THE QUESTION OF HEAVY GUNS IN AMERICA.

UNDER this title the U.S. *Army and Navy Journal* of October 29th last had an article written to show that the system of conversion of cast iron guns by the insertion of a coiled tube—in fact, the Palliser system—is a mistake, that steel is a mistake, whether employed in masses or successive layers, that the combination of steel and wrought iron is a great mistake, and that the material for rifled ordnance is American cast iron. We have recently had before us the case of a Spanish converted gun bursting, and this article gives other examples of failure. We have spoken highly of the Palliser system of conversion, and also of steel employed in concentric rings. We feel it therefore necessary to notice the article to which we refer, but have waited for the correspondence which it was sure to draw forth. We will now endeavour to put the various writers' facts and views forward, and then to draw our own conclusions from them. The article in the *Army and Navy Journal* dealt with a number of facts, so that it is desirable to speak of it separately.

It appears, according to our contemporary, that certain guns have burst, of which more by and bye; that an "able, not to say conclusive, argument" has been presented by Mr. W. P. Hunt, president of the South Boston Iron Company, to the Board on Heavy Ordnance, in favour of certain systems of cast iron ordnance. It is urged that "the charge and projectile in a rifled gun are relatively heavier, but there is less surface in the gun presented to pressure, the pressure is lighter and the walls thicker" than in smooth bores, and that with improved ammunition greater uniformity of pressure may be insured than formerly, when "powder pressures varied with the same projectiles and the same weight of powder between the extremes of 41,000 lb. and 150,000 lb." Only two 8in. Rodman rifles—cast iron—have been tried. One was burst after firing over 1000 rounds by a projectile wedging and stripping, causing a pressure of 150,000 lb.—67 tons; the other after nearly 900 rounds is still "healthy." A 12in. Rodman burst after nearly 500 experimental rounds, having had pressures running up to 90,000 lb.—over 40 tons. A 12·25in. rifle is now under trial. It is therefore thought to be a question whether the endurance of the converted guns is not due to the cast iron rather than the lining. Colonel Laidley has made experiments which, it is urged, seem to show that a wrought iron lining rather weakens a cast iron cylinder. General Rosset is quoted as placing wrought iron with cast iron as the weakest combination of metals. The conclusion is then quoted, presumably from Mr. Hunt, "that the homogeneous reinforce of good American gun iron with a high elastic limit, great tensile and transverse strength, and applied with moderate tension, would in all probability prove actually superior on the average to the Italian reinforce of fifty steel rings of possibly great but uneven tangential strength, uncertain temper, and deficient in transverse strength altogether." Next ordnance officers whose names are not given are "believed" to hold (1) that wrought iron merely reduces the bore without strengthening it much, if at all; (2) that this being so, it is about the worst form of tube, owing to its welds and deficiency in "transverse" strength; (3) that a coiled iron tube inside a heavy steel jacket, inside a cast iron casing, is "a combination without justification;" (4) that the use of steel in large masses in the Crispin breech-loaders is hardly justified by the successful proof of the single heavy breech-receiver of Whitworth compressed steel, especially since Firth steel is being used; (5) "that other than the Krupp system of breech-closing should be tried, in order that the letter and spirit of the recommendation of the Board of 1872 may be carried out, and that a policy which favours the spending of one-half of our appropriation for the benefit of foreign capital and labour at the expense of our own should not be encouraged;" (6) that the conversion of guns should be discontinued, and no more smooth bore guns should be spoilt by conversion into inferior rifles, instead of keeping them as useful auxiliaries.

Lastly a series of ominous incidents is referred to in support of the above opinions. These are—"the more or less free opening of welds in every gun tested, and 'demoralisation' of the material;" the cracking from breech to muzzle of the steel tube and jacket in one of the early converted guns . . . the blowing out of a tube of a heavy 10in. gun at the fourth or fifth round through the opening of a defective weld, the body of the gun sustaining no apparent injury. The discontinued proof of the new 12·25in. rifle through fear of a similar accident; the complete cracking through of the tube of the 11in. converted muzzle-loading rifle; the opening of welds in 8in. tubes which have been chambered; the failure of the only 11in. breech-loading rifle; and lastly, the destruction of the new 8in. converted breech-loading gun by rupture of the heavy steel jacket at its thickest part, the gun body being uninjured.

In dealing with this characteristic defence of cast iron, and array of facts, we will begin with the facts as the more more definite and serious part. It is clear that a steel tube and jacket in an early converted gun split, that the tube of a 10in. gun actually blew out from a weld opening, we suppose near the bottom of the bore, that welds of other tubes have opened, and that one 8in. steel "jacket"—or breech piece apparently—has burst at the breech. How long a period this has extended over we do not know; the recommendation of a board in 1872 being insisted on, suggests that it extends over a long period, and apparently all these accidents have occurred in proofs not on service. We should judge from the above that the Americans have failed in their steel castings. We are not surprised at this. Heavy steel parts we have always distrusted. We should, however, certainly expect that if as much pains were bestowed on steel castings as on iron in America, good results for castings might be obtained. In the Spanish gun to which we have referred the cast iron yielded in the same way that this steel is recently said to have done. We have argued from the circumstances of the accident that the casting was bad. We argue the same in this case with regard to the steel. The Spanish and American accidents taken together hardly admit of our speaking more confidently for one metal than for the other. The opening of the wrought iron tubes at the coils in connection with chambering certainly deserves attention. The weak place of a wrought iron tube is along its welds. It does not pretend to claim great longitudinal strength, and this must be remembered in chambering a gun, because a longitudinal strain not originally contemplated may be thrown upon it. Sir W. Palliser might urge that having merely argued individual badness in the case of the cast iron and steel, we ought to do no more in the case of the wrought iron; the report states that there have been repeated instances of welds opening—although we must admit that the language is too vague to be satisfactory, and it is flatly contradicted by another writer. Certainly we ought to be told whether such tubes are "pot welded," and specially fitted for the bores, or not; and we must not let the repetition of rather vague matters prevent us from noting that the coils appear in no case to have failed tangentially. One point of the Palliser system of conversion is the application of coils with the great tangential strength—which is generally felt to be the chief requirement—to the complete unbroken wall of cast iron which it is thought ought to furnish abundant longitudinal strength.

In short, the American and Spanish accidents show that cast iron and cast steel are liable to flaws in large masses, and that wrought iron tubes are liable to open, if at all imperfect, especially in chambered guns, along the welds. There is nothing in this to alter our opinion on the question of the conversion or construction of guns. The attack made on rings of steel is gratuitous—that is to say, no facts are adduced to support it—and the expectation of obtaining cast iron, possessing all the excellent qualities so naively summed up, and beating steel, on "an average," is amusing. We want the certainty of attaining a standard; an "average" will not do, if really bad are included with good guns to get it. As a matter of fact, there would be much less chance of danger from an unseen flaw of a serious character in fifty concentric rings of steel than in a mass of cast iron.

In the *Army and Navy Journal* of November 26th, another article appeared giving long extracts from Mr. W. P. Hunt's letter to the Board on Heavy Ordnance. The pith of this letter, which has already been referred to the article of October 29th, consisted in the plea that cast iron guns had been barbarously treated in the days when they were used, whereas the powder question has since been studied to such purpose that the strains imposed by slow burning powder on rifled guns are less than those to which smooth bores were often subjected, owing to the great irregularity in the action of the powder. In support of this plea is given a table of records of guns fired at Fort Monroe from 1866 to 1871, which show gross irregularity, such as 14 lb. and 15 lb. of cannon powder fired in an 8in. gun, giving respectively 44·6 tons and 18·3 tons pressure. Such great variations would not often be found in rifled guns fired with slow burning powder. Mr. Hunt refers to good service done by smooth bore cast iron guns in the American War, and he proceeds to show that a 10in. smooth bore is subjected to a greater strain than an 8in. rifled gun. He concludes that Palliser guns owe their strength to their cast iron rather than to their wrought iron linings, and denies that the latter modifies the violence with which a bursting gun opens asunder.

With regard to this letter, we concur in the statement that guns some years since were subjected to great strains from irregular action in the combustion of the charge. We must, however, point out that the system of registering pressures by Rodman's gauges was extremely faulty, and we think the very table we have quoted proves it to be so. For example, in the rounds above noticed the 44·6-ton pressure only gave a velocity of 1092ft., while that of 18·3 gave 1285ft. The shot in the former case stripped, but this does not account for this discordance. Again, however, we have 70 lb. of mammoth powder in a 12in. gun giving 89·2 tons pressure with a 683 lb. shot, and 60 lb. giving only 30·8 tons with a shot of 600 lb. weight; but the velocity of the former projectile was only 924ft. and that of the latter 1193ft. This shows how little reliance can be placed on the registration of pressures in these experiments. Occasionally unexpected pressures are doubtless developed in rifled guns. The Italian Committee found this to be the case in the 100-ton gun accident. We do not question the fact that very strong cast iron guns may often be produced; our doubt is whether a reasonable degree of certainty can be secured. The flaw which cannot be detected, but which developes lines of weakness, is the danger in heavy castings, and this is only found in some guns, by no means in all.

On December 10th appeared a letter signed "Fiat Justitia" on "The Question of Heavy Guns," admitting that it might be desirable to make experiments with modern powder, &c., on cast iron guns, but urging that scoring would tell much on them. General Rosset, the great advocate of cast iron, is stated to have strengthened his gun by steel hoops shrunk on to the exterior, so that one-third or one-fourth of the weight of his gun consists of steel. Coiled iron linings were defended. The statement that free openings had occurred in every gun tested is flatly contradicted. The case of 180 eight-inch tubes is quoted, in which not a single instance of such harm occurred. In reply to the statement that the employment of cast iron, steel, and wrought iron is without justification, is urged the uniform success attending the Palliser lined guns in England. Colonel Laidley's testing machine experiments at Watertown are referred to with the observation that statical pressure differs too widely from the momentary strain on a gun to be applicable. The shot range of 10in. smooth bores and their uselessness against modern ironclads is noticed, and the failure of certain steel parts of guns is attributed to imperfect manufacture, and the tone of criticism adopted in the article of October 29th is condemned strongly.

With regard to this reply and to the whole question we should sum up as follows:—Unquestionably the powers of cast iron have never been tried as carefully as could now be done. American cast iron is very good, and it would be interesting and of value to try cast iron in the light of modern improvements. At the same time we doubt if cast iron has any future in gun making; the objection to cast iron, even when cast hollow, is the liability to flaws. We see no reason to suppose that it is less liable to this evil than cast steel, and we have seen Krupp modify the construction of his guns till they resemble in a measure those of Whitworth and Vavasseur. We remember seeing a most interesting correspondence on Russian guns made of solid cast steel, in which minute flaws had extended, so as to produce rupture even where the strain had been very moderate. We are prepared to hear of some great results being obtained by cast iron, but we do not expect that uniformity or safety under severe stress will be secured. The addition of a wrought iron coil lining we have already spoken of as giving great additional tangential strength, and placing the stronger metal where it meets the chief tangential strain. The cast iron generally has sufficient longitudinal strength. This the wrought iron, we admit, does not supply—in fact, we think it a mistake to throw even the longitudinal strain due to chambering on it. The strength supplied by wrought iron is, of course, not exhibited under statical tests, because it depends partly on the total work required to stretch it through a certain range of expansion. It was on this that Mallet originally based his conclusion that a greater quantity of work had to be done to burst wrought iron than any metal of his day. A coil lining may be inserted loose enough to exhaust a great quantity of work before the stress falls on the cast iron.

In applying a statical pressure the only register is the *maximum* applied; the *work absorbed in stretching through a certain period would go for nothing*, and after the whole work had been done, as it were; and when a gun would have discharged its shot and be free from strain the statical machine would be occupying itself as to the maximum stress, precisely in the same way that it would with a rigid piece of steel. Obviously this kind of test is a test of "tenacity," not one of "tensile strength," and it favours rigid metal of high tenacity, which is by no means the best for guns. If cast iron or other metal is employed which is liable occasionally to burst violently and suddenly from flaws, which cause exceptional and unsuspected weakness, safety is secured in a great measure by combining soft wrought iron with it. We have yet to learn that wrought iron coiled linings have failed tangentially. The Spanish gun would have burst in a very much more dangerous manner if the coils had not held well together.

THE ITALIAN NATIONAL EXHIBITION AT MILAN.

HAVING in THE ENGINEER for August 19th, 1881, written about the exhibition, I now propose to say something more about its contents. There can be no two opinions as to the great importance of the portable engine. In innumerable cases the advantages of steam power could scarcely come to the aid of man were it not for the particular design and construction of engines to which the expressive name of portable has been universally given. In an agricultural country this class of engine is particularly important, and it is an eloquent fact that in 1880 the five or six English firms which have depôts in this city sold over 200 portable engines and their respective thrashing machines. A sufficiently noteworthy show of portables might justly have been looked for at the Exhibition, but it happens instead that there are only thirteen of such engines representing ten makers. Not one of this number merits special notice, for they are all either passable or beneath passable. Undoubtedly the best is an 8-H.P. by the Società Veneta of Treviso, and this particular engine is in every way laudable when compared to its comrades. Indeed it may safely stand on its own merits. All these engines are single cylinder, none exceeds 10-horse power, and all are considerably below the standard of finish noticed in other classes of steam motors. The elegant appearance which characterises English portable engines is but faintly attained by our makers, who, however, have evidently taken the English type as model. Unless special, absolutely special, works are set up for the construction of portable engines, it does not appear to me very likely that England will, for a long time to come, lose ground in Italy, as far as the sale of this class of engine is concerned, especially as an undoubted superiority attaches to the English construction of thrashing machines, which usually form with the portable the set. The indifference of these engines does not in any way detract from the merits of their respective makers as mechanical constructors, but it proves once again the impossibility of perfection, or even of good mediocrity, where everything is indiscriminately attempted. Nothing appears more natural than to notice the thrashing machines immediately after, or in conjunction with, the portable engines. Why, is easier said than proved, seeing how very frequently the latter is used for driving other than the thrashing machine; such as, for example, pumps, boring machines, grinding mills, stone breakers, ventilators, &c. A really good show of thrashing machines could scarcely be looked for, as the construction of such machines is quite recent among us, and it is only by long experience and special attention that they can be brought to perfection in all their details and niceties. Even a distant glance at the twenty-three machines in one long row suffices to convince, however, that great progress is being made, and the clumsy look of the first attempts has disappeared. Judging from a superficial examination, the best exhibits are those by Cosimini, of Grosseto, by the Società Veneta of Treviso, by Chinaglia Bros. of Villimpenta, and by Grimaldi of Milan. These are all very good machines, and very well made and finished, the last mentioned combining thrashing and chaff cutting. Grimaldi's exhibit is exceedingly English-looking, and I would not like to vouch that the machine is not English, especially as, to my knowledge, Grimaldi is only a merchant of agricultural machinery. Among the good thrashing machines may be placed those by De Morsier, Bosisio and Company, Busato, and Necti and Magni. The rest are beneath average. Generally speaking there is nothing noteworthy, no novelty in design or mode of working, and the show may be looked upon as poor, yet encouraging to Italian makers.

As regards other species of agricultural machinery, the Exhibition is very uninteresting. The plough—this first of all instruments—is shown by different makers in various sizes and shapes, but there is so much primitiveness of design and rudeness of make in them all, that the sight of them might remind us of good old days. A few chaff cutters, sifting ventilators, maize cleaners, seed sowers, and earth breakers, constitute the main portion of the agricultural implements or machinery; and I note with much regret that this section is probably the worst in the Exhibition. I hope those among my countrymen who turn their attention to the construction of agricultural machinery may soon produce something more worthy of themselves as mechanics, and of their country as an eminently agricultural one; and to this end it appears to me they must use a great deal less wood, a deal more iron and steel, and learn a lesson in England and in America. It will not fail to strike many of your readers as curious, that with so great an exportation as there is from England of all classes of agricultural machinery for Italy, our constructors should not have attempted to supply the native demand except to a very limited degree, and in only some kinds of machines—for example, there are no mowers, reaping machines, sheaf binders, straw elevators, much less steam ploughs.

A section in which, as might be expected, native talent shows itself to sufficient advantage, is the hydraulic. Many of the things here produced can only be considered as models, or illustrations of ingenious theories which could never answer practically; but others among the exhibits merit instead the serious consideration due to useful, practical applications of physical and mechanical laws. Among these I notice some very excellent turbines, centrifugal pumps, suction pumps, double-action pumps, and water-wheels. In the way of specialities may be mentioned Chiazzari's pump, Nathan's direct-action steam pump, and Chizzolini's twin collar pump. The most successful makers in this section are Bosisio and Co., Neville and Co.—who show a Girard turbine—the Società Veneta, Cerimedo and Co., and Cravero and Co. The very few fire pumps or engines exhibited, though they may be sufficient, good, and effective for the usually tame conflagrations which but for a moment flicker in our stone and brick buildings, are nevertheless very poor indeed, and would be next to useless in the case of any really serious fire. There is an absolute want of pressure pumps—a singular omission in a country where such pumps are used for so many purposes, and where machinists are more than able to construct them. Generally, the pumps and other contrivances shown are for irrigating or drainage purposes, operations of great magnitude in Italy.

Steam boilers are not the least important part of a mechanical exhibition, though undoubtedly the least attractive. Our engineering works most decidedly excel in boiler making; the boilers produced by them could not be neater, stronger, or more powerful. Bosisio and Co., of Milan, show some very fine boilers on Fox's system; one set is in active service producing steam for part of the machinery at work. Cantoni, Krumm, and Co., of Legnano, have also a fine set of Cornish boilers under steam. Also Suffert and Co., of Milan, and De Morsier, of Bologna, show good boilers in active service. Cerimedo and Co., of Milan, rank among the best makers, and have got their boiler going. Miani, Venturi, and Co., also of Milan, exhibit two very large boilers, superbly made and finished; one is a high-pressure Cornish type, the other an ordinary tubular boiler. The only novelty, however, in this class of construction is Forlanini's inexplosible tubular boiler, a description of which might interest the readers of THE ENGINEER, but would occupy too much space in a summary review like this, and would also require drawings. The one shown by Signor E. Forlanini is a 12-horse power, and has pressure on for the service of another part of the working machinery. The advantages claimed for the system are—safety from explosion, economy in consumption of fuel, facility in cleaning, smallness of space required. If these are facts they are also advantages of some account. The fittings of the boilers are most complete and perfect; the plates used by our makers are the best English, the shells being of Lowmoor. It may be incidentally remarked that boilers here are contracted for by weight, and £2 5s. is about the average price charged per cwt., taking the gross weight of boiler with grate, fire-doors, and every accessory fitting, such as taps, cocks, safety valves, pressure and water gauges, &c.

Few indeed, and happily so, are the makers of machine tools, and the main merit is easily won by M. Guller, of Intra, whose only competitors are Neville and Co. of Venice, the Società Veneta of Treviso, and Tarizzo and Ansaldo of Turin. This latter firm construct what in juxtaposition to high-class may be called low-class machinery. They exhibit two screw-cutting and one foot precision lathes, besides a vertical drill and a small doubtful looking steam hammer. All these tools are wanting both in design and in make, and are so behind what any works that desire to turn out good machinery should possess, that it is surprising the makers should find buyers even at the low prices they quote. Neville and Co. show a good screw-cutting and turning lathe, of about 7in. centres and 12ft. to 13ft. bench. It cannot be looked upon as perfection, but it is a well and solidly constructed tool. A vertical drilling machine by these same makers is equally well made, but is open to criticism with respect to design. The table, for example, has not a clear swing round out of the way of any large piece that might require to be drilled, and the strap pulleys are so placed as not to allow the free position of strap. The Società Veneta exhibits a heavy punching and shearing machine for 1in. to 1¼in. plates. The same excellence of work noticed in other constructions by this company is noticeable in this, the only tool they exhibit, against which the only remark that can probably be made is its excessive massiveness. It shows a very fine casting, admirable for size, solidity and clean surface.

Guller occupies the largest portion of the space covered by machine tools, and his display is somewhat varied, and most interesting. There is one tool only, however, which attracts notice as being of original design. It is a small drilling machine, which consists of a vertical screw column carrying the table or bench, which, when unlocked, can be turned round the column, either to clear it out of the way, or for the sake of raising or lowering it. All the arrangement of strap pulleys, spindle, feed, &c., is very good and well balanced, and the tool, which is undoubtedly a useful acquisition in any works, is graceful, strong, and well made. Sig. Guller has exhibited lathes, slotting, drilling, planing, milling, shaping, and chasing machines. In all of these there is little or nothing to comment on, further than remarking the inferiority of his milling machine to the American type, and also his little success so far with respect to chasing lathes. This maker is on the right road, has a good field before him, and if he keeps to a speciality, not troubling himself even about turbines, he may attain very honourable results. The workmanship of his machines is very good, by far superior to that of the German tools which infest the country, gaining an *entrée* merely because of their low prices.

A pretty but unnecessarily complicated wheel-cog cutting machine, made in the Royal Arsenal at Turin, is exhibited by sanction of the War-office. The machine is very beautifully made, the finish is that of a mathematical instrument, but it is too delicate to do anything like hard work. As to the cutters being used, they are defective in pattern and in temper.

Very few other constructors besides those already mentioned above exhibit machine tools, and, be it for the absolute insignificance of the tools shown, as for the bad design and make, are not worth notice. The best advice that could be given to all these makers is not to attempt the construction of tools until they are prepared to give the whole of their attention and means to this particular class of machinery, and are further disposed to dedicate the most serious study to the perfecting of tools in every single detail. Strength and simplicity united to speedy economical production of good work, are the characteristics of a good tool, and are usually only obtainable at a relatively high cost. Our makers unfortunately want to turn out tools at a low cost, and as a consequence their machines do not possess those valuable features which alone are of intrinsic worth in a workshop. Hence it is that many of our engineering establishments totter along unprofitably; they turn out their work by hook or by crook at a sacrifice of time and money as a penalty for parsimony in the erection of their plant.

Another proof of the falsity of the penny-wise principle is to be found in the fact that all through the Exhibition no large or heavy machinery is to be seen. Large lathes, planing, drilling, slotting, or other machines, steam hammers, cranes, &c., are as wanting in our categories of construction as are the finer class of spinning machinery, in which trueness and delicacy are essential.

Our arsenals and shipbuilding firms do undoubtedly turn out some heavy castings and forgings of fine finish, but their power of so doing is due to the large and perfect tools they possess, and which have been imported from foreign works. Also some of our railway workshops are thus equipped to a greater or lesser extent, but little can be said in a general way for our engineering works, which are too confined, for the stated reasons, to relatively inferior productions, and are practically excluded from Government and railway tenders. It is quite clear that a country which desires to occupy an eminent position in mechanics must furnish itself with the means of constructing every kind of machinery, light or heavy, high or low class, and the sooner Italian makers do so the better for them and for the nation at large.

ARTURO GALLICO,
Milan. M.I.S.H., Ing.

PHOTOMETRIC STANDARDS.

THE committee, consisting of Messrs. Williamson, Odling, and Livesey, appointed by the Board of Trade to consider the question of photometric standards, have made their report to Mr. Chamberlain. The report has not, we believe, yet been published, but we are able to indicate the salient features of it.

The committee commence by saying that experiments have shown that standard candles are not uniform in the quantity of light which they emit, for, in the first instance, the spermaceti employed in the manufacture of the candles is not a definite chemical substance, but a mixture of solid, fatty ethers, containing also a small quantity of oil; and, secondly, although the standard is defined in the Acts relating to gas testing as "sperm" candles, a proportion of beeswax, varying between four and five per cent., is mixed by the manufacturers with each sample of spermaceti to prevent crystallisation. Owing to differences in the proportion of the natural and added constituents, small variations are found to occur in the melting point of the sperm employed in making the standard candles. Thirdly, the number and size of the threads in the wick, the chemical treatment of the wick, the closeness of the plaiting of the strands, and the degree of tightness with which the wick is stretched, are conditions which affect the light of a sperm candle; yet they are all left undefined by the Acts, and in practice manufacturers differ in regard to them.

The committee then proceed to give actual examples of the evils arising from these irregularities, showing that they are sufficient of themselves to account for differences of between five and six per cent. of light measured by various samples of sperm candles, all of which come under the parliamentary definition of a standard sperm candle. They add:—Even were the candles made as exactly alike as possible in all these respects, there are other conditions of variation which cannot be eliminated, and which affect the illuminating power of a candle; such as the bending over, more or less, of the wick; the accumulation, or burning away, of the knob at the end of the wick; and the cup being full or emptied of melting sperm. A number of experiments made with the particular kind of candles at present supplied to the official testing places showed that, while the candles from a single packet gave fairly concordant results, the average obtained by ten experiments with one packet differed 15 per cent. from the average obtained by ten experiments with another packet. And in 115 determinations the committee found a maximum variation between two pairs of candles of over 22 per cent. in illuminating power. It appears to the committee, they say, from these facts, that the method of taking the average of three consecutive candle determinations to indicate the illuminating power of coal gas for the day does not always serve to eliminate the errors of the candle standard, for the candles employed may be taken from a packet containing candles of a uniformly high or a uniformly low illuminating power. There is, the committee state, another class of errors incident to photometric testings with candles, besides the variations which arise from irregularity in the candles themselves. Standard candles are greatly affected by slight differences of treatment, according to the operator into whose hands they are. The committee give a striking example of this fact, showing that these differences will sometimes affect the illuminating power recorded as much as 15 per cent. For the reasons thus enumerated, they consider the sperm candle to be so untrustworthy as a standard of light as to render the introduction of a better standard essentially important. The committee then report on the several systems proposed as substitutes for the candle standard. We do not intend at present to deal with such of those projects to that end as, for various reasons, the committee cannot recommend for adoption; but only to indicate their views respecting the system which they deem the most efficient, viz., the air-gas flame suggested by Mr. A. G. Vernon Harcourt. This flame, the committee state, is exact and trustworthy as a standard of light. It is not, they add, subject to the chief sources of variation which affect the amount of light emitted by a sperm candle, and those variations to which it is subject are under the control of the operator. The combustible gas is a definite mixture, prepared by the operator, of air and the vapour of light petroleum. The gas is burnt at a definite rate, from a ¼in. orifice, in a brass burner, and the height of the flame is adjusted to 2½in. The difference between the amount of light given by the air gas prepared in one apparatus, and the amount of light given by another sample of the air gas prepared in a second similar apparatus, cannot, the committee assert, be detected by a skilled operator. The committee then report on the further question of the relation of Mr. Harcourt's air-gas flame to the variable candle standard. They made, it appears, a comparison by determining the average illuminating power of a specially stored sample of coal gas alternately by means of the standard candles and by the air-gas flame. The average illuminating power of the coal gas according to the sperm candles was 15·99 candles for the fortnight the experiments lasted; according to the air-gas flame the average illuminating power of the coal gas for the same period was 16·02 candles, being practically an identical result.

Finally, the committee recommended as follows, viz.:—(1) That in official documents the quantity of light furnished by coal gas should be expressed, as heretofore, in standard candles. (2) That, for the determination of the illuminating power of coal gas, the use of the sperm candle should be discontinued, and that for the future Mr. Harcourt's air-gas flame should be employed instead, as a means of affording with constancy the light of one average sperm candle. And in the event of any other mode of measuring the illuminating power of coal gas, such as any modification of Messrs. Keates and Sugg's lamp or Mr. Methven's lamp being resorted to, on account of its practical convenience, this other mode of measurement should be standardised, and from time to time checked, by comparison with Mr. Harcourt's air-gas flame, which should alone be taken as the official standard.

The standard proposed by Mr. Vernon Harcourt, which has been adjusted to correspond to the light of a sperm candle consuming 120 grains of sperm per hour, has been described by him in a paper "On a New Unit of Light for Photometry," read at a meeting of the British Association in August, 1877, and in a letter addressed to the Board of Trade in April, 1879. The following extracts from these documents contain Mr. Harcourt's description:—

"For the standard combustible, I employ a mixture of air with that portion of American petroleum which, after repeated rectifications, distils at a temperature not exceeding 50 deg. C. This liquid consists almost entirely of pentane, the fifth member of the series of paraffins."

"The proportion which I propose to maintain is 576 volumes of air to one volume of pentane, measuring the liquid at, or near, 60 deg. Fah.; or measuring both as gases, 20 of air to seven of pentane."

"In the burner proposed to be used with the standard gas, the opening has a diameter of ¼in. The length of the brass tube, which the gas enters near its base, is 4in., its diameter is 1in., and the thickness of the disc which forms the mouthpiece is ⅛in."

The height of the flame is accurately adjusted to 2½in. The specific gravity of the liquid, the volume of the gas yielded, and the rate of burning to produce a 2½in. flame, are defined by Mr. Vernon Harcourt in the following letter addressed by him to the committee:—

"The petroleum used is prepared by fractional distillation from the light American petroleum prepared by Messrs. Pratt and Co., of New York, and imported to this country in tins for the air gas companies. The specific gravity of this petroleum varies very slightly from ·65 deg. For purification it is shaken up first with oil of vitriol and then with a solution of caustic soda. The liquid decanted off is distilled four times backwards and forwards between two large flasks at 60 deg., 55 deg., 50 deg., and again at 50 deg. C."

Comment of ours on the foregoing report and appendix would, as yet, be premature. We shall therefore rest satisfied for the present with having placed before our readers the principal views and recommendations of the committee on this important subject.

PLYMOUTH HARBOUR.—The steamship Ravenna arrived at Plymouth yesterday, that being the first occasion on which a vessel belonging to the Peninsular and Oriental Steam Navigation Company had called there to land passengers, mails, and specie on the homeward passage.

THE MENAI SUSPENSION-BRIDGE.—At the Carnarvonshire Quarter Sessions, on the 5th inst., it was reported that a joint committee of Anglesey and Carnarvonshire magistrates had met to consider the proposal by the Board of Works that the maintenance of the Menai Suspension-bridge should be transferred conditionally to the two counties. The committee—over whom Captain Verney, chairman of the Anglesey Quarter Sessions, presided—recommended that the proposal should not be entertained, seeing that many districts in the two counties enjoyed no benefit from the structure. The Anglesey Quarter Sessions having adopted the report, the same resolution was agreed to by the Carnarvonshire magistrates.

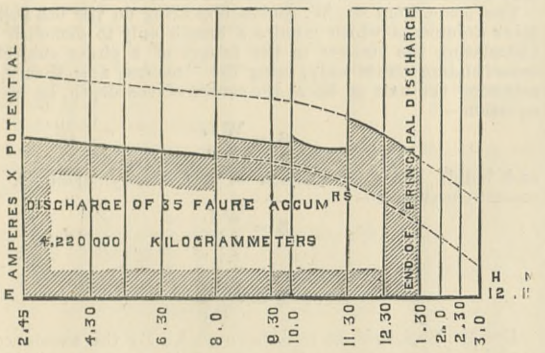
FIRE RISKS OF ELECTRIC LIGHTING.—In an article published originally in the United States, and reprinted in our contemporary, the *Chemical News*, Professor Henry Morton has called attention to the risks to which property is exposed from the increasing employment of powerful currents of electricity for electric lighting. The caution and the remedies suggested are assuredly timely when preparations are being made on so many hands for a vast extension of electric lighting. No fewer than five times did fire break out in the Paris Exhibition, and in each of these cases the cause was the same, namely, defective insulation of the conducting wires. Professor Morton divides the dangers into two kinds—those arising from the conductors, and those arising from the lamps. When naked wires are used as conductors, and when both are, as is sometimes the case, merely nailed or stapled to wall or floor side by side, there is a great chance that some stray scrap of wire, a falling nail or pin, may short-circuit the line and become red-hot in an instant. Loose wires are again a source of danger, as they may be momentarily short-circuited, and arcs set up of a dangerous nature at the point of contact. These remarks are specially cogent in such cases as those where many arc lights are being worked on a single circuit, and where there is of necessity a very high electro-motive force employed. On such circuits, moreover, should some of the arcs go out, there is a risk of the others becoming excessive in power, risking the metal-work of the lamps, and thereby endangering a conflagration. Moreover, the lamps themselves are not free from danger, if so constructed that fragments of red-hot carbon can fall from them, as was the case not many months ago with one of the Siemens' lamps in the reading-room of the British Museum. As a remedy to diminish such risks, Professor Morton makes the following recommendations, every one of which we can heartily endorse:—Firstly, that both the conductors—the outgoing main and the return wire as well—should be completely insulated; and that the machines and fixtures of the lamps should also be insulated, so far as regards all ground connections. Secondly, that the outgoing and return wires, instead of being laid side by side, should be separated as widely as possible. And he also recommends that, in the case of arc lamps in series, there should be automatic adjustments, to short-circuit a part of the current in case the arc in the lamp becomes too powerful, and to diminish the electro-motive force of the generators in proportion to the actual resistances in circuit. Even on those systems of electric lighting which apply the principle of incandescence, where the electro-motive forces employed are, as a rule, smaller than with arc lighting, there is need of caution. And one cannot too highly admire the ingenious device with which Mr. Edison has met most of the possible objections beforehand, by interposing automatic "cut-off" joints of lead wire at every branch of the ramified circuit of his system of supply; the thickness of the wire being adjusted according to the circumstances of each case. It would be well for fire insurance companies to lose no time in laying down a code of reasonable conditions to be complied with in case of buildings lit by electric lights. Without such precautionary conditions, electric lighting is at least as unsafe as lighting by gas, and that is saying a good deal. But where proper precautions are taken, we think it should be a far safer mode of lighting; and should be recognised as such by the imposition of a lower insurance premium than is fixed in the case of lighting by gas.

LETTERS TO THE EDITOR.

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

FAURE'S ACCUMULATOR.

SIR,—In a very interesting article in your last issue I notice amongst some very valuable matter a paragraph which, although written in a very agreeable mood, might mislead your readers as to your meaning. This paragraph refers to the Faure accumulator; it is impossible for me to modify your opinion as to the relative merits of two things of which I know only one, but I may call upon you for the sake of the impartiality and reserve which has characterised your paper for so many years, not lightly to give your opinion in a matter, the commercial aspects of which you may greatly influence. The pedestal may have been so very high and the kingsmen so very small that the latter may not reach the former. As I have not any dimension I cannot judge. I am very delighted with the part where you say the battery is a good thing; but you next say it is "nowhere;" and at most, taking Sir W. Thomson's figures, "not the best." I beg you will take Sir W. Thomson's figures as greatly underrating my battery; so that we are really somewhere, and mean to be more and more in the lead. On the other hand, you lead me to believe that the great improvement you refer to has been made upon my battery. This is rather satisfactory, and as a man of science I cannot but be pleased by the progress made. I have also reason to believe that the owners of my patents will only disagree with you when you say that such improvement belongs to others but them. This is rather an *ex parte* statement, and had better be left to parties less independent than the staff of THE ENGINEER, or to some writers the other side from your side of the Channel.



If you can give me a little more space, I will now give you a very brief account of some very interesting experiments which teminated yesterday at the Conservatoire des Arts et Metiers, Paris, under the absolute superintendence of the Commission des Experiences de l'Exposition Internationale d'Electricité, and of which Mr. Tresca is the chairman. Messrs. Potier and Joubert, the eminent electricians, took the measurements, with the assistance of Mr. G. Tresca. Photometric measurements were taken by Messrs. Allard et Leblanc. These results will be officially published, I believe, after all the lesser corrections have been made, but in the meantime I give you the following data as quite trustworthy for practical purposes, and as having been obtained with a set of laboratory cells not supposed to be above the going average, and not meant to be employed but for laboratory purposes; in short, they had a high resistance, and are not suited for tram-car driving, for instance, where the capability of being charged and discharged rapidly is most important on account of the weight to be carried for a definite work and time. The experiments lasted six days, and include:—(1) A discharge to a known level leaving the useless tail end in the cells. (2) Charging with a dynamo and registering the mechanical work spent by means of the dynamometer, and the useful electrical work obtained and sent in the cells to be stored; this was done during a few hours each day on Wednesday, Thursday, Friday, and Saturday, and lasted in all 22 hours 45 minutes. The mechanical work spent, deduction been much of an outside resistance not necessary in the system, was 8,400,000 kilogrammetres. The work sent in to be stored up was 6,100,000 k.m., being that due to a mean current of 8·5 Ampère per second for 22 hours 45 minutes, and means potential of charge of 87 volts. The work given out during the discharge was 4,280,000 k.m., being equal to the lined surface of diagram below, and corresponding to 178 Ampères hours by a mean potential of 61 volts during the 10 hours 45 minutes that the principal discharge lasted, viz., from Saturday 2.45 p.m. to 10 p.m., and from Monday 10 a.m. to 1.30 p.m. The ratios are thus: Mechanical work spent, 100; useful work produced by dynamo, 71; duty of batteries, 70 per cent. of electric work equal 50 of original work. The diagram below gives the mean work at the divers times specified and the total work by its surface. To explain the form of the curve it is necessary to say that out of the thirty-five elements employed thirty were first used, then two more were put in, then three more as the light given out needed in order to be nearly uniform. The dotted lines have been obtained by calculation, and show what the curves might have been had thirty or thirty-five elements been used right off from the beginning. The accumulators employed weighed 30 kil.—66 lb.—each making a total of little over one ton, and it will, therefore, be seen that they contained and yielded nearly 16 horse-power per hour to the ton, and at the rate of about 1½-horse power—electrical—for 11 hours.

Paris, 22, Boulevard Voltaire, January 10th. C. A. FAURE.

ENGINEERS FOR INDIA.

SIR,—I have lately seen an article in your paper published on the 22nd July last regarding the civil engineers who have entered the Indian Public Works Department from Cooper's Hill. It is admitted that these gentlemen have received a good education, and are generally able and industrious, in fact you credit them with a great many qualities which any public servant might be well satisfied to possess; but you make what you appear to consider a fatal objection to the men and to the system under which they are serving, that they are wanting in practical experience, or that they are not, as you put it, "practical men." You quote in support of your opinion an extract from a minute by Sir A. Clarke, late Public Works Member of the Governor-General's Council, which you consider bears out your contention, and in which it is stated that the Coopers Hill men when they arrive in India are deficient in practical experience, in which respect at any rate it is added, the so-called "Stanley Engineers" appointed under the old system by direct examination had the advantage.

Sir A. Clarke's minute was written in 1878, and as the first batch of Coopers Hill men had arrived in India only in 1874, and were at that time occupying quite subordinate positions in the service, it was surely premature to pronounce so soon an opinion on the merits of the men or the system, or to compare them with others who were their seniors by ten or fifteen years. As well complain that a house is not water-tight before the roof is put on, as allege that any body of men have proved a failure or otherwise when in fact they have had no opportunity of being tested. But as regards the statement that the "Stanley Engineers" possessed the advantage of superior practical training before they entered the service, Sir A. Clarke was misinformed as to the facts. Some of them may have had some practical training, but a large proportion of them had had none whatever. The conditions of admission to the Indian Public Works Department in those days were the passing a very elementary examination, and the having served for one year as pupil to an engineer. But as it was not specified what sort of an engineer they were to serve under, or what amount of practical training they were required to undergo during that year, and as any one who chooses to do so may dub himself a civil engineer and take pupils, practically the preparation of a large proportion of these young engineers had fallen into the hands of a few "crammers" who lived in London; who had no professional practice to speak of, and who worked up their pupils to pass the needful examination in mathematics and the elements of surveying. The so-called pupilage, in fact, instead of being pupilage under an engineer as was intended, had in many cases degenerated into pupilage under a tutor. As a means for selecting engineers, trained or untrained, the examination and the test were a mere sham. Many of these gentlemen appointed in this way have no doubt turned out skilful engineers and valuable Government servants, but with few exceptions their practical experience has been gained since they entered the service, and have been employed in India on Government engineering work. The Coopers Hill men on the other hand do undergo a real course of practical training; after they pass out of the College they are placed as pupils by the Government under civil engineers in large practice or in workshops of repute, so that although the training is short, it is good as far as it goes. In this respect, then, of practical training they have a decided advantage over the majority of the "Stanley Engineers." But after all, this is not the point on which stress need be laid. Coopers Hill does not profess to turn out practical engineers; what it does profess to do is to educate young men of ability, and prepare them for becoming engineers. And the point you raise is really the much larger one, whether in the engineering profession, as in any other, technical education should not precede practical training. In all the other scientific professions this controversy, if such it can be called, has long ago been laid to rest. Time was when the proper preparation for the medical profession was deemed to be purely practical training. A boy was taken from school at an age when now-a-days boys have hardly entered the public schools, and apprenticed to a medical practitioner, to gain a practical knowledge of his business, by watching what his master did and said. After four or five years spent in this way, making up his master's prescriptions, and picking up such scraps of knowledge as he could, he went to London and walked the hospitals for a year or two, to get a smattering of anatomy and chemistry, and finally, after passing a very easy examination, he was launched in the world as a qualified medical practitioner. And certainly if he was not a "practical man" he was nothing else. But this barbarous method of preparation has long since given way to a more rational method. The medical practitioner now-a-days is educated first and trained in practical work afterwards. So too with the army. In old times a youngster was gazetted to a regiment and became a "practical man" from the outset, that is to say, he learnt his drill and nothing more; he began practising at once what he was going to practise all his life. But now a certain amount of preparatory education is deemed necessary even for the army, and it is thought that a man who is going to spend all his life in practical work may well devote a small part of his early days to studying in a scientific way the principles which underlie the business of his profession. This sort of reform has still to be carried out in the engineering profession in England, although the necessity for it has long been recognised on the Continent. The question at issue is obviously not which method will supply the most useful men at the outset, but which will furnish the most useful men in the long run. A man enters the Indian Public Works department expecting to pass thirty or thirty-five years of his life in it. Engineering in India is essentially a more practical business than it is in England, for the reason that the sub-division of labour between the engineer and the contractor has yet to be accomplished, and the engineer in India has all his life to be engaged in work which will tend in a large degree to give him practical experience. He will have to be his own brick-maker and stone-mason, his own surveyor, his own designer, his own erector, while the multifarious nature of his occupations and his continuous service will leave him but little leisure for scientific study. The danger in India, indeed, is that men will be too practical in the popular sense of the term, and that in respect of scientific engineering they will lag behind their brethren in Europe. And this being so, can it be seriously argued that out of the thirty or thirty-five years' professional life which a man has before him, three years is too long a time to give to preparatory scientific training, especially when it is considered that of the three years' college course at Coopers Hill a large part of the time is given to such essentially practical subjects as drawing and surveying, which must be learnt at some time or other? Deduct these, and the time given to purely theoretical subjects is reduced fully one-half. Does that deserve to be called a scientific profession at all for which eighteen months' preparatory education is excessive? Of course if it be held that no education at all is required for the engineer; that engineering is to be regarded as a trade, and not a profession, then there is no room left for argument; but among those who hold that engineering is a scientific profession, and needs a scientific training at some time or other, then there can be hardly but one reply.

