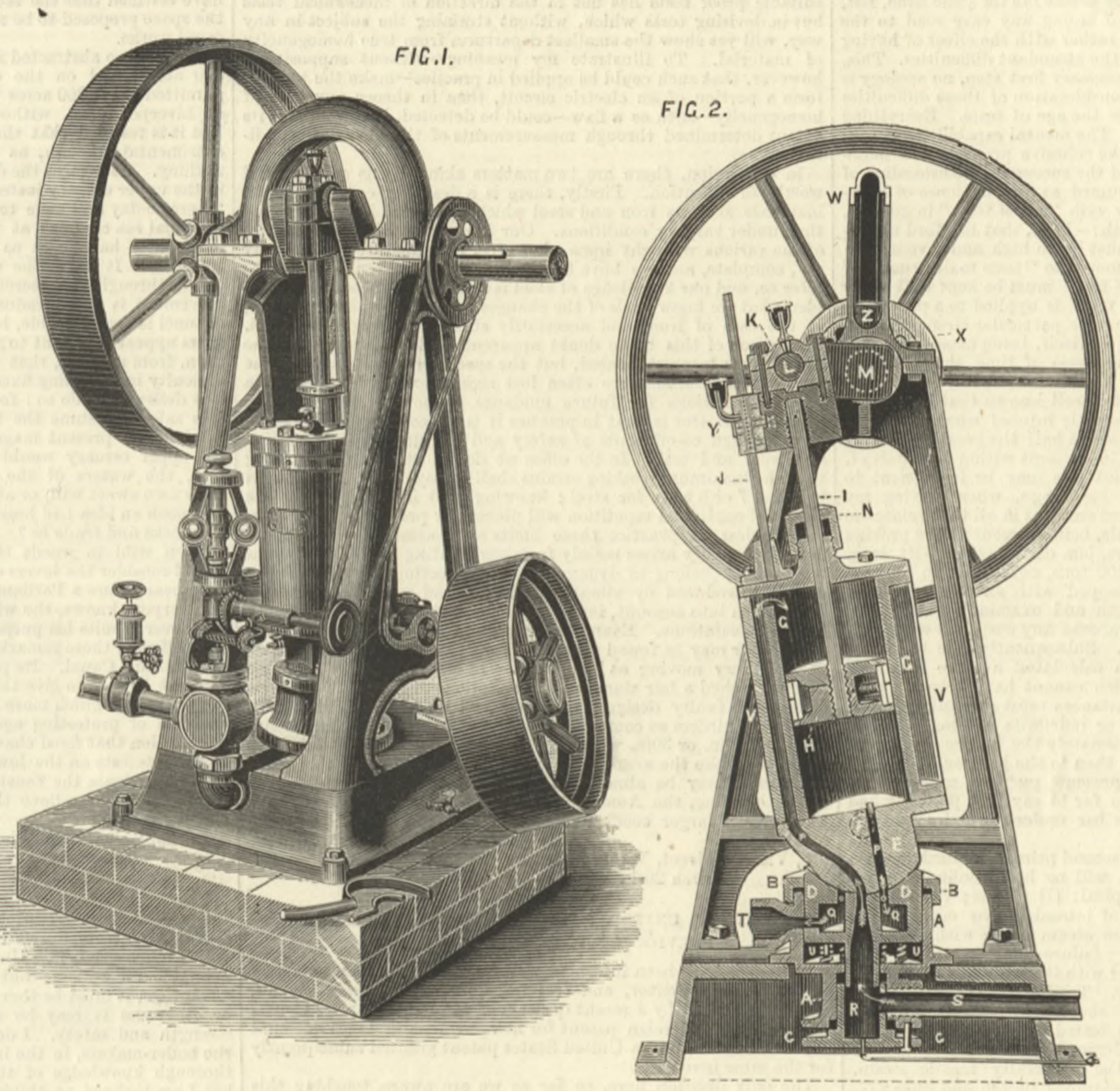
THE NEW ORLEANS EXHIBITION.

No. II.

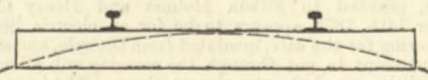
No official catalogue has yet been published, though it is stated that the contract for preparing and printing one was arranged some months ago. The exhibitors as well as the visitors suffer from this omission, and there are naturally many complaints; but this departure from one of the rudimentary rules of international exhibitions is only one of many novelties in this somewhat remote and peculiar city. The entries from abroad are few when compared with previous international exhibitions, although facilities were offered in regard to Custom House modifications and cheap freight rates. England has very little here, and hardly anything of an engineering or metallurgical kind, which can hardly be wondered at, seeing that however politely exhibits might be welcomed and honours awarded, the tariff prohibits trade. Messrs. Rose, Downs, and Thompson, of Hull, show a very complete oil mill suitable for cotton seed. This appears to be the same machinery that was shown at the recent Calcutta Exhibition, and consists of crushing rolls, steam kettle, moulding machine, and hydraulic press, the style and workmanship comparing very favourably with similar American machinery. Jamaica and British Honduras show their natural products, and put in their lot with Mexico, Guatemala, Venezuela, and other of the central American countries that do business here. Mexico has the best display in the Exhibition, but, with the exception of a street tramcar, nothing of interest to engineers. Germany is conspicuous by her absence; France has little to show except a very complete display of the Decauville portable railways, which are regarded with much interest, and would be of great service here. It is strange that in this country of labour-saving appliances such aids to transport are, at any rate in the South, unknown; but tramways here are so associated with the passenger service in towns, and railroads with long journeys, that the minor conveniences obtainable from suburban lines, or from light field tramways, appear to be unknown. In the sugar plantations of Louisiana these portable railways would be particularly useful, and the Decauville Company doubtless considers that its patents and its long experience in manufacture will enable it to compete with American makers. The nearest approach here to the French system are the logging lines for transporting timber in the forests to the saw mills. These lines are temporary, are roughly, cheaply, and easily laid, but they are 3ft. gauge, laid on timber cross sleepers, and are in no sense portable. Belgium is very well represented, her iron and steel makers probably deeming themselves able by the very low prices that rule at home to be able to resume business here directly trade revives. Cockerill has a good show of railway wheels and axles; the Providence Company exhibit their various beams, channels, and other forms of rolled iron; the Valère Company of Mabille shows springs and buffers, but the latter being of the usual European kind are quite useless on American railways. The Jemmappes rolling mills at Mons show an admirable assortment of light sections.

There is a very large display of American wood-working machinery. Unlike the custom in England, where the leading firms make all kinds of machines, here the manufacture of saw mills and the various appliances for dealing with rough timber, is kept entirely distinct from the moulding, planing, and sawing machines used in workshops. There seems to be a marked advance since the Philadelphia Exhibition in the design and workmanship of all these classes of machines. E. P. Allis and Co., of Milwaukee, who employ 1500 men, show some splendid saw mills working. Timber is cheap, and little is thought of the great waste which the system involves. Circular saws of from 60in. to 72in. diameter, with large teeth, rip up the trees at great speed, the timber advancing at the rate of 10in. for each revolution of the saw. These machines will saw 60,000 superficial feet of timber per day of ten hours. In other machines the timber is stationary, and the saw, fixed on a moving carriage, advances as it revolves. The principal exhibitors of wood-working machinery are Goodall and Waters, of Philadelphia; J. A. Fay, of Cincinnati; and the Concord Machine Works, of New Hampshire. Some very fine band-saws are shown, and there is less of woodwork in these machines, and much more symmetrical design in the ironwork, than was usual here a few years ago. There is one very neat band-saw, arranged on a bracket frame for bolting on a wall, the frame being much lighter than that of ordinary self-contained machines.

There is a good display of railway rolling stock and permanent way appliances. Some of the lines content themselves with showing the products of the districts they serve, but others give information about the line itself. There is a cleverly executed model in relief of the State of Florida, showing the whole of her railway system and the general contours of the country, which serves well to explain the physical difficulties of some of the routes. The Cincinnati, New Orleans, and Texas Pacific Company exhibits a full-size section of its track, showing the system of ballasting, rail jointing, &c. A great advance is being made on many of the main lines here in regard to the solidity of the permanent way, but there are essential differences from what is deemed best on English railways. The great majority of even the principal roads which are laid with steel rails have sections only of from 56 lb. to 65 lb. per yard; the Pennsylvania Railway has adopted a standard of 70 lb., and only on a few miles of the New York Central are rails of 80 lb. laid. The sleepers are, however, nearer together than in England. Oak sleepers are largely used, a length of 8ft. by 8in. by 8in. being the usual size; but the sleepers are not sawn from the log, but are hewn, this, though more costly, being deemed an advantage for the durability of the timber. The system of ballasting does not at all accord with English notions. Instead of packing well up to the ends of the sleepers, so as to give ample support there, the ballast is arranged as in the dotted line above. The sleepers being thus better supported in the middle than at the ends, the latter become loose under the pressure of the traffic, the heavy engines rock, the gauge spreads, and the sleepers are apt to break after repeated bendings.



THE KRIEBEL STEAM ENGINE



There is a considerable variety of locomotives. In most of them black is the colour adopted—a great improvement on the earlier gaudy ornamentation exemplified in the American engines shown in Paris in 1867. Generally now the barrel of the boiler is covered with Russian sheet iron, unpainted. The largest engine in the Exhibition, and the only one of the Consolidation type, is that shown by the Roanoke Machine Works, Virginia, with 20in. cylinders. The Baldwin Company, of Philadelphia, shows a ten-wheel engine, with 18in. cylinders, and a Mogul engine, with 19in. cylinders, as well as two smaller engines. The Pittsburgh Company and the Rhode Island Company each exhibits two engines. Two firms exhibit logging locomotives for carrying timber on the temporary roads previously alluded to. For one of these engines a railroad has been laid down in the grounds, with irregularities purposely exaggerated to show the behaviour of the engine under difficult circumstances. The Lima—Ohio—Machine Company exhibits one of its geared locomotives for working on steep inclines, the driving wheels running at half the speed of the main shaft. The Pullman Company is making these engines at its car works.

There is a good display of freight and passenger cars. Among the former are some refrigerator cars for carrying fruit and meat; some depending only on special systems of ventilation, as in England, and others with chambers full of ice. There are three exhibits of sleeping cars. The Pullman is too well known to need description; there is a car made by the Woodruff Company, the patentee of this name, who was really the inventor of the sleeping cars introduced by Pullman, to whom he sold his invention, having since the patents expired established a manufactory. The Pullman cars still have the supremacy here, because of the clean and business-like way in which they are managed. Many Americans, however, are in favour of the Mann system, of which there is a highly-finished specimen, which gives more of the privacy of an English carriage. The Mann car has four-wheel bogie trucks, a departure from the almost universal system here of six-wheel trucks, these four-wheel trucks having a longer wheel base than usual, and having two sets of bolsters and bolster springs. This abandonment of the six-wheel trucks, as has already been done in England by the Midland Company, is with a view of lightening the cars, an alteration much needed on some of the older roads with defective permanent way.

There are a few exhibits of switches and crossings, a part of railway equipment which requires great improvement in this country, only a few of the leading companies giving it the attention it deserves. Signals are everywhere wanting on the southern lines of road, but the New England roads, the New York Central, the Pennsylvania Company, and the Chicago, Burlington, and Quincy lines have made a manifest advance in this direction. The latter company, not much known in England, is one of the best equipped and most honestly conducted of any of those in the West. The main line of this company extends from Chicago to Denver, and with branches includes nearly 4000 miles of line. The absence of signals is the more conspicuous in this country because of the general appreciation of labour-saving appliances, the waste of time, and the risks involved by trusting only to the flagmen for the protection of a train at a stopping place, being very marked to those who are acquainted with European railways. At the same time, on some of the new lines in poor, sparsely populated districts, it is useful to notice how many of what Englishmen at home and abroad deem essential parts of railway equipment may be altogether omitted where the available money is limited and the needs of communication and transport great. The cost of a railway per mile may obviously be reduced by having no other stations than a few wooden sheds, like those of a contractor, and by omitting fences, road bridges, and signals altogether. While on this point of railway making, it is interesting to note how the grading of a road is here effected without in any way attempting to balance the earthwork of the cuttings and embankments. The spoil from the cuttings is thrown on the side of the line, land for spoil banks costing nothing here, and material for the embankments being obtained from the adjacent land by means of "scrapers," or scoop ploughs drawn by one or two horses, and holding from half a yard upwards. Horses, mules, and provender are cheap here, while labour is dear, and the method adopted seems to be cheap and effective.

The railways concentrating on New Orleans have had an increase of traffic, which has greatly tried their organisation and plant. Only one line, the Georgia Pacific, has had the enterprise to run special trains. This line, which runs south about 500 miles from Atlanta, Georgia, passes for 400 miles of this distance through almost continuous forest, broken only occasionally by small clearings and timber mills. Yet along a route like this a so-called "limited express" is run, with hardly any local traffic to contribute to the earnings. Near this city there is a timber trestle viaduct, twenty miles long, of which five miles is over a lake or inlet from the sea. This viaduct is a new one. The teredo worm is said to be very destructive, and as reliance is placed entirely on the creosoting of pitch pine timber, its durability would, judging from English experience, appear to be doubtful.

THE KRIEBEL STEAM ENGINE.

In many small manufacturing establishments an independent source of power is often desirable, and especially in cities where steam distribution from central stations is carried on, small engine ranging from 2 to 10-horse power find many applications. To meet this want the Kriebel engine, manufactured by Messrs. Rice, Whitacre, and Co., of Chicago, Ill., has been constructed. In the illustration on page 275, Figs. 1 and 2 show the engine in section and in perspective. The engine, as will be seen, is of the upright oscillating type, and has a simple valve arrangement. The lower end of the valve E is semi-cylindrical, and is seated in a steam chest D D, which is enclosed in a casing A A, and supported on springs U U. These springs cause the chest to always make a steam-tight joint with the valve, allowing it to slide up when wear occurs, and are of sufficient strength to accomplish this without causing extra friction. A flanged packing cup C C fits into the lower part of the casing and packs a neck-shaped extension of the steam chest, so steam cannot pass under the chest. The flange of the cup also packs the bottom of the casing, so steam cannot escape there. There are two ports P P in the valve, one running alongside of and opening into the top of the cylinder, and the other connecting with the bottom of the cylinder. The steam chest has a central steam port R, which connects with the steam pipe S, and one exhaust port on each side of this O O, which open into an annular exhaust chamber Q Q, connecting with the exhaust pipe T. As the valve vibrates back and forth, each of the valve ports alternately takes steam from the port R, and exhausts through the port O, on the corresponding side of the steam chest; and while one valve port takes steam the other exhausts, as shown in the cut. The engine is, according to the *Electrical World*, well made and finished, and, judging from the testimonials of those who are using it, gives very good satisfaction.

LETTERS TO THE EDITOR.

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

PROOF TESTS.

SIR,—I write the following remarks chiefly in consequence of reading in your issue of the 13th inst. the notice of the lecture on "Flexural and Torsional Rigidity," recently delivered in Glasgow University. No doubt all will agree with Sir William Thomson that a great need would be supplied if tests, satisfactory in theory and applicable in practice, were devised whereby assurance could be given that there should be no failures of screw shafts, railway axles, and such-like, under circumstances productive of disastrous results to life and property, as was now only too commonly the case.

This subject has been prominently before me for some time, not, I regret to say, with the result of seeing any easy road to the attainment of the end desired, but rather with the effect of having formed a closer acquaintance with the attendant difficulties. This, however, being admittedly the necessary first step, no apology is needed for entering into a brief consideration of these difficulties here. The present is *par excellence* the age of tests. Everything which is to be used is first proved. The mental capabilities of men are tested by examinations, and the cohesive properties of materials are tested by experiments, and the successful withstanding of the "proof test" is ordinarily assumed as final evidence of satisfactory qualification. Dealing now with "proof tests" in general, two primary difficulties are met with:—First, that to afford unfailing evidence of perfection, tests must be so high and severe as to cause permanent injury, and thus amount to "tests to destruction," whereas it is clear that any "proof test" must be kept well below this limit. Secondly, the "proof test" is applied to a particular subject at a particular time and under particular circumstances, and these latter, including the subject itself, being necessarily in a state of perpetual change by mere lapse of time, the proof test thus ceases to have applicability.

To come to practical examples, it is well known that in the case of wrought iron it becomes permanently injured when submitted to a direct tensile strain exceeding about half the breaking strain; consequently "proof tests" have to be kept within the limit of, say, 10 tons per square inch. But this may be insufficient to reveal defects. I remember, ten years ago, when serving my pupilage to one of our engineers most eminent in all that relates to the testing and strength of materials, being present at the proving of a set of four large suspension bars, 5in. diameter and 35ft. long. Each bar was tested to a strain of 160 tons, equivalent to 8·2 tons per square inch of section, and tapped with an ordinary hand hammer throughout its whole length and examined while under this strain. Nothing occurred to arouse any suspicion whatever, and the set of bars was put in use. Subsequently, one bar failed under normal conditions and at a calculated average strain of 4·6 tons per square inch, and which cannot have actually been appreciably exceeded, as the circumstances most carefully guarded against the possibility of unequal or indefinite loading, and all shocks or jars were avoided. Fortunately the failure resulted in no damage worth mentioning other than to the bar itself.

Further comment is for my present purpose unnecessary, although it is perhaps not going too far to say that probably had the proof test not taken place the bar under normal conditions solely might have had a long life.

Now examples under head of the second primary difficulty noted may be indefinitely multiplied, but will be here confined to two cases which may be considered typical: (1) chains; (2) railway axles and screw shafts. Failures of proved chains occur daily. Assume an instance of a new 2 ton steam crane with $\frac{9}{16}$in. jib chain; it works for twelve months—failure—inquest—the broken chain handed in in evidence, together with the proof test certificate, which reads as follows:—" No. 119. Testing Works. . . . . This is to certify that a $\frac{9}{16}$in. short link chain weighing 0 tons 3 cwt. 0 qrs. 2 lb. has been tested at this machine, and found capable of sustaining a degree of tension equal to 3 tons 15 cwt. 0 qrs. 0 lb., being the Admiralty tensile strain. Length 100ft., mark and numbers stamped on the end links 777. . . . Signed . . . . Superintendent. To Mr. . . . .'s order. London, . . date . . 18 . ." A juryman might be right in saying, "Oh, but the certificate is for a $\frac{9}{16}$in. chain, and this one is now worn and grooved to $\frac{7}{16}$in.;" and it would thus be an improvement if such certificates were to indicate the amount of wear and tear permissible. Indeed, a certificate such as the above may be a direct source of danger, seeing it usually comes into the hands of a buyer possessing no technical knowledge. He sees he has a chain certified to lift 3¾ tons, which he naturally assumes to be the safe load, there being nothing said to the contrary, and his experience is that materials and structures generally can carry much in excess of what is stated as the safe load; and, moreover, he is not cautioned in any way that the proof test is applied gradually and with care, whereas in practical work even the minimum shocks and jars attendant on lifting loads quickly may often occasion strains equal to double that due to the load when stationary.

The case of railway axles and screw shafts differs somewhat from that of chains in that wear and tear produces in them mainly molecular change, and not to any great extent loss of weight and altered form through attrition. It is well known that railway axles of the best fibrous iron become crystalline and short in grain from long continued vibration, and no initial "proof test" can be of service here. Some guarantee might be afforded by fixing absolute mileage limits, after which axles should be considered as worn out. The "growth of flaws" is another source of failure just as subtle; a hidden flaw which is at first of small extent, gradually increasing until failure results, and the larger the axle or shaft the smaller may be the area of the flaw as a percentage of the whole cross section, to still be of serious moment, and proof tests are incapable of evincing small percentage defects. The difficulty and expense in providing machines, and in proof testing the larger class of shafting, &c., are matters which need not be entered upon here. The general conclusions arrived at are: (1) That from the nature of things mechanical proof tests must be unsatisfactory; (2) that proof tests as at present carried out are of little value; (3) that if proof tests were periodically repeated on each subject from time to time they might be of more value, but the manifest inconvenience in general attending this course renders it prohibitive. An exception to this last is found in the case of boilers, as each contains within itself all the means necessary for the convenient application of the proof test, the only thing required being to weight the safety valves to a given pressure and get up steam. Furthermore, the custom of insurance, now so general, has done much service in causing the boilers to be periodically examined from time to time by competent inspectors. What, then, are we, in general, to look to for security, is the question which naturally arises; and I think, so far, the answer must be said to be contained in the principle of the uniformity of manufacture. Take the case of steel rails. These are turned out by our best firms in enormous numbers and with wonderful uniformity. The laboratory and bending tests are carried out on each charge of the converter to ensure the proper quality of steel, and portions of a few rails—say, 1 per cent. of the bulk—are tested to destruction in various ways to ascertain the ultimate tensile and transverse strengths and elasticity, &c., but the rails which are to be used are subjected to no tests whatever, and only to an examination to discover superficial defects. The result of this system cannot be otherwise described than as eminently satisfactory. In specifications I have gone so far as to reserve power to have the rails rolled from each charge of the converter kept separate, and to subject a portion of one rail out of each lot to the ultimate tests. This excessive amount of precaution will be found to be quite unnecessary when dealing with good manufacturers; and, as an example, may be quoted two orders executed by the Barrow Hematite Steel Company to the same specification, but at dates differing about twelve months, and the uniformity throughout both lots of some 10,000 27ft. rails was remarkable, and a more than ordinarily precise specification was almost literally adhered to. No test showed anything except the highest quality, and, in fact, the only departure from the specification was that whereas the ultimate tensile strength was to have been between 28 and 32 tons, in a few cases it went as high as 36 tons.

Now the difficulty of ensuring uniformity of manufacture in the case of such matters as large screw shafts is very great, not only from their size but also from the fact that in the aggregate comparatively few are made, and these by various firms, so that any one maker can at best have but small experience; and, moreover, there is this marked feature wanting, namely, the information gained through testing to destruction a shaft sister to the one which is to be put in use, the cost of so doing rendering it out of the question. I think the solution of the problem of obtaining suitable proof tests lies not in the direction of mechanical tests but in devising tests which, without straining the subject in any way, will yet show the smallest departures from true homogeneity of material. To illustrate my meaning—without supposition, however, that such could be applied in practice—make the subject form a portion of an electric circuit, then in theory any lack of homogeneity—such as a flaw—could be detected, localised, and its extent determined through measurements of the electrical conditions.

In conclusion, there are two matters akin to this subject, and worthy of attention. Firstly, there is a dearth of experiments on materials such as iron and steel which have been in use for some time under varying conditions. Our knowledge of the properties of the various wrought irons when first manufactured is, we may say, complete, and we have the results of almost endless tests to refer to, and our knowledge of steel is similarly fast becoming complete; but we know little of the changes produced by vibration, &c., in the case of iron, and necessarily still less in regard to steel. The reason of this is no doubt apparent, as by the lapse of time not only is interest abated, but the special circumstances of the original manufacture are often lost sight of, without which data useful deductions for future guidance cannot be drawn. The remaining matter is that in practice it is too common not to allow large enough co-efficients of safety and margins for depreciation and wear and tear. In the office we design structures intending that the maximum working strains shall be, say, 5 tons for wrought iron and 7 or 8 tons for steel; knowing that if these strains are exceeded continued repetition will ultimately produce failure; but, nevertheless, in practice these limits are constantly overstepped. This discrepancy arises mainly from our treating as static problems what really belong to dynamics; and neglecting the altered conditions introduced by vibration, impact, and velocity, which, if fully taken into account, impart extreme mathematical complexity to the calculations. Examples of cases in which excessive strains daily occur may be found in rails, railway couplings, and some parts of machinery moving at high speed. In bridge work we have, no doubt, reached a fair standard of perfection, although in this one often sees faulty design; thus take, as an instance, the large single web girders so common with piles of flange plates 3in. or 4in. deep and 24in. or 30in. wide. It is certain the outside plate does not nearly take the average strain, and at the edges of this plate the strains may be almost *nil*. In some respects, even in iron bridge building, the Americans are more scientific than we; thus they give a larger coefficient of safety to the cross than to the main girders.

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

3, Victoria-street, Westminster.
March 26th.

DURATION OF UNITED STATES PATENTS FOR INVENTIONS PREVIOUSLY PATENTED ELSEWHERE.

SIR,—We have been informed that a circular has been issued by a Washington solicitor, and forwarded to patent agents abroad, setting forth that by a recent decision of the United States Courts the lapsing of a foreign patent for non-payment of taxes does not affect the duration of a United States patent granted subsequently for the same invention.

The only decision here, so far as we are aware, touching this question is the following brief opinion of Judge Wheeler on a motion for preliminary injunction in the case of Holmes Electric Protective Company *v.* Metropolitan Burglar Alarm Company, August, 1884. The opinion was given in the Circuit Court of the United States, Southern District of New York, August 24th, 1884, in the case of Holmes Electric Protective Company *v.* Metropolitan Burglar Alarm Company, on a motion for injunction:—"The orator's patent, No. 120,874, for an improvement in electric linings for safes, granted to Edwin Holmes and Henry C. Roome, November 14th, 1871, appears to be for an electric lining to an outer covering for the safe, insulated from the safe, and so arranged that an attempt to get through the covering will affect the electrical conditions, and thereby give an alarm. The inventors could not have a valid patent for protecting safes by electricity any more than Morse could for sending messages to a distance by that agency: neither could they for every form of device for that purpose, for various such devices existed before their invention. They were entitled to protection only for their specific improvements upon what existed before. Ry. Co. *v.* Sayles, 97 U.S. 554. So far as shown, there were no such insulated coverings fitting the outside of safes before. There was such protection for the outside of houses, and other buildings and rooms, but none for the safes themselves. The application of this form of protection to the safes themselves is different from that to habitable structures. The patent appears now to be valid for this specific improvement. The claims are for a safe provided with the outer covering, and for the covering. It is also urged that the patent has expired, because the invention is the subject of a prior English patent which has been suffered to lapse for non-payment of tax. The statute merely requires that in such case the patent shall be so limited as to expire at the same time with the foreign patent. Rev. St. Section 4887. This seems to mean that the term of the patent here shall be as long as the remainder of the term for which the patent was granted there, without reference to incidents occurring after the grant. Henry *v.* Providence Tool Company, 3 Ban. and A., 501; Reissner *v.* Sharp, 16 Blatchf., 383. It refers to fixing the term, not to keeping the foreign patent in force. It is urged that infringement has been so far acquiesced in that a preliminary injunction would now be inequitable; but this claim does not appear to be borne out by the proofs. The fact of infringement is not in reality contested. The patent has been so far acquiesced in, respected, and upheld, that, appearing to be good and valid as to this specific form of electrical protection, it affords sufficient ground for a preliminary injunction to restrain further infringement by the use of this form. Motion granted."

His opinion, being on a preliminary motion only, is so far from conclusive that we could not advise anyone to base any action thereon. If the opinion had been one given on final hearing it would have been of importance.

In United States applications where the original oath is in proper form, but a patent has been granted for the invention while the application here has been pending, the Patent-office authorities will now allow such a case to go forward for issue without a supplemental oath, on the furnishing of a complete list of patents granted for the invention, giving numbers and dates in full.

HOWSON AND SONS.

119, South Fourth-street, Philadelphia,
March 2nd.

THE MANCHESTER SHIP CANAL BILL AND TIDAL SCOUR.

SIR,—As the case for both sides is now closed as far as the engineering evidence on the effects the proposed works will have on the navigable channels goes, I am desirous of offering a few remarks on the anomalous character of some of that evidence, such comment, I assume, being permissible without any impropriety.

The line of high-water appears to travel from the Bar to Eastham at the rate of, say, 32½ miles per hour; as it is quite impossible for any water to traverse the Mersey at that velocity, it is clear high-water in the upper estuary cannot arise from the accumulation of water which has crossed the Bar with the same tide, and that it is, in fact, caused by the damming up by the tide of the land waters, along with the normal quantity of water in the river's basin.

The distance from Eastham to the Bar being, say, twenty miles, any water which travels from Eastham across the Bar cannot do so in less than 6 hours 40 min., if the velocity be three miles per hour in an unobstructed channel. The time of high-water at Eastham being, say, 37 min. later than at the Bar, the water from Eastham cannot cross the Bar in less than 7 hours 17 min. after the time of high-water there; that is, it cannot actually cross the Bar at all, as it will be met by the young flood and turned back up the river. Yet one of the professional witnesses is reported to have testified that the scour on the Bar would be reduced $\frac{1}{35}$ by the space proposed to be abstracted from the upper estuary for the canal works.

The area so abstracted is estimated on one side to be less than 500 acres, and on the other to be more than 1400 acres. It is admitted that 1300 acres have been abstracted for dock purposes at Liverpool, &c., without closing the entrances to the Mersey. Yet it is testified that the loss in the upper estuary will be very detrimental, though, as shown above, the direct effect will be nothing. As regards the disastrous effects of having fixed channels in the upper estuary instead of channels which ramble everywhere, "here to-day and gone to-morrow," it is to be noted that the two principal sea channels at the mouth of the Mersey are practically fixed, and have been as far as record reaches, that is, for two centuries. It is true the northern channel moves gradually westward, through the accretion on the coast of Lancashire, but the movement is very gradual. It is also true that the bar of that channel is very variable, but the variety is so charming the authorities appear reluctant to give it fixity of tenure. It would appear then, from analogy, that not only would there be no insuperable difficulty in providing fixed channels in the upper estuary, but that it is desirable to do so; for if the sea channels were not fixtures, it is safe to assume the trade of the Mersey would never have attained its present magnitude. But it is said to fix channels in the upper estuary would be to interfere with nature, and, therefore, the waters of the Mersey should be allowed to wander at their own sweet will, or at nature's, whichever it may be.

If such an idea had been dominant in Liverpool, where would all her docks and trade be? A state of nature might be very proper "when wild in woods the noble savage ran," but most people would consider the lovers of *laissez faire* very improper if they were to appear before a Parliamentary Committee in *puris naturalibus*. As everyone knows, the wise man is ever ready to assist nature whenever it suits his purpose to do so.

In offering these remarks I do not wish to pose as an advocate of the Ship Canal. Its promoters are independent of such aid as I might be able to give them. But I have long desired to see the upper estuary much more navigable than it is, and therefore I am desirous of protesting against a negligent policy, and against a supposition that fixed channels would be in any way detrimental to the interests on the lower Mersey. With my present information I anticipate the construction and maintenance of such fixed channels would relieve the lower part of the river from much embarrassment.

JOSEPH BOULT.

Exchange-buildings, Liverpool,
March 30th.

BOILER STEEL.

SIR,—The paper read by Mr. Parker before the Institution of Naval Architects draws the attention of engineers to a subject which much needs it. Undoubtedly mild steel is the best material available for boilers; but it is well known that, to be used to advantage, it must be thoroughly understood and properly treated, or otherwise it may be made much inferior to iron as regards strength and safety. I do not wish for a moment to imply that the boiler-makers, in the instance Mr. Parker describes, had not a thorough knowledge of the best methods of working mild steel; but I am inclined to think, with Mr. Parker, that it is not generally known how much harder a thick steel plate is than a thin one to stand the same tensile tests, and therefore is it not probable that the boiler-makers in this case had no knowledge of the special hardness of this plate, and that they worked it in their usual way without special care as to its uniform heating and cooling? It will, I suppose, be said that steel for boilers should not require such special care, or rather, that they should not be such as will be easily damaged by any ordinary treatment. So long, however, as the Board of Trade, Lloyd's, &c., insist upon having such high tensile strengths, the makers of such large plates must have an excess of carbon in the steel in order that they may come up to the requirements, chiefly because they do not usually get the same relative amount of working upon them that a thin plate does.

Seeing, then, that it is the required high tensile strength that necessitates the plates being made harder than usual, does it not appear that the remedy lies in reducing this required tensile strength, say, for such plates as exceed a certain thickness? Mr. Parker urges that the tensile strength should not exceed 30 tons per square inch, but is not this too high for thick plates? The experience with the plate in question appears to indicate that it is, as its recorded strength at the steel works was 29·6 tons per square inch. To prevent such occurrences one or more temper tests should be taken from every plate, and if the steel must be mild, and the 28 to 30 tons per square inch is to be insisted upon, the only way out of the difficulty seems to be for the plate-makers to have machinery capable of working from thicker ingots and dealing with them equally as effectively as with the smaller ones for thin plates, thus giving them the same relative amount of working. It will be of interest to some to know how much influence extra work in the rolling mill has upon the tensile strength of steel, and as I happen to have some results by me of an experiment made at these works, I give them here.

An 8½in. ingot was taken and rolled down to 3in. diameter only; a piece of the 3in. was rolled to 2in., the 2in. to 1in., and the 1in. to ½in., with the following results:—

Tensile Tests made from Bars rolled from the same Ingot.

