in London-road and St. James's-road, Leicester, as follows:—60 yards of 20in. brick sewer, 11 yards of 20in. cast iron syphon, 170 yards of 15in. stoneware pipe sewer, 562 yards 12in. ditto, 350 yards 6in. ditto with manholes, &c., for the Corporation. Mr. J. Gordon, C.E., borough surveyor and engineer.

	£	s.	d.
J. Smart, Nottingham—accepted	470	15	3
Henry Hilton, Birmingham	471	18	0
G. Cowdery and Sons, Nswent, Gloucestershire	495	3	3
John Lea and Co., Leicester	518	0	0
John Hutchinson and Son, Leicester	575	0	0

CLEVELAND INSTITUTION OF ENGINEERS.—The meeting of Jan. 23rd is postponed till Feb. 6th, of which due notice will be given.

NAVAL ENGINEER APPOINTMENT.—The following appointment has been made at the Admiralty:—Thomas J. Osborne, engineer, to the Pembroke, additional, for service in the Stork.

SHIPBUILDING IN BARROW.—Figures have already been published as to the work of shipbuilding done in Barrow in 1881, and now we have to add in addition that Messrs. Caird and Purdie, of Barrow, built shipping to the amount of 3179 tons, a gross tonnage of 4927. The Barrow Shipbuilding Company built 32,700 tons, so that the total for Barrow will represent 35,879 tons.

TRAMWAY STREET LOCOMOTIVES.—Messrs. Merryweather and Sons have just despatched to Stoke-on-Trent one of their steep gradient tram engines, to work a section of the tramway, 1 in 16. This engine has a pair of 9in. steam cylinders, 14in. stroke. Another engine of rather less capacity has been sent to the Rhineland Tramway Company. This makes twenty-seven in number of the Merryweather type of tram engine running in Holland.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending Jan. 21st, 1882:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m., Museum, 11,924; mercantile marine, building materials, and other collections, 3636. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. till 4 p.m., Museum, 1347; mercantile marine, building materials, and other collections, 285. Total, 17,192. Average of corresponding week in former years, 14,177. Total from the opening of the Museum, 20,679,354.

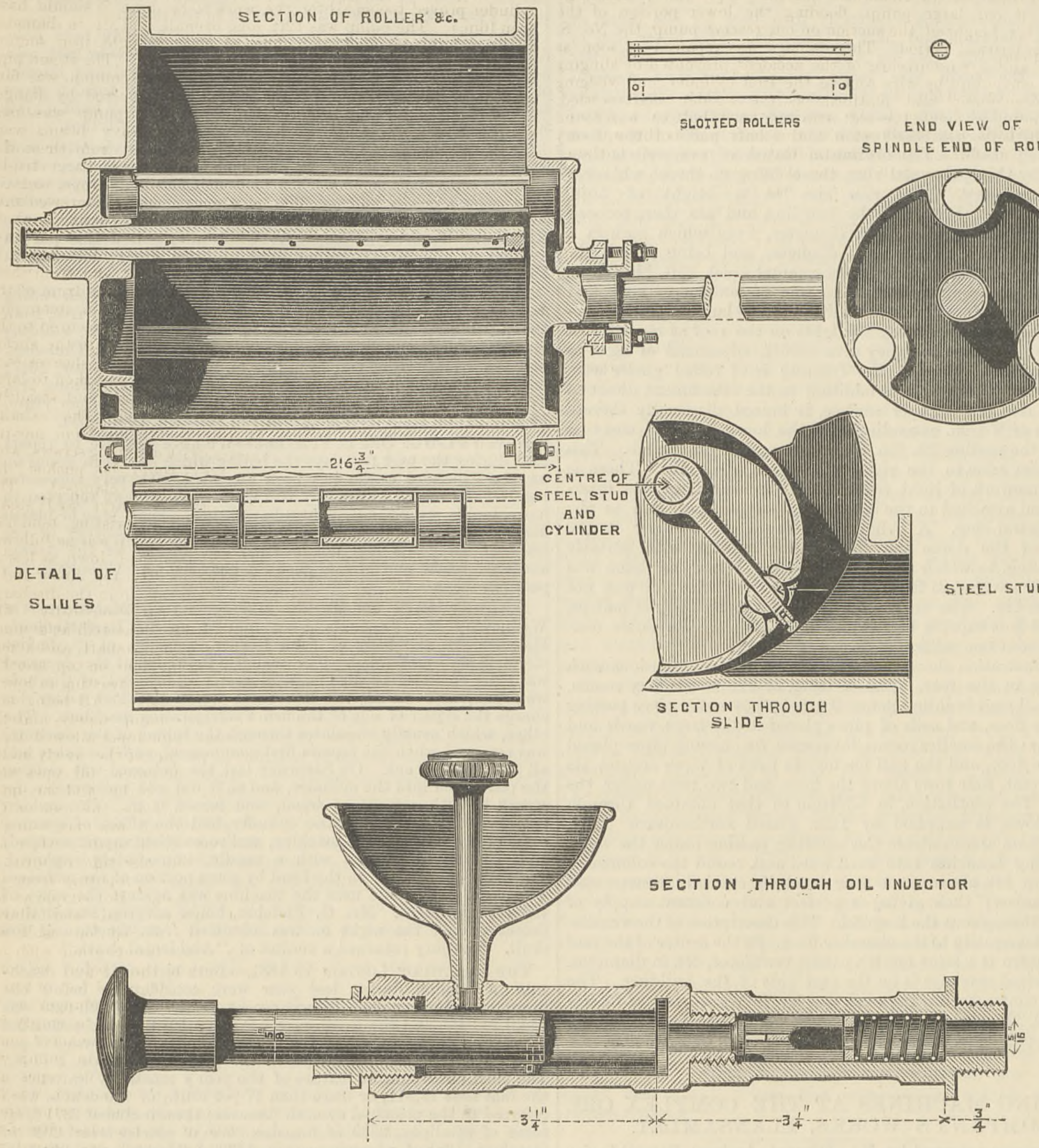
A NEW FIND OF ORE IN FURNESS.—We have pleasure to report that during the past few days the boring which has been going on on the Elliscales estate has been attended with very successful results, and where a discovery was made recently, and reported in our columns, near the Elliscales Farmhouse, a shaft is to be immediately sunk. It is now announced another discovery of ore has been made in a field not far from the junction of the Askam and Park-roads, and 14ft. of good ore has been gone through in the past few days.

ACCIDENT WITH AN ETHER REFRIGERATING MACHINE.—On Wednesday Mr. Payne held an inquest at St. Bartholemew's Hospital, on the body of John Burden, aged 30, of 18, Baker-street, King's-cross-road. The evidence showed that the deceased was chief engineer to Messrs. Reid and Co., brewers, of Clerkenwell-road, and during the last three weeks had had under his charge the repair of one of the firm's refrigerating machines. The ether, which usually circulates through the tubing of the machine, was removed when the repairs first commenced, and the tubes had all been washed out. On Saturday last the deceased was putting the piston-rod into the cylinder, and as it did not move easily, he struck it with a piece of wood, and forced it in. The sudden entrance of the rod into the cylinder had the effect of opening some of the valves of the machine, and some ether vapour escaped, and, coming in contact with a candle, immediately exploded, deceased being struck on the head by some portion of the machine. The use of the candle near the machine was against the rules of the establishment. Mr. G. Fletcher, house surgeon, stated that deceased died the night he was admitted from fracture of the skull. The jury returned a verdict of "Accidental death."

THE HEALTH OF LONDON IN 1881.—Both birth-rate and death-rate in London during last year were considerably below the average, and lower than in any recent year. The birth-rate was equal to 34·8, and the death-rate 21·2 per 1000 of the estimated population in the middle of the year. The death-rate was 1·3 per 1000 below the mean death-rate in the preceding decade, 1871-80. The most unfavourable feature of the year's mortality statistics is the fact that 13,811, or more than 17 per cent., of the deaths were referred to the principal zymotic diseases; these included 2371 fatal cases of smallpox, 2533 of measles, 2108 of scarlet fever, 2988 of diarrhœa, 1961 of whooping-cough, 1196 of "fever"—including 96 of typhus, 977 of enteric, and 123 of simple or undefined forms of fever—and 654 of diphtheria. The death-rate from these zymotic diseases was equal to 3·6 per 1000, and was identical with the rate from the same diseases in 1880. The fatal cases of smallpox, which had been but 458 and 475 in the two preceding years, rose to 2533 in 1881. The deaths from "fever," measles, and diphtheria also showed a marked increase, while the fatal cases of scarlet fever, whooping-cough, and diarrhœa were considerably less numerous. The rate of infant mortality was lower than in 1880; the deaths under one year were equal to 148 per 1000 of births registered, against 158 in 1880, a result mainly due to the decline in the fatality of summer diarrhœa. The rate of infant mortality measured in this manner averaged 158 per 1000 in the ten years 1871-80. The total death-rate was very low and smallpox high, while scarlet and other fevers were also higher than ever.

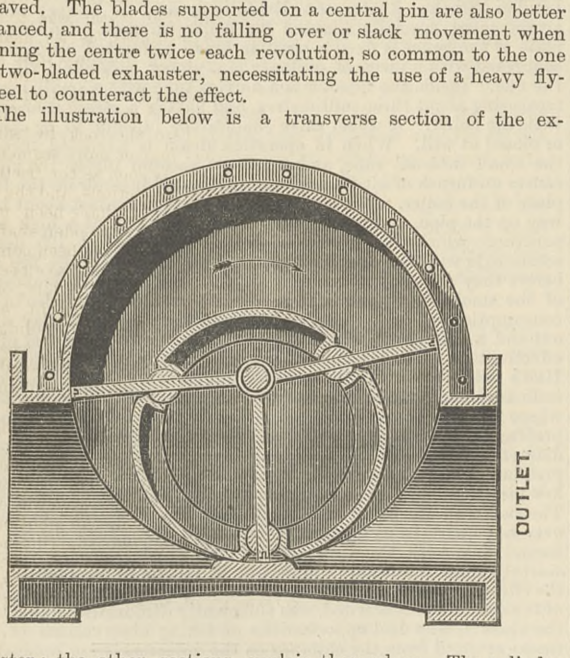
SMOKE-BURNING FURNACE ATTACHMENT.—Our Manchester correspondent has given a brief description of a series of experimental trials with a new smoke combustion air injector which have been carried out recently at the Heap Riding Mills, Stockport. The apparatus, which is the invention of Mr Hall—Fairburn and Hall—of Manchester, is shown at the London Smoke Abatement Exhibition, and is a very simple arrangement, specially adapted for boiler furnaces. On the face plate of the boiler is fixed a circular brass perforated air injector, connected with a piece of ordinary 2in. piping extending 2ft. into the flue. Inside the injector is a narrow tube with a small nozzle, measuring about three millimetres, and having a steam connection with the boiler. A wheel valve enables the injector to be opened or closed at will. When in operation steam is admitted through the small internal tube, and creating a vacuum inside the piping causes an inrush of air through the perforated injector on the face-plate of the boiler. The air and steam come in contact about half-way up the pipe, and passing out at the pipe end at a high temperature—which during the trials was registered at 125 deg.—commingle with the furnace gases as they rise from the fire and before they get away over the bridge. A more perfect combustion of the smoke and gases is thus secured, with economy also in the consumption of fuel. The trials, which were made one day without and a second day with the injector, were a very fair test of its effectiveness. The injector is designed specially in connection with Hall's patent revolving furnace bars, but these trials were made over ordinary cast iron stationary bars, which under certain circumstances where intense heat is generated in the furnace would seem to be preferable. The boiler was a two-flued Lancashire, 30ft. long, 7ft. diameter, fitted with ten Galloway tubes, working to an average pressure of 80 lb. and driving an engine with 19in. high and 30in. low-pressure cylinders and 5ft. stroke at 247 indicated horse-power. The fuel used was common riddled slack, and the trials extended over ten hours in each day. Constant interruptions during the second day, with the view of affording illustrations to visitors, scarcely allowed an exact comparison of results to be obtained, but the effectiveness of the injectors, so far as a considerable abatement of the smoke was concerned, was sufficiently demonstrated to satisfy the visitors, who had opportunities of taking observations of the smoke emitted from the chimney as the injectors were applied or taken off. When the furnace bars were in good order the smoke was reduced to a thin vapour, and there was no doubt as to the successful operation of the injectors in causing a very good combustion of the smoke and gases. One point, which of course presented itself, was the cost of steam required for creating the blast in the injector, but this, it is stated, does not exceed more than 1 per cent. of the total amount generated in the boiler, and this it is claimed is more than compensated by the increased evaporation secured by the blast. In addition to the abatement of the smoke it is also claimed that a more economical consumption of fuel is effected by the use of the injectors, but upon this point no reliable data was afforded by the trials. I was informed, however, by Mr. Hall that during previous trials with the same boiler a saving of 25 per cent. in the consumption of fuel, and a reduction of 60 per cent. in the amount of waste ashes had been effected by the use of the injectors.

WALLER'S GAS EXHAUSTER.



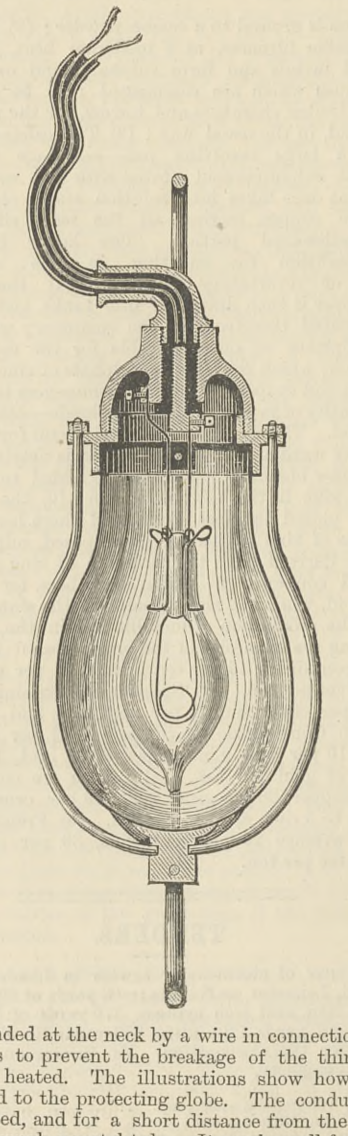
WE illustrate by the accompanying engravings a new form of gas exhauster, designed and made by Messrs. G. Waller and Co., Holland-street, Southwark, S.E. It may be made in any size, but the smallest sizes have two blades instead of three, as shown. The medium sizes have three blades, and for sizes of 60,000 cubic feet and above, it may be made with four blades, which still further reduces the oscillation or pulsation, and as they may be run at a higher speed than is usual with gas exhausters, pulsation is very much reduced. The chief points between this and the Beale exhauster are, that with three blades it will deliver one-third more than the latter with the same sized cylinder, and at the same speed, the contents of the cylinder being discharged three times in each revolution, against twice in the latter; the oscillation is thereby reduced in proportion. It is of course still further reduced when four blades are used. The blades work on a central pin, and being thus radial with the cylinder, instead of being, as formerly, excentric to it, they work smoothly round its circumference, and much friction and power in moving them round with the heavy ring or segments at the ends of the blades is saved. The blades supported on a central pin are also better balanced, and there is no falling over or slack movement when turning the centre twice each revolution, so common to the one or two-bladed exhauster, necessitating the use of a heavy fly-wheel to counteract the effect.

The illustration below is a transverse section of the exhauster; the other sections explain themselves. The cylinder has, as usual, two branches, and either can be inlet or outlet. The covers are recessed for ends of the roller, and have a boss for a central stud, or in large sizes for a central pin going through both covers. This stud or pin is of steel, and hollow, to admit of oil being injected to lubricate the joints of the blades. The roller is open at one end and solid at the other; the ends fit in the covers, and round the circumference of the roller are steel slotted rollers to carry the blades and swivel with them to suit the varying position, as shown in the section through slide. The blades each have two hinges fitting between each other, making together a continuous bearing on the central pin. The oil injecting lubricator for the central spindle above referred to is shown in section. These exhausters work very smoothly, and appear to be giving great satisfaction.



SWAN'S ELECTRIC MINING LAMP.

SINCE the trials of Swan's lamp at Pleasley Colliery, under the superintendence of Mr. R. E. Crompton, and the subsequent installations at Risca and Earnock, Mr. Swan has been constant in his endeavours to still further perfect the lamp. After a number of modifications, the final form adopted is that shown in our illustration. The lamp proper is enclosed in a thick glass globe which is still further protected by a wire caging. The lamp is surrounded at the neck by a wire in connection with the metal cap, so as to prevent the breakage of the thin globe by being suddenly heated. The illustrations show how the metal cap is connected to the protecting globe. The conducting wires are well insulated, and for a short distance from the cap of the lamp passed through a metal tube. It speaks well for the future of electric light in mines that it has for some time been working admirably in that most dangerous mine of Risca.



SHAFT SINKING UNDER DIFFICULTIES AT DORCHESTER BAY TUNNEL, BOSTON, MASS.

[*Concluded from page 41.*]

Sinking West or Inlet Shaft.—All of the foregoing description applies to the three shafts generally; we will now confine our remarks to the west shaft, where the depth of the material overlying the rock was greatest, and the difficulty of sinking in like degree increased. Previous to the letting of the contract, test borings had been made over the line of the tunnel by the city of Boston, and the results exhibited. Owing to the great expense of so doing, these borings in no place penetrated the rock proper, and, therefore, they failed to give any certain indication of the presence, at each shaft at least, of a stratum of boulders, sand, and gravel, lying immediately on the rock, and containing a large body of water. At this west shaft especially the worst feature shown by the borings was a sandy clay. The tunnel grade had to be finally lowered 3½ft. below contract grade, to meet this changed condition of affairs. The material was actually deposited at the west shaft in about the following sequence: Commencing at the top, mud 3ft., pure sand 5ft. and then strata of varying thicknesses of pure tough clay—clay with thin seams of fine sand, and clay intimately mixed with sand. Above the surface of the solid rock, and meeting the clay and sand deposits, was a stratum, 14ft. thick, of large boulders, gravel, and very sharp sand; and in this lowermost stratum water to the amount of about 17,000 gals. per hour was found. This water was salt, and seemingly in direct communication with the bay above. In the sand seams struck before the boulder stratum was tapped, brackish water, in maximum quantity

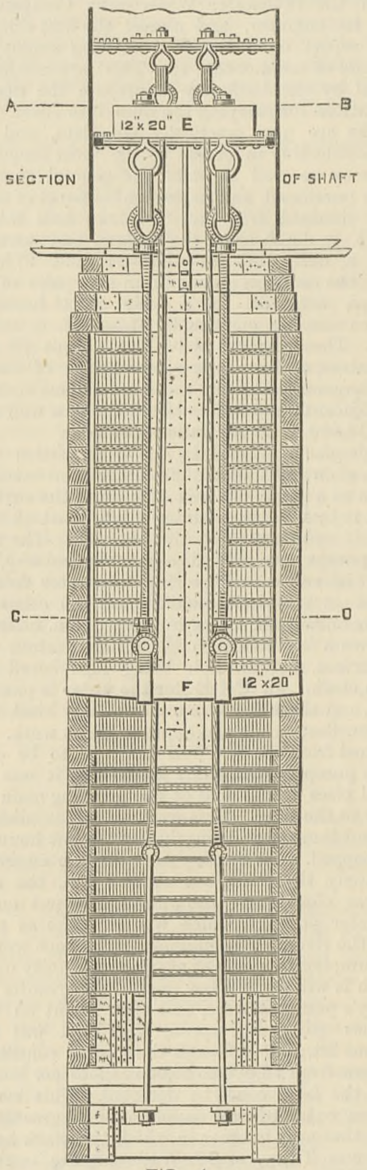
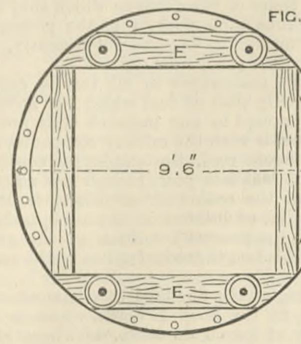


FIG. 4

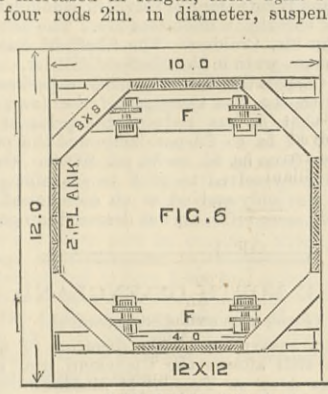
not exceeding 200 gals. per hour, was found; but these seams generally drained out, and gave little or no trouble. The surface of the solid rock was finally located at the west shaft, 123ft. below city datum. Seven cylinder sections, making 35 lineal feet of iron shafting were sunk without much trouble; but at this point the frictional resistance of the clay was sufficient to prevent any further sinking of the iron lining by its own weight merely, although the material was excavated below the cutting edge. At this time the surface water was entirely excluded, and the shaft was dry. A dead weight of at first fifty tons was now applied, as follows:—On top of the flanges forming the second cylinder joint, or 10ft. from the bottom of the shaft, a platform was built, made of four 12in. by 12in. hard pine sticks, laid in pairs parallel to each other, leaving a 6in. space between the two sticks in each pair, and a space of 4ft. between the pairs. These four sticks were accurately fitted to the inside of the cylinder, with as great a bearing surface on the flanges as was possible, holes being made in them for the heads of the cylinder bolts. Two struts, 12in. by 12in. and 4ft. long, were let in between the pairs, and at right angles to them, so as to leave a central opening 4ft. square; opposite the ends of these struts and between the sticks forming the pairs, four wedges were now driven, and the whole structure thus secured in the cylinder. A shaft 4ft. square inside, made of 4in. plank, on end, and internally braced, was next erected on this platform, and the space outside this box shaft well packed with iron refuse from a puddling furnace. As the cylinder descended, and the friction became greater, this dead weight was increased to a little over 100 tons by putting in a second platform and box higher up in the shaft. Eight heavy screw jacks were also applied in addition to this weight, on the top flange of the cylinder, reacting against trussed beams secured by chains to the bulkhead piles. When the cutting edge of the shaft lining had reached a point 57ft. below city datum, the area of surface then exposed to possible friction being over 1800 square feet, all our combined appliances failed to push it any further, and the use of the specified solid iron cylinders had to be discontinued.