As I remarked above, Sir Andrew Clarke's opinion on the Coopers Hill men was delivered too soon, and moreover the reports on the young engineers on which it was based were made by men who had entered the service in a different way, and on whom the establishment of Coopers Hill was to a certain extent a reflection. I am old enough to remember the earlier reports on the Indian civilians appointed by competition; these reports were not favourable ,but then they were drawn up by the older civil servants who had entered the service in the good old time of undiluted patronage, and it was the man who painted the sign-board and not the lion; and I should say that it is even now too soon to express a final opinion on the merits or otherwise of the Coopers Hill men, based upon what they have done themselves. They are still the juniors in the service, and have not had time to rise to the higher and more responsible posts in it. But now there are nearly 300 of them in India, employed in all sorts of ways, on railway construction, on running lines, in the traffic department, on the construction and maintenance of irrigation works, and in the other multifarious works carried out by the Indian Government; and I can assert that the opinions of the senior engineers under whom they are serving, civil and military, are everywhere highly favourable to them. But indeed I do not see how any other result could be looked for by any rational person. A body of young men are chosen in the first instance by a severe competitive examination; are then brought together for their subsequent education in an institution which has a numerous and very competent staff, containing some men of the highest professional attainments, and which offers advantages for educating engineers such as hitherto could not be obtained in England, but were to be found only at the great engineering schools of the Continent. Then, after a well-directed course of study, and being finally subjected to a very rigorous test, they are sent out into a public service, in which the standard of industry and public spirit are already high, where the opportunities for obtaining professional experience are unusually great and varied, and where their subsequent advancement will be due to their own exertions. I do not see how a body of men under these circumstances can possibly prove a failure. The defect of the Indian Engineer Service in former years has been, not the want of practical experience amongst its members, civil or military, but defective preparatory scientific education. Neither the civil or military engineers have been sufficiently well educated in the scientific part of their profession. This defect Coopers Hill goes some way to supply. The Coopers Hill men will, I am satisfied, display all that energy, devotion to duty, and public spirit which have long been the honourable characteristics of the Indian Service, while they bring with them the additional qualification of a much better education than their predecessors had received.

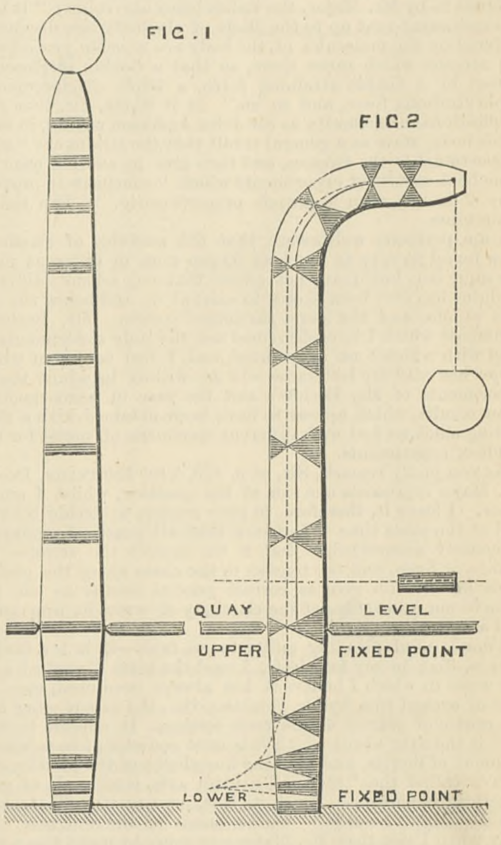
Calcutta, December 12th. G. CHESNEY.

STRAINS ON CRANE POSTS.

SIR,—There have appeared in your columns within the last few months numerous letters on the above subject, in which a great diversity of opinions are expressed, hardly any two of the writers agreeing upon any one point.

I have prepared diagrams which, if you will kindly allow them to appear in your paper, may possibly put your correspondents on the right track. I shall make few allusions to their remarks, as they will be able to judge for themselves where their errors are. I may simply remark that they arise from their utter confusion as to the term "central axis." Now, there is really no such thing in the post of the crane, but only in the horizontal part, and not even in the curved portion of what may in this case be termed the jib, and which acts as a cantilever.

In my diagram, Fig. 1 represents a vertical pillar of a solid rectangular section fixed at the bottom and at the floor line, and loaded with a weight on the top. The rectangular shadings show the various compressive forces due to the varying weight of the column itself as we ascend upward, and the weight on top. The centre vertical dark line is an important one to be taken into the calculation, and is the centre of gravity of all the cross sections, and also the axis of rotation of all the forces when the column is bent into the form shown in Fig. 2, the length



of which line will not alter in the vertical or column part, but where the column begins to bend the conditions are altered, and the top portion becoming horizontal instead of vertical, the normal pressures shown in Fig. 1 are converted into shearing forces, while in the curved portion they are resolved into a direct pressure acting tangentially to the curve and a shearing force acting perpendicularly to it. If the pressure thus obtained be added to the compression, and deducted from the tension at the two edges of the post due to the moment of the load, and the weight of the projecting portion of the crane post about the centre line, the actual strain at these two points will be given, and the neutral line—not axis—will lie at a point between the two, proportional to the amount of the two strains, the compression on the centre line being always equal to the direct pressure already obtained. This neutral line is shown dotted in Fig. 2, starting from where the horizontal part of the jib joins the bent portion, running away from the centre of gravity, or, in other words, the axis of rotation upon which all the forces turn, passing down through the shaft in a line almost parallel to the centre of gravity of all the cross sections until it reaches the point at which it is fixed in the quay or floor level, when it begins to part from it, and ultimately leaves the post altogether. The position of the line can still be traced by calculation, by producing the rotating lines until they meet, forming complete triangles, whose apices determine its position, and will be found to fly off to infinity, still tending to meet a horizontal line passing through the lower fixed point, but never meeting it. The dark-shaded triangles in Fig. 2 show the amount of tension; the light ones the amount of compression.

In referring back to the various correspondents' letters it will be seen that Mr. F. D. Vasconcellos's diagram is the nearest approach to mine; next came Mr. Coventry, in his letter to you which appeared in your issue of the 30th December, in which he shows a diagram of two unequal triangles and two neutral axes. How he arrives at these calculations I am at a loss to understand, they really mean nothing as to the point in question. As to his diagrams Figs. 1 and 2, I am also at a loss to understand their meaning, like many of Mr. Major's diagrams; and it appears to me that this neutral axis is at the bottom of it all, the discovery of which, if I am right in my reasoning, is of minor importance. The thing to discover is the neutral line, which only Mr. Coventry seems to have attempted and then unfortunately he terms it neutral "axis." I presume that Mr. Pendred will be somewhat astonished to find that instead of the neutral line following the direction indicated by him in his first letter to you, that my diagram shows it going off in the opposite direction.

I consider Mr. Pendred quite right in comparing this particular sort of crane to an ordinary safety valve, although I see no reason why he should do so, and I am astonished at so many of your correspondents disagreeing with him, some of them stating that the three diagrams are indentical, whereas they each one vary from the other, some as cantilevers, others as both columns and cantilevers.

For further information on this subject I must refer your readers to my remarks on rigid arches and roofs in vol. 33 of the "Minutes of Proceedings" of the Institution of Civil Engineers, 1871-2, Part I, and may add that the late Mr. Gravatt once remarked at the Institution alluded to, that it was astonishing what a large amount of knowledge lay hidden in books, and further that no amount of sarcasm will ever solve a problem in mechanics.

15, Great George-street, Westminster, S.W. W. H. BIDDER.

SIR,—I hope you will be able to find space for one or two remarks which I still wish to make, and which I think will probably be the last that it will be necessary for me to address to you on this subject. I have adhered to the original title throughout, but should have preferred to speak of strains or stresses "in" and not "on" a crane post.

The substance of nearly all my arguments is embodied in equations (8) and (9) of my previous letters—(8) gives the stresses in the flanges, and (9) the "final" position of the neutral axis in any given section. These equations are based on four generally admitted hypotheses mentioned at the commencement of my first letter; and I may say that to whatever extent these hypotheses are true, to the same extent are these equations true. Mr. Major in his letter which you published on December 30th says: "I venture to dispute the soundness of the hypotheses." Further on, however, he says: " . . I admit hypotheses (1) and (2), but I assert that (3) and (4) are *groundless* assumptions unsupported by *any experiments* upon metals used in the arts." The italics are mine. With regard to hypothesis (4), I have given, in the first of my two letters which you published together on December 30th, my authorities for saying that it is not a "groundless" assumption, and that it is supported by experiments on wrought iron, which I believe is a metal occasionally "used in the arts." I will now give my reasons for saying that hypothesis (3) is not a "groundless assumption," &c. With reference to this hypothesis, Mr. Major says: "In my letter above referred to"—*i.e.*, THE ENGINEER, Dec. 9th—"experiments are quoted which *conclusively prove* that the extension and compression for both cast and wrought iron *do not even approach* proportionately to the strain"—this should be "stress"—"exerted." The italics are again mine. Now in this sentence of Mr. Major's which I have just quoted, that gentleman takes Dr. Anderson for his authority. I am quite willing to do the same, and the following is an extract from page 4 of the book referred to by Mr. Major, the italics being also mine: "It is found by experiment that up to the limit of elasticity the displacements suffered by the molecules of the body are *sensibly proportional* to the stresses which cause them, so that a double displacement is caused by a double straining force, a triple displacement by a triple straining force, and so on." Is it likely, Sir, that such an unquestionable authority as Sir John Anderson should, in one page of his book, state as a general result that the strains are "*sensibly*" proportional to the stresses, and then give in another page of the same book results of experiments which "conclusively prove" that they "do not even approach *proportionally?*" The italics are again mine.

I am perfectly well aware that the modulus of elasticity has been found to vary as much as 30 per cent. in different pieces of the same bar, but I am not aware that any sensible difference of modulus has ever been shown to exist above and below the neutral axis at one and the same particular section. Mr. Barlow's experiments which I have described are the only experiments of the kind with which I am acquainted, and I feel sure that when Mr. Major has read my letters he will be willing to admit that these experiments of Mr. Barlow's suit the case in point much better than results which appear to have been obtained with a different testing machine and with different specimens of metal for the two kinds of experiments.

As you justly remark, Sir, at p. 479, THE ENGINEER, Dec. 30th, Mr. Major represents one side of the question, whilst I am on the other. I leave it, therefore, to your readers to decide between us, and at the same time I feel sure that all practical engineers will ultimately acknowledge that if we neglect the stresses due to change of form, and the tension in the chain along the post, equations (8) and (9) give as correct general results as the present state of our knowledge of the elasticity of wrought iron and steel will admit of.

I don't mind pleading guilty to one fault—if it is a fault—and that is, that in my first letter I used the term "neutral axis" in the sense in which I believe it has always been used, even in the case of arched ribs, by Dr. Rankine, viz., the axis passing through the centre of gravity of the cross section. It appears to me that this is the axis about which it is most convenient to calculate the moment of inertia, and that the knowledge of the position of what I have called the "second" neutral axis, is after all of no great practical importance. Such as it is, my equation (9) places it—to use Mr. Major's words—"in the hands of the designer." It was only when I saw that Mr. Major was going to make this a point in the discussion that I thought it might interest some of your readers to know that the position of this axis could be accurately fixed, either in a horizontal beam or in a crane post. Mr. Major, in his last letter, says: "My letter appearing on the 23rd inst. shows where it is to be found." But *nota bene* that that letter does not show "where" it is to be found. It is true that a "neutral axis" is drawn in Fig. 1; but the length and area of the section are not given, and the "neutral axis" is only figured from the centres of effort, which are themselves unknown until the position of the neutral axis is known; and as to Fig. 2, why, no areas are mentioned.

As Mr. Stokes, in his letter which you published on the 6th inst., has divided your correspondents on this subject into "two distinct factions," I think it as well to point out that, according to his definitions of these factions, it may logically be said that I belong to both of them, inasmuch as I have written to show that Mr. Pendred's so-called "safety valve theory"—*i.e.*, equations (a) and (b) in one of my former letters is correct; and that the neutral axis theory when properly applied—*i.e.*, equations (a) and (b) in the same letter—is also correct. I proved the same in my first letter, which Mr. Stokes must have seen, and in my equations (8) and (9) I have taken account of a neutral axis. It may therefore be said that my calculations are based on a "neutral axis theory," but most emphatically not on what Mr. Stokes calls "the" neutral axis theory, of which he purports to give an application in the 7th paragraph of his letter, and which is simply an attempt to obtain two unknown quantities from one equation. He speaks of his experiment as a conclusive proof of the "untenability of the neutral axis theory," whereas it really affords a conclusive proof that the "neutral axis theory," when properly applied, is correct, and that the compressive force in the breast flange is numerically equal to the tensile force in the back flange plus the load. I will leave it for Mr. Major himself to answer as to whether he has said anything from which it may be inferred that "the strains" in a cantilever, as shown in Mr. Stokes's Fig. 3A, "will be given by the equation $\frac{W\,L}{2d}$." I cannot see that Mr. Major has ever expressed sufficiently clearly what he considers the values of the stresses, and this, as I have already hinted, is a very weak point in his arguments.

I will take the opportunity of correcting an erroneous statement in Mr. Major's last letter, Dec. 30, where, in referring to my first letter, he says: "Mr. Coventry contends that the neutral axis is still at the centre." Now, nothing can be clearer than the fact that I never contended for anything of the kind, and as a proof of this I need only say that in the letter referred to, December 16th, I took particular care to confirm the calculations of Mr. Tozer, Mr. Fyson, and "J. H. H." in which a direct compressive force is applied to the neutral axis, leaving it to the intelligence of your readers to perceive that this compressive force causes a stress in that axis, and consequently that in that letter I never used the term "neutral axis" in any sense, but as that axis which is neutral only so far as stress due to bending is concerned. I hope that by this time Mr. Major is able to understand that this bending may be considered separately, and that such a process of calculation is no more entitled to be called "cumbrous and misleading" than the method adopted in calculating the stresses in a section of a horizontal beam when we consider the load once as producing a bending stress, and once again as producing a shearing stress. With reference to the last sentence of Mr. Stokes's letter, may I suggest that it would be interesting to have a measurement of the position of the neutral axis indicated by his model, by way of comparison with the result that would be obtained from my equation (9) in THE ENGINEER of Dec. 30th, bearing in mind that in that equation I is the moment of inertia about an axis through the centre of gravity of the section, l the lever arm of the weight about the same axis, and A the area of the cross section.

I see that in my letter published on December 30th I have made an error in figures. The result of my equation (9) applied to Mr. Fyson's crane post is ·9in. and not 10·53in., consequently the neutral axis with regard to the total stresses is 15·9in. from the breast and 14·1in. from the back. I have as much as suggested that if this position of the neutral axis were known beforehand we could use it in the calculation of the moment of inertia. The stresses could then be obtained from a simple expression of the form $\frac{M\,x}{I}$; but it is evident that the knowledge of this position of the neutral axis involves a calculation which would also give us the stresses. In other words, we can calculate the stresses without ever knowing the final position of the neutral axis, but not the converse. The neutral axis of flexure is settled beforehand by the elasticity of the metal and form of section, but the distance $n_1\,n_3$ in my equation (9) depends on the total stresses. This, I trust, will explain to Mr. Major not only that the load may be considered twice, but that it is useless to attempt to obtain the stresses by considering it only once. He can, however, in a certain sense realise his ideal calculation by ascertaining the position of the neutral axis from equation (9); then, if $M_1 =$ moment of weight, and $I_1 =$ moment of inertia about this axis, the total stress at any point distant x_1 from the same axis is given by the equation—

$$T = \frac{M_1\,x_1}{I_1} \quad . \quad . \quad . \quad . \quad . \quad . \quad . \quad (11)$$

the result being the same as by equation (8). This calculation is facilitated by remembering that $I_1 = I + A \times \overline{n^1\,n_3}^2$.

Fordingbridge, January 7th. W. B. COVENTRY.

SIR,—Mr. Coventry, in his letter printed on the 30th ult., says that in my first letter I stated that the neutral axis "should be assumed to be in the centre, and later, write to show that it is not in the centre." What I did say was, quoting from my first letter, "For the purposes of design, the neutral axis should be assumed to be in the centre, as leading to the best distribution of metal." At later dates I have twice stated that the position of the neutral axis for a box girder is in the hands of the designer, and the above quoted sentence means that before deciding upon the section the designer would do well to accept the central neutral axis as a basis for his calculations. Now, as to the statement that on Dec. 9th I wrote to show the axis was not in the centre. Had I said so, there would be no inconsistency, for I was then considering the strains, not in a box girder which was yet to be designed, but in a solid bar which was assumed to exist. But I did not say so; here is a quotation from the letter in question: "Calculating for an axis at the centre of the depth, the areas of moments are equal, and that therefore is the true position."

Mr. Coventry then proceeds to make a calculation, showing that I make the ratio of compression modulus to tension modulus 2·25 for a given stress. But the calculation begs the question at issue; it is only correct if both moduli are constant for all stresses, and this I deny. There were two stresses in question—3·7 tons and 5·9 tons. Comparing the respective moduli, as obtained from my diagrams, for the first stress, I find the ratio to be 1·9 in favour of compression, and for the second stress 1·8; not 2·25.

Your correspondent is anxious to know how I obtain my diagram of compressive stress, Fig. 3. Permit me to explain. In Table 9 Mr. Coventry finds the lowest recorded stress 7·8 tons, and he correctly calculates the compression modulus for this stress as 11,650,000 lb. He could also have found that the same specimen, under a stress of 15·8 tons, showed a modulus of only 4,720,000 lb., the modulus gradually falling away from the higher value at every increment of the load; and further, that the same remarkable reduction in the value of the modulus for the higher degrees of stress occurred with the two other specimens referred to in the same table. That it might not be said I had selected a favourable example, I laid down the three sets of results by superposition in one diagram, and took the mean curve of the three. This curve showed that, from a value of 4,720,000 lb. at a stress of 15·8 tons, the modulus had increased more than 100 per cent. in passing to a stress of 7·8 tons. Here ended my facts; how was the diagram to be completed? Mr. Coventry does not say so, but all his arguments show that he thinks that when the number 7·8 was reached the curve should turn a sharp corner, and run down to zero as a straight line. In other words, that the modulus, which was up to this point increasing in value at an enormous rate, should, beyond this point, be assumed to remain at the same value. Why are we asked to believe this? I say that, in the absence of any proof to the contrary, I am justified in assuming that the modulus goes on increasing at the same rate as before, and that the curve in my Fig, 3 is to be continued to zero without break or change of character. This is the reason why my compressive modulus for small stresses comes out so much greater than the tensile modulus; and it is not an "inversion" of Dr. Anderson's results, but only a logical application of them.

Mr. Coventry expresses a doubt as to the possibility of finding a sample of iron with so low a modulus as 11,650,000; the three samples given by Dr. Anderson with minimum moduli at or about 5,000,000 lb. must be very surprising to him. If he doubts the low values, why does he attack me for, in certain cases, placing them so much higher? My critic then goes on to quote five authorities, whose results averaged point to the values of the tensile and compressive moduli as being equal, both for wrought iron and steel. Most probably all these ratios were obtained from stresses at or about the elastic limit. Now my diagrams 3 and 4, Dec. 9th, are drawn to the same scale, and may be superposed; if this is done, making the abscissæ and the zero points of both coincident, it will be seen that for a stress of 10 tons the two moduli are equal; and the average tensile modulus for stresses ranging from 7 to 12 tons is equal to the average for compression within the same range. This is quite near enough to be called agreement with Mr. Coventry's five authorities, and this result is taken from the portion of the diagrams which is fully supported by Dr. Anderson's figures, and yet Mr. Coventry "excepts" that writer's book as differing from all the others. But, on the other hand, note the quotation from Mr. Mallet referring to "the high resistance of wrought iron to compression, and the small change of length resulting therefrom within the elastic limits." This is very strong testimony in favour of my method of completing the diagram, and instead of being a conclusion the reverse of that to be drawn from Dr. Anderson's book, it is precisely the conclusion to which that book points, and which I deduced before Mr. Coventry penned a line. But that gentleman thinks that this evidence must be "the result of an error."

Mr. Coventry's Figs. 1 and 2, December 30th, both show that the neutral axis for a solid bar, subjected to bending strain up to about the elastic limit, is at the centre of the section, and this result I demonstrated by the use of my diagram on December 9th. His figures also show that the alteration of length of the fibres is proportional to their distance from the neutral axis, as stated by me December 9th; the other inferences drawn by Mr. Coventry are in no way supported by the diagrams, unless the question is again begged and moduli of constant value assumed for all degrees of stress.

I wish to compliment Mr. Coventry upon the clearness with which, in his Fig. 3, he shows that in a girder subjected to cross-breaking strain, and also to an end compressional strain—*i.e.*, a crane post—the neutral axis is not in the centre of gravity. It is a pity he did not consider this before he wrote his previous letter, as he would then have enabled me to shorten my last. On the 16th ult. your correspondent writes, replying to a remark of Mr. Fyson's, "I have, however, shown that it does not fail, and that by taking the neutral axis in its proper position, *i.e.*, in the centre of gravity of the cross section," &c. On the 30th he writes, "The neutral axis, when bending alone is considered, is in the plane passing through the centre of gravity of cross section. . . The effect of direct compression due to load is to alter the neutral axis, and to create, as it were, a second neutral axis at a distance from the first." These quotations read together show either a great change in Mr. Coventry's views or an unfortunate vagueness of diction.

Mr. Coventry says I ridiculed the idea of the post having two-fold functions to perform. Not so. I ridiculed a supposed error of Mr. Fyson's, by which the strains due to the superposed load would be first allowed for by Mr. Pendred's method, and then again allowed for by the method of addition and subtraction of $\frac{W}{2}$ to and from the stress for breast and back flanges respectively; and the figures of my *reductio ad absurdum*, November 11, show that this was the process ridiculed.

My statement commencing, "Mr. Pendred's error arises solely from," &c., is objected to. Mr. Coventry's lengthy proposition in statics is quite beside the mark. Mr. Pendred arrives at a stress result without knowing the position of the neutral axis; therefore he cannot know the distance of his particles from that axis; and as their capacity for resisting stress is dependent upon such distance in an irregular degree, he cannot know that they are in a position to resist the strains which he proposes to bring to bear upon them, and therefore his error does "arise solely from and consist in," &c.

Mr. Coventry thinks I do not know the stresses in Mr. Fyson's flanges because I have not stated them. If he wishes to know what I should make them, my diagrams and letters printed Dec. 9th and 23rd are at his service, and I have no doubt as to his competence to make his own calculations.

My reason for neglecting the weight of the jib was that it may readily be reduced to an equivalent addition to the load. The other strains due to temperature and chain are trivial.

Mr. Coventry, in summing up his position, states that the neutral axis of the crane post is not in the centre of gravity of the section. But on Dec. 16th he says, "Let Fig. 1 represent a crane of symmetrical cross section, and the neutral axis consequently half-way between the two flanges." This is surely contradictory. May I ask, has Mr. Coventry changed his opinion?

The letter from Mr. W. Stokes appearing on the 6th inst. contains arguments which require a breath only to demolish them. Calculating the stresses in the flanges of a girder subjected to cross-bending strain only, using the "neutral axis theory," and assuming the axis to be at the centre of the depth, he gives the equation—

$$S = \frac{W\,L}{2\,D}$$

and builds his condemnation of the theory upon it. The correct equation is—

$$S = \frac{W\,L}{2\frac{D}{2}}$$

$$\text{or } S = \frac{W\,L}{D}$$

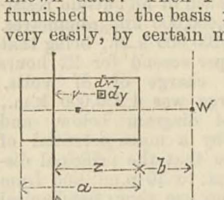
But Mr. Stokes is an experimentalist. By the assistance of a model he has proved that the breast of the mast is subjected to a strain greater by W than that exerted upon the back. Seeing, however, that nine other of your correspondents, including myself, have previously made the same statement without the aid of the model, Mr. Stokes will perhaps see that he has been needlessly exhausting his experimental energy. C. J. MAJOR.

34, Freke-road, Lavender Hill, S.W., Jan. 7th.

SIR,—I have been much surprised and disappointed by seeing in your journal a paragraph of a letter of mine which was not intended for publication, as it could be easily seen from the rough terms in which it was written. As it was referred to in your last number of the 16th of this month, which I received yesterday, I cannot but beg you to let me say something more about it through your journal.

Mr. W. B. Coventry says in his letter, I "find the neutral line to lie where the tensile forces exist." I am quite certain that if Mr. Coventry will be so kind as to read once more the paragraph he will be able to see that I never made such a blunder. Sustains he, however, the proposition, then I can with equally good foundation say he "finds the tensile forces to lie where the neutral line exists."

But let us put aside questions of words, and try to offer a reasonable solution of the matter. I think correspondents—some at least—acknowledge the moments of the forces must be taken from the neutral axis of any section; then the whole question resumes to this—Which is the path of the neutral axis under the known data? Then I say I am very glad Mr. Coventry has furnished me the basis from which I am going to try to "show very easily, by certain mechanical laws which have long been established, that the nutral axis is not the plane passing through the centres of gravity of the cross-sections," that its position is dependent from the elements of the forces, and has not a constant position in the cross-section. Let A B be the section of a rectangular beam, solicited by the gravity of the weight W, and let the letters of the figure denote the elements shown by it; then we have the following series of equations, calling f the force of resistance, whatever it be, of an element $dv\,dy$:—



$$f = cv\,dv\,dy \quad \epsilon f = ff\,cv\,dv\,dy = W$$
$$vf = cv^2\,dv\,dy \quad \epsilon vf = ff\,cv^2\,dv\,dy = (b + z)\ W$$
$$ffv^2\,dv\,dy = (b + z)\ ffv\,dv\,dy$$

Then, supposing the breadth of beam to be unity, we can write:—$3\,(z + b)\,[z^2 - (a - z)^2] = 2\,[z^3 + (a - z)^3]$ which can be written:—$(b + \frac{1}{2}a)\,(z - \frac{1}{2}a) = \frac{1}{12}a^2$. *Du reste* we could have stopped at the equation A, and said $(b + z)$ is then the length of the simple pendulum isochronal with the compound pendulum formed by the section oscillating round the line passing by W; this length is divided in two parts by the centre of gravity, which, multiplied, are equal to a constant, the radius of gyration of the section round an axis passing the centre of gravity. Writing immediately the equation B. We have then:—

(1) z is always dependent on b.

(2) Making $b = o$ we have $z = \frac{2}{3}\,a$

(3) Making $b = -\frac{1}{3}\,a$ we have $z = a$; which means, in the opinion of Mr. Coventry, the neutral axis lies where the tensile forces are. F. DE VASCONCELLOS.

Madeira, December 27th.

SIR,—Permit me to say a few words in reply to Mr. Coventry. I repeat that "two such correspondents as Mr. Major and Mr. Coventry are quite enough to emperil the reputation of mathematics as a means of solving such questions." We have two correspondents, each dogmatically and flatly contradicting the other, and each making a great display of mathematics to prove that he is right and his adversary wrong. Mathematics will appear to the outsider in this case as capable of proving anything. Instead of being an exact science, they lend themselves to either side of an argument indifferently.

Let me add that in another way Mr. Major and Mr. Coventry imperil the reputation of mathematics. Neither one gentleman nor the other argues with courtesy. A tone of acerbity pervades their communications, and each would, apparently, be more delighted to show that the other was wrong than to establish a truth.

I have now only to repeat what has long been evident, no doubt, to others, that Mr. Major and Mr. Coventry are at cross purposes. The one deals with the strains in a crane post; the other, it appears to me, with the strains transmitted by the crane post to the ultimate support, whatever that may be. I assert, for example, that the strain beneath the toe—I hope Mr. Coventry and Mr. Major know by this time what this means—will be greater than the strain on the back of the post. This cannot be denied. It is undoubtedly accurate. Mr. Coventry, as I understand him, holds that this strain is continued up the breast of the crane, and must be provided for; while Mr. Major holds that it is at once distributed through the whole post by the action of the web. If there were no web, according to Mr. Major, Mr. Pendred would be right; as there is a web, he is wrong. These are the conclusions I have arrived at, after carefully reading your correspondents' voluminous effusions. Q. E. D.

Cambridge, January 9th.

SIR,—Mr. Major and Mr. Coventry, to say nothing of many other correspondents, have written a great deal about strains on crane posts, and so far as can be seen, they may go on writing for ever. Their letters were at first interesting and useful, but they have ceased to be either for some time. To practical men like myself it seems clear enough that neither party quite understands the other, and I suspect that there is really but little difference between them. Will you let me ask what all this mass of writing comes to? and in order to ascertain its practical value, I make the following suggestion:—

I am at present designing a bent crane to lift 3 tons. The radius is 16ft. from the centre of the crane base to the centre of the axis of the sheave at the point of the jib. The lift is 18ft.—that is to say, that is the height of the centre of sheave axis from the wharf. The crane must make a complete circle, and the strains must not exceed 5 tons per square inch, whether in tension or compression; but to allow for jerks—for the crane has to do a great deal of lowering work, which is more trying than hoisting—I am keeping the normal strain due to 3 tons load down to 4 tons per inch.

Now, I suggest that Mr. Coventry and Mr. Major submit designs for the jib of this crane, to be published in THE ENGINEER simultaneously. Either there will be a difference in sectional area of breast and back in the two designs, or there will not. If there is, we shall know what your correspondents' arguments amount to. If there be not, then it will be evident that they are of no practical value whatever, and that so far as the designing of real bent cranes is concerned, both gentlemen might have saved themselves the trouble of writing. H. WARD.

Birkenhead, January 10th.

[Mr. Ward has made a very sensible suggestion. We trust that Mr. Major and Mr. Coventry will see their way to act on it.—ED. E.]

SIR,—It appears to me that all these discussions as to strains on crane posts is contained in two queries: (1) Was Mr. Pendred correct in calculating his crane as a safety valve? (2) Where is the neutral line? The following experiment conducted by me some time ago I think will settle the first point. I made a strong light wood frame, Fig. 1, representing a crane, with holes bored as follows: the hole d for weight W, 12in. from centre line C of crane post. The holes marked a b a^1 b^1, &c., were each 3in. from centre line of crane post, or 6in. apart horizontally, and 12in. apart vertically. I suspended a plumb line down centre of post, attached a Salter's balance through the hole marked b, and pivotted the whole affair on the hole marked a. I next attached the weight W through hole d and pulled on the balance until the crane came upright; I found the balance to register 84 lb. I repeated the same process in the holes a^1 b^1 a^2 b^2, &c., and found when the crane came upright the balance in every case registered the same, viz., 84 lb.

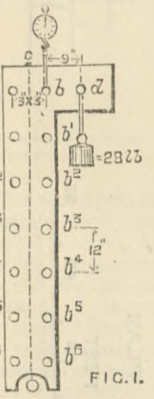


FIG. 1.

I next reversed the process, and pivotted the crane in hole marked b, attached the balance through a, and pulled downwards; the balance in this case registered 48 lb., and so on in the next and next, and throughout the series, the register in each case being practically the same, viz., 48 lb. The weight of the crane alone, without the weight, gave 12 lb. in the former and 5lb. in the latter case. I think this proves conclusively that the length of the crane post does not affect the question.

Where is the neutral line? In the centre of a wrought iron crane post of uniform section, or in the centre of gravity of a crane post of any section whatsoever; which can easily be proved by the following simple experiment. Take a bar of iron, say 1in. by $\frac{1}{4}$in., and mark off on the side of the bar parallel lines $\frac{1}{2}$in. apart; next bend the bar and measure the distance between the lines, and you will find the lines at the centre of the bar remain the same distance apart, even when the bar is bent at right angles. Now take two bars of T-section; mark off and bend one towards web and the other from the web, and you will find the neutral line in each case as near the centre of gravity as possible.

Where Mr. Pendred has made the mistake is in bringing his neutral line down the breast of his crane. The outer surface of the breast of this crane is the fulcrum and point of greatest compression. Therefore it cannot be the point of greatest and no compression at one and the same time. IMTA.

Stowmarket, January 7th.

SIR,—While thanking you for inserting my letter on the above subject, in your issue of to-day, I must ask you to be good enough to correct a clerical error which occurs towards the end of the second paragraph. The equations should read:—"$S = \frac{W\,L}{d}$, and not $\frac{W\,L}{\frac{1}{2}d}$, &c.," instead of "$S = \frac{W\,L}{d}$, and not $\frac{W\,L}{2\,d}$, &c.," as printed; also in Fig. 3 the weight is shown hung from the centre of the rocking shaft, instead of at the end of the lever, similarly to Fig. 3A, as was intended. W. STOKES.

13, Holland-street, Kensington, W., January 6th.

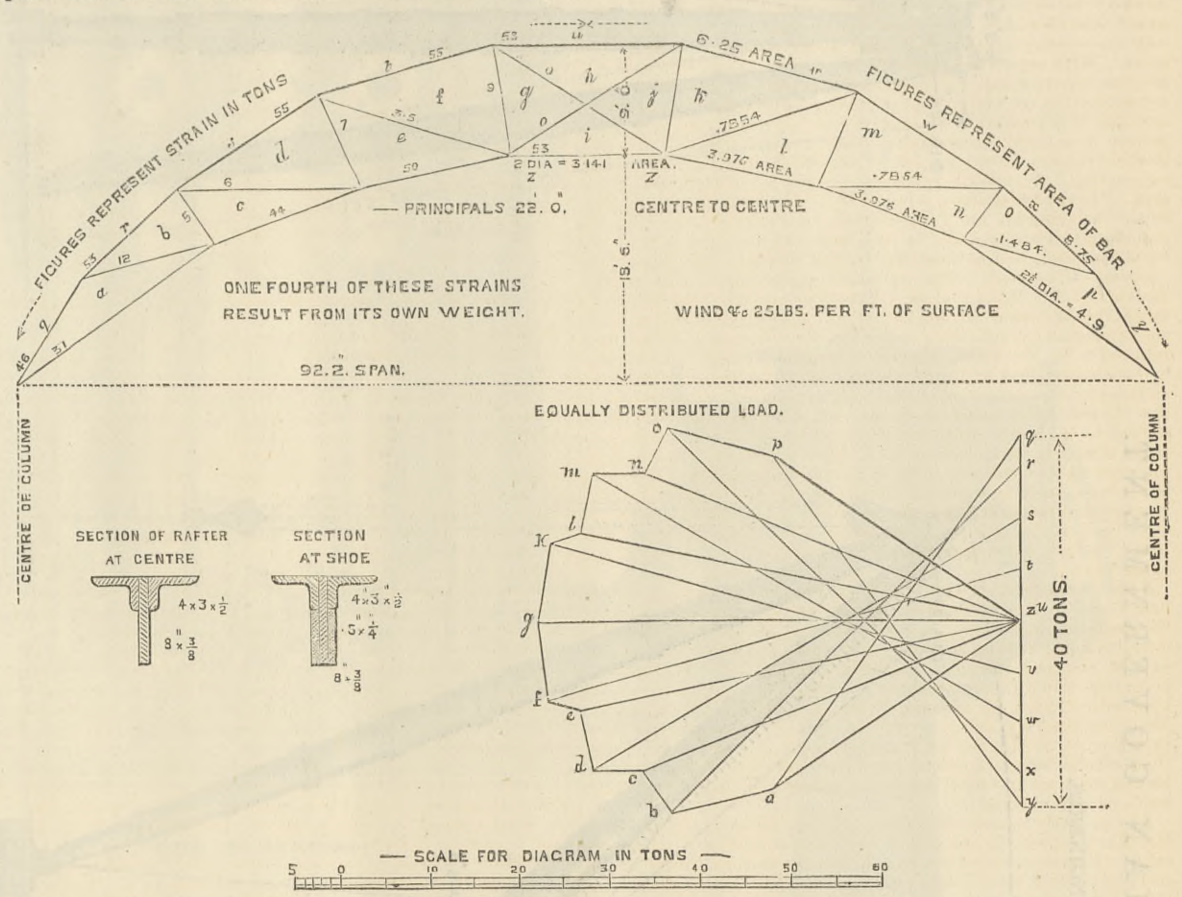
SNOW HILL STATION ROOF.

SIR,—In Mr. Walmisley's paper on "Iron Roofs," recently published in THE ENGINEER, reference is made to the one over Snow-hill Station, Birmingham. Permit me to make an addition to his remarks. I am of opinion that this roof is like the Ashtabula and Tay Bridges, and will some day prove what a dangerous thing a little knowledge is. But so long as these badly constructed roofs and bridges, by some extraordinary means, manage to stand erect, they are pointed at as examples of successful engineering, and in some instances copied. Besides, it is impossible for outsiders to judge of the merits of any structure without putting themselves to much inconvenience to obtain the necessary particulars upon which to base their calculations; and for this reason structures often escape the criticism they would otherwise get. There can be no doubt that, if the details of the Ashtabula Bridge had been submitted to any competent engineer, it would never have been built; and I maintain that, if the Snow-hill roof had passed a similar ordeal, it would have been erected in much safer proportions.

Further than this, all roofs and other structures of such magnitude—and more especially when of an unusual design—ought to be subjected to severe and accurate tests, both theoretically and practically; and this was not done in the case in question. I believe I am correct in saying that it was copied from the Old Lime-street Station Roof, and the metal altered in proportion to the span, disregarding the fact that this roof was made at a time when iron roofs were but little understood; and I believe this roof failed under the very ordinary tests applied. Probably, however, the principal argument would be that it had stood all weathers for many years, and had proved perfectly safe.

I give below an outline of the Snow-hill roof, with the sizes and areas of the different members marked on one side, and the strains on the other. I also give the diagram from which I have taken the strains. I have assumed a distributed wind pressure of 25 lb. per square foot, which I think will be admitted is not excessive. I will pass over the point that with almost any conceivable load some of the ties will be in compression as this is a minor evil when compared with the fact that the main tie-rod at the centre is strained with the weight of the structure alone to about 4·5 tons per square inch, and with the assumed pressure of 25 lb., to about 17 tons per square inch. I guarantee my dimensions to be correct, and will venture to say that there is not another roof in existence of such magnitude with such dangerous proportions, and erected with such utter disregard of the weight it may be called on to bear. There is not a redeeming virtue in the whole roof, except cheapness, from beginning to end. I have calculated other strains, assuming various angles of reaction for the supports, and with the load only on one side; and the result is as bad, if not worse, than the above. I have therefore adopted this diagram as very fairly showing the real state of the roof. THOMAS TIMMINS.

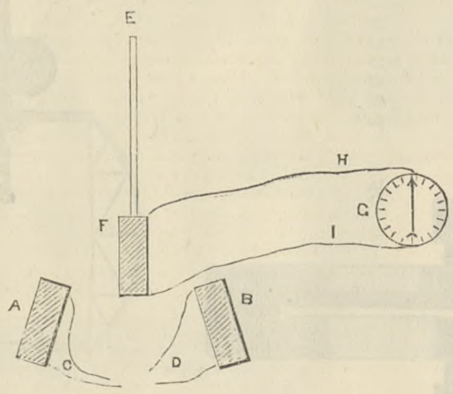
28, King's-road, Peckham, January 2nd, 1882.



A PROBLEM IN ELECTRICITY.

SIR,—Will you permit me to endeavour to obtain by the aid of THE ENGINEER an answer to a very important question. I may say that I have searched various text books for a reply in vain. I have also put the question to certain electricians; from some I have obtained a reply that they did not know, from the others an answer to which I shall refer further on.

My question seems to be at first sight very simple; apparently, however, it is not so simple as it looks. A and B are two straight electro-magnets, excited by a battery to which lead the wires C D. The battery is not shown nor is a contact maker, by the aid of which A and B are alternately magnetised and demagnetised, that is to say when A is excited B is not, and so on. Suspended from the point E is a pendulum, the bob F of which is an electro-magnet similar to A and B. The wires H and I from this are led off to a galvanometer G. These wires are supposed to offer no resistance to the swinging of the pendulum.



The whole arrangement is very similar to that used in the electric clocks, which may be seen in many places, synchronised with a good regulator.