No. of test piece.	Mark of steel.	How manufactured.	Dia. of bar inches.	Breaking stress in tons per square inch.	Elongation in a length of 8in.
728	N.B.I.C. Corngreaves Steel R.	By open-hearth process	3	22·08	16·4 per cent.
729	"	"	2	23·4	30·4 "
730	"	"	1	24·4	32·4 "
731	"	"	½	26·5	26·5 "

Of course no maker of steel bars would think of making a 3in.

bar out of an ingot so small as 8½in. It was rolled that size in this case for the purpose of illustration. In some other tests which we made and rolled down to as low as $\frac{5}{16}$in., the tensile strength rose from 22 to 32 tons per square inch, or nearly 50 per cent. increase due to the increased working.

This clearly shows, then, the effect of working, and shows by what means the tensile strength may be kept up. In the present state of things, however, I can only advocate what I did in the letter which appeared in your issue of the 30th January, and which, in the main, I am glad to see Mr. Parker agrees with, viz., that engineers, wherever possible, should be content with steel having a less tensile strength, and thus secure a trustworthy, soft, and easily workable material, which imperfect treatment will not easily damage; and whenever higher strengths of steel are to be used, they should be worked with care by experienced men, and annealing should, in such cases, be always carried out after local heating, or such treatment as bending. It would be difficult and expensive to properly anneal all such large steel plates after being bent; but that is therefore the more reason for using a milder steel. Mr. Denny, in the discussion, advocated the use of "the strongest steel that can be got." What engineers ought to use, however, is not "the strongest steel that can be got," but the steel that will make the strongest boiler. THOMAS TURNER.

Corngreaves Iron and Steel Works, near Birmingham, April 7th.

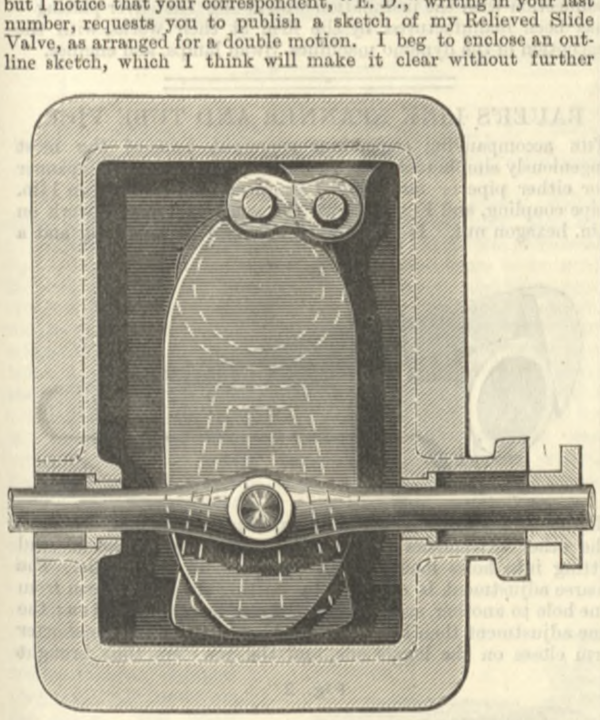
SIR,—Having read in THE ENGINEER of April 3rd the paper on "Thick Steel Boiler Plates," by Mr. W. Parker, likewise your own remarks about the same, I cannot come to any other conclusion but that, first, the material has been of very high quality, as far as I can judge from the tests made, which I at present will not comment upon. The only objection I have to make is in the working of the material, as I shall proceed to show you with your kind permission. My opinion is that no boiler-plate of any kind of steel whatever should be heated in the manner described, and as I have been six years in a situation where, during that period, I have superintended the manufacture of over 100 steel boilers, I venture to think that my little experience is, if anything, rather to throw some light on the above subject. In my opinion, which is fully borne out by experience, all boiler-plates should be carefully punched or drilled as the case may be, and all other labour necessary done on them before bending them. Next the plates should be put into the furnace and got to a red heat, and then allowed to cool down as gradually as possible, that is to say, the plates should not be taken out of the furnace, but let the furnace go down, and when cold the plates are soft enough to roll cold, if the rolls are as powerful as has been stated.

This system I have carried out now for over four years, and I have very seldom indeed found it to fail, and I have no hesitation in saying that if it be carried out properly, it cannot fail in many instances. B. DEAN.

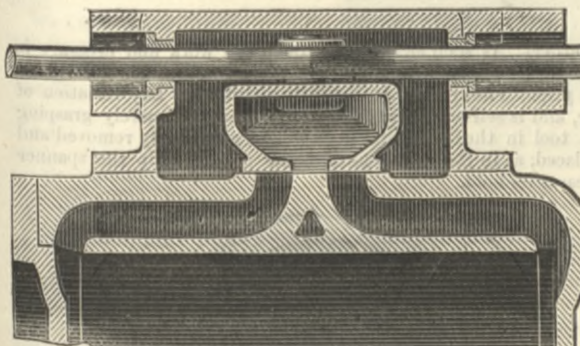
47, Whitehouse-street, Hunslet, Leeds, April 8th.

FRICTION OF SLIDE VALVES.

SIR,—I am sorry to encroach again upon your valuable space, but I notice that your correspondent, "E. D.," writing in your last number, requests you to publish a sketch of my Relieved Slide Valve, as arranged for a double motion. I beg to enclose an outline sketch, which I think will make it clear without further



explanation; but will merely submit that it is a method which, in my opinion, would secure a perfectly smooth and uniform wear, as explained in my letter in your number of March 13th. I may take this opportunity of pointing out another simple arrangement for working the valve in a non-reversing engine to



be regulated from the governor, which consists in fixing the fulcrum pin to the valve, bringing it through a stuffing-box in the casing and fixing one end of a slot link to it; the excentric rod end being moved in the slot by the governor in the usual way.

Old Charlton, Kent, March 31st. EDWARD C. PECK.

TANKS FOR SUAKIM.

SIR,—We notice in your issue of the 27th ult. a letter which calls in question the accuracy of a statement made in yours of the 20th ult. Had your correspondent written us on the subject before communicating with you—a courtesy which, under the circumstances, we think most firms would have extended to us—we would have felt pleasure in showing him that the statement was substantially correct, and have spared your readers the differences of rival firms. We can only suppose that irritation, consequent on losing the contract, caused the hasty step.

We would first remark that the time asked by your correspondent for making the tanks in this particular instance was fourteen days. It was late in the day of Saturday, the 28th, when we received the order for the tanks, and our promise for delivery alongside was for Monday, the 16th. We had nothing to do with unloading or getting into position. The tanks were actually in lighters waiting orders for delivery on Thursday and Friday, the 12th and 13th. The tanks were shipped and got into position by the owner of the vessel, who, after placing the forward tanks, was persuaded to alter their disposition, and for this purpose these tanks were removed, altered, and the second time replaced as they were at first arranged. This re-arrangement had nothing to do with us.

We would also add that these tanks were also fitted with an elaborate arrangement of valves and pipes, and also with large pumps capable of throwing 60 tons of water per hour.

FRASER AND FRASER.

Bromley-by-Bow, London, E., April 9th.

ON THE EFFICIENCY OF MARINE BOILERS.*

By Mr. J. T. MILTON.

THE struggle for economy in the production of power for the propulsion of vessels, which has shown itself during the last few years by the gradual increase of steam pressures from 60 lb. to 90 lb. per square inch, has lately been marked by the extensive adoption in new vessels of the tri-compound engine using steam with a pressure of from 140 lb. to 180 lb. per square inch. These pressures are not likely to be increased for some time at least, unless some type of boiler is introduced which will not necessitate the present size of casing for containing the steam and water, nor the present method of internal firing, as, with the obtaining pressures, the thicknesses of plates for these portions have reached the maximum capable of being worked on the one hand and of being used for the transmission of heat on the other. The almost universal failures of new types of boilers in the past seem to show that the supercession of the present type of boiler is not at all probable; while, even if a new type of boiler does come into general use admitting of higher steam pressures being obtained, it is extremely improbable, in my opinion, whether steam of the higher pressures would be usable, owing to its high temperature. At a pressure of 180 lb. per square inch the temperature is 379 deg.; while, if we go to, say, 300 lb., the temperature would be over 420 deg. From these considerations it appears to me that if any further great step in economy is to be obtained it must be looked for in the making of the steam rather than in the using of it, that is to say, we must turn our thoughts to the boiler, rather than to the engine, which has up to the present nearly monopolised the attention of engineers. Undoubtedly there is here a promising field for improvement. It is well known that, theoretically, the heat which may be developed by the combustion of 1 lb. of good coal is sufficient to evaporate about 14 lb. of water from 100 deg. to 212 deg.; but actually few marine boilers when working at full power really evaporate more than 8 lb. or 9 lb. of water per lb. of coal burned. Suppose that the evaporation of 9 lb. of water is obtained, there is still between 9 and the theoretical 14 a large margin upon which to work. In ordinary boilers working with chimney draught we have at the outset a very large amount of heat necessarily expended in producing the draught; but even with chimney draught much might be done in the design of the heating surfaces and funnels to abstract more of the heat from the products of combustion, and still to leave them of sufficiently high temperature to produce the draught required; but when we consider that experience with many ships has shown that forced draught can be applied with almost equal facility to the chimney draught, it is evident that we are no longer compelled to waste heat up the funnel otherwise than by our inability to abstract it from the products of combustion. It is, I believe, by the application of forced draught to marine boilers that the next step in economy will be obtained. The conditions to be aimed at in the design of steam generators are principally three—(1) the most perfect combustion of the fuel must be effected so as to obtain the maximum amount of heat from it. (2) The arrangement and extent of the heating surfaces must be such as to be capable of extracting the greatest possible portion of this heat from the products of combustion. (3) The construction of the boiler must be such as to ensure its endurance under the conditions to which it will be subjected. Now as regards the first of these, the theoretical requirements are well known. An amount of air must be supplied to provide sufficient oxygen to completely oxidise the carbon and hydrogen of the fuel, and must be brought into intimate contact with the fuel at a high temperature. In order to supply this oxygen, however, a greater or less additional supply of air must be admitted to dilute the carbonic acid formed, and so allow a fresh supply of oxygen to have access to the fuel. It appears that the sharper the draught the less additional air of dilution, as it is called, is required, and it is evident that the less air of dilution required, the higher will be the temperature of the products of combustion.

This question is gone into in detail in Arts. 227-233 of "Rankine's Manual of the Steam Engine," so that it will only be necessary for me to here quote the following figures from a table given in Art. 233:—

Temperature.	Supply of air in lbs. per lb. of fuel.		
	12	18	24
	Volume of gases per lb. of fuel in cubic feet.		
deg.			
4640	1551	—	—
3275	1136	1704	—
2500	906	1359	1812
1472	588	882	1176
752	369	553	738
392	259	389	519

If the temperature of the atmosphere is 60 deg., and the fuel is burned by just so much air as contains the necessary amount of oxygen for combustion, viz., 12 lb. of air per lb. of fuel, the resulting temperature of the products of combustion will be 4640 deg. If 18 lb. of air are used the temperature will be 3275 deg., and if 24 lb. of air the temperature will be 2500 deg. The table given shows the volumes of the resulting products of combustion at these and also at lower temperatures; and it is seen that with the smaller quantities of air not only are the temperatures much higher, but, although the products are more expanded on account of their higher temperatures, yet their resulting volumes are also less, while, of course, at equal temperatures their less volumes are still more apparent. This reduction of volume has a most important bearing upon the transmission of heat from the products of combustion to the water, even if the temperatures are the same, for in a given boiler the less the volume of the gases which has to pass through it in a given time the less will be their velocity; or, in other words, the individual particles of the gases will be in contact with the heating surfaces for a time, longer in direct proportion to the reduction of the volume, and therefore, other things being equal, more heat will be transmitted. And since the reduction of volume is also accompanied by a much higher initial temperature, from both considerations, intensity of draught, if accompanied by reduction of air supply, must be conducive to increased efficiency. The influence of the higher temperature will be most marked at the first part of the heating surface, and the reduction of volume at the last part or tail end of the run of gases. The correctness of this deduction has been proved over and over again in cargo steamers, with the performances of which I am acquainted, in which, when first built, large grates have been fitted. The grate areas have been gradually reduced in some cases by as much as 20 per cent., maintaining the same evaporation of water, since the engines have been worked at the same speed. The greater rate of combustion resulting from the decreased grate has resulted in higher furnace temperatures and greater efficiency of boiler since the consumption has been reduced to a marked extent.

With regard to the second point, viz., the proportion of heating surface to the quantity of fuel burned, I think that the recent practice of some of our engineers has been retrograde so far as economy is concerned, the proportion of surfaces having been reduced considerably. There is a manifest temptation to do this, as undoubtedly the last portions of heating surface to which the gases are exposed must be, surface for surface, less efficient than the first portions, owing to the temperature of the gases being lower, so that a reduction of tube surface does not make nearly so great a reduction in steaming capacity as it does in weight and cost. And where a large power on trial trip only is worked for, irrespective of economy of fuel, or where the total weight of boilers is more important than coal consumption, this might be considered to be a good practice; but there can be no doubt that for long ocean voyages, where the coal to be carried forms an important part of the carrying capacity of the vessel, a larger extent of heating surfaces would often mean less total weight of boilers and coal to be carried, besides being a continuous economy in cost of coal and labour of stoking. As an instance, I may quote the case of some steamers of over 4500 tons gross register, and regularly advertised as being 4000-horse power, built in 1882, in which the total heating surfaces of the boilers bear to the grate area the proportion of 25·8 to 1; while in a similar vessel built by the same firm last year the proportion is only 21·4 to 1. In very many vessels doing good work the proportion is from 30 to 35 to 1. That the extent of the heating surfaces may be increased with advantage considerably above that obtaining in the steamers quoted, I will adduce the cases of some other vessels in which the boilers were constructed with the proportion 35 to 1, and in which, in addition, feed-water heaters have been fitted in the base of the funnels, bringing up the surfaces to the proportion of 36·7 to 1, without even then reducing the temperature of the gases to an extent incompatible with good draught. This heater has given results, even with the large amount of heating surfaces in the boilers, sufficiently encouraging to warrant their being fitted into several other vessels. In a later vessel by the same firm the proportion of heating surfaces in the boilers proper to the grate area is 30 to 1, and the feed heaters in this case have been made rather larger, raising the proportion to 32·1 to 1. In this case I am informed that when running at full power the feed-water becomes raised in temperature more than 40 deg., while even when the vessel is running at a lower speed with less consumption of coal, and therefore with a less funnel temperature, the feed-water is raised in temperature 25 deg. If these figures are correct, it is evident that the boilers in which the proportions are 21 or even 26 to 1, cannot be expected to be even fairly economical.

I may here remark that Mr. Howden, in his system of forced draught, places an amount of heating surface in the uptake, in order to absorb some of the heat which would otherwise pass up the funnel, but he prefers to heat the air supply in this manner, instead of heating the feed-water. Although with the same area exposed, the feed-heater must be heavier, both on account of the greater thickness of tubes on account of strength, and also by the weight of the contained water, yet area for area the feed heater must be much more efficient, not only on account of the specific heat of water being more than four times that of air, but also on account of the much greater weight of the water. Assuming the abstractive power of water and air to vary as the products of their specific gravities and specific heats, water would be about 3500 times as efficient as air. If the system of forced draught be introduced, it appears from what I have endeavoured to sketch out, that even with the present ratio of heating surface to the coal consumption, greater evaporative efficiency will be obtained, and therefore the final temperature of gases will probably be lower; but still greater efficiency will then be possible by further increasing the extent of the heating surfaces. This will probably be best effected by decreasing the diameter of tubes in proportion to their length, and also by increasing either their number or length. When the draught has to be obtained by the heat of the gases in the funnel, the ratio of length to diameter of tubes has to be limited, owing to the necessity of not offering too great a resistance to the passage of the gases, and this has led to the general practice of making the diameter of tubes not less than $\frac{1}{24}$ of their length. If, however, forced draught be used, there is no limitation of this kind imposed, and smaller tubes can be used with advantage. For instance, in a given boiler capacity, taking 3¼in. tubes as a standard, and maintaining 1¼in. spaces for cleaning purposes, as is usual in good practice, we find that with 2¾in. tubes 10 per cent. extra, and with 2in. tubes 20 per cent. extra surface is obtainable, while if the spaces were reduced to 1⅛in. with the 2¾in. tubes, and 1in. with the 2in. tubes, which would probably be found to be equally efficient for cleaning when we consider the reduced size of the tubes, these figures are increased to 18 per cent. and 43 per cent.

I now come to the third part of the subject, viz., the continued endurance of the boilers. In my judgment experience has shown us pretty clearly what will and what will not endure the action of the fire under usual conditions, the present boiler, in this respect, being the result of a large amount of experience and of the law of the survival of the fittest. For instance, it is pretty evident that the only furnace likely to give satisfaction is a circular one, exposing no rivetted seam to the fire, and allowing a small amount of expansion, due to variation of temperature, without undue straining, a flat-sided furnace, with its necessary stays, having repeatedly been shown to be altogether unsuitable. Again, we know that the present method of fixing the tubes—viz., by rolling them till their expansion puts them in a state of compression in the tube holes—although efficient when the tubes and tube plates are kept clean, will not keep the tubes tight when even a comparatively small amount of non-conducting scale is allowed to accumulate on the tube plates or about the tube ends, the ends of the tubes then becoming so overheated as to relieve the strain they are put to by being rolled; while in other boilers in which a less than usual amount of heating surface is interposed between the grates and the tube plates, or in which the tube plates themselves are exposed to the direct radiant heat from the fires, the same thing happens even when the tubes and plates are clean. It is, therefore, apparent that so far as tube fixing is concerned, we are about at the limit of successful endurance with our present practice. On this account it will probably be found that, if forced draught is to be successful with a very high rate of combustion, the boiler must be so designed that the temperature of the products of combustion will be reduced before they reach the tube ends. This will not be a difficult matter to accomplish. In other respects I believe the present type of boiler will require no modification so far as endurance is concerned.

We have been much indebted to the Admiralty for taking the lead in the matter of forced draught, and their experience has shown that the system is quite practicable; but so far I believe I am correct in saying that their experiences have been directed only towards the end they have in view, viz., by burning an excessive amount of coal to obtain excessive power out of a given amount of boiler for a short time, irrespective of the question of economy of coal. This is directly opposite to the direction in which I have attempted to show progress in economy is to be effected, but as the question of economical cruising is also an important one, it is probable that as some of the vessels fitted with forced draught appliances become brought forward for active service, experiments will be made on them at powers corresponding to, and lower than, those obtainable with natural draught, by working with all the boilers with forced draught, but with much reduced grate areas. If these experiments are carried out and the results made public, we shall all be greatly indebted to the Admiralty, as the results cannot fail to have a considerable influence upon the future progress of marine engineering.

* Institution of Naval Architects.

THE ELECTRIC LIGHT ON BOARD S.S. UMBRIA AND ETRURIA.

MESSRS. J. D. F. ANDREWS AND Co., Woodside Electric Works, Glasgow, have just completed on board s.s. Etruria the last of two installations, which are said to surpass anything that has hitherto been attempted in the application of electric light to steamships. In the Umbria and Etruria the installations consist of about 850 lights each, and we append a description of one of the installations, but which applies to both. The space allotted to the electric machinery is unusually large, measuring 32ft. by 14ft., and is situated on the lower deck midships forward of the engine-room. Here are placed four Brotherhood engines, two abreast, back to back, three of which have cylinders 8in. diameter by 6in. stroke, and the other 6in. diameter by 4½in. stroke. The small engine drives a Siemens' 200-light dynamo, and the other three a 350-light dynamo each. Swan lamps are now used, and of these ninety are distributed in the engine-room, stokeholes, &c. The wires conveying the current to these lamps are covered with india-rubber and a special composition for resisting sea water, and they are sheathed over all with iron wire as a substitute for the tube generally used in engine-rooms and such places. The joints between the branch and main wires are protected by a small T-shaped joint box—see Figs. 1, 2, and 5. Each lamp in the engine-room, as well as in every other part of the ship, is fitted

FIG. 3. FIG. 1. FIG. 2. FIG. 9.

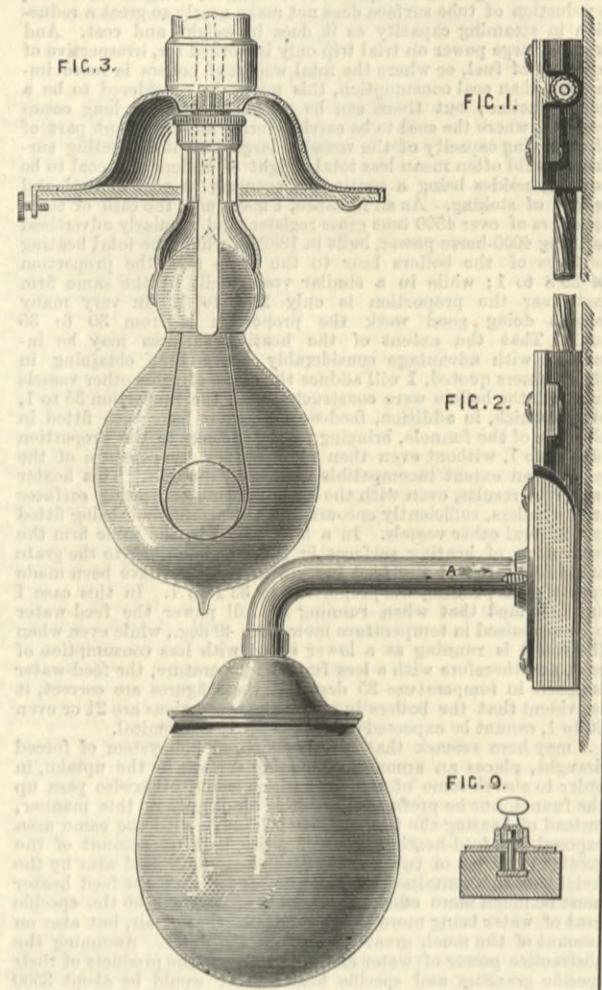
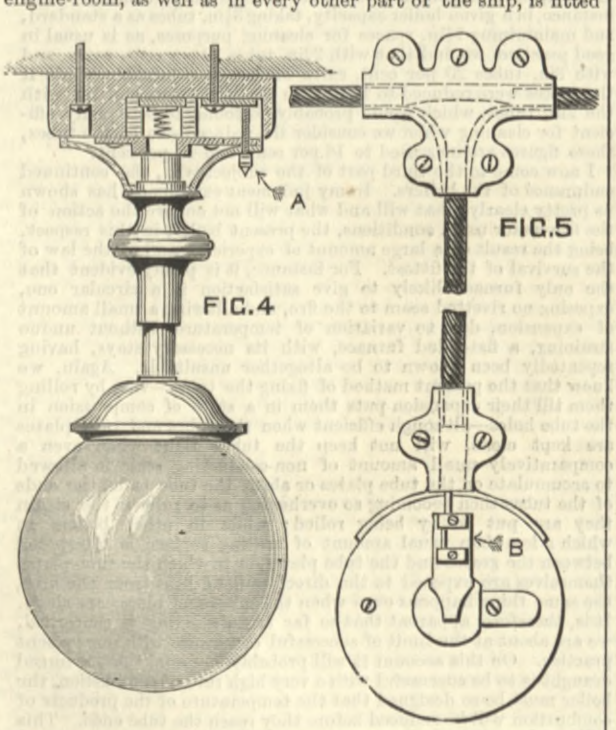


FIG. 4 FIG. 5



with a very simple switch—A, Fig. 2—consisting of a screw severing connection to the lamp from the ship which is used as a return, and a fusible connection—B, Fig. 5. The engine-room lights are divided into two circuits, each with a separate switch, and each stokehole is also on a separate circuit.

The dynamos are connected to the main switch board on the bulkhead close to the engines. To this switch board also are brought the six main circuits which supply the ship. The switch board—Fig. 6—consists of an iron box about 4in. deep, with its opening against the bulkhead. In the face of the box are four rows of six holes, each 2in. in diameter, radiating from the centre, and the box is half filled with a board of teakwood with corresponding holes. In each of the holes in the teakwood are fixed copper springs, one on each side of the hole; one spring of each hole of a row is connected to a brass strip in connection with one of the machines, the other spring being joined to a circuit of lights in the ship. A brass knob, with a stem and an insulated ring at the end of the stem, is pushed into one of these holes when the machine is to be connected with one of the circuits. The corresponding holes in each row are joined together, so that by removing the plug from the hole in one position of the row and placing it in the corresponding hole in another, the circuit will be joined to another machine. The circuits are numbered, starting from the stern of the ship, the first circuit supplying the night system, in which are about 200 lights, including those in the engine-room and stokeholes. No. 2

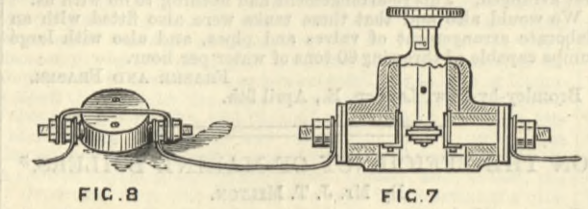


FIG. 8 FIG. 7

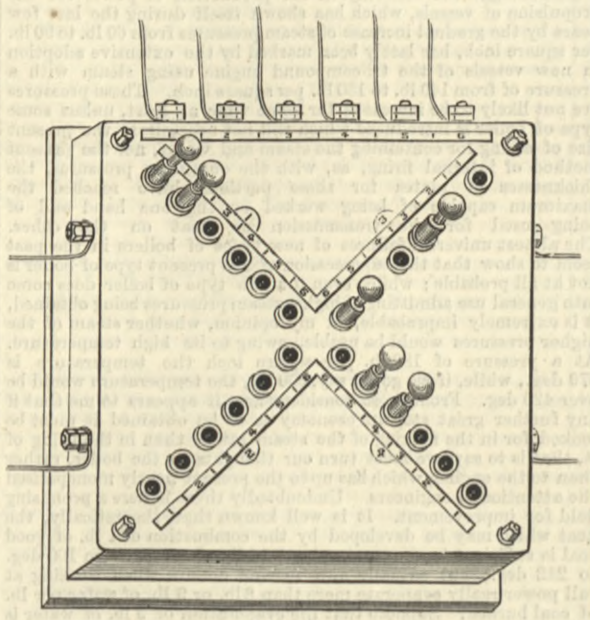
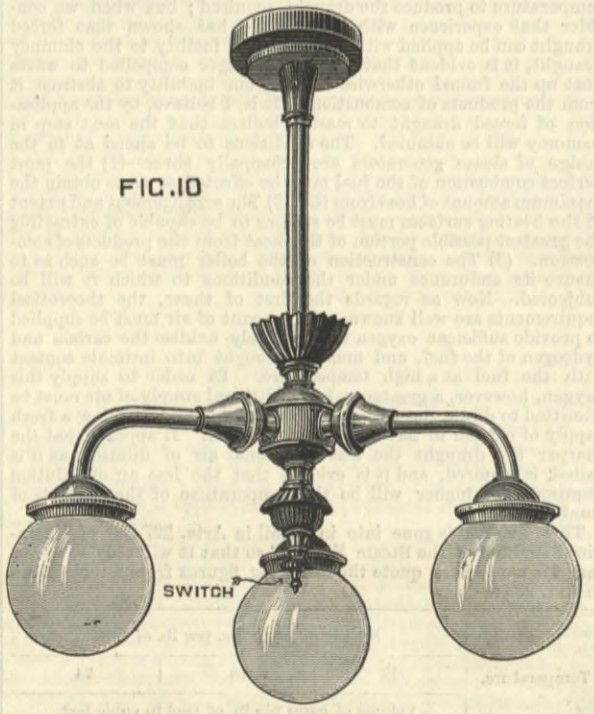


FIG. 6

circuit lights the after portion of the ship; No. 3 lights amidships; Nos. 4 and 5 supply the saloon, ladies' saloon, music room, &c.; No. 6 supplies all lamps forward of the saloon. Each of these main leads is carried to a group of switches at the junction of the mainand branch leads, where there is also a fusible connec-

FIG. 10



tion—Fig. 11. Each of these switches controls a group of about thirty lights, and they are placed in boxes recessed in any convenient place—in passages generally and at the foot of stairs. The switches are constructed of a brass box, and on a similar

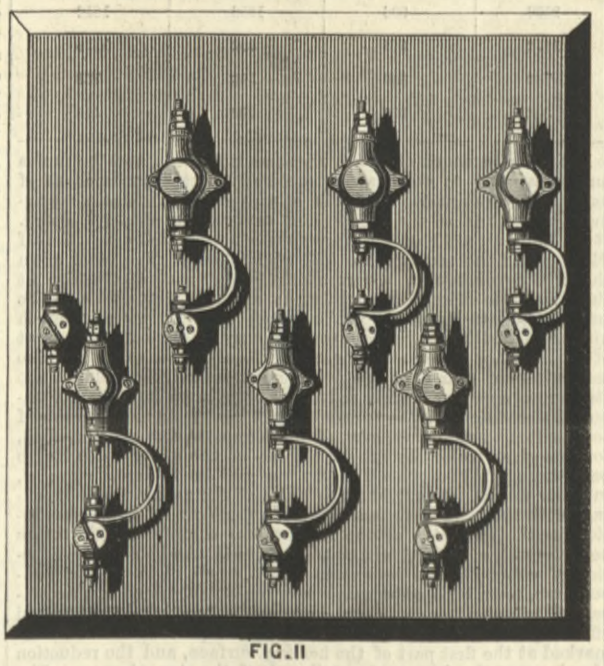


FIG. 11

arrangement to that described as being used in the main switch board, except that the plug cannot be entirely withdrawn. In appearance this switch resembles the ordinary steam wheel valve—see Fig. 7.

The main branch fusible connection which protects the wires is a small circular block of wood—Fig. 8—with a groove across it, in which is laid a piece of lead wire, No. 16 b.w.g., connected at each end to a screw which projects at diametrically opposite sides of the block—see Fig. 8. The switch and fusible wire are connected together by a loop of wire. The small branch wires lead to the lamps direct without the intervention of other fusible connections, but in the back blocks of the lamps there is a piece of No. 20 lead wire, which protects the lamp, and also in the event of a defect shows in which lamp it is—see Figs. 2 and 5. In addition to the switch inside the room or in the lamp, there is also a switch of the same kind placed in the return wire in the passage—see Fig. 9—one switch for each state room. This firm was, we are told, the first to introduce switches in the return wire.

The holder is also of new design, although the same as used by this company in various other installations. It consists of four spring prongs formed from a brass tube. Two of these grip the neck of the lamp, which is made of plaster of Paris, knob-shaped to suit them. The other two have saucer-shaped ends, and press on the brass contacts held in the plaster. As will be understood, one of the prongs is insulated from the rest by a small piece of wood forming the body of the holder, the insulated prong being attached to a pin passing through the centre of the wood. The holder is screwed on to the nozzle or nipple of the electric bracket, and in screwing it the pin holding the insulated prong meets with the wire projected from the end of the nipple, thus making contact with the central wire fitting—see Figs. 3 and 4.

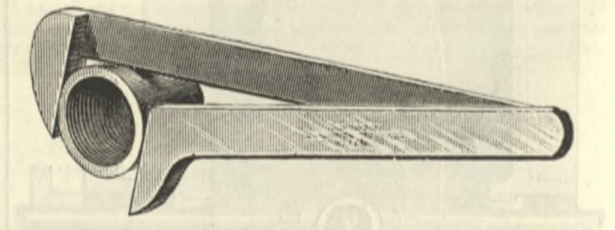
Altogether 103 lights are used in the lighting of the main dining saloon, eighty-four of which are suspended over the tables in three light electroliers hanging about 2ft. 6in. from the ceiling—see Fig. 10. The remainder of the lamps are in small brackets and pendants—Fig. 4—so as to give light over the side seats. The lighting of the saloon is very effective. Above the saloon is the music-room, having seventeen lights round the walls and over the piano and organ. The smoking-room has also seventeen lamps. The remainder of the lamps are distributed about the ship, 172 being in the state rooms. All the fittings are silver-plated with the exception of those in the galleys, seamen's quarters, and engine-room. On the upper deck, just outside the engine-room, is a cast iron box containing two switches and connecting terminals for the "Andrews" arc lamps. These lamps are of the same design and construction as those adapted to a masthead light on board the North German Lloyd's Company's s.s. Ems and Eider. The lamp is simple, and suited for the use of those not thoroughly conversant with electrical matters. In this case the lamp is arranged with double carbons.

These installations have been carried out in all their details under the personal supervision of Mr. Andrews, who also worked out the various fittings here illustrated. Everything in connection with the installation—including the silver-plating—has been manufactured by the firm at their works, with the exception of the dynamo machines, Swan lamps, and engines.

BAUER'S LINK SPANNER AND TUBE VICE.