Continuation of the Shaft to Rock.—No plan whatever of continuing the shaft after the cylinders were pushed as far as was possible being specified, the contractor was at liberty to adopt any method that might seem to him most fitting. From the data before him timber was deemed sufficient, and a timber lining was adopted. The shaft was dry, all water from above excluded, and nothing but clay indicated below him until the rock was reached. Of the wisdom of this decision we will here say nothing, considering that all the known data was derived from deep borings, which more often lead to trouble than exhibit the actual condition of affairs. The timber shaft was 10ft. square inside, and built of 12in. by 12in. spruce timber, laid skin to skin. As shown at Fig. 7, the sticks were cut and laid in alternate lengths of 10ft. and 12ft., locking over each other at the corners; and to prevent the shorter timbers from being forced inward, they abutted against cleats 4in. by 10in. by 16in. well spiked to the long sticks. They were further held in place by the bracing described further on. The first timber course laid was only 8ft. 10in. square inside, each succeeding course stepping back 2in., until the full dimension of 10ft. square was reached. This was done to give the cutting edge of the iron cylinders a bearing on top of the timber work, at least in the centre of the four sides. Between the top course of the timber work and the iron a space 4in. wide was left, in which 4in. sheet piling was driven out horizontally into the clay, and the



SECTION ON A.B

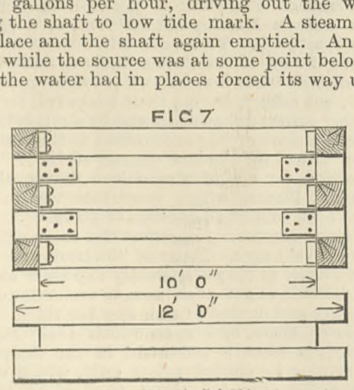
corners outside the circle thus closed. The greatest difficulty to be dealt with from the start, and the chief objection against such a compound shaft of iron and wood, was that of properly connecting the two. The corners of a square wooden shaft are the point best adapted for the location of any suspending members; but in our case these corners were outside the cylinder, and, consequently, not available. At first four of the cylinder bolts were removed from the bottom joint in the cylinder and replaced by four 1¼in. rods, with nuts at the top and lipped plates, catching under the bottom of the second timber course, and secured by 1in. rag bolts to this course; below this the hanging was continued by vertical planks spiked to the timbers. As the shaft increased in length, these 1¼in. rods were supplemented by four rods 2in. in diameter, suspended opposite the



SECTION ON C.D

centre of each side of the shaft, from heavy iron castings, bolted on top of the second cylinder joint. An iron plate 6in. by ⅞in. and 8ft. long was bolted by eight 1in. bolts to the middle of each side, and at the top of this plate was an L-shaped head 8in. by 1½in., through which the 2in. rod passed, and was there secured by a nut. This timber shaft was sunk with very little trouble to a point 95ft. below datum, with a maximum quantity of water from the thin sand seams not exceeding 200 gallons per hour. But at the point first mentioned water suddenly burst in from below at the rate of about 10,000 gallons per hour, driving out the workmen, and rapidly filling the shaft to low tide mark. A steam pump was at once put in place and the shaft again emptied. An examination showed that, while the source was at some point below the bottom of the shaft, the water had in places forced its way up behind the

FIG 7



SHAFT FRAMING

timbering, and was entering the shaft in jets through any possible crevice. And what was worse, the main stream was undermining the sides at the bottom, and the jets above were washing the fine sand inside, leaving voids outside the shaft lining. The sides were at once caulked, and the water driven to the bottom, and the 8in. by 8in. bracing, only partly in place, was completed to within 4ft. of the bottom. The iron cylinder soon commenced to sink very slowly, showing that the ground surrounding the shaft was in motion clear to the surface. The bulkhead and the adjoining portion of the machinery wharf sank with the cylinder.

The bottom was now a sandy clay, but firm, the water passing to the south-west corner of the shaft as soon as we commenced re-sinking. The material on the east and north sides seemed to drain out and remained quite firm, while on the other sides it soon became very soft, in places semi-fluid. This action increased the strain on the soft sides and tended to throw the timber courses out of the horizontal, the west side sinking more rapidly than the east. As long as the bottom remained firm this inequality of settlement was arrested by "rakers" and "props." All timbering on the soft sides could only be put in place by first carefully poling those sides, but surplus material would escape inside, and increase the pressures. All went well enough under the circumstances until we reached grade 104, where we suddenly struck a stratum of soft, almost dough-like clay, which we afterwards found was the direct covering of the water-bearing stratum of boulders, &c. Into this soft material our rakers, props, &c., easily sank and became useless as supports, and thereby the strain upon the rods and hanging members on the soft sides was enormously increased, and the west and south 2in. rods both broke, just above the lower nuts; the immediate cause being the slight bending of the L-shaped heads of the straps, thus acting as levers on the nuts and ends of the rods. Some of the plank lacing also commenced to give way, and being behind the corner bracing could not be repaired. Two steam pumps, a No. 8 Blake, and a No. 10 Knowles, were at this time located in the timber portion of the shaft, supported upon platforms; the discharge and steam pipes were clamped to both the iron cylinder and to the sides of the wooden shaft. As soon as the 2in. rods broke, severing the connection on those sides between the iron and the wood, the lower portion began to settle more rapidly than the cylinder. The effect of this was to break the bottom elbow on the discharge column of our large pump, flooding the lower portion of the shaft to the height of the suction on our reserve pump, the No. 8, at a very critical period. This damage was repaired as soon as possible, and a re-occurrence of the accident prevented by slinging both of our pumps by wire rope to the iron cylinder, and wedging up between pump and platform as the wooden shaft settled. On sounding through the soft stratum hard bottom was found about 7ft. below the then bottom of the shaft, and as this was very near the point which the boring indicated as rock, we continued sinking. After some tedious and dangerous work, and much trouble and delay from our pumps, which, it is usually the case, were always breaking down just when most needed, we reached the hard stratum only to find it was not ledge rock, but the top of a boulder stratum, of then unknown depth, and the source from whence came all our water, now much increased in quantity. The sand in this deposit was unusually sharp, and would scour through a brass pump lining ¼in. thick in less than three days, causing further and dangerous delays. We attempted to sound the boulder stratum by driving iron bars, but failed to get any satisfactory results until we started an artesian boring in a 5in. pipe, and finally drilled some 8ft. into the rock establishing its actual depth and character. At this time the bottom portion of our timber shaft was in very bad shape, many timbers broken, the hanging appliances a failure, and the courses very much out of the horizontal. To continue sinking under these conditions was to invite certain disaster. On the other hand, if we stopped sinking, the only alternative to building a new shaft, in another location, was the somewhat desperate one of attempting to re-timber the lower 36ft. of the shaft in the face of the moving ground and the consequent pressures. We determined to re-timber without waiting for the ground to settle. The upper 23ft of the timber work was still in good condition, the courses almost level, and the lacing intact. This portion we concluded to leave in, but it had first of all to be securely connected with the iron cylinders, and upon the integrity of this connection all success depended. Iron rods were abandoned in our plans for several reasons, among these the difficulty of attachment, and the fact that in one place certain obstructions in the shaft prevented a fair lead. Iron wire cables were substituted for rods. Four cables, made by Roebling Bros., were at first used, each cable 6⅝in. in circumference and 22½ft long from bearing to bearing of the eyes, and thimbles spliced into each end. The upper eye was made heart shaped, so that the lashing to be used would not ride and cut under the strain to be put upon it, the lower eye was made to take a 2in. iron pin, and the splices on each cable were further secured by broad iron clamps bolted over them. On top of the first or lowermost cylinder joint, two hard pine timbers 12in. by 20in. were placed, after having first been accurately fitted to the inside of the cylinder; holes were bored vertically through these sticks, just clearing the cylinder flanges, and passing through these holes, secured above by nuts and 12in. cast iron washers, were four eye-bolts made of 2½in. round iron; two struts were driven between the 12in. by 20in. timbers, to prevent motion. The lower connection of the cables were more troublesome. At the point selected, two hard pine beams 12in. by 20in. and 12ft. long were inserted in the shaft horizontally, the ends extending out under the sides. These two beams ran in the same direction as the shorter beams in the cylinder, and were vertically under them. Around each of the 12ft. beams, and directly under the eye-bolts, were four iron stirrups each 6in. by 1in., with two eyes in each stirrup just over the centre of the beam. Between these eyes the lower end of the cable was inserted and secured by a 2in. iron pin. The upper eye of each cable was now lashed to its proper eye-bolt by steel wire rope set taut by a purchase connected with the hoisting engine. The connection being now completed between the iron cylinder and the 26ft. of wood work to be left in place, the workmen commenced replacing the old and crippled timbers, below the hanging beams, with new and level courses—in other words, rebuilding the lower portion of the shaft. As shown on Fig. 4, a system of timber hanging was first attempted with 4in. plank, which plank acted at the same time as struts for the corner braces. This system was soon abandoned. It was all right theoretically, and had it been as easy of application in the shaft as on paper, would no doubt have answered admirably, but in practice it was found impossible, under the circumstances, to keep the inside faces of the timbers sufficiently true to plank against in the manner intended. The same principle was, however, retained by using iron straps 3in. by ⅝in., and 4ft. long, spiked with 10in. wrought iron spikes to the timber. These straps were applied in the corners behind the braces, in such manner that each new stick was suspended by two of these straps as soon as it was in place—4ft. of the bottom of the shaft was necessarily left unbraced for convenience in working. A second set of hanging timbers was put in 20ft. below the first, and entirely independent of that set (Fig. 4). In this set each hanging beam was made up of two 12in. by 12in. timbers, placed one on top of the other; the upper one was 12ft. long and passed through the sides of the shaft, the lower one was 10ft. long, and acted as a strut as well. Two 2in. iron rods, about 10ft. long, each provided with an eye for a 2in. pin above and a nut below, secured the lower end of each secondary cable to the beams. These rods, in pairs, carried the compound beams between them, the lower ends of each pair of rods passing through a stirrup plate 8in. by 1½in. under the bottom stick, and there secured by nuts. These cables were galvanised iron wire 4½in. in circumference. They were lashed at the upper end to four 2in. eye-bolts, which passed through castings bolted on to the second cylinder joint. This re-timbering was slow and dangerous work, and the greatest care possible in poling could not prevent the escape of some of the outside material into the shaft, the voids thus created, though comparatively slight, kept the ground in constant motion, the settlement being apparent clear to the surface. The first wire cables soon became as taut as harp strings. At first the greatest weight was thrown on the western pair of cables, leaving the east cables comparatively slack; the strain on the cables was equalised by setting up rakers, extending from the heavy west side to the east end of the main hanging beams. The total settlement of the iron cylinder after the timbering was commenced was just 5ft. The timber shaft was in the above manner successfully carried down to the solid rock, the shaft continued 20ft. into the rock, and the tunnel commenced. About five months after the completion of the timber work the brick lining was commenced. To conform to required lines it was necessary to cut entirely through some of the shaft timbers, and at the centre we found the clay outside generally drained, and in good condition. In the time specified above, the brickwork was completed with but little trouble from any motion in the adjoining ground, caution, however, was required, and the work was slowly and carefully done.

Pumping out Shafts.—The west and the east shafts were at different times filled with water; the first was lost by a failure of our boilers, the other by suddenly uncovering an unusually large seam in the rock, through which more water entered the tunnel than could be handled with safety by the two pumps then in place —one of the pumps broke down under the hard work, and the tunnel and shaft filled up. All of our shafts were too small in diameter, when their depth and the quantity of water to be raised through them is considered. This want of shaft room made our method of regaining them somewhat peculiar, and we will relate our experience. When the eastern shaft was flooded the amount of water to be pumped against was 18,000 gallons per hour, constantly flowing into the tunnel. To handle this quantity of water with safety, under the working conditions, would require a pump of the capacity of a No. 11 Knowles, which measures 9ft. over all, and would require an additional 2½ft. of room at the water end to allow packing, &c. It can be readily seen that such a pump could not be located horizontally within the iron cylinders, which, as before mentioned, were only 9ft. 6in. in diameter, a space further reduced by the flanges to 8ft. 10in. To overcome this difficulty we had a special pump built by the Knowles Company, of the bucket and plunger type, double-acting, and working vertically. This pump had a 14in. steam cylinder, 12in. plunger, 17in. bucket, and 24in. stroke; its capacity was 11⅞ gallons per stroke. (The steam cylinder proved too small for the work to be done, it should have been 16in.). The pump was 12ft. long over all, and 3ft. in diameter at the widest part, and with 20ft. of thin wrought iron suction pipe 10in. in diameter attached, weighed 7000 lb. The steam pipe was 2in., the exhaust 3in., and the discharge column was 6in. galvanised iron spiral pipe in 16ft. lengths, connected by flanges and six ⅝in. bolts. On account of its shape this pump was used without platforms built in the shaft. Two heavy beams were thrown across the top of the shaft cylinders, and from these the pump was suspended by a purchase made up of two large triple-sheaved masting blocks, and six parts of 4in. Manilla rope, connection with the pump being made by a strong eye-bolt screwed into the head of the steam cylinder, and by chain slings passing down to the water barrel of the pump. The running end of this purchase passed from the lower block up to a large single block lashed to the top of the four-legged shears, shown at Fig. 2, and from there down to the wharf, and through a snatch-block to the drum of the hoisting engine. The 6in. discharge column and the 2in. steam pipe were clamped to separate steel wire ropes, that were secured to the pump below, and thence passed over sheaves lashed to the shears near the top, but as far apart as possible; from these sheaves each rope went through a snatch-block on the wharf, and then to large cleats, all so arranged that each rope could be paid out steadily, and independently, as the pump was lowered. The exhaust steam passed into the water. To keep the pump from moving laterally when it was at work, oak slides, with clamping screws, were attached to the pump, so that they could be pushed out against the sides of the shaft, and then clamped. The spreading of the blocks to which the discharge and steam pipes were suspended was to overcome the twisting tendency in the falls. The method of operating this pump was as follows: When the water in the shaft had been pumped down as low as possible, the steam was shut off at the boiler, the top elbow and a 10ft. length of horizontal pipe was taken off from the discharge column, and a 16ft. length added to the discharge vertically. The steam pipe was at the same time being disconnected, at a union provided for that purpose just at the top of the shaft, and a new 16ft. length screwed on; while this was being done on top, another gang of men, stationed on the pump to prevent twisting in lowering, had hauled in the slides mentioned above. All being now ready for a shift, the engineer lowered the pump slowly, and the men stationed at the discharge and steam pipe ropes allowed these pipes to descend with the pump until the top of the newly added section of steam pipe was just opposite the union; all ropes were at once secured, connection made with the boiler, and the upper discharge elbow and its pipe again bolted in place, the men on the pump adjusted and secured the slides, and all was once more in position, ready to pump out another 16ft. of the shaft. After the men became expert in their several duties the time required to make a shift was about twenty-five minutes, computing from the stoppage of the pump to the starting again. But simple as the above may appear, it was only after repeated trials and failures, and considerable experimenting, that the wished for result was attained. At the east shaft we reached the tunnel grade with our suction pipe 166ft. below the top five several times before we could stay there long enough to pump out the 500 lineal feet of tunnel already driven. It should be remembered that the plunger, as we called it, was only an emergency pump intended to empty the shaft and tunnel preparatory to setting up a large permanent pump of the horizontal type in the tunnel. The vertical pump was troublesome to handle, took up much room with its ropes and pipes, and was difficult to pack. The steam connection was the most troublesome feature. When the pump was in action there was a very considerable vertical motion due to the elasticity of the fall ropes. This was especially the case when we neared the bottom of the shaft, and a rigid steam connection was consequently impossible. After trying a jointed steam pipe without success, we made use of a 6-fly gum and canvas steam hose, 6ft. long, placed between the steam pipe and the steam cylinder on the pump, but, under the steam pressure carried, 100 lb. at the boiler, this hose burst in a few hours; 10-fly canvas and pure gum was next tried, but even this would sometimes fail, by the intense heat softening the gum and thus allowing the hose to blow off the iron nipples in the end, in spite of grooves and broad iron clamps, intended to prevent any such accident. The radiation from the steam pipes, and the ascending steam, caused by water falling on the hot cylinder and pipes, made the temperature in the shaft almost unbearable. This, and the entire want of ventilation in the deep and narrow hole, caused great physical suffering among the men whose duties called them inside, especially when this experience was varied by the bursting of 2in. steam hose in the face of the pumpman. To the pluck and endurance of these faithful workmen all success was really due. This 166ft. of shaft was finally pumped out in little less than nine hours. Having, we hope, given a sufficiently detailed description of how we got into a scrape at the west shaft, and how we finally got out of it, we can now look back and see where we made our mistakes. First of all, it should have been taken as granted that water was to be met with in abundance, under the circumstances, as we neared the the rock. All indications to the contrary, obtained from borings, should have been disregarded. Had this been done, in the opinion of the writer it would have been ill-advised to have used any form of compound shaft, partly wood and partly iron. The iron cylinders should have been continued to the rock, by using iron rings of reduced height, and cut into four or more segments, put into place at the bottom of the shaft, as soon as the friction prevented the further descent of solid cylinder sections, and the surface water was excluded. The advantages would have been many as compared with the attempt to hang a square wooden shaft to an iron cylinder, the vertical connection would have been continuous and abundantly strong, and the entire shaft could have been made water-tight by caulking the joints with dry pine wedges, or otherwise. And with rings not more than 2½ft. in height, any soft ground could have been passed by a proper system of poling. It is true that some hanging appliance similar to that finally used might have been at first put into a timber shaft, had the possibility of meeting water been duly considered by all parties concerned, but the experiment, we think, would have been a dangerous one, as compared with a continuous iron cylinder, and all things considered, it would not have been as economical as iron. The Dorchester Bay Tunnel was commenced in January, 1880, and at this date some 4600ft. of the tunnel are driven. The contract was let to Mr. R. A. Malone, of Pennsylvania; the writer was engineer for the contractor. We cannot, in justice, omit the mention of our personal indebtedness to Michael Nolan, who superintended the retimbering of the west shaft, and to William Reardon, the rigger, who put into place our hanging-up appliances. To the pluck, endurance, and practical knowledge of these two men, very much of the success was due.

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

(*From our own Correspondent.*)

THE usual January quietude has come over the iron trade of thi part of the kingdom. New orders are being distributed only slowly, either for finished or for pig iron; and traders expect this quietude to extend into nearly the middle of February. Greatly more, however, is being now done than was in hand at this time last year. Few works are other than busy throughout all their departments; and there are some who will close the month with a better account than has been possible with them for five years past.

Marked bars were quoted firm on 'Change in Birmingham to-day —Thursday—as in Wolverhampton yesterday, at from £7 to

£8 2s. 6d.; but scarcely so firm as a week ago were certain of the brands sold at between those two extremes. A perceptible decline was noticeable at each market in the tendency to quote extreme rates by the marked bar firms who have not yet officially put up their prices, and very few reported themselves either in brisk employment or in the receipt of many inquiries.