It is evident that A and B can be made to alternately attract F, and consequently to keep it in constant oscillation. It is supposed that F at each swing cuts the magnetic field of A or B, neither being demagnetised until F begins its return journey.

Now, the question I wish to ask is this, will a current be set up in the coils on the pendulum bob F every time F cuts the magnetic field of A and B, which current will be shown on the galvano meter?

I have stated that electricians have told me that they do not know. The others give me the remarkable answer that so long as the pendulum swings with no resistance, a current will be set up in F which will be nearly equal in electro-motive force to the currents in A and B. It will not be quite equal because of what may be termed the internal sources of loss of energy in the system. But when the pendulum meets with resistance, the current developed in F will be less and less until a point is reached when the resistance is just equal to the propelling force, *and then no current whatever will be produced in F.*

Can this be true?

It is stated in all text books, without limitation, that whenever a bar of soft iron with a coil of insulated wire round it cuts a magnetic field, a current is set up in the wire. Why should the pendulum in the case I have stated be an exception? Why does it happen that the electric inductive action is diminished or destroyed by the performance of work by the magnets A B, said work being expended on attracting the pendulum?

On the other hand, let it be supposed that a current is produced, then it is evident that we have not only work done, but our current as well, ready to do more work, and although because of internal resistance it is impossible to obtain what is known as perpetual motion, it is at least evident that, by using the current excited in F to stimulate another pair of magnets, additional mechanical effects can be produced.

I assert that to say that this is impossible in our present state of knowledge of what electrical energy is would be rash. I am inclined, however, to the belief that no current would be produced in F, but if this is the case what becomes of the inductive influence of the magnet?

No matter which case is right, such important deductions may be drawn that I am much surprised the question has not been asked and answered before. What these deductions are, and how they bear on the whole theory of electricity, I may, perhaps, with your permission, proceed to show one of these days.

I may be asked why I have not tried the experiment, and I answer that I have not the time, nor, indeed, the practical electrical knowledge which would enable me to try the experiment in a way to satisfy myself that I was beyond all dispute right

London, January 11th. Φ. Π.

THE SOCIETY OF ARTS' PATENT BILL AND FREE PATENTS.

SIR,—The Society of Arts, trying its hand at a patent bill, and professedly thoroughly recognising that it is invention that is to be legislated for, would nevertheless perpetuate the gross blunder that has disfigured all preceding patent legislation—that of ignoring invention for inventor. Let it not be supposed from my having joined together "Free Patents" and the "Society of Arts" in the heading to this letter that the society contemplates any such unfashionable alliance. In the preamble to their bill they had unwittingly given countenance to such an idea; but the instant they realised this, a very strong measure was taken to at once crush out even the seeming of such a thing. At the outset of the late three nights' public discussion on the Society of Arts' Bill, Sir Frederick Bramwell, chairman of the committee, announced that the bill was the work of an influential committee, who had "assiduously for months" prepared it, had "amended" it after that, and "had had the assistance of one of the most experienced draftsmen." At the close of the discussion, Sir Frederick Bramwell announced that the preamble of this bill—that is, its very foundation—would, spite of all the above most elaborate scrutiny through which it had passed, "probably be abandoned."

How came this about? Had the committee unconsciously built over a chasm? Yes; they had. They had built over the chasm of Free Patents! Of course this remarkable step of abandoning a preamble was taken in deference to a consensus of disapprobation of it on the part of the speakers at the discussion? Not at all. Instead of disapproval it was highly commended, Admiral Selwyn considering it "one of the finest ever drawn." The first sentence of it runs thus:—"Whereas it is highly important, for the good of the arts, manufactures, and commerce of this realm, that new and meritorious inventions should receive all possible assistance and encouragement." Now the logical equivalent of this is that the grant of patents shall be free. The bill, however, makes the grant dependent on the payment of £12 10s.; and one of the speakers had used the following argument: "That the genus inventor comprised two species, A and B—A the well-to-do inventor, B the poor one. But the bill legislated for A only; that if such position was sound, it could be supported by arguments that appertained to A only; that no such arguments were forthcoming, but that to justify property in invention for species A the committee were obliged to rely on arguments that justified such property for the whole genus—for B as well as A; and that this position was illogical." Of course, to be illogical is to be both wrong and ridiculous; so the committee, taking alarm, and not being prepared to recognise the equality of all men before the law, ran away from their so deliberately chosen standing-ground, and would seek some other.

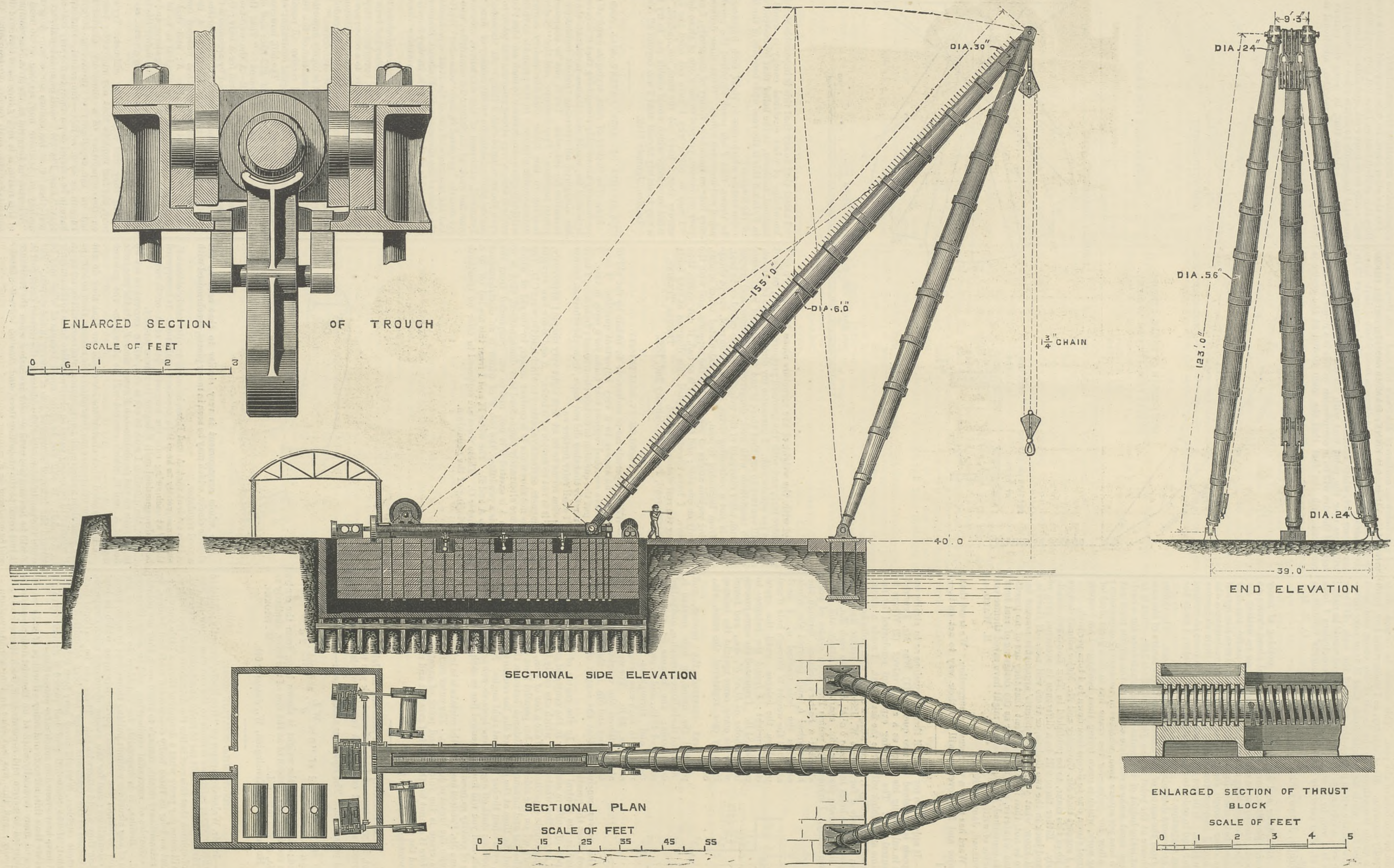
Will they find any? They will not. Try and hide it as they may, the fact remains that any and every patent law rests, but on the expediency of a monetary classification of inventors, but on the expediency of protecting invention. What will have to be done is this,—the actual structure of the Bill will have to be carried down right to the very bottom of the chasm, so that "Free Patents" shall be an integral part of the Bill, which will then in so far endure for ever. A preamble such as the Society of Arts are now seeking would read somehow thus:—"Whereas for the good of the Arts, Manufactures, and Commerce of this realm, it is highly important that inventions, however new and meritorious, shall receive no assistance and encouragement whatever until certified by £12 10s., a certificate without which an invention can be neither new nor meritorious." Such *raison d'être* for a Bill is, however, manifestly absurd. Therefore the grant of patents must be free.

HENRY W. LEY.

150-TONS SHEERS FOR THE RUSSIAN GOVERNMENT.

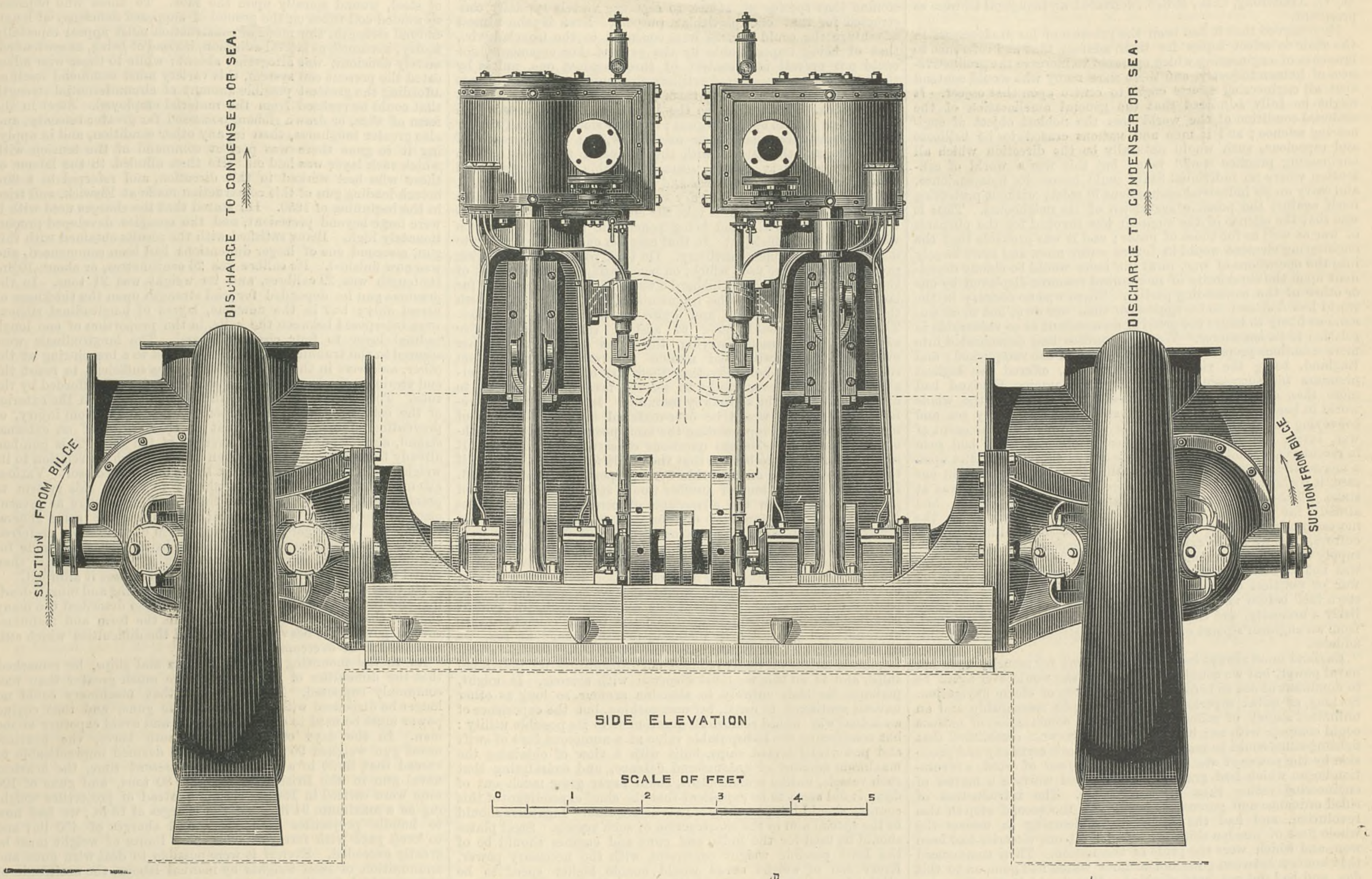
MESSRS. DAY, SUMMERS AND CO. SOUTHAMPTON, ENGINEERS.

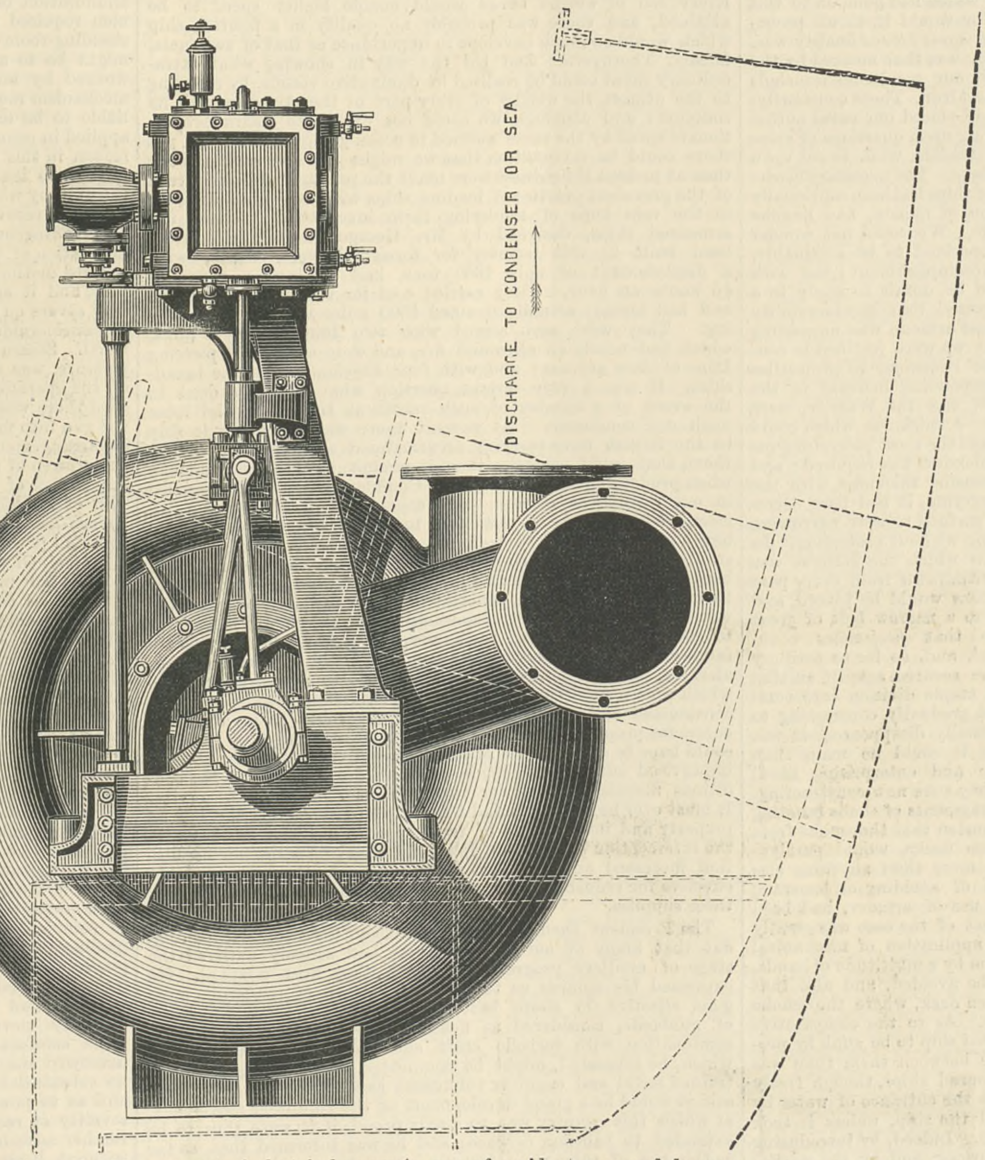
(*For description see page* 33.)



CENTRIFUGAL PUMPING ENGINES, S.S. SERVIA.

MESSRS. J. AND H. GWYNNE, HAMMERSMITH, ENGINEERS.





THE accompanying engravings illustrate very completely a set of what is known as 20in. "Invincible" pumping machinery, supplied by Messrs. J. and H. Gwynne, of Hammersmith, to the Great Atlantic liner Servia. The type of machinery made by Messrs. Gwynne is so well known, and our engravings are so clear, that little description is necessary. The engine frames are of cast iron supported by a wrought iron rod in front; the guide is of the slipper type; all the working parts are of steel, which will take a far higher polish than iron. The wearing surfaces are very large, the engines making easily 250 revolutions per minute. The whole system is double, and should one engine break down, the other will drive both pumps, or either engine and pump can be driven separately by disconnecting the shaft at the coupling box. The pumps can be used either to supply the condensers, or as bilge pumps, in which latter case they will easily lift 2000 tons of water per hour overboard, and are therefore competent to deal with a very considerable leak.

We need scarcely add that the workmanship of the machinery fully maintains the reputation of the firm.

THE EDISON LIGHT IN NEW YORK.

LAST week we commenced a series of illustrations to show the details of the installation of the Edison electric light system in New York, as well as that on a smaller scale in London. The illustrations previously given show the arrangements of engines and boilers, and the connections to the dynamo machines adapted to a 2000-horse power central station at 255 and 257, Pearl-street, New York, these two buildings having each a frontage of 25ft. and a depth of 100ft. The Porter-Allen engine is used. This week we give illustrations of the Edison dynamo machine, which will be followed in our next issue by a perspective view, &c., of the machine as *in situ* in Holborn. When we have finished our illustrations it will be found that the Edison system is most complete. The dynamo machine is designed for efficiency, the intention of the designer being to have a low resistance machine with lamps of a high resistance; and thus he hopes to solve the problem of incandescent electric lighting, so far as economy is concerned. The greatest care is taken before commencing the work to have everything ready, and to trust nothing to chance. In order to have a surplus amount of electrical power in case of accident, a second dynamo machine, now being tested in New York, is to be placed in the central station at Holborn. With our next issue the views of the dynamo electric machine will be so complete as to enable us to describe it with its various peculiarities, from the machine to the mains. Mr. Edison takes his current from the machine by large copper conductors, the large and small mains as well as the house connections being composed of this material. Ingenious devices have been provided to obviate danger arising from too great a current, acting in a manner similar to the fusible plugs used in steam boilers. In the box street connections, shown in the drawings, F C shows the fusible conductor, and C the copper conductor, the fusible conductor being so arranged as to melt, and thus break the circuit when the current passing is too large. Smaller fusible conductors are placed at branch streets, at the entrance into houses, and at each street lamp, so that accident from fire is to a great extent prevented.

CHESTERFIELD AND DERBYSHIRE INSTITUTE OF MINING, CIVIL, AND MECHANICAL ENGINEERS.—The next general meeting of the members of the Institute will be held in the town of Nottingham, on Saturday, the 14th instant, at 2.45 p.m., at the George Hotel. It has been found impracticable to print the proceedings of the October meeting *in extenso* in time for the present meeting, in consequence of the long and valuable contribution of the Coal Dust Experiments Committee preceding it. As much of these proceedings as relate to discussion on compressed air, which it is desired now to conclude, will, however, be printed and supplied by post to members before the coming meeting. The following papers will be open for discussion:—On compressed air, viz.: Mr. D. P. Morison's paper, "On the Application of Compressed Air to Coal Mines." (See Part I., vol. vii.) Mr. John Sturgeon's paper on "Compressing Air." (See Part III., vol. viii.) Mr. Joseph Timms' paper, entitled, "The Connection between Heat Expended and Work thereby Done; also the Use of Compressed Air as a Transmitter of Power Theoretically Considered." (See Part II., vol. ix.) Mr. C. T. Owen's paper, on "A Compensating Air Compressor." (See Part II., vol. x.) The following paper will be read:—"On the Application of Fleuss' Patent Noxious Gas Apparatus, and Foster and Fleuss, Patent Safety Mining Lamp, at Seaham Colliery," by the Secretary. Mr. H. A. Fleuss will be present to give any explanation that may be desired.

CANALS IN ENGLAND.—According to the *Economist*, the Wolverhampton Chamber of Commerce has adopted a resolution, which will be submitted to the February meeting of the Associated Chambers in London, recommending that all canals in Great Britain be entirely emancipated from the control of railway companies, as in other countries, and made as free as the highways, and the cheapest ways for conveying manufactured and agricultural goods to markets, instead of being, as they are now, obstructive tools in the hands of railway companies. This resolution points clearly to a desire on the part of its promoters for a purchase of the canals by the Government. Cheap conveyance is the life of trade, and we have every desire to see a greater use made of the canals of this country. We, however, should distinctly prefer to see this carried out by means of private enterprise, for which Parliament should grant every reasonable facility.

THE INSTITUTION OF CIVIL ENGINEERS.

THE DEFENCE OF GREAT BRITAIN.

At the ordinary meeting on Tuesday, the 10th of January, Sir W. G. Armstrong, C.B., F.R.S., delivered an inaugural address as president.

He observed that it had been the practice of his predecessors in the chair to select topics for their address that had reference to branches of engineering which operated to increase the productiveness of human industry, and there were many who would contend that all engineering efforts ought to centre upon that object. It might be fully admitted that the general amelioration of the material condition of the world was the noblest object of engineering science; and if men and nations ceased to be bellicose and rapacious, such would naturally be the direction which all engineering practice would take; but this was a world of contention where no individual State could insure its independence, and carry on its industrial occupations in safety without protecting itself against the possible aggression of its neighbours. Thus it was that the science of the engineer was invoked for the purposes of war as well as for those of peace; and it was probable that the engineering element would in future enter more and more largely into the operations of war, until the issue would be chiefly dependent upon the superiority of mechanical resource displayed by one or other of the contending parties. There was no country in the world less disposed to be aggressive than our own, but there was none so likely to incite the greed of an assailant or so vulnerable in relation to its commerce. War indemnities had degenerated into mere exactions proportioned to the wealth of the vanquished; and England, being the richest of all nations, offered the highest premium for successful attack. As to commerce, England had more than one-half of the ocean-carrying trade of the whole world in her hands, and her ships, swarming over every sea and conveying merchandise of enormous value, would, in the event of war, invite the depredations of hostile cruisers. We had seen in recent years what ravages a single armed ship could inflict upon a mercantile navy incomparably smaller than our own, and, in our case, it was not only property, but indispensable food that was at stake. The ever increasing population of Great Britain had already far outgrown its internal means of support, while the increasing cheapness of imported food so discouraged native agriculture, that we might expect our future dependence upon foreign supply to increase even more rapidly than our population. This was not the occasion to discuss either moral questions affecting war or political questions concerning free trade. We had the stern fact before us that national defence was in our case peculiarly a necessity, and the question how it could best be effected, from an engineer's point of view, was a legitimate subject for this address.

England must always be chiefly dependent for security upon her naval power, but we could not hope that she would ever again be so dominant at sea as before the introduction of steam navigation. So long as naval superiority depended upon seamanship and an unlimited supply of sailors, no nation or combination of nations could compete with us; but as soon as it became established that fighting-ships could be manœuvred with more certainty and precision by the power of steam than by the power of wind, a revolution began which had gradually made naval warfare a matter of engineering rather than of seamanship. The introduction of rifled ordnance and percussion shells was the second step in this revolution, and had the effect of condemning as useless the whole fleet of wooden ships with which all our victories had been won, and which were the pride of the nation. Then commenced that contest between guns and armour which had gone on to this day, and had not yet been decided. Nor would it, in all probability, ever be decided, seeing what an *ignis fatuus* finality was. The most recent stage of this revolution was that marked by the introduction of torpedoes, against which our ponderous ironclads were no more secure than ships of thinnest iron. These constantly-changing phases of attack and defence had placed our naval authorities under extreme difficulty in deciding upon questions of ships and armament. To stand still was impossible, while to act upon uncertain data was sure to lead to a mistake. The necessary consequence had been that types and patterns of ships had been continually changing, and vessels, costing vast sums of money, had become nearly obsolete almost as soon as made. We could not wonder that, so long as invulnerability was conceived to be attainable, great sacrifice should be made for its accomplishment; but with our present knowledge, which it would be unfair to apply to a criticism of the past, we might feel assured that invulnerability was a chimera. Not only did we see that armour was unavailing against torpedo attack and ramming, but we were justified in concluding that every attempt to increase resistance to projectiles would be quickly followed by a corresponding increase in the power of artillery. Our early ironclads, like the Warrior, were plated all over with armour 4½in. thick—a thickness which could now be pierced with field pieces. To resist the most powerful guns now afloat, armour of at least 2ft. in thickness was required; and in order to reconcile the constantly increasing thickness with the weight which the ship was capable of carrying, it had been necessary to restrict the area of armoured surface to ever narrowing limits, leaving a large portion of the ship without protection. In those magnificent and tremendous vessels which the Italians was now building, the armour would be withdrawn from every part except the battery, where guns of 100 tons would be placed, and where the armour would be confined to a narrow belt of great thickness. Everything of importance that projectiles could destroy would be kept below water-level, and, so far as artillery fire was concerned, the ships would be secured against sinking by means of an under-water deck and ample division into compartments. Armour, therefore, seemed gradually contracting to the vanishing point; but, until it actually disappeared, it was probable that no better application of it could be made than had been decided upon by the acute and enterprising naval authorities of Italy for the great ships they were now constructing. The dread of the terrible effects of the fragments of shells bursting amidst a crowded crew, and the apprehension that the smoke from the explosion, when it occurred between decks, would paralyse the service of the guns, had conduced more than anything else to the adoption of armour. Methods of avoiding or lessening these dangers, otherwise than by the use of armour, had been little considered; yet the alarming aspect of the case was greatly altered when we reflected that, by the application of mechanical power, to do what had hitherto been done by a multitude of hands, the exposure of a crowded crew could be avoided, and also that the guns might all be mounted on an open deck, where the smoke from shells would speedily clear away. As to the comparative liability of an ironclad and an unarmoured ship to be sunk by projectiles, there was much less difference between them than was generally supposed; because the unarmoured ships, though freely penetrable, might be so constructed that the entrance of water by perforation would not extensively flood the ship, unless it took place at a great number of critical places. Indeed, by introducing an under-water deck, with divisional spaces, and by the partial application of cork, as in the Inflexible, for displacing influent water, and thereby preserving stability, and also by a proper distribution of coal for the same purpose, an unarmoured ship might be rendered almost incapable of being sunk; and it was rather surprising that so little attention had been directed to the attainment of that object. It was not too much to say that for the cost of one ironclad we could have three unarmoured ships of far higher speed, and carrying collectively three armaments, each equal to that of the armoured vessel. It might be asked, which would be the better investment? If it were imagined that the three were matched in combat against the one, it would be perceived that, in addition to their numerical superiority, the former would possess many advantages. Being smaller, they would be more difficult to hit. Being swifter, they could choose their positions, and be free to attack or retreat at pleasure. Being more nimble in turning, they would be better adapted both for ramming and for evading the ram of their adversary. Finally, the conditions of superior speed and agility would favour their use of torpedoes and submarine projectiles; although it was a question whether, for the sake of a much needed simplification, it would not be better to confine that species of attack to separate vessels specially constructed for that one particular purpose. Even if the utmost advantage she could possess were conceded to the ironclad, viz., that of being impenetrable by the guns of her opponents, she could not prevail in a contest of three against one, unless by the use of securely-protected artillery she could keep her assailants at bay, and gradually destroy them by her fire if they persisted in their attack. Such might be the issue if the allied vessels had nothing but guns to oppose to guns; but they would naturally under such circumstances place their men below, out of the reach of projectiles, and then attack with their rams or torpedoes. With the crews in safety, it was scarcely possible that unarmoured vessels, with under-water decks and all their machinery beneath, should suffer any disabling injury by being pierced in a few places by either shot or shell. But take the much more probable alternative of the armoured vessel being penetrable by the guns which would be used against her. In that case her enemies might elect to make the contest one of artillery. On their part, armour-piercing projectiles would be used which, on penetrating the thick sides of the ironclad, would carry inboard a mass of broken material far larger in quantity than the fragments of the shells with which they would be assailed, and quite as destructive in effect. The ironclad would have to sustain the converging fire of three ships, each carrying the same armament as her own, and her swift and nimble adversaries would steam round and round her, directing their fire on the most vulnerable points, and ever ready to seize a favourable moment to dash in and finish the contest by ramming. In either case, therefore, the ironclad would be over-matched by a combination of unarmoured vessels representing the same pecuniary value. Without entering into technical questions concerning fleet-fighting, it seemed reasonable to believe that the result would be the same if the number engaged on each side were proportionately multiplied. Inferiority of speed and of number would still give the choice of position, and secure the advantage of converging fire, besides which the greater power of division and of concentration must always belong to the more numerous fleet. But if ironclads were not needed for the purpose of opposing ironclads, it was difficult to see for what purpose they were wanted at all. For every other kind of service, a numerous fleet of smaller and swifter vessels, unencumbered with armour, would clearly be preferable. To protect our commerce, to guard our extensive seaboard against invading flotillas, to lend naval assistance to our colonies in case of need, and generally to maintain our supremacy at sea, we required a far more numerous navy than we possessed or could afford to possess unless we vastly reduced our expenditure on individual ships, and to do this we must dispense with armour. It might, perhaps, be rash entirely to abandon armour so long as other nations continued to use it, because nothing, but the experience of an actual war would remove all question as to its possible utility; but considering the indisputable value of a numerous fleet of swift and powerfully-armed ships, built with a view of obtaining the maximum amount of unarmoured defence, and considering that such vessels, unlike armour-clads, could never grow much out of date, it did seem to be expedient that the chief expenditure of this country should be upon ships of that description. Lightness should be the special aim in the construction of such vessels. Steel plates should be used for the hulls, and guns and engines should be of the least possible weight consistent with the necessary power. Every ton of weight saved would enable higher speed to be attained, and there was probably no quality in a fighting ship which would so much develope in importance as that of swiftness. Messrs. Thornycroft had led the way in showing what extraordinary speed could be realised in diminutive vessels, by reducing to the utmost the weight of every part of the structure and its contents; and although we could not expect to attain proportionate speed by the same method in ocean-going ships of war, yet there could be no question that we might have far swifter ships than at present if lightness were made the principal object, instead of the prevalent practice of loading ships with cumbrous armour, in the vain hope of rendering them invulnerable. Light unarmoured ships, designed by Mr. George Rendel, had lately been built in this country for foreign Powers, which, with a displacement of only 1300 tons, had attained a speed of 16 knots an hour. They carried coal for steaming 4000 miles, and had already actually steamed 3500 miles without replenishing. They were each armed with two 10in. new-type guns, which had nearly an all-round fire, and were capable of piercing 18in. of iron armour; and with four 40-pounders on the broadsides. It was a very serious question what could be done in the event of a number of such vessels as those being let loose upon our commerce. At present there was not a single ship in the British navy carrying an armament competent to engage them, that could overtake them in pursuit, or evade their attack when prudence dictated a retreat. Confidence was often expressed in our mercantile marine being capable of furnishing on an emergency a supply of vessels fit to be converted into cruisers; but where were there to be found amongst trading or passenger steamers, vessels possessing a speed of 16 knots, with engines and boilers below water-level, and having an under-water deck to save them from sinking when penetrated by projectiles at or below the water-line? From his own experience he knew how difficult it was to adapt mercantile vessels to the purposes of war, and how unsatisfactory they were when the best had been made of them. It was alarming to think how unprepared we were to repress the ravages which even a small number of swift marauding vessels, properly constructed and armed for their purpose, could inflict upon the enormous property we had at all times afloat, and how little we could hope to clear the sea of such destructive enemies, by cruisers improvised out of ready-made steamers destitute of all the conditions necessary to render them efficient for such a service. It must ever be borne in mind that it was not merely the loss of property and interruption of trade that we had to fear, but also the interception of food supplies; and that the more our population increased and our agriculture declined, the more terribly effective for reducing us to submission would be the stoppage of those supplies.

The President then adverted to harbour defence. He pointed out that many of our ironclad forts had already outlived the stage of artillery progress for which they were adapted. He expressed his opinion as to the best method of rendering large guns effective in shore batteries. He dwelt upon the value of gunboats, considered as floating gun-carriages, and used in combination with torpedo craft and submarine mines; all of which, he suggested, might be committed to the management of trained naval and engineer volunteers resident on the spot. He said it would be a grand development of the volunteer movement, of which this country was so justly proud, if it were thus to be extended to harbour defence; and he was informed that, so far as the use of submerged torpedoes was concerned, a project of intrusting their employment to a corps of volunteer engineers was already under consideration. The superior education and intelligence of the class from which our volunteers were mostly supplied would especially fit them for the discharge of duties involving skill and discretion, such as would be required in the handling of electrical apparatus, and we might be sure that, wherever dash was needed in the use of torpedo boats, there would be no lack of that quality amongst volunteers in the hour of trial.

On the subject of artillery, he described the progress of gun manufacture since the introduction of rifled ordnance, prior to which a gun was simply a tube of cast iron or bronze closed at one end. He also discussed the question, what, under the present condition and prospects of steel manufacture, should be our practice as to the use of that material for artillery purposes. He was then led to speak of a system of construction which had not passed through the experimental stage, but which, from the results it had already given, promised to attain a wide application. He referred to that system in which the coils surrounding the central tube consisted of steel wire, or ribbons of steel, wound spirally upon the tube. To those who objected to welded coil tubes on the ground of supposed deficiency of longitudinal strength, this mode of construction must appear especially faulty, inasmuch as lateral adhesion, instead of being, as contended, merely deficient, was altogether absent; while to those who advocated the present coil system, this variety must commend itself as affording the greatest possible amount of circumferential strength that could be realised from the material employed. Steel in the form of wire, or drawn ribbon, possessed far greater tenacity, and also greater toughness, than in any other condition, and in applying it to guns there was perfect command of the tension with which each layer was laid on. He then alluded to the labour of those who had worked in this direction, and referred to a 6in. breech-loading gun of this construction made at Elswick, and tried in the beginning of 1880. He stated that the charges used with it were large beyond precedent, and the energies developed proportionately high. Being satisfied with the results obtained with this gun, a second one of larger dimensions had been commenced, and was now finished. Its calibre was 26 centimetres, or about 10¼in. Its length was 29 calibres, and its weight was 21 tons. In the previous gun he depended for end strength upon the thickness of barrel only; but in the new one, layers of longitudinal ribbons were interposed between the coils, in the proportion of one longitudinal layer to four circular layers. The longitudinals were secured to the trunnion ring at one end and to a breech-ring at the other, and were in themselves calculated as sufficient to resist the end strain on the breech, independently of strength afforded by the tube. The whole was encased in hoops shrunk upon the exterior of the coil, for the treble purpose of protection from injury, of preventing slipping in the event of the failure of an external strand, and of adding to the strength of the gun. This gun had already been tried, and had given results which, in relation to its weight, were unexampled except by its 6in. predecessor. Various attempts had also been made abroad to reduce this system to practice, and it was understood that the French were at present engaged in making experimental guns upon the same general principle. With regard to the ribbon form of section, he preferred it to a square section of equal area, as being more favourable for bending over a cylinder, but any rectangular form was better than round wire, on account of the flat bedding surfaces it afforded.

He then discussed the subject of breech-loading and muzzle-loading, and the various forms of rifling. He also described the many changes that had been found necessary in the form and manufacture of powder for heavy ordnance, and the difficulties which still remained to be overcome.

As to the mounting of guns in forts and ships, he remarked that the difficulties of the problem were much greater than was commonly supposed. It was certain that machinery could no longer be dispensed with for working the guns, and that engine power must be used to economise labour and avoid exposure of the men. In the days of cast iron smooth bores, the heaviest naval gun weighed 95 cwt., and it was deemed impracticable to exceed that limit in a ship. At the present time, the heaviest naval gun in the British service was 80 tons, and guns of 100 tons were carried in Italian ships. Instead of projectiles weighing as a maximum 94 lb., and the charges of 16 lb., we had now to handle projectiles of 1500 lb. and charges of 450 lb.; and to keep pace with foreign navies those limits of weight must be greatly exceeded. Even if it were possible to deal with guns and ammunition of such weights by manual labour, the multitude of men required for the purpose would be greater than could find standing-room at the guns. Up to a certain point hand-power might be so aided by machinery as to enable larger guns to be worked by men than was formerly deemed possible; but the mechanism required to render hand-labour available was quite as liable to be disabled by an enemy's fire as that which would be applied in connection with engine-power. There was therefore no reason in this respect for employing a numerous gun-crew in preference to inanimate power. Automatic methods of running out the gun, by which the gun was lifted in recoiling by slides or radius bars, and recovered its position by gravitation, might in many cases be advantageously used to save labour, but in a ship the varying inclination of the deck interfered with uniformity of action. The upward motion of the gun also involved the objection of a higher port, and it added greatly to the downward shock, which became very severe on the deck where the guns were large and were fired at considerable elevation with such heavy charges as were now usual. Steam power, acting through the medium of hydraulic pressure, was already largely applied in recent ships for effecting all the operations of working the guns, and where such power was used there was nothing to gain by automatic action for returning the gun into firing position. In considering these various mechanical arrangements now applicable to naval warfare, we perceived the growth of the engineering element in our ships of war, and the importance of mechanical, as well as nautical, acquirements on the part of the officers, as also, in a less degree, on that of the men. Breech-loading guns, carriages fitted with all modern appliances, shot and powder lifts, mechanical rammers, and torpedo apparatus, all combined with steam or hydraulic machinery, or with both, constituted mechanisms requiring to be supervised by officers qualified as engineers, and to be handled by men trained in the use of machinery. Before drawing to a conclusion he would advert to a subject of grave national importance. Our navy was at present armed with guns which could not be expected to contend successfully with the best modern guns that could be used against them. Happily, most of the older ships of foreign Powers were in the same predicament; but all their new vessels, and some of their older ones, were being armed with artillery which, weight for weight, was far superior in power to that of our Navy. Our service guns had simply been overtaken in that rapid progress of artillery which had been going on for the last eight or ten years; and it might be doubted whether any partial remodelling during that period would have averted the present need of re-armament; while it would certainly have involved great sacrifice and confusion of ammunition and stores. But a new departure could not longer be delayed. An irresistible demand has arisen for breech-loading guns, and it was imperative to combine, with the introduction of that system, such other modifications of construction as would realise the increase of power which we now knew to be attainable. It might, however, be asked, What better prospect of finality there was now than we had ten years ago? As to absolute finality, it would probably never be reached, but the country might take some comfort in the reflection that every stage of progress narrowed the field for further development. There was already no substantial room for improvement in the accuracy of guns; and as to power, we were nearly approaching the limit at which severity of recoil and extravagant length of gun would prohibit further advance. We might go on building larger guns almost without limit, though he doubted the policy of so doing, but mere increase of size did not revolutionise system. There seemed, therefore, to be more hope of permanency now than at any former period; but whether this were so or not, we could not, with danger, remain passive.

What, then, should our Government do in regard to the great work of re-arming the fleet? He took it for granted that all new ships would be armed with the best guns that could be now made, and that the more important of the older vessels would speedily receive the same advantage; but beyond this, so long as experience of novelties was deficient, it was a case for cautious procedure. In the meantime, no expense should be spared in judicious experiments, seeing that the expense of experiments was trifling in comparison with that of mistakes. Above all, the Government should pursue such a course as would bring into full play the abundant engineering resources of this highly mechanical country for increasing the efficacy of our national defences.

RAILWAY MATTERS.

A VERY clear map of the railways of Mexico, showing those completed, in construction, and proposed, has just been published by Mr. W. Abbott, of Tokenhouse-yard. A new line is proposed in the southern part of Mexico, namely, from Tlaxcala to Manzanilla on the Pacific.

THE traffic on the elevated steam street railways of New York city for the month of October was the heaviest yet recorded, aggregating 7,121,961 passengers, as against 5,881,474 for the corresponding month of 1880, an increase of 1,240,487, representing just about the entire population of the city.

ON the 29th inst. the servants and officers of the Colne Valley Railway Company met at Haverhill, for the purpose of making a presentation to Mr. A. G. Fenn, C.E., Assoc. M.I.C.E., who is about to leave the service of the company. The *East Anglian Daily News* says:—"Mr. Fenn has occupied the responsible position of locomotive and permanent way engineer for thirteen years, and during that time he has earned for himself the goodwill of the public at large, and the respect and esteem of the whole of the servants and officers of the company." The present consisted of a handsome massive timepiece bearing a suitable inscription.

ALONG the Clyde the high tides following the gales at the end of last week caused considerable damage. The half-past two train from Helensburgh was stopped before reaching Bowling, the line being several feet under water, and on examination it was found that a breakwater near Douglas Castle was washed away, and had carried rails, sleepers, and embankment with it. No communication can yet be held with the west coast by train beyond Bowling. At this place the piers were covered during the height of the gale. The lighthouse at the end of the east pier was completely destroyed, as well as a wooden house in the neighbourhood.