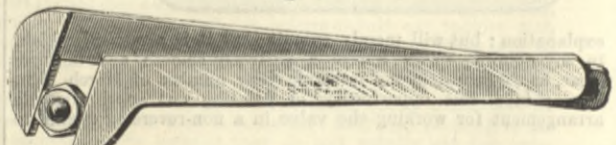
THE accompanying engravings represent two of the most ingeniously simple tools ever invented. The first is a spanner for either pipe or nut. Fig. 1 shows spanner at work on 1½in. pipe coupling, and Fig. 2 shows the same spanner at work on ½in. hexagon nut. It consists of but two parts, a long and a

Fig. 1

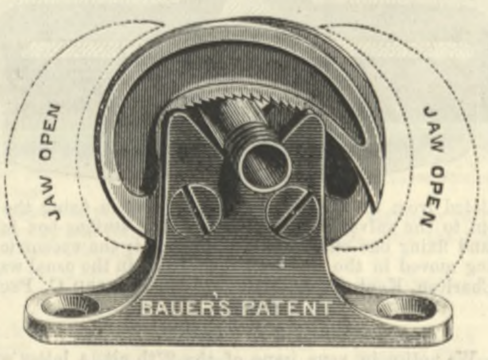


shorter arm, each provided at one extremity with suitable jaws; the other extremities are linked together by a hooked stud fitting into holes made for the purpose in the handle. The coarse adjustment is obtained by shifting the shorter arm from one hole to another, according to the size to be operated on; the fine adjustment then being obtained automatically as the shorter arm closes on the longer one, and the jaws are thus brought

Fig. 2



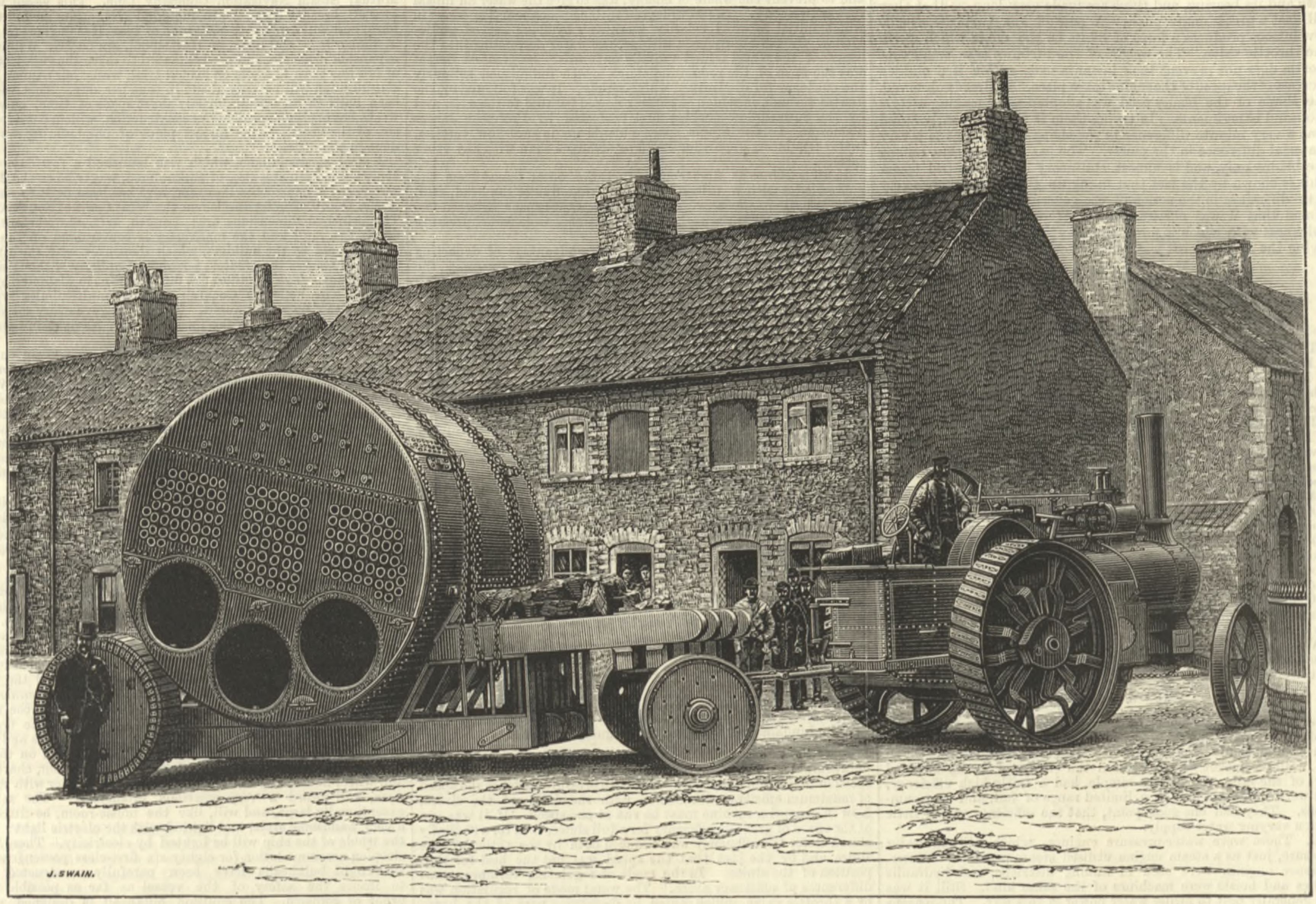
together. As soon as the jaws touch the work and pressure is applied, they grip firmly, and the more the pressure the tighter the grip. The spanner is instantly adapted to any variation of size, and is self-acting, as it grips the work by merely grasping the tool in the hand, and need not be alternately removed and replaced, as in the return motion for a fresh grip the spanner releases its hold.



The tube and bolt vice is shown by the annexed engraving. It will be seen to consist of a standard with an angular seating for the work, and carrying a pair of curved jaws pivotted eccentrically. The action is instantaneous and automatic, and so obviously simple as to need no description. These tools are sold by Messrs. James Gibb and Co., Fenchurch-street, E.C.

LIEUT.-COL. H. C. SEDDON, Royal Engineers, has proceeded from the School of Military Engineering, Chatham, to Portsmouth on appointment as superintending engineer at her Majesty's dockyard at that port.

TRANSPORTING A MARINE BOILER BY ROAD.



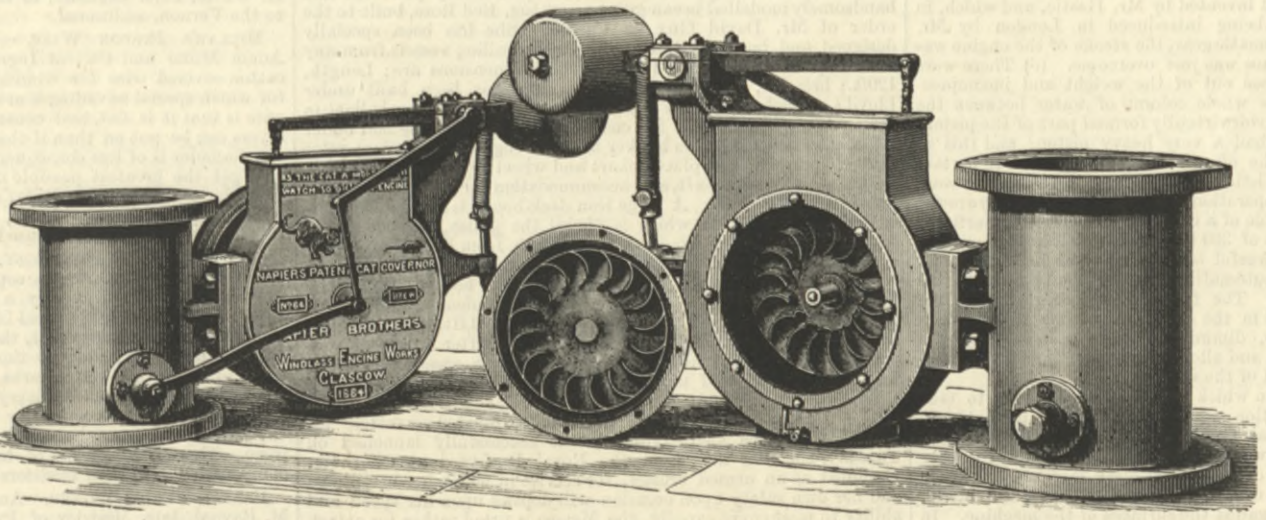
WE illustrate above a marine boiler and trolley which were drawn from Thetford to Lynn in November last by a traction engine. The boiler, which is 11ft. 6in. diameter by 10ft. long, weighing about 25 tons, was too large to be sent by rail, consequently Messrs. Charles Burrell and Sons constructed the trolley to convey it to Lynn. This trolley which weighs about 14 tons, is mounted on four wheels, the two hind wheels being fitted with india-rubber tires, and the front axle being carried by a ball-and-socket joint. This, combined with the general construction of the trolley, enabled it to carry the boiler, even over the roughest roads, without any perceptible jar or vibration. The distance, which is about 36 miles, was accomplished easily in two days, although there were several long hills to climb, and the road in many places was very rough and stony. The wheels of the trolley being arranged to follow in a different track to those of the engine, over 5ft. of the surface of the road was rolled; and instead of the engine and trolley doing any damage, they positively benefitted the roads. The boiler was delivered under the crane on the dockside in Lynn, and then lowered in its place in the ship without any hitch whatever.

We illustrate on page 282 the engines for which this boiler was made. The Mona is 100ft. long by 17ft. 6in. beam. She is built of steel, and fitted with a cabin aft for the captain and crew, and the coal bunkers are amidship, with a passage through the centre. She has a "steam quarter-master" on the bridge, and a steam winch fitted forward. She has two masts, with sails. The mizen mast can be lowered. The engines require no practical description. The cylinders are 20in. and 40in. diameter, by 2ft. stroke. They are a very substantial and well finished job in every respect.

Last autumn Messrs. Burrell and Sons began building steam launches, and have just completed one 35ft. long, fitted with compound surface condensing engines, 5in. by 9in. by 6in. stroke, with a patent "Reliable" boiler for use in salt water. The cabin is 7ft. by 6ft. wide, in American walnut. There is an elaborately fitted engine-room, fitted with skylights, &c., and space forward to seat twelve persons; all the seats are of polished teak, and finished in the highest possible manner. The speed is eleven miles an hour. They have another boat just ready to receive her machinery, 35ft. by 6ft. by 3ft. 6in., and a third boat nearly plated, 45ft. by 7ft. by 4ft. Both these will be fitted with "Reliable" boilers and compound non-condensing engines. The firm are just completing an engine and boiler for a canal boat 74ft. long by 7ft. beam. The engine has single cylinder 9in. diameter by 10in. stroke, and a "Reliable" boiler with 120 square feet of heating surface.

We have here another example of the freedom with which agricultural engineers adapt themselves to varying conditions of trade. For a great many years Messrs. Burrell's specialities were portable and traction engines and thrashing machines. There is very little in common between the latter and a sea-going steamer, but this has not prevented the firm from making a new departure. Thetford is a long way from the sea, yet even this difficulty has been overcome, as we have seen. The river which runs past the St. Nicholas Works is the Little Ouse, and joins the Cam about twenty miles lower down, when they run on to Lynn. The total distance from Thetford to Lynn by river is about fifty miles. Barges drawn by horses and tug-boats are regularly used on this river, and there is also communication by canal with the Midland Counties. They have just delivered two pairs of 32-horse power marine engines, viz., 14in. by 25in. by 18in. cylinders, with boilers 8ft. by 9ft., and shipped them to Buenos Ayres for tug-boats, and are building a pair of 12½in. by 22in. by 18in. for Messrs. Stothert and Pitt, of Bath, to be fitted in a barge.

NAPIER'S PATENT "CAT" ENGINE GOVERNOR.



THE "CAT" ENGINE GOVERNOR.

IN the engine governor here illustrated two saucer-shaped shells, or hollow discs fitted with appropriate blades, work face to face in a casing filled with water. One of these turbines is driven by the engine, and the other oscillates and works the throttle valve. The right-hand figure shows the casing attached to the part of the steam pipe containing the throttle valve and the oscillating turbine in its working position. The middle figure shows the revolving turbine removed along with the casing door, through which its axle works. The left-hand figure is a face view of the governor. The revolving turbine turns to the right when in its place, that would be to the left as shown removed and turned round.

Calling the revolving turbine A and the oscillating one B, then if turbine B is fixed while A is made to revolve to the right, the water in turbine A is thrown outwards, forwards, and sideways into the outer part of the blades of turbine B. The blades of the latter deflect the currents from a forward and sideways direction into an inward, backward, and sideways direction, which sends the water back into the inner part of the blades of turbine A. It is then again sent outwards, forwards, and sideways into turbine B, and so on. Hence there arises a cumulative action in this way. The faster the water enters turbine A the faster it is delivered from it into turbine B, and the faster it enters turbine B the faster it is delivered from it into turbine A, and so on. The water may, therefore, be delivered from the revolving turbine at a very much greater forward velocity than the rate at which the turbine itself is going, and there is no theoretical limit to that increase of speed. The shape and number of blades to get the best results have been obtained entirely by experiment, and after making several thousands of them.

The reversing of the motion of the water by the blades of the oscillating turbine gives it a great tendency to revolve in the same direction as the other one. This tendency is resisted by a chain attached to a pulley on the turbine, the other end of the chain being fixed to a lever connected with the throttle valve. The strain on the chain tends to shut the throttle valve, and it is resisted by a weight or spring tending to keep it open. When the strain on the chain exceeds that due to the weight it shuts the throttle valve, and *vice versâ*. Governors have been made and worked with partial success on the principle of oil or water being forced by centrifugal action under a loaded piston. In a remote degree the principle of the governor under consideration may be considered to be similar, but the practical results are very different. In the first place, from the cumulative action described a very small proportionate velocity of turbine is required to obtain a given power. In each turbine there are sixteen blades, and the average pressure on the blades is found to be four times that due to a stream flowing against them at the velocity of the circumference of the turbine, and, therefore, four times what could be produced on a piston by the centrifugal force derived from an ordinary centrifugal pump of the same diameter and making the same number of revolutions.

Taking a pair of turbines of 8in. diameter, which is found sufficient for working a 5in. throttle valve, the blades in the oscillating turbine have each an area of 2 square inches, or 32in. in all, so that the power over the throttle valve is equal to what would be produced by a centrifugal pump acting on a piston of four times 32 square inches area, or equal to a piston of 12in. diameter. The travel of the end of the lever arranged for is 15in., which corresponds with the length of stroke of a 12in. piston to give an equivalent power. In the "Cat" governor the oscillating turbine, 8in. diameter by 1in. wide, weighing about 4 lb., takes the place of such a piston and corresponding cylinder. The turbines do not require to work very close to each other, and are usually placed about ⅛in. apart. It will thus be seen that the only part of the machine requiring to be kept tight is where the turbine spindle passes through the casing door. Leakage there is prevented by a collar on the spindle working against a facing to which it is kept by a spring. The only part of the governor subject to wear is the turbine axle and its bearing, and these are made very long, so that they will last a great many years. A pair of 8in. turbines at 200 revolutions produces a force of 36 lb. on the chain which works the throttle valve. The weight of the turbines is so small that inertia does not prevent their instantaneous action if a sudden increase of the speed of the engine takes place. As already observed, the shape of the blades used was adopted after making several thousand experiments. In trying them it was frequently found that a very minute difference in the shape or angle made a very material difference in the power. The water circulates among the blades only, and is almost stationary in the central space. This is shown by the fact that filling up that space makes very little difference in the action of the governor. It may be mentioned that it was christened the "Cat" governor from the quickness with which it prevents an engine from running away, giving the idea of a cat watching a mouse.

THE INSTITUTION OF CIVIL ENGINEERS.

WATER MOTORS.

The third of the course of lectures on "The Theory and Practice of Hydro-Mechanics" was delivered on Thursday evening, the 5th of March, by Professor W. Cawthorne Unwin, M. Inst. C.E., the subject being "Water Motors." The chair was occupied by Sir Frederick J. Bramwell, F.R.S., the President.

The lecturer remarked that water motors were not in this country so important as heat motors, but yet a larger amount of water power was utilised than was commonly supposed. Either a rise in the price of coal or greater ease in the electrical transmission of mechanical energy would make water motors more important.

At Windisch 1000-horse power were utilised, and at Bellegarde 3700-horse power. But it was in America that the largest installations were found. For instance, at Holyoke, a weir 30ft. high and 1000ft. long had been built across the river, and the water, taken off above the dam in a canal 140ft. wide and 22ft. deep, supplied power to the mills. Two other canals on lower levels had also been constructed. The whole water power available was 20,000-horse power in ordinary dry seasons, and the power was leased to the millowners at the rate of £1 per effective horse-power per annum.

When water was descending from a higher to a lower level, in a pipe, for instance, it would in general have acquired, at any point, velocity and pressure. Then if H was the total fall,

$$H = h + \frac{p}{G} + \frac{V^2}{2g}$$

where the terms on the right represent three forms the energy took, viz., unexpended fall, pressure head, and velocity head. Corresponding to these were three classes of water motors.

I. Cell or bucket wheels utilised the energy of an unexpended part of the fall. They were simple, had a fairly high efficiency, but were applicable only in a limited range of fall, and were cumbrous. They had one good point, that the efficiency varied little with a varying water supply.

II. There were water-pressure engines, which utilised water pressure, just as a steam engine utilised steam pressure. Water-pressure engines were used in mining districts, and hydraulic cranes and hoists were machines of the same kind. Still it was not generally best to utilise water power in this way. The reasons that a cylinder and piston acted so well with steam, and less well with water, were these:—(1) The frictional losses in fluids were proportional to their weight for equal velocities of flow. If water were 500 times heavier than steam, then the friction at given velocities would be 500 times greater. Hence the piston-speeds, which might be 400ft. or 500ft. per minute in a steam engine, were rarely greater than 60ft. in a water-pressure engine. In the pipes the steam might flow at 100ft. per second, but water only at 6ft. to 10ft. Hence the water-pressure engine was much more cumbrous than a steam engine. (2) From the incompressibility of water, the same volume was used in a pressure engine, whatever the amount of work to be done. The system of hydraulic-pressure-mains introduced by Sir W. Armstrong had proved entirely successful for intermittent work, such as lifting, but not so successful for ordinary power purposes. Probably the reason was that the consumption of water in pressure engines was extravagant. The only engine in which the consumption of water varied with the work to be done was in that invented by Mr. Hastie, and which, in an improved form, was being introduced in London by Mr. Ellington. In this, by automatic gear, the stroke of the engine was lengthened till the resistance was just overcome. (3) There were other difficulties which arose out of the weight and incompressibility of the water. The whole column of water between the engine and the supply-reservoir virtually formed part of the piston, so that a pressure engine had a very heavy piston, and this in general tended to render the effective effort variable. In certain cases the action of the friction and inertia of the water were favourable to particular operations. Mr. Tweddell's hydraulic rivetter furnished an example of a machine in which the inertia of the parts was virtually that of 300 tons acting at the rivetter-ram. To control such a mass, powerful brake action was necessary, and this was supplied by the automatic action of the friction of the water in the supply pipe. The friction, while preventing the velocity becoming excessive in the early part of the stroke, when there was little resistance, diminished when the velocity was checked in closing the rivet, and allowed the development of a high effective pressure at the end of the stroke.

III. There were motors in which the head was allowed to take the form of energy of motion, and in which the water acted in virtue of its inertia. It was first necessary to consider in what way this energy might be wasted. There was a waste of energy if the water broke up into eddies or irregular motions. Energy might be rejected from the machine into the tail race, and lastly, energy was lost in friction against the surfaces of the machine. In a good motor the loss due to breaking up could be almost completely avoided, if the passages changed gradually in section, if the surfaces had continuous curvature, and if the inclination of the receiving edges of the vanes was in the direction of relative motion. The loss due to rejection of energy could also be made very small, but by reducing this beyond a certain point, the loss from skin friction was increased.

The nature of a turbine would be best understood by considering first some simpler machines. In an ordinary undershot wheel about 25 per cent. of energy was rejected into the tail race and about 25 per cent. was lost in shock, besides the losses due to shaft friction and leakage. Suppose that instead of striking normally a flat float the water struck a hollow cup. Then both the losses in shock and in energy rejected were greatly reduced. An interesting motor of this kind had been introduced in California. Water power was there obtained from canals or ditches built to supply the mines, at elevations of from 1000ft. to 3000ft. above the valley. The fall was too great for an ordinary turbine, and a kind of undershot wheel with cup-shaped floats was used. Thus, at the Idaho mines, seven of these wheels were used, working to 320-horse power. The water was brought in a 22in. wrought iron main, the head being 542ft. The water was delivered on to the wheels from nozzles $\frac{15}{16}$in. to $1\frac{15}{16}$in. in diameter. These wheels were said to give 80 per cent. efficiency, and in the special circumstances, where the jets were of small diameter under very high pressure, a high efficiency was probably obtainable. Such a wheel was the simplest form of an impulse turbine.

Next, consider a machine well known at one time as the Scotch turbine. The water, entering the centre of the wheel, was discharged from tangential jets, and drove the wheel by reaction. The water issuing from the jets had a backward velocity, and energy was therefore rejected. It was the study of a wheel of this kind which led Fourneyron to the invention of the turbine. Fourneyron saw that the only way of reducing the backward velocity of discharge, and to prevent the waste of energy, was to give the water an initial forward velocity. The Fourneyron turbine was a reaction wheel in which initial forward velocity was given by fixed curved guide-blades. In the Fourneyron turbine, the water descending into the centre of the wheel issued radially outwards. Its greatest defect was the form of the regulating-sluice, which diminished seriously the efficiency for diminished water-supply. It was followed by the Jonval turbine, in which the water flowed parallel to the axis, and by the inward-flow turbine first perfected by Professor James Thomson. In the ample space outside an inward-flow turbine, better regulating apparatus could be arranged than with any other form.

In all turbines as first constructed, the water issued from the guide blades with a velocity less than that due to the head, and, therefore, there was a pressure in the clearance space between the guide blades and the wheel, and such turbines were called pressure turbines.

M. Girard was the first to perceive the advantage of departing from Fourneyron's practice, and to allow the water to enter the wheel with the whole energy of motion due to the head. Such turbines were called impulse turbines. In pressure turbines the water must enter the whole circumference of the wheel simultaneously, and fill the wheel passages, or the pressure in the clearance space could not be maintained. Further, there must be rate of flow through the wheel to maintain the distribution of pressure and velocity for which the turbine was designed In impulse turbines each particle of water acted for and by itself; the wheel passages were not filled, and the water might be shut off from any part of the wheel circumference without affecting the action of the water. Regulation was therefore easier in impulse than in pressure turbines.

The consideration of the action of water in a turbine was facilitated by replacing the turbine wheel by a turbine rod, that was by supposing the turbine to have straight instead of circular motion. From such a rod, the transition to the case of a turbine wheel by simple projection was easy. The water entering vertically, was deflected by fixed guide blades, till it had a horizontal velocity, w_i; it then entered the wheel, the vanes of which were so placed as to receive it without shock, and was deviated back to a vertical direction, having given up all its horizontal energy of motion. Hence, applying Newton's second law, $\frac{w_i}{g}$ was the horizontal pressure driving the wheel due to each pound per second of water. But V being the velocity of the wheel, the work done on the wheel, $\frac{w_i V}{g}$ foot-pounds per second. Now the work might also be written η H, where H was the effective fall, and η the efficiency. Hence

$$\frac{w_i V}{g} = \eta H.$$

was the fundamental equation in designing a turbine.

There was one point in the action of a turbine which was unfavourable. The efficiency varied with the speed. There was a speed of maximum efficiency. But with pressure turbines the speed of maximum efficiency diminished with the closing of the sluice. Now in general a turbine must be run at one speed. If it was run at the speed of greatest efficiency for a full sluice, then for a partially closed sluice the efficiency was reduced both by the action of the sluice and by the fact that the speed was not the best for that position of the sluice. In the mode of regulating turbines great differences of efficiency arose. The worst mode of regulation was by a throttle valve, which acted by destroying part of the head. Next to this perhaps the worst was the circular sluice, used with the Fourneyron turbine. Some modern turbines gave, in experiments which appeared to be reliable, much better results. The best mode of regulation for a pressure turbine was by means of movable guide-blades, invented by Professor James Thomson. In a Girard turbine the regulation was not so difficult, and results of an experiment carried out under the direction of Professor Zeuner on a 200-horse power Girard turbine gave 79·5 per cent. efficiency with full sluice, and 80·1 per cent. with half sluice.

Diagrams of turbines constructed by Mr. Günther, Messrs. Gilkes and Co., Mr. Hett, Mr. Rigg, and others, were exhibited.

LAUNCHES AND TRIAL TRIPS.

On Tuesday, the 31st ult., Messrs. Edward Finch and Co., of Chepstow, ran a very successful trial trip of a very powerful and handsomely modelled ocean-going screw tug, Red Rose, built to the order of Mr. David Guy, of Cardiff. She has been specially designed and built for towing the largest sailing vessels from any distant port to Cardiff. Her principal dimensions are: Length, 120ft.; breadth, 22ft.; depth, 12ft. She has been built under Lloyd's special survey for the highest class, has water ballast in after peak, a small hold for coal at each end of engine and boiler room, also a large cross bunker between engines and boiler; pilot bridge, upon which is placed chart and wheel house; saloon cabin, with state-room, &c., aft, and accommodation for captain and crew forward, under deck. A large iron deck-house is carried over the engines and boiler, in which is placed the galley, bunker-hatch, &c. She has steam windlasses, telegraph from bridge to engine room, and all the latest improvements; carries two boats, and is rigged as a two-masted schooner. She has been fitted by the builders with a pair of compound surface-condensing engines, of 99 nominal horse-power, and large steel boiler, 14ft. 6in. diameter, designed for a working pressure of 90 lb. After steaming continuously for several hours, and maintaining a speed of thirteen knots, proving herself not only the largest but at the same time the fastest tug afloat in the Bristol Channel, she entered Cardiff.

The Mersey, the first of a new class of "protected corvettes" intended to act as swift cruisers, was successfully launched on Tuesday, the 31st ult., from the Royal Dockyard at Chatham. Designed as an armed cruiser, for service in which her usefulness and her own safety upon occasion will depend upon her speed and ability to manœuvre rapidly, the Mersey is fitted rather for attack than defence. Her armament, includes two 8in. and ten 6in. breech-loading guns, torpedoes, and ram. The guns will be disposed so as to give the power of firing with the greatest possible effect while manœuvring. The two large guns are to be pivoted, one on the forecastle and one on the poop. On either side, fore and aft of midships, are two projections or sponsons, and in each of these one of the 6in. guns is to be placed, the others, three on a side, between the sponsons, increasing the effectiveness of her broadside fire. Long ports in the forward sponsons permit the guns to be trained 4 deg. across the bow and to an angle of 60 deg. abaft, giving a lateral range of 154 deg., while they may also be fired with a depression of 7 deg. or at an elevation of 20 deg. The after-sponsons admit of an equal range of fire. These guns carry their own shields for the protection of the gunners. She is also to carry one 9-pounder and one 7-pounder boat and field gun, a 1in. Nordenfelt, and two ·45in. Gardener guns. Whitehead torpedoes will be carried, and provision is made for discharging them either above or below water on each broadside. Except for the steel faced armour, 9in. thick, protecting the conning tower and the steel protective deck-plating, 2in. thick where it is horizontal and 3in. thick where it slopes downwards across the coal compartments at the sides, the Mersey is unarmoured. The authorised complement of coal is 500 tons. Her engines, of the horizontal compound pattern, are to be of 6000 indicated horse-power. She is provided with twin-screw propellers, and it is anticipated that her speed will be 18 to 19 knots an hour. The principal dimensions of the ship are—Length between perpendiculars, 300ft.; extreme breadth, 46ft.; mean draught of water, 17ft. 9in.; load draught amidships, 19ft.; load displacement, 3600 tons. Her crew will number 300 officers and men. In the adjoining shed is another of the sisterhood—the Severn, now so far advanced that it is expected she will be ready to leave the ways in about three months.

On the 31st ult. Messrs. Raylton Dixon & Co., of Middlesbrough, launched a fine steamer, the Ching-Woo, for the China Shippers' Mutual Steam Navigation Company Line. This vessel is 332ft. over all, breadth 38ft., depth moulded 27ft. She is built on fine lines, and will carry over 4000 tons of tea. Her engines by Messrs. T. Richardson and Sons, of Hartlepool, are on Mr. Willie's triple expansion principle, and are estimated to drive the vessel at a speed of not less than 12 knots on loaded trial, whilst her regular working consumption will be only about 16 tons per day. This vessel has been built in an extraordinarily short space of time, only eleven weeks having been spent in her construction, which, considering the size of the vessel, is the fastest piece of shipbuilding work ever done in the district.

A steel steam launch, which was launched a few days ago by Messrs. Cochran and Co., of Birkenhead, was tried on the 2nd inst The vessel is named the Pescador, and has been built to the order of Mr. Geo. Petrie for service on the West Coast of South America. The principal dimensions are: Length, 42ft. 6in.; breadth, 9ft.; depth, 5ft. 3in.; and the machinery is constructed on the system now adopted by the builders, which dispenses with the air pump, and thus secures the greatest possible simplicity without any loss of efficiency. The cylinders are 6in. by 12in. in diameter by 10½in. stroke. The boiler is Cochran's patent multitubular type, and works with a natural draught. The vessel gave every satisfaction, and has been shipped on the Pacific Steam Navigation Company's ss. Valparaiso for the West Coast.

On the 1st inst. the new steamer Hispania was taken out to sea for her trial trip. The vessel has been built by the Tyne Iron Shipbuilding Company, Willington Quay, and engined by Wigham, Richardson, and Co., Neptune Engine Works, Low Walker. She is intended to run between Sweden and Spain, and is fitted with triple expansion engines of an improved type, introduced by Messrs. Wigham, Richardson, and Co., and on trial proved in every way most satisfactory; the engines worked with remarkable smoothness at 90 revolutions, and at 85 revolutions indicated 940-horse power, the ship steaming 12 knots.

On Thursday, the 2nd inst., Messrs. Earle's Shipbuilding and Engineering Company launched from their yard at Hull a steel screw steamer, the Eldorado, built to the order of Messrs. Thomas Wilson, Sons, and Co., of the same town, for their passenger and mail service between Hull and Norway, and will run to Bergen and Stavanger. She will be a very valuable addition to the magnificent fleet of steamers which Messrs. Wilson already have engaged in the Swedish and Norwegian service, being much faster and more elegantly furnished than any previous ship. The following is a general description. The vessel is built of steel, and classed A1 in the Liverpool registry. Her dimensions are 235ft. by 30ft. by 15ft. depth of hold, and, being intended exclusively for passenger traffic, is designed with very fine lines, and the utmost available space has been set apart for passenger accommodation. She has a long full poop and topgallant forecastle, the engines being placed as far aft as possible; the whole of the first-class accommodation is thus provided forward of the engines and boilers under the poop. A large iron deck house is fitted on the poop containing saloon entrance, music-room, smoke-room, chart-room, and wheel-house, and the top of this house, together with the poop deck, will afford a very spacious promenade. The saloon is exceptionally large, and will, like the music-room, be fitted up in a very handsome style, and lighted with the electric light; in fact, the whole of the ship will be lighted by electricity. There will be sleeping accommodation for eighty-six first-class passengers. The watertight bulkheads have been carefully constructed so as to insure the safety of the vessel as far as possible in the event of collision. The collision bulkhead is designed with a conical form, and is unusually strong, in order to resist pressure in case any damage is done to the bow. The officers, engineers, and firemen are berthed aft, near the engine-room, and the crew forward into the forecastle. The 'tween decks forward will be arranged for carrying emigrants. She will be fitted by the builders with their triple compound three-crank engines, of 300 nominal horse-power, having cylinders 26in., 40in., and 68in. diameter, by 39in. stroke, which will be supplied with steam of 150 lb. pressure from two large steel boilers, each fitted with four of Fox's patent corrugated furnaces. These engines, it is calculated, will drive the ship at a speed of at least fourteen knots.

Naval Engineer Appointments.—The following appointnents have been made at the Admiralty:—John L. Michell, engineer, to the Pembroke, additional, for service in the Rodney; G. E. Bench, engineer, to the Asia, additional, for service in the Edinburgh; W. H. White, chief engineer, to the Racer; Charles Lane, engineer, to the Vernon, additional.

Millar's Ribbon Wire. — We have received from Messr Adam Millar and Co., of Ingram-street, Glasgow, specimens of cotton-covered wire for winding electro magnets, dynamos, &c., for which special advantages are claimed. The peculiarity of the wire is that it is flat, and consequently in a given diameter more layers can be put on than if the wire were round; but, as a rule, the diameter is of less consequence than the length, and the object is to get the greatest possible number of turns in a given length. In order to do this with Millar's wire, it would have to be wound on edge. There are no doubt, however, conditions under which this flat or oval wire can be used with considerable advantage.