Medium and common bars were maintained in larger proportionate inquiry, but they were unable to command quite so firm rates. Quotations were unchanged at from £6 17s. 6d. up to £7 5s.

Gas strip was less difficult to buy at £6 17s. 6d. to £6 15s., the demand from the tube firms having a little slackened. Strip used for stamping out purposes of gauges up to 20 w.g. was procurable from some firms at a little within £7, while firms whose brand is in more favour still demanded £7 10s. Similar variations characterised the hoop trade, as well as to coopers' as to baling sections. In both departments orders were sought, but without much success.

Common sheets are in larger supply, the demand of the braziers having become less animated, and the export inquiry a trifle less conspicuous. Some makers would have accepted a reduction of 2s. 6d. upon the week. The article might have been purchased to-day at from £8 5s. to £8 2s. 6d., and in a few instances after some negotiation at even £8.

Galvanising sheets were without quoted change in the open market. Consumers were ready to purchase on bargain terms, but declined to give makers' full terms of £8 10s. to £8 15s. for singles; £9 5s. to £9 10s. for doubles; and £11 5s. to £11 10s. for latens.

Galvanised slate sheets were a shade less strong than they were at the close of the meeting of galvanisers a fortnight since, when prices were mostly advanced from 10s. to 20s. per ton.

Plates are steady for bridge and girder building at firm prices; and orders for boiler plates of good quality do not fall off in number, though they are scarcely so for large quantities. Makers of good brands will not take less than from £8 10s.—"Wright" quality—to £9 for "Monmoor," and so on for other reputed qualities.

Puddled iron was sought after to-day for use in the mills, for the production of sheets mainly, and they were in a trifle better supply at variable rates.

The Globe Ironworks, Walsall, having recently been acquired by Messrs. Simpson and Wood, of James Bridge, Darlaston, are now turning out merchant bars of all descriptions, and best rivet iron. At the Globe Works is a pair of 60-ton shears which will cut through two permanent way rails at once. These are believed to be one of the most powerful pairs of shears in South Staffordshire, and they have been sought to be bought by engineering firms all over the kingdom.

Pig iron was not in much demand, though Bessemer pigs might have been sold in a few heavy lines if vendors would have accepted half-a-crown under their quoted prices. But they stood firm at 77s. 6d. delivered into this district. Cold blast pigs were unchanged at £4 10s., and all-mine were quoted up to £3 12s. 6d., while common—cinder—qualities descended to £2 5s. as the minimum.

There have been sales this week of broken-up plant, and good prices have been realised. As much as £3 10s. has been given for some cold blast which will require some expenditure in labour before it can be got into the furnace. Such rates were realised under the hammer at the sale on Tuesday of the plant at the Shrubbery Finished Ironworks, Wolverhampton. The Gold-green blast furnace plant and land of John Bagnall and Sons, Limited, was some time ago offered at £10,000, but failed to sell. The plant has yielded £7500, and the site of the works and some surplus land is likely to fetch £6000, for thick-coal is believed to underlie it.

The Board of Conciliation in the Cannock Chase coal trade is arranging the agreement which is to regulate wages in the future.

The iron makers still show themselves dissatisfied with their wages scale. A mass meeting was held at Brierley Hill on Monday to consider the proposed alteration in the scale—which now regulates wages in Staffordshire, South Yorkshire, and Lancashire. It was resolved to follow the example of the West Bromwich men, and give notice for a reconsideration of the scale so that it should embrace all classes of iron, and providing that wages shall be one shilling in advance of equal shillings to the equal pounds that represent the net average selling price of iron. This would be 6d. advance on the present scale. The average selling price of iron upon which wages are at present calculated is obtained as to bar iron only; and it is this limitation which the men wish to do away with.

At a meeting of the operative chain men on Tuesday, it was determined to give notice for a rise of 10d. per cwt. upon best work, and 6d. per cwt. upon common chain. It was asserted that two of the largest employers had already conceded an advance of 10 per cent. on best crane chain—a class of work upon which a large number of the operatives are employed.

The Amalgamated Society of Brassworkers, whose head centre is in Birmingham, have determined through their executive council to shortly give notice for an advance in wages of 10 per cent.

The constructive engineers are doing fairly well upon some railway work, and the nut and bolt firms are mostly in steady employment upon the same account, but the demand is not brisk for export.

The directors of the Union Rolling Stock Company, Limited, Birmingham, report that the operations of the company during the past half-year have been, owing to special circumstances, exceptionally profitable. The profit for the half-year is nearly £4000, out of which it is proposed to pay a dividend at the rate of 10 per cent. per annum on the ordinary shares; to pay the usual preference dividend; and to place £1800 to the reserve fund.

The profits of the Wolverhampton Railway Rolling Stock Company for the half-year have been £3257—a dividend of 3 per cent. on ordinary shares, a sum slightly in excess of the previous half-year. The business of the company in purchasing and leasing wagons on deferred payments has largely exceeded that of the previous period, but very little of the advantages of such business is shown in the present accounts. Six hundred and eighty-seven wagons have been bought and 243 sold during the half-year, leaving 5068 in possession of the company.

Towards the close of next month, Mr. Nepean, the director of army contracts, will, according to engagement, visit Wolverhampton and Walsall to hear suggestions which manufacturers may care to lay before him touching improvements in the mode of seeking supplies of hardwares for the land forces.

The Wolverhampton Chamber of Commerce has received a communication from the Associated Chambers, pointing out that the apparent intention of the Austrian Government as to her pending commercial negotiations is to increase her tariff on iron and on metal wares.

The Walsall Chamber of Commerce has received from the Associated Chambers a communication upon the French Treaty negotiations, in which they state that the communication which Lord Lyons has now been instructed to make to the French Government may be considered to be the last words of our Government. That the negotiations should be left in the hands of Lord Lyons was a course which several of the Chambers advocated last spring. "After all that has passed, however," says the communication of the Associated Chambers, "it may not be possible now for him to make satisfactory tariff arrangements."

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—For the present there is comparatively very little new business coming into the market, and the easier tone at Glasgow and Middlesbrough is evidently acting as a check upon buyers, who being mostly well covered for existing requirements prefer to wait before giving out further orders, with the view of getting more favourable terms. The large advance in freights has also had a tendency to check shipments, and the weight of new business coming into the hands of finished iron makers is considerably less than it was a month or two back. Makers on the other hand have their books so well filled for the remainder of the quarter that they are not at all anxious sellers, and in this district prices both of pig and finished iron are firmly maintained.

There was only a quiet market at Manchester on Tuesday, and Lancashire pig iron met with very little inquiry at the advanced rates, which came into operation last week. Makers, however, evinced no disposition to give way, and were firm at 52s. 6d., less $2\frac{1}{2}$, for forge and foundry iron delivered into the Manchester district. For Lincolnshire iron makers are asking 52s. 6d. to 53s. 6d., less $2\frac{1}{2}$, delivered equal to Manchester, and at these figures orders are being placed. Derbyshire brands are quoted at 54s. 6d. to 55s. 6d. less $2\frac{1}{2}$ delivered. There are, however, second-hand lots in the market to be bought at under these figures, and Middlesbrough iron has now got to a price which enables it to compete here, g.m.b.'s being offered during the week at 51s. to 51s. 6d. for net cash delivered equal to Manchester. Finished iron remains firm at an average price of £7 2s. 6d. for bars, and £7 10s. to £7 12s. 6d. for hoops delivered into the Manchester district.

The engineering trades throughout this district continue generally well employed. Tool makers are full of orders, locomotive builders and boiler-makers are all busy, and amongst cotton machinists increasing activity is reported, although it seems probable that several of the projected new cotton mills may not be proceeded with. Although the last returns of the Amalgamated Society of Engineers show an increase in the number of unemployed members on the books, this is readily accounted for as the temporary result of the new year holidays and the stoppages for stock-taking. As to the actual condition of trade, the reports from the various districts are encouraging. Throughout the Manchester district trade is returned as either good or improving; at Barrow, Blackburn, Farnworth, and Newton-le-Willows it is also returned as good. At Liverpool, Lancaster, Oldham, Bacup, Bury, Heywood, Hollinwood, Preston, Staleybridge, Todmorden, and Sutton, trade is returned as moderate; at Rochdale as moderate and bad; and at Ashton and Wigan as bad. Amongst the men, although no definite action has yet been resolved upon, there is an unquestionable movement going on for an advance of wages, and a pretty general determination is expressed to obtain a return of the 2s. per week taken off wages during the depression in trade three years ago.

I still here of inquiries for men in this district being made on account of American engineering firms.

A large new goods station is just being completed by the Cheshire Lines Committee. The new goods depôt, which occupies an area of about 500 square yards, adjoins the Manchester Central passenger station. The building is of brick, with stone dressings and terra cotta cornice; the main frontage, which is nineteen windows long by four high, is to Watson-street; there is a second frontage twelve windows long by four high to Windmill-street, and a return frontage to the passenger station twenty-three windows long by three high. The upper floors are carried on cast iron columns, and consist of heavy plate girders with concrete cement archings. The goods trains enter the station on the second story, and powerful hydraulic lifts are being provided for raising and lowering the wagons. The brick archways under the central passenger station are also being utilised for loading and unloading goods. The plans for the goods station, which will cost upwards of £80,000, have been designed by Mr. W. G. Scott, the company's engineer, and the building is being carried out under his supervision. The ironwork has been supplied by Messrs. Eastwood and Swindell, of Derby; the hydraulic machinery, with accumulators and engines, by Tannett and Walker, of Leeds, and the general contractors for the work are Messrs. Neill and Sons, of Manchester.

In the coal trade the better classes of fuel for house fire purposes continue a drug in the market, with a downward tendency in price. Common round coals for iron making and steam purposes although in good demand are also plentiful and offered at very low figures. Engine classes of fuel move off well at late rates. The average pit prices are about as under:—Best coal, 9s. to 9s. 6d.; seconds, 7s. to 7s. 6d.; common coal, 5s. to 6s.; burgy, 4s. 6d. to 5s.; good slack, 4s. to 4s. 3d., and common sorts 3s. upwards.

Barrow.—The tone of the Hematite pig iron market has assumed a much firmer attitude during the past week. As a consequence higher prices are being asked, but quoted prices can hardly be taken as giving a correct idea of the state of prices. I am aware of some makers refusing to contract unless higher figures can be given, and the prices demanded are rarely refused. Quoted prices are, No. 1 Bessemer, 65s. 6d. per ton; mixed samples, 64s.; forge iron, 62s. 6d.; and Nos. 3 and 4, 62s. 6d. f.o.b. at works. Bessemer samples are in especial request, and the consumption of forge iron is very large. The demand goes on steadily increasing, and the inquiries which come from the Continent, the colonies, and America, give every indication of increasing in a much greater ratio than at present. I feel confident that we shall have an extraordinarily good year's trade. Makers are of course pushing all the metal out of the furnaces they can, and some of the works are hurrying forward to increase their supply, so as to be in a position not only to meet the demand but to be able to work off their contracts within the period contracted for.

Steel makes are very actively employed in all departments, and the orders which are held, and the inquiries which are being made, place this industry in a very active and satisfactory position. Iron ore in large consumption at a shade higher values. Iron shipbuilders are busy and have secured some good orders. Engineers, ironfounders, and others busy; shipping brisk.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

THE West Yorkshire coalowners have followed the example of those in South Yorkshire, and distinctly declined to accede the 10 per cent. advance asked for by the miners. Their reply is to the effect that the present price of coal will not admit of any advance whatever, and that no higher wages would be given until it was shown to be required by the operation of the sliding scale. The miners having hinted that they desired some revision of the sliding scale, the coalowners informed them that if they were dissatisfied with that agreement, they were at liberty to give the six months' notice required for its termination.

A "hitch" has arisen in reference to the adoption of the sliding scale at Messrs. Newton, Chambers, and Company's collieries at Thornecliffe. The firm employ both unionists and non-unionists, the latter being in the majority. At the Rockingham and Tankersley collieries, however, the men belong to the Yorkshire Miners' Association, and they, acting on the advice of their officials, oppose the adoption of the sliding scale, unless preceded by an advance of 10 per cent. in wages. The employers are anxious for the adoption of the system, and as the non-unionists are equally anxious, it is probable that the latter will press for this system of regulating wages, which once fairly established, and equitably worked, would render strikes and lock-outs unnecessary.

A curious document came into my possession a few days ago. It was headed "Yorkshire Miners' Association," and addressed "To our Members and Local Officials." It professes to be a statement of the case for the miners, and is signed by four officials, Edward Cowey, Benjamin Pickard, John Frith, and William Parrott. It is denied that in consequence of the short time worked the cost of production went up 1s. per ton—an argument which has been used by the coalowners in the past when "the men have been asked to submit to indirect reductions." Even if it is true, the officials contend that trade has so far recovered as to cause pits to work on an average six days per week, which makes it necessary for "the one shilling added cost argument to be given up, and the indirect reductions taken from the men to be again added to their wages." Further, add the officials, "along with the improvement of trade prices have improved to such an extent that neither coalowners nor managers can gainsay." Figures are then given of the prices of coal at several collieries in West Yorkshire, which are said to show a total increase of 24s. 6d.—on 87s.—or a general advance of 28 per cent. on the prices obtained in July. Similar figures are given for South Yorkshire, where it is contended that a total increase is established of 16s. on 80s., or a general advance in the rates of 20 per cent. on July prices of 1881. The officials also state that "the directors of the railway companies establish the fact that coal has gone up in value;" "the committees of gas companies' bear similar testimony, and "all companies paying dividends where they were not formed in the inflated times," and "another fact quite as significant" is stated thus—"Although railway companies are paying, if anything, more money for the enormous quantities of coal they use, they are paying, if anything, larger dividends than when prices were lower." With all "these facts" the officials are confident the employers are in a position to give the men "a fair share of the advance which they (the employers) alone are putting into their pockets at the present time;" hence they call on the men "to demand intelligently, earnestly, and persistently the ten per cent. now claimed."

The reply of the coalowners to all this is exceedingly brief. Steam coal is the only class of fuel which has advanced. In that case the advance—except in one instance—has not been secured, owing to the contracts with the railway companies not having yet expired. As for house coal, the employers contend it is 1s. to 1s. 6d. less than it was last year, though it is admitted that the merchant, and not the coalowner or consumer, is obtaining the advantage. A strike or lockout in the coal trade would be so serious a matter in the present condition of the general trade of the district, that this lengthened reference to the position of affairs is important.

A further meeting of the Sheffield steel manufacturers has been held in reference to the hoop L mark, which is claimed as the exclusive property of Baron de Giers, of whose iron the firm of Messrs. Thomas Firth and Sons, Norfolk Works, have the concession. The meeting for the defence of the general right to use the mark hoop L was, I am informed, a most influential one. The manufacturers do not intend to contest the right of Messrs. T. Firth and Sons to the sole use of the word "Leufsta;" but they contend that "hoop L" has been a common mark for thirty or forty years. The action, when it comes on for hearing, will be one of the most interesting ever tried in connection with the Sheffield steel and iron trade.

Messrs. George Wright and Co., stove-grate manufacturers, Burton Weir, Rotherham, had a very complete exhibit of their productions at the Smoke Abatement Exhibition at South Kensington, where it was minutely inspected by the Prince of Wales. His Royal Highness has since given the firm an order to fit up his Royal Highness's private apartments at Marlborough House, the grate selected being their patent bi-valve, in combination with the Siemens grate for ensuring a smokeless fire. The firm have also an order in hand for Mr. Childers. The Sheffield Gas Company is pushing the Siemens grate in the Sheffield district.

The Barnsley Corporation recently made experiments with the electric light, which the Gas Company of the town has taken so much to heart that it has reduced the price of lighting the public lamps from £2 5s. to £2 per lamp, and the price of gas to private consumers from 3s. 6d. to 3s. per 1000ft. On these terms the corporation have resolved to stick to gas, though they admit that the decision was only arrived at on economical grounds, the electric light being more brilliant, but dearer, than gas.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE reactionary movement in the direction of quietness previously reported still affects the Cleveland iron market. But little business was done on Tuesday at Middlesbrough, and what transactions did take place in pig iron were at easier prices. The news of the financial crisis at Paris, and a rumour of political complications between Austria and Italy, both tended to disincline buyers from entering into contracts. Tuesday was also the polling day for the North Riding election, and many who ordinarily attend the Exchange meetings were absent on electioneering business.

The price of No. 3 g.m.b. ranged from 42s. 9d. to 43s. for prompt delivery. Warrants were not in much request, notwithstanding that they were freely offered by some holders who have been anxious to sell since the tendency to lower values set in. The price on Tuesday was from 43s. to 43s. 6d. for Connal's No. 3 f.o.b. Cleveland warrants. The stock of pig iron in Connal's Middlesbrough store was on Monday 176,236 tons, or a gain of 122 tons upon the previous week. There are still some American inquiries afloat, but few, if any, of them seem likely to come to business.

The finished iron trade is steady at previous prices; buyers are not so urgent, but sellers, having their books full for six months to come, are rather relieved than otherwise by a relaxation of pressure.

The quarterly return of the accountant to the Board of Arbitration has been issued for the last quarter of 1881. It shows that the price realised for manufactured iron during that period has slightly fallen. Plates, which constitute the most important element, have been sold at an average of £6 1s. $8\frac{1}{2}$d., as against 1s. more the previous quarter. Consequently, there will be no alteration in ironworkers' wages. Many of the ironworkers are dissatisfied with this result, as they confidently expected an advance. It is extremely difficult to get such men to understand that realised price is one thing and quoted price is another thing. The information accessible to them, and upon which their expectations are usually founded, is what is published in the daily papers. This information relates to quoted prices only, which at the moment are more than 20s. per ton above the prices lately realised. Beyond a little ebullition of temper, it is not expected that the ironworkers will take any action until April next, when the present sliding scale terminates and a new one will have to be negotiated. This may prove a difficult matter. The Union officials are in favour of a sliding scale, but never miss an opportunity of declaring their intention to have the basis price raised. The rank and file of ironworkers are divided amongst themselves, but according to present appearances there is a large contingent who are altogether opposed to sliding scales on any terms whatever.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

AT the close of last week the pig iron market was very dull, with prices declining, and this week the market opened and has been for several days in a languid condition. The fall in quotations since the downward tendency began has been very considerable, but the impression seems to be that the prices will ere long recover. As yet, however, the condition of business in the market is somewhat discouraging. While the iron trade outside is busy in nearly every branch, the immediate demand for pigs appears to be considerably below the average. The exports have been comparatively small, but the last return shows that they are on the increase and, with a better demand from America, it is probable that the market will soon gather strength. The deliveries into store during the past week have been somewhat larger, amounting to 1200 tons. There are 105 furnaces in blast, as compared with 122 at the same date last year and 108 in the corresponding week of 1880.

Business was done in the warrant market on Friday forenoon at from 51s. 1d. to 50s. 9d. cash and from 51s. 3d. to 51s. one month, and in the afternoon from 51s. 1d. to 51s. $1\frac{1}{2}$d. cash and 51s. $3\frac{1}{2}$d. to 51s. 5d. one month. On Monday the market opened at 51s. 4d. and then fell to 51s. 2d., and subsequently recovered to 51s. 5d. cash and from 51s. 6d. to 51s. 5d. and 51s. 8d. one month. In the afternoon business was done at from 51s. $7\frac{1}{2}$d. to 51s. $2\frac{1}{2}$d. one month and 51s. 4d. to 51s. $4\frac{1}{2}$d. cash. The market was flat on Tuesday with transactions at 51s. $1\frac{1}{2}$d. one month and 51s. to 50s. $7\frac{1}{2}$d. cash. Business was done on Wednesday between

50s. 7½d. and 51s. 2d. cash, and 51s. 4½d. one month. To-day — Thursday — the market was irregular, with business at 51s. 3d. to 50s. 10½d. cash, and again up to 51s. 1d.

On account chiefly of the backward state of the warrants, the values of special brands of makers' iron in second hands are again reduced this week, while Carnbroe and Glengarnock No. 3 have been reduced by makers 1s. per ton. The quotations are as follows:—Gartsherrie, f.o.b. at Glasgow per ton, No. 1, 60s. 6d., No. 3, 54s.; Coltness, 61s. and 54s. 6d.; Langloan, 62s. 6d. and 55s. 6d.; Summerlee, 60s. 6d. and 53s.; Calder, 60s. 6d. and 53s. 6d.; Carnbroe, 56s. and 52s. 6d.; Clyde, 52s. and 50s.; Monkland and Quarter each, 51s. 6d. and 49s. 6d.; Govan, at Broomielaw, 51s. 6d. and 50s.; Shotts at Leith, 51s. and 55s.; Carron, at Grangemouth, 53s. 6d. (ditto specially selected, 56s.) and 52s. 6d.; Kinneil, at Bo'ness, 51s. 6d. and 50s.; Glengarnock, at Ardrossan, 55s. 6d. and 52s. 6d.; Eglinton, 51s. 6d. and 49s.; Dalmellington, 51s. 6d. and 50s.