OUR Birmingham correspondent writes:—"The usual difference of opinion amongst the local residents upon the introduction of steam tramcars is noticeable in the Potteries. A memorial from fifty-eight gentlemen has recently been forwarded to the Board of Trade, praying for the prohibition of steam power on the Hanley and Stoke line; but at a special meeting of the Hanley Town Council on Tuesday, resolutions were passed denying the statements made in the memorial as to the dangers arising from steam and approving of steam power being used, with a limitation of time, in the first instance, to three years. It was stated that another memorial in favour of steam traction has been signed by about 230 Hanley people, and was about to be forwarded to the Board of Trade. After the meeting of the Hanley Coporation there was a public meeting at Newcastle-under-Lyme, at which approval was given to the proposed extension of the system from Hanley to that town."

COLONEL YOLLAND'S report to the Board of Trade has been published, but it adds very little to what has already been said in our columns, or to the careful verdict of the coroner's jury which we publish below. He attributes the collision to the unauthorised mode of working the four passenger trains introduced by the signalman Hovey. He says:—"This man made a great mistake. I do not think that when a signalman does not on the instant make out what a signal is intended to convey, he is at once justified, and without waiting to read carefully the instructions placed in his signal-box for his guidance, in introducing a mode of working which is not specified in those instructions, merely because he has used them elsewhere, under different circumstances, where that kind of working is sanctioned. Signalman Hill need not have sent either six or seven beats, as the ordinary needles or indicators on the telegraphic instruments should have been sufficient to show Hovey that the line was not clear, and that trains should not have been sent on, but it was virtually only adopting an additional precaution to make the line safe, which, however, would have been better carried out by six rather than by seven beats. I recommend that seven beats, 'permissive block,' be struck out of the North London Instructions. Permissive block working should not be allowed on any lines where the traffic is heavy, and with very short intervals of time between the trains."

THROUGHOUT nearly the whole of the railway system worked by the Lancashire and Yorkshire Company important extensions and improvements are at present either in progress or in contemplation with the view of providing increased facilities for the company's steadily growing traffic in the above districts. These include the widening and extension of lines, the improvement, enlargement, and in some cases re-erection of stations, and work of this description is either already in progress or in preparation at Manchester, Salford, Liverpool, Bolton, Blackburn, Chorley, Accrington, Lower Darwen, Hellifield, Blackpool, Southport, Fleetwood, Bradford, Halifax, Dewsbury, Rochdale, Wakefield, Goole, Bromley Cross, Smithy Bridge, Daisy Field, Walsden, Maghull, and other places. Of the more important work which is being undertaken may be mentioned that at Manchester an extensive enlargement of the Victoria Station has just been commenced upon the site of the old workhouse, which was a short time back purchased for this purpose by the company, whilst the whole of the line between Manchester and Bolton is being widened. At Liverpool important alterations are being carried out both at the Tithebarn-street station and at the North Docks, where a number of the sidings are being covered in to protect the goods in cartage from the weather. At Bradford the company are at present engaged carrying Croft-street over their line preparatory to a further extension which will embrace the erection of an entirely new goods depôt on the western side of the line, a reconstruction and enlargement of the present passenger station, and a widening of the line extending to the junction with the Great Northern at Mill-lane. This widening of the line will extend about two miles out of Bradford, and will accommodate six additional lines of way, so as to enable the Lancashire and Yorkshire and the Great Northern traffic to be worked separately on opposite sides of the station.

THE adjourned inquest on those killed in the Canonbury accident concluded on the 4th inst. After an absence of about forty minutes, the foreman of the jury handed in the following verdict:—"That on the 10th day of December, William West, Edward W. Saunders, Joshua H. Newman, Alexander Vicary, and Gerrit Ament were found dead from the mortal effects of injuries received by the collision of four trains belonging to the North London Railway Company in the tunnel on the Great Northern Company's line, between Finsbury Park and Canonbury Stations. And the jurors further say that they are of opinion that the said collisions were the direct result of the unauthorised mode of working the four passenger trains introduced by the signalman, Henry Hovey, and that in so doing he committed a grave error of judgment, although the signal seven beats given him by signalman Henry Hill was superfluous for the occasion. At the same time, they also consider that the introduction of the words 'permissive block" in connection with the obstruction signal seven beats is calculated to deceive and leave a false impression upon the mind of a signalman not perfectly instructed and not always employed in working an absolute block system. The jury further consider that the words 'permissive block' should be at once expunged from the North London Company's code of instructions 'for working the block telegraph and outdoor signals.' With regard to the outdoor signals, they would suggest that by an extended use of the interlocking system with the electrical, greater precision, with certainty of action, would be obtained. With regard to the position of the up distant signal, worked from Canonbury Junction, the jury are of opinion that it was against the drivers of the four trains in question; and they recommend that the repeater for the Canonbury Junction 'up home' signal be placed on the ground at 286 yards from the north end of the tunnel, so that it can be seen by drivers on entering the tunnel. The jury further suggest that a less complicated code of instructions should be arranged, and, if possible, a uniform code established. The jury desire the coroner to forward a copy of this verdict, together with a copy of the said code of instructions, to the Board of Trade."

NOTES AND MEMORANDA.

ACCORDING to Mr. G. M. Whipple, F.M.S., Superintendent of the Kew Observatory, the amount of sky covered varies inversely as the barometric pressure, between the limits of 29·0in. and 30·3in., the variation being most rapid between 29·8in. and 30·1in. And above 30·3in. cloud increases with increasing pressure, attaining the mean at about 30·5in., and rising above it at 30·6in.

To prevent the cracking of cast steel in hardening, a correspondent of the *Metall Arbeiter* says he places the article before hardening it in a tin box, packing it with clean wrought iron drillings, and, luting the box carefully, heats the whole slowly to a dark red. After cooling it as gradually, he finds that all internal strains, which otherwise would have developed cracks in the tool during hardening, are removed, and that after such annealing before hardening, no trouble, he says, is ever experienced; but he does not say anything as to the effect of the process on the steel.

A RECENT number of the *Comptes Rendus* contains a paper on the diffusion of solids in solids, by M. Colson. When, in a reducing atmosphere, an iron plate is heated in lampblack, not only does carbon pass into the iron, changing it successively into steel and cast iron, but notable quantities of iron are diffused in the carbon. This will occur at a temperature below red. At a low temperature the iron is more easily diffused in the carbon; at a high, the reverse is the case. Nothing of the kind occurs with platinum. For two solids to diffuse into each other, there must be affinity, or more generally, they must react on each other. M. Colson illustrates this, and he describes an experiment establishing the law of diffusion.

A COMPANY has been formed in Philadelphia to manufacture glucose from cassava, the source of tapioca. As at present manufactured from corn, the average yield of corn being taken at 35 bushels to the acre, the glucose product is about 1000 lb. to the acre. The yield from cassava is reckoned, the *Scientific American* says, to be fully twenty times as great. The company's expectations will doubtless bear considerable paring down. They say that well-authenticated evidence is at hand to the effect that 20 tons of cassava to the acre is no unusual crop in Florida. This, at 56 lb. to the bushel, would give a yield of over 700 bushels per acre, or, at the rate of 30 lb. of glucose per bushel, would produce over 21,000 lb. of glucose per acre. A comparison of the yield of glucose from corn and cassava shows that 1000 acres of corn yields about 500 tons of glucose; 1000 acres of cassava yields about 10,000 tons of glucose.

FROM a note on a discussion of Mr. Eaton's table of barometric height at London, with regard to periodicity, by Mr. G. M. Whipple, Superintendent of the Kew Observatory, it appears that the author submitted them to the same method of reduction that he used when determining the non-periodicity of rainfall, as described in the "Proceedings" of the Royal Society last year. He computed the means for each year in terms of years varying in length from 5 to 13, together with the variation of these means from the mean of the whole period discussed—100 years. The results are given in a table From this the years of maximum and minimum pressure were determined for each series; for example, in the five year series, those years represented by $(1775+5n)$ would be maximum years, and those by $(1776+5n)$ years of minimum. Next the average variation of each year's reading from the mean of the century was found to be ·034in., and accordingly values of 29·952in. ± ·034in. were taken as limiting values. All years found to exceed these limits were then marked; those above 29·986in. as years of maximum, and those below 29·918in. as minimum years. An enumeration being made of the numbers of these maxima and minima falling in the years marked as above as the extremes in each series, the ratios were determined of the proportion between the number of cases where the observed maxima or minima coincided with the computed maxima and minima, or failed to do so. In all cases it was found that the non-coincidences far exceeded the coincidences in number, so proving conclusively that at London no periodicity of an integral number of years in duration between 5 and 13 exists in the average annual height of the barometer.

AT the Kew Observatory it has been found that the range of the barometer varies considerably in different seasons, and that the relative frequency of the readings at given heights varies from time to time. The barometer range is much greater in the winter months than in the summer, and there is a less preponderance of readings at any one pressure. The extent of range covered by the daily means has varied during ten years from 2·1in., viz., from 28·5in. to 30·6in. in January, to 1·0in.—29·4in. to 30·4in.—in June. As might have been expected, the greatest frequency is at 30·0in., at which point 13·7 per cent. of the readings take place. Exceptions to this occur, however, in the months of July, August, and September, when the readings at 29·9in. are the more numerous, and also in April and May, when the percentage stands highest for 30·1in. For any given month the actual maximum percentage of readings at one point is 23·9 in July, at 29·9in.; in the other months the highest numbers are as follows:—August, 21·8, and September, 17·4, also at 29·9in. Then follow June, 19·7, February and March with 13·1, November, 12·8, and January, 12·7, all at 30·0in. May and April have 15·4 and 13·7 respectively at 30·1in. In October 12·1 occurs at both 29·7in. and 30·0in., while in December the maximum is 9·8 at 29·8in., the last month being, therefore, the one in which there is the greatest barometrical movement. The most noteworthy of these exceptions are in the case of 28·3in., which was registered for five hours in December, 1876, and of 28·4in., which was twice noted in March of the same year. The highest percentage of hourly frequency for separate months is 20·3, given by 29·9in. in July. In different seasons, we get 20·4 for the same point in the third season, for the summer half-year the maximum frequency is 15·3, and it becomes 11·6 in the winter half. Finally, taking all observations discussed, 13·4 per cent. of them, or, roughly speaking, one in every eight, is a reading between 29·90in. and 30·00in.

M. LISTON has made a series of observations on the temperature of water and on the conditions of freezing and thawing of a salted lake, Kupalnoye Ozero, in the province of Orenberg. This Lake Cupalnoye has a surface of 473 square metres and a depth of 1·42 metres, and its water contains 16 per cent. of salt, its bottom being covered with mud very rich in sulphide of hydrogen. The temperature of the air having been, during the month of January, 1879, from – 6·3 deg. to – 28·2 deg. Celsius, with one interruption, when the thermometer reached for one day 0·2 deg.; the temperature of the water at the surface was from – 3·4 deg. to – 13 0 deg., and at the bottom from – 3·8 deg. to – 12·8 deg. On December 27th, with a temperature of air as low as – 21 deg., the lake was covered with viscous ice, which soon began, however, to thaw when the temperature of the air rose to – 6 deg., and the temperature of the water was as low as – 7·8 deg. On January 3rd all ice had disappeared, but the temperature of the water was still 7·2 deg. below the freezing point. On January 11th the temperature of the air being – 22 deg., and that of water being – 9·8 deg. at the surface and – 5·6 deg. at the bottom, the lake began again to be covered with viscous ice, and soon froze, the ice having a thickness of 38 millimetres, which thickness reached 153 millimetres ten days later. But the remainder of the water was still unfrozen, notwithstanding that its temperature regularly decreased to – 10 deg. on January 17th, and even – 12·8 deg. on January 30th. It was never observed before, M. Woeikoff—by whom a paper on the subject has been presented to the *Archives des Sciences Physiques*—says that in laboratories salt water was cooled below – 4 deg., without being frozen, and here we have salt water which remains unfrozen at 13 deg. below zero. However, former experiments, especially those of M. Zöppritz, proved that there is no diffusion of salt before congelation; it seems that in Lake Kupalnoye there is such a diffusion of salt towards the lower strata of water, even before the freezing begins; otherwise it would be difficult to explain how colder water might remain on the surface, were it not for the greater amount of salt in the lower strata.

MISCELLANEA.

MESSRS. VAUGHAN AND SONS, the makers of the self-acting water ejector, of which 12,000 have been made, and other apparatus, notify their removal to the Royal Ironworks, West Gorton, Manchester.

A SHEET of "Useful Information for Users of Belting" has been published by J. Moxon, of 29, Scotland-street, Sheffield. Mr. Moxon is the maker of belts, and a well made belt-stretcher for pulling the ends of belts together for lacing or other fastening.

THE Liverpool Watch Committee last week received a letter from the British Electric Light Company withdrawing from the contract to supply Liverpool with the electric light, unless the time for doing so were extended to a year. This the committee declined to grant. It is said that the company has lost £15,000 by the experiment.

THE proposal to make an island of Devonshire and Cornwall and part of Somerset by constructing a ship canal connecting the Bristol Channel, at Bridgewater, with the English Channel near Exmouth, is being brought forward by Mr. F. A. Owen. It would lessen the water carriage distance between Cardiff and London, or the northern parts of France and the Baltic, by about 240 miles.

MESSRS. OSLER glass manufacturers, have just completed a remarkable decoration for the table of the King of Siam, consisting of a large sheet of glass 56ft. long, silvered after the fashion of the day so as to look like a crystal lake, and so arranged that it can be bordered with growing flowers, or, if preferred, with cut blossoms. It is ornamented with temples, fountains, candelabra, fern baskets in glass, and, of course, dessert dishes, and at intervals are the Royal Arms exquisitely engraved on *plaques* of the same material.

THE Meteorological Society has determined upon holding an Exhibition of Anemometers at the Institution of Civil Engineers, 25, Great George-street, on the evening of March 15th next. The committee are anxious to obtain as large a collection as possible of various patterns of anemometers, either full size, models, photographs, or drawings. Special interest will attach to all apparatus bearing upon the history of anemometers and to their modification and improvement. Those having anemometers illustrating the improvements in these instruments are invited to exhibit them in the collection.

AT the West Riding Court-house, Pontefract, Charles Rowbotham, Doncaster, was charged, on the 4th inst., under the Highway and Locomotive (Amendment) Act, 1878, with having allowed a traction engine to remain motionless for more than twenty minutes on the Pontefract and Doncaster road on the 23rd December. For the defence it was stated that the engine broke down on the road, and it was left for the necessary repairs. Lights were attached at each end. The Bench remarked: "If defendant argeed to pay costs, £1 8s. 8d., the case would be dismissed." The defendant maintained that he had complied with the law; and his solicitor, who said it was evidently pure accident, was instructed to appeal. The Bench, however, in a meaning manner asked: "Will you pay the costs?" The proprietor very reluctantly agreed to pay.

A NEW form of window is being introduced by the Imperial Window Company, 18, Great George-street, Westminster. The main object of the invention is the prevention of accidents in cleaning, but the arrangement affords an efficient means of ventilation. The principle consists in dividing the two side bars of each of a pair of ordinary sash-frames into two parts vertically, and swivelling the part carrying the glass in the side pieces at a point central to its height. The frame with the glass is held in position by a couple of small bolts in the top rail, which shoot into the side strips. Thus arranged, the two sashes slide up and down in the ordinary way. At a very moderate cost existing frames can be fitted with it. The pivotting obviates the necessity of the cleaner getting outside the window.

A TABLE containing the times of high-water at London Bridge and the depths on the sill of the Shadwell lower entrance of the London Docks, and showing the possible overflow of the Thames in 1882, has been published by Mr. E. Roberts, of 3, Verulam-buildings, Gray's-inn, who designed the new tide predictor and calculator. In the table the tides which exceed the limit of safety—determined from past experience—and which under certain conditions of wind, &c., may develope into "overflow" tides, are printed conspicuously in red to indicate danger. The causes which may augment them are also printed in red. Thus every information that can be given beforehand is stated; and if ordinary precautions are taken, and the meteorological conditions at the time watched, the tide-table may be the means of preventing loss and damage to property.

WE have several times recently, says the *North-Western Miller*, in conversation with owners of small mills, had occasion to discuss the need of a small gradual reduction mill, and from what we have heard we do not doubt that four out of five of the small mills in the West and North-west, and also a good many in the East, are ripe for a change. The mill furnisher who first puts on the market a small and compact gradual reduction mill will have a veritable gold mine. Already we have met with several inventors who have given the subject considerable study, and we think the time is not far distant when a good start will be made in this direction. We know of one firm which has made a speciality of remodelling small mills on a modified gradual reduction system, and with such good results that they are crowded with orders, and have more jobs on hand than they can well attend to."

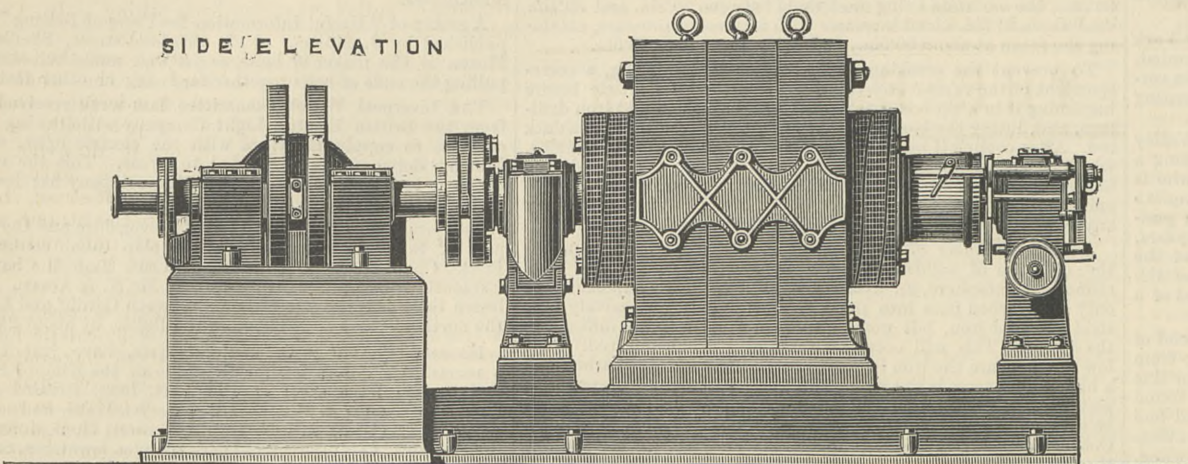
THE embers of the London Bridge question have received a gentle touch in a faint breeze, which may, however, grow into a good blow. At the last meeting of the Metropolitan Board of Works a letter was received from Mr. C. R. Rivington, Clerk of Aldgate Ward, stating that the Wardmote consider that it is more necessary than ever that a bridge should be erected across the Thames east of London Bridge. The matter was referred to the Works Committee. This question has probably now been sufficiently dealt with on paper. It is time that something was done towards construction, and it is probable that the low level bridge with northern approaches at Tower-hill will ultimately be selected as best in construction and site, as here the northern river frontage which would be shut off between London Bridge and the new one would be chiefly the old Billingsgate Market and the Custom House, and vested interests to be interfered with would thus be small. An opening bridge would then need to be seldom opened.

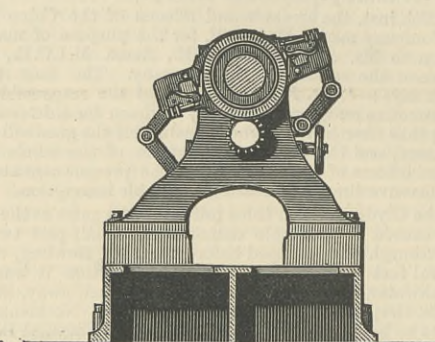
WE have heard of dredger pumps which have brought up cable links, dredger bucket pins, flogging hammers, and other such solid food of very slow flow, but the following letter received by Messrs. John and Henry Gwynne, from Messrs. Decker and Mot, of Paris, relating to French Government trials, of their "Invincible" direct-acting pumps, is perhaps equally corroborative of the omnivorous character of some of these modern tools:—"You will be pleased to learn that another trial was made at the request of the Government engineer, in charge of the works of the harbour at Bordeaux. Two barges full of mud dug out from the river were brought alongside the shore and connected with your No. 12 pump. The density of the first lot was 1200 kilos. per cubic metre, say 500 kilos. solid, 700 kilos. liquid, which was easily pumped out by us; whereas the pump of Commander Erling—our sole competitor—could not do so without the aid of a jet of water to dilute the mud. The density of the second lot was 1600 to 1700 kilos. per cubic metre, half solid, half liquid; it was also pumped out with only two stoppages, the first one caused by an empty tin can and an accumulation of solid mud was overcome by an effort, and the pump produced a jet like that of a brick machine. The other obstruction could not be so easily overcome. The pump was opened, and from the interior our engineer removed a conglomerated coal-brick, $10\frac{1}{4}$in. by $6\frac{1}{2}$in. by $5\frac{1}{2}$in., of about 8 kilos. weight. Of course the admiration of the bystanders was emphatically expressed."

THE EDISON ELECTRIC LIGHT IN NEW YORK.

(*For description see page 25.*)

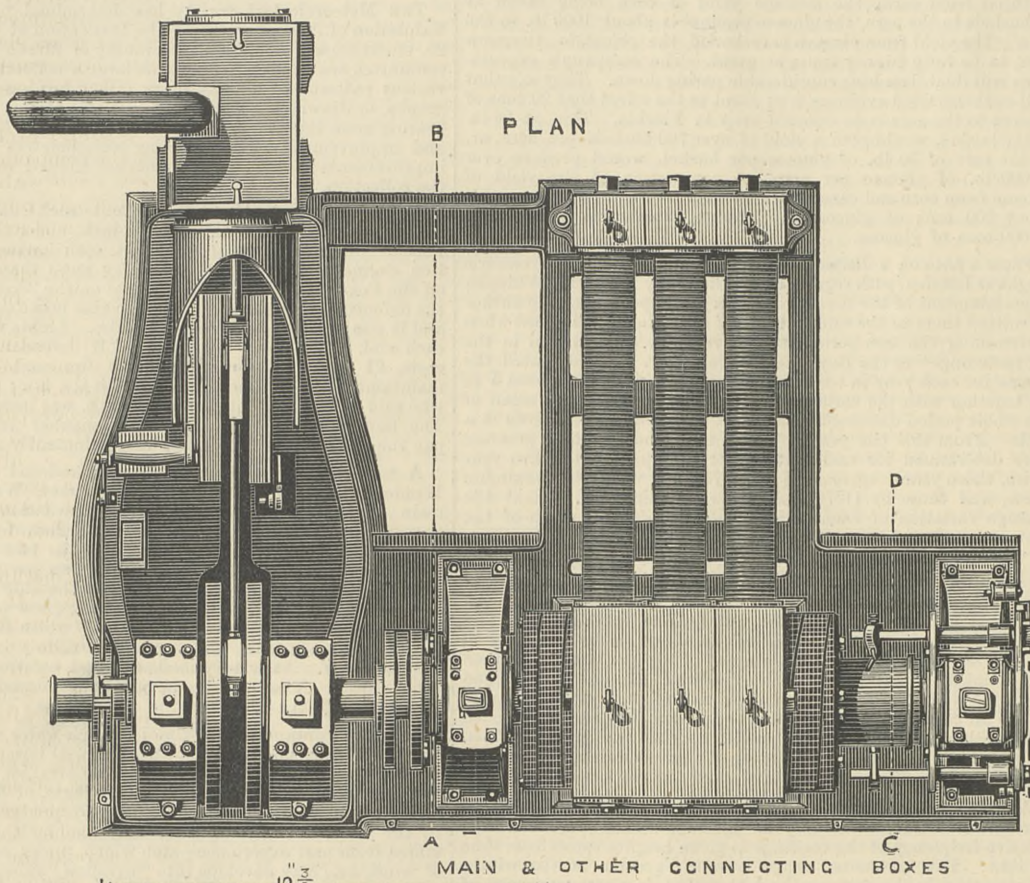
SIDE ELEVATION





SECTION ON LINE C.D.

PLAN



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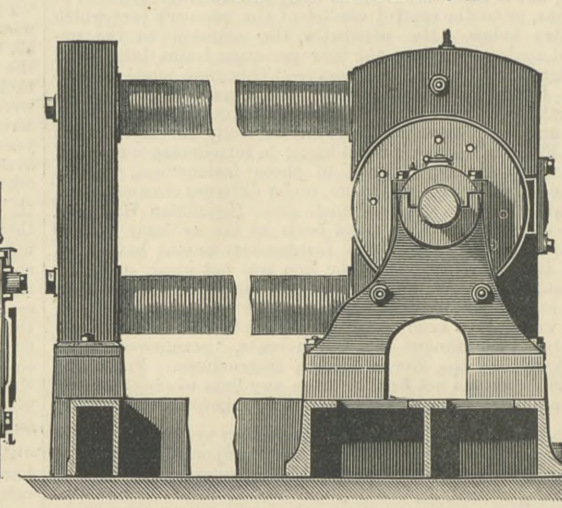
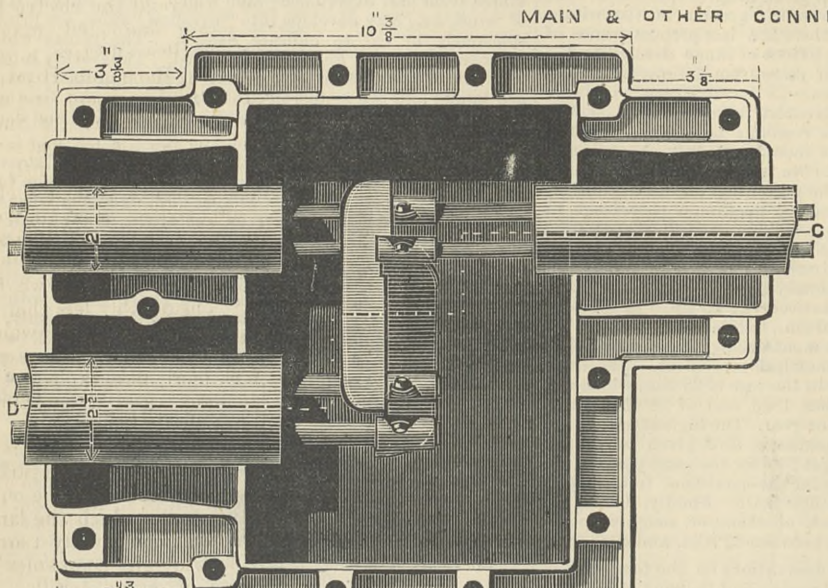
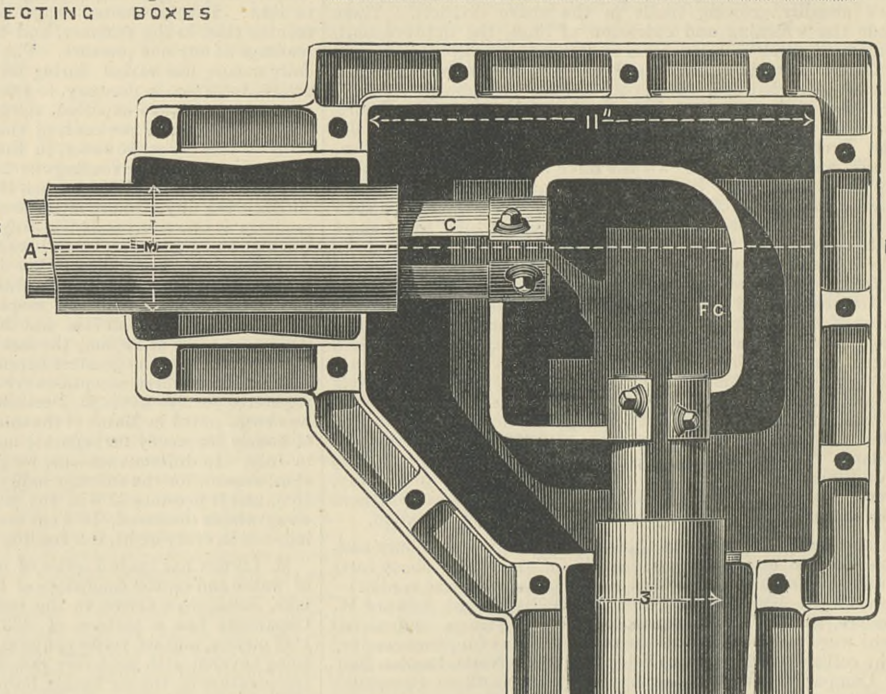
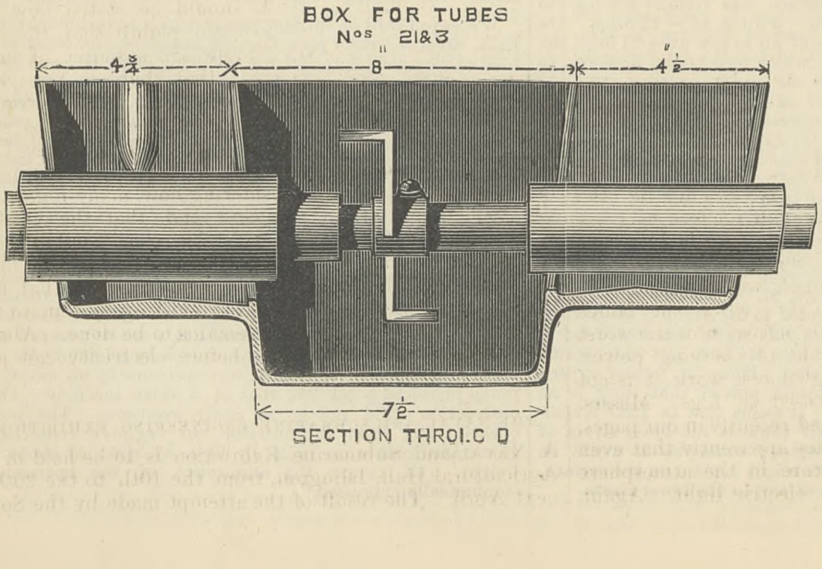


MAIN & OTHER CONNECTING BOXES



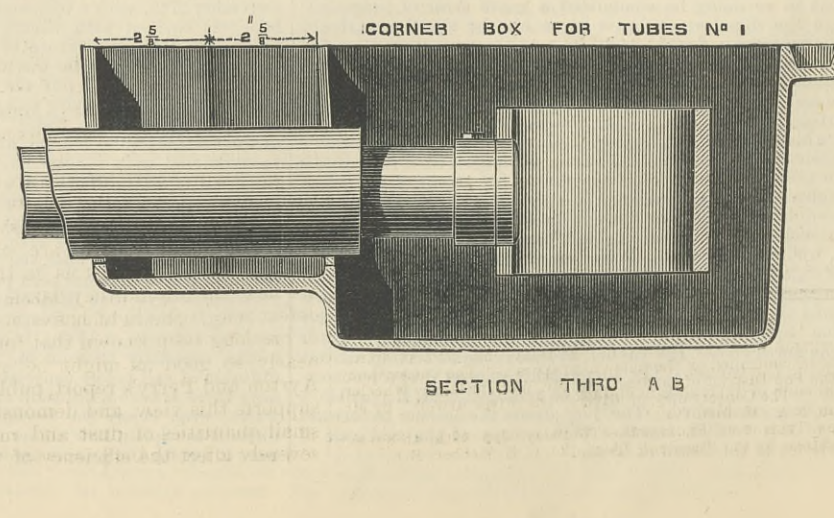


BOX FOR TUBES Nos 21&3



SECTION THRO' C D

CORNER BOX FOR TUBES No 1



SECTION THRO' A B

PUBLISHER'S NOTICE.

*** *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.*

*** *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.*

W. B.—(1) *Within six months from the date of patent.* (2) *Yes.*
ENQUIRER.—*You cannot do better than consult our advertising columns.*
G. B. (Hidley-street).—*Ede's " Treatise on the Management of Steel," last edition. You can obtain it through any bookseller.*
A. B.—*There is very little difference in the results obtained with various systems of fire-bars. The principal points to be attended to are that the air spaces shall be as small as will suffice to admit air enough to burn the required quantity of fuel, and that the whole surface of the grate is properly proportioned to the work to be done. The area will be different for different coals. The best plan is to start with the grate full size. Weigh the coals for a week. Then put a row of fire-bricks across the grate at the back end; and weigh coals for a week, and so on. The best area of grate will thus be found by direct experiment.*

"ANCHOR" SHIPS' LAMPS.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers give us the name of makers of ships' lamps marked "Anchor"? W. R. AND CO.
London, E.C., January 9th.

CHOCOLATE MACHINES.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers oblige me with the name of a firm of engineers or machine manufacturers in this country making machinery for the manufacture of chocolate? H. DE S.
London, January 2nd.

BRASS CASTINGS.

(*To the Editor of The Engineer.*)

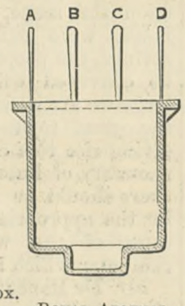
SIR,—I should feel much obliged if any of your readers will inform me how to cast brass sockets on iron screws so as to obtain a full thread all the way through. I have tried, but cannot get a complete screw thread. H. W.

GUN-METAL CASTINGS.

(*To the Editor of The Engineer.*)

SIR,—In reply to "Pneumatic" in reference to gun-metal castings, I think that if he runs his casting a little hotter and gets the vent away properly from the parts A B C, he may get over the difficulty. It would also be as well to have a good-sized rising head on part D. If the loam is good and the air carried properly away, the casting should not scab.
January 9th. FOUNDRY MANAGER.

(*To the Editor of The Engineer.*)



SIR,—One of your readers, replying to a question in your last issue on unsound castings put forth by your correspondent "Pneumatic," wishes to tender a suggestion that, if not already been tried by the querist, may prove useful. Make the "cast" in position as shown in this sketch, having six ways for the metal to enter mould, each way to be equidistant from the other when looking on the plan. Let the lower part of the runners be in size ⅜in. by 1in., tapered, of course, gradually towards the top, which should be about 15in. in height. It will be observed that any one of the six ways, A B C D, &c., may act as the runner, whereas they all play the important part as risers or head. In casting by the way stated the core, if built up in loam, will be suspended from a top plate. If moulded from a pattern, the core should then be held in position by the top box.
Woolwich, January 11th. ROYAL ARSENAL.

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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, Jan. 17th, at 8 p.m.: Discussion to be continued on the following papers:—"The Conservancy of Rivers; the Fen District of England," by Mr. William Henry Wheeler, M. Inst. C.E. "The Conservancy of Rivers; the River Irwell," by Mr. Arthur Jacob, B.A., M. Inst. C.E.

SOCIETY OF TELEGRAPH ENGINEERS.—Thursday, Jan. 19th, at 8 p.m.: Inaugural address by the President, Lieut.-Col. C. E. Webber, R.E.

THE METEOROLOGICAL SOCIETY.—Wednesday, Jan. 18th, at 7 p.m.: Annual general meeting of the Society, when the report of the Council will be read, the election of officers and Council for the ensuing year will take place, and the President will deliver his address.

SOCIETY OF ARTS.—Wednesday, Jan. 18th, at 8 p.m.: Seventh ordinary meeting, "The Relation of Botanical Science to Ornamental Art," by Mr. F. Edward Hulme, F.L.S., F.S.A. Sir Philip Cunliffe-Owen, K.C.M.G., C.B., C.I.E., will preside.

THE ENGINEER.

JANUARY 13, 1882.

THE ELECTRIC LIGHT *versus* GAS.

ELECTRICITY just now makes slow progress as a light, probably because so much remains to be learned about it. That it can be made to give eminently satisfactory results under favourable conditions no one, we fancy, now disputes; that its average public performance is not all that could be desired is just as certain. After a very expensive attempt to light a portion of Liverpool by electricity, the struggle has been abandoned for the present; and we have learned within the last few days that Bray's gas-burners have practically carried the day in Edinburgh, and that electricity as a means of lighting streets has been abandoned. Reports also reach us from works in the country to the effect that the electric light has failed to realise the hopes formed concerning it, and has been given up after months of costly experiment. It is useless to shut our eyes to these facts, absurd to assert that they all result from the negligence, parsimony, or incompetence of the managers of a single company. We believe that the electric light has a great future; but it is about time that those who supply machinery and apparatus for producing the light considered the position into which they have drifted, and set themselves to work to overcome difficulties. The public will not be slow to let the electric light companies know what it thinks of them, and no attempt to prove by argument that the electric light is better than gas will have the smallest effect in promoting the extended adoption of the former. There must be facts, not words—facts in favour of the electric light. Up to the present unfortunately the facts are on the whole much against it. Let us see how matters stand.

Every system of electric lighting, no matter whose, contains three principal elements, namely, the generator or producer, the conductor, and the lamp. Putting on one side Faure's batteries and their various modifications—which will to a certain degree it is to be hoped, dispense with the second element or conductor—it may be said that the generator or dynamo-electric machine is satisfactory. It wastes little power, does not readily get out of order, and is sufficiently certain in its action to be regarded as trustworthy. It can be put anywhere that a steam or gas engine can be fixed to drive it. The conductors—wires—take the place of the gas mains and service pipes of our streets and houses, and, curiously enough, they constitute the weak point in the whole scheme. The public lighting of towns and cities has failed notably over and over again, because of the shortcomings of the conductors. On more than one occasion the lights now being tried in London went out because of want of insulation in the conductors. After the wires had been laid for the lighting of Bridge-street, Blackfriars, and Ludgate-circus, they had to be all taken up and replaced by other and better conductors at a heavy expense. Electric lighting has failed in Liverpool, because it was found impossible to carry the wires properly overhead—we suppose if it had not been impossible, the company which undertook the work would have succeeded—and the corporation could not see their way to letting their streets be ripped up to lay underground wires. In Edinburgh it is said that the Anglo-American Brush Company was unable to overcome these wire difficulties, after a struggle which lasted four months; at least it is stated that only the day before the lamps were removed, a leakage due, we suppose, to want of insulation, was discovered and remedied, which had done much to diminish the brilliancy of each lamp. No doubt the fact that such a leak existed was well known to the officers of the company. To assume that it was not known would be to assume unusual ignorance on their part, but four months only just sufficed it would seem to show where the leak was, and to permit it to be stopped. It is from the wires that fire and loss of life arise. We have said enough, we think, to show that they constitute the weak element in the system; but we could say much more were it necessary. As regards the lamps, it is enough to state that they are all on their trial, and a very moderate amount of observation will suffice to demonstrate that what may be termed a perfect, or nearly perfect, lamp is not yet in the market. We refer now more particularly to arc lights. Concerning Swan's and Edison's incandescent lamps it will be time enough to speak decidedly in a year. That they are both full of promise is all that can be said now.

Let it be supposed that a perfect lamp is produced. It can be used to light cities in two ways, according as it is an arc or an incandescent lamp. If the former, it must be fixed at comparatively distant intervals. We may cite as examples of interval the lights on the Thames Embankment, in Cheapside, the Poultry, and Ludgate Circus. If the latter, then one would, let us suppose, take the place of each gas lamp in our streets. The Swan light may be depended on to give rather more than as much light as a street lamp of the ordinary kind. As for the arc lamp, our readers may ask themselves whether the results are quite satisfactory; we think there can be but one answer, which is that they are not. The best results are obtained when the light is carried on a high mast as in the City; when the lamps are near the ground they dazzle and confuse. But the worst defect which the light has is its want of carrying power. It has long been known that for lighthouse work it is not nearly so good as might be supposed in fogs. Messrs. Ayrton and Perry's report, published recently in our pages, supports this view, and demonstrates apparently that even small quantities of dust and moisture in the atmosphere severely affect the efficiency of the electric light. Again, there is no mode of illumination in existence so much modified by its surroundings. Those who know what the electric light in the Place de l'Opera in Paris was in 1878 would scarcely believe that the light subsequently seen on Holborn Viaduct was the same thing. In Paris the lamps had at each side of the street a row of lofty white houses to reflect their rays, and the effect was wonderful. In London nothing of the kind existed, and the want of effect was wonderful. Gas, with its comparatively yellow flame, is practically unaffected by its surroundings; and while it does not dazzle, it diffuses its light admirably. We have recently referred to the lighting of Parliament-street, but the system adopted there has extended to the Strand, and bids fair, indeed, to extend almost without limit, and there is a tolerable unanimity of opinion extant that the Strand is now better lighted by gas than the City is by the electric light. Something seems to be wanted between the 1500 or 2000-candle arc light and the 20 or 30-candle Edison or Swan lamp. We want lamps of about 250 candles each, which can be fixed at moderate distances apart in our streets. Nothing approaches this desideratum so well as the Jablochkoff light, and at this moment there does not, so far as mere illumination is concerned, seem to be a better lamp in the market. The lamp has many defects—that goes without saying—but the lighting of the Thames Embankment, at all events, compares very favourably with that of any other place with which we are acquainted.