City of London Directory.—We have received from Messrs. W. H. and L. Collingridge a copy of the fifteenth annual issue of the City of London Directory, a few of the chief features of which are a Street List, Alphabetical List, Banking, Insurance, and Public Companies' List, Trades List, the Conveyance Directory—which is a ready reference guide to the prompt despatch of parcels and goods to all parts of the suburbs, and every town of importance in the United Kingdom — Livery Companies of London, list of liverymen who have votes for the City. A coloured Map gives the parish and ward boundaries, and improvements to date of issue. There is also a list of bankrupts and of traders who have compounded with their creditors during the year.

French Public Works.—According to a statement made by M. Raynal, late Minister of Public Works, a large outlay will shortly be made on the canals and harbours of France, following out the financial scheme of M. de Freycinet. The sum to be expended is 879,000,000f., of which 713,000,000f. are for canals, 100,000,000f. for ports and harbours, and 66,000,000f. for rivers, and in addition to this amount there has been a supplementary grant of 100,000,000f. for the ports, and 30,000,000f. for the canals. Havre is to have 100,000,000f. spent upon harbour works, and Bordeaux 20,000,000f. The State proposes to borrow upon annuities, commencing in 1887, and to be paid off in 10, 15, and 20 years.

University College, Bristol—Engineering Department.—The winter session of the Engineering School concluded last week, and the Engineering Society ended its work for the term by an excursion to Birmingham. The members were enabled, through the kindness of the various firms, to visit successively the pen-works of Messrs. Gillott, the sword and matchet works of Messrs. Hole, the vast engineering works of Messrs. Tangye, and the nut and bolt works, and the opportunity for instruction was thoroughly appreciated by all. The work of the Engineering Society this term has been most satisfactory, papers at the various meetings having been read on "The Canada Pacific Railway," "The New Bedminster Bridge," "The Channel Tunnel," "The System of Telpherage," "Electric Accumulators," "Brakes," "Cornish Viaducts," and "Electric Fire Alarms." These meetings have been attended not merely by past and present students of the Engineering School, but by engineers in practice in the City, and from the nature of the above subjects the work of the society cannot fail to be productive of substantial educational results, besides being a means of bringing together those in the neighbour hood interested in engineering and mechanical pursuits.

RAILWAY MATTERS.

THE *Railroad Gazette* says "the longest train ever seen on the Lehigh Valley road was noted a few days ago. It consisted of 123 eight-wheeled coal cars, all loaded, and was drawn by a single engine."

IN connection with the exhibition at the Alexandra Palace opened on the 31st ult., there will shortly be completed for passenger conveyance a line of railway, about a mile in length, leading from the gate of the Palace grounds to the Palace itself, by which visitors will avoid a tedious uphill walk and enjoy a novelty of transport. The line will be worked by electricity.

THERE were 3729 miles of new railways constructed in the United States in 1884, against 6755 miles in 1883, 11,591 miles in 1882, and 9789 miles in 1881. Assuming an average consumption of 100 tons of rails to the mile, the reduced mileage of railway in 1884 would represent a reduced consumption of rails to the extent of 302,600 tons as compared with 1883, 786,200 tons as compared with 1882, and 606,000 tons as compared with 1881.

ON the 3rd inst. a steam tram-car belonging to the Manchester, Bury, and Rochdale Steam Tramway Company, while turning a sharp curve from King-street into Rochdale, after going a short distance on the outside wheels, turned over, throwing the passengers from the top on to the road. The inside passengers were all pitched on the top of each other. Twenty people, including several children who were going out to Rochdale and Heywood on pleasure, were seriously injured.

THE Prussian Government have submitted to the Landtag Bills authorising the expenditure of £3,035,000 for the construction of new lines of State railways and the completion of old railways. Of this sum £2,474,200 are wanted for fourteen new lines, of a total length of 365 miles, the remainder for the completion of existing railways. The new roads comprise two main lines, of a total length of 27 miles, the cost of construction of which is estimated at £7174 per mile, including the cost of the land required, and twelve branch lines, of a total length of 337 miles.

ANOTHER phase of the tramways question has now appeared in Birmingham. The Birmingham Tramways and Omnibus Company has received an official communication from the Board of Trade stating that the Board have struck out from the draft provisional order sought by the Central Company all the clauses giving running and other powers to the Central Company in relation to the existing lines of the Birmingham Tramways and Omnibus Company. The Board have also disallowed the proposed completing lines of the Central Company in various portions of the town.

IT is thought that the capitals of Victoria and South Australia will be connected by railway within the next eighteen months. The *Colonies and India* says, tenders are shortly to be invited for the extension of the Victorian line from the present terminus at Dimboola to join, at the border of the two Colonies, the South Australian extension from Murray Bridge across the 90 mile desert. We now learn that representatives of the Railway Departments have met and agreed to recommend the two Governments to provide and maintain the border railway station and the rolling stock necessary for the intercolonial traffic at their joint expense, arrangements being made whereby each Colony shall contribute to the cost in proportion to the benefits derived from the use of the rolling stock.

THE work of building the new "island" railway station at Rugby, which is to cost some £70,000, and to be the biggest thing of its kind in Europe, continues to be rapidly pushed forward. Although it is expected that quite another year must elapse before the alterations are completed, yet it is hoped that the down side will be ready for use by about June next. The line has been widened 150ft. southwards, so as to give room for nine sets altogether of through metals instead of four as now. For the greater safety at the junctions of the new Northampton line of the Stamford branch important works, presenting considerable engineering difficulties, have been effected. The traffic will be regulated by large signal boxes at each end of the platform, that at the south end having 180 levers.

MR. P. A. PLEWE, well-known on the Continent as the originator of the large and perfect tramway network, Die Grosse Berliner Pferde-Eisenbahn, and who is also the sole concessionaire of the Brush system of electric lighting for Germany, is now introducing Reckenzaun's system of propulsion on the above-mentioned tramways, and the first of a series of cars is now in course of construction. Mr. Plewe has been in London recently for the purpose of examining the car which is now on the South London lines, and on the strength of favourable reports from independent scientific experts, the permission of the Municipality and the Berliner Pferde-Eisenbahn Gesellschaft was obtained. The first car, which will be fitted internally with unusual elegance, is to be ready for the opening of the Japanese Exhibition next month, and it will be running between the Spittel Markt and Bauer's Ausstellungs Park—Alt-Moabit—a distance of about four kilometres, from the centre to the west end of the city of Berlin.

A *Times* correspondent, writing from Rawul Pindi, says:—"The Quetta railway cannot be completed for two years to come. Orders have, however, been issued to construct a temporary railway through the Bolan. Starting from Pir Choki, it will follow the bed of the river, and then run along the old road to Sir-i-Bolan, and be continued from Darwaza into Quetta. The gradients between Sir-i-Bolan and Darwaza are too steep for the laying of a railway. The instructions are to leave the new military road free for traffic; but that road is useless for the purpose of making a railway, owing to the want of a bridge." But the *Times* also says:—"It is stated that the railway plant for the military line through the Bolan Pass to Quetta, which is to be at once commenced, has been to a great extent stored in India for some years. When the Quetta Railway extension was originally projected rails and sleepers were collected for the purpose. Some miles of these rails were subsequently used elsewhere, but the store has lately been replenished by the despatch of material from England. The hired transport Duke of Devonshire, on proceeding to Suakim with troops six weeks ago. took out many tons of flange rails, which, after debarking her troops, she conveyed to Bombay. Several ships going out to India within the last two months have had tonnage of rails, and it is understood that sufficient plant has now been collected for the construction of the projected line."

DURING the second half of last year twenty-six new locomotives were built at the cost of revenue by the Great Western Railway Company. The number of locomotives upon the system at the close of December, 1884, was 1577, as compared with 1577 at the close of June, 1884. The number of tenders was the same at both dates. The cost of locomotive power upon the system in the second half of 1884 was £484,781, as compared with £492,665 in the second half of 1883. The aggregate distance run by trains in the second half of last year was 15,381,103 miles, as compared with 15,515,079 miles in the second half of 1883. The average performance of each locomotive upon the system in the second half of 1884 was thus 9753 miles. It will be seen that the directors have been slightly reducing the train mileage of late. The number of locomotives owned by the London, Chatham, and Dover Railway Company at the close of December, 1884, was 180, the number of tenders being 104. At the close of June, 1884, the corresponding figures stood thus:—Engines, 172; tenders, 102. It follows that eight additional locomotives and two additional tenders were placed upon the system in the second half of last year. The cost of locomotive power in the second half of 1884 was £76,970, as compared with £75,088 in the second half of 1883. The aggregate distance run by trains in the second half of last year was 2,042,506 miles, as compared with 1,976,477 miles in the corresponding half of 1883. It follows that the average performance of each locomotive was 11,347 miles in the second half of last year.

NOTES AND MEMORANDA.

IN Greater London, 3026 births and 2129 deaths were registered, equal to annual rates of 30·4 and 21·4 per 1000 of the population.

AT the Royal Observatory, Greenwich, last week, the duration of bright sunshine was registered as 55·4 hours, as against 42·7 hours at Glynde-place, Lewes.

A HARMLESS soldering mixture, to take the place of chloride of zinc, has been patented in the States, and consists of lactic acid and glycerine, the best proportions being 1 lb. of each of these substances with 8 lb. of water.

THE deaths registered last week in twenty-eight great towns of England and Wales corresponded to an annual rate of 23·1 per 1000 of their aggregate population, which is estimated at 8,906,446 persons in the middle of this year.

IN London, 2404 births and 1701 deaths were registered last week. The annual death-rate per 1000 from all causes, which had been 21·4 and 22·2 in the two preceding weeks, declined to 21·7. During the thirteen weeks ending last Saturday, the death-rate averaged 21·6 per 1000, against 24·3 in the corresponding periods of the nine years 1876-84.

THE total production of finished iron in the United States of all kinds in 1883 was 2,348,874 tons, as compared with 2,493,831 tons in 1882, and 2,643,927 tons in 1881. The returns for 1884 are not yet available. They are expected to show a decrease. Between 1882 and 1883 the decrease in the production of iron rails was 162,920 tons. In other rolled iron there has been a steady increase.

IN an article on "Some Probable Causes of Earthquakes," Mr. R. A. Proctor calculates the pressure over a large area due to the fall of the barometer half an inch. This represents nearly a quarter of a pound per square inch—really it is $\frac{49}{50}$ths of a quarter of a pound; so that the total pressure on a square mile reaches 972 millions of pounds, or, on an area of 100,000 square miles, 42,600,000,000 tons.

THE following fourteen ships for the French Navy were in course of construction during 1884 at the cost of 49,431,000f., viz.:—Le Foudroyant, 9,416,000f.; Le Terrible, 6,431,000f.; Admiral Baudin, 11,023,000f.; Brennus, 132,000f.; Charles Martel, 13,000f.; Formidable, 3,788,000f.; Hoche, 2,716,000f.; Magenta, 977,000f.; Neptune, 1,302,000f.; Caïman, 3,541,000f.; Furieux, 5,052,000f.; Indomptable, 4,000,000f.; Coquin, built in private yard, 3,295,000f.; and Marceau, 2,260,000f. When all are finished the total expenditure will be 130,000,000f.

THE German iron and steel production between 1878 and 1882 increased by 119·7 per cent., against an increase of only 32·9 per cent. in the case of manufactured iron, and of 57·4 per cent. in that of pig iron. One of the most remarkable items of increase is that of wire, amounting as it does to 111·4 per cent. The numbers of workmen employed have risen from 135,973 to 187,567, being an increase of 37·9 per cent.; but in the steel works the increase of workmen has been from 14,562 to 27,974, or 92·1 per cent. In one item only—that of "other hammered iron"—has there been a decrease, amounting to 52·9 per cent.; but the quantities are small.

THE total quantity of steel produced in France during the first half of 1884 was 239,764 tons, being a decrease of 14,748 tons on the quantity produced during the latter half of 1883. Of the quantity made in 1884, 31,173 tons were obtained in the Meurthe-et-Moselle district alone by the basic Bessemer process, of which 29,192 tons took the form of rails, and 130,000 tons of basic steel were made in France as a whole, in the nine months ending September 30th. Of the 45,662 tons of merchant steel produced in the first half of 1884, 4190 tons were crucible, 1207 tons cementation, and 6713 tons puddled steel; while the open-hearth process is credited with 27,398 tons of merchant steel, as against only 6154 tons produced by the Bessemer process. Steel is now produced in twenty-three departments of France. The Bessemer process, however, is carried on in only eight departments, against twelve departments manufacturing steel on the open hearth.

IN the official report of the Geological Survey of Wisconsin is an account of the determinations made by Dr. J. M. Anders of the amount of water pumped from the earth by trees. He finds that the average exhalation from soft thin-leaved plants in clear weather amounts to about $1\frac{1}{2}$ ounces troy per day of twelve hours for every square foot of surface. Hence a moderate sized elm raises and throws off $7\frac{3}{4}$ tons of water per day. In the report the facts are applied to what is going on in America, where certain inland fertile districts are becoming converted into deserts by wholesale clearings; and in other places, such as the plains of Colorado, where, says the *Boston Journal of Commerce*, only five or six years of irrigation and planting has already produced a measurable increase of rainfall. We may venture to remark that 7·75 tons, or 1736 gallons per day, would appear to us to be a busy day's work for the elm, and rather a tax on any means of water supply to the roots of even the largest elm.

AT a recent meeting of the Paris Academy of Sciences M. Troast presented a note from MM. Osmond and Werth dealing with certain experiments made during the last few years at the Creusot Works. The results obtained indicate that cast steel possesses a kind of cellular tissue, the iron being contained in cellular envelopes formed by the carburet. These single cells are grouped in agglomerations, designated composite cells. It is remarked in the note that it is easy to identify the composite cells with the grain of the steel, it being possible to define the fracture of a steel bar, as the surface which in the part acted upon contains the minimum of carbon. The experiments and subsequent microscopic examinations were carried out according to various methods, such as Weyl's process, the use of azotic acid on polished surfaces, hardening and cold-hammering. The tests made with azotic acid showed very clearly the crystalline organisation of the iron globules, the composite cells being regarded as resulting from dendritic growths, which, being developed in an independent manner, have mutually limited themselves, expelling from their joints in a still liquid form the carburet of iron which they had imbibed. These remarks apply to cast steel, cooled slowly. After a rapid hardening, the composite cells have completely disappeared, and the single cells form the constituent elements. Cold-hammering produces a permanent deformation of the cells, with an elongation of the core in the direction of the local effluxion, together with a more or less complete correlative dislocation of the envelope, which is only malleable in a limited degree.

IN a recent meeting of the Glasgow Philosophical Society, Mr. J. J. Coleman, F.C.S., F.I.C., gave an address "On the Liquefaction of Atmospheric Air and other Effects of Extreme Cold; and on Artificial Light and other Phenomena of High Temperature," with experimental illustrations. In the course of his address he pointed out that all gases had been recently reduced to the liquid or solid state. Faraday liquefied most of them forty years ago, but he failed in liquefying atmospheric air or oxygen, although he employed a pressure of fifty atmospheres, or 750 lb., per square inch. Great cold as well as great pressure was required to liquefy atmospheric air. It had been accomplished, however, by compressing air in tubes to the extent of about 1000 lb. per square inch, and surrounding the tubes externally with a temperature of 175 deg. below zero Fah.—*i.e.*, 187 deg. below freezing point, for oxygen and 231 for nitrogen. When air was liquefied it boiled at about 300 deg. below zero Fah. The low temperatures required for liquefaction of air were got by means of liquefied olefiant gas, which itself boiled at 152 deg. below zero F., and could be prepared by compressing the gas in a coiled tube cooled by a cold air machine. Cold air machines gave temperatures as low as 120 deg. below zero, and by such means ordinary alcoholic liquids, such as brandy, gin, and strong whisky, were frozen, the temperature required being about 60 deg. below zero Fah. Young's paraffine oil No. 1 froze at 31 deg. below zero, and American petroleum at 62 deg. below zero. Mr. Coleman has prepared a valuable table, giving the physical conditions of various gases and liquids dependent upon temperature.

MISCELLANEA.

AT the Royal Institution a course of five lectures, on "Natural Forces and Energies," will be given by Professor Tyndall, F.R.S., at three o'clock on the Thursdays commencing April 16th.

THE *Electrician* fears that the new cable ship, Magneta, of the Eastern Extension Telegraph Company, has been lost, nothing having been heard of her since she left Falmouth nearly six weeks ago. Since the La Plata went down no calamity of this kind has occurred.

WITH a view to the probable necessity for large store space, Messrs. Clark, Bunnett and Co., who have recently completed a contract for iron houses for Suakin, have received instructions from the War-office to erect iron storehouses at the Royal Army Clothing Depôt, Pimlico.

IN our preliminary notice of the electric lighting installation in the Inventions Exhibition, we omitted to mention a large contribution by Messrs. Siemens Bros. and Co., which will include some very large dynamos, driven by direct-acting compound engines by Messrs. Goodfellow and Matthews.

IN the manufacture of steel America has made most remarkable progress. The capacity of the Bessemer steel works of the United States was in 1882 2,150,000 tons; in 1884, 2,490,000 tons; increase, 340,000 tons. This large increase has apparently been accomplished with an increase of only ten in the number of converters erected.

MR. W. BLATCH, B.D., writes us from Hanford Vicarage, suggesting that as a means of averting the disaster of a strike among the coal miners, coalowners should agree all round to raise the price of coal 1s. per ton, and give the men a fair advantage from the rise. This, he says, would advantage both owners and miners, and do no harm to anyone.

THE next general meeting of the Chesterfield and Derbyshire Institute of Mining, Civil, and Mechanical Engineers will be held to-morrow, at Chesterfield, at 2.45 p.m. The following papers will be open for discussion:—Mr. George Addenbrooke's paper, "The Bulkley Patent Injector Condenser;" Mr. A. H. Stokes' paper, "On Colliery Explosions;" Herr C. Meinicke's paper, communicated by Mr. J. Clark Jefferson, entitled, "Counterbalancing Winding Ropes;" Mr. P. M. Chester's paper, entitled, "Colliery Winding Ropes, and their attachments to the Cage." The following paper will be read or taken as read:—"Mining in North America," by Mr. Arnold Lupton, Leeds.

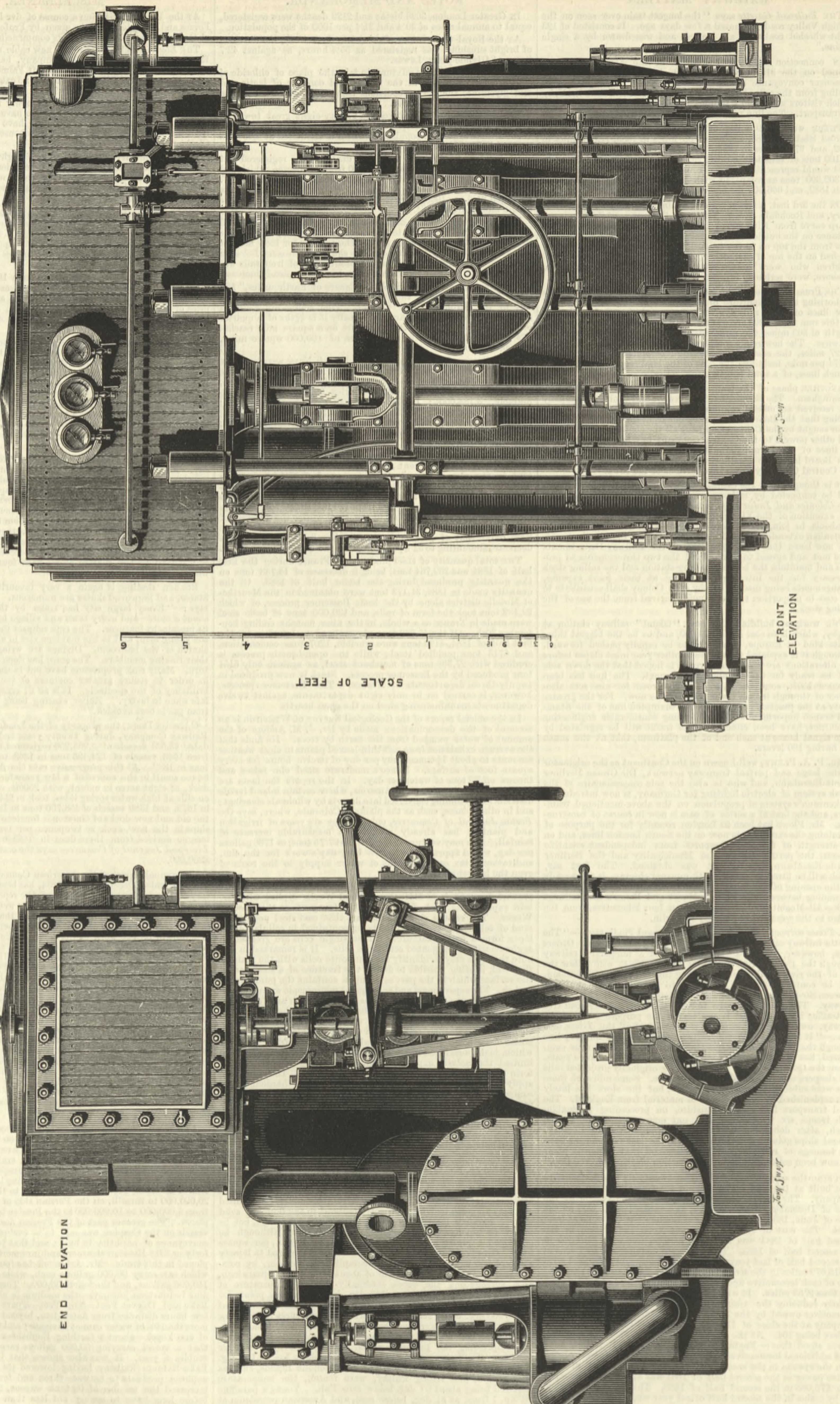
A SERIOUS colliery fatality occurred at Stoke-on-Trent on Wednesday. About one hundred men were down in the No. 1 stone pit of the Great Fenton Colliery, in which the Duke of Sutherland is a large shareholder, when an explosion happened through, it is believed, the firing of a shot in a place where gas had previously accumulated. Four men were instantaneously killed, and sixteen others were seriously injured, two of whom have since died. Had the accident happened a little later a further hundred men would have been in the workings. Immediately after the catastrophe a rescuing party descended. They succeeded in bringing three of the dead to the surface along with four of the badly injured workpeople.

ROLLER skating is again a very favourite amusement in the States, and improved skates are numerous. The *Electrical World* says:—"Every large city has rinks by the dozen—New York about a score—and every town and village has now added a rink to its prominent features. The rink eclipses the saloon in the eyes of the young men, and to the maidens vies in attractiveness with the church or the ballroom. Divines are wringing their hands over their rinking members. The craze has done electric lighting a good turn. Many rink proprietors have put in the electric light lately, in order to secure greater coolness of the air and enhance the brilliancy of the spectacle. It is an ill craze that does not stimulate some industry." Roller skating being warm work, the heat from gas is best avoided.

GARSTON DOCK, the property of the London and North-Western Railway Company, during twenty years ending in 1882, accommodated 43,551 vessels of 5,965,256 registered tons. The trade grew from 1543 vessels of 124,195 tons in 1863 to 3024 ships of 505,472 tons in 1882. At this progressive rate the dock area will prove to be too small in the course of a few years for the trade. The new dock, of eight acres in extent, with 2500ft. of quay space and 28ft. on sills at high water spring tides, took in 214 vessels of 60,984 tons in 1875, and 1380 vessels of 458,700 tons in 1884. The total area of the old and new docks of Garston is fourteen acres. The charge on ships in the new dock is twopence per ton of register, and the income derived from these dues in 1883 was £8401 7s. 1d. The *Liverpool Journal of Commerce* says the cost of the new dock was £200,000.

THE annual report of the American Commissioner of Patents for the year ended December 31st, 1884, has been handed to the Secretary of the Interior. That part of the report that relates to the finances of the bureau shows that there were received during the year from all sources 1,075,799 dols., and that there were expended 970,580 dols., an excess of receipts over expenditure of 105,219 dols. A summary of the work of the office for the year shows that there were issued 20,297 patents and designs, that 116 patents were reissued, and that 1021 trade-marks and 513 labels were registered; 12,301 patents expired during the year, and patents were withheld in 2839 cases for non-payment of the final fee. Of the patents issued, 19,013 were to citizens of the United States and 1284 to citizens of foreign countries. The Commissioner again calls attention to the inadequacy of room and of facilities for conducting the business of the office, and to the unfitness of the rooms now occupied for occupation by human beings. He also calls attention to the insufficiency of the facilities for conducting examinations, and recommends that an appropriation be made for a laboratory and such appliances and fixtures as are necessary. He asks that the force of examiners be largely increased, stating that the present force is inadequate. In connection with this matter he says: Many important interests are lost or greatly damaged by reason of the inability of inventors to have their applications disposed of within a reasonable time.

AT a recent meeting of the society for encouraging Russian navigation a paper was read by a M. Valdemar on the carriage of naphtha in bulk—instead of in barrels or cans—as a new and abundant source of profit for the owners of small sailing craft trading in the Black Sea. "At the present time there are transported yearly from Baku by this means of cisterns in coasting sailing luggers 200,000,000 gallons of naphtha, kerosine, and residuum to the mouth of the Volga; 20,000,000 to Enzelli, on the Persian side of the Caspian Sea: and from 8,000,000 to 10,000,000 to the Persian town of Resht and other places. The greater part of the Persian fleet of commercial sailing vessels on the Caspian was said to be exclusively employed for the conveyance of naphtha in bulk; and that besides these there are forty or fifty Russian steamers and innumerable sailing vessels employed in this trade. Mr. Artemieff has four sailing vessels two of which can carry 60,000 gallons each, while one vessel can manage 110,000 gallons, and the fourth 36,000. These vessels perform from nine to fourteen journeys—the medium is eleven—a year, between Baku and Dayvet Foot—Nine Feet—a part of the Caspian Sea, a few hours distance from Astrakhan, beyond which vessels drawing more than 9t. of water cannot navigate; and they earn a freight rate of one kopek—about a farthing English—a gallon per journey, so that a vessel carrying 50,000 gallons earns five or six thousand roubles a year. It was also shown that in consequence of the Baku-Batoum Railway having lowered its tariff for carriage of naphtha products to between three and four kopeks a gallon and increased the number of its tank wagons, that line will doubtless before long have to convey not less than 200,000,000 gallons of naphtha products yearly, and, therefore, hundreds of vessels will be required to convey these products, not only to the ports of the Black and Azov Seas, but also to those of the Mediterranean Sea."



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MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS.—Tuesday, April 14th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion, "On Rivers Running into Tideless Seas, illustrated by the River Tiber," by Mr. W. Shelford, M. Inst. C.E. Thursday, April 16th, at 8 p.m.: Special meeting. Fifth lecture "On the Theory and Practice of Hydromechanics"—Subject, "Tides and Coast Works," by Mr. Thomas Stevenson, F.R.S.E., M. Inst. C.E.

SOCIETY OF ENGINEERS.—Monday, April 13th, at 7.30 p.m.: Paper to be read, "On the Distribution of Electrical Energy by Secondary Generators," by Mr. J. Dixon Gibbs, the leading features of which are as follows:—(1) The difficulties attending, and the conditions necessary to insure, a complete and economical system of a house-to-house distribution of electricity. (2) The solution of the problem by the employment of primary currents of high potential, capable of being conveyed by conductors of small diameter over large areas. (3) That secondary generators afford the means of transforming such primary currents by utilising the phenomena of induction.

METEOROLOGICAL SOCIETY.—Wednesday, April 15th, at 7 p.m., the following papers will be read:—"Report of Committee on Decrease of Water Supply." "Report of Committee on the Helm Wind of Cross Fell, Cumberland." "Results of Meteorological Observations made at Asuncion, Paraguay," by Mr. Richard Strachan, F.R. Met. Soc.

SOCIETY OF ARTS.—Tuesday, April 14th, at 8 p.m.: Foreign and Colonial Section. "British Interests in East Africa, particularly in the Kiliman'-Jaro District," by Mr. H. H. Johnston. Wednesday, April 15th, at 8 p.m.: Seventeenth ordinary meeting. "On the Removal of House Refuse Independently of Sewage," by Mr. B. W. Richardson, M.D., M.A., F.R.S. "Proposal for the Abolition of Water Carriage in the Removal of Effete Organic Matter from Towns," by Mr. Thomas Hawkesley, M.D., M.R.C.P. Friday, April 17th, at 8 p.m.: Indian Section. "The Parsis and the Trade of Western India," by Jehangeer Dosabhoy Framjee. Field-Marshal Lord Napier of Magdala, G.C.B., G.C.S.I., will preside.

THE ENGINEER.

APRIL 10, 1885.

ENGLISH AND RUSSIAN FIELD ARTILLERY.

THE outbreak of hostilities between Afghanistan and Russia leaves, we fear, little room for hope that war may be averted between this country and Russia. At such a moment it becomes important that we should understand as fully as possible the precise nature of the ground on which we stand; and it need hardly be said that the part which will be played in such a war as that impending, by field artillery, can hardly be exaggerated as regards the magnitude of its influence; and here we may observe that it is not likely that any war in Afghanistan would test the special excellence of our most recently adopted guns. Such pieces would hardly get out there either from Russia or from England until a struggle had lasted for some time; nor is it probable that the conditions would be favourable for the display of the general forms of excellence in scientific features, such as high development of power and accuracy. The Afghan ground is itself difficult, and the place is difficult of access, and practically so distant, that the question is one of peculiar armaments suited to a particular nature of warfare. Machine guns and mountain guns, rather than field and siege guns, will here find their scope; and the question will be rather of quantity and readiness to hand than of abstract quality. In all this we ought to be in advance of Russia. Our wars in Afghanistan have surely given us more experience available for serious fighting than the Russian fights and marches—for they hardly took the shape of "wars"—with the Turcomans. Observe, we do not say that the Russians have not had the schooling that they need specially for the work of advance and concentration of supplies, and this may be the principal matter; but we are now speaking of the feature of war that it is our province more particularly to discuss—namely, *matériel*—and we say that the Russians can hardly have had occasion to consider this as we have. Small-arm ammunition was nearly all that was called into play with them. This has not been the case with us, because we have had to deal with an enemy using artillery, and possessing fortresses which were sufficiently formidable to call into operation the effort to bring artillery and material across the difficult mountainous country surrounding them. It is precisely this experience that ought now to be valuable to us. Our screw mountain guns naturally first suggest themselves. These were described and illustrated in THE ENGINEER of November 22nd, 1878. We pointed out that even at that time, by the screw principle, a powerful field gun was furnished, instead of a feeble inaccurate little howitzer. This was effected by making the gun in two pieces, which each weighed respectively 201 lb. and 200 lb. for breech and muzzle portions, the latter being made up of a gun tube weighing 133 lb., and trunnion hoop, &c., 47 lb. The old mountain gun of 200 lb. weight, fired at an elevation of 2 deg. 10 min., had a range of about 706 yards only. The screw gun would probably command something like double this. Without going into details, however, it may be said that we learned in 1878 that we could carry a powerful field battery on the backs of mules. This was specially valuable in the case of a war where we might have to cross mountains and then fight on comparatively level ground. Something perhaps even more important was then suggested. This we knew at the time, and abstained from discussing in THE ENGINEER, because we thought it might do harm to call attention to it. It was a special weapon, likely to be useful in case of a war with Russia, and we wished to give the idea every opportunity of remaining our own possession, with what success we shall see presently. The idea was a siege gun, which could be taken asunder sufficiently to enable a really powerful piece to be carried on the backs of elephants. It was especially valuable to England, for England only has any considerable supply of trained elephants. In 1878 this idea was taken up and considered. In 1885 we find that the fruit of seven years' work in the hands of our authorities is one gun of this kind, which is on trial in India. Russia, however, has made a number of guns which unscrew into several smaller pieces; and at the present moment it is probable that Russia could bring many more powerful screw guns into action than ourselves, without the advantage of elephant carriage. Another idea brought out by our wants was that of very powerful rockets—Sir William Congreve's "soul of artillery without the body." A few enormous rockets were made in the Royal Laboratory, and sent out to India, such as would undoubtedly produce a tremendous effect. They might be easily carried and fired, because, of course, they only represent the transport of ammunition, not of a gun. One drawback of rockets, however, among their various uncertain elements, is that they keep badly in hot climates. The metal case is apt to separate from the composition, and when the rocket is ignited the flame is apt to reach so large a surface and generate so much gas that the rocket explodes near the place from which it is fired. Shaking on the road may produce a similar effect from cracking the composition. Consequently it is probable that these rockets which have now been some years in India are in a dangerous condition. They may be sound, but they may not. It is quite an open question, we should think, whether they would act among friends or enemies. As the action among friends would be accidental and without aim, and that at an enemy would be directed at a particular point desired, that is if the rocket went reasonably well, thus it might be worth while trying them if fired from an isolated position where they were not likely to do much harm if they burst. Next, to come back to mountain screw guns for mule batteries, we have no confidential information, so we may say that there are two or perhaps three, but hardly, we think, more of these in the North of India. These, however, are as near the seat of war as we could reasonably expect.