There is a good demand for Cleveland iron among the Scotch manufacturers, and the imports to date show an increase of 3950 tons, as compared with those of the same period last year.

There is nothing new to report with reference to the manufactured iron trade. The malleable works are all very busy, and prices continue firm. At the beginning of this week a strike of moulders took place in the foundries of Glasgow, and surrounding towns where general work is done. The men allege that their fellow-workmen engaged in the marine foundries had their wages increased gradually during the past year, while their requests for an advance had been refused. The reason of this, no doubt, is that in the marine shops trade has been very brisk; whereas, although there has been a good deal doing in general founding, the masters in that department have not been quite so well employed as in the marine establishments. The advance sought by the men is 7½ per cent., which they say has been deducted from their wages at different times during the past few years, when trade was dull. Some of the firms have conceded the advance.

The coal trade is still in a rather backward condition, although the returns from the different shipping ports appear to indicate that a gradual improvement is taking place. Indeed, the shipments compare favourably, not only with those of the past week, but with those of the corresponding date last year. Complaints are made in the West of Scotland that the railway charges are too high, and that on this account a considerable quantity of business is driven away to the English coast. The North British Railway give very favourable rates to the Fife ports, and in consequence the shipments at Burntisland are higher than at any other port in Scotland, with the single exception of Glasgow. At the present time, when competition is very keen and prices small, it is felt that the railway companies might greatly help the trade without damaging their own interests, by a slight curtailment of the rates of carriage. There is no change to report this week in the prices of coals.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE Glyncorrag, Rhondda, and Swansea Junction Railway Bill was on Monday before Mr. Frere, one of the examiners, and that gentleman, after various proofs had been admitted, declared the standing orders complied with.

This week there has been a good deal of discussion in Swansea with regard to the two companies who seek to connect that port with the Rhondda Valley, and a strong party favours the amalgamation of the two, especially as some fear that by the persistence of both, another twelvemonths' delay may be caused. At this early stage I content myself with remarking that the plan which secures a greater certainty of connecting the Rhondda is the one that should be adopted.

Swansea port has taken quite a forward position, and its improved exports of coal to foreign ports is well kept up. The total last week was 25,446 tons. It is not long ago that a total of 17,000 tons on the week was remarked upon as extraordinary.

The two ports, Swansea and Newport, are now in sturdy emulation of each other, and maintain a tolerable equality. Thus, last week the coal exports from Newport amounted to 23,741 tons, showing a decrease of about 3000 tons in comparison with the preceding week.

Cardiff still maintains its high position, and last week came up to 130,000 tons within a few tons only. The character of the trade, too, is good, and it is very probable that if the men pursue a peaceable track that an improvement will follow in wages. But I note that agitation is beginning with regard to the sliding scale, and though the feeling so far is stronger in the house coal collieries than in the steam, there is no knowing how soon it may extend.

An important meeting with the house colliers has taken place this week at the Nelson, a great centre for the house coal men. A few days will show the course intended. Action is to be taken before the end of the month.

A large and important ironworks in Glamorgan may again come into action. I am prohibited from mentioning names at present as, the treaty may fall through. Still prospects are hopeful.

Cyfarthfa may be regarded as settled. All conflicting points are stated to be adjusted, and very soon indications will be given that business is intended. The time taken up has been considerable, but it must be understood that very weighty and important questions had to be arranged and knotty subjects settled.

There is to be a branch rail from the Brecon line, which is also used by the London and North-Western, into the Cyfarthfa Works. This will be useful in the new steel era which may be expected to dawn with the spring.

It has been decided not to pay an interim dividend on the Rhymney Works this time, and this is reasonable considering the extensive improvements to be carried out.

Mr. Inskip has been elected chairman of the Taff Vale. It was at one time expected that Lord Wimborne would have accepted the position. It would have been a judicious step. The weighty interests of South Wales require a broader policy than Bristol is disposed at all times to give. Sir John Josiah Guest, the first chairman of the Taff, was father of the present Lord Wimborne, and in the early days, before the coal and iron development, the railway had a hard struggle for existence.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

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

Applications for Letters Patent.

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

17th January, 1882.

226. PROTECTING BOTTLES, J. Thorpe & J. Belloli, U.S.
227. RANGEFINDER, G. W. Hart, Portsea.
228. WHEEL, E. A. Brydges.—(*W. Richter, Berlin.*)
229. TEMPERING WIRE, H. Carter, Manchester.
230. LAMPS, C. W. Siemens, Westminster.
231. TELEPHONIC CONDUCTORS, C. W. Siemens.—(*F. Jacob, s.s. "Faraday."*)
232. ELECTRIC CONDUCTORS, H. R. Meyer, Liverpool.
233. RING SPINNING, E. Clarke, Todmorden.
234. DYNAMO-ELECTRIC MACHINES, W. R. Lake.—(*C. A. Hussey and A. S. Dodd, New York, U.S.*)
235. SCREW PROPELLERS, R. Griffiths, Bayswater.
236. TREATING GERMS, W. Lake.—(*L. Chiozza, Austria.*)
237. SASH FASTENER, M. Delmard, Plumstead Common.
238. SPINDLES, J. Dodd and G. Little, Oldham.
239. PIGMENTS, F. Wirth.—(*O. Kall, Heidelberg.*)
240. CIGARETTES, W. H. Beck.—(*E. F. Leblond, Paris.*)
241. HOLDING STAMPS, &c., C. A. Drake, London.
242. LOADING APPARATUS, A. Clark.—(*C. Meserole, U.S.*)
243. LOOMS for WEAVING, H. Livesey, Blackburn.
244. RECEPTACLES, E. W. Cooke, Liverpool.
245. ELECTRIC CURRENTS, W. R. Lake.—(*A. de Khotinsky, Paris.*)
246. PLOUGHS, J. Hornsby & I. Trolley, Spittlegate.
247. GUNS, W. R. Lake.—(*D. M. Mefford, Ohio, U.S.*)
248. INHALATION CHAMBERS, W. A. Barlow.—(*M. L. Encausse et Canésie, Paris.*)

18th January, 1882.

249. CLEANING BOOTS, G. H. Ellis, London.
250. ALCOHOLIC LIQUIDS, H. J. Haddan.—(*J. A. J. B. Devèze, France.*)
251. RECORDING INSTRUMENTS, R. Pickwell, York.
252. BATTERIES, H. H. Lake.—(*La Société Universelle d'Electricité Tommas, Paris.*)
253. SPRINGS, H. Woodruff and G. Barson, Sheffield.
254. BRAKES, W. Wakefield, Dublin.
255. SEWING MACHINES, M. H. Pearson, Leeds.
256. STEAM BOILERS, H. W. Pendred, Kingstown.
257. MOTIVE POWER, A. J. Lehmann, West Hartlepool.
258. STOVES, R. G. Greig.—(*The Detroit Stove Works Company, Michigan, U.S.*)
259. FLOATING VESSELS, R. Richards, Manchester.

19th January, 1882.

260. RAIL, A. S. Hamand, Westminster.
261. ORNAMENTING, &c., E. L. Voice, London.
262. SEWING MACHINES, H. Lake.—(*D. Campbell, U.S.*)
263. IRON-POTS, D. Cowan, Larbert, N.B.
264. SOUNDING INSTRUMENTS, T. Bassnett, Liverpool.
265. BLINDS, J. Westley, Chorley.
266. GRINDING, S. Pitt.—(*H. A. Duc, jun., U.S.*)
267. HOISTS, &c., J. Lindley, Clifton, near Manchester.
268. INTERCEPTING APPARATUS, P. Lowe, Darwen.
269. LOCKS, J. R. Nottingham.—(*G. Hathaway, U.S.*)
270. RIVETS, H. J. Haddan.—(*Q. Packard, Montreal.*)
271. PURIFYING GRAIN, H. J. Haddan.—(*P. Lefebvre and J. Nagel, Belgium.*)
272. MOVING TARGETS, S. T. Lander, Mere.
273. UMBRELLAS, H. Haddan.—(*C. Neumeister, Saxony.*)
274. HOLDING COINS, &c., H. J. Haddan.—(*I. Guttmann, Berlin.*)
275. EXTRACTING GOLD, L. F. Gowans, London.
276. WATER-CLOSETS, &c., T. Rowan, London.
277. STEAM PUMPING ENGINES, W. D. Hooker, U.S.
278. ELECTRO-HYDROTHERAPEUTIC, W. A. Barlow.—(*M. L. Encausse et Canésie, Paris.*)
279. PENDANT LAMPS, D. C. Defries, London.
280. SAW, F. C. Glaser.—(*Isaakson and Co., Germany.*)
281. GRABS, J. Johnson.—(*C. W. Maclean, Melbourne.*)
282. TRENCH SPADE, N. W. Wallace, Major of H.M. King's Royal Rifles.
283. TRENCHES, A. M. Clark.—(*Mrs. M. Pidgeon, U.S.*)
284. VESSELS, T. Teodoresco, Galatz.
285. LAMPS, W. Howes and W. Burley, Birmingham.
286. BELLOWS FORGES, L. C. Gomant, Paris.

20th January, 1882.

287. EARTHENWARE, W. Boulton, Burslem.
288. DYEING COTTON, J. Auchinvole, Glasgow.
289. SECONDARY BATTERIES, J. Humphrys, Norwood.
290. CONDUCTORS, H. Haddan.—(*J. D. Morel, France.*)
291. RECORDING SPEECH, H. J. Haddan.—(*J. D. Morel, France.*)
292. RUDDERS, H. Lumley, London.
293. HOOK FASTENER, J. McKenny, Dublin.
294. HEATING WATER, G. Nussey & W. Leachman, Leeds.
295. WATER-CLOSETS, S. H. Terry, Whitehall.
296. STOVES, F. Engel.—(*J. & J. Koopmann, Hamburg.*)
297. BATTERIES, J. and A. J. Higgin, Manchester.
298. PRESSES, F. Engel.—(*P. Schneider, Hamburg.*)
299. SLAGS, S. Pitt.—(*G. Rocour, Belgium.*)
300. ALARM, W. R. Lake.—(*H. S. Maxim, U.S.*)

21st January, 1882.

301. SEWING BUTTONS, H. Haddan.—(*J. Mathison, U.S.*)
302. VOLTAIC BATTERIES, A. R. Bennett, Glasgow.
303. PLATES, T. Sowler and W. Ward, Manchester.
304. OIL CAP, T. Watson, Paisley.
305. ELECTRIC LAMPS, J. N. Aronson, London.
306. EARTHENWARE TUBES, G. Smith, Bradford.
307. WEAVING LOOMS, T. Sutcliffe, Todmorden.
308. APPLYING SPRINGS, H. Smellie, Kilmarnock.
309. BOXES, H. Stevenson, Manchester.
310. GOVERNORS, W. Knowles, Bolton.
311. PHOSPHATIC SUBSTANCES, H. Scott, Sydenham.
312. SPINDLES, W. Lake.—(*G. H. Miller, U.S.*)
313. COPYING PRESSES, J. M. Plessner, Wurtemburg.
314. BOOTS, &c., W. T. Haynes, Leicester.
315. ROCKING CAR, E. O. Hallett, Weymouth.
316. TRANSMITTERS, E. Brewer.—(*J. Olmsted, U.S.*)
317. TROUGH CLOSETS, J. Holroyd, Leeds.
318. COLLECTING, &c., MONEY, J. Kaye, Kirkstall.
319. SECONDARY BATTERIES, J. S. Sellon, London.
320. RECORDING APPARATUS, A. M. Clark.—(*L. Hours-Humbert, Paris.*)
321. BRACE BUCKLES, T. Walker, Birmingham.
322. GLOVES, W. Dibble, London.

23rd January, 1882.

323. SPINNING, B. A. Dobson, E. Gillow, and D. Davies, Bolton.
324. RANGES, H. M. Ashley, Knottingley.
325. CHENILLE, &c., J. R. Lawson, Glasgow.
326. ROOF-TILING, O. Seefels.—(*H. Klehe, Germany.*)
327. SMALL-ARMS, S., R., and W. Trulock, Dublin.
328. MOTORS, G. Smith, Bradford.
329. TRANSMITTERS, S. P. Thompson, Bristol.
330. REGULATING TENSION, J. Foley, Dublin.
331. SHOES of HORSES, T. W. Overden, Kilburn.
332. BOOTS, &c., H. and T. Craston, London.
333. ELECTRIC CABLES, T. Handyford.—(*P. Delany, U.S.*)
334. VACUUM PUMPS, C. Abel.—(*J. Patrick, Germany.*)
335. VACUUM PAN, H. H. Lake.—(*A. R. Mackenzie and J. F. Maclaren, Australia.*)
336. BRACKET, T. S. Lyon, London.
337. GAME of SKILL, G. F. Neville, London.
338. KNIVES, H. H. Lake.—(*P. Brion, Paris.*)
339. ELECTRIC LAMPS, E. de Pass.—(*B. Abdank, Paris.*)
340. CIGARETTE PAPERS, A. G. Goodes, London.
341. OPERATING MECHANISM, G. K. Cooke, London.
342. STARTING ENGINES, W. H. Allen and R. Wright, Lambeth, and W. L. Williams, London.

Inventions Protected for Six Months on Deposit of Complete Specifications.

204. DISTILLING APPARATUS, G. E. Vaughan, Chancery-lane, London.—A communication from F. Lürmann, Osnabrück.—*14th January*, 1882.
215. STEAM BOILER FURNACES, G. H. Watson, St. Louis, U.S.—*16th January*, 1882.
223. PUMPING LIQUIDS, A. M. Clark, Chancery-lane, London.—A communication from C. W. Cooper, New York, U.S.—*16th January*, 1882.
226. PROTECTING BOTTLES, &c., J. M. Thorpe and J. A. Belloli, San José, U.S.—*17th January*, 1882.
266. GRINDING MILL, S. Pitt, Sutton.—A communication from H. A. Duc, jun., Charlestown, U.S.—*19th January*, 1882.
270. RIVETS, H. J. Haddan, Kensington, London.—A communication from Q. E. Packard, Montreal.—*19th January*, 1882.

Patents on which the Stamp Duty of £50 has been paid.

211. ELECTRIC CURRENTS, J. Rapieff, London.—*18th January*, 1879.
212. STEAM BOILER FURNACES, J. Young, Bunker Hill.—*18th January*, 1879.
26. SHEET METAL, J. Jones, Southwark.—*3rd January*, 1879.
198. MARINERS' COMPASSES, H. A. Severn, London.—*17th January*, 1879.
217. RAILWAY BRAKE, E. D. Barker, London.—*18th January*, 1879.
218. BOTTLES, C. F. Wood, Sheffield, and J. Wilkinson, Swinton.—*20th January*, 1879.
235. CARDING FIBRES, J. Schofield, J. Walton, and T. Holt, Littleborough.—*20th January*, 1879.
237. WATER MOTORS, F. C. Glaser, Berlin.—*20th January*, 1879.
269. SEPARATING METALS, F. M. Lyte, London.—*22nd January*, 1879.
308. SKATES, F. E. Dowler, London.—*25th January*, 1879.
264. COP-WINDING, W. W. Urquhart, J. Lindsay, and R. Ailan, Dundee.—*22nd January*, 1879.
265. WATER-CLOSETS, J. Shanks, Barrhead.—*22nd January*, 1879.
292. KNITTING MACHINES, W. R. Lake, London.—*23rd January*, 1879.
315. TRANSMITTING SOUNDS, J. H. Johnson, London.—*25th January*, 1879.
394. TELEPHONES, J. H. Johnson, London.—*30th January*, 1879.
412. TRANSMITTING SOUND, L. J. Crossley, Halifax.—*1st February*, 1879.
244. LOCKS, L. Berlsel, Iserlohn.—*21st January*, 1879.
290. LOCKING DOORS, N. Thompson, London.—*23rd January*, 1879.
294. COMBING MACHINES, E. de Pass, London.—*23rd January*, 1879.
378. STEAM GENERATOR, T. and J. Vicars, sen., and T. and J. Vicars, jun., and J. Smith, Liverpool.—*30th January*, 1879.

Patents on which the Stamp Duty of £100 has been paid.

298. UMBRELLAS, J. Willis, Sheffield.—*26th January*, 1875.
462. RAILWAY POINTS, F. W. Webb, Crewe.—*6th February*, 1875.
254. BUSK FASTENINGS, R. Stokes and R. Goff, Bow.—*22nd January*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 10th February, 1882.

3931. WRINGING COTTON, J. Wolstenholme, Radcliffe.—*10th September*, 1881.
3961. DRAINAGE, R. H. Reeves, Isle of Wight.—*14th September*, 1881.
3979. COVERING TRAM-CARS, E. H. Grey, Islington.—*15th September*, 1881.
3999. MEAT EXTRACT, L. A. Groth, London.—A communication from H. Bloch.—*16th September*, 1881.
4003. WHEELS, W. Somers, Halesowen, Worcester.—*16th September*, 1881.
4006. SAWING MACHINERY, F. Myers, London.—*16th September*, 1881.
4007. CARRYING APPARATUS, G. White, Wilden, Bedfordshire.—*17th September*, 1881.
4008. ROCK-BORING APPARATUS, M. Macdermott and W. Glover, London.—*17th September*, 1881.
4010. COOKING STOVES, J. Imray, London.—A communication from La Société des Specialitiés Mecaniques reunies.—*17th September*, 1881.
4014. MOUNTING CROCHET COTTON BALLS, H. Greg, Bolton.—*17th September*, 1881.
4017. ELECTRIC LAMPS, S. Hallett, London.—*17th September*, 1881.
4028. CASES for WATCHES, F. Wirth, Germany.—A communication from G. Speckhart.—*19th September*, 1881.
4029. TELEPHONE TRANSMITTER, S. Pitt, Sutton.—A communication from H. Machalski.—*19th September*, 1881.
4083. MEASURING WATER, W. Richards, Norwood-road, Surrey.—*22nd September*, 1881.
4084. RACQUETS, A. Hodgkinson, Manchester.—*22nd September*, 1881.
4112. PRINTING COLOURS, J. W. Stringer, Bradford.—*23rd September*, 1881.
4138. FILLING BOTTLES, A. M. Davis and H. des Forges, Westminster.—*26th September*, 1881.
4210. BOATS, S. Pitt, Sutton.—A communication from R. P. Pictet.—*29th September*, 1881.
4217. WEIGHING MACHINES, T. Moore, South Stockton-on-Tees.—*29th September*, 1881.
4620. CISTERN VALVES, H. T. Dawson, Chiswick.—*21st October*, 1881.
4662. HEATING BATHS, E. P. Alexander, London.—A communication from C. Martin.—*25th October*, 1881.
4663. BURNERS, E. P. Alexander, London.—A communication from C. Martin.—*25th October*, 1881.
4954. SELF-ACTING MULES, A. Metcalf, Preston.—*12th November*, 1881.
5104. ELECTRIC BATTERIES, A. M. Clark, London.—Com. from G. Fournier.—*22nd November*, 1881.
5432. TELEPHONES, A. W. Rose, Kirby-street, London.—*12th December*, 1881.
5438. SPINDLES, T. Watson, Paisley, Renfrewshire.—*13th December*, 1881.
5482. CARTRIDGES, R. M. Gardiner, Westminster, and G. Trench, Faversham.—*14th December*, 1881.
5552. HEELS for BOOTS, A. M. Clark, London.—Com. from P. Lemarchand.—*19th December*, 1881.
5595. ELECTRIC CALLS, A. W. Lake, London.—A communication from W. Lockwood.—*21st December*, 1881.
5631. SECONDARY BATTERIES, J. S. Sellon, London.—*23rd December*, 1881.
5637. CONTROLLING ACTION of MARINE ENGINES, R. J. Smith, Sunderland.—*23rd December*, 1881.

Last day for filing opposition 14th February, 1882.