We see no reason why, as events progress, electric lighting should not undergo substantial improvements with the best results; but they will be all completely useless in competition with gas unless the cost of the electric light can be reduced; at present it is simply exorbitant. We do not assert for a moment that the companies charge too much, we only state a fact; on every side we hear the same complaint. It is urged that the light given for the money is superior to that of gas, but the answer is in the negative. When gas is used to the best advantage it answers most purposes better than the electric light—not all. If a manufacturer finds that 200 gas burners, giving an aggregate of 3200 candles, answers his purpose better than two arc lights giving 3000 candles each, he will continue to use the former, especially if the cost of the gas is less than that of the electric light. In the district supplied by the South Metropolitan Gas Company the price now paid is 2s. 10d. per 1000ft. for 16-candle gas. With good burners this will give a light equal to four candles per cubic foot. Dr. Siemens with, we understand, 16-candle gas, has got over five candles with his new burner; but, taking the figures we have assumed, it will be seen that for a cost of 2s. 10d. a light of 4000 candles can be had for an hour. To this must be added something for cost of renewals and interest on fixtures. If we suppose that sixteen candles per burner are obtained, we shall require 250 burners. These with swinging branches and necessary piping could be put up for about £40. The interest and depreciation on this sum at 20 per cent. would amount to but 3·15s. a week, or for an average of fifteen hours a week all the year round to 2·6d. per hour. If we add 1·4d. per hour for renewals of burners, which is much more than enough, we have the cost of 4000 candles—3s. 2d. Can it be said that there is an electric light in the market which even distantly approaches this economy? The question for solution is, Why should the electric light cost so much? One horse-power indicated may be reckoned on to give, say, 300 candles effective, a globe being used to diffuse the light. The Ransomes, Head, and Jefferies engine on the Thames Embankment indicates 42-horse power, and the lowest consumption of fuel is 3·2 lb. per horse per hour. Now 19s. per ton for coal is very nearly one-tenth of a penny per pound, consequently the cost for coal may be taken at being even with dear fuel but about 0·32 penny per hour for 300 candles, or, say, in round numbers, 4d. per 4000 lights per hour. The cost of an engine-man, oil, and water, may be taken at 1s. 2d. per hour, interest and depreciation at 6d. per hour, and we have 4000 candles for 2s. per hour, or considerably less than the cost of gas, and be it noted we have made large allowances. But it is well known that after everything has been paid, the cost of the electric light is more like 6s. per 4000-candles per hour than 2s. In many cases it enormously exceeds even this figure. We wish to know why? No information worth having can be obtained as yet on this subject. So far as can be ascertained the cost of the carbons is a very large item, and to this must be added the outlay for little adjustments and minute repairs which the lamps, and, in fact, all the appurtenances, continually require. We do not find fault with the electric light companies and firms for not making the items of outlay public. We believe that they are not as yet in a position to speak quite explicitly as to the cost of the electric light; but it is certain that before it can compete successfully with gas its cost must be reduced. We do not wish to be misunderstood. We do not wish to discourage those who are toiling to give the world a new light, but the reverse. Yet it is good for all parties that the truth should be stated now and then very explicitly. We have said plainly that the conducting wires of electric lamps are a source of much trouble, danger, and expense; that there is not yet a perfect electric lamp in the market; that all the arrangements connected with the placing of electric lamps seem to need revision and improvement; and that the light ought to be made cheaper and more trustworthy. We hold it to be impossible, considering how many minds are all labouring to attain the same end, that the existing troubles and defects will not be overcome; but we also add that it will not do for any company or firm to fancy for a moment that finality has been reached; that it is the happy possessor of the best existing system in the world, and that nothing more remains to be done. Almost everything remains to be done before electricity can play the part now played by gas.

THE NAVAL AND SUBMARINE ENGINEERING EXHIBITION.

A NAVAL and Submarine Exhibition is to be held in the Agricultural Hall, Islington, from the 10th to the 20th of next April. The result of the attempt made by the South

Kensington authorities to hold annual international exhibitions was so unsuccessful that every proposal to do anything even distantly resembling the South Kensington experiment has been looked on with doubt, if not positive repugnance, by engineers and manufacturers. But it is rash to assume that because an ill-managed enterprise fails no similar enterprise should ever succeed; and it is especially unwise to take it for granted that if South Kensington cannot make an exhibition a success no one else can. A careful examination of the present position of the Naval and Submarine Exhibition will result, we think, in showing that not only is the Exhibition likely to be unique in its character, but that its success may now be regarded as assured. It is intended that the Agricultural Hall shall contain a collection of all the most improved machines and appliances connected with naval engineering of all kinds, navigation, and shipbuilding.

Within the last twenty years very great advances have been made in naval engineering of all kinds. As regards submarine operations, it is not too much to say that the practice of construction has been greatly altered and modified. The use of béton monoliths in the construction of breakwaters, and the employment of "Titans," "Goliaths," and other cranes of great power in the construction of piers and sea-walls, does not date back much further. In dredgers, again, enormous improvements have been effected. The diving-bell, an apparatus clumsy in action and limited in its sphere of operations, has been almost wholly superseded by the diving dress; and it is by no means improbable that the electric light will render submarine work almost as easy of performance, up to a certain point, as land work. But considerable as have been the changes made for the better in the art of marine civil engineering, they are as nothing to the changes effected in naval construction. Twenty years ago high pressures at sea, the surface condenser, and the compound engine were practically unknown. Happy was the shipowner whose engines burned less than 4 lb. of coal per horse-power per hour. The consumption now is little more than one-third of this. Even within the last ten years the consumption of fuel by marine engines has been reduced by nearly 14 per cent. Steel has been introduced as a material for boilers, crank shafts, propellers, and ships. Marine engineering has not been modified, it has been revolutionised during the last twenty years. Nor has the change been confined to ships and their engines. It has extended to everything connected with ships. The finest intellects of the day have come to help the sailor. One example will suffice—Sir William Thomson's sounding apparatus. The indomitable energy of the Briton has led him to attempt the apparently impossible; and fresh meat is now brought from Australia by the aid of refrigerating machines, one of which will in future form part of the equipment of every steamship making rapid voyages. Turn in what direction we will, we find evidence of change, of progress, and improvement in marine engineering. Is it not a legitimate enterprise to attempt to bring together examples of this great change, so that all interested may see and realise for themselves what England has been doing?

We have said that the Islington exhibition will be unique; and it will be so because there never has been a naval exhibition, in the full sense of the term, held before. The nautical exhibitions held at Havre, that in Fishmongers' Hall, and Glasgow, have been limited in scope and dimensions. In 1862 there was a very fair show of marine engines and nautical appliances exhibited in London. But they were either scattered about Captain Fowkes' huge building, or concentrated and crowded together in one of the wooden annexes. The display was in no sense representative, and was lost in the crowd. The naval engineering display at Paris in 1867 was very poor and inadequate. Of the Vienna Exhibition in 1873 it may be said that there was really no marine engineering display whatever. Italy sent a couple of marine engines, and in an annexe in the grounds were some of the Danube Steam Navigation Company's engines. That was about all that was noteworthy. Nearly the whole of the naval engineering exhibits at Paris in 1878 were got into a comparatively small shed on the banks of the Seine; and but for the French Ministry of Marine and Messrs. Schneider, who showed a large compound engine in their own annexe, there would have been little worth looking at. Thus it may be safely said that during the last twenty years no successful attempt has been made to exhibit the condition of the art of marine engineering. Various causes have contributed to this end. One was no doubt the reluctance of manufacturers and others to incur the enormous cost incurred at international exhibitions remaining open for long periods. No such objection can be urged against such a display as that to be made at Islington. Nor is the magnitude of the exhibition likely to be so great that exhibits, unless made on a very large scale, will be overlooked. As the Exhibition will remain open but for ten days, the expenses incurred will be very small; and as its existence will be made known all over the world, exhibitors will, even to put matters on their lowest footing, enjoy the benefit of a good advertisement at a moderate cost. We know, however, that many great firms are co-operating, perhaps unintentionally, to prevent the undertaking from degenerating into a bazaar. The names of those under whose auspices it is being held are, indeed, sufficient guarantee for this. To begin with, among its patrons are included the presidents of the Institution of Civil Engineers, the Iron and Steel Institute, the Institution of Naval Architects, the Society of Telegraph Engineers, and several others. Lord Alfred Paget, Admiral Sir W. Houston Stewart, Vice Admirals Boys, Sir Ed. Commerell, and other naval officers; the Director of Naval Ordnance, Rear-Admiral Herbert; Mr. Barnaby, Director of Naval Construction, Sir W. Thomson, Sir Joseph Bazalgette, and many other men of mark. Indeed, we cannot call to mind any exhibition which has enjoyed more patronage of the right kind, for all the men we have named are distinguished for their abilities and knowledge quite as much as for their rank. If we turn from the patrons to those who have already taken space to exhibit, we find cause to augur the success of the undertaking, many of the best firms having taken space. Among them we mention Sir W. G. Armstrong and Co.; Messrs. Inman and Co.; the Dominion Line Company; Messrs. J. and G. Thomson, the builders of the Servia; Messrs. Palmer, of Jarrow; the Kirkstal Forge Company; and the Leeds Forge Company. Besides these we may name, as makers of specialities, the Berthon Boat Company; Messrs. Hall, of Dartford, and Bell-Coleman and Co.; Messrs. Tangye; Fielding and Platt; Siebe and Gorman; Stone, of Deptford, and so on. The Admiralty, too, will exhibit freely, and we hope Woolwich will make a good display. The Hall is too small to permit the erection of large marine engines, but it is more than probable that the exhibition of models will be the finest ever made. The space available for the exhibition in the Agricultural Hall is 354ft. long by 213ft. wide on the ground floor. This space will be divided into eight rows of stands running lengthwise. In the centre of the Hall will be a tank, 25ft. in diameter and 12ft. deep, with glass sides, in which diving apparatus will be shown in action. The galleries which run all round the Hall, are 46ft. wide. They will be used for the lighter exhibits. The large apartment, Berners Hall, will be used as a lecture-room, in which lectures will be delivered illustrative of the exhibition, and papers will be read and discussed. We understand that already about one-half the space has been allotted.

It may be said with truth that an exhibition is just what the exhibitors choose to make it. We have been at some trouble to ascertain what the characteristics of the Naval and Submarine Exhibition are likely to be, and we have placed the facts at the disposal of our readers. We see no reason to doubt that the undertaking will result creditably to all concerned. We have, as is well known, a strong objection to international exhibitions, which call for an enormous expenditure and are so unwieldy that they really fail to teach much. None of the arguments on which our objections are based will apply to special exhibitions open for too short a time to lose their interest, and so small that what they have to teach may be learned in the course of a few visits. If the great English firms—Scotland is well represented—who have not already notified their intention of exhibiting will come forward, and if, as there is reason to believe, France and Italy exhibit freely, the success of the undertaking will be very great.

OFFICE HOURS FOR RAILWAY EMPLOYÉS IN VIENNA.

THE article on the office hours of railway employés to which we referred in our impression of 9th December last appeared as a "Leader" in the *Beamten Zeitung*, a journal devoted to the interests of clerks in general in Vienna, on the 12th August, 1881. The system advocated by the author is that of earlier and continuous office hours. In most of the administrative offices of the different railways in Vienna, the normal attendance is seven hours, in one or two only six, and in all, with the exception of the Kaiserin Elizabeth Westbahn, where the employés are allowed to work either from 8.30 a.m. until 3.30 p.m., or from 8·30 until 12.30, and from 2 until 5 p.m., according to individual option, the attendance is continuous, *i.e.*, there is no interval for refreshment in the middle of the day. The advantages put forward for the continuous system, are the opportunities it affords to the better paid clerks to escape from the heat of the town in summer to their residences in the country, or to spend more time with their families at home; and to poorer paid officials, to enable them to eke out their miserable salaries by utilising their spare time in other occupations. The author further advocates an earlier commencement of work, and consequently an earlier closing, as advantageous to the health of the employed, and a pecuniary benefit to the employers. Men that are kept at work in summer time through the hottest portion of the afternoon, when the heat exerts its greatest influence on the human body, and a certain amount of energy is expended in combating the drowsiness it produces, are less fitted for their labours, and consequently the loss through physical incapacity to the employer increases in direct proportion to the ratio of the post-meridian office hours to those before the sun has reached its zenith. An answer to the above appeared in the same journal on the 26th of August, in which the author states that the continuous labour of six to eight hours, whether it be mental or physical, is so great a strain on the human system that the work of the latter cannot equal in efficiency or value that of the earlier hours. The human body requires a rest or change if only for a few moments, and as soon as this is granted, there is no longer any control over the individual advantage that may be taken of the indulgence; whereas with the interval of an hour and a-half, most of the officials who, as a rule, live as near as possible to the scenes of their labours, are enabled to take their meals with their families at an hour which is so far the custom of the country, that all the schools are closed, and the children at home for their midday meal. The author of the original article returns to the charge on the 30th September, but his arguments are merely a repetition of what he said therein, and by no means a refutation of his opponent's. We may add the hours of attendance in offices and places of business are nearly as varied as the several branches of industry. Amongst the engineers many offices are open from 8 a.m. until 3 in the winter, from 7 a.m. until 2 in summer. The Government and public town office hours are from 9 a.m. until 3 or 4. Many banks, shops, and exchange offices close at midday for a couple of hours; and an intimate acquaintance with the peculiarities of the several branches is necessary to prevent a good deal of disappointment, when one is bound on business interviews, or desirous of making the smallest purchase.

THE PATENT-OFFICE LIBRARY.

THE operation of "weeding" a library is dangerous, even when performed by skilled hands. Sooner or later it is sure to be found that the books which have been sent away are in particular request, and often they have to be replaced at great cost. The circumstances which can justify the controllers of a large and useful public library, supported by parliamentary grant, in depriving the public of the use of books to which they have been accustomed, must be of a very exceptional kind. We greatly doubt whether they exist in the case of the Patent-office Library, to which, to our sorrow, we find the weeding process is now in course of application. The full extent of the injury which the library has sustained does not yet appear, but we know enough to justify a very emphatic protest. No doubt space is becoming more difficult to find as the bulk of printed specifications preserved for reference increases. But instead of enlarging the building the authorities have adopted the speedier process of getting rid of the books. Amongst the books so cleared away was a complete set of the *Gentleman's Magazine*. Now this is a work which any librarian would be supposed to cherish, and in a library such as that of the Patent-office it was unusually appropriate, for it is an epitome of the history of science and manufactures during many years, in a period during which there was scarcely another repository for stray facts and articles on such subjects. One such instance occurs to us as we write. The report of Dollond's patent case is only to be found in the *Gentleman's Magazine*. The relief which this ill-considered and unfortunate scheme will afford cannot at best be but temporary, while the injury will be more and more apparent every year. It would seem that the present passion for bookselling sways even Government departments, and that our neighbour, Mr. Punch, only displayed his usual foresight when he penned the lines which we have taken the liberty of altering slightly to meet the case—

> Perchance 'twill be found that this practical Nation
> Will follow the lead of the two noble Dukes;
> And send auctioneers, with the least reservation,
> To the *Office for Patents*, and sell all the books!

We do not say that it is impossible that there may be books which it is not worth while to keep, but we do say that the elimination which is now being effected is improper. It is conceived in the same spirit which permitted a few years ago the destruction of a hundred tons or so of printed specifications—a waste which is now beginning to be very seriously felt. Is it too much to hope that wiser counsels will prevail in Southampton-buildings?

LITERATURE.

The Water Supply of England and Wales; its Geology, Underground Circulation, Surface Distribution, and Statistics. By CHARLES E. DE RANCE, F.G.S. London: Edward Stanford. 1882.

WE have here an excellent book, and one that was wanted. The progress of scientific discovery in relation to the laws of health and disease has given increased importance to the subject of water supply. Mr. De Rance, in his official connection with the Geological Survey, has enjoyed special opportunities for discovering the extent to which the water which permeates a district is affected by the geological formations through or over which it flows. The facts thus detected afford the clue to others of more or less importance, and obviously the entire subject is one of much interest to the engineer, as well as to all who are concerned in the sanitary well-being of our towns and cities. From all time the water supply has been a matter of moment to the human race. The story of the Irishman who is said to have been puzzled by the circumstance that large cities always had big rivers may either be true or mythical, but it serves to illustrate the fact that large communities can only thrive where water is abundant. Naturally, men settled first where water was easiest to obtain, and every village bears witness to this procedure, while the large towns grew up by the side of the broad rivers which favoured navigation. Science now pushes the inquiry a step further, and shows that the streams themselves were governed by geological conditions. Parish boundaries, seemingly the most erratic of all things, are found amenable to the same law. The settlement of London was first of all determined by the ample volume of the Thames; and the extension of the city was regulated by the prevalence of freely gushing springs. When the water companies came upon the scene, artificial influences began to tell, and houses were built in all directions, irrespective of the springs, the people being confident that the water would be conveyed wherever it was wanted. In England at large we are now arriving at another stage; the growth of the great towns, and the immense demand for water, giving rise to a competition in the transport of this prime necessary of human life which has suggested the idea that there should be more of intelligent control than hitherto in the appropriation of the water. Hence the significance of the watershed boundary, and the territorial character which now attaches to the various river basins.

Mr. De Rance has arranged his book on a thoroughly scientific basis, while at the same time comprehending a number of facts connected with the jurisdictions of the urban sanitary authorities. Beginning with the consideration of the rainfall, and its percolation into the strata, we are led on in the next place to a review of the more salient points connected with the composition of water, according to the classification adopted by the Rivers Pollution Commissioners. After this we have the main subject treated in divisions harmonising with the river basins, a final chapter dealing with the propagation of epidemics by potable water. Six coloured maps illustrate the text, and will be found of much value, showing respectively the amount of rainfall in the different districts, the hydro-geological features of the country, the river basins, the growth of London, the water supply of the metropolis, and the density of the population throughout England and Wales. These maps, taken in relation to each other, give an admirable survey of the whole subject. In the first we see the varying quantities of the rainfall from 23in. per annum in the lowlands to more than 75in. in the elevated tracts, while in the last map of the series we are shown the groupings of the population and their demand for a million gallons of water per day up to more than a hundred millions.

With so rich an array of facts as Mr. De Rance has here brought together, the reader will probably feel regret that there are not a few more deductions and generalisations; but to enter on this tempting domain would have been to enlarge the bulk of the volume and to increase its costliness, a result which the author was doubtless desirous of avoiding. He has fulfilled his present purpose, and has produced a work which will be of lasting value. Every river is traced, every township is described, including acreage, population—according to the census of last year—rateable value, geological features, character of the water supply, nature and cost of waterworks, and a variety of other matters, the larger towns having of course the greater share of attention. The idea which has given rise to this volume is excellent, and it has been admirably worked out. The task has been a heavy one, but it has been successfully accomplished, and the information thus scientifically arranged cannot fail to be of eminent use in relation to the great sanitary question which it concerns.

THE PERIODICAL VARIATIONS OF GLACIERS.

It has been long known that the glaciers in Alpine regions are subject to variations in length, their lower ends now advancing into the valley, now retreating. Physicists have generally thought to explain these variations by the more or less rapid fusion of the glacier at its lower extremity, and the alimentation by the snows of the immediately preceding winter or winters.

Professor Forel, however, in a recent paper in the *Archives des Sciences*, shows that observed facts do not by any means agree well with this theory. One finds that in cool summers, when the melting must be small, many glaciers nevertheless retire, and that in hot summers many advance; also, that in one year some glaciers advance while others retire, and that the snowfall of the winter does not suffice to account for these differences. Professor Forel considers that certain facts observed within recent years favour a more accurate explanation; one which, indeed, was offered as far back as 1821 by Venetz, and developed to some extent by Hugi in 1830, but which has now much more to recommend it. One fact which is here of importance is that glaciers vary in size in periods embracing a long series of years—five, ten, twenty, or more. Observations to this effect range, for some glaciers, from 300 years back. Another significant fact established by direct observation is, that a glacier may retire for a long series of years without interruption by a motion of advance. Professor Forel furnishes several proofs of this in recent years. A similar behaviour of glaciers in advance he is at present unable to affirm from exact observation. From these phenomena—and especially the fact that the Rhone glacier from 1857 to 1880 has continuously retired—he concludes that the determining factor in variations of the length of a glacier is not the melting away, but the velocity of motion of the ice. Since the melting of the glacier is caused by the heat of summer, or of the whole year, and the temperature, *e.g.*, within the last twenty-four years, has been in fifteen or sixteen years above the normal, and in eight or nine below it, yet the Rhone glacier has continuously retired,—this factor evidently has no influence on the periodic variations of the glacier.

With regard to the velocity of motion of glaciers, data for two periods of their variations are lacking. On the Rhone glacier, measurements have only been made in the last seven years, *i.e.*, in the period of retreat. These show that the velocity has amounted, on an average, to 6·7 metres a year, and that it becomes less the nearer the marking stones approach the lower end. During this time the front of the Rhone glacier has retired annually about 50 metres through melting. Now, when the glacier advances, the melting action is probably somewhat smaller; we may assume it to be 40 or 20 metres in the year. But since the glacier advances, its velocity at the front must be greater, perhaps superior to 40 metres, and, at least, superior to 20 metres a year.

The causes of these enormous fluctuations in the velocity of flow of glaciers at their lower end will be understood on considering that very small variations of the velocity at the upper part of the glacier are strengthened in the progress of the ice-current, and become very considerable at the lower part. Suppose that at the origin of the glacier variations occur in long periods, during which the glacier becomes now a little thicker, now a little thinner. When the glacier becomes a little thinner than in the normal state, it flows a little more slowly. A particular section takes more years to pass over so much ground; it remains longer exposed to melting on this stretch, and will lose more of its thickness in the first kilom. than if it moved more quickly. Thus the decrease of the subnormal thickness progresses, also the decrease of the velocity; consequently, the small decrease of thickness at the upper part results in an enormous diminution, both of the velocity and of the thickness at the lower part. The reverse is the case when the glacier is thicker than usual at the beginning. It then flows faster, remains a shorter time exposed to melting, and loses comparatively little in thickness. The smaller decrease of thickness results in a smaller loss of velocity, so that finally there is a less excess in thickness of the glacier at its upper end, and a considerable elongation and maintenance of its thickness and velocity at the lower end. Professor Forel fully discusses the connection between the velocity of glacier motion and thickness thus set forth, which has been recognised by all authors, and is experimentally proved by the diminution of velocity from above downwards, and from the middle to the sides of the glacier. He also refers to internal fusion as an important element; in the thinner ice-masses this is relatively greater, and therefore adds to the decrease of velocity.

We have thus merely to assume as cause of the changes of length of glaciers slight variations of thickness at the upper part—variations which are repeated in the same sense during periods of ten, twenty, or more years. Now, such variations actually occur. They are caused by variations in the thickness of the *névé*, or snowy part of glaciers, which is formed of the sum of snow layers that have accumulated in previous years. There are, it is known, periods of increased precipitation and periods of drought, which are not, indeed, to be thought of as uninterrupted, but which, in their totality, furnish amounts of snow above or below the normal. Professor Forel makes an inquiry into the amounts of rainfall at Geneva from 1826 to 1880, and compares it with the average precipitates; and extending these relations to the Alps, he concludes that the *névé* of the Alps from 1835 to 1841 was less than the normal, from 1842 to 1857 more, from 1862 to 1877 less, and from 1878 to 1880 more. In these variations there is a character of long periodicity similar to that in the variations of length of the glaciers. These periodic variations of the masses of snow and *névé* cause periodic changes in feeding of the glacier. There arise periodic variations in its thickness, and so in the rate of its flow; hence a periodic advance and retreat of the glacier at its lower end. "We must, therefore," says Professor Forel, "ascribe the variations in length of the glacier, not to near variations of fusion, depending on the heat and moisture—variations of the year, but to a much more remote cause—the feeding of the glaciers by more or less abundant snowfall on the *névé* in past years."

Data are wanting as to the time in which a variation of the masses of *névé* at the upper end of the glacier appear as an advance or retreat at the lower end. We know at present only some values of the velocity of flow during the present period of retreat, and, as has been shown, it must be considerably greater during advance. So much is clear, that this influence becomes felt only after a lapse of years, and that the time of action of the *névé* on the lower end of the glacier must be different in different glaciers, for it is conditioned by the length of the glacier and its velocity, which, again, depends on the size of the *névé*, and the height, inclination, and orientation of the valley.

The variations in length have, however, something common. While it is seldom that all glaciers advance simultaneously—as *e.g.*, 1817 and 1818—or all retreat simultaneously—1872 to 1874—this, nevertheless, occurs with the majority of glaciers. To give an idea of the nature of this community of behaviour, Professor Forel furnishes the following data with regard to Alpine glaciers:—"In the period of 1872-74, all the glaciers were in retreat. This retreat began in the case of the Mont Blanc glacier about 1854, the upper Grindelwald glacier 1855, the Gietroz glacier 1855, the Rhone glacier 1857, the Aletsch glacier 1860, the Gorner glacier 1870, the Fiesch glacier 1870, the Unteraar glacier 1871." Thus, between the first-named glacier and the last there is a difference of fifteen to twenty years in the beginning of the retreat.

This period of retreat is now nearly ended. There are already data which indicate a forward motion of the following:—The Bossons glacier since about 1875, the Schallhorn glacier since 1878, the Bois glacier since 1879, the Trient glacier since 1879, the Zigiorenove glacier since 1879, and the Gietroz glacier since 1880. It is probable that all glaciers, one after another, will cease to shorten and begin to lengthen. To what time the diminished snowfall corresponding to the terminating period of retreat is to be referred cannot be said with certainty; probably to the dry period preceding the wet one which began in 1838. The considerations here urged have some important bearings on the phenomena of the ice-age.

LETTERS TO THE EDITOR.

[*Continued from page* 23.]

COLD-AIR MACHINES.

Sir,—I think Mr. James Hawley would have done better had he "let middling alone," rather than write the letter which appeared in your last issue, which shows that he has yet much to learn both in air-compressing and the application of cold air for food-preserving purposes. Had he possessed that experience in air-compressing machinery which "Purchaser" lays so much stress upon, he would not have stated that the volume of air delivered from the machine "depends entirely upon the speed at which the piston is driven." Let him try the effect of high speed with his machine, measuring the volume of air from indicator diagrams taken continuously throughout a measured run; and let him compare results of running at various speeds, and if he has ordinary suction inlet valves, and much clearance and port space in his air-compressing cylinder, he will find that after passing a certain speed the results will begin to fall off, until at last he reaches a speed at which the result is practically *nil*, the air being simply baffled to and fro within the cylinder, with only an occasional puff through the valves, and that, too, at a speed by no means excessive for ordinary engines. It does not, therefore, "depend entirely upon the speed at which the piston is driven," but as I said in my last letter, it is "simply a question of speed, provided the valves are so constructed as to work at any speed;" that is, they must be positive in action, not depending upon vacuum to open the inlet valves; the clear area of inlet and delivery must be large, certainly not less than one-tenth of the cylinder area, and there must be practically no clearance and port spaces to leave any undischarged compressed air in the cylinder at the end of the stroke. If the valves of Mr. Hawley's air-compressing cylinder comply with these conditions—which are of more importance than facility for removing and replacing—then I admit the volume discharged from his cold air machine will depend entirely on the speed at which the piston is driven.

Again, Mr. Hawley expresses his surprise that I should state that a machine is "no better for working at a low temperature." I did not say any such thing. What does Mr. Hawley imply by "low temperature?" There is nothing whatever in the mere production of low temperature. That is easily done, but it is not everything, as Mr. Hawley will discover in due time. What I said was that it was no use wasting power in the production of extremely low freezing temperatures when it was not required, and, indeed, undesirable to reduce the air as low as freezing point. I can obtain as low a temperature with my machine as any other, but my chief aim and object is to avoid the necessity for doing so. Mr. Hawley says that if air at 18 deg. Fah. is discharged into a chamber of 40,000 cubic feet capacity it will take longer to cool this chamber than if it was discharged into it at 50 deg. below zero. It does not seem to have occurred to Mr. Hawley that this, at any rate, is a question of speed and volume. In any case it is a bad method to cool a large space by the discharge into it of a small concentrated volume of extremely cold air. It produces a shower of snow by the freezing of the moisture in the immediate vicinity of the discharge orifices, and the required temperature is reached long before the whole 40,000 cubic feet have been changed. It is far better to pass the whole 40,000 cubic feet through the machine, returning it at a temperature slightly above freezing point, and abstracting the moisture and impurities from the air during the process.

Mr. Hawley then proceeds to knock over all "Purchaser's" fine arguments about the accessibility of the valves, by showing that, in his own case, it was of no importance whatever, as hardly any time had to be spent on them during a period of nine months. It is true, he says he was only "experimenting" with the machine during that time; so that probably the actual working may not have been much.

It is much against my desire to say anything in disparagement of Mr. Hawley's machine, or in any way tending to damage his interests or interfere with his plans; but his name was brought up by "Purchaser" with the object of instituting and publishing unfavourable comparisons with my machine, and I simply defend myself.

Referring to the remarks of "Octopus" on Mr. Lightfoot's principle of stage expansion, I would simply remark that though at first sight very elegant in theory, it is upon examination of very doubtful advantage. It seems to me that the partial relaxation of pressure would enable the air to take up and absorb probably as much moisture as the partial lowering of temperature would tend to discharge by condensation. In my machine I get rid of all the natural moisture by abstracting it from the air while compressed, and so discharged out of the air as from a sponge when compressed, and this is fully effected without the complication of an intermediate cylinder, which really appears to me like "flogging a dead horse."

I am much surprised at the style of argument adopted by Mr. T. B. Lightfoot, who writes you on the above subject. He applies my remarks as to the frosting over of the valves of the expansion cylinder and consequent necessity for daily examination as though they referred to my own machine, whereas those remarks applied to the Water Injection Machines, and I distinctly stated that such was not the case in my machines, inasmuch as there was no water injection, and even the natural moisture was collected and drained off from the air while under pressure and before it reached the expansion cylinder. I never questioned the desirability of having the compressor valves accessible. I contradicted the statement of "Purchaser" that my valves were not accessible, though they might appear so at first sight, and until the proper *modus operandi* was explained; and I stated that though accessibility was desirable, it was about the least important point to be considered in the machine. If the valves do not need examination more than once in six months, surely it is of very little consequence whether the taking out and replacing occupies three minutes or ten minutes. Mr. Lightfoot's compressor valves (as they appear to be illustrated in the scientific papers) do require clearance, and cannot be efficient at high speeds, as the inlet valves, as shown, are not positive in their action, depending upon vacuum to lift them. Mine are positive in action at any speed, and require no clearance whatever. Besides the great advantage of increased speed and increased duty thus attainable, there is a positive gain at every stroke the piston makes, and these advantages far outweigh a few minutes' difference in removing valves on the rare occasions when it ought to be necessary.

Mr. Lightfoot says it will be "news" to most of your readers that the expansion valves may require daily examination. If this is "news" to Mr. Lightfoot he cannot know much about Water Injection Cold Air Machines. I have known such machines stopped after a few hours' run by the blocking up of the expansion cylinder valve with ice, which had to be chipped out of the valve box with a chisel before the machine could be started again. This is also a common experience in mines, and invariably more so where water injection compressors are used than with dry compressors. These facts are totally at variance with the extraordinary theory enunciated by Mr. Lightfoot, that water injection tends rather to dry the air. I entirely dissent from Mr. Lightfoot's very positive statement that because air at 30 lb. absolute pressure will hold just double the amount of water in solution as air at 60 lb absolute, I shall have double the loss from condensation and freezing. This proportion does not hold good in practice, the natural moisture being only a limited quantity, and the bulk abstracted at a moderate pressure, and there can be no freezing if I keep just above freezing point, although I am not, as Mr. Lightfoot implies, confined to this or any particular temperature or pressure.

My machine is not tied to the one temperature of 18 deg. Fah. nor to one pressure of 30 lb. absolute. In most cases that pressure will be found enough to render the air sufficiently dry and cold. I consider it of importance to pass the whole contents of the cooling chamber through the machine as rapidly as possible, for the purpose of abstracting the moisture therefrom and the organic impurities which always find their home in that moisture. "Purchaser," to whose letter I was replying, seemed to regard accessibility of valves and low temperature as the whole desiderata of cold air machines. It is quite possible to accomplish both these objects and yet render the air unfit for food preserving purposes.

Mr. Lightfoot goes on to state that it would require 10,000 cubic feet of air from my machine to effect the same cooling as 1000 cubic feet from a machine of ordinary construction and ten of my machines to do the work of one of the others. I dispute the accuracy of his figures. Even supposing them to be correct, it does not follow that ten of my machines would be required to one of the others, for my machine is capable of running at nearly three times the effective speed of the others. It is also partly a question of time; if a rapid reduction of temperature is required, I can give it with my machine. If rapidity is not essential I prefer working at a lower pressure and taking in more volume for the same power. Theoretically the power required to abstract so many units of heat is the same in either case. But as it is well known that working at higher pressures involves more loss of power than working at low pressures, I prefer the latter plan whenever it can be applied with advantage.

3, Westminster-chambers,
London, S.W.

John Sturgeon.

PENSIONS FOR INDIAN ENGINEERS.

We are in a position to state, says the *Indian Daily News* of December 10th, 1881, that the Government of India has decided to recommend to the Secretary of State that the pensions of civil engineers in the Public Works Department shall be as follows:—

Rs. 1000 a year after ten years' service, increasing by increments for each year of service to—

Rs. 1500	a year after	15	years' service.
,, 2500	,,	,,	20	,,	,,
,, 4000	,,	,,	25	,,	,,
,, 6000	,,	,,	30	,,	,,

Voluntary retirement to be allowed at any time after the completion of twenty years' service.

The effect of these proposals, if sanctioned, will be to materially reduce the pensions of all civil engineers who may have to retire before the completion of eighteen years' service; to reduce the pensions of all above the rank of executive engineer who may retire before the completion of twenty-two years' service, or between twenty-five and twenty-seven years' service, and to place them in a worse position than all other officers of the uncovenanted service on the same salaries.

In March, 1880, we published a scheme for the reorganisation of the department, drafted by Colonel William Trevor, R.E., and passed by a committee of Royal Engineers appointed by the Government of India; and we then pointed out that no civil engineer had been placed on the committee, or been consulted on the matter. This scheme collapsed directly its publication enabled those outside the secretariat to criticise it, and even the Government of India felt obliged to repudiate having fathered the proposals of a committee that was actually ignorant of the increments of pay that a first-grade executive engineer was entitled to draw. The Royal Engineers, who have drawn up the present scheme, and the average of whose ages is probably over fifty-five years, are apparently incapable of learning experience from the past, and have remained true to their former principle of consulting and considering no one but themselves. They have had the advantage of spending the first five years of their so-called Indian service at Addiscombe and Chatham, and the last ten in the hills, and have further had the privilege of counting the whole of their leave in England, without any limit whatever, as Indian service. Their entire service may therefore be taken to be equivalent, as regards wear and tear of the constitution, to that of a civil engineer of about twenty years' standing; and for this they receive pensions double in amount of that a civil engineer can possibly obtain, with the further immense advantage of being paid in gold instead of in silver.

We believe that it is the opinion of every competent officer in the department, and that it would not be denied by those who advised Government in this matter, that it is to the interest of the State that any officer of the department who does not reach the rank of superintending engineer before the completion of twenty-five years' service should receive a pension that will induce him to retire. In fact, we doubt whether it is advisable to offer any increased pension or other inducement to any officer of the department to remain who has served twenty-five years in the plains of India.

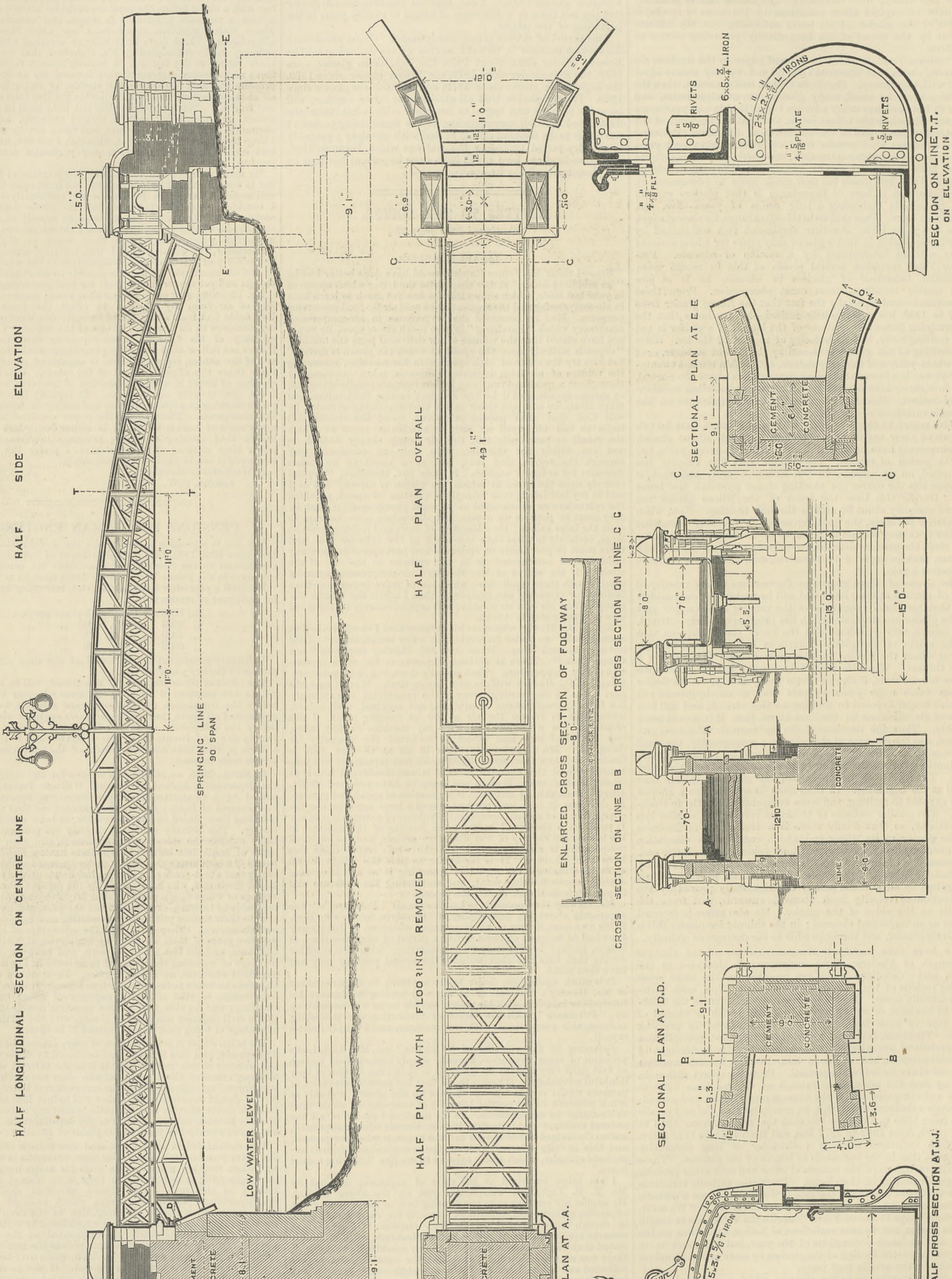
The radical defect of the proposed new rules is that they hold out every possible inducement for men to remain to an advanced age, when they are more or less unfit for active duty, and when the engineering school in which they were trained has become a thing of the past. The almost universal desire to quit the department which at present exists amongst civil engineers is, we have reason to know, due to the deep mistrust of the Government of India, and was engendered by certain flagrant cases of jobbery, on which we commented at the time they occurred, and to the breach of faith to reduce the number of Royal Engineers, which was promised in 1879, when over 200 civil engineers were swept out of the department. If the promise of 1879 is kept—and we understand that there is some intention of doing so by re-opening the warrant of 1878—and if there is no recurrence of systematic jobbery, the past will soon be forgotten, and good men will have no wish to leave the service of the State.

If the scheme now put forward is all that the united wisdom of the elderly gentlemen who at present comprise the Government of India in the P. W. D., can produce, it would be far better that they should leave the subject alone; and that the department should wait until, in the ordinary course of nature, they are replaced by younger men, who are capable of taking a broader and more intelligent view of the situation. To give an idea of the effect of the proposed new rules, we may mention that under them the senior secretary to the Government of Bengal, who in rank is the senior civil engineer in the department, will, on retiring at the age of fifty-five years, receive a pension of Rs. 1500 a year, or about £10 a month; whereas if he belonged to any other branch of the Uncovenanted Service, and drew only half his present salary, he could obtain a pension of double that amount. We can only hope that he and others similarly situated will long live to enjoy the liberal pensions that the new rules will provide for them.