As to field guns as above noticed, probably neither Russia nor ourselves could at first bring new-type guns into the field. Russia would be most likely to have at her most advanced artillery depôts her old-pattern 24-pounder and 13-pounder guns—both of them breech-loaders on the Krupp system. We should have our 16-pounder and 9-pounder muzzle-loading guns. As to machine guns, it is likely that we should not be unevenly provided. We have not heard of either nation employing them in the district; but both have them elsewhere, and they are not difficult to send from place to place. Altogether, then, in *matériel* we ought to have some advantage at first over Russia. Nevertheless, we maintain that it is by no means the condition of things that ought to exist under the circumstances, because England has had the peculiar need as a practical question before her for seven or eight years. Surely three screw mountain batteries, one elephant divided gun, and a few doubtful and dangerous rockets, which we feel are very unlikely to be fired, are not an adequate result to show for the unhindered efforts for seven years of the Government departments of a rich and powerful country whose mind is set on holding her own in India. Is it to be wondered at that in military as in naval matters recourse is had to the press to stir authorities up?

MARINE BOILERS.

THE paper read by Mr. J. Milton, "On the Efficiency of Marine Boilers," at the last meeting of the Institution of Naval Architects, apparently embodies the opinions of those most competent to speak from experience on the subject. The paper itself will be found on another page. In the discussion which followed on its reading, the speakers generally agreed that the triple expansion engine, possibly the double expansion engine, represents the limit of possible improvement in the machinery, strictly so called, of ships; and that further economy must be sought in improvements in boilers. To this proposition we take no exception. It is no doubt substantially if not wholly true. At all events theoretically, pressures are already too high; and the results obtained in practice ashore show that the rate of expansion is also too high for economy in triple cylinder engines. It is maintained, however, by those who ostensibly ought to know best, that pressures and ratios of expansion are not too high, but the number of those marine engineers who assert that they might be yet higher is very small indeed. Every one, however, is agreed that the marine boiler is not what it ought to be; and Mr. Milton has done good service by opening up the whole subject of its merits and demerits for discussion.

From some cause or other not apparent, the steam engine at sea is more economical than the steam engine on shore. There is, for example, scarcely a recorded instance, if we except a few pumping engines, in which a horse-power indicated is obtained for $1\frac{1}{2}$ lb. of coal per hour on land. But at sea this seems to be a by no means unusual performance. The number of land engines for which 2 lb. per horse per hour suffice is very small. Already marine engineers look on a seagoing engine which needs so much fuel as exceptionally bad, or, at all events, as a machine of which no one can be proud. Now it is known about as well as anything can be known, that 16 lb. of steam per horse per hour in ordinary every-day work represents an extraordinary economy; and we believe that it is very doubtful if any marine engine, triple expansion or otherwise, does with less. If this be the case, then the boilers must evaporate 8 lb. of water per pound of coal to keep down to 2 lb. of coal per horse per hour, or over 10·5 lb. if the consumption of fuel is at the rate of $1\frac{1}{2}$ lb. per horse per hour. Now a boiler which evaporates 8 lb. of water per pound of coal is by no means bad, and one which evaporates 10·5 lb. is exceptionally good, and one is not unnaturally disposed to ask, Is it possible to improve on such a boiler? Unfortunately there are few or no experimental data available to tell us what the economical efficiency of any marine boiler really is, because no attempt is ever made to measure the amount of water evaporated per hour. During the Wigan trials, made in 1867, a marine "box" boiler of the Admiralty type evaporated 10·153 lb. of water at 100 deg. per pound of Lancashire steam coal—26 lb. of coal were burned per foot of grate per hour, and 269 lb. of water evaporated. The boiler had 364 square feet of tube surface, and the grate surface was varied from time to time during the experiments. The normal area was 13·75 square feet, or 1ft. of grate to about 26·5 of heating surface. The temperature in the smoke-box seldom reached 400 deg. More water than we have stated was evaporated in some of the experiments by special coal; but we have given what represented a normal performance. We may well ask, Is it possible to improve much on this? and we may say, without hesitation, that we doubt it. It is difficult, indeed, to see in what direction improvement is to be sought. We assume that the existing type of cylindrical boiler, with from two to eight furnaces in it, will be retained for some time to come at least, because no other type that has been tried seems to grow in favour or promises to be adopted extensively. Now, leaving on one side for the moment all questions of strength and internal arrangement, let us consider what is to be done to make the coal burned produce more steam than it does.

The first thing that suggests itself is that the heating surface should be augmented. In theory this is right. In practice it is wrong. The theorist continually contemplates the perfect combustion of a perfect fuel. The practical man knows that he has to burn a more or less dirty mixture of carbon, hydrogen, oxygen, sand, lime, iron, &c. He finds that if his heating surface is too large the products of combustion are cooled down so much that they deposit a heavy coat of soot in the tubes. Now, soot is a splendid non-conductor. A column of hot gas passing through a boiler tube, finding itself chilled, at once puts on a blanket; in other words, it lines the tube with soot, which is never afterwards burned up, and then the hot gas goes on its way to the chimney rejoicing. Besides, much heating surface means many tubes and interference with circulation—a very serious evil. On the whole, the best results appear to be got when not more than 25 square feet of heating surface are allowed to each foot of grate. It is tolerably clear therefore that nothing is to be had in this direction. Next we have to consider the combustion of the fuel to the best advantage. Smoke is a nuisance, and it does harm in the way we have just explained by fouling the tubes; but it represents in itself very little waste of money. When fuel is improperly burned a large quantity of invisible carbonic oxide—a most valuable fuel—escapes; and it is the loss of this gas that explains the want of economy shown by some boilers. Mr. Milton calls attention to forced draught, which no doubt may tend to prevent the evolution of the oxide. It is worth considering whether certain modifications might not be made in the construction of furnaces which would specially provide for the production and subsequent combustion of this gas. If we take the case of a locomotive, for example, we find that we have, first, the grate, on which a very thick fire indeed is carried. This fire is nearly covered by a brick arch, and the space between this arch and the tube plate constitutes a veritable combustion chamber. What happens is this: The thick bed of coal in a manner distils into gas. This rises and rolls along the brick arch towards the fire-door, where it is met by a rush of air entering through the scoop deflector, and the result is that that portion of the box between the brick arch and the tube plate is filled with an almost solid—if we may use the word, for want of a better—mass of flame, and the combustion is practically complete. It was proposed during the discussion on Mr. Milton's paper that grates should be shortened. Now, if this were done, considerable space would remain available for a combustion chamber in the interval between the bridge and the back uptake. On a former occasion we suggested that when forced draught is employed it should be applied to the back ends of the grates only; but it is easy to see that if grates were made short as proposed, it would be quite possible to arrange fire-bricks in the further end of the furnace tube, and to turn in there a blast from a fan in such a way that very perfect combustion would be obtained. In fact, the object would be to fire the coal so as to obtain the greatest possible quantity of "smoke" from it in the first instance, and to burn this afterwards. With ordinary draught it is not possible to work in the way we suggest; but given the blast, and much before out of our reach becomes possible.

Another way of augmenting economy lies in heating the feed-water. There is really no good reason why, under proper arrangements, feed-water at 100 deg. or 110 deg. only should be pumped into a marine boiler, and by the time it has traversed the pumps and pipes between the hot well and the boiler it is seldom more. Mr. Milton refers to the use of heaters at sea. In the course of the discussion it was stated that the great objection to their use is that they become choked up with deposit. This, however, might be got over, and there does not appear to be any valid reason why feed-water should not be sent into a boiler at sea as well as a boiler on land at 200 deg. or 250 deg. We may call attention here to the existence of an engineering conundrum, the answer to which is not yet available. It has been proved apparently beyond any question that a very sensible economy is attained by drawing live steam from the boiler and using it to heat feed-water. Now, it is certain that no economy is attained by the injector in this way, but, on the other hand, if the injector did not heat feed-water, it would be the most extravagant feeding apparatus in the world. Yet it seems that if live steam is used to heat the water as we have said, fuel is saved. Why?

THE EVOLUTION OF MACHINES.

Evolution, natural selection, and survival of the fittest, are terms so commonly monopolised for expressing a system of biological or physiological speculations, that to speak of the evolution of machines seems almost like the appropriation of an idea, though, of course, it is nothing of the kind. A very interesting paper on this subject was recently read before the Society of Arts by Professor H. S. Hele Shaw, in which he endeavoured to show that a time may arrive when a knowledge of mechanics and of the functions and possible combinations of mechanical elements may be so complete that a synthetic process of designing a machine for any purpose will be realised. He compared our present knowledge of mechanics and the methods of designing, inventing, and making a machine or mechanical combination, with the knowledge and groping-in-the-dark methods of the alchemists. After reviewing the evolution of some kinds of machines, he dwelt upon the steam engine, and drew the conclusion that all improvement was attended with increased complication or numbers of parts. As an illustration, he gave the following as the number of parts belonging to the engines and boilers of a first-class Atlantic steamer:—Jam nuts, 238; split pins, 400; levers, 37; guard rings, 108; pins, 1144; moving parts, 100; total number of pieces in engine, 6000; auxiliary engines, 23; steam pipes, 271; pumping-out arrangement, 172; valves, 147; gauges, 9; lubricators, impermeators, 147; bolts, 7868; studs, 3000; nuts, 10,407; rivets, 64,888; boiler tubes, 2270; condenser tubes, 4456; boiler stays, 1582; furnace bars, 1356; furnaces, 24. Of this, Professor Shaw says, "Perhaps one of the most significant items is that of the twenty-three auxiliary engines, each a separate, self-regulating, self-contained motor, supplied simply to work separate portions which, at first, used to be worked by the main engines or by hand. Consider the 764 parts made up of jam nuts, split pins, and guard rings, placed solely for extra security, not to say the 1144 pins, many of which are for this purpose; and, lastly, the enormous total of which appear to amount to 104,642 parts, each requiring separate construction, fitting, and securing, and truly it will be said that progress does not take place in the direction of simplicity. But if the visitor is led to turn from the difficulty of even understanding this complex system, to the thought of what a marvellous achievement the design of such a machine must be, perhaps what strikes him even more than its complexity is the perfect interdependence of the parts, and the extraordinary ease with which it is all controlled, and, in short, the wonderful unity of the machine as a whole." Here it will be seen that the author considered all this machinery as a machine; and in this, as in two or three other instances, he seems to have compared combinations of machinery with earlier separate machines, which accomplished a much smaller variety of operations. His comparisons are not altogether of like things or things for like or similarly limited purposes. Still he recognises when speaking of tools the difference between the earlier lathes and the modern lathe, and the separate or special tools which are now employed to do more cheaply what was formerly done in a lathe. This he recognises as a complication as to numbers, but a simplification of parts with a more definite and positive range and effectiveness of separate operations. It will, however, be remarked that the auxiliary engines above-mentioned, for instance, are hardly parts of a whole, but are distinct machines for performing work which was either not performed at all formerly, or was performed by parts in the main engines which those engines do not now possess, and are to this extent simplified. The author's consideration of his subject and of the process of invention leads him to remark that this process is practically the same, and differing only in degree as to the amount of groping in the dark, with the man who has correct knowledge of the principles which concern his end and the one who is not so educated. "Though the former may have used one or more known sciences, it was to a certain extent by a process unknown to himself that ever he arrived at the result." . . . "This is clearly not science, but art. . . . Why is not a distinct science of machines directly applied to the problem to be solved?" With a view to an answer to the question thus put, Professor Shaw glances at the history of the study of machines and at its present state, and follows Reuleaux in his well-known writings on the subject; but the answer is not found, though the inference from a consideration of the subject is that the man versed in the kinematics of machines is more likely to arrive easily at the solution of a practical problem in the brain evolution of a machine than one who has not had that training. Altogether it would appear that a strong case for a sound theoretical knowledge of applied mechanics is made out in the paper, but there is not much evidence of an early realisation of a distinct science of machines such as will enable one who is a master of the science to invent to order, by any other way than by the art which even he who arrives at results does not quite understand. It is rather discouraging, as far as the acquirement of such a science is concerned, that hitherto those whose training in theoretic mechanics has been most complete have seldom produced a new machine either by art or by science.

THE STRIKE IN THE COAL TRADE.

There is now an end of negotiations and interviews. Both sides have spoken, and Yorkshire coalowners and colliers have alike made up their minds to proceed to extremities. The employers, after passing their resolutions for the reduction of 10 per cent., held no more meetings, but quietly went on giving their notices in the terms of the decision. The miners met in conference at Rotherham, where they confirmed their previous resolution to resist the reduction, "and to fight to win." There were present 144 delegates, representing 31,538 colliers and trammers. It was stated that up to that time 20,000 colliers and trammers had received notice. Including what are known as datallers and boys and other persons concerned in or about the pits, it would be safe to add another 10,000. There are now 40,000 persons at least dependent upon coal getting, out of work, and now Derbyshire has joined the movement. It was reported at the conference that there were 11,500 colliers and trammers at various collieries who had not received notices; but even if all these coalowners should remain passive during the struggle, the moment the 10 per cent. is conceded they will be ready enough to reap the fruits of it, so that it is hard to see what advantage the men gain by the circumstance that they keep these collieries going. It will be a relief to the general industries of the Midlands, as well as to consumers of the high-class household coal for which South Yorkshire is famous, if a considerable number of collieries keep working. Coalowners generally have been very easy about the business. They have said all along that even if the men abandoned their uncompromising attitude and decided to grant the 10 per cent., there would be very little work for them on account of the tremendous accumulations of coal at the pits and in the sidings. Many colliery proprietors made no secret of their desire to have a month's "play" to clear off stocks, for which they might probably get a slight advance. The hopeful phase of the miners' conference was the resolution to ask the employers for an interview—a proposition which was scornfully rejected at the first conference. When masters and men get to talking together they frequently arrange a basis of settlement much more easily than by letter-writing and speech-making. The interview took place, but it ended without any result. Matters were certainly not improved, the differences between employers and employés being sharply accentuated by the utter absence of any give-and-take on either side. Once more the miners' delegates met in conference, when the result—or rather, no result—of the interview with the coalowners was reported; 36,000 colliers and trammers were represented, and a resolution to resist the reduction was carried with five dissentients. The Manvers Main and other mines were prepared to meet the employers half-way by conceding five per cent. This proposal, however, was not accepted. It was expected that even at the eleventh hour, though hopes of agreement were very faint, some mutually-acceptable plan might be hit upon to avoid the costly and clumsy expedient of a strike with all its attendant miseries to the collier and his family and unremunerative expense to the coalowner, who has to pay royalties, keep his fan going for ventilation, and incur other expenses, though there is not a single ton of coal being raised to compensate him for the outlay. We hear of "shipping rings" to raise freights, and "steel rail rings" to prevent rails being sold at a loss. We may yet have a "coal ring," to keep up the price of coals for the large consumers. Only the other day a leading railway company in the North placed its contracts at 9d. per ton less than in January of last year. In the face of northern competition, what can the coalowners do? Collieries cannot be kept going without orders—orders can only be obtained at low prices; low prices mean low wages. A colliery worked only three days a week, is worked to a loss; four days a week means expenses cleared; five days a week, a slight profit; and six days a week a reasonable profit. In the absence of effective combination, low values are certain to rule when the iron, steel, and other great industries keep so depressed as to diminish demand far below supply. The old economic law cannot be over-ridden or ignored. If more of an article is put into the market than the market needs, down comes the price, and the labour involved in the getting of the article must fall with it.

THE NORTH BRITISH RAILWAY.

At the present time the North British Railway has a special engineering interest. The works that it has in hand are not heavier than those of some other great railways, but they include one which is of vital interest to the future of the company, and one which has special interest to the general public—the Tay Bridge works. The total estimated expenditure of the North British Railway on capital account was at the date of the last report £1,280,270—a sum that is small compared with that of some of the great railways. It includes £370,389, which is the amount that it was estimated would be needed from the beginning of the present year for the completion of the Tay Bridge. The rate of the expenditure on that great work was for the past six months rather over £11,000 per month, whilst for that half year which is now half completed it was expected that the rate of expenditure would be £16,600 per month, so that it will be seen that the works are now so far advanced that, with the present rate of expenditure, about eighteen months should complete the work. This is, of course, a mere deduction from the estimate, and does not take into account any circumstances that would retard or expedite the spending of the money. But so far this year, in the time that is usually most trying—in winter—there has not been the stoppage of works which inclement weather often causes, and should there be seasonable weather in the summer, a very considerable progress should be made with the works. Apart from this, the only great work that the North British Railway Company has in prospect is the doubling of its road north of the Forth Bridge, and the construction of the Glengary line. It is not in contemplation to expend anything on this work during the current half year. It would take one-third of the total sum to be spent on new capital account, so that the commitments of the company, apart from the Tay Bridge and the works that will in degree depend upon the completion of the Forth Bridge, are very small. On these works, then, will depend very largely the future of the North British, and their progress will be keenly watched by those interested in it.

NEW STREETS AND MODEL DWELLINGS.

If any proof were needed of the wisdom of the provision of late years introduced into our Public Works Acts, that, prior to the disturbance for improvement of a settled population, dwellings should be provided in the vicinity adequate to the reception of its numbers, we should see it in the quietude and absence of complaint with which the ejectment of the large mass of residents in the houses now in course of demolition for the new street from Oxford-street to Charing-cross has been effected. Our readers will recollect the distress that arose—which found powerful exposition in the papers at the time—among the various classes of the people who were turned out of their homes when the Gray's-inn-road improvements were taken in hand; and it is most gratifying to observe that, not only has our legislative action secured immunity from such complaints during the progress of the present improvements, but that those dispossessed welcome with delight the change enforced upon them from the wretched cellars and dilapidated garrets of their former abodes to the light, air, and cleanliness of their new homes in the model dwelling houses opened last year by the Prince and Princess of Wales. Such a change, with all its attendant moral consequences, cannot but greatly stimulate the undertaking of further much-desired work of the same character in London; and we can hardly doubt but that we shall now find in such improvement, not alone the convenience demanded by our increasing traffic, but a powerful agency for good in raising the character and increasing the comforts of a class which demands our most active sympathy.

A NEEDED IMPROVEMENT.

While so much is being done to obtain for the poorer classes of London the advantages of shade and recreation ground, it seems strange that one of the finest open spaces in the metropolis should be left in such a condition as to be altogether inapplicable to such purposes. Few will be found who can deny the great beneficial results which have followed the devotion of Leicester-square to secure these advantages. We have only to go there during the noontide hour, when there is a temporary lull in the active working of our mechanical classes, to realise the practical boon to them afforded by the garden which has superseded, by the aid of private liberality, the wretched waste that space previously enclosed. Now in Trafalgar-square we have an adjacent site fully as capable of being utilised and made pleasing to the eye as any we know of in London, and yet it remains an arid expanse of flagstones, that in our hot summer days reflects a burning glare and heat, rendering it a dreadful thing to cross. Who now thinks of venturing to the waterside of its fountains save a few boys who paddle in their basins? It is only within the last two years that even a few trees have been planted around the sunken space which is a *terra incognita* to the large proportion of Londoners, who would delight to find in it shade and a temporary resting place during their walks. These trees, limited though the shade they afford is as yet, have done much to temper the blinding glare of what has been described as the finest site in Europe; but they only make us the more long for the early conversion of the flagstoned incongruity into a garden fitted for healthful resort, certain greatly to enhance the beauty of its fine surroundings.

TRIAL OF A MONCRIEFF HYDRO-PNEUMATIC CARRIAGE AT SHOEBURYNESS.

The Moncrieff hydro-pneumatic carriage for the 6·6in. M.L.R. gun, permanent emplacement, made by Messrs. Easton and Anderson, was officially tested on the 31st ult. Forty-two rounds with battering charges were fired under various degrees of elevation. Observations of muzzle velocity, pressures recorded by crusher gauges, and the pressure in the air vessel were carefully taken. Mr. Anderson's novel arrangement of small vertical hydraulic cylinders for softening the jerk on the attachment of the carriage to the masonry worked extremely well, the carriage rising about 2¼in. and falling quietly back again without any injurious blow to the racers or strains on the holding-down bolts. This carriage possesses very great interest because it has failed more than once, and has led Mr. Anderson to investigate the energy of recoil from a novel point of view, and develope the theory which he explained in his recent lecture at the Society of Arts. The correctness of Mr. Anderson's method is proved by the circumstance that the carriage having been charged with the calculated volume and pressure of air, the recoil proved to be 95 per cent. of the expected amount. The experiments were under the direction of Captain Perrott, R.A., the successor of the late Captain Goold-Adams, who was one of the victims to the terrible shell explosion.

LIGHTHOUSE ILLUMINATION.

The results of the labours of the Committee appointed to enquire into the relative efficiencies of oil, gas, and electricity for the purpose of lighthouse illumination must be looked upon as very favourable to an increased application of electricity. The arc lamp turns out to be superior to either of the combustion illuminants in its power of penetrating a fog, and thus experiments under like conditions have removed all doubt on a much disputed point. Gas and oil lights have much the same recommending qualities, the relative values being chiefly affected by cost, heat, and facility of employment. The electric lamp not only proves under the most searching tests made under all practical circumstances and scientific conditions to be the best for penetrating a fog, but also for clear weather. As a light, it far outstrips its competitors, while the advantage it offers of avoiding the damaging high temperature in the lantern is not one of the least in its favour. It will certainly cost less than oil, and will not involve more trouble in maintenance.

THE SUAKIM-BERBER LINE.

Of the Suakim-Berber Railway progress various reports are rife, it having been said, amongst other things, that as up to last Monday only four miles of main line have been laid, the work was getting on very slowly, and that difficulties of a serious sort had occurred with the navvies sent out. It appears, however, that up to Monday last four and a-half miles of main line had been laid, and that work representing much more than this had been completed. A great deal of this has been expended on the sidings at Suakim which cover a large area, and which it has been found necessary to proceed with at first, in order that sufficient room shall be found for disembarking, receiving, and despatching materials as required for the construction of the line. There is no difficulty, we are informed, with the men, and all is proceeding to the satisfaction of the contractors' agents at Suakim.

ANTWERP WATERWORKS.

AT the Water Conference held at the Health Exhibition on the 25th July last, Mr. W. Anderson read a paper on the "Purification of Water by Iron on a Large Scale," and explained a novel method, first suggested to him by Sir Frederick Abel, of causing the water to be treated to flow through cylinders turning slowly on their axes, and fitted internally with shelves or ledges, which caused a moderate charge of iron in a finely divided state to fall through the water in a continuous shower. We hear that since the date of the paper three revolvers have been erected for the Antwerp Waterworks, of sufficient capacity to purify the whole of the water being supplied to the city; and that the old spongy iron filters are being converted into sand filters. The water under the new treatment is exceptionally bright and pure, though 3 tons of iron only are in use, instead of the 1800 tons which would have been necessary to do the same work on the filter system, and the space occupied is only 110 square yards against 11,500, which would have been required by filters. We shall give a more extended account of this process after the Antwerp Exhibition opens.

LITERATURE.

Fourth Annual Report of the State Mineralogist of California. By HENRY G. HANKS. 8vo., pp. 410. Sacramento. 1884.

THE Legislature of California commenced a detailed geological survey of the State in 1860, under the direction of Professor J. D. Whitney, who continued the work with a staff of very able assistants until 1873, when, in a capricious fit of economy, the annual vote was discontinued, and the work ceased in consequence. Several valuable reports were published during that period; but the most important result of Whitney's work—the detailed description of the auriferous gravels of the Sierra Nevada—did not appear till 1880, the cost of publication having been defrayed by the Museum of Comparative Zoology at Cambridge, Massachusetts. In 1880 a new department, called the State Mining Bureau, was created, and placed under the author's charge, with the duty of forming a Californian State Mineral Museum, and reporting annually. This is now to be the fourth and last report of the State Mineralogist, whence we presume that the office is a terminable one, or possibly renewable at intervals of four years. The expenditure appears to have been about £8500, in return for which a collection of some 6000 mineral specimens, and the part commencement of a library, have been obtained, besides the publication of five volumes of a total of about 1200 pages. In former reports the author has dealt with points of special interest in Californian mining, as, for instance, in that of 1883, which was largely devoted to a description of the different borax deposits in the interior of the State, and the methods adopted in working in them; while in the present volume the information collected has been summarised into the form of an alphabetical catalogue of California minerals as far as known, having special reference to those of economic value. Among these, of course, gold takes the first place, although the production is now considerably lower than it was before the exhaustion of the superficial deposits, having fallen from £4,000,000 in 1859 to somewhat less than £3,000,000 in 1883. The total production since 1846 is estimated at about £216,000,000, which if refined and melted into one mass, would give a cube of 14ft. 5in. edge. The improvement in quartz mining is very marked, as quartz averaging about 12s. 6d. per ton value is now mined and milled to profit, while in former times 20-dollar rock (£4 per ton) was considered too low to be worth removal. The subject of alluvial mining was discussed in the author's second report. The production of Californian borax in 1883 was estimated at 1866 tons, which is not likely to increase.

Mercury, another Californian staple, was produced to the extent of 46,725 flasks of 75 lb. in 1883, which is about equal to the output of the Almada mine in Spain, now the chief seat of production in the world. The industry is, however, in a depressed condition, prices being down to a rate at which scarcely any of the mines can live. The remedy suggested is the characteristic American one of further protection, as the duty of 10 per cent. is not sufficient to prevent importation from Spain.

The production of petroleum, though small as compared with that of Pennsylvania, is an item of considerable importance in Californian industry. It seems to have been about 4,000,000 gallons in 1884, and to be decidedly on the increase. Some curious facts are mentioned as to natural tar pools formed by the overflow of petroleum springs. These are excessively dangerous to animals, which are liable to become entangled in the viscid mass. The stockowners in the neighbourhood are therefore in the habit of burning out the tar pools; the fire when started consumes the more fluid portions, leaving a comparatively solid mass of pitch behind.

The total number of mineral species found up to the present time is 161, all of which receive due notice, according to their importance, in the author's report, which will be found to be very useful to those interested in the mineral region of the Pacific Coast.

The Gas Manager's Hand-book. By THOS. NEWBIGGING, M.I.C.E. London: W. King. 1885.

THIS is the fourth edition of a well-arranged hand-book for the use of gas engineers and managers, and contains tables, rules, and information selected with a knowledge of the most frequent requirements of those engaged in the manufacture and distribution of gas, and in the construction of gasworks' plant. It is but a short time since we noticed a former edition, so that it is unnecessary to speak of its contents in general. It contains 426 pages of closely printed matter on thin paper, and is provided with a good index. To the information on coal-gas there might be added a little on calorific values, not now given; but it already contains so much that it is difficult to find omissions.

THE TELEPHONE AND TELEGRAPH WIRE QUESTION.

TAKING up the thread of our story at the point where we stopped last week, we may say that when the Committee again assembled, Mr. Hunter handed in a more specific statement of the amendments of the existing law proposed by the Post-office both with regard to telegraph wires and the telephones. These suggestions, in brief, amount to this: That in regard to telegraphs the Postmaster-General, when he intends to erect a wire, shall give properly furnished notice thereof to the occupiers affected, before obtaining the consent of the road authority if he thinks fit; that those persons desiring to raise objections shall have a specified time—say three weeks—in which to make them; that all objections shall be referred to the county-court judge sitting as arbitrator; that if there is to be an appeal it shall be to the Railway Commissioners, and within a fixed limit of time; that the Postmaster-General shall be authorised to make attachments to private property by arrangements with the occupier alone, such agreement to last only during the occupancy; and that various provisions in the existing Acts shall be repealed, especially that requiring the Postmaster-General to obtain the consent of the occupier of every dwelling-house within 30ft. of a pole. And with respect to telephones the Postmaster-General recommends that laws as to Post-office overhead wires shall be extended to all persons having occasion to erect such wires, and the laws as to underground wires shall apply to the Postmaster-General's licensees but not to other persons; and finally, that the Postmaster-General shall be entitled to notice of every intended line, and shall have a veto upon it if he is likely to require the space to be occupied within a year.

The evidence in the interest of the telephone companies was continued by the examination of Mr. J. Fletcher, engineer to the United Telephone Company, who described the *modus operandi* of erecting wires. The attachments were made, he explained, either to poles or by brackets fixed to buildings. Where there were more than two or three wires standards were used, and these standards were made of wrought iron for over-house purposes, and of wood for the ground. In all over-house work the wires were shackled off at each pole, and the spans varied from 50 to 150 yards, according to circumstances. As to the good condition of the wires, he stated that they were under almost constant inspection, as fresh wires were being run and existing wires renewed or taken up; and the linesmen had express instructions to report every wire, whether belonging to the company or to anyone else, that required attention, it being in the interests of the company to do this, because some other person's wire, if left to perish, might fall and damage one of the company's wires. The inspection was, of course, most frequent and constant where the wires were most numerous, and that was the case in the City. It was easy to detect flaws, for the communication was at once affected by defects. He was not aware of any accident in London since his company was formed due to the breaking of a wire, and as to how the wires should be laid he was ready to agree with the other witnesses in favour of overhead wires, on the ground of cost and of the frequent necessity of long detours. These circumstances would render an underground system prohibitive.

Mr. Radcliffe, telegraph engineer to the Great Northern Railway Company, and Mr. John Fletcher, telegraph engineer to the London and North-Western Railway Company, gave the Committee some particulars as to the working of telegraph and telephone wires along and in connection with wires, both speaking decidedly in favour of the overground system as less costly than below-ground wires, and much more convenient, and as safe. They also referred to the rapid growth of the telephone as an essential in business, and were favourable to a system of bye-laws by local authorities.

Mr. Charles Moseley, chairman of the Lancashire and Cheshire Telephonic Exchange Company, was the next witness, his evidence being to the following effect:—His company hold the sole licence from the United Telephone Company for the use of all its patents in Lancashire, Cheshire, South-East Westmoreland, the six northern counties of Wales, and the Isle of Man—the chief office being in Manchester. The company has forty exchanges, 3009 subscribers, 889 renters of private wires, the whole representing a gross income of £67,000 a year, in comparison with £22,000 in May, 1881. This increase, moreover, is exclusive of the income from the new service of trunk wires, public call offices, and telegrams. The subscription in Manchester and Liverpool is £20 per annum to firms within a mile of the exchange, with a further charge of £7 a mile beyond that range; but in other towns the charge varies from £20 to £8, according to requirements. Under recently enlarged powers from the Post-office, the company has opened fifty-three call offices, open to the general public upon payment of 3d. for local service, and 6d. for trunk service between town and town, for a conversation of three minutes. This extension has already been very much used by the public, and promises to be still further resorted to as its value becomes known. Besides these facilities, the company has a fire alarm system connecting fire stations, which has already proved of immense service in checking fires; and it also has established communication between several distant constabulary head-quarters, with a view to emergencies, and this the Manchester magistrates have pronounced a very important feature. Passing from this statement of the existing operations of the company, Mr. Moseley said the whole of their system was worked by overground wires—hardened copper wire of No. 16 gauge; and they were satisfied that an underground system would be impossible—first, because of the enormous cost and public inconvenience; and secondly, because of the difficulty in regard to the greater resistance in all such lines. If they adopted the underground system they would have to increase the subscription very considerably, and even now people complained of having to pay as much as £20 a year. As to the element of danger, the company agrees with the Post-office authorities in the view that there is scarcely any danger from overhead wires, no injury to any person having occurred through the breaking of one of their wires. In connection with this point, Mr. Moseley mentioned that, although in the neighbourhood of chemical works, a wire would probably be destroyed in a year, owing to the sulphuric acid in the air, in other parts wires would last four or five years. With reference to the arrangements for fixing wires, he explained that the practice of the company was to obtain permission to fix poles and wires, and make attachments, and their chief difficulties had come from people who objected to wires merely passing over their property. That often involved considerable detours, and caused serious delay in carrying out orders. Mr. Moseley, therefore, urged that, looking to the great public value of telephones, the company should receive some mild form of compulsory power to overcome these obstacles, proper safeguards, of course, being provided against their acquiring easements, and securing to owners the right of requiring wires to be taken down, and provision being also made for compensation for injury. He also thought that greater facilities should be given to them to cross roads and fields and private property, for although they now stretched wires without asking permission, they were always liable to be required to take them down. So long as a wire did not touch a house or other property they ought to have an absolute right to stretch it. At the same time he would be willing to agree to bye-laws drawn up by the proper local authorities, and approved by the Board of Trade, with respect to the proper erection and maintenance of wires and other appliances.

Colonel Raynsford Jackson, chairman of the National Telephone Company, gave similar evidence on the various points raised. He stated that this company had twenty-three exchanges already, and were prepared to establish a great many more if they could only get greater facilities. Their system also was overground—being in operation in the Midlands, many northern counties in Scotland, and in Ireland—except in Birmingham, where some special causes had obliged them to go underground. The difference in cost was, however, so enormous that the latter system would be commercially impracticable if generally adopted. As to danger, they had only had two slight accidents through wires breaking; and with regard to facilities, as a rule they had had no difficulty in arranging with local authorities. He urged, however, that they should be invested with some form of compulsory power to take their wires where necessary, subject to certain necessary conditions. In fact, they should be placed in somewhat the same position as a man building a house, in reference to his neighbour's light.