4021. LAMPS, T. Ward, Kentish Town.—*19th September*, 1881.
4031. SKEIN HOLDER, F. M. née Lecocq, Belgium.—*19th September*, 1881.
4035. GLUE, G. W. Bremner, London.—*19th September*, 1881.
4049. PICKS, T. Trussel, Nottingham.—*20th September*, 1881.
4051. VELOCIPEDES, W. Brown and W. Peover, London.—*20th September*, 1881.
4054. PAVING BLOCKS, E. de Pass, London.—A communication from W. Hunt.—*20th September*, 1881.
4061. DRAWING OFF LIQUIDS, H. H. Lake, London.—Com. from E. Judytski.—*20th September*, 1881.
4063. HAIR-PINS, A. M. Clark, London.—A communication from M. T. Foote.—*21st September*, 1881.
4067. COINS, C. Horner, Halifax.—*21st September*, 1881.
4078. ALARM SIGNALS, J. Norris, Sunningdale.—*21st September*, 1881.
4087. CUTTING APPARATUS, J. H. Smiles, Stockton-on-Tees.—*22nd September*, 1881.
4088. TREATING SEWAGE, H. E. Newton, London.—Com. from L. de Roussen.—*22nd September*, 1881.
4095. PRINTING MACHINERY, H. H. Lake, London.—Com. from J. A. Heuse.—*22nd September*, 1881.
4107. DYNAMO-ELECTRIC MACHINE, P. E. Fahrig, Southampton.—*23rd September*, 1881.
4115. FLOOD VALVES, F. Dyer, Camden Town.—*23rd September*, 1881.
4128. DISTRIBUTING ELECTRICAL POWER, J. Imray, London.—A communication from M. Deprez and J. Carpentier.—*24th September*, 1881.
4129. SPINNING, J. Bastow, Bradford.—*24th September* 1881.
4134. TOILET LOOKING GLASSES, E. W. Elmslie, St. Leonard's-on-Sea.—*26th September*, 1881.
4165. TELEPHONE EXCHANGE APPARATUS, E. de Pass, London.—Com. from F. Shaw.—*27th September*, 1881.
4176. TREATING CLAY, J. Gillespie, Garnkirk, N.B.—*28th September*, 1881.
4187. HEATING APPARATUS, G. W. Wigner and R. H. Harland, London.—*28th September*, 1881.
4219. SECURING KNOBS, J. Hill, London.—*30th September*, 1881.
4261. CUTTING APPARATUS, G. Hamit, Haddenham.—*1st October*, 1881.
4431. TABLES, H. E. Newton, London.—A communication from J. Jorgenson.—*11th October*, 1881.
4524. COLLECTING APPARATUS, F. W. Borland, France.—*17th October*, 1881.
4547. WATER-TIGHT SLIDING DOORS, E. Crompton and J. T. Cochran, Birkenhead.—*18th October*, 1881.
4590. CHIMNEY FLUES, F. Wirth, Germany.—A communication from the Gesellschaft des Emser Blei- und Silberwerks Society.—*20th October*, 1881.
4598. WATER-CLOSETS, G. Pitt, Sutton.—A communication from Dr. J. Finck.—*20th October*, 1881.
4603. FIRE-GRATES, T. E. Clarke, Minehead, Somerset.—*20th October*, 1881.
4807. PROPULSION of SHIPS, W. R. Kinipple, Westminster.—*3rd November*, 1881.
4838. LAUNCHES, &c., W. R. Kinipple, Westminster.—*4th November*, 1881.
5310. PURIFYING ALKALINE SOLUTIONS, E. Carey, H. Gaskell, jun., and F. Hurter, Widnes.—*5th December*, 1881.
5340. LOOMS, J. Baird, Glasgow.—*6th December*, 1881.
5365. SELF-CLOSING COCKS, J. Barr, Kilmarnock.—*8th December*, 1881.
5494. VOLTAIC CELLS, J. W. Swan, Newcastle-on-Tyne.—*15th December*, 1881.
5498. SPRING PACKING, W. Lockwood, Sheffield.—*15th December*, 1881.
5513. COILED WIRE, J. Hudson, St. Helen's, Lancashire.—*16th December*, 1881.
5532. WOOD, &c., FIBRE, D. O. Francke, Sweden.—*17th December*, 1881.
5556. TRAMWAYS, R. S. Cunningham, C. A. F. Vinkeles-Houssart, W. May, London.—*19th December*, 1881.
5564. REVOLVING FIRE-ARMS, W. Stringfellow, Mistley.—*20th December*, 1881.
5575. TRAMWAY LOCOMOTIVES, J. Quick and J. Quick, jun., Westminster.—*20th December*, 1881.
5577. ELECTRIC TELEGRAPHS, Sir J. Anderson and B. Smith, London.—*20th December*, 1881.
5689. ATTACHING DEVICES, W. R. Lake, London.—A communication from the Automatic Music Paper Company.—*27th December*, 1881.
223. PUMPING LIQUIDS, A. M. Clark, London.—A communication from C. W. Cooper.—*12th January*, 1882.
266. GRINDING, &c., MILL, S. Pitt, Sutton.—A communication from H. A. Duc.—*19th January*, 1882
270. RIVETS, H. J. Haddan, London.—A communication from Q. E. Packard.—*19th January*, 1882.

Patents Sealed.

(*List of Letters Patent which passed the Great Seal on the 20th January*, 1882.)

3180. TRICYCLES, J. G. Smith, Eccles.—*21st July*, 1881.
3191. TYPE, G. K. Cooke, London.—*22nd July*, 1881.
3194. SCISSORS, G. G. M. Hardingham, London.—*22nd July*, 1881.
3199. CARRIAGES, J. N. Rowe, Tue Brook, Lancaster.—*22nd July*, 1881.
3201. PRINTING CHARACTERS, W. P. Thompson, London.—*22nd July*, 1881.
3213. VELOCIPEDES, G. Singer, Coventry.—*22nd July*, 1881.
3215. CENTRIFUGAL MACHINES, J. H. Johnson, London.—*22nd July*, 1881.
3217. CATCHES for BRACELETS, E. P. Wells, London.—*23rd July*, 1881.
3239. FEED-WATER HEATERS, J. H. Johnson, London.—*25th July*, 1881.
3240. ELECTRIC LIGHT, T. E. Gatehouse, Camberwell.—*25th July*, 1881.
3247. SELF-ACTING ELECTRIC CLOCKS, F. T. Reid, Exeter, and J. U. Valentine, Teignmouth.—*25th July*, 1881.
3252. SHIPS' PENDULUMS, J. Short, Southwark.—*26th July*, 1881.
3264. BARREL-MAKING MACHINERY, H. J. Haddan, London.—*26th July*, 1881.
3300. REPEATING SMALL-ARM, F. J. Cheesbrough, Liverpool.—*28th July*, 1881.
3302 FURNACES for STEREOTYPING, C. Pieper, Berlin.—*28th July*, 1881.
3313. FIRE-ARMS, W. E. Gedge, London.—*29th July*, 1881.
3323. SPINDLES, C. H. Openshaw, Bury.—*30th July*, 1881.
3365. CAPPING CANS, B. J. B. Mills, London.—*3rd August*, 1881.
3370. BRAKE, W. Walton, Romiley, Chester.—*3rd August*, 1881.
3379. DRYING WOOD SHAVINGS, E. G. Brewer, London.—*4th August*, 1881.
3389. WIRE HAIR BRUSHES, W. R. Lake, London.—*4th August*, 1881.
3400. ELECTRIC MACHINES, J. H. Johnson, London.—*5th August*, 1881.
3402. ELECTRIC LAMPS, J. H. Johnson, London.—*5th August*, 1881.
3412. GALVANIC BATTERIES, T. Coad, London.—*6th August*, 1881.
3426. LOCKS, F. C. Glaser, Berlin.—*8th August*, 1881.
3560. SULPHURIC ACID, W. Weldon, Burstow.—*16th August*, 1881.
3563. DRIVING MACHINERY, W. Clark, London.—*16th August*, 1881.
3578. BOAT DISENGAGING GEAR, M. H. Robinson, Hampton Wick.—*17th August*, 1881.
3666. STEAM PIPES, W. D. and S. Priestman, Kingston-upon-Hull.—*23rd August*, 1881.
3796. LENSES, A. M. Clark, London.—*31st August*, 1881.
3828. RAISING GASALIERS, M. Merichenski, Poplar.—*2nd September*, 1881.
3949. OILING SHAFTING, W. Currie, Belfast.—*13th September*, 1881.
4180. STEAM BOILERS, C. W. King, Manchester.—*28th September*, 1881.
4287. CHECK VALVES, M. Merichenski, Poplar.—*3rd October*, 1881.
4458. VACUUM PUMPS, W. H. Akester, Glasgow.—*13th October*, 1881.
4522. SAFETY SADDLE BARS, R. Spence, jun., Yorkshire.—*17th October*, 1881.

4541. GENERATING ELECTRO-MAGNETIC CURRENTS, R. Kennedy, Paisley.—*18th October*, 1881.
4592. GENERATING ELECTRICITY, A. Millar, Glasgow.—*20th October*, 1881.
4613. LOOMS, W. Hanson, Bradford.—*21st October*, 1881.
4625. STEAM BOILER FURNACES, G. W. Clarke, San Francisco, U.S.—*22nd October*, 1881.
4814. STEAM ENGINES, N. Macbeth, Bolton.—*3rd November*, 1881.
5027. OPEN STOVES, E. R. Hollands, London.—*16th November*, 1881.
5035. BOTTLING AERATED WATERS, J. T. Hayes, Walthamstow.—*17th November*, 1881.
5117. METRICAL CARBURETTERS, H. J. Haddan, London.—*23rd November*, 1881.
5127. SETTING TYPES, S. Pitt, Sutton.—*23rd November*, 1881.
5137. PUMPING LIQUIDS, A. M. Clark, London.—*24th November*, 1881.

(List of Patent Letters which passed the Great Seal on the 24th January, 1881.)

3261. GLAZING APPARATUS, T. W. Helliwell, Brighouse, Yorkshire.—*26th July*, 1881.
3271. GLASSES, &c., A. McLaren, London.—*26th July*, 1881.
3281. PURIFYING OILS, W. A. Barlow, London.—*26th July*, 1881.
3284. SEPARATING GLYCERINE, F. J. O'Farrell, Dublin.—*27th July*, 1881.
3316. SPINNING, J. J. Broadbent and E. Mitchell, Bradford.—*30th July*, 1881.
3322. CONTROLLING SUPPLY OF STEAM, S. Hallam, Manchester.—*30th July*, 1881.
3344. GRINDING CORN, H. H. Lake, London.—*2nd August*, 1881.
3453. CRUSHING MACHINERY, A. Lamberton, Coatbridge, N.B.—*3rd August*, 1881.
3360. WATER-BALLAST TANKS, C. J. D. Christie, Newcastle-upon-Tyne.—*3rd August*, 1881.
3368. FOLDING BEDSTEAD, H. H. Lake, London.—*3rd August*, 1881.
3390. PERMANENT WAY, P. J. Neate, Belsize Park, London.—*4th August*, 1881.
3392. ASBESTOS PACKING, C. J. Allport, London, and A. Hollings, Manchester.—*5th August*, 1881.
3405. TELEPHONIC APPARATUS, T. A. Connolly, London.—*6th August*, 1881.
3408. BICYCLES, G. Strickland, Strada San Paolo, Malta.—*6th August*, 1881.
3442. LIQUID ROUGE, C. D. Abel, London.—*9th August*, 1881.
3453. ENGINES, H. A. Bonneville, London.—*9th August*, 1881.
3490. TELL-TALE APPARATUS, L. V. Bunnen, Brussels.—*12th August*, 1881.
3491. FLAT-HEADED TACKS, &c., G. Klug, Glasgow.—*12th August*, 1881.
3653. ORE GRINDING, T. A. Readwin, London.—*22nd August*, 1881.
3668. ELECTRIC-LIGHTING, W. R. Lake, London.—*23rd August*, 1881.
3862. REGENERATIVE KILNS, J. Dunnachie, Lanark, N.B.—*6th September*, 1881.
4329. PROJECTILES, H. Simon, Manchester.—*5th October*, 1881.
4336. TREATING RAW HIDES, D. R. S. Galbraith, Edinburgh.—*5th October*, 1881.
4422. SPINNING YARNS, T Briggs, Manchester.—*11th October*, 1881.
4430. BICYCLES, T. T. Harrison, Bristol.—*11th October*, 1881.
4448. ELECTRO-MAGNETS, J. Imray, London.—*12th October*, 1881.
4450. TELEPHONIC APPARATUS, J. Imray, London.—*12th October*, 1881.
4532. CONFITURE PRESERVES, H. A. Bonneville, London.—*18th October*, 1881.
4711. FIGURED FABRICS, J. Makin and J. E. Johnson-Ferguson, Bolton.—*27th October*, 1881.
4713. WEAVING FIGURED FABRICS, J. Makin and J. E. Johnson-Ferguson, Bolton.—*27th October*, 1881.
4720. REFRIGERATING, J. Chambers, Manchester.—*28th October*, 1881.
4733. CARRIAGES, J. R. Hancock and W. Smith, Nottingham.—*29th October*, 1881.
4777. ELECTRIC LAMPS, E. R Prentice, Stowmarket.—*1st November*, 1881.
4808. FIRE-ARMS, H. Simon, Manchester.—*3rd November*, 1881.
4868. SHIPS, J. Dickie, London.—*7th November*, 1881.
4966. ELECTRICAL SIGNALLING, W. R. Lake, London.—*12th November*, 1881.
4979. COMPOSITORS' RULES, J. C. Mewburn, London.—*14th November*, 1881.
4990. INDIA-RUBBER, I. Livermore, London.—*15th November*, 1881.
5024. BICARBONATE OF SODA, E Carey, H. Gaskell, jun., and F. Hurter, Widnes.—*16th November*, 1881.
5058. PNEUMATIC BRAKE APPARATUS, G. Westinghouse, jun., London.—*18th November*, 1881.
5080. CONDUCTING ELECTRIC CURRENTS, R. E. B. Crompton, London.—*21st November*, 1881.
5095. ELECTRICAL COMMUTATORS, W. R. Lake, London.—*22nd November*, 1881.
5167. WOOLLEN FABRICS, H. A. Bonneville, London.—*26th November*, 1881.

List of Specifications published during the week ending January 21st, 1881.

2007*, 4d.; 2524, 6d.; 2538, 6d.; 2557, 6d.; 2558, 6d.; 2561, 6d.; 2573, 6d.; 2577, 4d.; 2582, 6d.; 2586, 6d.; 2592, 6d.; 2602, 6d.; 2604, 6d.; 2611, 6d.; 2613, 6d.; 2619, 2d.; 2620, 6d.; 2623, 6d.; 2624, 6d.; 2632, 8d.; 2642, 6d.; 2643, 6d.; 2646, 6d.; 2647, 1s.; 2650, 8d.; 2653, 6d.; 2664, 6d.; 2657, 4d.; 2658, 6d.; 2660, 2s.; 2661, 4d.; 2662, 4d.; 2666, 2d.; 2667, 2d.; 2668, 4d.; 2672, 6d.; 2673, 2d.; 2675, 6d.; 2676, 2d.; 2677, 6d.; 2681, 6d.; 2682, 4d.; 2685, 2d.; 2688, 6d.; 2689, 2d.; 2691, 2d.; 2692, 6d.; 2693, 6d.; 2695, 2d.; 2696, 2d.; 2697, 2d.; 2698, 6d ; 2703, 2d.; 2705, 2d.; 2706, 6d.; 2707, 6d.; 2709, 6d.; 2711, 8d.; 2714, 4d.; 2715, 6d.; 2718, 2d.; 2719, 2d.; 2721, 2d.; 2724, 2d.; 2725, 6d.; 2726, 2d.; 2727, 6d.; 2728, 2d.; 2729, 6d.; 2731, 2d.; 2732, 2d.; 2733, 6d.; 2734, 6d.; 2737, 2d.; 2741, 4d.; 2742, 6d.; 2743, 6d.; 2746, 6d.; 2751, 2d.; 2752, 6d.; 2753, 6d.; 2755, 2d.; 2756, 2d.; 2758, 2d.; 2760, 2d.; 2763, 2d.; 2764, 6d.; 2766, 4d.; 2767, 2d.; 2770, 2d.; 2779, 2d.; 2780, 2d.; 2784, 2d.; 2791, 2d.; 2795, 2d.; 2797, 4d.; 2798, 6d.; 2813, 4d.; 2816, 4d.; 2840, 6d.; 2874, 6d.; 2876, 6d.; 2957, 6d.; 3016, 6d.; 4330, 6d.; 4573, 6d.; 4617, 6d.; 4705, 6d.

*** Specifications will be forwarded by post from the Patent-office on receipt of the amount of price and postage. Sums exceeding 1s. must be remitted by Post-office order, made payable at the Post-office, 5, High Holborn, to Mr. H. Reader Lack, her Majesty's Patent-office, Southampton-buildings, Chancery-lane, London.

ABSTRACTS OF SPECIFICATIONS.

Prepared by ourselves expressly for THE ENGINEER *at the office of Her Majesty's Commissioners of Patents.*

2041. APPARATUS FOR CONTROLLING AND LOCALISING ELECTRIC CURRENTS, *L. M. de Bejar-y-O'Lawlor.—10th May*, 1881. 8d.

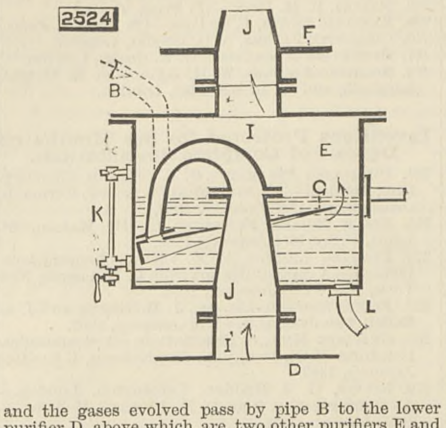
This is a modification in the apparatus described in specification No. 408, 1878, its object being to use a wire such as a telephone wire, so that messages to or from the principal station are inaudible or invisible elsewhere.

2263. APPARATUS FOR EFFECTING ELECTRICAL MEASUREMENTS, *J. C. Cuff.—24th May*, 1881. 6d.

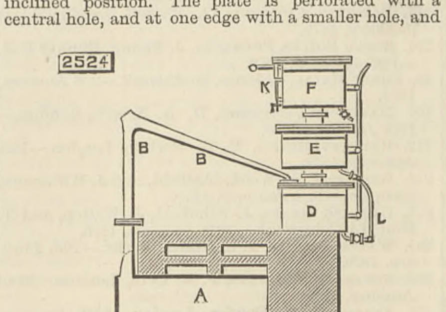
This invention relates to modifications in the making of resistance boxes, the principal of which are the use of a sliding contact piece to put coils in or out of the circuit, the arrangement and construction of the coils.

2524. MANUFACTURE AND PURIFICATION OF GAS, *J. H. Johnson, London.—10th June*, 1881.—*(A communication from A. M. H. T. du Montcel, Paris.)* 6d.

The gas may be obtained from coal, oils and fat, and any substance capable of producing hydro-carburetted gaseous products and hydrogen by distillation. The substance is placed in retorts A heated by a furnace,



and the gases evolved pass by pipe B to the lower purifier D, above which are two other purifiers E and F, through which the gases pass successively. Each purifier, as shown in Fig. 2, contains a plate G immersed in the purifying liquid, and placed in an inclined position. The plate is perforated with a central hole, and at one edge with a smaller hole, and



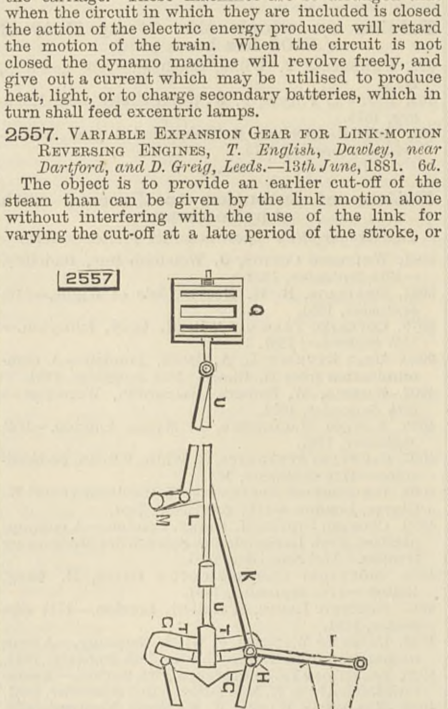
on the under side webs or deflecting plates are arranged in the form of a fan so as to divide the stream of gas. Each purifier has an orifice I for the escape of the gas, a syphon pipe J through which the gas is admitted (except the lower vessel, where the gas enters by pipe B), a gauge K to indicate the level of the liquid, and an outlet L for the liquid.

2538. ELECTRIC AND MAGNETIC BRAKES, &c., *M. R. Ward, London.—10th June*, 1881. 6d.

The inventor does away with brake blocks, and employs a dynamo-electric machine for each carriage, the machine being connected with and put in motion by an endless band or other gearing from the axles of the carriage. These machines are so arranged that when the circuit in which they are included is closed the action of the electric energy produced will retard the motion of the train. When the circuit is not closed the dynamo machine will revolve freely, and give out a current which may be utilised to produce heat, light, or to charge secondary batteries, which in turn shall feed excentric lamps.