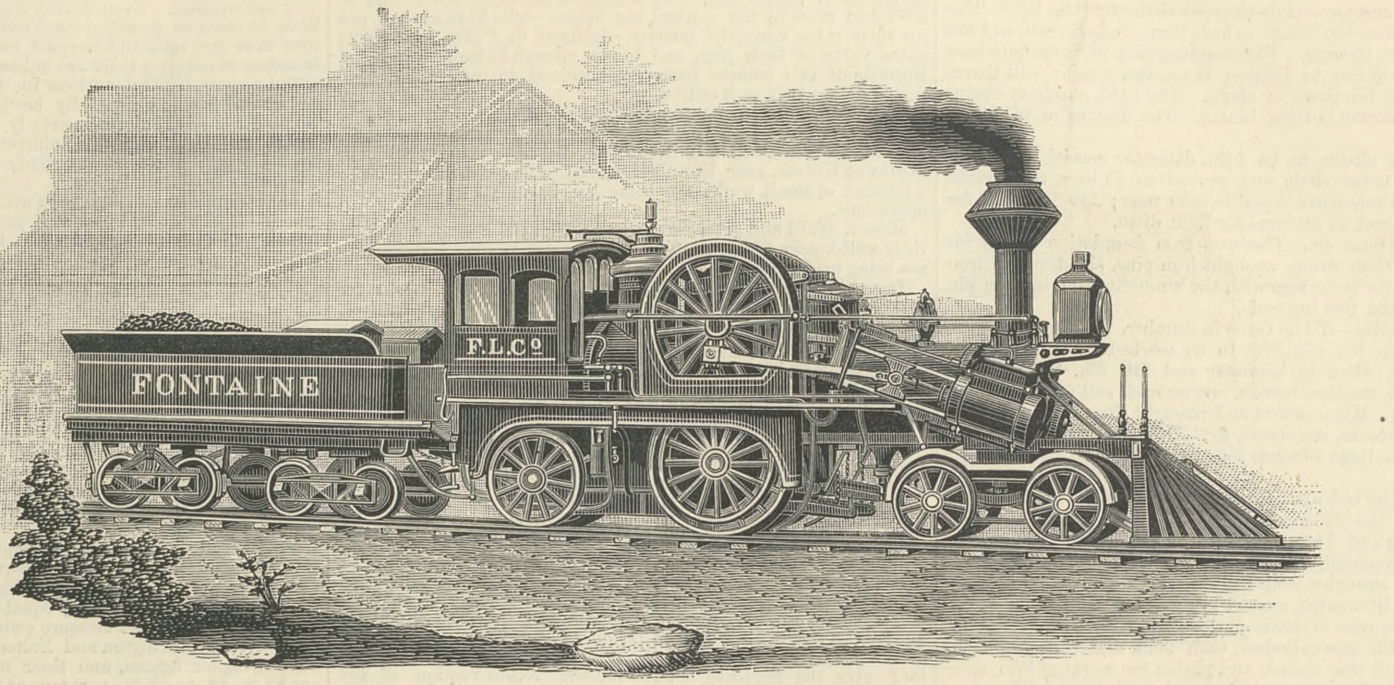
FOOT BRIDGE OVER THE RIVER WELLAND, AT STAMFORD.

MR. J. B. EVERARD, C.E., LEICESTER, ENGINEER.

(For description see page 33.)

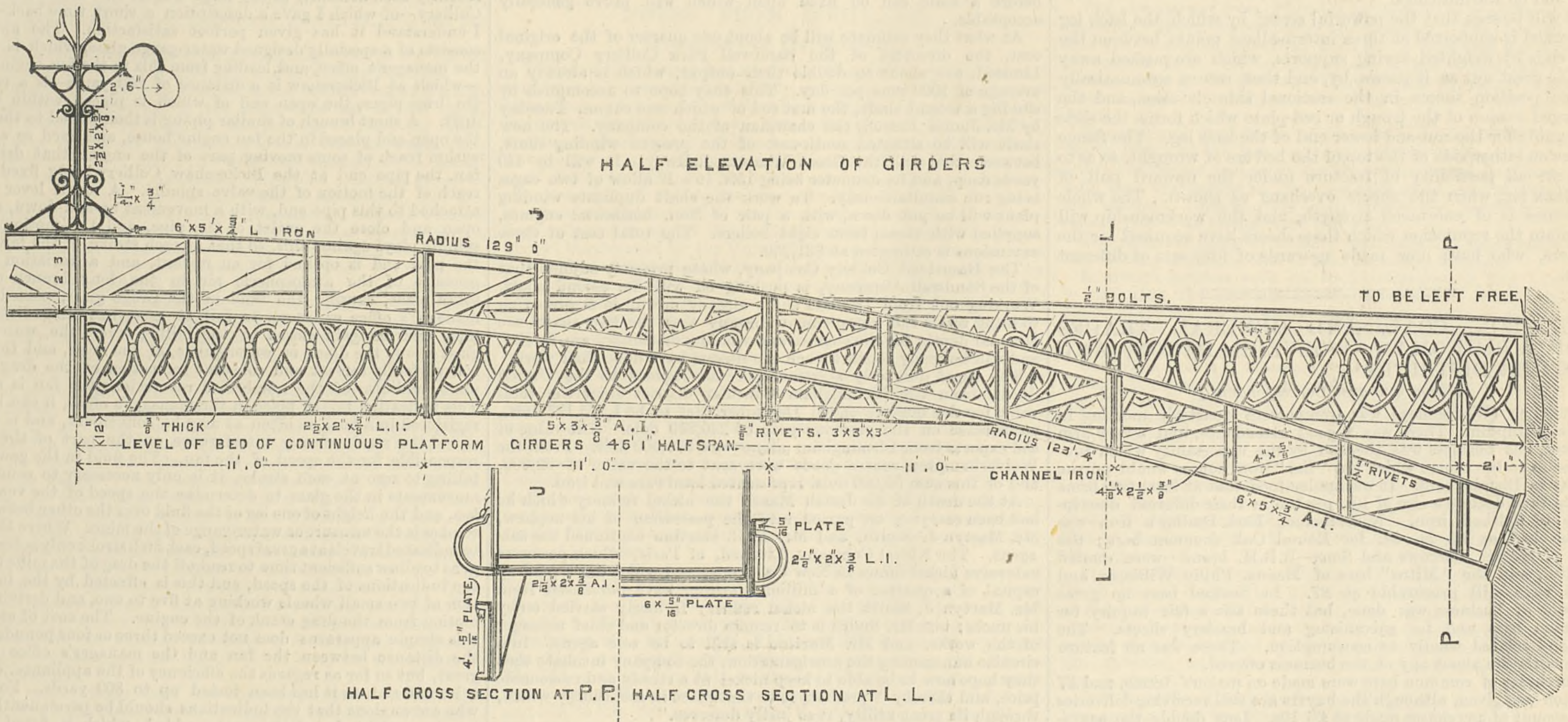


THE FONTAINE LOCOMOTIVE.



A GREAT deal has been heard recently in the United States about the Fontaine locomotive. The engraving above illustrates it. We need scarcely add that it is a mechanical absurdity, but all the more interesting for that reason. It shows what blunders even clever engineers can make when they are ignorant of the fundamental principles of dynamics. The machinery, instead of being below the boiler, is almost entirely above it. There are three pairs of driving wheels, but only two rest on the rails. The third pair are on top of the boiler, directly in front of the cab. These wheels are termed the "main drivers," and the power is communicated to them from the cylinders. The steam chests and cylinders are set at an angle of about 45 deg. on the sides of the boiler. The trailing wheels are coupled, 4½ft. in diameter. The forward pair are called the "lower drivers," and are double. The main part of each wheel is 6ft. in diameter. The other part, which is a separate wheel, inasmuch as it does not come in contact with the rails, although in the solid casting, is known as the friction wheel. It is 4½ft. in diameter, and is supplied with a steel tire, the same as the others. The main drivers stand upon the friction wheels and transmit the motive power to them. The main drivers run in one direction, and turn the friction wheels and lower drivers in another. In order to prevent the wheels from slipping, and thus losing motion, steam pressure is applied to the main drivers to hold them down upon the wheels beneath. The force can be increased from the simple weight of the wheels to 16 tons at the will of the engineer, who is governed by the length of the train the locomotive may be drawing. The diameter of the truck wheels under the front end of the engine is 40in. Otherwise the Fontaine does not differ materially from the ordinary locomotive. The whole affair weighs 38 tons. The cylinders are 17in. by 24in. in dimensions. The pressure of steam carried when running is 130 lb. A velocity of sixty miles per hour has been obtained.

FOOT BRIDGE OVER THE RIVER WELLAND, AT STAMFORD.



IN July, 1880, the valley of the river Welland was visited by a storm which caused a flood higher than had been known for 200 years. At Stamford the river rose 10ft. higher than its ordinary level, and washed away an iron foot bridge of 80ft. span erected as a memorial to the late Prince Albert, depositing the whole of the superstructure in the bed of the river some distance below its proper position. The bridge was a very light arched structure, and about 5ft. 6in. wide. Although the water did not rise above the platform of the bridge, the hay and other matter brought down filled up the spandrils of the arch, and it is supposed some large object coming down with the flood finished the work which the accumulation of *débris* had prepared.

Considerable discussion took place in the Town Council as to whether the bridge should be replaced by a foot bridge or a road traffic bridge, and a report with drawings was obtained from Mr. J. B. Everard, C.E., of Leicester, upon the subject. It was finally decided, in consequence of the considerable cost of a road bridge and the necessary approaches, to rebuild the foot bridge, and this has now been done from the designs and under the superintendance of Mr. Everard, and we give some illustrations of the work herewith and on the opposite page. These illustrations are complete in themselves, and require no explanation.

The bridge and abutments have been entirely rebuilt, it being considered advisable to increase the span and to widen the structure. In view of the disaster which befel the first bridge, it was considered advisable to keep the whole structure well above the water; and as the council objected to raising the level of the platform, a simple arch was out of the question; but as a straight girder bridge of the necessary depth would have had an unsightly appearance, particularly where the girders joined the abutments, a compromise was effected by putting in arched girders at a high level and carrying the platform between, and the result justifies the method adopted. The construction of the bridge will be readily understood from the illustrations, the whole of the weight being taken by the arched ribs, which are strongly braced together partly under the platform and partly by the central cross-brace which carries the gas lamps. The clear span is 90ft., and the width of the platform 8ft. The abutments are largely composed of concrete. The platform is cement concrete covered with Val de Travers' asphalte, the concrete enclosing the cross rolled iron joists, but having no plates underneath.

The cost of the structure has been between £700 and £800; the contractor for the builders' work, Mr. C. Hinson, of Stamford; and for the ironwork, Messrs. Dawson and Nunneley, of Hunslet, near Leeds; Mr. T. J. Ward, of Stamford acted as clerk of works.

SHEERS TO LIFT 150 TONS.

THE engravings on page 24 illustrate the most powerful sheer legs ever constructed. These have been recently completed and sent out to Cronstadt for the Russian Government by Messrs. Day, Summers, and Co., of the Northam Ironworks, Southampton. To this class of lifting machinery Messrs. Day, Summers, and Co. have for several years devoted special attention, and have made a large number of sheer legs for loads up to 100 tons. Three sets for this load have within the past year been made by them for the Spanish Government, one set being erected at the Carthagena Dockyard. Another has been erected at Ferrol.

The Carthagena sheers were tested on the 24th of September, and what is called an imposing religious ceremony took place on the occasion. An altar was erected alongside the machinery, and when the weight—composed of anchors and chains—was suspended the religious ceremony commenced in the presence of all the dockyard officials in full uniform, and many hundreds of spectators, military band, &c. The thing, of course, went off quite well.

We recently visited Messrs. Day, Summers, and Co.'s works when these large sheers for Cronstadt were in course of completion, and were strongly impressed with the insufficiency of any drawings we could prepare in conveying an adequate size of this monster lifting appliance. The front and back legs were in parts, which covered the large yard with what seemed like a large number of cylindrical boiler shells up to 5ft. in diameter. The engines and other parts are of a very powerful description; and the hauling drums of unusually large diameter, so that no undue strain shall be thrown on the chain or ropes used. It has been decided to use Bullivant's patent steel wire rope, for the two main purchases will be 6in. circumference, and that for the light purchase 4in. in circumference.

To describe the sheers we cannot do better than give the following extract from the specification to which they were constructed:—

Front and Back Legs.—The front legs to be parabolic spindles, 22½in. diameter at their ends, 56in. at the middle, and 123ft. long. The back leg to be a parabolic spindle, 30in. at ends, 60in. at middle, and 155ft. long, with wrought iron steps on its top side. To be made of best boiler-plate; overhang from quay wall to be 40ft. The legs to be finished in convenient lengths for shipment.

Blocks.—The sheers to have four upper blocks, two for the main purchase and two angle-sheaved ditto for the light lifts. The main purchase top-blocks to have three sheaves each, and the bottom ones two sheaves. The standing part of main purchase chain to be made fast to bottom block, the weight will therefore be taken by ten parts of chain. The light purchase chains to have single sheave bottom blocks. The sheaves of blocks to be of cast iron.

Chains.—The chains to be 1¾in. diameter special made best best short link crane chain and proved to 45 tons, the weight being taken on ten parts equal to 450 tons; 250 fathoms for main purchase, and 65 fathoms for light ditto.

Foundation Plates, &c.—The cast iron foundation plates for front legs with their strong wrought iron pins, also the cast iron shoes and caps for front legs with the wrought iron bolt or pin for connecting the two top ends.

Hoisting Winches.—To be three in number, two for main purchase and one for ten ton lifts, to be worked by main engine, smooth barrels, 42in. in diameter and 8ft. 6in. between the flanges, and two smaller barrels, one on each end of the spindle for light whips. Worm-wheel and wrought iron worm, thrust, and plummer blocks, standards, &c. Provision to be made for working the two large winches together to ensure them lifting simultaneously.

Bed-plate.—The bed-plate for back leg to be of the best cast iron, planed on the sliding surface. To have a wrought iron screw 57ft. long and 11½in. diameter, with gun-metal nut and wrought iron crosshead, fitted with guide shoes. The top guide plates to be of wrought iron hammered bars, planed on guide faces. A sheet iron cover, curved to throw off rain.

Engines.—One pair of horizontal steam engines for working the back leg, with two cylinders, each 20in. diameter and 18in. stroke, fitted with link motion and pinion for working into spur wheel keyed on long screw. Two pairs of horizontal steam engines for working hoisting winches, each with two cylinders, 18in. diameter and 15in. stroke.

Boilers.—The boilers to be three in number, 6ft. 7in. diameter and 12ft. long, fitted with brass tubes, and constructed to work at 60 lb. pressure and tested to 120 lb. per square inch, To be fitted with three gauge cocks, glass water gauge, steam gauge, two safety valves, steam stop valve, blow-out cock, and non-return feed valve. The back tube plates, tops, and sides of furnaces and flame-box to be of Lowmoor iron or equal quality. the other parts of the boilers to be made of best Staffordshire boiler plates; boilers to be complete with funnels and up-takes.

Donkey Engines.—Three small donkey engines for feeding boilers; cylinders, 7in. by 7in.

Boiler Seats.—Four cast iron seats for each boiler.

Holding Down Bolts.—The necessary holding-down bolts with nuts, washers, and cotters.

Since this specification was written and our illustration prepared, it has been decided, as above stated, to employ wire rope in place of the chains, of the dimensions given in the specification and on the drawings.

It will be seen that the powerful screw by which the back leg is worked is supported at three intermediate points between the two ends by weighted spring supports, which are pushed away by the great nut as it passes by, and then return automatically to the position shown in the sectional side elevation, and the enlarged section of the trough or bed-plate which forms the slide and guide for the nut and lower end of the back leg. The flange plates on either side of the top of the bed are of wrought, so as to prevent all possibility of fracture under the upward pull of the back leg, when the sheers overhang as shown. The whole structure is of enormous strength, and the workmanship will maintain the reputation which these sheers have acquired for the makers, who have now made upwards of fifty sets of different sizes.

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

(*From our own Correspondent.*)

Yesterday (Wednesday) was ironmasters' quarterly meeting in Wolverhampton. There was a good attendance, and a very firm market, but business was checked by the uncertainty which prevailed as to the course which the "list" iron houses would pursue to-day in Birmingham. It was understood that at least two firms would then declare a rise of 10s. per ton in their different descriptions of finished iron. Nevertheless, Earl Dudley's iron was to be had at £8 2s. 6d. for Round Oak common bars; the bars of Messrs. Barrows and Sons—B.B.H. brand—were quoted £7 10s., and the "Mitre" bars of Messrs. Philip Williams and Sons were still procurable at £7. In marked bars no great amount of business was done, but there was a fair inquiry for common bars and for galvanising and braziery sheets. The demand related wholly to consumption. There was no feature of speculation about any of the business offered.

Purchases of common bars were made on makers' terms, and £7 per ton was given, although the buyers are still receiving deliveries on account of purchases made at £6 10s. Lots double the aggregate of former purchases were bought at the 10s. rise.

Common braziery sheets were secured at £8 5s. per ton, and £8 2s. 6d. for singles, but nothing under £8 10s. would be accepted for galvanising singles, and the majority of makers demanded £8 15s. Doubles were to be bought at £10 and trebles at £11 10s.; in truth, there were men who asked £12. At the same time there were those who were now and then prepared to accept from good customers £9 15s. for doubles and £11 5s. for trebles. Galvanising sheets were mostly from 10s. to 15s. up upon the quarter.

Stamping sheets sold steadily. There was an inquiry for this iron on Australian account. Makers secured their full rates on the basis of £13 as the quoted price for the "Severn" brand of Messrs. E. P. and W. Baldwin.

Hoops could not be obtained at less than £7 10s. at the works. Shropshire fencing rods were £7 10s. to £8 as a minimum, which is a rise of 20s. upon the quarter. Boiler-plates were difficult to buy at £9 to £9 10s.; £9 10s. and £10 being asked by the makers of reputed brands. These higher quotations were made to cover the rise in pig iron.

The Lillieshall and Madeley Wood Company confirmed at Wolverhampton their recent advance of 5s. per ton, making hot blast £3 10s., and cold blast £4 10s. High class Staffordshire iron was not quoted below those figures. Indeed, a few firms quoted £3 12s. 6d. for all-mine iron, and Spring Vale iron was priced at £3 10s., £3, and £2 10s. respectively. Thorncliffe forge pigs were quoted up 2s. 6d. a ton, making the present price 62s. 6d.

The Birmingham quarterly meeting to-day was very numerously attended. The only declared alteration in marked bars was a rise of 10s. per ton in the iron of John Bradley and Co. No such declaration was made by the New British Iron Company, notwithstanding the statement in Wolverhampton yesterday that they had advanced. The galvanisers met and resolved that the lowest price for sheets in bundles in London must be £15 10s.

Both in Birmingham and Wolverhampton the variation in prices tended to keep down transactions. Ironmasters who had not made up their minds what course to pursue hesitated to name their price, or asked rates which consumers would not accept. When prices were quoted which were little or no advance upon those of a fortnight ago, orders were not difficult to secure in most finished departments. A few firms were pressed to give customers the benefit of their having bought at moderate rates a good store of pig iron; but others, who believe in an early declaration of advanced rates by the marked bar houses—who have not yet put up their rates upon the quarter—declined to "give away" the extra value of their pigs, and having enough to keep them going throughout two months longer, determined to remain till that period before they seek orders.

Preparations for augmenting the make of finished iron continue. The Albion-street Iron Company, of West Bromwich, have re-opened the Bateman's Hill Ironworks, Bilston; the Whittington Works at Kinver, near Stourbridge, are to be recommenced; and a number of small works are being got ready for recommencing operations.

Messrs. Ward and Sons are preparing to put in a furnace to make their well-known brand of all-mine iron; and similar preparations are being made by Messrs. Philip Williams and Sons.

The Lillieshall Company is proceeding with its works for making steel with their own iron direct from the blast furnace, partly upon the Thomas-Gilchrist system, and subsequently with machinery designed by Mr. Lloyd, the manager and engineer of the company. The process, it is believed, will prove more economical and simpler than the methods hitherto in vogue. Elementary trials have proved highly gratifying, resulting in the rolling of sheets of 24 w.g. which have taken a very deep stamp; and plates of over ⅜in. in thickness have lapped over in every direction without the slightest trace of flaw.

Yesterday there were some successful experiments at the Round Oak Works of the Earl of Dudley with the Dupuy direct process, in the presence of foreigners, engineers, and others.

The operative ironworkers of this district are moving for an alteration in the basis of the present wages scale, which is worked by the Wages Board constituted of a committee of masters and men respectively. At a large representative meeting at West Bromwich on Monday, where the secretary of the men's committee delivered a lengthy address in favour of the existing method of determining wages, it was resolved—"That the operatives' secretary give the requisite notice for the reconstruction of the wages basis, with the view of getting a fresh sliding scale which would include all classes of iron in regulating the wages; and that an advance of 1s. in the £ be claimed in addition to the equal shillings to equal pounds." A second meeting is to be held at Wednesbury, on Monday next, when further force will be given to this resolution by the men in that portion of South Staffordshire.

Representative masters' and miners' agents have come to an agreement upon the new sliding scale for the regulation of miners' wages in the old South Staffordshire district. Hitherto wages have been paid under what is termed the "Birmingham Agreement." The scale in that agreement is now modified to the following:—"When thick coal is 9s. per ton wages shall be 3s. for thick and 2s. 6d. for thin per day; and when thick coal is 10s. per ton wages shall be 3s. 4d. for thick and 2s. 8d. for thin per day." This arrangement yields an increase of 4d. thick and 2d. thin for every 1s. above 9s. Should the selling price fall below 9s. the reduction in wages for every 1s. fall is to be 3d. for thick, and 1½d. for thin. This new scale should have come generally into force on the 1st inst., and wages were paid according to it only at the leading collieries. Some of the colliers, however, have decided against it, and it looks as though there must be a meeting of representative masters, mining engineers, and miners' agents before a scale can be fixed upon which will prove generally acceptable.

At what they estimate will be about one quarter of the original cost, the directors of the Sandwell Park Colliery Company, Limited, are about to double their output, which is already an average of 1000 tons per day. This they hope to accomplish by sinking a second shaft, the first sod of which was cut on Tuesday by Mr. James Bessell, the chairman of the company. The new shaft will be situated south-east of the present winding shaft, between that and the Great Western Railway. It will be 440 yards deep, and its diameter being 15ft. it will allow of two cages being run simultaneously. To work the shaft duplicate winding plant will be put down, with a pair of 36in. horizontal engines, supplied with steam from eight boilers. The total cost of these extensions is estimated at £31,250.

The Hamstead Colliery Company, whose property adjoins that of the Sandwell Company, is pushing on with its second shaft. Working out from the one shaft already down, it is preparing to bring up its full complement directly that the two shafts are of equal depth, for the engines and winding machinery are *in situ*, and will be ready to start when the sinkers have done their work.

The usual quarterly statement of the exports to the United States from the Birmingham Consular district show the total value for the quarter ended December 31st to be 1,275,197 dols., an increase on the previous year of 240,819 dols. The value of the exports from Birmingham alone was 970,000 dols. From the Wolverhampton centre goods were sent to the value of 62,000, and of this sum 53,000 dols. represented hardware and iron.

At the death of Sir Josiah Mason the nickel refinery which he had been carrying on passed into the possession of his nephew, Mr. Martyn J. Smith, and Mr. F. R. Martino continued the sole agent. The Nickel Company, Limited, of Paris, which possesses extensive nickel mines in New Caledonia, and which has a paid-up capital of a quarter of a million sterling, have purchased from Mr. Martyn J. Smith the nickel refinery formerly carried on by his uncle; but Mr. Smith is to remain director and chief manager of the works, and Mr. Martino is still to be sole agent. In a circular announcing the amalgamation, the company intimate that they hope now to be able to keep nickel at a steady and reasonable price, and thereby "promote it to that place in metallurgy which, through its great utility, it so justly deserves."

The wrought iron hinge makers of Tipton and district have given notice for a 10 per cent. advance in wages. The notice expires on the 21st inst.

On Monday the customers of Mr. George Hughes, ships' tackle maker, of Wolverhampton, received a circular setting forth that "net goods and hooks and hinges of all kinds are advanced one shilling per cwt. from this date." It is added, "Discounts remain the same, viz., 55 per cent. ships' tackle, 30 per cent. odd work, and 25 per cent. bicycle work."

A somewhat better state of things is noticeable among the wrought nail makers of South Staffordshire and East Worcestershire. A representative meeting of the Wrought Nail Makers' Association, consisting of operatives from these districts, was held on Blackheath on Monday, and satisfactory reports were received from the various branches. The horsenail makers also have formed themselves into a protection association, or trades' union, for South Staffordshire and East Worcestershire; and at a meeting on Tuesday night at Cradley Heath it was determined to forward a memorial to the employers asking them to increase the wages from 3s. to 3s. 3d. per thousand.

Sir F. Bramwell estimates that the sum needed for the requisite additions to the Smethwick Gasworks and the attendant supply apparatus will be £75,382. At a meeting of the board on Monday, Sir Frederick's estimate was passed over to the gas committee.

The Birmingham, Tame, and Rea District Drainage Board are sparing no expense to bring the area over which they have control into good order. The estimate just issued sets down the probable expenditure of the board during the coming year as £28,754, a sum in excess of last year's estimate by some £8700.

As 'Change closed in Birmingham this afternoon it transpired that the quarterly meeting of the tin-plate trade had been held. Nearly forty works were represented. The price of coke plates was fixed at 19s. per box delivered in Liverpool, and charcoal plates 23s., as compared with 16s. and 19s. respectively at the last quarterly meeting. This advance has been rendered necessary by the increased cost of pig iron and tin, the latter being fully £12 a ton dearer than three months ago, and pig metal from 10s. to 15s.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—The general trade prospects of this district continue very encouraging. Even during New Year week, when usually as little is done as possible, large consignments of goods were being sent over the rails to Liverpool for shipment, and in nearly all branches of industry there are indications of reviving activity which afford a most hopeful outlook for the ensuing year. In the iron trade business has naturally been restricted during the week, pending the result of the quarterly meetings; but any absence of business is due more to the indisposition on the part of makers to book further, to any large extent, at present rates, than to any want of inquiry from buyers.

Lancashire makers of pig iron are open to book orders up to the end of March at 51s. per ton, less 2½ per cent., for forge and foundry qualities delivered equal to Manchester, but they still decline to go beyond the present quarter, although considerable orders of late, which have gone elsewhere, would have been placed in their hands if local makers had been willing to concede more extended deliveries.

In district brands, such as Lincolnshire and Derbyshire, some of the makers, I understand, have been selling largely over the next six months, and having now very little iron to offer have put up their prices to a figure which is only being obtained in odd cases, where outside buyers who have been holding back are absolutely compelled to cover. For delivery into the Manchester district the quoted prices for Lincolnshire and Derbyshire brands range from 52s. and 53s. up to 56s. and 57s. per ton, less 2½ per cent. For Middlesbrough iron delivered equal to Manchester the prices quoted during the week have ranged from 42s. 4d. up to 43s. 4d. per ton net cash.

Finished iron makers report a continued good inquiry, and this is not only on account of iron required for shipment, but home consumers are increasing their orders. Wigan district bar iron is still being offered for delivery equal to Manchester at about £7 per ton, but this is in part measure owing to the recent re-starting of works. The Warrington and Bolton makers, however, are holding out for higher figures, and their minimum quotations this week are £7 2s. 6d. to £7 5s. per ton, at which figures business is being done.

The general improvement in the cotton trade, which is bringing about an increased demand for new machinery, and the projected new mills in the district, are making the Lancashire machinists, who for a considerable time past have been kept mainly employed on foreign orders, busier on local work; but I do not, as yet, hear of much actual spring in prices.

In connection with the projected new mills tolerably large orders for fire-proof work have recently been placed out in this district.

A very simple but effective apparatus for indicating and recording the speed of colliery ventilating fans was exhibited and described by Mr. H. Hall, Inspector of Mines, at a meeting of the Manchester Geological Society, held in Wigan on Friday. Where, through carelessness or neglect, even a temporary slackening off in the ventilation might result in fearful disaster, it is scarcely needful to point out the importance of some automatic arrangement, safe from being tampered with, for indicating at all hours of the day the speed at which the fan is being driven, and the indicator or "tell-tale," which is the invention of Mr. Hall, has been designed with this end in view. The apparatus can be fitted up in a few hours by any colliery mechanic, and one of these appliances has recently been attached to the large Guibal fan at the Bickershaw Colliery—of which I gave a description a short time back—where I understand it has given perfect satisfaction. The apparatus consists of a specially designed water-gauge glass, which is fixed in the manager's office, and leading from this to the fan engine-house—which at Bickershaw is a distance of 200 yards—is a range of ¾in. iron pipes, the open end of which is placed within the fan drift. A short branch of similar piping is then joined to these, and the open end placed in the fan engine house, and fixed so as to be within reach of some moving part of the engine that drives the fan, the pipe end at the Bickershaw Colliery being fixed within reach of the motion of the valve spindle. A small lever is next attached to this pipe end, with a movement up-and-down, so as to open and close the outlet of the pipe, and the motion of the spindle plays against this, so that at each stroke of the fan engine the pipe end is opened for an instant, and a variation in the pressure of the atmospheric air in the long branch of pipe takes place, causing the fluid in the gauge glass, placed in the manager's office or room, to fall to zero, but immediately the pipe end is again closed by the falling lever, the water-gauge glass shows the drag, or water-gauge, of the mine, and the result is a perfectly correct and constant indication of the drag of the mine, and also of the number of revolutions the fan is making. This indication taking place in the manager's office, it can be there registered in a book as often as may be convenient, and is entirely out of the reach of any interference on the part of the person responsible for the speed of the fan. The fluid in the gauge glass falling to zero at each stroke, it is only necessary to count these movements in the glass to determine the speed of the ventilating fan, and the height of one leg of the fluid over the other between the strokes is the measure or water-gauge of the mine. Where the fan to be indicated travels at a great speed, each fifth stroke only is dealt with, so as to allow sufficient time to read off the drag of the mine between the indications of the speed, and this is effected by the introduction of two small wheels working at five to one, and deriving their motion from the drag crank of the engine. The cost of attaching this simple apparatus does not exceed three or four pounds, unless the distance between the fan and the manager's office be very great, but so far as regards the efficiency of the appliance, distance is immaterial, as it has been tested up to 800 yards. For those who are anxious that the indications should be permanently registered, an eight day clock can be added, which is fitted with a revolving brass cylinder carrying a diagram paper upon which a spiral line is drawn by a pencil, showing the number of revolutions of the fan and the water gauge during any and every hour of the day or night.

Safety lamps, in consequence of the recent explosion at Abram, were also prominently before the same meeting, and Mr. Hall exhibited specimens of the new tin-can—Davy—safety lamp, which has recently been largely introduced into the North of England collieries. This lamp consists of an ordinary Davy placed within a tin cylinder or lantern, perforated at the bottom for the admission of air and open at the top, the light being passed through a glass window in the cylinder. Mr. Hall considered this to be the safest lamp that could be obtained, as the outer cylinder not only made it a double-locked lamp, but protected it against the action of any air current travelling at a high velocity, and from risk of accident in the mine. He hoped that if the Lancashire mineowners approved of the lamp they would not be slow in adopting it. Mr. Wm. Smethurst, who is well known for his experiments with safety lamps, admitted that this new form of Davy was a great improvement, and if the perforated holes were not put too high up, as they sometimes were in the tin cylinder, it was a safe lamp. There was, however, a tendency for dust to lodge within the cylinder and thus obstruct the light. He was in favour of a properly constructed Muesler, with a double disc for the chimney to rest upon and a narrow top to the chimney, and then they had a perfectly safe lamp. He thought, however, that Government should insist on certain lamps now used in mines being abandoned and then they would have a better lamp. Mr. W. Pickard, formerly miners' agent in this district, objected, from a working man's point of view, to the new tin can lamp. The Davy was dark enough already without adding further complications, which, though they might lessen danger in one direction, would probably aggravate it in another. He hoped the Lancashire mine owners would not take into consideration the adoption of this form of lamp.

The proposed scheme for bridging over the Irwell opposite the new station, which is being built on the Salford side of the river by the London and North-Western Railway Company has been practically abandoned, and the company are now proceeding with their original plans sanctioned by Parliament, the only improvement which is being carried out being the setting back of the river for a distance of 20ft. at this point.

The coal trade continues extremely dull so far as house fire classes of fuel are concerned. There is, however, a good demand for iron making and other trade purposes, but supplies of common coal are still very plentiful. The only description of fuel at all scarce in the market is the better quality of slack. Prices for round coal are weak, common sorts being in cases as low as 5s. per ton at the pit, but in quoted rates there is no material change.

Barrow.—When the present outlook of the hematite pig iron market is thoroughly examined, I think it must be admitted by all that the prospects of good trade for 1882, which have been shadowed forth, and which I have often noted, are of a most satisfactory character. At this time last year the position was not quite so promising as it is at present, for to-day we find that the demand from all quarters shows not only an increase, but every likelihood of this increased demand for some time to come.

America has increased her demand very considerably, and the inquiry promises to be even yet larger. The continental inquiries likewise show an increase, and the deliveries to Russia, France, and Germany will be very heavy. The colonies also have increased their demand. Altogether the position of the market is good, and a very good and steady business will be done for a considerable period. Prices are: No. 1 Bessemer, 64s.; No. 2, 62s. 6d.; No. 3 forge, 61s. These prices, however, do not give a correct indication of prices, as many of the makers are getting higher figures than these. I know that in one or two cases makers have secured 67s. 6d. per ton for best samples. The deliveries at present are large, and when the season is more advanced deliveries will be very heavy. Steel works are in receipt of good work, and the mills are busy. Iron-shipbuilders are likely to find plenty of employment shortly. Other industries steadily employed. Iron ore in good demand. Coal and coke firm.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

At the beginning of the year I expressed the opinion that there would be a steady increase of trade all during the season, and that the gloomy anticipations expressed as to the business with the United States would not be justified by actual experience. Dr. Webster, the United States Consul at Sheffield, has just completed his return of exports from this district for the month ending December last. This return bears out the anticipation formed at the commencement of the year. The export of Sheffield goods to the United States shows a total of £1,462,057, as compared with £1,075,242 for 1881. On the month of December there is a large increase as compared with the corresponding month of 1880—the values being £128,371 and £77,337 respectively. The quarter shows a total of £304,977, as compared with £241,406. It is scarcely satisfactory to observe, however, that the increase is mainly in steel rails and similar heavy goods, there being only a slight improvement in cutlery, and a distinct falling-off in steel. On the other hand, it is noteworthy that the return for 1881 is the largest since 1873, and has been exceeded by only two years—1873 and 1872. The totals from 1872 are as follows: 1872, £1,734,628; 1873, £1,659,773; 1874, £1,263,048; 1875, £691,232; 1876, £475,696; 1877, £479,594; 1878, £429,016; 1879, £691,723; 1880, £1,075,242; and now in 1881, £1,462,057. The highest point in our trade with the United States was touched in 1872, and the lowest in 1878.

The value of steel—not including steel rails—sent to the United States during the year was £391,137, and of cutlery £314,191.

A curious stage has been reached in the colliers' wages dispute. As arranged, a deputation of the coalowners sat at the Royal Victoria Hotel last Tuesday, for the purpose of receiving representatives of the Miners' Association, to talk over the wages question. Messrs. Pickard and Frith presented themselves on behalf of the Yorkshire Miners' Association, Mr. Wm. Chappell appeared for the Sheffield and Rotherham District Association, and Mr. Philip Casey for the South Yorkshire Association. Messrs. Pickard and Frith demanded that their representatives should have a separate interview. The coalowners were proceeding to consider this request, when these two delegates abruptly left the room, and the business was proceeded with in their absence. The coalowners declined to consider any advance in wages on the ground that there had been no increase in the value of coal to warrant any rise in their rates of remuneration; but with a view to settle the question they renewed the terms of an offer made in 1881, to the effect that their books should be placed in the hands of accountants with a view to ascertaining the net selling price of coal; that if an advance was shown wages should be increased 2½ per cent. for every complete 4d. per ton advance until the fifth advance, when the increase should be 5 per cent., so that for every 1s. 8d. advance the miners should have 15 per cent. more wages. The coalowners also offered the men the principle of the sliding scale. Messrs. Chappell and Casey accepted the proposals subject to the approval of their constituents. Mr. Pickard and Mr. Frith subsequently reappeared and requested a separate interview. They were informed that the business was over, and rebuked by the chairman of the coalowners for their discourtesy in abruptly leaving the room. They were also informed that if they desired a separate interview they must make application for it again and it would be considered. The settlement can scarcely be called a definite one, as Messrs. Pickard and Frith represent the great majority of the miners in South Yorkshire.

In the cutlery trade there has been an increase of orders this week, and colonial requirements are rapidly extending. Considerable supplies of horns have arrived at Liverpool and London, but holders stand out stiffly for recent advances in prices. There is a noticeable improvement in the Australian trade, both in respect of steel for tool purposes, and heavy cutlery and spring goods, with every indication of further good orders during the spring. Several excellent orders for light files have been placed for the East Indies, a market which is again becoming active, the demand for the principal centre, Demerara, being especially gratifying.

No. 1 Bessemer billets have advanced to £9 17s. 6d.; ordinary billets £6 14s. 6d.; and even higher rates are beginning to be asked. Bessemer prices are bound to go higher.

Shares in steel and iron concerns have been very firm during the week—particularly Brown's and Jessops, the latter having been freely done at par, and now quoted at a premium. A good dividend is expected. Local holders of Ebbw Vale shares were gratified this week by a circular from the trustees for the mortgagees and debenture-holders, stating that after paying off debentures during the year amounting to £36,200, a surplus balance remained in the bankers' hands of no less than £58,673.

The Union Grinding Wheel Company is to pay its shareholders 20s. per share for the half-year ending December last.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

TUESDAY last was quarterly meeting day at Middlesbrough, and the Exchange had an unusually animated appearance. Consumers seemed much more anxious to buy than has been the case for some weeks, and indeed a very considerable amount of business was transacted, and that at somewhat enhanced prices. The general figure for No. 3 iron for prompt delivery was 43s. 9d. per ton, but in some cases 44s. was given. Makers' were much firmer in their prices than merchants, and asked from 44s. 3d. to 44s. 6d. For forward delivery the prices were from 44s. to 45s. The improved tone of the market is partly in sympathy with Glasgow and partly because there have been rumours of inquiries from America. The unusually mild weather for the time of the year has also facilitated every kind of outdoor work, and this in turn has helped the demand for all materials including iron. Connal's warrants are somewhat higher in price, the figure paid on Tuesday being 44s. 6d. for f.o.b. brands. The quantity of iron in store had diminished by 103 tons, leaving 176,137 tons still in stock.

The finished iron trade continues in a healthy condition, the amount of contracts on the books of the makers being very considerable, and probably enough to last quite to midsummer. Plates are now quoted at £7 5s., and bars and angles at £6 15s. f.o.t. Middlesbrough less 2½ per cent. Puddled bars are not to be had under from £4 5s. to £4 10s. net. Old rails from £4 to £4 5s.

The puddlers at all the manufactured ironworks at Stockton have given in their notices, not only to the effect that they will no longer fettle their furnaces on Sundays, but also that they intend to cease working on Mondays. This is evidently not a question of having one day's rest to themselves per week—a demand with which they might properly claim the sympathy of the public—but it really means two days idleness out of seven. At the meeting where this matter was discussed, several of the speakers advocated giving in their notices avowedly in order that the production of puddled bars might be restricted. It was said that, if this were done, the employers would be forced to put up the price of finished iron, and that this would dispose them to grant the higher wages which the puddlers intend to have by-and-by. Other speakers pointed out that with these higher wages they could well afford to "play," as they call it, two days per week. What the result of this movement will be no one as yet can foresee. It first effect will evidently be to run up the values of puddled bars and manufactured iron generally; also all kinds of scrap iron, including old rails. Its ultimate effect will very likely be to give an impetus to the manufacture of steel, and its introduction for shipbuilding purposes, to the detriment or supercession of the iron industry. There is, however, still a possibility that the Stockton puddlers—who have acted so far without the authority of their union—will not be successful in enforcing their desire to lay off the forges on Mondays.

The strike of rollers' helpers against the rollers at Newport Rolling Mills has now terminated. The men were brought up before the Middlesbrough stipendiary for leaving work without notice; but the summonses were dismissed on Monday, on the ground that the previous week's holiday had terminated their engagement, and they were not bound to recommence work unless they chose. This unexpected decision will render it necessary to alter the rules of the works. It would clearly be impossible to conduct manufacturing operations unless an employer had power to enforce the attendance of his men at a given date after brief cessations of work desired by them as holidays.

The coroner's inquest upon the death of five men, owing to the explosion of a locomotive boiler at South Stockton, has now terminated. The jury found that the deaths were caused by the explosion of a certain locomotive, and that the accident was due to the over-heating of the fire-box top plate caused through shortness of water; and they suggested that a more reliable fusible plug should be sought for than the one used, and that duplicate water gauges should be adopted on locomotives. This verdict was in accordance with the evidence of Mr. Lavington E. Fletcher, of Manchester, who examined the boiler and reported upon it. Mr. Fletcher spoke very strongly as to the unreliability of fusible plugs as a safeguard against accident.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

TOWARDS the close of last week the Glasgow iron market became very strong, in consequence chiefly of the favourable reports that have reached this country with reference to the demand for Scotch pig iron in the United States. Stocks there are all but exhausted, and the shipments have of late been somewhat restricted, and on this account any fresh increase in the demand was likely to make itself distinctly felt. It does not as yet appear that any considerable accession of orders has been received from the States by merchants on this side; but yet the reports above alluded to have been sufficient to excite the warrant market and send up prices. Should the demand for the United States really grow in volume, it is to be feared that the amount of business will be restricted by high freights. Within the past ten days the freights of pig iron have advanced from 12s. 6d. to 17s. 6d., and this week the steamboat owners have been asking 20s. per ton. The trade is practically in the hands of the great ocean companies, as the inward cargoes from America are just now so scarce that there is no inducement for other vessels to undertake the shipment of iron. There is a moderately good inquiry from the Continent for Scotch pig iron, but the home consumers appear to be purchasing less than of late, many of them having large contracts fixed for future delivery.