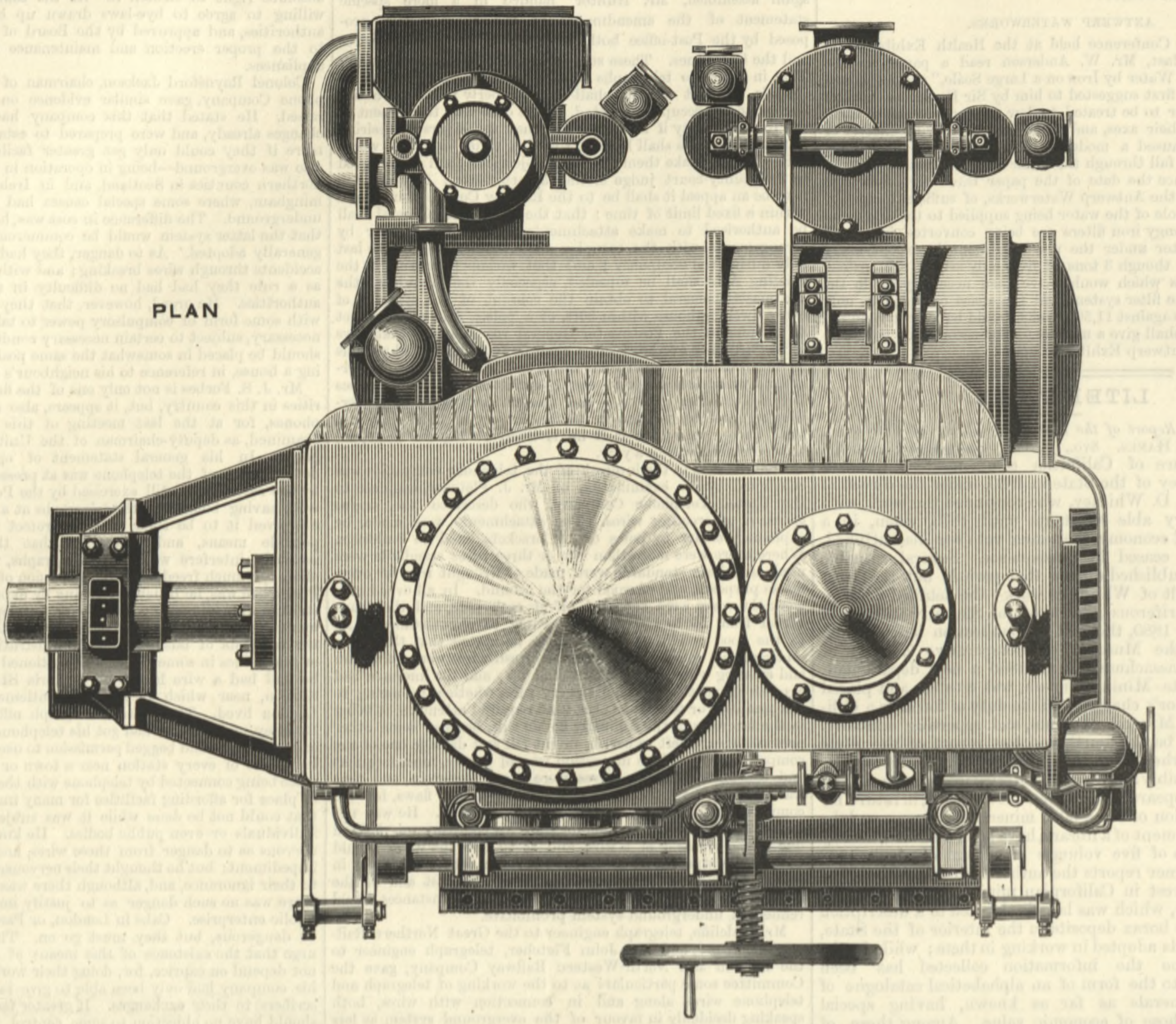
Mr. J. S. Forbes is not only one of the first of railway authorities in this country, but, it appears, also a promoter of telephones, for at the last meeting of this Committee he was examined, as deputy-chairman of the United Telephone Company. In his general statement of opinions he said the development of the telephone was at present greatly hampered by the restrictions still exercised by the Post-office authorities, who, having bought up the telegraphs at a high price, probably conceived it to be their duty to protect their purchase by all possible means, and, foreseeing that the telephone might seriously interfere with their telegraphs, were anxious not to allow too much freedom in the extension of the telephone. The Post-office was, he believed, learning by experience that these restrictions must be relaxed; but so far the telephone companies were unable to do rapidly and effectually what the public required in the interests of business. As an illustration of the great need of telephones in some places, he mentioned that for his own use he had had a wire laid from Victoria Station to Beckenham Station, near which very many gentlemen daily engaged in London lived. The nearest telegraph office was at Bickley or Bromley, and after he had got his telephone a surprising number of people came and begged permission to use it. He was strongly in favour of every station near a town or other well-populated place being connected by telephone with the centre of such town or place for affording facilities for many important matters; but that could not be done while it was subject to the caprice of individuals or even public bodies. He knew many people were nervous as to danger from these wires, and that caused further impediment; but he thought their nervousness was in proportion to their ignorance, and, although there was a theoretical danger, there was no such danger as to justify impediment to a great public enterprise. Cabs in London, or Parcels Post vans, might be dangerous, but they must go on. Therefore he wished to urge that the existence of this means of communication must not depend on caprice, for, doing their work only on sufferance, his company had only been able to give facilities to 4000 subscribers to their exchanges. If greater facilities were given, he should have no objection to some control, and he could imagine no authority for this purpose in London better than the Board of Works, with an appeal to a Department of the State if any vital issue arose. The railway companies were rapidly extending the use of telephones for signalling purposes; but he greatly wished to have telephonic communication between the principal railway stations and managers, so that, whatever necessity arose, the authorities could deal with it at once, and in a few minutes come to conclusions as easily as if they were all in a room together. In such a case, for instance, as moving troops suddenly and rapidly, such direct communication would be of immense value.

Replying to various questions by the members of the Committee, Mr. Forbes said he did not desire to override public authorities or the rights of the public, and he would give the Metropolitan Board of Works, and similar authorities, the power to make bye-laws subject to approval by the Board of Trade; but at present, living on sufferance, the company could not always get way-leaves—not even on the railways, for the railway companies had parted with their rights of way-leave to the Postmaster-General. They did that in a weak moment, but it would be rather too much for them to ask to be relieved from this disability, seeing that they were paid a sum of money in consideration of resigning their powers. The wires of telephones must for obvious reasons be put overhead; and then as to other facilities, he considered that the telephone companies must have facilities for making attachments, erecting poles, or crossing private property, they of course paying compensation for any damage done. He had come to the conclusion that for telephonic purposes it was absolutely necessary to have over-ground wires, and that if they were prohibited the telephone could not commercially be developed. One of the present complaints was as to the cost. No doubt in time, with greater simplicity in construction, appliances, and so on, the telephone would become cheaper, but owing to difficulties as to way-leave, the company had been obliged to erect eighteen points of exchange instead of one in London, and that by itself caused increased cost. There were not telephones to all the railway stations at present, but as he had said that it is very desirable to have that system, his two companies would be willing to have telephones between London and the principal stations in the country. There were some on the District Railway now, but some difficulty had arisen respecting them. The Postmaster-General had a right to object to way-leaves being given along that line, but in some way that right was lost sight of, and the Telephone Company was allowed to lay wires in a cable. The Postmaster-General, remembering his rights, did object, but he recognised the public importance of the matter and allowed the wires to remain. Then, however, the Metropolitan Company took some objection to the Postmaster-General giving this right, and the matter had been hung up until it was unearthed a few days ago. With regard to control, he should not care much which was the authority, but there must be one authority in London, and not thirty-eight different vestries, and an intelligible law reasonably exercised. The company ought to have a right to throw wires from one point to another, and if they paid for making attachments, it was difficult to say they should not pay something for crossing land. As to attachments, they ought to have some power of compulsion in the event of failing to make agreements, some penalty for abuse being provided. The power of compulsion could not be exercised without raising some objections, but

COMPOUND ENGINES OF THE S.S. MONA.

MESSRS. C. BURRELL AND SONS, THETFORD, ENGINEERS.

(*For description see page 279.*)



individual caprice could not be allowed to operate to the detriment of the public in regard to something admittedly of public utility and value. Compensation should be made for injury or inconvenience to occupiers and not to owners not in occupation: an agreement with an occupier should be limited to the term of the tenancy, and finally he would be willing to pay a nominal sum for permission to run wires over land.

Mr. Winterbotham, solicitor to the United Telephone Company, gave some particulars as to the statutory aspect of the subject, and pointed out that a lengthy notice, such as was required under the Telegraph Act of 1863, would be quite inapplicable to telephones, and even a notice of a month would seriously interfere with the development of the system. He agreed generally with Mr. Forbes as to the increasing importance of the telephone and the necessity for more facilities, and expressed the opinion that there was a general agreement that companies ought to be empowered to run wires from point to point over intervening property without being obliged to get the consent of the owner, subject to making compensation for any damage done. The telephone companies proposed that they should be restricted from going within a certain limit of a roof, and that if the owners required at any future time to use the property in a way with which the wire would interfere, then they should be obliged to remove the wire. They claimed the right to pass over property, subject to regulations and restrictions similar to those on the Postmaster-General in regard to passing along or under roads. At any rate, they ought to have some power of overriding factious opposition. With regard to the making of bye-laws, in most towns there was one municipal authority. In London that was not so; but there must be one authority for this purpose, unless the bye-laws of various bodies were identical. One authority was necessary for the sake of uniformity, rapidity, and other important considerations.

After this evidence, the Committee adjourned until April 16th—a week after the day on which Parliament reassembles.

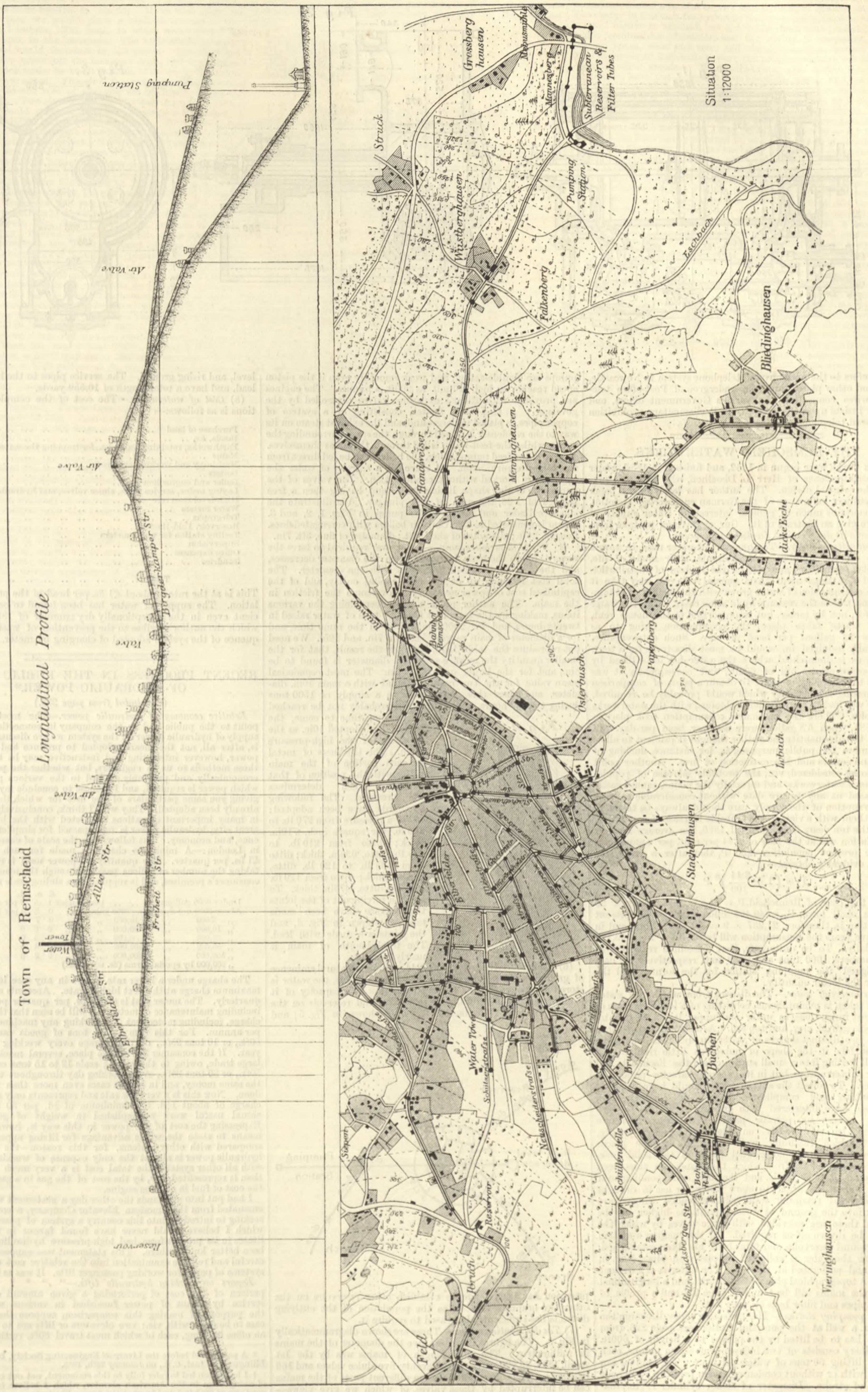
In connection with this subject, it is interesting to notice that at a meeting of the City Commissioners of Sewers, on Tuesday, it was referred to the Finance and Improvement and Streets Committee to examine and inquire into the acquired rights or assumed powers of the telephone companies to run their wires over the houses and streets within the jurisdiction of the Court, and the correspondence between the companies and the Postmaster-General was also referred to them. The solicitor was instructed to report on legal and other rights of the Telephone Company so far as they may affect the Court and the public. The Commissioners were empowered to proceed to Paris to inspect the system of underground wires.

As frequent reference has been made during the inquiry now proceeding by the Select Committee, and in the extra-parliamentary controversy respecting telephone and telegraph wires, to the Bill promoted by the United Telephone Company to provide that company with additional facilities for telephonic communication, a summary of the provisions of this measure will probably be of interest. The Bill contains in all twenty clauses, but, of course, a number of these are not enacting, but merely declaratory and defining clauses. The first of the enacting clauses (6) proposes to provide that the company may, after giving certain prescribed notices and obtaining certain consents, (1) suspend, place, and maintain a telephone wire over, along, or across any land or road, and may alter or remove the same; (2) place and maintain posts in or upon any land or road, and may alter and remove the same; and (3) may place and maintain a telephone wire under any land or road, and alter and remove the same, provided, in all these cases, that the company shall not thereby be deemed to acquire any right other than that of user in the soil, and shall make full compensation for any and all damage done. Clause 7 provides that in carrying out these works under Clause 6, with regard to wires, the company shall not, without the consent of the owner or occupier, place a telephone wire over any land at a less height above the ground than 15ft., or over any building at a less height above the roof than 3ft.; and shall not place a telephone wire over, along, or across any road at a less height from the surface of such road or way than 15ft., without having, in the first place, obtained the consent of the road authority or other person. The 8th clause further provides that the company shall not place any post or telephone wire in or upon or under any land without the consent of the occupier, or—failing an occupier—of the lessee or owner; that the consent of an occupier shall operate only during his occupancy; that at the end of an occupancy the owner or lessee shall have power to require the company to remove such wire; and that any dispute as to such removal shall be referred to and decided by two justices of the peace. With regard to the opening of any road for placing or removing a wire, there are numerous restrictions provided—Clause 9—to insure the work being properly executed, under proper supervision, and without more than absolutely necessary inconvenience to the public; Clause 10 preserves the rights of owners of land to require the removal of wires if they desire to use the land for building or any other purpose with which the wires would interfere; and the next clause (11) proposes to enact that:—In every case where the company has suspended or carried a telephone wire over, along, or across any land or road, the Local Government Board shall, upon credible information being given them that any such wire is, or is likely to become, dangerous to the public safety, make an inquiry into and inspect the condition of the telephone wire complained of, and make such order with respect thereto, and upon such terms as may seem to be necessary and expedient in the public interest under the circumstances of the case, and the Board may of their own motion, and without receiving any such information, from time to time after twenty-four hours' notice to the company, proceed to inspect, test, and examine and inquire into the state of repair and condition of any telephone wires or posts to which such notice shall refer, and may make such order as to the removal, repair, or alteration of any such telephone wires or posts as shall seem to the Board necessary for the protection of the public. The next five clauses deal with powers to the Local Government Board to make rules to prevent danger from the company's works; the liability of the company for damage done; the exemption of the company's wires and appliances from distress, and with penalties for injury to the company's wires and apparatus. Clause 17 exempts Crown lands and property from the powers conferred by the Act, except under express permission from the Crown authorities; and by Clause 18 it is laid down that "nothing in this Act shall prejudice or diminish, or in any way vary the rights, the privileges, and authorities of the Postmaster-General, under or by virtue of the indenture between the Postmaster-General and the Company, dated November 29th, 1884, or shall authorise any work to be laid, erected or done, which would prejudicially affect any pipe, tube, wire, post, or apparatus belonging to or under the control of the Postmaster-General; and if the Postmaster-General is of the opinion that the exercise of their powers by the company will be in contravention of this section in any respect, he may by notice require the company or any road authority exercising the powers of this Act to take such steps as may in his opinion be necessary to prevent such contravention; and if any difference shall arise between the Postmaster-General and the company, or such local authority, with reference to any such requirement, the same shall be referred and determined subject and according to the provisions of sections 4 and 5 of the Telegraph Act, 1878; and section 12 of the Telegraph Act, 1878, shall apply to notices under this section." The last two clauses refer only to the payment of costs in obtaining and in carrying out the Act.

According to the clauses here set out it would seem that the rights and interests of private persons, the privileges of the Crown, and the convenience and welfare of the public are well guarded, while large new powers are provided for the promoting company; but upon these points no doubt many other parties may have something to say when the Bill comes before a Committee. For example, a sort of "counterblast" has already been published and circulated by Messrs. Unwin Brothers, of Ludgate-hill, among the members of the Select Committee now sitting and others interested in the subject, in the form of a pamphlet, entitled "Overhead Telephone Wires." This *brochure*, while dealing generally with the question indicated in the title, is specially directed against the United Telephone Company, which it describes as "one of the chief offenders," and the Bill summarised above, which it says may be designated "a Bill to relieve the United Telephone Company from the necessity of paying for the rights which it acquires over other people's property.' Against such privilege the writer protests strongly, and cites the obligations and powers of railway and other companies as analogous of what must be done with regard to telephone companies, and after giving sundry reasons in support of his view, he combats the contention that this Bill is founded on the Telegraph Acts relating to the old telegraph companies. The "padding of the Bill," he says, "is founded on the Telegraph Act of 1863, but, he contends, none of those old Acts gave any power to place a single wire or post except with the previous consent of the owner, lessee, and occupier, or, in the case of streets, of the local authority;" "and the power to do these things without any consent is the very essence of this Bill." On this point our readers may form their own opinion from the *résumé* we have given of the Bill. The writer further seeks to derive a lesson, as against these proposals, from the result of the "bargains" made by Parliament with the water and gas companies, which he argues have been abused, and have proved disastrous to the public; and to show "the spirit by which this company is actuated," he quotes the agreement under which the company now requires every subscriber, amongst other things, "to permit the company, its agents, and workmen to have access at all times to his premises, and to every other place under his control, through or over which any part of the said wire or apparatus passes," and "to give every facility in his power in the way of poles, attachments, &c., to the company for running his own wire, and also those of other subscribers, to the company's system, whether exchange or private." Finally, the anonymous

THE REMSCHEID WATERWORKS.—PLAN AND PROFILE OF SUPPLY AREA.

(For description see page 288.)



REMSCHEID WATERWORKS—DETAILS OF PUMPING ENGINES.

Fig 1.

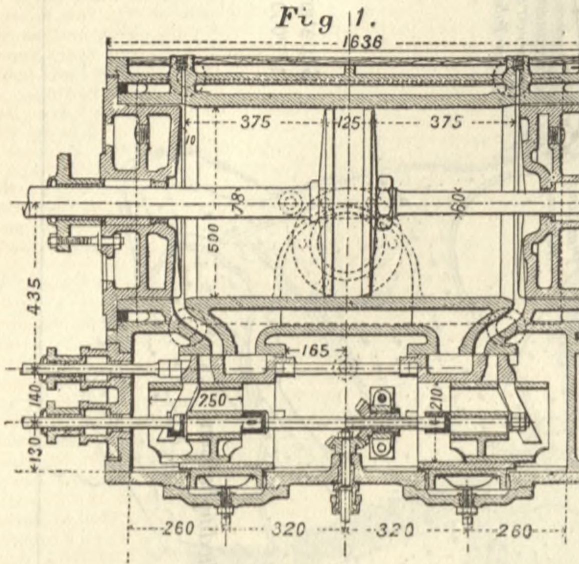


Fig 2.

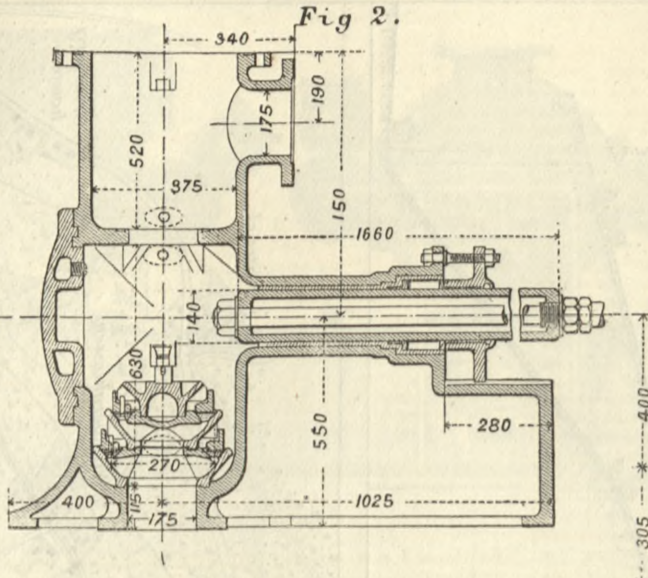
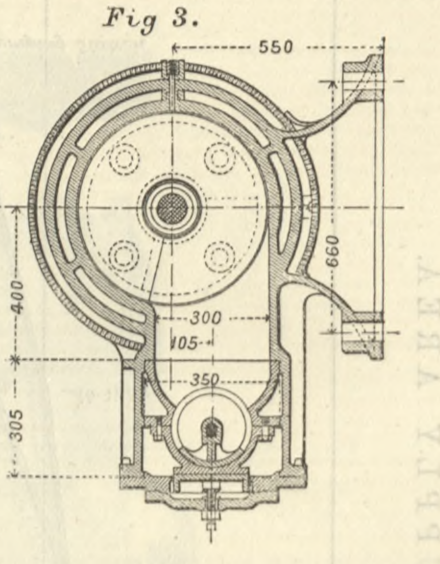


Fig 3.



writer refers to the underground telephone system in Newcastle, Paris, and other places, and the underground Post-office telephone wires connecting the various Government offices, and strongly insists upon the necessity of Parliamentary prohibition of overhead telephone or other wires.

THE REMSCHEID WATERWORKS.

THESE works were begun in 1882, and finished in 1883, under the superintendence of Herr L. Disselhoff, who had also prepared the original design. The author has lately read a paper on this subject before one of the German engineering societies. As this contains much of general interest on water supply of towns we give an abstract of it. Our engravings we take from the *Zeitschrift des Vereines Deutsche Ingenieure.*

(1) *Quantity of water.*—The quantity of water used in towns depends on the number of inhabitants, their mode of life, prosperity, occupation, and also on the system of distribution and kind of fittings used. As a general rule, we may take it that the consumption of water grows with the facility of obtaining it, and this is the reason why in some cases, where the water is paid for, not by meter, but in proportion to the house rent, a great waste takes place—the consumption rising to as much as 22 gallons per head per day. Such extravagance, if generally indulged in, would be most disastrous for a town situated as is Remscheid, where the water has to be lifted by steam power over a hill of 600ft., and consequently it was resolved to charge by meter. To obtain a point of comparison for estimating the quantity which would probably be required, recourse was had to the experience obtained with the waterworks of Iserlohn. There the maximum consumption took place in June, 1881, when 6·8 gallons were used per head per day. In addition to this quantity the author thought it prudent to allow a third more for public purposes, as, for instance, flushing of streets and sewers and the extinction of fires. Another point must also be considered, viz., the probable increase of population. Since waterworks, and especially the mains, cannot easily be increased at any future date without considerable expense and interruption of the supply, care should always be taken to arrange them with a view to the probable increase of population. During the ten years from 1870 till 1880, the average increase of population was at the rate of 3·44 per cent. per annum. If P is the present population, and P_1 that after n years, the equation evidently obtains—

$$P_1 = \left(1 + \frac{3{\cdot}44}{100}\right)^n P$$

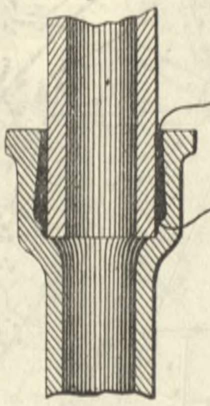
Now, in the case of Remscheid P = 21,237, and after n = 25 years we shall have P_1 = 49,466 inhabitants. The present consumption is, therefore, 21,237 × 9 = 191,133 gallons, and in twenty-five years the consumption will be 49,466 × 9 = 445,194 gallons daily. To be quite safe, Herr Disselhoff reckoned, in round numbers, 1000 tons and 2000 tons respectively per day, and designed the pumping station for the former and the mains for the latter quantity.

(2) *The source of water.*—The district from which the water has to be taken is mountainous, consisting of a lower stratum of slate almost impervious to water and upper layers of disintegrated rock, gravel, clay, and top soil. As a natural consequence there are two distinct sources of water supply. The one visible on the surface in the shape of numerous little rivulets and brooks, all feeding into a small stream called the Eschbach, and the other subterraneous, but in its general character parallel to the former. To collect the surface water would have required a far-reaching and complicated system of conduits, and would also have interfered with existing rights to the use of these waters by private parties. It was therefore determined to rely solely on the underground supply, to collect which retaining walls were in suitable places sunk into the ground and carried down to the solid rock. The width of the slope from which the water has thus been trapped is about 1000 yards, and the area corresponding to it $5\frac{1}{2}$ square miles. In order to store water for use in drought times, additional retaining walls with extended wings have been sunk into the ground at various positions higher up the valley, and these are provided with sluice valves by which the water can be drawn off as required. In this manner a system of underground reservoirs and filter beds has been established. From these the water is collected by cast iron pipes 10in. in diameter and perforated at the top. The water is of excellent quality. A topographical plan of the district and a longitudinal profile of the mains will be found on page 287 and a profile of collecting pipes and filter beds on page 244.

(3) *The pumping station.*—The collecting pipes discharge the water into a well at the pumping station, see page 226, from whence it has to be lifted by the pumps to a height of 600ft. The machinery consists of two independent steam pumps, each capable of lifting 50 tons of water per hour. The engines can be worked with or without condenser, steam pressure 75 lb., cut off at $\frac{1}{4}$th of stroke. Diameter of steam cylinder $19\frac{3}{4}$in.; diameter of pump plungers, $5\frac{7}{8}$in.; length of stroke, $29\frac{1}{2}$in. The pumps are double-acting, and work smoothly even if the piston speed reaches as high a limit as 200ft. a minute. The engines are provided with Rider's expansion valves controlled by the governor. A feed-water heater, consisting of a system of copper pipes, is placed underground, and the exhaust steam on its way to the condenser is passed through the space surrounding the tubes, whilst the feed-water is led through the tubes themselves. In case of the feed pump failing, the boilers can be fed direct from the high-pressure main. If there be a scarcity of water the engines are worked without condensation. The valves of the pumps are of ring shape, lifting 0·4in., and having then a free passage of 1·66, the area of the plunger. We illustrate the steam cylinder and part of the pump in Figs. 1, 2, and 3. Steam is generated in two Cornish boilers with corrugated flues. Length, 26ft.; diameter of shell, 6ft.; diameter of flue, 3ft. 7in.

(4) *The high-pressure main.*—The power required to force the water through the main increases when the diameter decreases, and the cost of the main increases with the diameter. The total cost is made up of the first capital outlay, and of the capitalised cost of power necessary to overcome the friction in the main. The author gives a table containing the various items, making up the total cost for 1000 tons of water raised in twenty hours, and for 2000 tons raised in the same time, and for a diameter of main varying between 7in. and 12in. We need not reproduce the table here, but note the result, that for the smaller quantity the most economical diameter is found to be 8in., and for the larger quantity 11in. The most economical mean value for the two cases is found with a main 10in. diameter, and since this corresponds to a supply of 1500 tons during twenty hours, which limit will probably not be reached

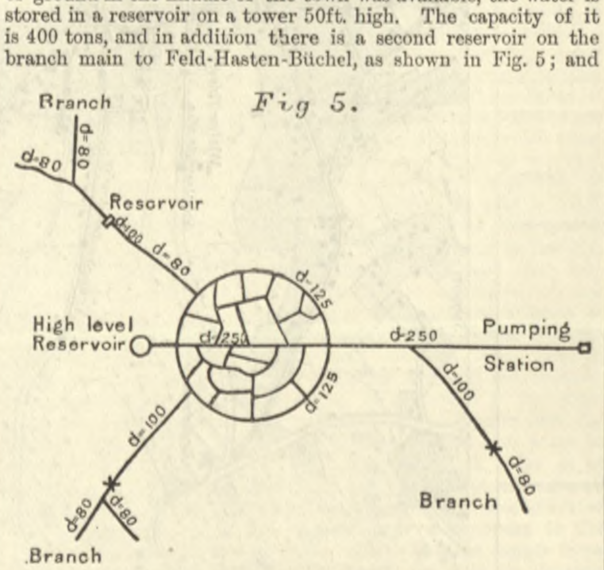
Fig 4.



for a long time to come, the author has adopted 10in. as the diameter of the high-pressure main. The thickness of metal in each portion of the main varies with the position of that portion which determines the pressure. The following standards have been adopted:—For a pressure from 270 lb. to 210 lb. per square inch, ·710in. thick; ditto from 210 lb. to 165 lb. ditto, ·630in. thick; ditto from 165 lb. to 120 lb. ditto, ·550in. thick; ditto from 120 lb. and less ditto, ·473in. thick. To avoid a forcing out of the joints the sockets have been made taper, as shown in Fig. 4, and the joints are made with lead. The total length of main is nearly $2\frac{1}{2}$ miles.

(6) *The high-level reservoir*, see p. 244.—Since no natural eminence of ground in the middle of the town was available, the water is stored in a reservoir on a tower 50ft. high. The capacity of it is 400 tons, and in addition there is a second reservoir on the branch main to Feld-Hasten-Büchel, as shown in Fig. 5; and

Fig 5.



provision has been made to establish other reservoirs on the other two branches as soon as the population of the outlying districts has sufficiently increased to require it.

(7) *The distributing mains.*—These are shown diagrammatically in Fig. 5. The figures inscribed give the diameter of the mains in millimetres. The total length of mains was by the 1st April, 1884, 29,000 yards, with seventy-five sluice valves and 166 hydrants. The connection between different parts of the mains can be interrupted by these valves, of which we give views—p. 226. Three different types are used, viz., for high level, low level, and rising ground. The service pipes to the houses are of lead, and have a total length of 10,550 yards.

(8) *Cost of waterworks.*—The cost of the complete installations is as follows:—

	£
Purchase of land	2,480
Roads, &c.	237
Earthworks, retaining walls, &c., for trapping the water ..	4,340
Mains	5,800
Machinery and working expenses	1,620
Boilers	770
Boiler and engine house	1,570
Laying mains, service pipes, sluice valves, and hydrants ..	7,660
High-level reservoir	2,130
Water meters	1,050
Telegraphs	188
Reservoir, Feld-Hasten	454
Testing station for water meters	63
Supervision	882
Office expenses	500
Sundries	113
Total	£29,857

This is at the rate of about £1 8s. per head of the present population. The supply of water has been found to be quite sufficient even in the exceptionally dry summer of 1884—a result which the author ascribes to the prevention of waste in consequence of the system adopted of charging by meter.