2557. VARIABLE EXPANSION GEAR FOR LINK-MOTION REVERSING ENGINES, *T. English, Dawley, near Dartford, and D. Greig, Leeds.—13th June*, 1881. 6d.

The object is to provide an earlier cut-off of the steam than can be given by the link motion alone without interfering with the use of the link for varying the cut-off at a late period of the stroke, or



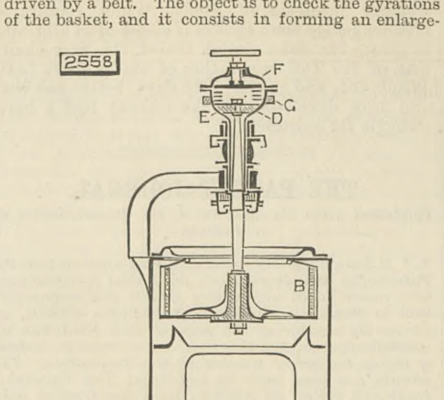
for starting, stopping, and reversing. The valve spindle U of the expansion valve mounted on the back of the main valve Q is jointed to the link G near the centre, and receives the reciprocating movement of this point. The spindle of the main valve may be jointed directly to the end of the radius rod K, but is preferably, as shown, actuated through unequal levers L and M, preferably in the proportion of two to one, in which case the relative movement of the expansion valve is always approximately equal to that of the main valve on its seat. The steam ports of the main valve will be closed at a period of the stroke which may be varied either by varying the lap of the expansion valve or the position of the slider H in the link, or by the two actions combined. The link G is restrained near its centre between parallel guides T, which allow the centre point of the link to receive the reciprocating motion due to the angular advance or lead of the excentrics C D beyond a right angle in advance of the crank.

2561. BARS FOR HOLDING AND SECURING GLASS FOR WINDOWS AND ROOF LIGHTS, &c., *C. H. Pennycook, Glasgow.—15th June*, 1881. 6d.

This consists of an inner core for imparting strength, a shell giving external form, and a finishing part for closing down upon and securing the plates, sheets, or pieces of glass, or other material, the parts being formed and adapted to each other.

2558. CENTRIFUGAL MACHINES, *W. Shears, Bankside.—13th June*, 1881. 6d.

This relates to improvements en patent No. 118, A.D. 1875, in which the basket was suspended by an axis carried up through a tubular axis and secured to a hemisphere, which rested in a cup at the top of the tubular axis, which was carried by fixed bearings and driven by a belt. The object is to check the gyrations of the basket, and it consists in forming an enlarge-



ment on the top of the cup E which receives the block or hemisphere D by which the basket B is suspended, and placing a coiled spring G therein, which is pressed on to the block by means of the cover F.

2573. IMPROVEMENTS IN MEANS FOR SUPPORTING AND PROTECTING WIRES, &c., USED FOR ELECTRICAL PURPOSES, *H. E. Newton, London.—14th June*, 1881.—*(A communication from C. A. Hussey and A. S. Dodd, New York.)* 6d.

This invention consists in the combination with the curb of the footways of a conduit fixed thereto, which carries the wires for electric lighting or other purposes, whilst branch conduits lead off into the houses.

2577. FASTENING FOR ATTACHING TOGETHER THE PARTS OF BEDSTEADS, *E. Edwards, London.—14th June*, 1881.—*(A communication from J. Dulery, Paris.)—(Not proceeded with.)* 4d.

A tie-piece fits into a recess in a covering plate, and the tie-piece is provided with a slot or opening at its outer end, into which fits a wedge or key, which, when driven in, abuts against the recessed plate, and draws the two parts of the bedstead as tightly together as may be desired.

2582. TRICYCLES, *H. J. Haddan, Westminster.—14th June*, 1881.—*(A communication from C. W. Oldreive, Mass., U.S.A.)* 6d.

This consists in the combination of a main or driving wheel provided with a rim, two hubs, and two sets of spokes, with a car or carriage body, and tubular journals thereto arranged within such wheels, and with a perch, auxiliary wheels, and an axle, the said wheel and car being provided with means or mechanism to enable a person while in the car to revolve the wheel in order to put the tricycle in movement.

2586. SHIPS' PENS FOR CATTLE, *H. J. Haddan, Westminster.—14th June*, 1881.—*(A communication from S. Shaw, Mass., U.S.A.)* 6d.

This consists in suspending the berth or pen from a frame or parts of the ship by inclined chains, ropes, or rods fastened to the sides or top of the berth or pen in such a manner that a space is left between it and the frame or part of the ship from which it is suspended sufficiently to allow it to move enough to overcome the fore-and-aft motion of the ship.

2592. IMPROVEMENTS IN THE MANUFACTURE OF TELEGRAPHIC OR TELEPHONIC CONDUCTORS, &c., *W. R. Lake, London. 14th June*, 1881.—*(A communication from H. A. Clark, Boston, U.S.A.)* 6d.

This invention relates to a machine adapted for coating wires with insulating material, which is so constructed that the material is forced through the die opening as the wire proceeds through the same, giving direction to the coating material in the line along which it passes through the die, opening before it reaches the wire it is to coat. It is thus prevented from working itself in a backward direction upon the wire. This, it is claimed, is an advantage where the wire may have previously been coated. The invention also relates to a compound cable for telephonic or other purposes, in which the wires are all at the same distance from and parallel with each other.

2602. COPYING PRESSES, *J. Mitchell, Sheffield.—15th June*, 1881. 6d.

This relates to the construction of a copying press of book form, or other convenient form, in which the pressure necessary to copy a letter is obtained from and by a spring or springs fixed or fitted therein acting on the copy-book through the medium of a plate or plates.

2604. COOKING EGGS BY HOT AIR, *W. H. Beck, London.—15th June*, 1881.—*(A communication from P. L. Labarbe, Paris.)* 6d.

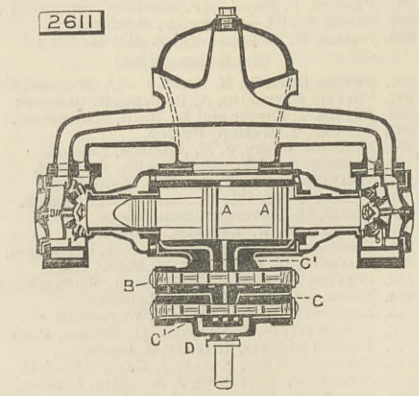
This consists in the application of hot air produced and generated by means of a lamp with asbestos wick arranged below the eggs to be cooked, and enclosed along with the said eggs in a case which allows of the admission of external air at the base of the apparatus only for supporting the combustion of the lamp alone.

2606. ELECTRIC ACCUMULATORS, *A. Muirhead.—16th June*, 1881.—*(Not proceeded with.)* 2d.

The electrodes were arranged similarly to the lead foil plates in condensers, and could be coated or not with red oxide of lead, &c.

2611. DISTRIBUTION OF FLUID IN MOTORS, &c., *W. L. Wise, Westminster.—15th June*, 1881.—*(A communication from C. Roux, Paris.)* 6d.

This is to a method of fluid distribution by three pistons mutually controlled without the aid of intermediaries other than orifices and passages by which the fluid passes. A is the motor or measuring



piston, B the distributing piston, and C the preparatory or initial distributing piston, D the inlet, and C' the exhaust passage. Channels communicate with each other and with the inlet, and also communicate or not, as the case may be, with other channels according to the position of pistons B and C.

2612. IMPROVEMENTS IN THE CONSTRUCTION OF ELECTRIC LAMPS AND APPARATUS FOR ELECTRIC LIGHTING, *W. Crookes.—15th June*, 1881. 4d.

After purifying the material to form the carbon filament from silica, it is treated with cuprammonia to destroy its structure. The copper is afterwards extracted. Modified methods are described.

2613. VELOCIPEDES, *A. L. Bricknell, Brixton.—16th June*, 1881. 6d.

This relates, First, to the framework of the bicycles; Secondly, to the construction allowing of the raising and lowering of the seat of the bicycle; Thirdly, the construction of a silent pawl and ratchet mechanism; Fourthly, the combination of the silent pawl mechanism with disconnected treadles; Fifthly, the combination of clutches with velocipedes; Sixthly, the mechanism for catching and holding the pawl out of gear with the ratchet to enable the machine to be wheeled backwards.

2619. BALL COCKS OR VALVES, *S. Owen, London.—16th June*, 1881.—*(Not proceeded with.)* 2d.

The outlet end of the body is formed with a socket or recess to receive a packing or seating of india-rubber or other suitable material. Around the exterior of the outlet end of the body is formed a screw to fit a female thread formed within a ring or cover used to keep the packing or seating in position, and to carry the axis of motion of the strig or ball lever. The plug of the valve is formed conical to fit a similarly shaped hole in the packing or seating.

2620. TOOLS FOR DRAWING OUT TUBES FROM MULTITUBULAR BOILERS, &c., *W. C. Dixon, Basingstoke.—16th June*, 1881. 6d.

This relates to the combination of a screwed rod, detachable head or mandril, a collar, screw nut, and suitable abutment, the whole constituting the improved tool to be operated by percussion applied after strain has been put on by the screw.

2623. TRANSPORTING CARRIAGES AND CATTLE OVER RIVERS, &c., *J. Bell, F. G. M. Stoney, and W. E. Richs, Westminster.—16th June*, 1881. 6d.

This consists in the adaptation to travelling floating structures of hydraulic lifting apparatus, and in combination therewith the use of a dock or its equivalent provided with guides for steadying the movements of the floating vessel when rising from or descending into the water.

2624. GAS COOKING STOVES, *W. T. Sugg, Westminster.—16th June*, 1881. 6d.

This consists in the combination with a gas cooking stove or domestic heating apparatus of covered galleries placed externally of the stove or apparatus, and gaspipes provided with flat flame burners.

2632. PLAITING FIBROUS OR OTHER TEXTILE MATERIALS, *N. Fraser, Arbroath, N.B.—16th June*, 1881. 8d.

This consists, First, in the system of plaiting together three or more strands or ends of fibrous or other flexible materials by passing the combined or plaited material in rotation over and under the several strands or ends; Secondly, in the combination of a plait receiver or shuttle moving in a circular course, with devices which move the strands or ends across its path.

2642. CORKSCREWS, *F. A. Whelan, London.—17th June*, 1881. 6d.

This consists in the combination with a collar, guide rods, and handle, of a sliding block and crossbar, or their mechanical equivalents, whereby the direct grip or muscular contracting power of the hand itself can be utilised for drawing the cork, by causing the said sliding block and handle to approach each other.

2643. GARDEN SYRINGE, GARDEN ENGINES, HOSE DIRECTORS, WATERING CANS, &c., *F. Cooper, Handsworth, Stafford.—17th June*, 1881. 6d.

This relates to means of preventing the back or drip water running down the hand, arm, or sleeve of the operator by means of an annular rim or flange.

2646. RECEPTACLES AND VEHICLES FOR STORAGE AND TRANSPORT OF DAIRY PRODUCE, PROVISIONS, &c., *J. Wilson, London.—17th June*, 1881. 6d.

This relates to the peculiar combination and arrangement of the internal fittings of receptacles or cases for the transport or storage of dairy produce, &c.

2647. LOCOMOTIVE ENGINE, *L. A. Groth, London.—17th June*, 1881.—*(A communication from C. Raab.)* 1s.

This consists of a locomotive, the centre of gravity of which is located in transverse centre plane of the entire structure, and which is provided with a fire-box at each side of its transverse centre plane, boilers extending longitudinally in opposite directions from the fire-boxes, and one central steam dome vertically above and surmounting the same.

2650. SEWING AND BINDING OF BOOKS, &c., *G. Brown, Glasgow.—17th June*, 1881. 8d.

The sewing is effected by needles pointed at both ends, with the eye in the middle, such as are used for embroidery machines, and worked and ranged as many in number as there are to be double rows of stitching across the back of the book, and passed right through each sheet as it is placed or fed into the machine open at the back folds in front of the row of needles, preferably on an angled rest with shifting or setting guides, and two or more spring or clip holders.

2653. STOVES, *W. Barton, Boston, Lincoln.—17th June*, 1881. 6d.

This consists in protecting from the destructive action of the fire the metal air tubes, which pass through the fuel in pedestal and other stoves by the application thereto of a casing of plumbago or fire-clay composed of loose sections.

2654. BOOK CASES, &c., *W. T. Rogers, West Dulwich.—17th June*, 1881. 6d.

This consists in the application to cases intended to receive shelves of interlocking parts so constructed and arranged that level bearings for shelves may be obtained at any desired height with facility.

2657. GLASS HOLDERS OF GASALIERS AND LAMPS, *J. Gordon, Birmingham.—17th June*, 1881. 4d.

This consists in attaching to the arms or brackets carrying the globe or glass of a lamp or gas burner loose clips pinned to the arms.

2658. APPARATUS FOR SAVING LIFE AND PROPERTY AT SEA, *A. D. Roth, Blackheath.—17th June*, 1881. 6d.

This consists in the general construction of a safety and signal buoy; Secondly, in coating such buoys with luminous paint and fitting them with lights and light-reflecting signals in combination with another mode of signalling, and the adaptation of electric action for the purpose of sight and sound signalling on such buoys.

2660. FEEDING FIBROUS MATERIAL TO CARDING ENGINES, *A. M. Clark, London.—17th June*, 1881.—*(A communication from E. Gessner, Aue, Saxony.)* 2s.

This relates, First, to means of delivering continuously an equal and regular supply of material to the machine, and to equalise and spread the fibre in an even and regular manner on the feed apron, or by omitting the apron to deposit the material directly on to the licker-in, or the cylinder, or any working roller of the machine; Secondly, to means of conducting the material equally and regularly supplied by a feeder to the first breaker card, onward to the second carding machine.

2661. STOOL TO PREVENT SEA-SICKNESS ON BOARD SHIP, *F. Lebacq, Paris.—18th June*, 1881.—*(Not proceeded with.)* 4d.

This relates to means of keeping a seat in a horizontal position when the ship is in motion.

2662. CEMENTS AND COMPOSITIONS, *A. M. Clark, London.—18th June*, 1881.—*(A communication from E. B. A. Sorel, de la Société Générale des Agglomérés Magnesiens, Paris.)—(Not proceeded with.)* 4d.

Magnesia and sulphate of magnesia are combined with water to produce a cement which rapidly acquires extreme hardness.

2666. GARDENER'S CLIPPING SHEARS, *G. Brockelbank, Anerley, Surrey.—18th June*, 1881.—*(Not proceeded with.)* 2d.

This relates to the employment of two extra shanks or legs, one on each half of the shears.

2667. AGRICULTURAL HARROWS, *E. Walker, Newark-upon-Trent.*—18th June, 1881.—(*Not proceeded with.*) 2d.
The longitudinal bars in the harrow framing are made of channel or trough iron, with the open side downwards; these bars are united by transverse bars of flat iron. In the channels are pivotted or loosely bolted the teeth of the harrows, which latter are flanged at their upper ends, so that when in use these flanges prevent the teeth from turning upwards, and thus keep them firmly in position during work.

2668. SAFETY PINS, *L. A. Groth, London.*—18th June, 1881.—(*A communication from J. Levi, New York, U.S.A.*) 4d.
The pin consists of two parts, one forming a common pin and the other a spring cap to be placed on the pin after it has been threaded through the cloth.

2672. TREATING TAN OR SPENT BARK FOR MANUFACTURE OF PAPER, *W. Guest, Deptford, and C. Court, Rotherhithe.*—18th June, 1881. 6d.
The tan or spent bark is put into a hopper or other receptacle, and is delivered therefrom by mechanical arrangements, and passes between and is crushed by revolving rollers. The fibrous tan and its knots having been thus opened up, or the fibres to an extent separated, the mass is introduced in convenient quantities into a rotary boiler or agitator, containing an admixture of water and caustic soda in solution, and when the boiler or agitator is closed steam is admitted therein, and the whole mass is agitated by means of arms or cutters.

2673. EXTRACTING METALS FROM ORES, *W. J. Fuller, London.*—18th June, 1881.—(*Not proceeded with.*) 2d.
The ore, after it has been treated together with sulphuric acid and washed to remove the soluble salts, is saturated with nitric acid, and again heated to convert the silver and other metals, such as nickel and cobalt, into nitrates.

2675. MILL GEARING, *N. Macbeth, Bolton.*—18th June, 1881. 6d.
This consists partly in forming countersinks in the arm heads of belt or rope pulleys which have wrought metal rims, and pressing or stamping the metal of the rim into the recesses thus formed.

2676. FELT HATS, *W. Grimshaw, Ashton-under-Lyne.*—18th June, 1881.—(*Not proceeded with.*) 2d.
This consists in crushing up the hat body whilst in its soft state, and then printing the same with a yielding or hard surface covered with colouring matter, so as to produce a mottled coloured appearance.

2677. FOLDING SEAT FOR BARS, SHOPS, &c., *J. Rettie, London.*—18th June, 1881. 6d.
The seat is fixed to the floor close up to the counter or wall near which the seat is to be used. When folded up the seat closes flat up against the counter or wall, and when down or open for use it comes away from the counter, leaving room for the knees as with an ordinary seat.

2681. LAMPS, *F. B. Baker, Birmingham.*—18th June, 1881. 6d.
This relates, First, to the construction of the piston and rod of the lamps; Secondly, to means for permitting the entrance and ready escape of air during the filling of the reservoir and charging of the cylinder with oil.

2682. TREATMENT OF SOAP, &c., *W. Green, St. Lawrence, Kent.*—18th June, 1881. 4d.
This consists partly in the treatment of petroleum, shale oil, or other mineral oil, grease, or fat, with an alcoholic solution of submuriate of potash and caustic soda, and with silicate of soda or potash.

2685. ENVELOPES, *S. R. English, Nottingham.*—20th June, 1881.—(*Not proceeded with.*) 2d.
This relates to the form of the blanks and to the manner of folding.

2688. BOSS AND UNION HOLDERS FOR JOINING AND MAKING SOLDERED CONNECTIONS TO PIPING, *W. A. Hudgell, Hendon.*—20th June, 1881. 6d.
According to one form a holder is used, consisting of a hollow stock A furnished with a screw, and provided with expanding clamping levers B attached to the lower end of stem A by a pin and near the upper end of the expanding levers, the lower ends of which are

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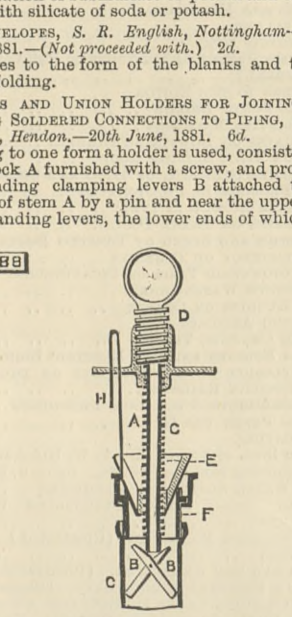

forced against the inner side of the pipe G by a rod C actuated by screw D. The upper ends of the levers B are made at an angle, so as when acted upon by the rod C their lower ends are forced outwards. When thus secured to the pipe the union piece F is placed in position and the conical clamping nut E screwed down against it, and is held up while the joint is being made by a wire spring H.

2689. APPLICATION OF COLOURING MATTERS TO FABRICS, *A. Sansone, Manchester.*—20th June, 1881.—(*Not proceeded with.*) 2d.
To obtain spotted effects in one or more colours on fabrics, an insoluble powdered or granulated material, such as sand, powdered glass, or suitable granular substance, is impregnated with a concentrated solution of aniline or other colour or substance, which is then dried. The granular or powdered substance is applied to the wet fabric.

2691. FILTER PRESSES, *H. J. Haddan, Westminster.*—20th June, 1881.—(*A communication from A. Collette, fils, Seclin, France.*)—(*Not proceeded with.*) 2d.
This consists in the construction of wooden battens or pieces placed in grooves in the metal frames, and these battens are planed instead of the metal frame, and their planed surfaces serve to press the cloths and make a water-tight joint.

2693. HACKLING OR COMBING FLAX, HEMP, &c., *J. C. Mewburn, London.*—20th June, 1881.—(*A communication from J. Dequoy, Lille, France.*) 6d.
The raw flax or other material is supplied directly to a machine, which delivers it in the state of a continuous sliver, the long fibres being collected, laid parallel, separated from the tow and shrive or noils, and ready for passing directly to the preparing and spinning machines.