The quantity of iron sent into the public stores since the holidays is necessarily small, the aggregate stock in the hands of Messrs. Connal and Co. now amounting to about 629,000 tons. The past week's shipments have been disappointingly small, even allowing for the stormy weather, only 3639 tons having been despatched as against 9358 in the preceding week, and 6182 in the corresponding week of last year.

Business was done in the warrant market on Friday forenoon at 52s. 1½d. to 52s. 7½d. cash, and up to 52s. 10d. one month. In the afternoon the quotations were 52s. 7½d. to 52s. 6½d. cash and 52s. 9d. to 52s. 11d. one month. The market opened strongly on Monday at 53s. 1½d. to 52s. 11d. and 53s. 4d. to 53s. 2d. and 53s. 3½d. one month, the afternoon prices being 53s. 1d. to 52s. 7½d. cash and 53s. 3½d. to 52s. 10d. one month. The market was easier on Tuesday, with business at 52s. 8d. to 52s. 4½d. cash and 53s. to 52s. 8d. one month in the forenoon, and 52s. 5d. to 52s. 4½d. cash in the afternoon. The tone of the market on Wednesday was easier, with business between 52s. 5d. and 51s. 11d. cash and 52s. 4½d. to 52s. 3d. one month. To-day—Thursday—the market was quiet, with a moderate business at 52s. 2d. and 52s. 1d. cash and 52s. 5½d. to 52s. 4½d. one month.

The improvement in the demand for makers' iron has been followed by a general advance in prices, which are now as follows:—Gartsherrie, f.o.b. at Glasgow per ton, No. 1, 62s. 6d., No. 3, 55s.; Coltness, 63s. 6d. and 55s.; Langloan, 63s. 6d. and 55s. 6d.; Summerlee, 62s. and 54s. 6d.; Calder, 62s. and 54s. 6d.; Carnbroe, 55s. 6d. and 53s. 6d.; Clyde, 53s. and 51s. 6d.; Monkland, Quarter, and Govan, each 53s. and 51s. 6d.; Shotts at Leith, 62s. 6d. and 55s.; Carron, at Grangemouth, 53s. 6d. (specially selected, 56s.) and 52s. 6d.; Kinneil, at Bo'ness, 52s. 6d. and 51s.; Glengarnock, at Ardrossan, 55s. 6d. and 53s. 6d.; Eglinton, 53s. and 51s. 6d.; Dalmellington, 53s. and 52s.

The malleable works are very busy, and prices are firmly quoted. The shipments of coal have been small as usual in the opening week of the year; but they compare favourably with those of the same week in 1881. Business at Glasgow Harbour has been much inconvenienced by the subsidence of a part of the mineral quay, owing principally, it is supposed, to dredging operations. As much of the coal traffic as possible has been transferred to the Queen's Dock; but the access to it is unsuitable to the Caledonian Railway, a considerable portion of the coal traffic of which will, it is expected, be sent to Port Glasgow until the necessary repairs shall have been made at the Glasgow Harbour terminus. The inland demand for coals is fair, and the supply abundant. The latest f.o.b. quotations are—main, 6s. to 6s. 6d. and 6s. 8d.; ell, 6s. 10d. to 9s.; splint, 6s. 9d. to 7s. 3d.

During the past year 1660 vessels arrived in the Clyde, with a total tonnage of 1,155,076, as against 1559 vessels and 1,117,488 tons in 1880. The sailings numbered 1769 with an aggregate tonnage of 1,503,331, as compared with 1569 vessels and 1,311,423 tons in the preceding year.

The Dalmerry Oil Company, Limited, at a meeting held in Edinburgh, has agreed upon a dividend for the past year at the rate of 15 per cent. on the called up capital.

There have been 1,555,260 lb. of gunpowder exported from the Clyde in the past year—an increase of 121,260 lb., as against the quantity shipped in 1880.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE quantity of coal sent down by Taff Vale during the past year was sufficient for the entire consumption in London. Such is the estimate given me, and I believe that it can be fully borne out. Five million tons is the gross quantity, representing an enormous amount of capital and labour centred in a few Welsh valleys. At one of the collieries which has been previously referred to, that of Clydach Vale, 1300 tons output per day is now below the average. The ordinary quantity is now nearer 1500 tons, or 12 tons every four minutes of the working day. There is no falling off in the coal trade. Both house and steam coal are in good request, and prices in all quarters are firm.

General interest is centred on the rapid progress making by Swansea. Twelve months ago the weekly foreign export coal trade of that port rarely exceeded 12,000 tons per week. Last week it was 25,639 tons. We hear that the anthracite question is being discussed practically in high circles in London, and a steady impetus is given to the trade thereby. Altogether, there is a considerable increase in vigorous enterprise at this port.

Newport also is trying to get up to its enterprising neighbour, and the new railway connecting it, *viâ* Caerphilly, with the Rhondda Valley promises to give it a good deal of importance. Many schemes are on foot—one is to dock the river, almost a necessity now, seeing that the shipping is so hampered. Then it is suggested that the new docks shall be called Newport and East Cardiff Docks. Newport suffers in some respect on account of its name. There are many Newports in the kingdom, but only one Cardiff, and as "East Cardiff" there might be an additional trade done. However, at present Newport is flourishing, and in five years hence, when the Severn Tunnel is completed, cannot but be prosperous.

I have always held forth the opinion that Newport, Mon., with its railways and large area of virgin coalfield, is to take a much higher position than at present. The total coal exports from Newport last week were 27,778.

From Cardiff the total was 99,448 tons only, showing a rather important decrease. Yet this is in some measure accounted for by the failure of vessels to turn up on account of the stormy season. The gale also on one or two days this week was such as effectually to keep vessels in the harbour. Prices of first-class coals remain firm, and all through it may be taken as authentic that there is no lowering in price, though in some few exceptional cases of secondary kinds, some sales have been effected at a slight reduction. I have referred to the satisfactory coal totals of 1881 as regards South Wales. I have now to hand the totals of the Forest of Dean, which are hopeful. The total increase of coal shipments from Lydney for 1881 over the previous year was 30,421 tons. This may be put to the credit of the Severn Bridge.

An important subject has been broached at the Merthyr Board of Guardians—the rating of royalties. I noticed last week that sooner or later a rearrangement of royalties would be brought about, seeing that coal is now everything and Welsh iron ore is of no value. This action to rate royalties will very likely bring matters to a crisis in this respect.

The new railway from Rhondda to Newport is progressing satisfactorily. It is to be completed by November. The Clydach Vale line will be a most successful venture. I hear that a number of bituminous veins will be opened out, a class of coal that is now getting short in the district. There are also the deeper measures there in great quantity, so this line presents a new field for capital.

The iron and steel trade promises to be better in 1882 than it was in 1881, and the last year was certainly fairly good. Makers are full of orders, and prices are firm with upward tendency. Iron rails, best, are quoted at £6; steel rails £6 5s., and at this figure one contract, colonial, has been booked for 33,000 tons 60 lb. rails. This is to be delivered this year.

Tin plates are going off steadily; ordinary I.C. cokes range from 18s. to 20s.; charcoals, 21s. to 24s., according to brand.

In several quarters work has been recommenced, and I am glad to find that the Dowlais dispute is ended. During the last month there has been a steady decrease in stock, so that I shall fully expect another advance of price to be recorded after the quarterly meeting.

Cefn Glas Colliery, house coal, equal to an output of 600 tons per diem, is in the market for sale. It is well situated as regards railway and canal, and about six miles from Merthyr.

A new sliding scale has been started in connection with the Ferndale Collieries. It is to run for two years.

CLEVELAND INSTITUTION OF ENGINEERS, SESSION 1881-82.—The annual dinner will be held in the large hall of the Erimus Club, Queen's-square, Middlesbrough, on Friday evening, the 20th of January, 1882. Mr. E. Windsor Richards, president, in the chair.

BUILDING EXHIBITION.—We have been requested by Mr. John Black, the secretary of the Building Exhibition which will be held at the Agricultural Hall in March next, to state that he will be pleased to forward to architects, surveyors, and clerks of works, on receipt of card addressed to 161, Strand, free admission tickets for the exhibition, which promises this year to be a collection of exceptional interest.

THE ELECTRIC LIGHT IN PARIS.—A scheme is on foot, having been approved by the Municipal Council of Paris, for extensively lighting with electricity the quarters of the Prefecture of the Seine, in the Tuileries. It is the work of M. Cernesson, and comprises lighting the Salle des Séances with eighty Swan lamps—in place of eighty Carcel lamps—and six Siemens' arc lamps; lighting the library with forty-eight Maxim incandescent lamps on the present lustres; another room with twenty-four Lane-Fox incandescent lamps; another with twenty Swan lamps; the Salle des Pas Perdus with two Werdermann lamps; a lobby with two Siemens' lamps; and a staircase with four Brush lamps. The whole will require an outlay of 75,000 francs. The horse-power necessary is 44, and while the idea of obtaining this from the Seine has been considered, it has been decided to set up a gas engine in the court of the Tuileries. A portion of the motor force is to be employed for electric hoists, for driving ventilators, and other uses.

THE INSTITUTION OF CIVIL ENGINEERS.—At the meeting on Tuesday, the 10th of January, Sir William G. Armstrong, C.B., F.R.S., president, in the chair, it was announced that the Council had recently transferred Charles Benjamin Braham, Jacob Forrest, and Tom Hurry Riches to the class of Members; and had admitted Francis William Ashpitel, Percy Bingham, James Fettes Boulton, Francis Boynton, George Frederick Charnock, William Chatham, George Charles Denison, Alexander Graham Drury, James Faweus, Francis Richard Flindell, Ernest Edward Gabriel, Alfred Hill, Joseph Henry Hirst, Edward Ramford Jackson, Ernest Allen Horsford James, Christopher Little, Henry James Marten, Alfred William Palmer, Martyn Noel Ridley, William Henry Severn, Edward John Silcock, Robert Algernon Summer, and Fred Spencer Yates, as Students. At the monthly ballot Thomas Hughes Gibbons, Cornwall Railway, and George Farmer Thomas, Wrexham, were elected Members; and John Edward Agustus Jenkins Blandy, Erith; Henry Ewart, Manchester; Isoji Ishiguro, Stud. Inst. C.E., Westminster; Joseph Lynch, Leopoldina Railroad, Brazil; James Osborne, Rio Tinto, Spain; and Herbert George Sumner, Stud. Inst. C.E., Brading Harbour Works, Isle of Wight, Associate Members.

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.

3rd January, 1882.

18. Whalebone, W. Morgan-Brown.—(*G. Phelps, U.S.*)
19. Pushing Ingots into Moulds, J. Imray.—(*T. James, Braddocks, U.S.*)
20. Stitching Machines, J. Day, Stafford.
21. Preparing Wire, W. R. Lake.—(*O. R. Chaplin, U.S.*)
22. Imitation Lace Printing, A. G. Tottem, Clapham, and J. B. Gloag, Bath-street, London.
23. Applying Motive Power, J. Jeffs, London.
24. Removing Flocculent Matter from Spent Acids, W. R. Lake.—(*M. C. Lefferts, New York, U.S.*)
25. Soap, G. Payne, Millwall.
26. Fittings for Anchors, S. Baxter, London.
27. Ball Bearings, A. Boult.—(*H. Büssing, Germany.*)
28. Artificial Coffee, J. W. Wood, Liverpool.
29. Secondary Batteries, D. G. FitzGerald, Brixton, and C. H. W. Biggs and W. W. Beamont, London.
30. Fire-grates, Sir W. W. Hughes, London.
31. Aerial Navigation, W. Lake.—(*C. Petersen, U.S.*)
32. Glove Fasteners, F. Wirth.—(*C. Koch and Co., Frankfort-on-the-Maine.*)
33. Street Cleaning, S. L. Hunt, London.
34. Flying Engine, J. K. Smythies, London.
35. Two-wheel Carriages, J. Marston, Birmingham.
36. Sewing Machines, W. R. Lake.—(*Rotary Shuttle Sewing Machine Company, Foxborough, U.S.*)

4th January, 1882.

37. Compound Packing, P. Blair, Birkenhead.
38. Stripping Cylinders, &c., G. H. Kenworthy and J. Beard, Ashton-under-Lyne, and J. G. Whitehead, Newton Moor.
39. Colouring Matters, J. A. Dixon.—(*Dr. C. Koenig, Höchst-am-Main, Germany.*)
40. Grape Sugar, W. R. Lake.—(*Dr. A. Behr, U.S.*)
41. Rings, C. Touaillon.—(*J. G. Bertry, Paris.*)
42. Stoves, E. G. Lakeman, Modbury.
43. Barges, E. Moxon, Tunbridge Wells.
44. Cure of Neuralgia, H. F. Mills, Notting Hill.
45. Roller Mills, A. V. Newton.—(*A. Mechwart, Buda-Pesth, Hungary.*)
46. Open Fireplaces, W. Haughton, London.
47. Candle Cases, A. M. Clark.—(*J. B. Choisy, France.*)
48. Ironing Neckties, M. Steinbock, New York, U.S.
49. Measuring Electricity, J. Hopkinson, London.
50. Locomotive Engines, T. Morgan.—(*D. Reid, India.*)

5th January, 1882.

51. Artificial Parchment, C. Weygang, London.
52. Lawn Tennis, A. W. Franklin, London.
53. Mining Coal, W. P. Thompson.—(*J. Du Bois, U.S.*)
54. Chimney-pot, J. Wetton, Abergavenny.
55. Distribution of Electrical Energy, J. Perry, Talgarth-road, London.
56. Opening Oysters, H. J. Haddan.—(*A. Lesquillon, Pontoise, France.*)
57. Tools, H. J. Haddan.—(*A. A. Rigaud, France.*)
58. Combing Machines, H. J. Haddan.—(*A. N. Sprecher, Auduze, France.*)
59. Candles, H. J. Haddan.—(*F. E. Berta, Germany.*)
60. Railway Signals, A. S. Allin, London.
61. Engines, J. James and W. Wardrop, London.
62. Preserving Timber, S. B. Boulton, London.
63. Rendering Fabrics Uninflammable, P. Jensen.—(*H. S. Suillot and H. David, Paris.*)
64. Dynamo-electric Machines, L. A. Groth.—(*R. J. Gülcher, Biala, Austria.*)
64. Bridges, H. H. Lake.—(*G. Eiffel, Paris.*)

6th January, 1882.

66. Testing Plates, G. Richards, Manchester.
67. Hand Stamps, A. C. Henderson.—(*E. Blum, Paris.*)
68. Optical Apparatus, J. B. Fenby, Sutton Coldfield.
69. Incandescent Lamps, E. H. T. Liveing, London, and C. V. Boys, Wing.
70. Seats of Ships, E. S. Copeman, Downham Market.
71. Electric-printing Registers, &c., A. J. Boult.—(*B. E. Valentine, New York, U.S.*)
72. Secondary Batteries, R. Kennedy, Glasgow.
73. Horseshoes, J. Vernon, Newton Stewart.
74. Retarding Motive Power, W. B. Tibbits, Clifton.
75. Syphons, J. D. Carter and J. A. Baker, London.
76. Fireplaces, J. H. Johnson.—(*M. Perret, Paris.*)
77. Moulding Cement, H. Reid, London.
78. Printing Labels, T. A. Briggs, Providence, U.S.
79. Vehicle Axles, C. Pieper.—(*J. F. Schmid, Germany.*)
80. Converting Iron into Steel, W. Jackson, Bradford.
81. Whitewash, J. I. Fordham, London.
82. Recording Fixed Amounts, J. T. Parlour, London.
83. Reclamation of Land, W. Lake.—(*G. Howell, U.S.*)
84. Dynamo-electric Machines, W. R. Lake.—(*C. E. Ball, Philadelphia, U.S.*)
85. Utilising Electricity, W. R. Lake.—(*J. S. Williams, Rivertown, U.S.*)

7th January, 1882.

86. Steam Generators, J. Jones, Liverpool.
87. Valves, J. W. Hackworth, Darlington.
88. Cutting Tobacco, C. J. Fox, London.
89. Lockwash, J. H. Drew, Walsall.
90. Back-sights, P. Taylor, Manchester.
91. Heddle Frames, F. W. Pim and T. Sands, Dublin.
92. Pianofortes, F. C. Glaser.—(*G. Knake, Germany.*)
93. Rolling Metal, F. Wirth.—(*L. Röhr, Germany.*)
94. Sugar, J. W. Culmer.—(*E. Wernickenck, Moscow.*)
95. Electric Lamps, W. J. Mackenzie, Glasgow.
96. Lock Spindles, S. Collett, Willenhall.
97. Bolts, C. J. Coxhead, London.
98. Tricycles, W. Dawes, Leeds.
99. Velocipedes, M. D. Rucker, jun., London.
100. Weighing Machines, F. Wolff.—(*F. Casse, Denmark.*)
101. Writing Pads, W. R. Lake.—(*M. Engel, Austria.*)
102. Teaching Reading, &c., E. Sykes and O. G. Abbott, Huddersfield.
103. Bottles, A. Jacobs and I. Jacobs, London.
104. Laminated Steel Springs, R. Hansell, Sheffield.
105. Omnibuses, H. W. Hart, London.
106. Barrels, W. R. Lake.—(*G. W. Laraway, U.S.*)

9th January, 1882.

107. Tentering Fabrics, J. Ashworth, Rochdale.
108. Gas Burners, W. Thompson.—(*P. Costes, France.*)
109. Soda, W. Weldon.—(*M. Schaffner and W. Helbig, Aussig, Austria.*)
110. Preserving Fish, C. Pieper.—(*J. H. G. Walkhoff, Hamburg.*)
111. Crushing Minerals, J. Spencer and J. Consterdine, Hollinwood, and N. G. Kimberley, London.
112. Bricks, H. J. Haddan.—(*L. Jäger, Germany.*)
113. Embossed Fabrics, H. Cryer, Ilkley.
114. Over-stitching Machines, J. E. Richard, U.S.
115. Washing, &c., W. Birch, Salford.
116. Knife-cleaning, E. M. Knight, Manchester.
117. Camber, N. Ager, London.
118. Telegraphy, P. Jensen.—(*F. W. Jones, U.S.*)
119. Window-sash Fastenings, E. R. Wethered, Woolwich.
120. Storing Electrical Energy, J. E. Liardet, Brockley, and T. Donnithorne, London.
121. Stoves, A. C. Engert, Bromley-by-Bow.

Inventions Protected for Six Months on Deposit of Complete Specifications.

5737. Ornamental Glass, J. Hewitt, London.—A communication from R. W. Harris, Calais, France.—*31st December*, 1881.
19. Pushing Ingots from their Moulds, J. Imray, Southampton-buildings, London.—A communication from T. James, Braddocks, Pennsylvania, U.S.—*3rd January*, 1882.
24. Removing Flocculent Matter from Spent Acids, W. R. Lake, Southampton-buildings, London.—A communication from M. C. Lefferts, New York, U.S.—*3rd January*, 1882.
79. Vehicle Axles, C. Pieper, Gneisenau-strasse, Berlin.—A communication from J. F. Schmid, Offenbach-on-the-Main, Germany.—*6th January*, 1882.

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

26. Sheet Metal, J. Jones, Southwark.—*3rd January*, 1879.
24. Safety Pins, R. Barlow, Dalston.—*2nd January*, 1879.
131. Refractory Basic Bricks, S. G. Thomas, London.—*11th January*, 1879.
257. Refractory Bricks, S. G. Thomas, London.—*22nd January*, 1879.
27. Electric Light, B. A. Raworth, Manchester.—*3rd January*, 1879.
34. Hubs of Wheels, B. Tillett, Leytonstone.—*3rd January*, 1879.
37. Switch Locks, J. Tomlinson, jun., London.—*3rd January*, 1879.
83. Electric Lamps, W. Ladd, London.—*8th January*, 1879.
319. Stretching Trousers, B. A. Bateman, London.—*25th January*, 1879.
56. Extracting Iodine, H. B. Barlow, Manchester.—*4th January*, 1879.
82. Weighting Silk, T. Hawley, Coventry.—*8th January*, 1879.
93. Measuring Water, T. Melling, Aigburth.—*9th January*, 1879.
105. Measuring Water, G. F. Deacon, Liverpool.—*10th January*, 1879.
157. Packing Machine, W. R. Lake, London.—*14th January*, 1879.
166. Water Meters, W. R. Lake, London.—*15th January*, 1879.
229. Telephones, W. R. Lake, London.—*20th January*, 1879.
70. Permanent Way, W. Seaton, London.—*7th January*, 1879.
72. Mules for Spinning, J. Dodd, Oldham.—*7th January*, 1879.
85. Storing Heat, J. B. Cox, Torquay.—*8th January*, 1879.
86. Ventilating Manufactories, H. Lacey, Manchester.—*8th January*, 1879.
95. Oatmeal, J. McCann, Middle Abbey-street, Dublin.—*9th January*, 1879.
102. Sweat Bands, H. A. Bonneville, London.—*6th January*, 1879.
225. Vacuum Brakes, F. W. Eames, Leeds.—*20th January*, 1879.
75. Rollers, J. S. Dronsfield, Oldham.—*8th January*, 1879.
89. Steam Engines, W. Hartley, Salford.—*8th January*, 1879.
92. Ventilaling Buildings, J. G. Tongue, London.—*9th January*, 1879.

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

43. Furnaces, C. W. Siemens, Westminster.—*5th January*, 1875.
224. Marine Engines, L. Perkins, London.—*20th January*, 1875.
69. Dried Yeast, T. Ellis, Hammersmith.—*8th January*, 1875.
100. Rivets, W. R. Lake, Southampton-buildings, London.—*12th January*, 1875.

Notices of Intention to Proceed with Applications.

Last day for filing opposition, 27th January, 1882.

3719. Ruling Machines, J. Wetter, New Wandsworth.—A com. from E. W. Blackhall.—*25th August*, 1881.
3791. Preparing Fibres, W. A. Barlow, London.—A communication from J. Roguet.—*31st August*, 1881.
3821. Electric Lamps, A. L. Fyfe and J. Main, London.—*2nd September*, 1881.
3838. Ratchet Braces, C. Neil, Sheffield.—*3rd September*, 1881.
3844. Salts of Zinc, A. M. Clark, London.—A com. from A. Lanquetin.—*3rd September*, 1881.
3855. Lubricants, W. J. L. Hollis, London.—*5th September*, 1881.
3893. Electric-lighting, W. R. Lake, London.—A com. from W. S. Hill.—*8th September*, 1881.
3896. Spinning Yarns, W. Lancaster, Accrington, and E. Slater, Burnley.—*8th September*, 1881.
3937. Direct-acting Steam Pumps, G. Heywood and S. Spencer, Radcliffe Bridge.—*12th September*, 1881.
4036. Cigar-lighters, W. Clark, London.—A com. from C. Vibbard & J. Brooks.—*19th September*, 1881.
4062. Shredding Sugar Cane, W. P. Thompson.—A com. from G. A. Bazé.—*21st September*, 1881.
4102. Window Sashes, A. Bedborough, London.—*23rd September*, 1881.
4596. Washing Bottles, J. J. Harvey, Kidderminster.—*20th October*, 1881.
4708. Fixing Screw Propellers, J. Leishman, London.—A com. from E. Cousteau.—*27th October*, 1881.
4728. Tunnelling, T. R. Crampton, London.—*28th October*, 1881.
5215. Horse Nails, J. H. Huggett, London.—*29th November*, 1881.
5257. Purification of Metal, S. Pitt, Sutton.—A com. from H. Harmet.—*1st December*, 1881.
5277. Ladders, G. Whalley, London.—*2nd December*, 1881.
5345. Cutting-out Cloth, J. Gracey, Belfast.—*7th December*, 1881.
5369. Car Trucks, J. N. Smith, New York, U.S.—*8th December*, 1881.

Last day for filing opposition 31st January, 1882.

3851. Detaching Ships' Boats, S. Petitt, Windsor.—*5th September*, 1881.
3852. Heels for Boots, F. Cutlan, Cardiff.—*5th September*, 1881.
3854. Clouded Yarn, B. Norton and C. Turner, Huddersfield.—*5th September*, 1881.
3860. Pianofortes, W. H. Squire, London.—*5th September*, 1881.
3865. Pentagraph Machines, J. Hope, Manchester.—*6th September*, 1881.
3866. Fire-escapes, W. R. Lake, London.—A communication from A. Bustin.—*7th September*, 1881.
3886. Hollow Moulded Forms, F. Hoskins and C. Harvey, Birmingham.—*8th September*, 1881.
3887. Fountain Penholders, D. H. Sparling, Oldham.—*8th September*, 1881.
3890. Electric Lamps, D. G. Fitzgerald, Brixton.—*8th September*, 1881.
3892. Ornamenting Linoleum, J. H. Allin, London.—*8th September*, 1881.
3908. Coupling Railway Vehicles, A. Eskew, Edinburgh.—*9th September*, 1881.
3912. Railways, F. Devooght, Antwerp.—*9th September*, 1881.
3913. Fire-arms, M. Kaufmann, London.—*9th September*, 1881.
3920. Rotary Engines, R. Hodson, London.—*9th September*, 1881.
3925. Locking Devices, G. W. von Nawrocki, Berlin.—A com. from L. Schmetzer.—*10th September*, 1881.
3927. Sugar, T. Duncan, London, and B. E. R. Newlands, Victoria Docks.—*10th September*, 1881.
3936. Harvesting, H. K. Stone, York.—*12th September*, 1881.
3952. Lifeboats, J. Wetter, New Wandsworth.—A com. from G. B. Berrell.—*13th September*, 1881.
3978. Churn, W. Rainbow, Luton.—*15th September*, 1881.
4114. Raising Water, W. Rainbow, London.—*23rd September*, 1881.
4195. Coating Iron, C. J. Davidson, Wolverhampton.—*29th September*, 1881.
4328. Paper Wires, M. M. Whiting, Manchester.—*5th October*, 1881.
4457. Bleaching Jute, T. G. Young, Penicuik.—*13th October*, 1881.
4486. Oxides, J. B. Readman, Glasgow.—*14th October*, 1881.
4595. Sash Fasteners, J. G. Chillingworth, London.—*20th October*, 1881.
4702. Sulphate of Lime, J. Young, Kelly.—*27th October*, 1881.
4736. Safety Letter-boxes, A. J. Little, Twickenham.—*29th October*, 1881.
5040. Stoves, J. B. Petter, Yeovil.—*17th November*, 1881.
5140. Telephonic Signalling, A. C. Brown and H. A. C. Saunders, London.—*24th November*, 1881.
5238. Portable Cabinets, R. H. and A. S. Bishop, Islington.—*30th November*, 1881.
5309. Electric Insulation, J. A. Fleming, Nottingham.—*5th December*, 1881
5329. Embroidery, C. A. Barlow, Manchester.—Com. from Messrs. Wetter Brothers.—*6th December*, 1881.
5350. Engines, C. W. Siemens, London.—*7th December*, 1881.
5429. Gelatine, J. H. Johnson, London.—*12th December*, 1881.
5431. Telephones, A. W. Rose, London.—*12th December*, 1881.
5469. Gas Motor Engines, F. W. Crossley and H. P. Holt, Manchester.—*14th December*, 1881.
19. Ingots, J. Imray, London.—A communication from T. James.—*3rd January*, 1882.

Patents Sealed.

(*List of Patent Letters which passed the Great Seal on the 6th January*, 1882.)

2820. Floor Cramps, H. Fabian, Erith.—*28th June*, 1881.
2994. Preserving Food, F. Pool, Stoke Newington.—*7th July*, 1881.
3008. Dredging Machines, W. R. Lake, London.—*8th July*, 1881.
3014. Photographic Cameras, G. Smith, London.—*8th July*, 1881.
3020. Sash Bars for Roofs, W. Howitt, Ilford.—*9th July*, 1881.
3021. Engine Regulator, R. M. Marchant, London.—*9th July*, 1881.
3022. Wagon Wheel, W. F. Lotz, London.—*9th July*, 1881.
3024. Grinders, R. R. Gubbins, New Cross.—*9th July*, 1881.
3027. Hammerless Breech-loading Fire-arms, T. and T. Woodward, Birmingham.—*9th July*, 1881.
3028. Axles for Carriages, H. H. Lake, London.—*9th July*, 1881.
3036. Rollering Machines, H. J. Macey, Wootton Bassett.—*11th July*, 1881.
3040. Softening Water, J. H. Porter, London.—*11th July*, 1881.
3042. Band Saw Machines, A. Dodman, King's Lynn, and N. G. Kimberley, London.—*12th July*, 1881.
3046. Spinning Cotton, T. Coulthard, Preston.—*12th July*, 1881.
3053. Transmitters, &c., L. Jacobson, Berlin.—*12th July*, 1881.
3054. Brooms and Brushes, A. Denjoy, Auch.—*12th July*, 1881.
3076. Mules for Spinning, H. Robinson, Bolton.—*13th July*, 1881.
3068. Flexible Strips for Corsets, R. Auerbach, London.—*13th July*, 1881.
3079. Open Fire-grates, J. Cornforth and E. T. Burton, Birmingham.—*14th July*, 1881.
3094. Propelling Ships, H. J. Allison, London.—*15th July*, 1881.
3113. Motive-power Engine, E. Etève and C. C. Lallement, Paris.—*16th July*, 1881.
3119. Register for Scoring Games, J. Wood, Newport.—*18th July*, 1881.
3135. Screw Propellers, W. Morrison and C. Norfolk, Kingston-upon-Hull.—*19th July*, 1881.
3145. Heating Gases, H. Haug, Strassburg.—*19th July*, 1881.
3155. Fog Signals, &c., A. Kellday, London.—*20th July*, 1881.
3164. Machine Guns, T. Nordenfelt, London.—*20th July*, 1881.
3176. Brussels Carpets, E. Crossley, G. Marchetti, R. Cochrane, & W. Mallinson, Halifax.—*21st July*, 1881.
3183. Decoration of Paper Hangings, W. and W. Cunnington, London.—*21st July*, 1881.
3187. Electric Lamps, W. R. Lake, London.—*21st July*, 1881.
3209. Gas, C. S. Ellery, Bath.—*22nd July*, 1881.
3230. Plain-bottomed Paper Bags, T. Coates, Carlisle.—*23rd July*, 1881.
3233. Spinning Cotton, T. Coulthard, Preston.—*23rd July*, 1881.
3238. Electric Contact, B. J. B. Mills, London.—*25th July*, 1881.
3246. Pumps, H. J. Haddan, London.—*25th July*, 1881.
3299. Floating Cranes, W. Hunter, London.—*28th July*, 1881.
3314. Treatment of Maize, T. Muir, Glasgow.—*29th July*, 1881.
3317. Vehicles, W. Jeans, Christchurch.—*30th July*, 1881.
3497. Pianos, J. M. Laboissière and C. L. Daujon, Paris.—*12th August*, 1881.
3667. Drilling Rocks, W. R. Lake, London.—*23rd August*, 1881.
3804. Commutators, P. Jensen, London.—*1st September*, 1881.
3932. Dynamo-electric Machines, P. Jensen, London.—*10th September*, 1881.
4034. Electro-motors, P. Jensen, London.—*19th September*, 1881.
4174. Electric Lamps, E. G. Brewer, London.—*27th September*, 1881.
4213. Drying Cut Pile Fabrics, J. Worrall, Ordsall.—*29th September*, 1881.
4241. Re-burning of Bone Black, A. W. L. Reddie, London.—*30th September*, 1881.
4249. Umbrellas, J. Minière, Paris.—*1st October*, 1881.
4312. Sewage, J. Hanson, Wakefield.—*4th October*, 1881.
4314. Drying Machines, R. Milburn, London.—*4th October*, 1881.
4340. Gas-motor Engines, C. Wordsworth, Leeds, T. Browett, and H. Lindley, Salford.—*5th October*, 1881.
4386. Utilising Air, A. M. Clark, London.—*8th October*, 1881.
4408. Compound Materials, W. O. Callender, London.—*11th October*, 1881.
4993. Horseshoes, H. J. Haddan, London.—*15th November*, 1881.

(*List of Patent Letters which passed the Great Seal on the 10th January*, 1881.)

2781. Oil Soldering, E. A. Brydges, Berlin.—*25th June*, 1881.
3051. Causing Force, G. Wilson, London.—*12th July*, 1881.
3055. Disinfecting, C. M. Scott, Dalkey.—*12th July*, 1881.
3064. Drying Sugar, A. and J. D. Scott, and T. R. Ogilvie, Greenock.—*13th July*, 1881.
3065. Propelling Ships, E. A. Brydges, Berlin.—*13th July*, 1881.
3067. Inducing Outward Draught from Chimneys, J. Gilmore, Lower Norwood, and W. Clark, Peckham.—*13th July*, 1881.
3072. Compositions, C. F. Claus, London.—*14th July*, 1881.
3081. Water-closets, W. Dawes and W. H. and D. Thompson, Leeds.—*14th July*, 1881.
3102. Internal Stoppers, A. T. King, Nottingham.—*16th July*, 1881.
3126 Boiler Tubes, F. H. F. Engel, Hamburg.—*18th July*, 1881.
3149. Malt Extract, H. R. Randall, London.—*19th July*, 1881.
3150. Evaporating, W. R. Lake, London.—*19th July*, 1881.
3163. Evaporating Vacuum Apparatus, F. H. F. Engel, Hamburg.—*20th July*, 1881.
3175. Steering Vessels, A. Figge, G. A. Köttgen, and H. Wedekind, London.—*21st July*, 1881.
3228. Controlling Telephonic Communications, J Imray, London.—*23rd June*, 1881.
3237. Bobbin Net, J. R. Hancock, Nottingham.—*25th July*, 1881.
3268. Breech-loading Fire-arms, H. A. Dufrené, London.—*27th July*, 1881.
3286. Deodorising, R. E. Goolden and A. Mackay Southwark.—*27th July*, 1881.
3726. Combing Machines, E. de Pass, London.—*26th August*, 1881.
3881. Gelatinisation of Grain, E. Luck, London.—*7th September*, 1881.
4154. Valves, W. J. F. Thomson, Cashirciveen Camp, Ireland.—*27th September*, 1881.
4251. Floorcloth, F. Versmann, New Charlton.—*1st October*, 1881.
4298. Device for Securing Bolts, W. R. Lake, London.—*4th October*, 1881.
4442. Securing Tubular Handles, C. Ezard, Manchester.—*12th October*, 1881.
4797. Telegraphic Cables, C. L. Gore, London.—*2nd November*, 1881.

List of Specifications published during the week ending January 7th, 1881.

1707*, 4d.; 633*, 4d.; 528, 6d.; 1302, 2d.; 1690, 2d.; 2310, 6d.; 2342, 6d.; 2366, 6d.; 2367, 6d.; 2368, 4d.; 2372, 8d.; 2373, 6d.; 2383, 6d.; 2396, 6d.; 2202, 8d.; 2404, 6d.; 2405, 6d.; 2408, 6d.; 2315, 2d.; 2416, 6d.; 2422, 6d.; 2424, 6d.; 2428, 6d.; 2429, 6d.; 2430, 2d.; 2432, 4d.; 2435, 2d.; 2436, 6d.; 2438, 6d.; 2453, 6d.; 2457, 6d.; 2460, 2d.; 2462, 6d.; 2467, 6d.; 2468, 4d.; 2470, 6d.; 2473, 2d.; 2477, 6d.; 2468, 2d.; 2479, 4d.; 2480, 8d.; 2481, 6d.; 2485, 10d.; 2486, 2d.; 2488, 4d.; 2492, 8d.; 2493, 2d.; 2494, 6d.; 2495, 6d.; 2501, 2d.; 2502, 6d.; 2503, 6d.; 2506, 6d.; 2507, 6d.; 2508, 6d.; 2510, 6d.; 2517, 4d.; 2520, 6d.; 2523, 2d.; 2525, 6d.; 2526, 2d.; 2527, 4d.; 2529, 2d.; 2535, 6d.; 2536, 2d.; 2537, 2d.; 2542, 4d.; 2545, 4d.; 2546, 6d.; 2547, 2d.; 2549, 2d.; 2560, 6d.; 2565, 6d.; 2569, 6d.; 2575, 4d.; 2581, 2d.; 2585, 6d.; 2597, 2d.; 2639, 4d.; 2683, 4d.; 2686, 6d.; 2821, 6d.; 3256, 6d.; 3725, 6d.; 3876, 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.*

528. Machinery for Sawing or Cutting Stone, &c., *J. Gay, Paris.—7th February*, 1881. 6*d*.

This consists in the application of one or more endless twisted wires or ropes having a travelling or continuously progressive motion, together with an axially revolving motion.

1302. Grates and Stoves for Burning Anthracite Coal, &c., *T. Parker, Coalbrookdale, Salop.—23rd March*, 1881.—(*Not proceeded with.*) 2*d*.

According to one arrangement the front bars are left, as in a grate of the usual form, and an opening or openings is or are arranged in the back, sides, or lower portion of the fire-basket, which is preferably constructed of fire-clay. This opening or openings, which is preferably at the bottom of the slab of fire-clay forming the back of the fire-basket, communicates directly with the lower part of a flue or chimney behind the back of the grate, the draught being regulated by a damper or its equivalent situate at or about the point of communication between the small back flue or chimney and the main flue.

1690. Apparatus for Heating and Ventilating Turkish Baths, &c., *W. G. and J. Sloane, Dublin.—19th April*, 1881.—(*Not proceeded with.*) 2*d*.

This consists in forming a shell or chamber of suitable dimensions and of suitable materials, rectangular in plan, and arch-shaped in the top or roof. At one end of the interior of this shell or chamber is constructed a furnace, an aperture being provided in said end for the door of same. Upon fire being kindled in this furnace, the heat circulates and is retained within the shell or chamber, having no means of escape except through a flue pipe fixed to an aperture in the back or extreme end of the shell or chamber, from which horizontal convolutions of wrought iron pipe are taken, carrying off the gas and smoke.

2264. Cables or Conductors for Electrical Currents, *W. L. Barney, London.—24th May*, 1881.—(*Not proceeded with.*) 4*d*.

The conductor is insulated, the whole covered with a conducting tube or conducting material in some shape.

2304. Apparatus for the Exhibition of Electric Light, *W. Crookes, London.—25th May*, 1881.—(*Not proceeded with.*) 2*d*.

The carbon filament has impurities removed by chemical treatment, and the contact points have copper deposited on them.

2310. Apparatus for Bleaching, Dyeing, Washing, Scouring, and Soaping Cotton, Flax, Silks, &c., *W. Mather, Manchester.—26th May*, 1881. 6*d*.

This relates to the treatment of cotton, flax, silk, and wool, in the combed or carded condition, also as yarn, and woven into fabrics by winding or batching the material to be treated into a roll and then subjecting it to the various processes of bleaching, dyeing, washing, scouring, and soaping.

2342. Brick-making Machines, *F., J. and E. Firth, Dewsbury.—27th May*, 1881. 6*d*.

This relates to improvements on patent 1791, dated 3rd May, 1878. The machines are arranged so that they can either be used for moulding bricks from semi-plastic material, by means of a pug mill, a cylindrical mould table, and a press working in combination, or so that by removing the pug mill and mould table bricks may be moulded from dry material, the material being then fed in granular form to the press from a hopper, by means of a reciprocating measuring box, which, after receiving its charge of granular material, is moved forward and deposits its charge into the moulding box of the press, where it is consolidated under heavy pressure; or the machines might be made for working only with semi-plastic material, or only with dry material.

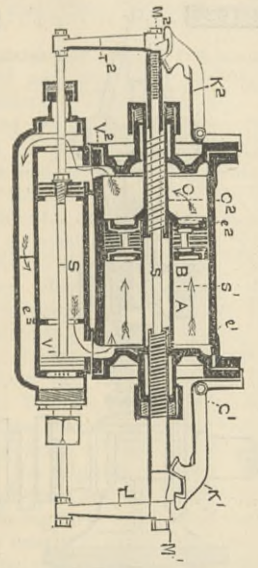
2366. Covers for Sewing Machines, *F. H. F. Engel, Hamburg.—30th May*, 1881.—(*A communication from Guhl and Harbeck, Hamburg.*) 6*d*.

The cover is constructed out of one saddle-shaped middle plate and two sheet iron end plates furnished with spring hooks that catch either into openings formed to the foot-plate of the machine or to metal plates or pieces attached to the table plate of the machine.

2367. WATER METERS, &c., *J. C. Dennert and G. G. Lind, Altona, Prussia.*—30th May, 1881. 6d.

The drawing is a longitudinal section of a water-meter. A is the cylinder with the piston B sliding on the hollow piston-rod C. This rod is provided with two annular projections c^1 c^2, by which the motion of the piston B is transmitted to the rod C; S^1 is the reversing rod pushed in one direction by the spring

2367



C^1 and in the other by the spring C^2. K^1 K^2 are hooks for retaining one of the noses or projections M^1 M^2 of the transverse arms T^1 T^2 according to the position of the piston-rod C. S is the valve-rod with the disc or globe valves V^1 V^2, and c^3 the outlet chamber.

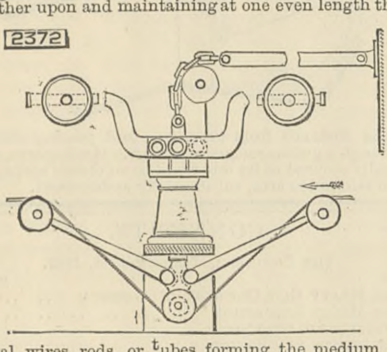
2368. HAND CARTS, *A. Specht, Hamburg.*—30th May, 1881.—(*A communication from O. Schumann.*) 4d.