RECENT PROGRESS IN THE PUBLIC SUPPLY OF HYDRAULIC POWER.*

(*Concluded from page 233.*)

Relative economy of hydraulic power.—The most important point to the public and to the company in connection with the supply of hydraulic power on the system we are discussing to-night is, after all, not the means adopted to produce and convey the power, however interesting and instructive may be the study of these methods to us as engineers, but whether the power can be economically and profitably applied to the various purposes for which power is required, and I propose to conclude my remarks by giving you some particulars of the uses for which the power has already been adopted. They will, I think, conclusively show that in many important operations connected with the business of a great city, hydraulic power is unsurpassed for simplicity, convenience, and economy. The following is the scale of charges adopted in London:—A minimum charge is made for each machine of £1 5s. per quarter. The quantity of power used is registered by taking the number of gallons passing through the machine on the consumer's premises, and is supplied on a sliding scale as follows:—

					£	s.	d.	
Under 3000 gallons				per quarter	1	5	0	per machine.
Above 3000	not exceeding	5000 gals.		,,	0	8	0	per 1000 gals.
,, 5000	,,	10,000	,,	,,	0	7	0	,,
,, 10,000	,,	20,000	,,	,,	0	6	0	,,
,, 20,000	,,	50,000	,,	,,	0	5	0	,,
,, 50,000	,,	100,000	,,	,,	0	4	0	,,
,, 100,000	,,	200,000	,,	,,	0	3	0	,,
,, 200,000 by special terms (2s. 6d. to 2s.)								

The charge under a lower rate is not in any case less than the maximum charge at the next highest rate. Accounts are made up quarterly. The meter rent is about 5s. per quarter per machine, including maintenance of meter. It will be seen that the minimum charge, including meter rent for working any machine, is only £6 per annum. For this sum 4 to 5 tons of goods can be raised 50ft., or 10 tons 25ft., on the average every working day of the year. If the consumer has a large place, several machines, and a large trade, owing to the sliding scale 12 to 15 tons can be raised 50ft., or 30 tons 25ft., every working day throughout the year for the same money, and in certain cases even more than this can be done. Now this is a very low rate and represents only a maximum charge of about $1\frac{1}{2}$d. to a minimum of $\frac{3}{4}$d. per 50 foot-tons of actual useful work accomplished in weight of goods raised. Expressing the cost of the power in this way is, however, by no means to state the whole advantage for lifting apparatus when compared with other systems, for this reason—the cost of the hydraulic power is almost the only expense of working, whereas with all other systems the total cost is a very much larger sum than is represented, say, by the cost of the gas in a gas engine, or the cost of fuel in a steam engine.

I had put into my hands the other day a statement which I find emanated from the American Elevator Company, a company now seeking to introduce into this country a system of passenger lifts, which I believe would never have found favour in the United States in its present form had high-pressure hydraulic apparatus been better known there. This statement was supposed to be a careful and reliable examination into the relative cost of different systems of power for working passenger lifts. It was as follows:—†

Report on working hydraulic lifts.—" * * * * a comparison of the cost of performing a given amount of elevator service by means of power furnished in various ways. For the purpose of making this comparison, suppose the following case to be dealt with, viz.: two elevators or lifts are to be fixed in an office building, each of which must travel 80ft. vertically, must

* A paper read before the Liverpool Engineering Society, by Mr. E. B. Ellington, M. Inst. C.E., on January 28th, 1885.

† I have been led to refer fully to this statement, not out of any spirit of antagonism to the American elevator, which I believe to be a very good one of its kind, but because the figures illustrate an erroneous kind of reasoning which is very often adopted on this question.—E. B. E.

carry a load of 18 passengers, must accomplish twenty complete journeys or trips per hour, and must work ten hours per day; that is to say, 7200 passengers could be carried 80ft. high per day, and 7200 passengers could be lowered per day, or in other words, 14,400 passengers to be handled in one day. If we were called to deal with this case we would place a tank at the top of the building, giving, I assume, 100ft. head, to which water would be pumped from a tank in the basement. The hydrostatic pressure due to 100ft. head would therefore be the power. The elevators would exhaust the water into the basement tank, and the pumps would pump it back again to the top tank, thus using the same water over and over again. Therefore the cost of working the two elevators would be the cost of pumping the required quantity of water 100ft. high. Two elevators doing the said amount of work by our system would make it necessary to pump 200 gallons of water per minute 100ft. high = 7·3-horse power. This to be done 10 hours=1 day. Now, compare various ways of doing the required pumping of 200 gallons per minute, 100ft. high, 10 hours per day. (1) Operate the pump by a 6-horse power gas engine. Then using 20ft. of gas per indicated horse-power per hour, the consumption would be 2314ft. at 3s.=6s. 11d. (2) Use a Worthington steam pump, which would require 876 lb. coal at 18s. per ton=7s.; or a compound pump, 584 lb. coal at 18s. per ton=4s. 8d. (3) Instead of using either steam or gas engine, work the pump by the hydraulic pressure laid on by the Hydraulic Power Company, then pump 5½in. plunger; 10in. stroke; speed, 80ft. per minute; area of plunger, 56·75in.; hydraulic pressure, 43·5 lb. per square inch. Total hydraulic pressure, say, 2468; one-third frictional loss, say, 822=3290 lb. Taking Power Company's pressure at 700 lb. per square inch, this would require piston area of 4·7in., and this doing the above duty would use 9764 gallons per day at 2s. 6d.=£1 4s. 5d. Suppose you use patent balance ram lifts, so perfectly balanced, that you lift only the load + frictional allowance of 33⅓ per cent., then required power is 4050 lb.; for frictional loss of 33⅓ per cent. is 1350 lb.; making required load of eighteen passengers, or 2700 lb. Pressure being 700 lb., required area of ram is 5·8in. = diameter 2¾in., but we suppose a ram not smaller than 3in. would be used for 80ft. rise. Then 3in. ram = area 7·07in. × length 960in. = 6787·2 cubic inches = 24·47 gallons × 200 trips per day = 4984 gallons × two lifts = 9788 gallons at 2s. 6d. per 1000 gallons = £1 4s. 6d.* Suppose we adapt standard hydraulic elevator to take power direct from power company. The load = 2700 lb., gear = 4 : 1 frictional loss of 50 per cent. 2700 × 4 = 10,800 + 5400 = 16,200 lb. power required. Power Company's pressure of 700 lb. requires piston area of 23·14in. Therefore required 5½in. cylinder, gallons per trip, 20·566 × 400 trips per day = 8226·4 gallons at 2s. 6d. = £1 0s. 7d."

A statement of this sort is really very misleading. On pointing this out to Mr. Gibson, the president of the American company, he informed me that the report was accompanied by a statement that of course the comparison excluded the element of superintendence, which he estimated at 5s. per day. Now I make the relative cost, under ordinary circumstances, in the case assumed by the American company, on the basis of equal efficiency in the lift, as follows:—

I.—Work done.—Taking the particulars given in the report, 200 gallons required to be pumped 100ft. per minute = 200,000 foot-pounds of useful work, or 6-horse power. This actual effective horse-power makes no allowance for friction in pipes or loss in the driving apparatus or pumps. Eighteen passengers are taken as being equal to 2700 lb. Work done for each complete journey: 300 gallons 100ft. = 300,000 foot-pounds of work. 2700 lb. raised 80ft. high = 216,000 foot-pounds of work. The efficiency of the assumed lifts is, therefore, say, 70 per cent.

II.—Cost of pumping.—(1) The gas engine proposed is 6-horse power, but this is wanted in water pumped, and allowing for loss in pumps, driving gear, and pipes, 9 brake horse-power must be provided; 20ft. of gas being the amount used per indicated horse-power, 30ft. at least will be used for brake horse-power, 9 × 30 × 10 = 2700 cubic feet at 3s. = 8s. 1d. cost of gas per day. This is, however, but a small portion of the total cost. Take the cost over twelve months:—

Five complete days per week × 52 = ...	260
One half-day per week × 52	26
	286
Less four Bank Holidays, Good Friday, and Christmas Day	6
Full working days	280

Then—

	£	s.	d.
Gas bill, say	113	0	0
Oil and waste used on gas engine and driving gear ..	15	0	0
Water to make up waste, &c.	5	0	0
Value of space occupied by machinery, 20ft. by 10ft. × 2s.	20	0	0
Wages of mechanic in attendance, 30s. per week ..	78	0	0
Wear and tear, and depreciation and interest on engines, pumps, tanks, and pipes, foundations, and other structural work for same, say £600 at 15 per cent.†	90	0	0
	£321	0	0

Divide by 280 working days = £1 3s. per day.

If duplicate pumping plant is provided, the items for rent and depreciation will be increased by say £10 and £40 respectively, raising the cost to £1 6s. 6d. per working day.

(2) *Using steam power.*—I will take the coal bill at the moderate estimate of two tons of coal, &c., per week, say—

	£	s.	d.
100 tons per annum at 18s.	90	0	0
Waste, oil, &c., used	15	0	0
Water used	10	0	0
Value of space occupied by engine, boiler, and coals, 20ft. by 10ft., at 2s.	20	0	0
Wages of mechanic, at 30s. per week	78	0	0
Wear and tear, depreciation and interest on boilers, pumps, tanks, and foundations and structural work, £600 at 15 per cent.	90	0	0
Extra outlay in enclosing boilers in fireproof building, £200 at 7½ per cent. (if this is not done charge for extra fire insurance)	15	0	0
	318	0	0

Divide by 280 working days = £1 2s. 9d. per day.

If duplicate pumping plant is provided as before, £1 6s. 3d. per day.

(3) *Using hydraulic power to pump.*—This is a method which can only be considered advisable in place of altering existing low-pressure machinery, and is not an economical way of using the power for working lifts. A good hydraulic pump will work with 80 per cent. of efficiency. Work required, 200 gallons 100ft. per minute = 200,000 foot pounds, or 250,000 lb. at 80 per cent. efficiency, divided by 1600ft. head, or 700 lb. pressure water = 9360 gallons per day of 10 hours for 280 days per year:—

	£	s.	d.
Annual charge for power (500,000 gallons and upwards per quarter are charged at 2s. per 1000 gallons).. ..	262	0	0
Oil, &c., used	5	0	0
Space occupied, 10ft. by 10ft., at 2s.	10	0	0
Wages of superintendent	15	0	0
Wear and tear, depreciation on pump, tank, pipes and foundations, £300 at 10 per cent.‡	30	0	0
	322	0	0

Divide by 280 working days = £1 3s. per day.

If duplicate plant is provided, the cost will be increased to £1 4s. 4d. per day.

(4) Using patent hydraulic balance lift, giving the same efficiency as the lifts first considered, or 70 per cent., or 200,000 foot-pounds of work per minute = 7500 gallons per day for 280 working days:—

	£	s.	d.
Annual charge	210	0	0
Oil, &c., for machinery outside lift	0	0	0
Space occupied ,, ,, ...	0	0	0
Wages and superintendence ,, ...	0	0	0
Wear and tear, and depreciation, &c., on £20 (cost of service pipe)	2	0	0
	212	0	0

Divide by 280 working days = 15s. 2d. per day.

Duplicate supply provided by company by laying on a second service raises the cost to 15s. 4d. per day.

(5) Using standard or other multiplying rope or chain lifts with hydraulic power direct pressure, also giving 70 per cent. efficiency, same cost of power as above, viz., 15s. 2d. and 15s. 4d. per day.

I have assumed in all cases that the efficiency of the lifts is the same; the difference between properly balanced lifts of different construction is not due to theoretical efficiency, but to practical manufacture and good design, and the special type to be selected is more generally a question of safety and convenience than of relative economy.

SUMMARY.

	£	s.	d.
A. Hydraulic power supply directly applied*, per average day	0	15	4
B. Ditto, through pumps and tanks, per average day	1	4	6
C. Steam pumping plant	1	6	3
D. Gas pumping plant	1	6	6

Even this is an unfair comparison for the hydraulic power, for the particular case contemplated is one of which there is, I believe, no instance in London. There is hardly a single office passenger lift which makes 200 journeys a day to a height of 80ft. An extreme case is that of two lifts travelling an average height of 50ft., making 200 journeys per day of ten hours; and if such lifts are taken instead of the altogether outside case on which the former calculations are based, the comparison is still more in favour of the Public Hydraulic Power, as it would be also in the case of a West-end lift, working eighteen hours a day, double shifts of men having to be employed. Taking an average height of 50ft. per journey instead of 80ft., all other particulars being the same, the comparison of the various systems is as follows:—

	£	s.	d.
A. Hydraulic power supply used direct, per average working day	0	12	0
B. Hydraulic power supply used indirectly per average working day	1	0	3
C. Steam engines and pump, per average working day	1	3	6
D. Gas engines and pump, per average working day	1	3	6

The average cost of power for working a well-constructed passenger lift from the power mains is only £80 per annum—lifts being very seldom constructed to carry more than 15 cwt. = 10 or 12 persons. The most efficient lifts are generally admitted to be those at work on the high-pressure system. If such lifts are used, and comparison made between private pumping plant, with those parts liable to derangement in duplicate so as to give in all respects equal facilities for working, it will, in most cases, be found that the hydraulic power costs little more, and sometimes less, than the interest, wear and tear, and depreciation on the first outlay that may be saved, and the charges are almost always less than the bare working expenses of private plant. Any money, therefore, spent on private pumping machinery is wasted, and if paid for the public power instead would enable the lifts to be worked for several years without any cost at all. Such calculations as those submitted by Mr. Gibson, apart from other errors, omit from consideration the most important items of cost where pumping machinery is used, whereas the Hydraulic Company's charge is practically the sole charge.† Moreover, it may be taken for granted that the public will willingly pay more for the direct hydraulic power than for either gas or steam, or re-pumped low pressure water, as, apart from cost, it is so desirable to get rid, where possible, of all machinery, and consequent noise, dirt, and general inconvenience. At the same time the scale of charges adopted for the power is so low that in almost all cases of lifting machinery it is cheapest, apart from the other advantages of using the public supply. There may be special cases in which the economy is not in favour of the Public Hydraulic Supply; but these cases are very rare, and I have not yet come across any building, large or small, in London, where any lifting had to be done, in which the hydraulic power as supplied by the company, with machinery specially adapted for its use, was not the most economical power. I have also found numerous cases in which considerations of economy in cost of power were secondary, the main question being to obtain machinery occupying little space, rapid in action, and being no nuisance to neighbours or owners, either by reason of smell, noise, vibration, or heat and risk of fire. Then I would add another word about such comparative calculations as I have mentioned. They are estimates only. When an hydraulic crane or hoist is made, it is a very difficult thing to use much more power than ought to be used. Every hydraulic machine may be considered as a water power meter in itself. But with steam engines or gas engines the consumption of coals or gas is a very variable quantity. One set of lifts about to be worked from the power mains in London for £200 per annum now cost, I have been informed, about the same sum for gas alone. Sir Frederick Bramwell, F.R.S., in his recent inaugural address as President of the Institution of Civil Engineers, mentioned that out of six tests of steam engines of various powers taken at random working in Birmingham, the coal consumption per I.H.P. amounted to from 9½ to 27 lb., and the average was about 18 lb. We have found in Hull, where steam is supplied by the Hydraulic Company to a few consumers, that, applied to pumping high-pressure water into the mains and used hydraulically, the same amount of steam will produce four times as much revenue to the company as if applied to work steam engines. When the steam engine and boiler are once obtained, waste of coal is not felt much by the ordinary small consumer, but if the steam is supplied and charged for by meter, only a very low rate can be paid by the consumer to compete with his own production, owing to his wasteful use of what is supplied. This is well illustrated by a comparison of the charges proposed in Birmingham for supplying power by compressed air with the charges for hydraulic power in London.

Actual results obtained in London.—In London this question of relative economy and advantage has been settled in favour of the public hydraulic power in the first year of its supply. There were a few machines at work before the end of 1883, but the main engines were only started in the autumn of that year, and serious work did not begin until December, 1883. The number of machines working from the mains in January, 1884, was thirty-one. The number at present is 155, and the number contracted to be supplied is considerably over 200.‡ This is a far more rapid result than we had anticipated, but its full significance is only to be realised by taking into account the various purposes for which the power is used, and its relation to previous systems in use. I should say that so far there has been no attempt to supply the power on any large scale for continuous driving of machinery. I look upon this as a future development of such undertakings when the improvements being effected in high-pressure and variable power rotary hydraulic machinery have been perfected. In one well-established instance it has been shown to be practicable and economical, and the hydraulic system was adopted after a careful inquiry into the cost of gas and steam. The charge in this case for hydraulic power was recognised as being in itself higher in amount, but the trade dealt with materials of highly combustible character, and the saving of insurance, the reduced space, wear and tear, and the convenience, turned the scale in favour of hydraulic power; the proprietors have not at all regretted their decision. Many consumers, after a few months' experience, have put down further hydraulic plant, and, as you will have noticed from the particulars I have given, every known system of power has been already superseded by the public hydraulic system, notwithstanding the cost of the alterations. In case it may be thought that special inducements have been held out to secure such test cases, I may perhaps be allowed to say that the scale has been rigidly adhered to, and considerable amounts in addition to the current charges are being paid for the extension of mains to buildings situated at such distances from the existing mains as without such additional charges would make the return on the capital expended unremunerative for single consumers. That the rate of charge for the power from the point of view of the public is not excessive is thus shown, and that the power can be remuneratively supplied at these rates is proved by the fact that the company is already working at a profit. Notwithstanding the regular increase of the number of machines at work during the autumn and early winter, there was no increase in the consumption to speak of, while the general irregularities of supply are by no means so marked as in Hull. The largest business in the city of London is done in the early spring and autumn, but as the trades are more varied than in Hull, the irregularities are not so great. The full effect of the large increase in the number of machines will not be seen until about six weeks from the present time, when I confidently anticipate a considerable increase in the demand on the mains. To meet the expected demand a third set of pumping engines has been erected at Falcon Wharf.* The inference I draw from this is—if, after all averaging elements in a public supply of power are taken into account, there is still this great variation in the supply, how great must be the waste, when each user of power is his own producer, and how misleading are figures based on such machinery being used up to the maximum during the whole year, such as so much cost per day, or so much per horse-power per hour. Such machinery as I am referring to is never worked up to its maximum capacity for any length of time. One word as to electric lighting in this connection. We are making experiments for using the power for this purpose. I am confident that the power will be largely so used, but when it is considered that in places of business the ordinary number of hours in which the electric light is needed does not exceed 400 or 500 hours in the year, it will easily be seen how very important an element in the production of the power is the cost of the machinery used, and the rent of the space occupied by it. In fact, storage of some kind seems to be an essential to economy. If storage is used, hydraulic power can be applied at present without difficulty and cheaply by the use of hydraulic engines to drive the dynamos. For continuous use the hydraulic power can be very cheaply supplied, probably as cheaply as gas, and with a much more certain cost, but for electric lighting involving the use of large amounts of power at very infrequent intervals, as in the city of London, it will be found that rates as high as 6d. per horse-power per hour of actual work would have to be charged, and in many cases could be profitably given. The paper was illustrated by a number of diagrams and models

* The figures relating to hydraulic balance ram lifts are incorrect, being founded on a misconception of the arrangement. See my paper on "Hydraulic Lifts for Passengers and Goods," "Proceedings" Inst. Mechanical Engineers, 1882. The economy of different classes of lifts is an entirely distinct question from the relative cost of various kinds of power.—E. B. E.

† 15 per cent. will not be found too high to cover all repairs and interest at 5 per cent. only, when machinery of this character is working to its full capacity.—E. B. E.

‡ 10 per cent. is taken in this case because the proportion of machinery is much less than with gas or steam, and its durability much greater.—E. B. E.

* The power can be applied direct to either ram or suspended lifts.—E. B. E.

† They assume also that the machine is worked constantly to its maximum capacity. This is never the case even for a single week, much less over twelve months. The cost of the public power is reduced in proportion to the diminished use—not so the cost of working private pumping plant.—E. B. E.

‡ The normal rate of increase has been from two to three per week since the commencement of supply.—E. B. E.

* These anticipations have been realised, as will be seen from the subjoined record of the work done in the first quarter of the current year.—E. B. E.

Date.		Gallons pumped per week.	No. of machines connected.
Jan.	4th	419,702	—
,,	7th	—	145
,,	11th	471,125	—
,,	18th	494,832	—
,,	21st	—	152
,,	25th	517,368	—
Feb.	1st	514,579	—
,,	4th	—	154
,,	8th	506,698	—
,,	15th	543,945	—
,,	18th	—	161
,,	22nd	495,567	—
March	1st	551,640	—
,,	4th	—	163
,,	8th	528,185	—
,,	15th	526,123	—
,,	18th	—	168
,,	22nd	552,624	—
,,	29th	572,756	—
April	1st	—	178

Total quantity pumped	6,695,144	gallons.
,, accounted for	5,636,400	,,
,, not accounted for	958,744	,,

EREСTION OF A CONCRETE BRIDGE IN ONE DAY.—The firm of Zurlinden and Co., of Aarau, having constructed a canal in connection with their works about two-thirds of a mile in length, were obliged by the town authorities to bridge it in two places. This they did by means of segmental arches of cement concrete, constructed to the designs of Professor Tetmajer, of Zurich. The dimensions of the arches—Proc. Inst. C.E.—are:—Span, 39ft. 4in.; rise, 6ft. 6¾in.; thickness at crown, 1ft. 7¾in.; thickness at abutment, 3ft. 3½in.; thickness of abutments, 9ft. 10in.; width of roadway, 13ft. 1½in. The foundation of both abutments is on fairly good gravel, at a depth of about 5ft. below the springing. Spandril walls are carried up to the level of the roadway, and surmounted by an iron hand rail, the space between the spandril walls being filled in with gravel covered with ordinary road metalling. The total weight of the structure between the abutments is 194 tons, or, including a live load of 300 kilogs. per square metre—61·5 lb. per square foot—211 tons. The first bridge was erected in two days in June, 1884, the two abutments being formed on the first, and the arch and spandril walls on the second day. The bridge was brought into use after standing for about two months, and has been in constant service ever since for heavy-wheeled traffic without any sign of settlement or cracking. On the 9th of October the second bridge was completed between 6 a.m. and 6 p.m. by sixty-five men. The concrete was mixed in accordance with the recommendation of Professor Tetmajer, as follows:—The cement and sand were first mixed dry, then the gravel added, water being gradually added during the mixing in such quantities that when the punning of the concrete was completed a thin film of water showed upon the surface. The concrete was mixed as follows:—

	Cement vol.	Sand vol.	Gravel vol.	Pounds of cement per cubic yard of concrete.
Abutments	1	3	7	337·2
Arch	1	2	4	505·8
Spandrils	1	2	6	421·5

The cost of such a bridge is given as—

	£	s.	d
Excavation 50 cubic metres (65 cubic yards) at 10d. ..	2	1	8
Concrete, including centreing, &c., 80 cubic metres (104 cubic yards) at 25s.	100	0	0
Filling-in over arch, forming road	8	6	8
Iron hand railing	10	8	4
	120	16	8

AMERICAN NOTES.

(*From our own Correspondent.*)

New York, March 27th.

The placing of orders on European account because of actual and threatened hostilities in remote Eastern countries is creating some expectation among the commercial and manufacturing interests as to the probable heavy demand. One Pennsylvania mill has just been started on a heavy order for armour-plates. One large concern started up manufacturing pumps; two or three others boats. One Chicago concern has received an order for 5,000,000 lb. of meat, and it is understood that several orders for merchandise of one kind or another are about being placed here on export account. The lumber interests are also looking forward to an improving demand in the event of European hostilities, because of the known fact that much of the British lumber supply would be therefore cut off. The American markets are in great need of an outside demand, and have every necessary facility for meeting a very large demand without affecting prices materially. The spring trade is at hand, and a better feeling prevails in all commercial circles. Agents for southern furnaces are pushing negotiations for crude iron on favourable terms to buyers, and large contracts will be placed during April. Pennsylvania companies are shading prices slightly where large orders are wanted, but at present standard irons are selling at 17 dols. to 18 dols. for foundry, and 15 dols. to 15.50 dols. for forge at tide water.

In view of the uncertainties as to the summer demand a great many requirements are being held back. Steel is steadily gaining on iron, and to-day's reports from the interior show that a great deal of iron making capacity is very scantily supplied with orders. Iron and steel nails are in active demand. Large orders for steel rails are in negotiation for 26 dols. to 27 dols. Old material is in active request, but the prices are above buyers' views. Small arrivals of foreign iron are to be noted, and until freight rates are more favourable business will be light. The volume of business, as reported by the Clearing House Association, shows a little improvement this week as against last. The labour troubles are quieting down, and no serious disturbances are probable excepting in the Western iron trade. The steel mills are satisfactorily engaged.

In Western Pennsylvania a strike of 10,000 miners is in progress, and a coal famine is threatened notwithstanding the utilisation of natural gas in that locality. The miners of Western Pennsylvania, Ohio, and West Virginia, numbering in all between three and four thousand, are endeavouring to agree upon uniform rates for mining in order that the employers may be deprived of the advantages heretofore possessed to work one region against another; all previous efforts in that direction have failed.

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

(*From our own Correspondent.*)

The April quarterly meetings this week have been but tame as regards the amount of business transacted. The attendances have been good, embracing merchants, iron and steel masters, colliery owners, agents, and other traders from nearly all parts of the kingdom. But the occurrence of the gatherings in the middle of a holiday week has been a disadvantage. The tone has been distinctly quiet, and sellers have preponderated over buyers. In no direction have prices shown any tendency to increased strength.

Consumers have declined to operate far forward, and merchants have not seemed to have many shipping orders to place at any price. Still in some directions a moderate amount of selling has taken place, and more contracts will doubtless be booked in the ensuing two or three weeks.

At Wolverhampton yesterday—Wednesday—the Lilleshall Iron Company, Shropshire, redeclared former nominal quotations of 80s. for cold-blast pigs, and 60s. for hot blast, and this example was followed by the Staffordshire makers. The quotations, however, were only nominal. The competition of hematites imported from other districts prevents more than 55s. to 57s. 6d. being realised for hot blast qualities, and even at these figures sales are not by any means large. Hematites themselves were quoted 55s. for Barrow grey forge, 55s. for Tredegar No. 3, and 54s. for Tredegar No. 4. In actual business less money was occasionally accepted. Some local buyers said that they could purchase hematites, though not of the brands named, at 52s. 6d.

Medium and common quality pigs varied greatly in price. 42s. to 40s. was about the average for native second-class sorts, and 36s. 3d. to 35s. the average for third-class qualities, yet occasional sales of the last-named were talked of at less than 33s. The Spring Vale make was quoted at: Hydrates, 52s. 6d.; mine, 45s.; and common, 37s. 6d. The Willingsworth brand was quoted at 40s. By limiting the output native makers are doing their best to keep stocks from largely increasing.

Second-class pigs from Midland districts were in great supply. Northamptons were priced at 39s. to 40s. delivered to works, though I heard of sales at sensibly less. Derbyshires were quoted at 41s. to 42s., the Westbury—Wilts—brand at 41s., and North Stafford pigs at 42s.

The finished iron market was tame all round. In consequence of the holidays numbers of the works are this week standing. Marked bars were announced in Wolverhampton, as I last week intimated was likely, without alteration for the new quarter, upon the basis of £8 2s. 6d. for the Earl of Dudley's make, and £7 10s. nominal for those of the other "list" houses, who are now very few in number.

The list of William Barrows and Sons stands as £7 10s. for bars, £9 for best, and £10 for double best. Best chain bars are £9; best plating bars, £9 10s.; best angle and tee iron, £9 10s.; best chain bars, £10; ordinary plating bars, £8; and double best swarf rivet iron, £10 10s. Hoops, from 14 to 18 w.g., are £8; best hoops, £9 10s.; best matched slit rods, £9 10s.; second best, £8 15s.; double best charcoal slit horse nail rods, £16 10s.; and double best rolled ditto, £18. Strip, fender, and plough plates, to 14 w.g., are £9; and best ditto, £10 10s.

Boiler plates the same firm quote as:—Ordinary, £9; best, £10; double best, £11; treble best, £12; extra treble best, £15; and best charcoal, £19 5s. Sheets to 20 w.g. are nominally £9; 21 to 24 g., £10; and 25 to 27 g., £12.

Messrs. N. Hingley and Sons' bars are quoted:—Netherton crown best, £7 10s.; Netherton crown best horseshoe, £7 10s.; best rivet, £8; double best plating, £9; double best crown Netherton, £8 10s.; treble best crown Netherton, £9 10s. These bars applied to rounds and squares ½in. to 3in., and flat bars 1in. to 6in. Angles were 10s. per ton extra, and tees 20s. per ton extra.

Capital branded bars for export were to be had from first-class firms at £6 10s. Medium bars were abundant at £6, while common were £5 10s. down to £5 5s. Common hoops were £5 15s. down to £5 10s. Sheets had a wide range of prices, and makers of ordinary merchant and galvanising sorts complained of the low rates which in many cases they are compelled to accept in order to get business. Merchant singles were £6 10s. per ton upwards, galvanising doubles were £7 to £7 5s., and lattens £8 to £8 5s. Makers of stamping and working-up sheets were in a position to command firmer prices than most people. Certain of them are experiencing a good American, colonial, and continental demand. Competition is also less severe in this branch than some other branches. Working-up qualities were quoted £10 to £11; stamping sorts, £12 to £13; and best sorts, £15 per ton.

There is a pretty good business being done in respect of shoe and tire iron. Actual orders are limited in angle and tee iron, but inquiries are coming in with some regularity. The bridge and girder works are good customers in this branch. Channel bars have lately shown more numerous inquiries.

Boiler plates are in dull sale, and the mills are very irregularly employed. Messrs. E. T. Wright and Sons quote for the new quarter their "Wright" qualities as:—Boiler plates, £8 and upwards; sheets, singles, £7; doubles, £7 10s.; lattens, £8 10s.; hoops, £6 5s. per ton. Their "Monmoor" boiler plates are £8 10s.; Monmoor singles, £7 10s.; and Monmoor hoops, £6 15s. per ton.

The galvanised corrugated sheet trade is not active, and makers are on only partial production. It is as to prices rather than demand that complaints continue loudest; £11 10s. is this week quoted as a fair average for 24 gauge bundled delivered Liverpool, £13 10s. for 26 gauge, and £15 10s. for 28 gauge, but these figures are higher than are being generally got.

At Birmingham to-day the prices announced in Wolverhampton were confirmed in every particular. The market was much unsettled by the news of the outbreak of war, and the telegrams were eagerly scanned. The effect was to render sellers cautious and slightly firmer in price, and buyers were unable to secure the acceptance of far forward offers. Generally speaking, however, there was but little business offering. Marked bar makers reported trade never before so quiet.

The coal trade does not improve. Yet the colliery owners upon Cannock Chase have for the present decided to postpone the notice for a reduction in wages. Prices in Staffordshire are very low. Forge coal varies from 5s. to 6s., and on to 6s. 6d. for best sorts, and furnace coal 8s. to 9s., and 10s. nominal for Earl Dudley's product.

The colliers are professing to keep up a show of righteous indignation concerning the refusal of the employers to meet as delegates, to discuss any propositions as to a new sliding scale, the previous members of the Conciliation Board. At a meeting held at Brierley Hill on Monday a resolution was passed "refusing to appoint a delegate to meet the employers, on the ground that the masters had refused to receive their paid representatives." Such resolutions are idle. The real fact is that the employers do not want to discuss a scale at all. They have solicited the appointment of no delegates. Therefore the men have no need to talk about "refusing" to appoint.

The Government have just lately placed in Birmingham a good order for engines for torpedo boats. It has fallen to Messrs. G. Bellis and Co., of the Ledsam-street Works, and is for five sets of machinery. The engines, specially designed for lightness and quick running, will each have to develope 1000-horse power on trial, the boats—125ft. in length—being designed to go about 20 knots. These boats will be fitted with two revolving turrets, to carry four Whitehead fish torpedoes, and will also be provided with machine guns and one or more of the new six-pounder quick-firing shoulder guns. They are intended to keep the sea with a fleet, and to act against a hostile fleet as ordinary torpedo boats, or to hunt the smaller torpedo boats of an enemy. Messrs. Bellis are now despatching from their works machinery for another sea-going torpedo boat, about 1400-horse power, which is the largest boat of this class yet built. They have also in hand machinery for a number of the large-sized fast-running service pinnaces used as vedette or torpedo boats.

The bridge and girder industries have good contracts in hand, both in respect of colonial and home requirements. Some new orders have just been booked in the last branch. Messrs. Ward and Co., engineers, Great Bridge, have obtained the contract for over 1300 tons of cast and wrought ironwork required for bridges and stations on the Lancashire and Yorkshire Railway.

Messrs. Firmstone Bros., of Stourbridge, have secured the order for the large cast iron pipes required for the extension of Kidderminster Corporation Waterworks. Mr. Geo. Law, Kidderminster, has taken the contract for the construction of the covered reservoir, culvert, sewer, and flushing chamber, needed in connection with the same work. The value of this last contract is nearly £12,000.