2695. COMPOSITION FOR DESTRUCTION OF RATS, MICE, &c., *W. Hagelsieb, London.*—20th June, 1881.—(*Not proceeded with.*) 2d.
This consists of one part scilla maritinia, one cheese, one flour, and one fat.

2696. BOX TO CONTAIN BOOT AND SHOE BRUSHES, &c., *J. F. Walters, London.*—20th June, 1881.—(*Not proceeded with.*) 2d.
This relates to the construction of a box to receive the blacking, brushes, &c., with a convenience for resting the boot or shoe upon at any desired elevation, in order to facilitate the cleaning.

2697. LOOMS, *J. West and J. Fish, Blackburn.*—20th June, 1881.—(*Not proceeded with.*) 2d.
This relates to the construction and combination of mechanism for actuating the taking-up roller, or roller on which the cloth as woven is wound.

2692. PRINTING AND ROLLING MACHINES, *F. H. F. Engel, Hamburg.*—20th June, 1881.—(*A communication from F. Schlatke and L. Hesse, Hamburg.*) 6d.
This relates to improvements on patent No. 2547, A.D. 1879, the object being to produce with one revo-

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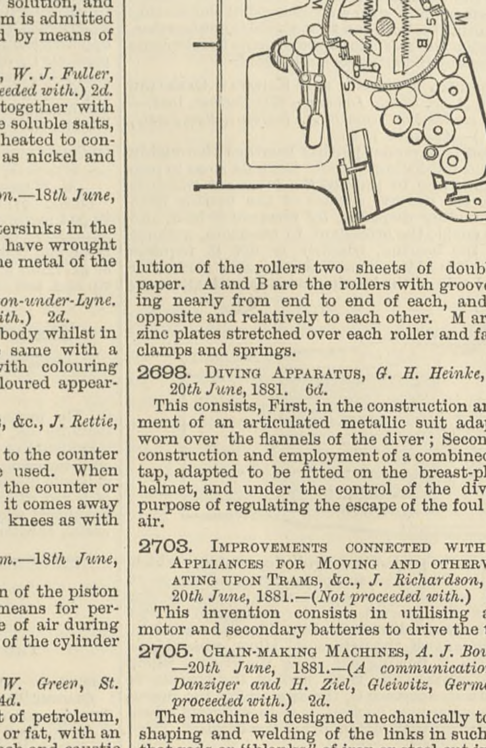

lution of the rollers two sheets of double printed paper. A and B are the rollers with grooves S reaching nearly from end to end of each, and arranged opposite and relatively to each other. M are prepared zinc plates stretched over each roller and fastened by clamps and springs.

2698. DIVING APPARATUS, *G. H. Heinke, London.*—20th June, 1881. 6d.
This consists, First, in the construction and employment of an articulated metallic suit adapted to be worn over the flannels of the diver; Secondly, in the construction and employment of a combined valve and tap, adapted to be fitted on the breast-plate of the helmet, and under the control of the diver, for the purpose of regulating the escape of the foul or exhaled air.

2703. IMPROVEMENTS CONNECTED WITH ELECTRIC APPLIANCES FOR MOVING AND OTHERWISE OPERATING UPON TRAMS, &c., *J. Richardson, Lincoln.*—20th June, 1881.—(*Not proceeded with.*) 2d.
This invention consists in utilising an electric motor and secondary batteries to drive the tram-car.

2705. CHAIN-MAKING MACHINES, *A. J. Boult, London.*—20th June, 1881.—(*A communication from L. Danziger and H. Ziel, Gleiwitz, Germany.*)—(*Not proceeded with.*) 2d.
The machine is designed mechanically to effect the shaping and welding of the links in such a manner that rods or "blanks" of iron or steel cut into suitable lengths and heated to a welding heat are introduced into the machine by the attendant, to be formed into links, and their ends to be welded together by powerful pressure, each subsequent link being passed through the preceding one, and a continuous chain thus produced.

2706. FIXING AND FINISHING THE FOLDS OF PLAITED FABRICS, &c., *W. P. Thompson, London.*—20th June, 1881.—(*A communication from M. F. Sallade, New York, U.S.A.*)—(*Complete.*) 6d.
This consists in subjecting the plaited fabric so soon as folded under moderate pressure and in connection with one or more thicknesses of suitable absorbent material to the heat and moisture of free steam.

2707. TREATING FERMENTED, FERMENTABLE, OR DISTILLED LIQUIDS, &c., *W. R. Lake, London.*—20th June, 1881.—(*A communication from C. W. Ramsay.*) 6d.
This relates to a converting or treating chamber, or a series of two or more thereof, having parallel ends and helical or nearly helical sides, provided with corrugations for a part of or for the entire working distance between the induction and eduction ports of each chamber, in combination with rotary distributors or beaters.

2709. MACHINES TO SET COPPER CAPS INTO EMPTY CARTRIDGES, *W. Lorenz, Carlsruhe, Germany.*—21st June, 1881. 6d.
This relates to the combination of parts constituting a machine for inserting the percussion caps in cartridge cases.

2711. IMPROVEMENTS IN ELECTRIC DANGER ALARMS AND SIGNALS AND OTHER SAFETY APPLIANCES FOR RAILWAYS, *T. A. Burtis Putnam, New York.*—21st June, 1881. 8d.
The object of this invention is to provide a means for warning the driver of an engine when he is too close to another train. The engine is fitted with an electric generator, an alarm apparatus, and a metallic brush which sweeps the rail and forms connection

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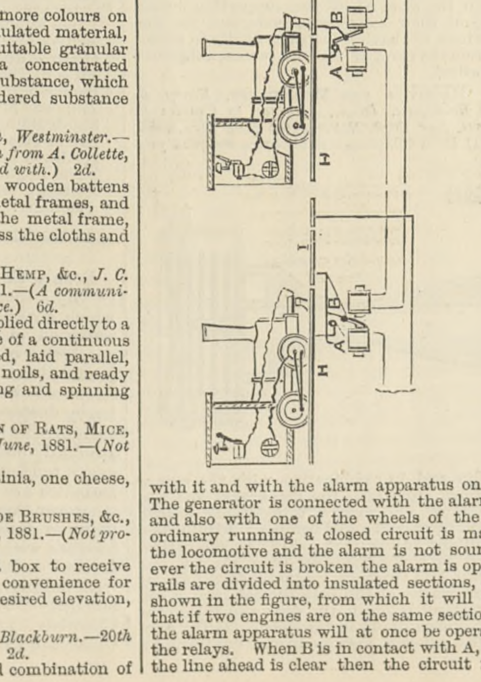

with it and with the alarm apparatus on the engine. The generator is connected with the alarm apparatus, and also with one of the wheels of the engine. In ordinary running a closed circuit is maintained on the locomotive and the alarm is not sounded; whenever the circuit is broken the alarm is operated. The rails are divided into insulated sections, connected as shown in the figure, from which it will also be seen that if two engines are on the same section of the rails the alarm apparatus will at once be operated through the relays. When B is in contact with A, that is when the line ahead is clear then the circuit is completed with the exception of the break between rails H and I, and this is done by the brush and the front wheel as the engine passes, and the circuit is not broken. But if B be away from A, that is when there is danger ahead, then the circuit is broken at A B, and when the left-hand locomotive bridges the gap between H and I with the brush and the front wheel, the circuit is broken and the alarm operated. The invention also includes an arrangement whereby if any points remain open that should be closed an alarm will be given to the driver on the nearest section of rails; in the same way should the points be closed and the signalman try to open them, a disc will indicate to him that a train is on that section of rails. In combination with the alarm on the engine is an arrangement for marking off on paper kept in constant motion the times at which alarm signals were received on the engine.

2714. SUBSTANCE OR CLAY FOR MANUFACTURE OF BUSTS, POTTERY, &c., *E. J. T. Digby, Hammersmith.*—21st June, 1881. 4d.
This relates to the utilisation of the precipitate which is deposited from the treatment of well-washed and powdered oyster shells by sulphuric or acetic acid, and the subsequent admixture therewith of an equal weight of water, as a clay, which by itself, or by the admixture therewith of any suitable cementing or adhesive material or substance, or by the aid of pressure obtained by any suitable mould or press, may be used for the making or moulding of various articles of ornament or of utility.

2715. NECKTIES, *J. Thomas and B. White, London.*—21st June, 1881. 6d.
This relates to the arrangement or construction of the parts containing the fastening or holding means.

2718. CARRIAGE BRAKES, *W. J. Corteen and T. E. Cooper, Brentford.*—21st June, 1881.—(*Not proceeded with.*) 2d.
This relates to the employment of a universal joint, which allows the driving or actuating rod to be placed at any angle.

2719. MACHINERY FOR REAPING AND MOWING, *J. Lines, Hadleigh, Suffolk.*—21st June, 1881.—(*Not proceeded with.*) 2d.
This consists in the addition of a horizontal spindle to which a wheel or roller is attached, which when the machine is operated brings it down, so that it becomes engaged with the hook on the top of a vertical spindle furnished with a spring, and depresses it at about every ten feet cut.

2721. EGG TIMERS, *A. B. Houghton, Birmingham.*—21st June, 1881.—(*Not proceeded with.*) 2d.
The instrument, made on the principle of the hour glass, is made of metal with glass bases.

2724. GLASS BOTTLES, DECANTERS, &c., *J. Jeffs, Islington.*—21st June, 1881.—(*Not proceeded with.*) 2d.
This relates to means for utilising glass bottles, &c., for advertisements.

2725. FORMING MOULDS OF SAND, &c., *F. Ley, Derby.*—21st June, 1881. 6d.
This consists in the combination of an axis, two cranks, two connecting rods, slides, and two pressure plates, forming apparatus for simultaneously ramming the upper and the lower parts of a mould.

2726. CARRIAGES, *D. Kerridge, Needham Market, Suffolk.*—21st June, 1881.—(*Not proceeded with.*) 2d.
This relates to constructing a carriage in such a manner that it may either serve as a two or four-wheel vehicle.

2727. MANUFACTURE OF HEALDS, &c., *W. E. Gedge, London.*—22nd January, 1881.—(*A communication from N. and J. Chaize, St. Etienne, France.*) 6d.
This consists, First, of the heald itself in its constitution or make, inasmuch that it is manufactured in one piece without knots and without elbow or bend, by the natural effect of the working on the loom of the six threads of which it is composed; Secondly, in the mechanism permitting the conversion at the required moment of the tension or twisting of the six threads of the two branches of the heald into a plaiting point which ties them together.

2728. EXCAVATING OR DREDGING, *W. Smith, Aberdeen.*—22nd June, 1881.—(*Not proceeded with.*) 2d.
This consists of a tubular frame mounted on wheels carrying a convenient number of hollow discs which communicate with the tubular frame by tubular stalks. Water under pressure is supplied to the frame and discs from pumping machinery either on a barge or ashore. The discs are drawn through the sand, &c., by a motor engine or engines, and back on the pier or shore, the frame and discs being capable of working in either direction backward or forward.

2729. BUTTONS, STUDS, LINKS, &c., *J. Harrington, Brixton.*—22nd June, 1881. 6d.
This consists in the arrangement and application of side spring locking contrivances to secure a movable part in position.

2731. KEYS FOR LOCKS, *C. Strauss, Birmingham.*—22nd June, 1881.—(*A communication from O. Strauss, Frankfort.*—(*Not proceeded with.*) 2d.
This relates to keys for indicating by the appearance or condition of the key itself after its withdrawal or removal from the lock, whether the lock has been left in a locked or unlocked condition.

2732. CUTTING OR SLICING APPARATUS, *G. W. Robertson, Glasgow.*—22nd June, 1881.—(*Not proceeded with.*) 2d.
A vertical frame or traveller reciprocates in V grooves or channels in the upper and lower frames, and on one side of the traveller is secured the knife or cutter.

2733. RAILS AND SLEEPERS, *A. Browne, London.*—22nd June, 1881.—(*A communication from H. Rimbach, Berlin.*) 6d.
This relates to metal rails and longitudinal sleepers combined. The rail A is made with a centre groove to

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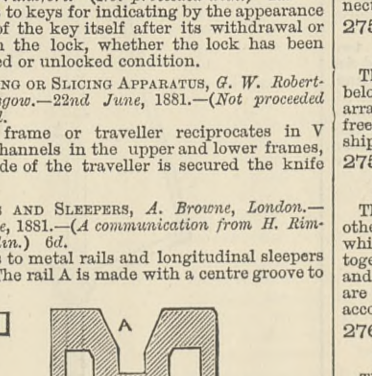

receive the flange of the wheel, and it fits over the upper part of the sleeper B and is secured by bolts C, whilst the two lines of rails are connected by bars D.

2734. AUTOMATIC REGULATING GAS-BURNERS, *W. J. Brewer, London.*—22nd June, 1881. 6d.
This consists, First, in the construction of a gas-burner in the form of an ordinary jet, with one or more smaller jets below the level of the nipple, projecting their flames into the lower portion of the main flame; Secondly, in the construction of governor for use with any gas-burner, consisting of a slightly coned chamber, spindle, valve, and projections thereon; Thirdly, in the use in any gas-burner supply pipe of a chamber containing the purifying composition.

2737. SPINNING AND TWISTING, *W. Riley, Keighley, and J. Riley, Bradford.*—22nd June, 1881.—(*Not proceeded with.*) 2d.
This relates to means for maintaining the tension on the driving bands equal at all parts of the traverse of the bobbin both in cap and fly spinning.

2741. TREATING VEGETABLE SUBSTANCES FOR COLOURING MATTER FOR STOUT AND PORTER, *A. Gough, Buckingham.*—22nd June, 1881. 4d.
This relates to treating mangold wurzel and other roots to render the same suitable for use as colouring matter.

2742. CALENDERING OR HOT PRESSING PRINTED SHEETS OF PAPER, *H. H. Lake, London.*—22nd June, 1881.—(*A communication from C. Chambers jun., Philadelphia, U.S.A.*) 6d.
The object is to enable the relative amount of pressure exerted upon the middle and edges of the sheet to be regulated with exactitude. The rollers R are supported in journal boxes in the housings H, the two being geared together, and each being bored with a

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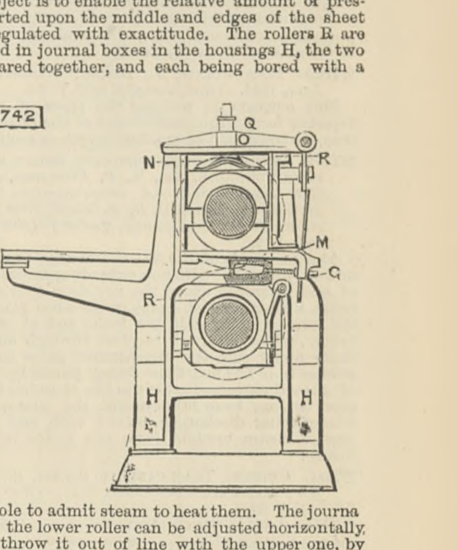


centre hole to admit steam to heat them. The journa boxes of the lower roller can be adjusted horizontally so as to throw it out of line with the upper one, by which means the pressure on the middle and edges is regulated, the amount of pressure being controlled by wedges M controlled by screws G, and by springs N controlled by screws Q.

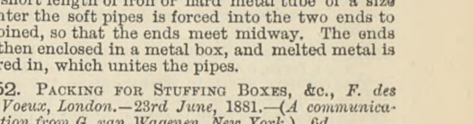
2743. PAVEMENTS, &c., *H. H. Lake.*—22nd June, 1881.—(*A communication from D. McLean, New York.*) 6d.
This relates to paving blocks formed of concrete, having their upper and lower longitudinal and transverse edges bevelled, so as to form when laid down V shaped channels running at right angles to each other, and adapted to be reversed at will.

2746. BOOTS AND SHOES, *D. W. Cuthbert, Glasgow.*—23rd June, 1881. 6d.
This consists in providing the soles and heels of boots and shoes with plugs or blocks, or projections of rubber, or other suitable elastic material or combination.

2751. FORMING JOINTS IN LEADEN PIPES, &c., *D. Church, London.*—23rd June, 1881.—(*Not proceeded with.*) 2d.
A short length of iron or hard metal tube of a size to enter the soft pipes is forced into the two ends to be joined, so that the ends meet midway. The ends are then enclosed in a metal box, and melted metal is poured in, which unites the pipes.

2752. PACKING FOR STUFFING BOXES, &c., *F. des Voeux, London.*—23rd June, 1881.—(*A communication from G. van Wagenen, New York.*) 6d.
The packing is composed of a metal spring A forming a hollow core and a covering B of fibrous or

2752



metallic material. A strip or length of this packing is coiled within the stuffing-box and pressure exerted thereon by the gland.

2753. HEATING FURNACES FOR MANUFACTURE OF IRON AND STEEL, *T. Adams, Brierley Hill, Stafford.*—23rd June, 1881. 6d.
This consists in making the slag tap hole in the back wall of the furnace and opposite the first working hole, the furnace being inclined downwards from both ends towards a line joining the said tap hole and first working hole of the furnace, the said tap hole opening into a recess or depression in the back wall of the furnace, into which recess the slag is conducted from the bed of the furnace, and in which it accumulates, and removing the slag when required from the said recess by means of a horizontal trough fixed outside the furnace.

2755. DRIVES FOR SEWING MACHINES, *J. Sefton, Belfast.*—24th June, 1881.—(*Not proceeded with.*) 2d.
This relates to improvements in the drives in connection with sewing machines.

2756. SHIPS, WAREHOUSES, AND WAGONS FOR CARRYING OR STORING FRUIT, &c., *G. A. Cochrane, Montreal.*—24th June, 1881.—(*Not proceeded with.*) 2d.
This consists partly in perforating all the decks below the main deck with numerous holes, and arranging the freight so as to allow air to circulate freely in a vertical direction from the ventilator on the ship deck to the bottom of the hold.

2758. APPARATUS FOR SEPARATING SOLID BODIES AND LIQUIDS, *H. J. Smith, Glasgow.*—24th June, 1881.—(*Not proceeded with.*) 2d.
The machine is constructed so that two circular or other shaped vessels provided with inlets and outlets, which may be protected by filtering apparatus, rotate together about the same axis, and whose edges, flanged and so arranged as to obtain close and perfect contact, are brought together or separated during rotation according as desired.

2760. RAILWAY AXLE GUARD, *J. Whittle, Chorley, Lancaster.*—24th June, 1881.—(*Not proceeded with.*) 2d.
This relates to means of increasing the strength without materially adding to the weight.

2763. WATER-CLOSETS, &c., *W. B. Bryan, Blackburn, and A. Fryer, Wilmslow.*—24th June, 1881.—(*Not proceeded with.*) 2d.
The water-closets are flushed by an improved self-acting tipping tank arranged to empty itself when it becomes nearly full.

2764. ADJUSTABLE PARTITIONS FOR CATTLE STORES, *W. S. Hunter, Belleville, Canada.*—24th June, 1881. 6d.
A combination of bars and folding partitions are provided in such a manner that a ship, railway vehicle, or stable may be divided off into any number of stalls or compartments transversely.

2766. EXERCISING MACHINES, *H. J. Allison, London.*—24th June, 1881.—(*A communication from J. K. Judd, New York, U.S.A.*)—(*Not proceeded with.*) 4d.
This relates to an apparatus in which a weight attached to a cord running over a pulley is raised and lowered.

2767. MACHINERY FOR DRESSING AND FINISHING LEATHER, *P. Newall and J. Barker, Warrington.*—24th June, 1881.—(*Not proceeded with.*) 2d.
This relates to a machine in which there is a rising and falling table, on which the pieces of leather are placed, and a revolving drum fitted with knives or dressers for dressing and finishing leather.

2770. IMPROVEMENTS IN ELECTRICAL RESISTANCE MEDIUMS, MORE PARTICULARLY ADAPTED FOR USE IN VACUUM AND OTHER ELECTRIC LAMPS AND TUBES, *R. H. Courtenay, London.*—24th June, 1881.—(*Not proceeded with.*) 2d.
This consists in preparing the carbon by fire

rubbing into the fibres of a skein of several threads of silk saccharine matter, such as date fruit, after which it is rubbed with a compound of plumbago, saccharine matter, and asbestos, to render it hard and smooth. The silk and compound are then gently heated. The inventor uses a compound of asbestos and fireclay as an insulator.

2779. PUMPING APPARATUS, *R. E. Dickinson, Birkenhead.—24th June, 1881.—(Not proceeded with.)* 2d.

This relates to improvements in apparatus for pumping or compressing air and for other pumping purposes, and has for its object to provide simple and efficient means which are now especially adapted for pumping air for condensing the exhaust steam from the engines of tramway cars.