The box of the cart is composed so that the front and the back board are hinged to the bottom, and attached to transverse beams connecting the main beams by metal angles or hooks. The side boards are simply thrust in, and kept in their proper position by the triangular axle supports. The transverse beams also are jointed to the main beams by means of flat metal hooks.

2372. APPARATUS FOR ACTUATING SIGNALS AND POINTS ON RAILWAYS, *B. C. Scott, Regent's Park.*—30th May, 1881. 8d.

The drawing represents in elevation the apparatus designed for counteracting the influence of the weather upon and maintaining at one even length the

2372



metal wires, rods, or tubes forming the medium of connection between the levers in the signalman's box and the signals and points which such levers work. The invention also relates to means of enabling the signalman when placing the "home" or "distant" signal at danger to automatically place in position for firing explosive cartridges or fog signals, in lieu of such signals being placed in position by hand.

2373. COMBING AND DRESSING MACHINES, *S. C. Lister, Manningham.*—30th May, 1881. 6d.

This relates to improvements on patent 2191, A.D. 1878. Just where the two nipping surfaces begin to open and separate from each other, two rollers are placed between them at right angles to the nips, and round these rollers two travelling aprons or sheets are so arranged as to take the silk or other fibre from between the nipping surfaces, and to carry it along between them to the feed apron of a gill, upon which it is deposited.

2383. MACHINERY FOR GRINDING, CUTTING, POLISHING, AND FINISHING SURFACES BY MEANS OF EMERY WHEELS, &c., *F. McD. Robertson, Croydon, and R. R. Gubbins, New Cross.*—31st May, 1881. 6d.

This consists in a grinding, cutting, or surfacing device, driven off the countershaft, of the race or races, or stop, in combination with the vice or holder for the work, said race, or races, or stop, serving as a guide and stop to the free running emery wheel or cutter.

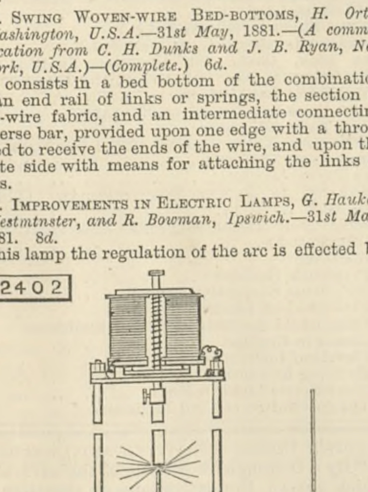
2396. SWING WOVEN-WIRE BED-BOTTOMS, *H. Orth, Washington, U.S.A.*—31st May, 1881.—(*A communication from C. H. Dunks and J. B. Ryan, New York, U.S.A.*)—(*Complete.*) 6d.

This consists in a bed bottom of the combination with an end rail of links or springs, the section of woven-wire fabric, and an intermediate connecting transverse bar, provided upon one edge with a throat adapted to receive the ends of the wire, and upon the opposite side with means for attaching the links or springs.

2402. IMPROVEMENTS IN ELECTRIC LAMPS, *G. Haukes, Westminster, and R. Bowman, Ipswich.*—31st May, 1881. 8d.

In this lamp the regulation of the arc is effected by

2402



means of the electro-magnet attached to the upper carbon holders, the carbons being kept in contact when no current is passing by the spring shown. The lower carbon holder is immersed in a metal tube—glass lined—containing mercury. As the lower carbon rises through the plate to which the mercury tube is fixed, it passes between the arms of an electro-magnet, and through a gripping piece pivotted at right angles. To the magnet attached to the gripping piece is the armature of the magnet, the attracting power of which rocks the former and causes it to grip the carbon. The lower carbon rises as it is consumed under the pressure of the mercury, but is prevented from rising too far by the action of the gripping piece.

2404. PORTABLE EFFERVESCENT FOUNTAIN FOR THE PRODUCTION AND SUPPLY OF AERATED WATER OR LIQUORS, *R. Seager, Ipswich.*—31st May, 1881. 6d.

This relates to the construction of the apparatus for the preparation and supply of aërated waters.

2405. FOLDING ARM CHAIR, *W. H. Beck, London.*—31st May, 1881.—(*A communication from E. Dubreil, St. Nazaire, France.*) 6d.

This consists in the arrangement and fitting of the joints, brackets, standards, and arms of the chair, of the extension and of the legs of the latter, and especially the chair back sliding in grooves in two of the standards stayed by spring brackets when the chair is opened out, and bound by connecting rods at the back of the seat, so that by working the chair back the chair can be either opened or closed.

2408. RAISING OR FORCING WATER, &c., *A. Clark, Lancaster-gate.*—31st May, 1881. 6d.

This consists of a combined gas engine and pump in which the expansive action of the gases of combustion is applied to act in one and the same cylinder directly upon the surface of the water, either with or without the intervention of a piston.

2415. MANUFACTURE OF FABRICS FOR GARMENTS, UPHOLSTERY, &c., *J. Cocks, Upper Norwood.*—1st June, 1881.—(*Not proceeded with.*) 2d.

This consists in the combination or union of plaits or braids of mohair or worsted with any suitable fabric to form a back or foundation for the surface of mohair or worsted, which surface can be varied and rendered ornamental.

2416. A MAGNETO-ELECTRIC MACHINE, *F. Wolff,*—1st June, 1881.—(*A communication from C. P. Jüngersen and L. V. Lorenz, Copenhagen.*) 6d.

This machine is somewhat similar to the Gramme. It has an outer electro-magnet, and an annular armature with wire coil sections, and rotating between the poles of the electro-magnet. Powerful action is obtained by means of a central electro-magnet inside the annular armature; this electro-magnet is of the shape of two bar magnets placed crosswise, and having north and south poles respectively, united by a pole-piece; it has also a central gudgeon, which is screwed into a standard, so that the north and south pole of the inner electro-magnet are opposite the north and south pole of the outer one. To steady the armature in its bearing, unmagnetic rings project from it; one of these has a central annular steel boss, which fits freely round the gudgeon, and a projection which works in the bearing, and the other is fastened to the armature spindle. The armature is made up of a number of insulated rings, held together by bolts. The spokes uniting the ring at the gudgeon end with its boss are chamfered off on the edges, and have little wings, so that by the rotation of the armature an air current is introduced, preventing any heating. The outer electro-magnet consists of two electro-magnets connected by the bed-plate of the machine; the two each resemble the half of a horseshoe. This machine has been illustrated and described in THE ENGINEER.

2422. FLUID METER, *W. R. Lake, London.*—1st June, 1881.—(*A communication from L. J. E. Jacquet, Paris.*) 6d.

This consists of a fluid meter characterised by the special arrangement of the distribution chambers, whereby they are rendered easily accessible, and of the valves which are brought to their seats by the effect of the current, and the combined effect of the piston and the spring, whose pressure may be regulated as desired, to compensate for the wear of the working or moving parts, the arrangement of the said valves being such that they are rigidly connected, easily placed in position, and regulated, and that they work freely and do not wear rapidly or loose their proper shape in use.

2424. OVERHEAD SEWING MACHINES, *G. F. Elder, Lochee, North Britain.*—2nd June, 1881. 6d.

This relates to the means for driving the needle of overhead sewing machines of the class in which a spiral needle is used, and consists in driving the said needle between two rollers, one of these rollers being inside the needle and bearing upon all the coils of the needle on the inner side thereof, the other roller bearing upon rather more than the first coil of the needle only, whilst the other coil or coils of the needle is or are left free from the pressure of the said outer roller, and the said coil or coils are therefore free to move or be moved elastically through a slight distance to accommodate themselves to the work. The invention also provides means for driving the outer roller, and for regulating the pressure thereof upon the needle.

2428. CLEANING AND POLISHING KNIVES, *J. Hargrave, Leeds.*—2nd June, 1881. 6d.

This consists in the combination of two horizontal discs with annular cleaning and polishing surfaces and central recesses, the said horizontal discs being mounted on independent axes, to allow of free passage of the knives to be cleaned and polished over and between the annular surfaces and across the central recesses.

2429. PLANISHING AND HAMMERING METALS, *H. Mainwaring, Manchester.*—2nd June, 1881. 6d.

This relates to the planishing and hammering of metals, and more particularly to the treatment of copper cylinders and of plates, whether curved or flat, and consists of a novel arrangement of apparatus whereby the cylinder or plate to be operated upon is hammered and fed automatically.

2430. ALARM AND STOP APPARATUS USED IN MACHINES FOR GRINDING CORN, &c., *F. Wirth, Frankfort-on-the-Main.*—2nd June, 1881.—(*A communication from J. Weber, Uster, Switzerland.*)—(*Not proceeded with.*) 2d.

This relates to an apparatus or device which, when the choking or filling-up of the spout or delivering device of the machine occurs, will cause a signal to be given which indicates that choking is taking place, or the said apparatus may be connected with suitable unshipping gear, and automatically cause the machine to which it is applied to stop.

2432. PERAMBULATORS, *T. G. Wells, Birmingham.*—2nd June, 1881.—(*Not proceeded with.*) 4d.

This relates to the construction of perambulators so that they may be easily taken to pieces and packed in a small compass.

2435. SAFETY VALVES FOR BOILERS OR WATER-HEATERS, *W. Payne, Birmingham, and W. Fisher, Tipton.*—2nd June, 1881.—(*Not proceeded with.*) 2d.

This relates to a double safety valve; to a combined float, water-level indicator, and safety valve; to combined safety valves, float, and bell weight.

2436. BREECH-LOADING RIFLES, *R. Hibbert, Manchester.*—2nd June, 1881.—(*A communication from N. Saverbrey, Basel, Switzerland.*) 6d.

This consists in the combination of parts constituting the breech action or apparatus for cocking, firing, and extracting.

2438. MACHINERY FOR CLEANING COTTONSEED, *G. Welburn, Beverley.*—2nd June, 1881. 6d.

This consists in the mode of cleaning cottonseed from adhering particles of cotton by means of beaters fixed on two rotating shafts revolving in opposite directions in a cylinder.

2453. ROADWAYS, PAVEMENTS, &c., *J. Herd, Birmingham.*—3rd June, 1881. 6d.

This consists in forming roadways, &c., of blocks or setts composed mainly of concrete or other earthy material, the said blocks or setts being faced with asphalte or other like material, with or without metallic projections.

2457. FEEDING PAPER TO PRINTING MACHINES, &c., *J. H. R. Dinsmore, Liverpool, and F. Hoyer, Waterloo.*—4th June, 1881. 6d.

This relates to the use and application of an exhaust or suction for withholding the under sheets of paper and preventing more than one sheet of paper being lifted and fed at a time.

2460. MANUFACTURE OF TIN AND TERNE PLATES, *J. Spence, London.*—4th June, 1881.—(*Not proceeded with.*) 2d.

When desired to make tin plates as cheaply as possible, the plates are placed in a solution of zinc, and a film of that metal is deposited on the surface. They are then placed in a solution of tin and a coating of that metal is deposited on the zinc surface. In manufacturing terne plates the sheet of iron is coated with zinc, and then a coating of lead is deposited by electric process.

2462. TREATMENT OF SOAP LEYS, GLYCERINE, &c., *C. Thomas, Bristol, and A. Domeier, London.*—4th June, 1881. 6d.

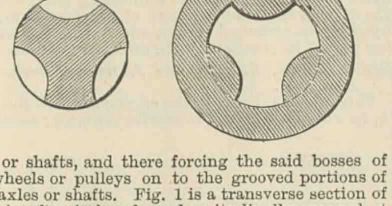
This relates to means of obtaining crude glycerine and other useful products from soap leys, and to remove from the crude glycerine the disagreeable smell and taste that remains in it.

2467. FIXING WHEELS OR PULLEYS UPON AXLES, SHAFTS, &c., *R. A. Hamsell, Sheffield.*—6th June, 1881. 6d.

This consists in the mode or method of fixing wheels or pulleys on their axles or shafts by producing, preferably by casting, ribs or longitudinal projections inside the bosses of the wheels or pulleys, forming corresponding longitudinal grooves or recesses in the

2467

FIG. 1. FIG. 2



axles or shafts, and there forcing the said bosses of the wheels or pulleys on to the grooved portions of such axles or shafts. Fig. 1 is a transverse section of an axle after it has been longitudinally grooved at the part intended to receive the wheel or pulley boss. Fig. 2 is a transverse section of the corresponding wheel or pulley boss showing the part circular or segmental-shaped projections therein.

2468. MANUFACTURE OF NECKTIES OR SCARFS, *W. R. Lake, London.*—6th June, 1881.—(*A communication from J. H. Fleisch, New York, U.S.A.*)—(*Not proceeded with.*) 4d.

This consists in a flat cross apron scarf constructed with a soft or yielding centre piece and with cross aprons, the upper outer portions of which are supported or stiffened.

2470. DISHES AND BASINS OF EARTHENWARE AND METALS, *C. Russel, Garforth.*—7th June, 1881. 6d.

The basins are constructed with division pieces, so as to form compartments for the various foods to be placed therein, and recesses are formed at the top edge to hold seasonings.

2473. WEAVING VELVET, VELVETEEN, AND PLUSH, *J. W. Hall and B. Cooper, Manchester.*—7th June, 1880.—(*Not proceeded with.*) 2d.

This consists in dispensing with what are commonly called the half-binding picks in weaving velvet, velveteen, and plush.

2477. BELT CLASP OR COUPLING, &c., *A. M. Clark, London.*—7th June, 1881.—(*A communication from W. M. Whiting, Elizabeth, New Jersey, U.S.A.*) 6d.

This consists of a bell clasp having bell-mouthed ends and inwardly projecting ribs that grasp the material of the belt near the ends. Pincers for applying the clasp are described.

2478. APPARATUS FOR APPLYING AIR TO THE EVAPORATION OF SUGAR-CANE JUICE, BEETROOT JUICES, SYRUPS, &c., *W. Hume, Buenos Ayres.*—7th June, 1881.—(*Not proceeded with.*) 2d.

The air to be used, more or less dry, will be obtained by the expansion into suitable passages or chambers of compressed atmospheric air which has been previously cooled down while under compression by several cooling mediums.

2479. IMPLEMENT FOR STIPPLING ON LITHOGRAPHIC STONES, &c., *W. R. Lake, London.*—7th June, 1881.—(*A communication from J. Gast, New York, U.S.A.*) 4d.

The following is a formula of the ingredients constituting the preferred composition of which the pad is made, viz.:—10 lb. india-rubber, 12 oz. sulphur, 48 oz. vermillion, 20 oz. French zinc, white, 4 oz. powdered soapstone. These ingredients are thoroughly mixed together, gentle heat being applied to render the mass homogeneous.

2480. TURBINES, *W. R. Lake, London.*—7th June, 1881.—(*A communication from W. F. Jobbins, G. E. Raymond, and J. Sherck, New York.*) 8d.

This consists, First, in the bucket having pockets located at the junction of their vertical and rearwardly inclined portions, whereby the water is chambered in its concussion; Secondly, in the combination with the wheel case and the gate ring of wooden bearings attached to the latter and adapted to bear against the

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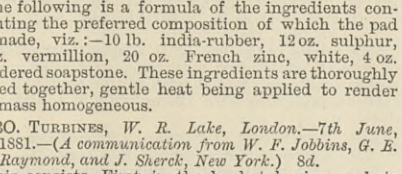

upper ring of the wheel case; Thirdly, in the combination with the wheel case and the gate of vertically adjustable bearings located in the horizontal flange of the wheel case and adapted to support the gate; Fourthly, in the combination with the wheel case and the gate ring of gate wings pivotted to upright pivots attached to the said wheel case, the said gate wings being provided with a bearing at one end on the periphery of the wheel case, and at their opposite end on the edge of the gate ring. Other improvements are described.

2485. SPINNING AND TWISTING MACHINERY, *P. Smith, jun., and S. Ambler, Keighley.*—8th June, 1881. 10d.

This consists in effecting the required vertical motion to the driving cylinder direct from the vertical motions of the lifter rails, so that the tension on the driving bands or cords from such driving cylinder remains uniform.

2481. SPINNING FIBROUS MATERIALS, *W. R. Lake, London.*—7th June, 1881.—(*A communication from B. and A. W. Harris, Providence, U.S.A.*) 6d.

This consists, First, in the combination of a ring adapted to support a traveller and having a band groove in its periphery with a hollow support or axis, through which the cop or bobbin passes in the process of spinning; Secondly, of a traverse cam constructed with a series of short rises and declinations in its periphery; Thirdly, of an auxiliary band cylinder having the same vertical motions as the ring rails, in combination with means for giving it such motions.

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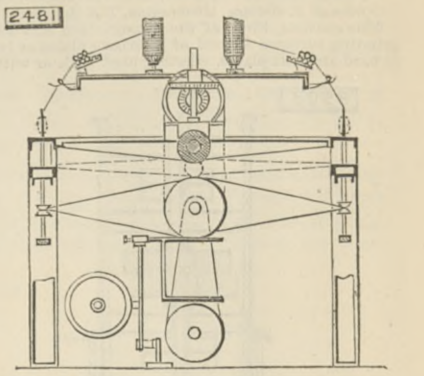

The drawing is a transverse section of the spinning frame.

2486. EMPLOYING GASES FROM WOOD OR CORK IN FURNACES FOR SMELTING, *M. Bauer, Paris.*—8th 1881.—(*A communication from A. C. d'Alma and F. Girot, Paris.*)—(*Not proceeded with.*) 2d.

The gases employed are produced from wood or cork in special ovens in the usual way; they are then conducted for the purpose of saving the bye products into a condenser, and then into a gasholder. From the gasholder the gases are conducted to special receivers surrounding the blast furnace, whence it enters the furnace through suitable pipes.

2488. EXPLOSIVE COMPOUNDS, *C. D. Abel, London.*—8th June, 1881.—(*A communication from M. E. Saulaville and R. Laligant.*) 4d.

This relates to the manufacture of explosive compounds, consisting of mixtures of two substances which are not separately explosive, but such that when the compound is ignited, matter of one of them by reaction with matter of the other effects explosion.

2493. HORSESHOES, &c., *J. Howard, North Hyde.*—8th June, 1881.—(*Not proceeded with.*) 2d.

The shoe is made, the upper part being somewhat conical, to fit within the wall of the horse's hoof, and the under part of the shoe flat with a groove, in which groove are a number of small perforations. Within the groove a circular or otherwise shaped leather or india-rubber band, or a band composed of other elastic material, is placed. The shoe is sewn to the hoof.

2494. OBTAINING WHITE COMPOUNDS FROM LEAD AND ZINC ORES FOR MAKING PIGMENTS, &c., *A. French, Morriston, Glamorgan.*—8th June, 1881. 6d.

This relates to the process for producing white compounds or pigments composed of sulphite of lead and sulphite of zinc, in which process calcined ores or materials containing lead and zinc are partly reduced and partly sublimed in a cupola smelting furnace, air being introduced amongst the volatile matters above the charge as well as at the tuyere, combined with the use of a wet condenser, in which the sublimate is collected and simultaneously purified by means of water.

2495. IMPROVEMENTS IN ELECTRIC ARC LIGHTS, *E. G. Brewer.*—8th June, 1881.—(*A communication from T. A. Edison.*) 6d.

In this lamp the carbons are rotated forward by means of an electro-motor as they are consumed. The regulation of the arc is obtained by means of the armature of an electro-magnet in the lamp circuit, which carries two pawls for clamping the rod, and holding it up. When, however, the resistance of the lamp circuit is increased beyond a certain point, a

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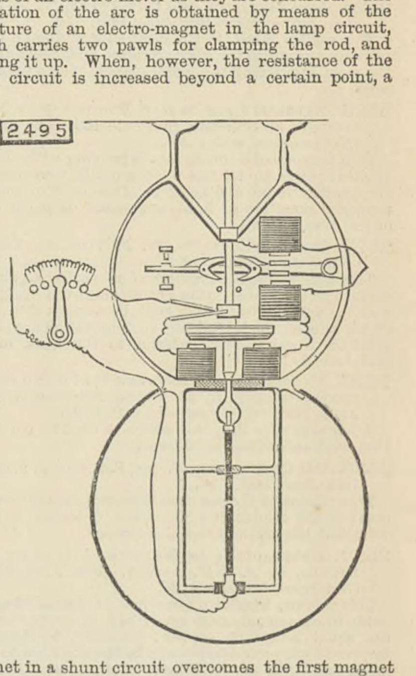


magnet in a shunt circuit overcomes the first magnet and draws the armature downward. The clamps have arms which strike stops when the armature reaches its lowest position, and throw the clamps away from the holding rod, thereby allowing the carbon to drop. The magnet in the lamp circuit again becomes the more powerful, and stops the further descent of the carbon, or raises it again to establish the arc. The mechanism will be better understood from the illustration.

2501. APPARATUS FOR SUPPORTING, FIXING, AND ADJUSTING SWING LOOKING GLASSES, &c., *W. J. Hinde, Camden-road.*—8th June, 1881.—(*Not proceeded with.*) 2d.

This relates to means of supporting, fixing, and adjusting swing looking glasses, &c.

2502. STEAM GRAIN DRIERS, *A. M. Clark, London.*—8th June, 1881.—(*A communication from H. Cutler, North Wilbraham, Mass., U.S.A.*) 6d.

This consists in constructing the steam head of a grain drier with a flange along the inner side of the rim, to receive and confine the ends of the casing boards; also in constructing the end spider with curved arms and a conical flange to receive the grain, and holes to receive the steam pipes; also in the combination with the drier shafts, the outer steam pipes, and the inner steam pipes of one or more spiders to support the steam pipes securely, and allow them to be made of any desired length. Other improvements are described.

2507. TRUSSES, *J. Mayer, Marylebone.*—9th June, 1881. 6d.

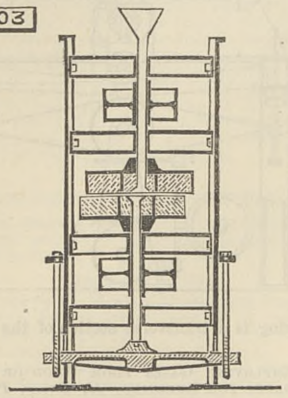
This consists in the adaptation or combination of parts of trusses, whereby the bearing part or pad of the truss is rendered adjustable by the adaptation of a ball-and-socket joint thereto.

2508. REMOVAL OF HAIRS FROM SEAL SKINS, *Sir C. M. Lampson, Bart., London.*—9th June, 1881. 6d.

This relates to improvements on patent 3226, dated 6th August, 1880, and consists in the employment of heat for burning, dividing, or separating the water hairs or stiff bristles from the skin in place of knives or shears.

2503. GRINDING OR PULVERISING APPARATUS, *P. M. Justice, London.—9th June,* 1881.—*(A communication from J. E. Holmes, Washington, U.S.A.)* 6*d*.

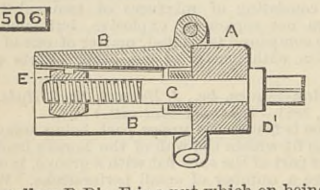
This consists, First, of the construction and use of grinding surfaces formed of alternate plates or layers of hard and soft plates, whether used with or without



a central crusher; Secondly, of the application and use of grinding surfaces excentrically placed to each other and operated upon separate shafts or axles; Thirdly, of the combination with a revolving grinding cylinder, which may or may not be capable of end motion, of a pivotted adjustable grinding surface. The drawing represents a vertical section of a mill.

2506. TUBE EXPANDERS, *J. Hall and S. Thompson, Sunderland.—9th June,* 1881. 6*d*.

In the drawing A is the hub or boss; B B sections hinged thereto; C is a screw having its bearing in the hub A, and prevented from moving endwise therein



by the collars D D[1]; E is a nut which on being drawn along by the screw C causes the sectional parts B B to expand, which in their turn press against the inside of a tube.

2520. MANUFACTURE OF BUOYANT ARTICLES, TO BE USED AS PROTECTORS FROM DROWNING AND AS INVALIDS' MATTRESSES, *J. Sexton, London.—9th June,* 1881. 6*d*.

A sheet of air cells is enclosed in a suitable cover, and the interstices between the air cells are filled up with suitable non-absorbent buoyant stuffing.

2523. LIFE RAFT OR BOAT, *A. M. Clark, London.—9th June,* 1881.—*(A communication from W. N. van Wagener, Newark, New Jersey, U.S.A.)—(Not proceeded with.)* 2*d*.

This consists in a raft or boat composed of two or more long flat-bottomed floats or pontoons, connected together side by side by means of hinged and pivotted braces or beams and other devices, in such a manner that they may be held in close contact with each other.

2525. APPARATUS FOR GLAZING PAPER, *T. R. Johnston, Edinburgh.—10th June,* 1881. 6*d*.

This relates, First, to the means for giving an intermittent motion to the glazing rolls; and Secondly, to the means for fixing the metal glazing plates upon the rolls.

2526. MATERIALS FOR TAKING PHOTOGRAPHIC NEGATIVES, *J. B. Holroyde, Halifax.—10th June,* 1881.—*(Not proceeded with.)* 2*d*.

This consists of a mode for dispensing with the use of glass plates in taking photographic negatives by the application of a film of gelatine or like matter, rendered sensitive to light, supported on paper more or less transparent.

2527. PRINTING SURFACES, *W. B. Woodbury, London.—10th June,* 1881. 4*d*.

This consists in the method of preparing a printing surface from type or other cut or engraved design by making a mould from such type, pressing a thin sheet of tin or other metal foil into such mould and applying gelatine or gelatinous material to the back of the metal sheet.

2529. MACHINERY FOR DRESSING FLOUR AND CLEANING GRAIN, &c., *H. M. Lucas, Bridgenorth.—10th June,* 1881.—*(Not proceeded with.)* 2*d*.

A horizontal or diagonal sieve is used in combination with an endless band brush.

2535. GAS CONDENSERS, *H. and F. C. Cockey, Frome.—10th June,* 1881. 6*d*.

This relates to the construction and general arrangement of the condensing pipes and chamber, so as to admit of the efficient use of a scraper.

2587. MANUFACTURE OF METALLIC ALLOYS OR COMPOUNDS, *G. A. Dick, London.—10th June,* 1881.—*(Not proceeded with.)* 2*d*.

This relates, First, to a method of deoxidising the oxide or oxides generally contained in copper and in the usual alloys of copper; Secondly, to obtaining improved alloys or compounds by the addition to gun-metal and brass of phosphuret of iron; and Thirdly, to the addition of lead to the said last-mentioned alloys, consisting of iron, phosphorus, and gun-metal or brass.

2545. FRAMES FOR PORTABLE LOOKING GLASSES, &c., *F. Wirth, Frankfort-on-the-Main.—11th June,* 1881.—*(A communication from F. Roeder, Frankfort-on-the-Main.)* 4*d*.

This consists in the employment of a springy loop or bow with two conical or tapered ends, in combination with a sleeve, box, or tubular piece fixed at the back of the article.

2546. SEWING MACHINE GEARING, *H. J. Haddan, London.—11th June,* 1881.—*(A communication from M. J. Lecœur, Darnetal, France.)* 6*d*.

This relates partly to the arrangement of a friction disc, communicating to a friction pulley in contact with the surface of said friction disc a rotary motion, which is directly proportional to the radius from the point of contact to the centre of the friction disc.

2547. THRASHING MACHINERY, *H. J. Haddan, London.—11th June,* 1881.—*(A communication from T. Martin, Poilly, France.)—(Not proceeded with.)* 2*d*.

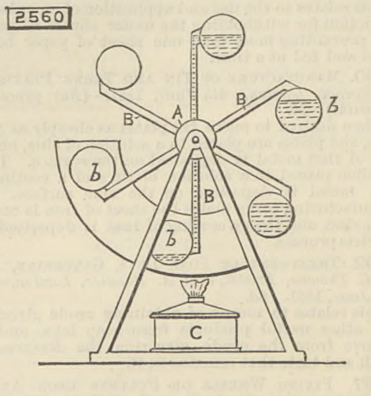
This consists in the addition to the machinery of a stripping or cleaning beater and its accessories, and by such means mechanically and in one operation extracting the seed and removing it from its envelope.

2549. SHAVING OR FINISHING HARD AND SOFT FELT HATS, *J. Eaton, Stockport.—11th June,* 1881.—*(Not proceeded with.)* 2*d*.

The hat is fixed on a revolving block upon a table. On the table and around about half the circumference of the block are arranged a number of adjustable reciprocating carriages carrying rubbers for shaving or finishing the hat as it is revolved.

2560. UTILISING VOLATILE LIQUIDS FOR THE PRODUCTION OF MOTIVE POWER, *W. R. Lake, London.—13th June,* 1881.—*(A communication from J. L. Landis, Lancaster, Penn., U.S.A.)* 6*d*.

A is the hub of a wheel, and B a series of tubes attached thereto at their central part. The tubes are provided at their ends with hollow bulbs *b*. These tubes and their terminal bulbs are partly filled with liquid, such as alcohol, and then exhausted of air and hermetically sealed so that the said liquid may move from receptacle to receptacle in vacuo. C is a lamp which in heating the bulbs causes a part of the liquid to vaporise, whereupon the pressure of the gas thus formed will force the remainder of the liquid out of



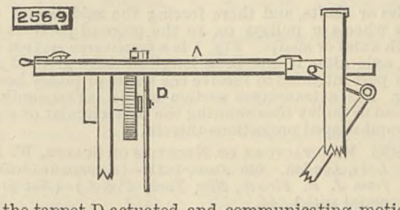
the said bulbs and through the tube into the upper bulb, thus causing the latter to preponderate and the hub drum or shaft A to turn.

2565. TRICYCLES, &c., *E. J. Lewis, Reading.—13th June,* 1881. 6*d*.

This consists in making at the side of each of the principal cranks of the driving shaft a secondary crank, preferably of about half the radius of the principal cranks, and connecting the treadles to their respective pairs of cranks by means of flexible connections and rigid rods and connecting gear, whereby the driving shaft during part of its rotation is acted upon by the principal cranks, and during the remaining part of its rotation by the secondary cranks.

2569. LOOMS, *R. Hall and J. Hobson, Bury.—14th June,* 1881. 6*d*.

This consists, First, in the employment of the lever A, in which is a groove to receive the wire; Secondly,



in the tappet D actuated and communicating motion to the lever A; Thirdly, of a temple fitted in the breast-plate.

2575. MANUFACTURE OF BARYTA, *W. E. Gedge, London.—14th June,* 1881.—*(A communication from E. J. Maumené, Lyons, France.)* 4*d*.

This relates to an improved process of manufacturing baryta.

2581. PREPARATION OF STAINS AND MATERIALS FOR POLISHING, *C. M. Sombart, Magdeburg, Germany.—14th June,* 1881.—*(A communication from G. Glafey, Nürnberg, Bavaria.)* 2*d*.

This consists in the use of carnauba wax in a hydrated state combined with metallic and other oxides and colouring matters for preparing stains, polishing, and scouring matters.

2585. MACHINE HAMMERS, *H. J. Haddan, London.—14th June,* 1881.—*(A communication from A. Beaudry, Massachusetts, U.S.A.)* 6*d*.

This consists in the new combination of various parts, being the frame and anvil, together with a reciprocating ram with springs actuated by a rod, spring, rotary crank shaft, and connecting rod, with a screw-threaded sleeve and springs.

2597. WIRE GAUZE FOR PAPER MILLS, &c., *R. H. Brandon, Paris.—15th June,* 1881.—*(A communication from L. Lang and Son, Alsace-Lorraine.)* 2*d*.

The wire cloths are nickelled, either before weaving the gauze or after the gauze is withdrawn from the loom.

2821. SUPPLYING AIR TO LAMPS, &c., *C. W. Torr, Birmingham.—28th June,* 1881. 6*d*.

This relates to the construction and combination of the parts of concentric tubes for supplying the air for combustion, and for carrying away the products of combustion.

2639. BESSEMER CONVERTER AND FURNACE LININGS, *D. Evans and A. E. Tucker, Rhymney, South Wales.—17th June,* 1881. 4*d*.

This relates to the use of a composition consisting of ground ganister or sandstone, or similar ground silicious material, mixed with tar or similar hydrocarbons, preferably with the addition of a little coal-dust.

2683. MANUFACTURE OF TUBES OF COPPER AND BRASS, *W. E. Everitt, Birmingham.—18th June,* 1881. 4*d*.

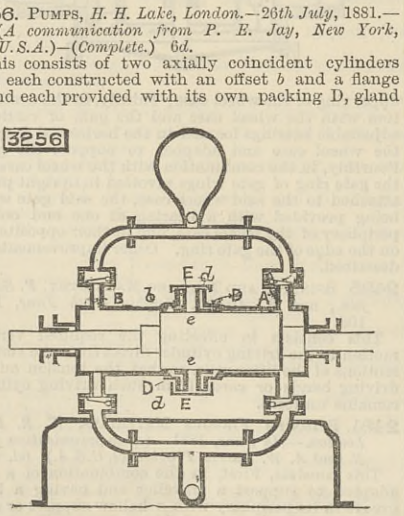
This consists in casting the hollow ingots from which the said tubes are made in a trough-shaped mould, open, or partially open, at top, having a central metallic core or mandril, the said mould being by preference rectangular, or nearly rectangular, in cross section, and the core or mandril by preference elliptical in cross section, the mould and core during use being so adjusted that the core and top of the mould are horizontal.

2686. PARQUET FLOORING, *A. Damman and A. Cassard, Brussels.—20th June,* 1881. 6*d*.

The flooring consists of parquetry laid upon blocks or slabs of terra-cotta, stone, cement, or other like materials, with the interposition between the parquetry and the said blocks or slabs of waterproof material.

3256. PUMPS, *H. H. Lake, London.—26th July,* 1881.—*(A communication from P. E. Jay, New York, U.S.A.)—(Complete.)* 6*d*.

This consists of two axially coincident cylinders A B, each constructed with an offset *b* and a flange *d*, and each provided with its own packing D, gland



E, and bolts *e*, and arranged with a space between them sufficient to permit access to their interiors, in combination with suitable pipes connecting the said cylinders, and a piston common to both of the same.

3725. REFRIGERATING APPARATUS FOR FLUIDS, LIQUIDS, OR SOLIDS, *H. D. Cogswell, San Francisco, U.S.A.—26th August,* 1881.—*(Complete.)* 6*d*.

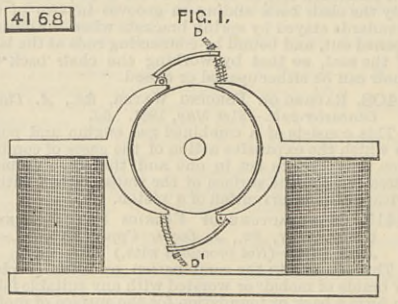
This consists in the employment of a series of pipes arranged in horizontal layers or coils within a chamber or case, so that ice may be placed upon the coils.

3876. SEWING MACHINES FOR MANUFACTURE OF BOOTS AND SHOES, &c., *W. R. Lake, London.—7th September,* 1881.—*(A communication from J. B. Anthony, Providence, U.S.A.)—(Complete.)* 6*d*.

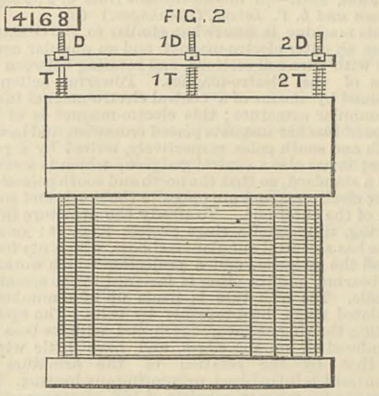
This relates to the completion of the stitch, to the mechanism employed for controlling the main or spool thread during the formation of a stitch, and to means for locating the position of the back of the threads in the goods.

4168. GOVERNING APPARATUS FOR ELECTRIC MACHINES, *W. P. Thompson, Liverpool.—27th September,* 1881.—*(A communication from Prof. J. W. Langley, Ann Arbor, Mich., U.S.A.)* 6*d*.

A piece of metal is arranged so as to tend to make contact and establish magnetic communication be-



tween the poles, its position being regulated by the strength of the current. Fig. 1 shows ordinary machine; Fig. 2 the apparatus attached. C C[1] are



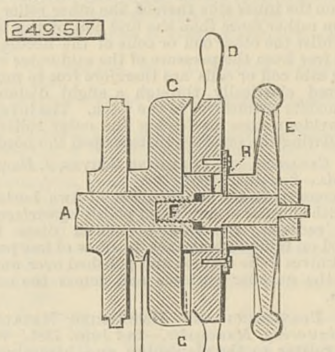
pieces of magnetic metal long enough to reach from pole to pole, D D_1 D_2 are guide rods of diamagnetic metal, T T_1 T_2 are springs of diamagnetic metal.

SELECTED AMERICAN PATENTS.

From the United States' Patent Office Official Gazette.

249,517. FRICTION LOCK FOR STEERING WHEELS, *Stephen B. Greacen, Perth, Amboy, N. J.—July 8th,* 1881.

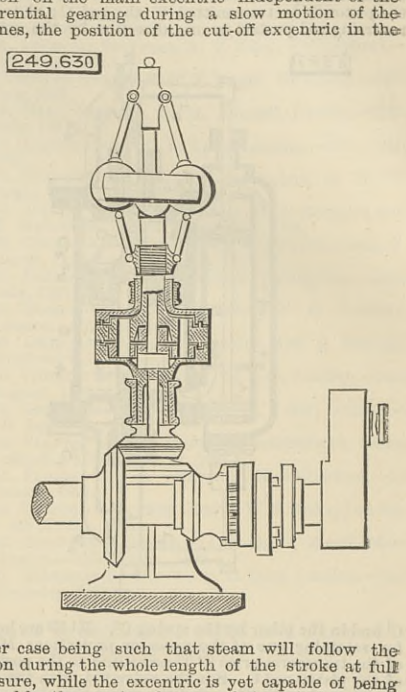
Claim.—(1) In combination with a steering wheel D, of a hand steering apparatus, a friction becket or lock connected with a hand-wheel and uniting screw, and adapted by the turning of said hand-wheel to form a locking contact with the friction plate C, the screw F turning in the square hub G and forcing the wheel D, sliding on the hub, against the plate C, substantially as specified. (2) In combination with the shaft A, having the square hub or boss G, and carrying the friction plate C, the steering wheel D, having in its inner face a square hole H, adapting it by the movement of the hand-wheel E, as above described, to slide upon the square hub G, substantially as set



forth. (3) In combination with the shaft A, having the square hub, substantially as described, and convex friction plate C, the concave face of the steering wheel D, adapted by the movement of the hand-wheel E, as above described, to form a locking connection with the plate C, substantially as specified. (4) In combination with the shaft A, plate C, and steering wheel D, constructed and arranged substantially as set forth, the hand steering wheel E, provided with the screw F, substantially as and for the purpose specified.

249,630. CUT-OFF MECHANISM, *Maximillian Jacker, Marquette, Mich.—May 20th,* 1881.

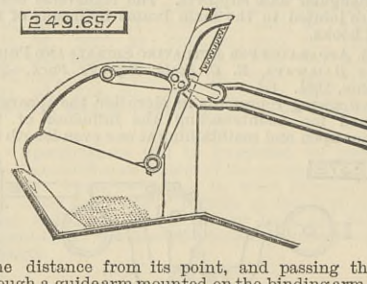
Claim.—(1) The combination of revolving and fixed friction discs with a centrifugal governor in a manner that a very slight vibration of the balls will, when the governor attains a certain speed, suspend adhesion to the driving friction disc and cause friction on the fixed disc, thus maintaining a steady normal speed for the governor, which does not increase during the subsequent higher speed of the motor, substantially as and for the purpose specified. (2) The combination of a planet wheel or its equivalent with the driving friction disc in one piece or firmly connected with the same, with intermediate gears fulcrumed on a part of the governor having a steady normal speed or motion, with a driven gear keyed to the central spindle or arbor, which transmits motion to the cut-off excentric, so that after the governor has attained its normal speed the increasing speed of the planet wheel or its equivalent will be communicated to the central arbor, driving the same in an opposite direction at a rapidly increasing speed until the motion of said arbor and the motion of the engine shaft become isochronous and remain so during the normal speed of the engine, while the slightest fluctuation in the motion or speed of the engine will destroy this isochronism, and will thereby change the position of the cut-off excentric, which is mounted loose on the engine shaft, thus adjusting the lead of the cut-off valve and regulating the degree of expansion automatically for every degree of resistance by a positive connection with non-intermittent motion. (3) In combination with the governor, differential gearing, and cut-off excentric, a clutch or ratchet interposed between gears and excentric, so that a direct motion is transmitted from the gearing to the excentric only in one direction, allowing the cut-off excentric to be carried by a projection on the main excentric independent of the differential gearing during a slow motion of the engines, the position of the cut-off excentric in the



latter case being such that steam will follow the piston during the whole length of the stroke at full pressure, while the excentric is yet capable of being shifted by the gearing far enough to cut the steam off at the beginning or at any point of the piston stroke, substantially as explained.

249,657. BUNDLE COMPRESSOR FOR GRAIN BINDERS, *Lewis Miller, Akron, Ohio.—September 7th,* 1881.

Claim.—The combination, with the binding arm of a grain binder, of a bundle compressor consisting of a flexible cord secured at one end to the binding arm at



some distance from its point, and passing thence through a guide arm mounted on the binding arm, and finally secured at its other end to an elastic spring on the said guide arm, substantially as described.

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