2780. PIPE JOINTS, *J. Barlow, Winchester.—25th June, 1881.—(Not proceeded with.)* 2d.

This consists in making the pipes of a slightly tapering form; the smaller end of the pipe is driven into the larger end of another length or section.

2784. APPARATUS FOR CONSUMING SMOKE AND GASES FROM FURNACES, &c., *W. P. Thompson, London.—25th June, 1881.—(A communication from C. McWillian, Montreal, H. A. Hogel, New York, and A. F. Foster, Coweansville, Quebec.)—(Not proceeded with.)* 2d.

Along one side of the fire chamber is placed a pipe or flue, which has a branch extending across the front of said chamber above the fire door; its other end forms a junction with a pipe or chamber placed across the furnace underneath the boiler and at or near the bridge, which chamber receives through an opening in its upper side the unconsumed gases and smoke arising from the fire, these being joined by a current of heated air introduced into the chamber through a pipe leading from underneath the grate, and the whole being discharged, mixed with, and aided by jets of steam brought from the boiler by suitable means.

2791. GUIDING TRAM-CARS AT POINTS, *W. Stirling, jun., Rusholme.—25th June, 1881.—(Not proceeded with.)* 2d.

This relates to the employment of a point wheel or plough that may be raised or lowered when required.

2795. FASTENING FOR LEGGINGS OR GAITERS, *M. and A. Hess, London.—25th June, 1881.—(Not proceeded with.)* 2d.

This consists of a spring-acted latch-plate fitted to a slide in a case fixed to the one part of the gaiter, and of a notched pillar or stud fixed on the other part of the gaiter, which enters a hole in the latch-plate and engages therewith when in the locked position.

2797. APPARATUS FOR TREATING GASEOUS FUEL, *S. Lloyd, Birmingham.—25th June, 1881.* 4d.

This relates to the arrangement of condensing the condensable matter and for precipitating the suspended matter of gaseous fuel before it is burned, and thereby causing the said gaseous fuel to burn with a smokeless flame.

2798. RAISING ALE, BEER, WINE, &c., *J. A. B. Bennett, King's Heath, and J. Herd and B. P. Walker, Birmingham.—25th June, 1881.* 6d.

This consists in raising ale, beer, wine, water, and other liquids, drinks, and beverages, by the pressure of carbonic acid gas applied to the liquid contained in a closed vessel by means of an automatically regulated pressure.

2813. PRODUCING DESIGNS ON SURFACES OF EARTHENWARE TILES, &c., *B. Lee, Leeds.—27th June, 1881.* 4d.

This consists, First, in setting off on the surfaces prints or impressions which have been received on blocks or cylinders from engraved blocks or plates, or lithographic stones, charged with the required pigments or material; Secondly, in breaking up the hard lines of designs, and producing a "tooled" appearance in the said designs by rolling a cylindrical brush or roller over the surface on which the print or impression has been set off, and while the varnish is fresh.

2816. TREATING SPENT LYES OF SOAPWORKS, *G. Payne, Millwall.—27th June, 1881.* 4d.

This relates to a process wherein tannic acid or tannin is used in the treatment of spent lyes resulting from the manufacture of soap.

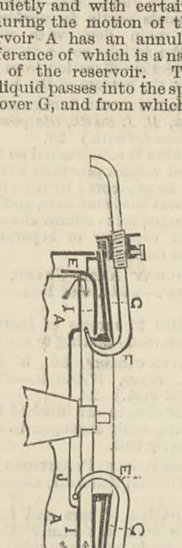
2840. TREATMENT OF GRAIN FOR MANUFACTURE OF DISTILLED LIQUORS OR SPIRITS, *W. R. Lake, London.—28th June, 1881.—(A communication from A. and W. T. Jebb, Buffalo, U.S.A.)* 6d.

This consists, First, in the method of separating the bran and gluten from the starch contained in the reduced grain, and then mashing, fermenting, and distilling the separated starch alone, whereby purer spirits are produced, and the bran and gluten are preserved in a more useful condition; Secondly, the process of manufacturing distilled spirits from grain, which consists in first steeping the grain, then reducing the steeped grain by grinding or beating, then separating the bran and gluten from the starchy liquid by sifting, and then mashing, fermenting, and distilling the separated starch alone.

2874. CENTRIFUGAL EXTRACTING MACHINES, *F. Wolff, Copenhagen.—1st July, 1881.—(A communication from Burmeister and Wains Maskin and Skibsbyggeri, Copenhagen.)* 6d.

This relates to means for drawing off the two liquids separated quietly and with certainty, and for varying the same during the motion of the machine. The rotating reservoir A has an annular plate E, around the circumference of which is a narrow groove I inside the walls of the reservoir. Through this groove the heavier liquid passes into the space between the plate and the cover G, and from which it is drawn

2874

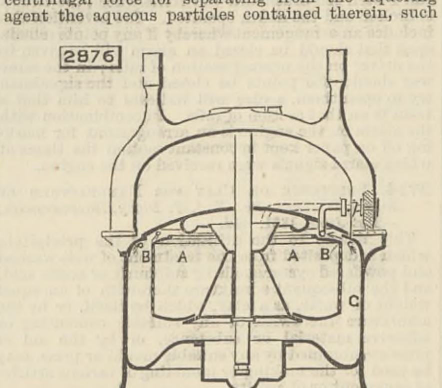


off by the tube F. The annular plate has on its inner circumference a collar which, along its inner circumference, is formed with a groove J opening towards the axis of the machine. By regulating the feed and the delivery, the level of the fluid in the reservoir can be kept just inside the inner edge of the collar, and the lighter part of the fluid will be gathered in the groove J, from which it is removed by the tube F. By sliding the tubes F and F[1] lengthwise the quality of the two separated liquids may be varied.

2876. LIQUORING OR CLEANSING SUGAR, &c., IN CENTRIFUGAL MACHINES, *H. E. Newton, London.—1st July, 1881.—(A communication from La Compagnie de Fives Lilles, Paris.)* 6d.

This relates to liquoring or cleansing substances by steam, either alone or mixed with other gases, in a centrifugal machine, the object being to utilise the centrifugal force for separating from the liquoring agent the aqueous particles contained therein, such

2876



separation taking place before its entrance into the machine. For this purpose the liquoring agent is led by a perforated tube A so as to impinge on the outer surface of the revolving drum B, whereby the aqueous particles are thrown off on to the casing C, and can be drawn off, while the liquoring agent thus deprived of its moisture penetrates into the drum and acts upon the sugar or other material placed therein.

2957. CAUSTIC HOLDERS OR CASES, *G. F. Redfern, London.—6th July, 1881.—(A communication from A. B. Clarin, Paris.)* 6d.

The caustic is fixed without glue and without pincers by a method of adjusting resulting from the conical shape employed, and from a peculiar construction of head or cap preventing it coming out of its socket.

3016. VELOCIPEDES, *G. L. O. Davidson, London.—9th July, 1881.* 6d.

This relates to the general arrangement of mechanism whereby one, two, three, four, or more persons are enabled to travel by the machine, one or two of whom only are required to work or propel the machine.

4330. MANUFACTURE OF KNITTING MACHINE NEEDLES, *W. R. Lake, London.—5th October, 1881.—(A communication from S. Peberdy, Philadelphia, U.S.A.)—(Complete.)* 6d.

This consists essentially in forming upon the needles a pivot, whereon the latch is hinged, which pivot is struck up by means of a die upon the inner face of one of the two flaps or jaws that hold the latch between them.

4421. APPARATUS FOR USE UPON TELEPHONE LINES, *G. Pitt, Sutton.—11th October, 1881.—(A communication from C. E. Buell.)* 10d.

The design of the apparatus is to signal to one of several stations upon the same telephone line without producing a signal at the others. The invention also relates to the arrangement of lines, and the apparatus at the central station. The details are exceedingly numerous, and relate to no less than twenty-seven claims.

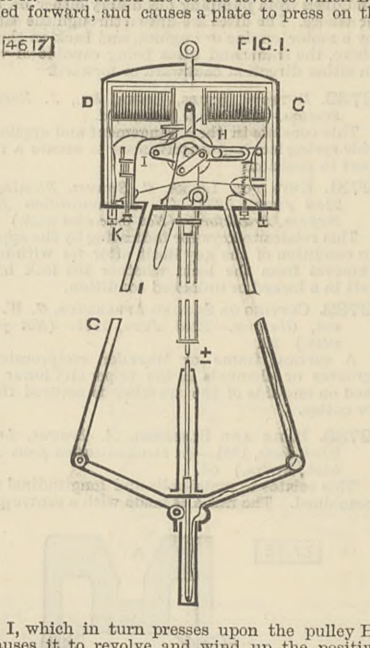
4573. LIFEBOATS, &c., *W. R. Lake, London.—19th October, 1881.—(A communication from A. Holmes, Petaluma, California, U.S.A.)—(Complete.)* 6d.

Alternate layers of air-tight metal tubes arranged partly in section are interposed between layers of cork, in which the said tubes are partly embedded, and removable air-tight are employed.

4617. IMPROVEMENTS IN ELECTRIC LAMPS, *A. M. Clark.—21st June, 1881.—(A communication from H. B. Sheridan, Cleveland, U.S.A.)* 6d.

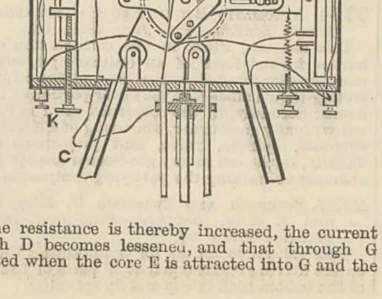
The regulation of the carbons in this lamp is effected by the pulley H and the chain C, which is attached to the ends of both carbons. When the current is on, the core E is attracted by D, and caused to enter it. This action moves the lever to which E is attached forward, and causes a plate to press on the

4617 FIG.1.



spring I, which in turn presses upon the pulley H, and causes it to revolve and wind up the positive carbon a short way by means of the chain, the same movement also lowering the negative carbon and establishing the arc. When the arc becomes too long,

4617 FIG.2.



and the resistance is thereby increased, the current through D becomes lessened, and that through G increased when the core E is attracted into G and the converse of the above takes place. The tension of spring I can be regulated at will by K, as will be seen.

4420. IMPROVEMENTS RELATING TO TELEPHONE AND TELEGRAPHIC APPARATUS AND CIRCUITS, *S. Pitt, Sutton.—11th October, 1881.—(A communication from W. R. Patterson and C. E. Scribner, Chicago, U.S.A.)* 6d.

Part of this invention refers to an improvement whereby a central office manager can regulate at will the number of subscribers to be taken care of by a single attendant, and also a method of notifying the latter of a call when he is not listening at his telephone. By this invention the subscribers' wires are grouped at the central office to a common wire which connects to a listening operator's telephone and thence to ground, and the terminals of subscribers' individual wires are connected through call bells at subscribers' offices, and thence to a common wire, the said wire serving to group the outer ends of the telephone wires together. Each subscriber is thus provided with two circuits—first, his individual telephone; second, the lines of his group that happen to be connected with the common line at their outer ends when he connected with the said common line. Another improvement consists in connecting the calling battery with a point near the lever of each spring jack, and so constructing the plug that the switchman may by means of it connect any subscriber's line with a contact point connecting with the calling battery, and thus signal the subscriber. The invention also refers to improvements in telephone cables, whereby induction is neutralised.

4705. JOURNAL BEARINGS FOR RAILWAY CARRIAGE AXLES, *A. M. Clark, London.—27th October, 1881.—(A communication from D. A. Hopkins, New Jersey, U.S.A.)—(Complete.)* 6d.

The object is to render journal bearings thoroughly yielding and self-fitting to their journals so as to prevent heating; also to prevent the lubricant which is applied to the concave surface of the bearing from becoming unduly displaced by pressure or heat, and further to enable the attendant to ascertain, without removing the bearing, whether or not it requires replacing. For this purpose the concave surface of the journal side of the bearing is made with alternate

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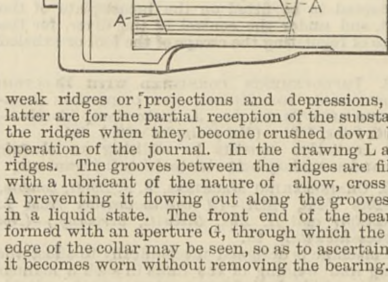


weak ridges or projections and depressions, which latter are for the partial reception of the substance of the ridges when they become crushed down by the operation of the journal. In the drawing L are the ridges. The grooves between the ridges are filled in with a lubricant of the nature of allow, cross ridges A preventing it flowing out along the grooves when in a liquid state. The front end of the bearing is formed with an aperture G, through which the upper edge of the collar may be seen, so as to ascertain when it becomes worn without removing the bearing.

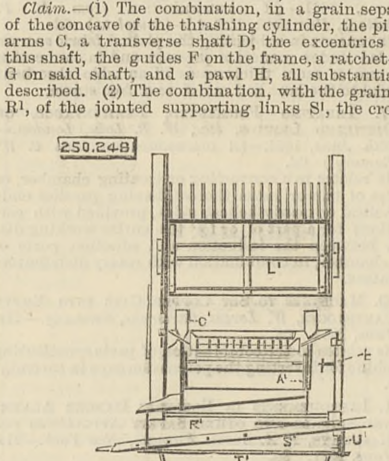
SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

250,248. GRAIN THRASHING AND SEPARATING MACHINE, *Edward Huber and Frederick Strobel, Marion, Ohio.—Filed 2nd June, 1881.* 2d.

Claim.—(1) The combination, in a grain separator, of the concave of the thrashing cylinder, the pivotted arms C, a transverse shaft D, the excentrics E, on this shaft, the guides F on the frame, a ratchet-wheel G on said shaft, and a pawl H, all substantially as described. (2) The combination, with the grain chute R[1], of the jointed supporting links S[1], the cross-bar

250,248



T[1], and the suspension links U[1], whereby the chute can be inclined to the right or left and given an endwise shaking motion, substantially as described. (3) The combination of the bottom L[1], the comb A[2], hinged to the main frame above the extension of bottom L[1], and the riddle T, having its tail end arranged above the jointed end of the comb, substantially as described. (4) The combination, with the shoe A[1], of the supporting braces B[1], pivotted at their convergent ends, and the suspension springs C[1], having their flat blades in planes radiating from the pivot of the said braces, substantially as described.

250,306. RECEIVER FOR TELEPHONES, *Henry E. Waite, Bridgport, Conn., assignor to Charles F. Livermore, New York, N.Y.—Filed May 23rd, 1881.*

Claim.—(1) In a telephone receiver, a magnet pro-

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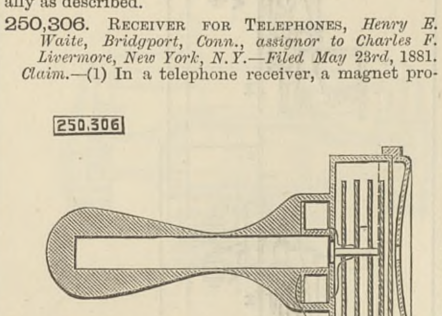

jected within and in combination with the cup or hollow chamber, to which the diaphragm and earpiece are secured, said magnet being provided with thin magnetic discs, and a coil arranged within said cup, substantially as described. (2) The combination, with the cup or sound-chamber, of a magnet projected within said chamber, magnetic discs forming flattened extensions of the pole thereof, and a coil or helix arranged between the discs and within the receiver cup, substantially as described. (3) The combination, with a hollow metal cup of a receiver, of a bar-magnet projected within said cup, magnetic metal discs secured thereto, a coil arranged between said discs and within the cup, and a second coil arranged upon the magnet outside the cup and connected with the first coil, substantially as described.

250,367. WRENCH AND PIPE-CUTTER, *Israel Kinney, Windsor, Ontario, Canada.—Filed March 18th, 1881.*

Claim.—(1) In a wrench, the combination, with the connected jaws having their inner edges opposite each other, of the handle provided with a tapering tongue, arranged to slide between said jaws and against the inner edge of one of them, substantially as described. (2) In a wrench, the combination, with the jaws arranged opposite each other, and connected by the bars or portion C of the handle provided with the tapering tongue passing through said opening and

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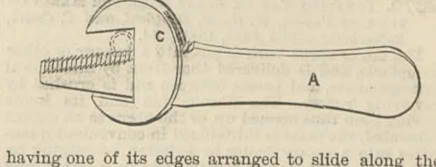

having one of its edges arranged to slide along the inner face of one of the jaws, substantially as described. (3) The combination of the jaws arranged opposite each other and connected by the bars and portions C, of the rotary cutter *d* pivotted on one of said jaws, and the handle A, provided with the tapering tongue passing between said connecting bars or portions, and arranged to slide against the jaw opposite the rotary cutter, substantially as described.

250,590. METHOD OF MAKING IRIDIUM-TIPPED METALLIC RODS, *Samuel W. Skinner and William M. Thomas, Cincinnati, Ohio.—Filed July 21st, 1881.*

Claim.—(1) The process of manufacturing an iridium-tipped metallic rod, which consists in charging with granulated iridium a cup-formed carbon positive electrode and bringing the same, while under the action of galvanic discharge, into repeated contact with the tip of a rod of other metal, substantially as set forth.

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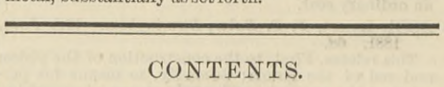

(2) The process of manufacturing an iridium-tipped metallic rod, which consists in charging with granulated iridium a cup-formed carbon positive electrode and bringing the same, while under the action of galvanic discharge, into repeated contact with the tip of a rod of other metal, the rod proper being then enveloped with a re-enforce of the same or different metal, substantially as set forth.

CONTENTS.

THE ENGINEER, January 27th, 1882.

PAGE
VISITS IN THE PROVINCES—FRANCIS AND CO.'S CEMENT WORKS 57
THE INSTITUTION OF CIVIL ENGINEERS—ANALYSIS OF POTABLE WATERS 58
RAILWAY MATTERS 59
NOTES AND MEMORANDA 59
MISCELLANEA 59
CONTRACTS OPEN—
Goods Wagons, Great Northern Railway. (Illustrated.) 61
LETTERS TO THE EDITOR—
THE FORTH BRIDGE 62
COLD AIR MACHINES 62
STRAINS ON BOWSTRING GIRDERS 62
SNOW HILL STATION ROOF 62
TENSILE STRENGTH OF LONG AND SHORT BARS.. 62
A PROBLEM IN PILE-DRIVING 62
WATER SUPPLY IN INDIA 62
STRAINS ON CRANE POSTS.. 62
POWER AND SPEED OF TORPEDO BOATS 63
EFFICIENCY OF TURBINES 63
PHOTOMETRIC TESTS OF INCANDESCENT LAMPS .. 63
PLYMOUTH WATERWORKS 63
DR. HUGGINS ON COMETS 63
LEADING ARTICLES—
THE CHANNEL TUNNEL 65
GAS ENGINES AND THE ELECTRIC LIGHT 65
EXPLOSION OF A LOCOMOTIVE ON THE NORTH-EASTERN RAILWAY 66
THERMOMETERS FOR LOW PRESSURES 66
THE PETER THE GREAT 66
LITERATURE—
The Book of Scales. By A. W. Holohan 66
Lightning Rod Conference. By G. J. Symonds. 66
THE WATER SUPPLY OF COLCHESTER 67
LARGE DOME ROOF, DEVONSHIRE HOSPITAL, BUXTON 67
ORE-WASHING MACHINES. (Illustrated.).. 67
TENDERS 67
WALLER'S GAS EXHAUSTER. (Illustrated.) 68
SWAN'S ELECTRIC MINING LAMP. (Illustrated.).. 68
SHAFT SINKING UNDER DIFFICULTIES. (Illustrated.) 68
THE IRON, COAL, AND GENERAL TRADES OF BIRMINGHAM, WOLVERHAMPTON, AND DISTRICT.. 69
NOTES FROM LANCASHIRE 70
NOTES FROM SHEFFIELD 70
NOTES FROM THE NORTH OF ENGLAND 70
NOTES FROM SCOTLAND 70
NOTES FROM WALES AND ADJOINING COUNTIES .. 71
THE PATENT JOURNAL 71
ABSTRACTS OF PATENT SPECIFICATIONS. (Illustrated.) 72
ABSTRACTS OF AMERICAN PATENT SPECIFICATIONS. (Illustrated.).. 74
PARAGRAPHS—
Large Engines for the Navy 63
British Coal Shipments 63
Original Researches 63
Fires in Theatres.. 63
Smoke-burning Furnace Attachment 67
Tramway Street Locomotives 67
Shipbuilding in Barrow 67
Ore in Furness 67
Health of London in 1881.. 67
Naval Engineer Appointments 67
Accident with an Ether Refrigerating Machine 67

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