Engineers and ironfounders note with satisfaction the continued buying on behalf of Indian railway lines. The needs of the Madras Railway, in respect of cast and wrought iron cylinders, and wrought iron cylinder bracings for bridgework, should mean business for this part of the kingdom; and so, too, should the requirements of the South Indian Railway Company. This line is seeking heavy quantities of iron fish-plates, fish-bolts and nuts, wrought iron tie bars, and split cotters and gibs, together with other work.

The contract for the supply of sixteen miles of cast iron pipes to the South-West Suburban Waterworks Company ought to prove a good thing for some foundry firm if the competition does not ruin the price.

A fair share of the enquiries for railway and road-making tools lately in the market from the War-office has been secured by Cannock firms. They have been most successful in the competition for the axes. A portion of the spade and shovel contracts are believed to have been placed with East Worcestershire makers. Wire reels, with sheet iron drums, for field telegraph service in connection with the operations in the East, are being turned out in Wolverhampton. At Cradley Heath, near Brierley Hill, a Government order for 120 tons of torpedo boat-rings has just been placed. Certain other wrought iron work needed for Government purposes, which has been offered by middlemen during the last few days, has had to be declined by the manufacturers solicited, because of the impossibility of executing it within the short time prescribed.

The employers in the nut and bolt trade have now formally given fourteen days' notice to their workpeople for a reduction of 10 per cent. in wages. They announce, however, that the old rate of wages will be restored immediately the necessity for reduced prices is removed, should the Operatives' Society even yet be successful in getting all the masters to join the trade Association. The notice affects about 1000 men in the South Staffordshire district.

On Wednesday an inquiry by the Local Government Board took place at Oldbury in respect of an application by the local authorities for power to borrow £12,000, to enable them to pay off £10,600 which is still due upon their purchase of the gas undertaking from the Birmingham Corporation, and upon which they entered some three years ago. The inspector stated that he would report the evidence to the Department.

The quarterly meetings of the North Staffordshire Coal and Ironmasters' Association, held at Stoke last week, elicited a general concurrence of opinion that business continued in an unsatisfactory condition in all its branches. Prices had become so low as to be in many cases positively unremunerative, and it was intimated that it was quite within the probabilities that unless an alteration for the better took place, some of the ironworks would follow the example of certain of the collieries, and cease operations.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business, both in the iron and the coal trades of this district, has during the past week been to a very large extent practically in abeyance, owing to the Easter holidays. Engineering and ironworks have in many cases been stopped for the greater portion of a week, and many of the collieries had only on Wednesday got again into full operation. No doubt the general depression existing in nearly all branches of industry has had the effect of inducing a longer stoppage than is usual in Lancashire at this season of the year, Whit week being generally reserved as the great holiday of the district, and it is with no more hopeful prospects that work has been resumed after the holidays. There is still a prevailing feeling of uncertainty and of want of confidence in the future, which keeps what business there is doing down at the hand-to-mouth level which has characterised trade for a considerable time past.

In the iron market there was but an indifferent resumption of business at the usual Manchester 'Change meeting on Tuesday. The attendance was only small, and with the near approach of the quarterly meetings there was naturally a disinclination to enter into any transactions beyond small purchases for pressing immediate requirements. For pig iron the inquiry continues extremely small, with the leading makers of local and district brands still quoting about 40s. to 40s. 6d., less 2½, for forge and foundry qualities delivered equal to Manchester, and in the ordinary way of business these are the minimum prices at which really good brands can be bought. When, however, there is anything like a large order to be placed, prices in many cases are to a considerable extent a matter of bargain; and although the low-priced brands are perhaps not being pushed at figures quite so far below the current rates for the leading brands, one or two of the furnaces having been blown out, they are still to be bought at 1s. or even 1s. 6d. per ton below the figures quoted above.

Hematites still meet with practically little or no demand in this district, and good foundry qualities are to be got at about 52s. to 52s. 6d. per ton, less 2½, delivered equal to Manchester.

Some of the manufactured iron makers continue to report orders coming forward rather more freely; but it is still only at very low prices that business is at all possible, and £5 7s. 6d. for good Lancashire and North Staffordshire bars, delivered equal to Manchester, remains about the average basis of quotations.

Ironfounders report trade as extremely quiet, and so keen is the competition for any work given out, that it is difficult to see what possible margin of profit there can be on the prices that are quoted. Rough castings for constructive work have been taken, for delivery into the Manchester district, at under £4 per ton; ordinary cast iron columns are to be got at from £4 10s. to £5, and ordinary cast iron pipes at £4 5s. to £4 7s. 6d. per ton. But even with prices cut down so excessively low as those quoted above, orders are only given out with hesitation, and work is placed out from hand to mouth, evidently in the expectation that, as it is required, it may be got at even still lower prices.

In the engineering trades there appears to be some slight improvement, so far as employment is concerned, in one or two branches of industry. Rather more activity is reported in shipbuilding, and in the Barrow district a considerable weight of work has been given out. Locomotive builders are kept busy, and the leading machinists are well supplied with work, in one or two instances for a considerable time forward. Tool makers, although not so well off for work as they were, are, as a rule, fairly employed. The general engineering trades are, however, but moderate, and stationary engine builders are very indifferently employed, and in the colliery districts they are very badly off for work. In the Manchester and Salford districts trade, as a rule, keeps fairly steady; in Bolton, Oldham, and Rochdale it is fairly good; but in the Liverpool district it is still only indifferent, whilst in such mining centres as Wigan and St. Helens it is bad.

A considerable portion of the boiler and engine power which will be required at the Inventions Exhibition is being supplied by Messrs. W. and J. Galloway and Son, of Manchester. In addition to the double compound engines and the two Galloway boilers which were put down for the Health Exhibition, and which are being retained for the Inventions Exhibition, two more Galloway boilers have been put down alongside to supply steam for the Western Galleries, and three boilers of larger size—viz., 28 by 7—together with a new type of superposed engine which has been specially built by Messrs. Galloway, are being put down in the North Court to supply steam and power for the South Galleries. The five new boilers have already been delivered, and the engine is to be delivered in the course of the present week.

The Bridgewater Navigation Company is pushing forward the improvement of its waterway, notwithstanding the Ship Canal project, which, if it succeeds, will render useless the new works which are at present being carried out. The company is now engaged on the work of building a new weir at Modewheel, and of cutting a new channel between the south-west end of the racecourse and the Modewheel Mills. The width of this canal, as staked out, is 28 yards, and its length about 450 yards. It will effect a saving in distance between the old and new courses of about half-a-mile, and when completed it is intended to fill up the old river course. The land for the new course, it may be added, was bought by the Old Quay Navigation Company as far back as 1868, when it appears to have been the intention of that body to proceed with the work.

In the coal trade the continued cold weather keeps the house-fire classes of fuel moving off freely, but for all other descriptions there is only a poor demand. Common round coals especially seem to become more of a drug than ever, and engine fuel is, with the exception of some of the better sorts of slack, generally plentiful in the market. The strike in the Yorkshire district is, however, for the time being helping to keep prices steady, and except that where common round coals accumulated in stock under load, they are pushed for sale in bulk at very low figures. Prices at the pit mouth remain about as under:—Best coal, 8s. 6d. to 9s.; seconds, 7s. to 7s. 6d.; common coal, 5s. 3d. to 5s. 6d.; burgy, 4s. 6d. to 5s.; and slack, 3s. to 4s. per ton, according to quality.

Shipping has been very quiet during the past week, and although for good qualities of steam coal 7s. to 7s. 3d. per ton is still quoted for delivery at the high level, Liverpool, or the Garston Docks, there are inferior sorts offering at 6s. 9d. per ton.

For coke there is a fair demand at about 9s. to 10s. for good ordinary qualities up to 12s. and 13s. per ton for the best local makes at the ovens.

Mr. Ellis Lever's recent alarmist letters with reference to the rapid exhaustion of our coal supplies, and his proposition that a small export tax should be put on shipments to foreign countries, has given rise to a good deal of correspondence in the local press, and Mr. Ellis Lever has found several supporters in the views he has set forth. Mr. Thomas Newbigging, the well-known gas engineer, however, ridicules the idea that this country is likely to suffer from a scarcity of coal supplies, which he contends are practically inexhaustible so far as our coal measures are concerned, but which, if need be, could be readily drawn from other countries or replaced by other substances of which we have an abundance. As to seeking a remedy in an export tax, he condemns such a policy as only tending to cripple our resources, and as certain to inflict injury on the country far greater than any benefit which might be derived. That the collieries of this country are at present being drained of an enormous output at prices which practically leave no return for the capital invested in mining admits of no question; but the real evil lies in the excessive development of mining enterprise, and this will have to work out its own remedy, as over-speculation in other directions has had to do.

Barrow.—The demand for hematite pig iron is quiet in all departments, and were it not for increased sales on steel making account, there would be nothing doing, practically speaking. This increased business is mainly due to the fact that makers of steel are more fully employed, and that they are consuming larger parcels of hematite pig iron in consequence. Stocks are largely held all round, and remain very large on all hands; there is, in fact, no diminution in stocks, although the output has been reduced. Prices are easy at 44s. for No. 1 Bessemer; 43s. 6d., No. 2; 43s., No. 3, net at works, with 1s. advance on these prices for forward deliveries. Steel makers are rather more fully employed than they have been, both in the rail and merchant departments, and there is a fair trade doing in special steel, for which there is a growing request. The works in this district have been specially fitted out for a good trade in special qualities of steel, and the demand is growing, as the output of mild and hard qualities of steel is on the increase, and the consumption in like ratio, inasmuch as this class of metal is in increasing demand on the part of consumers, who are using it for purposes which at one time were confined to finished iron. Shipbuilders are fairly employed, although not actively employed, and one new order—that of a cargo-carrying steamer—is reported. Iron ore and coal quiet. Shipping more actively employed. It is expected the tramways of Barrow will be opened next month, and the new high level bridge is fast approaching completion.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE quarterly meeting of the Cleveland pig iron trade was held at Middlesbrough on Tuesday last, but owing to the Easter holidays and the still slack state of the trade, the attendance was but small. There was not a single exhibit of any kind, and scarcely any visitors from other districts were present. Neither buyers nor sellers showed any disposition for business, and few sales were made. Prices may be said to be the same as last week. Merchants offered No. 3 g.m.b. for prompt delivery at 34s. per ton, whilst makers asked 34s. 3d. to 34s. 9d. The mills and forges throughout the district have been standing during the holidays. Consequently, the consumption of forge iron has fallen off, the price remaining at 33s. 3d. to 33s. 6d. per ton.

There is no inquiry for warrants. The price stands nominally at 33s. 9d. per ton.

There is very little activity apparent this week in the manufactured ironworks. The demand for ship plates and bar iron has, however, slightly improved of late, and prices are somewhat firmer than they were. Ship plates are £4 15s. to £5 per ton, according to specification; angles, £4 12s. 6d. to £4 17s. 6d., and common bars £4 17s. 6d. to £5 2s. 6d., all free on trucks at makers' works, cash 10th less 2½ per cent.

The Cleveland ironmasters' statistics for March were issued a few days since. They show that the total make of pig iron of all kinds was 208,644 tons, being an increase of 28,321 tons when compared with February. The stocks of pig iron in the whole district amounted to 389,254 tons, being an increase for the month of 11,517 tons. The shipment of pig iron from the Tees amounted to 69,393 tons, and of manufactured iron and steel to 36,486 tons. The principal items in the pig iron reports were as follows:—Scotland took 29,306 tons; Germany, 10,743 tons; Holland, 7244 tons; France, 6010 tons; Wales, 4945 tons; and Spain and Portugal, 2430 tons. The stock of pig iron in Messrs. Connal and Co.'s store at Middlesbrough at the end of the month was 50,832 tons, being a decrease of 130 tons since the end of February.

The accountants' certificate, issued in connection with the Northumberland miners' sliding scale, was published on the 31st ult. The average net selling price of coal for the three months ending February 28th was 4s. 10·56d. per ton. The wages of underground workmen and banksmen will in consequence be reduced 1¼ per cent.

It is stated that an order has just been placed with a shipbuilding firm at West Hartlepool for a very large well-deck steamer. It will be built of steel, and have 3500 tons dead weight capacity. It will be fitted with triple expansion engines.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

WHILE I write the last of the notices given to the miners is expiring. Earl Fitzwilliam's collieries at Elsecar and Stubbin will remain open some time after the others are closed, owing to his lordship's notices having only been served last week. There are now nearly 40,000 miners "out," and the women and boys add several thousands additional to that great army of unemployed. Very little anxiety, and singularly restricted interest, are expressed about the strike. It has been fixed to fall at a time when the men usually take a few days' holiday, and the coalowners who are also ironmasters have the stock-taking "on." In this way the strike will fit in nicely. Probably the Easter holidays, lasting longer than usual, will be followed by stock-taking in several instances, and in this way three weeks will be covered. Then, with only a week to complete the month, it is believed the colliers will be disposed to return to their work on the masters' terms. Several coalowners have advanced the price of household coals by 6d. to 1s. per ton, but this rise in prices is not general, being confined to colliery proprietors who have only small stocks and wish to make the most of them. At several pits the men are already talking of going back to work at the reduction. The employers say that the 10 per cent. reduction will enable them to secure more contracts, and that they will thus be able to give the men increased work, so that practically they will benefit by what at first sight looks an affliction.

The Barrow Steel Company, which has large collieries at Worsborough, near Barnsley, has joined the movement for a reduction of wages. Its notices were served on Tuesday, to the surprise of the men, who did not anticipate the step. The company raises about 1000 tons of coal per week, and employs about 1000 hands. It has just recovered from a strike of considerable duration, and as the company depends upon the colliery coke ovens for a supply of coke for its steel works at Barrow, it must have been driven to risk another strike by nothing short of what another coalowner has termed "the irresistible pressure of circumstances."

Derbyshire now follows the lead of Yorkshire in the matter of the miners' wages. The leading collieries are now serving their notices, which all expire a fortnight and a month after those in the adjoining county. Probably by the latter date the strike in Yorkshire will be over, and its decision in the one coal-field will rule the other. At one Derbyshire colliery the miners are stated to have consented to the reduction, and I hear that at two large collieries in this district the men are wishful to arrange the difficulty amicably. An offer to settle on the basis of 5 per cent. would at once be accepted by the men, but the coalowners will not hear of it.

At Thorncliffe and at Parkgate the ironworkers have received notice. This, I learn on inquiry, is simply a precautionary measure taken by the companies to protect themselves, lest supplies of fuel should run short. The engine fitters and turners employed by Messrs. Newton, Chambers, and Co. at Thorncliffe have received notice that their wages would be reduced 2s. per week. Sometime ago the firm advanced wages to that amount, and now the depression demands its withdrawal. The Holmes furnaces, near Rotherham, have been blown out, and the men discharged, owing to depression of the pig iron trade, and the expected falling off in the coal supply.

A few quotations will be interesting for future reference. At present South Yorkshire coal is easily obtainable at the following rates:—Silkstone best house, 9s. to 10s.; second-rate sorts, for which inquiries are more frequent, 7s. to 9s.; nuts, 6s. to 7s. 6d.; slack, 3s. to 6s. per ton—all at the pits. The house coal obtained from the Barnsley thick seam is now quoted from 8s. to 9s.; nuts, 5s. 6d. to 6s.; and smudge, 2s. to 4s. per ton at the pits. Pig iron is at the lowest point reached since before the boom of 1879; and in the manufactured iron trade the quotations at works are:—Angles, ordinary, £6 to £6 15s.; best, £7 to £7 5s.; bars, ordinary, £5 2s. 6d. to £5 15s.; best, £5 12s. 6d. to £6 5s.; best best, £6 12s. 6d. to £7 5s.; best best best, £8 2s. 6d. to £8 15s.; hoops, ordinary qualities, £5 15s. to £5 17s. 6d.; best, £6 7s. 6d.; B B, £7 7s. 6d.; plates, bridge, and girder, £6 10s. to £7 10s.; boiler plates, £7 to £7 10s.; B B boiler plates, £8 to £8 10s.; B B B do., £10 to £11 10s.; sheets, ordinary, £6 15s. to £7 7s. 6d.; best, £8 10s. to £8 15s.; B B, £9 12s. 6d. to £9 15s.; B B B, £12 5s. to £12 7s. 6d.; T's, from £6 to £10 per ton, according to quality.

A serious accident occurred at the Atlas Steel and Ironworks—Messrs. John Brown and Co.—on Friday. A large mould, capable of holding several tons of steel, was being filled, when the mould fell over, and the molten metal, pouring out in a stream, knocked over a platform on which three workmen were standing. One named Thomas Bryan fell into the liquid fire, and was burnt to death. At the same time an explosion took place; the steel flew about, and two other men were seriously injured. One named Henry Baldwin has since died.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

THERE has been considerable interruption to business in the past week owing to the holidays. The Glasgow iron market was closed from Thursday to Tuesday, and the tone has been somewhat weaker this week than last. Speculative business has, however, been again affected by the blowing-out of furnaces, and also by an appeal which has been made to the management of one of the iron-producing companies to put an end to the present unprofitable system of manufacture. One furnace has been re-lighted at Dalmellington, but two have been extinguished at Coltness, one at Calder, and one is immediately to be put out at Govan. This will reduce the number in operation to 89 against 93 at the same date last year. Of the number blowing, twelve are now making hematite pigs, but the output of ordinary pig iron is still larger than the current home consumption and shipments, so that a quantity is being sent every week into store. In Messrs. Connal and Co.'s Glasgow stores, the increase for the past week has been about 750 tons. The shipments have been disappointing, amounting to only 7525 tons, as compared with 10,877 in the preceding week and 11,457 in the corresponding week of 1884. The total shipments to date are 112,393 tons, as against 139,759 tons in the same period last year, showing a decrease of no less than 27,366 tons.

Business was done in the warrant market at the close of last week at 41s. 11d. cash. On Tuesday forenoon transactions occurred at 41s. 9d. to 41s. 8d. cash, and 41s. 10½d. to 41s. 10d. one month, the quotations in the afternoon, when the market was firmer with a fair business, being 41s. 8½d. to 41s. 9d. cash, and 41s. 10½d. to 41s. 11d. one month. On Wednesday transactions occurred up to 42s. cash, closing at 41s. 11½d. To-day—Thursday—being a holiday, the pig iron market was not held.

The market values of makers' iron are as follows:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 51s. 3d.; No. 3, 46s. 6d.; Coltness, 54s. and 50s. 6d.; Langloan, 53s. 6d. and 50s.; Summerlee, 51s. and 46s.; Calder, 51s. 6d. and 46s. 3d.; Carnbroe, 48s. 6d. and 46s.; Clyde, 46s. 9d. and 42s. 9d.; Monkland, 42s. and 40s.; Quarter, 41s. 6d. and 39s. 6d.; Govan, at Broomielaw, 42s. and 40s. 3d.; Shotts, at Leith, 51s. and 50s. 6d.; Carron, at Grangemouth, 52s. 6d. and 47s.; Kinneil, at Bo'ness, 44s. and 43s.; Glengarnock, at Ardrossan, 48s. and 42s. 6d.; Eglinton, 43s. and 39s. 6d.; Dalmellington, 46s. 6d. and 43s.

The malleable department continues quiet. Common bars are quoted at £5 5s. to £5 10s.; angles, £5 to £5 5s.; ship-plates, £5 15s. to £6; boiler ditto, £6; nail rods, £5 15s.; rails, £6 to £7; railway chairs, £3 10s. to £4; and pipes, £4 10s. to £5.

Machinery and other iron manufactures shipped from Glasgow in the past week included sugar-crushing plant, valued at £2530, for Brisbane; £1981 machinery to Calcutta, £1074 sewing machines, £2700 steel goods, and £32,380 miscellaneous articles, including railway wagon work to the value of £15,000, for Bombay.

Steel for different purposes is in demand, and the works are fairly active.

Notwithstanding the dulness in the shipbuilding branch, the workmen are giving a great deal of trouble in a great number of the shipyards. In one or two cases men have also had to be discharged. This is the case with over sixty boiler makers and pattern makers employed by Messrs. Elder and Co., who had been engaged in the construction of the Nile stern-wheel steamers, which are now approaching completion. About two hundred rivetters who were on strike at Port Glasgow have resumed work at the masters' terms, the employers having agreed to meet their representatives in confidence, with the object of fixing a basis of prices to be in force for a stipulated period of six to twelve months.

Messrs. A. and J. Inglis, of Pointhouse, Glasgow, are about to lay down at their own risk a vessel of 3000 tons, to provide immediate employment for a number of their operatives who would otherwise have had to be dismissed. A similar act of consideration has been performed by the directors of the London and Glasgow Engineering and Shipbuilding Company. In some of the shipyards the dull times have led to a curtailment of the wages of the permanent staffs, clerks having their pay reduced as much as 20 per cent.

There is more activity in the Scotch coal trade. The Quebec timber fleet are now starting from the Clyde, and taking cargoes of coals, which helps at the moment to increase the amount of the shipments. The contract arrangements for the Baltic have, on the other hand, been retarded by the uncertainty that has prevailed as to the relations between this country and Russia. But a fair shipping trade is now being done with other parts of the Continent. There is in most places a good demand for dross, and furnace coals are meeting with a rather better sale. The cold weather has likewise helped to maintain the domestic inquiry. In the Fife district a reduction of about 3d. a ton is notified in shipping coals.

Operations have been suspended at Hirst Colliery, Cumbernauld. Reductions of miners' wages are being carried out all over the western mining districts. Some dissatisfaction is being exhibited by the colliers, who have held indignation meetings in several places, alleging that there was no necessity for the reduction. At a number of the collieries in the Glasgow district pickets have been at work endeavouring to enforce the observance of a weekly holiday, and an effort is to be made to reorganise the unions.

The Fife and Clackmannan coalmasters have virtually declined through their secretary, Mr. John Connell, to reconsider their determination to reduce wages by 10 per cent.

WALES & ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE holiday week has shown itself, as usual, in lessened output of coal, reduced make of iron and steel, and utter wasteful expenditure of savings by colliers and workmen. It is fortunate for their health and happiness that holidays are so few. The door boys of the coal pits, just over the legal age for working, spent upon an average £1 each, and were to be seen drunk in every direction.

The coal returns of the week will show a great falling off, but the coal trade is certainly beginning to look up again, and the prospects of the future may be regarded as good. The Cunard Steamship Company's contracts are being put out, also those of the Alta Italia, and in other respects there is a growing steadiness in demand, and a firmness of price which augur well. The relations of men with employers are satisfactory, and if, as I imagine, trade is going to show a spurt, there will be no difficulty in keeping up good outputs. The new colliery speculations are going on with vigour. The Ocean Company has struck a fine 6ft. seam at Blaengarw pits, and are now well placed. The new manager of Clydach Vale is Mr. Pritchard, who has done good service at Mountain Ash, and will bring the requisite ability and vigour to bear on this fine colliery—perhaps the finest in Wales, the place being more like a quarry of splendid 6ft. coal than an ordinary working.

Middle Duffryn continues stopped. Mr. Hann has written to state that the stoppage of the colliery must not be regarded as a lock out. I hope that the leverage of the sliding scale will be brought to bear upon the difficulty. A meeting of Mountain Ash men has been called to discuss the sliding scale, with a view to add certain additions. There is a prospect of the Tylacoch difficulty being amicably settled by a compromise of 10s. in the pound. In iron little has been done, and only two small consignments sent away from Newport. The business in hand is well husbanded, and workers are putting up with a minimum of loss in consequence—as for profit, it is out of the question; but the men suffer a good deal, and especially the lowest class of labour.

I was looking at Plymouth Ironworks this week, and wondering why something could not be done with the upper works. Upon them, at the very last portion of Mr. Fothergill's administrations, he spent a quarter of a million sterling in arranging for hot blast. It is questionable if he ever realised a penny by the transformation, but surely something might be done with such capital plant.

At Dowlais transformation and extension continue, and Cyfarthfa also is busy. Tredegar, at a recent visit, showed little of a hopeful nature. Orders came in slowly, and are worked off in the same way.

Rhymney is now under new management, Mr. David Evans having left for Barrow-in-Furness. Mr. B. Jones, who succeeds him, is a capital manager. He succeeds an able man, and I trust will win equal repute when he has grappled the situation and its difficulties.

The *Times* comments favourably upon the wisdom of the tin-plate manufacturers in holding their quarterly meeting at Swansea. This is now the recognised head-quarters of the trade, and the first meeting has been voted a success. The resolution come to last week was, to fix a minimum of 14s. for ordinary coke plate per box, and also to make every effort to prevent over production. Instructions were given to draw up a report on the subject for next meeting. The meeting was well and influentially attended. Prospects of the trade are good, and other industries are being benefitted. For example, this week 10,000 boxes came to hand. A large make of these is in Goulcestershire.

Steady progress has been made with dredging operations outside Swansea Harbour, and the channel is all but complete. It is estimated that 2,500,000 tons of mud have been removed. The improvement will be a great one, and should place Swansea on a level with Cardiff and Newport. Some surprise has been felt that Swansea was not visited by the Admiralty Commissioners for coal-buying purposes.

Cardiff Chamber of Commerce has petitioned in favour of the Cardiff and Monmouthshire Valley Bill. They have also supported the Barry Railway.

I am glad to see that Evance Coppee and Co. are making good headway. They are to build eighty more coke ovens forthwith, the seventy-two previously constructed by them having answered the fullest expectations. The result, too, of the coal washing at Dowlais has been such that the same firm are about putting up additional feldspar coal-washing machinery in substitution for the plant of another firm.

Newport is moderately brisk of late, but iron ore imports are scant. Pitwood is abundant and tolerably cheap. Patent fuel at Cardiff and Swansea brisk; prices firm.

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 number of the Specification.*

Applications for Letters Patent.

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

31st March, 1885.

4034. CHAINS for CONVEYING MOTIVE POWER, R. Harrington, Finchfield.
4035. MOULDING PIPES, R. Smith and G. Wood, Bradford.
4036. SAFETY CATCH for BROOCH PINS, G. Sherlock and H. O. Christensen, Isle of Wight.
4037. CHAMFERING MILLBOARD, &c., J. E. Sowerby, Halifax.
4038. LOCOMOTIVES, &c., H. Harrison, Manchester.—*9th December*, 1884.
4039. HAMMERLESS GUNS, R. Redman and T. Green, Birmingham.
4040. VELOCIPEDES, F. Jones and T. Reading, Birmingham.
4041. INTRODUCING STEAM, &c., into CARBONACEOUS MATTER, J. A. B. Bennett, King's Heath.
4042. FASTENINGS for ARTICLES of DRESS, &c., W. A. and W. J. Bancroft, Birmingham.
4043. DRYING, &c., E. Keighley, Scarborough.
4044. COMPOUND PUMPING ENGINES, A. B. Brown Glasgow.
4045. LINING COMPRESSED PAPER, &c., with THIN METAL, B. W. Stevens, Birmingham.
4046. DESTROYING SEWAGE in BUILDINGS, &c., A. Englo Liverpool.
4047. REPRODUCTION of CHARACTERS at a DISTANCE, T. Tubini, London.
4048. HOT BLAST STOVES, F. W. Gordon, London.
4049. LANTERNS, G. C. Dressel and F. Storey, London.
4050. ROCK DRILLS, W. R. Willetts and H. Ball, London.
4051. CASTERS, S. C. Mendenhall, London.
4052. CHEQUE BOOKS, G. A. Mason and W. Bonwick.—(*E. W. Mason, United States.*)
4053. PENCIL POINT PROTECTOR, &c., E. MacEwan, Birmingham.
4054. INTERNAL STOPPERING of BOTTLES, T. and J. Brooke, London.
4055. NUTLOCKS, A. T. Allen and H. Cavill, London.
4056. DRIVING and REVERSING GEAR for SLIDE RESTS, G. W. Budd, London.
4057. PROPELLING SHIPS and VESSELS, J. H. Lake, London.
4058. MUSIC CASES, J. C. Bardili, London.
4059. HORSERAKES, &c., A. G. Margetson, London.
4060. LINK PRESS, F. G. and A. Johnson, Hanley.
4061. TRANSMITTING ELECTRIC SHIP'S TELEGRAPH, W. Skinner, J. Farquharson, and D. W. Lane, London.
4062. LINING for HATS and CAPS, D. W. Wall, London.
4063. ELECTRIC RAILWAY SIGNALS, W. T. Waters, London.
4064. HINGED BACKS of ALBUMS, &c., E. S. Glover, London.
4065. WEDGE for FASTENING RAILWAY RAILS, J. H. Johnson.—(*A. David, France.*)
4066. WASHING MACHINES, A. Lumsden and J. Sternberg, London.
4067. DOOR LATCHES, C. H. James, London.
4068. BEER and MALT LIQUORS, &c., W. Lawrence, London.
4069. AXLES for CARTS, &c., E. Benn, Leeds.
4070. REVOLVING FIRE-ARMS, H. Webley and J. Carter, London.
4071. DRESS FASTENINGS, W. Beer, London.
4072. OBTAINING the RESULT of ELECTIONS by BALLOT, J. Withers, London.
4073. FASTENING of CRAVATS, TIES, &c., R. W. Thomas, London.
4074. EVAPORATING SEA WATER, &c., F. B. Doering, London.
4075. TRACTION ENGINE, W. and J. Hart, London.
4076. PACKING of BOTTLES, JARS, &c., T. W. Jones, Clapton.
4077. BALL TAPS O. J. Allen, London.
4078. GAS PLIERS, &c., H. C. Gilchrist and C. Bellamy, London.
4079. SUPPORTING, &c., CORDS, J. Saunders, Cirencester.
4080. TOOTHED WHEELS, J. Leck, London.
4081. HEATING APPARATUS, A. Mackie, London.
4082. CANDLES and NIGHT-LIGHTS, G. Brownen, London.
4083. COUNTER, Sir R. P. Gallwey, Bedale.
4084. BAKERS' and other OVENS, G. F. Redfern.—(*S. Lamoureux, France.*)
4085. TOBACCO PIPES, H. E. Meyer.—(*Mons. Jeantet-David, France.*)
4086. MATHEMATICAL DRAWING INSTRUMENT, W. T. Smith and C. Smith, London.
4087. MINING MACHINES and DRIVING CHAINS, B. A. Legg, London.
4088. GALVANISED METAL PLATES, E. Matheson.—(*E. V. McCandless, United States.*)
4089. ROLLING STOCK, T. C. Fidler, London.
4090. REFINING GLYCERINE, G. Payne, London.
4091. TRAVELLER for SPINNING MACHINES, W. R. Lake.—(*H. Dodt, Belgium.*)
4092. PRODUCING CARBONATE of SODIUM, E. F. Trachsel, London.
4093. PROJECTILES, E. W. Young, London.
4094. REGULATING the RECOIL of CANNON, W. Anderson, London.

1st April, 1885.

4095. LOCK FURNITURE, J. Taylor, Manchester.
4096. LUBRICATORS, J. Holt, Manchester.
4097. STEERING PARTS to VELOCIPEDES, D. L. Reaney, London.
4098. TAPS, E. Cope and A. Hollings, Openshaw.
4099. MARINE STEAM ENGINES, G. Allibon, Liverpool.
4100. FINISHING LEATHER-COVERED ROLLERS, &c., J. S. Dronsfield, Manchester.
4101. PREVENTING GREASE from COMING through the BOTTOMS of BOOTS and SHOES, E. S. Bates, Ipswich.
4102. PHOTOGRAPHIC CAMERAS, G. Lowdon, Dundee.
4103. OPERATING the HEALDS of LOOMS for WEAVING, E. O. Taylor and D. Kenyon, Halifax.
4104. CAUSTIC DRUM LID, D. H. Lowry, Liverpool.
4105. COMBINED LATCH and BOLT LOCKS, W. Neilson, Glasgow.
4106. ROLLER MILLS, T. A. Marshall, Glasgow.
4107. PICKERS in LOOMS for WEAVING, J. Gabbott, Halifax.
4108. STOPPING or CLOSING BOTTLES, D. Rylands and W. Wharldall, Barnsley.
4109. FLOUR MIXING MACHINES, T. Wedd, Boston.
4110. ELECTRIC ARC LAMPS, H. W. Pendred, Streatham.
4111. PULVERISING APPARATUS, W. A. Koneman and H. H. Scoville, London.
4112. ORE CONCENTRATORS, W. A. Koneman and H. H. Scoville, London.
4113. CRYPTOGRAPHY, W. E. Gedge.—(*J. L. Winnea, United States.*)
4114. ENGINES and PUMPS, R. H. Twigg, London.
4115. SHAPING WOOD by HEATED MOULDS, A. Grafton, London.
4116. CARRIAGE BRAKES, G. Osborne, London.
4117. VALVES, J. Westley, London.
4118. TREATMENT of PLANTS, A. E. Newman, London

4119. Cutter Bars, E. Benn, London.
4120. Dynamo-electric Machines, Prof. G. Forbes, London.
4121. Clip or Holder for Glass, &c., J. Goddard, London.
4122. Stoppering and Opening Bottles, &c., S. Bunting, Dublin.
4123. Friction Igniter, C. D. Abel.—(*J. Jenc, Austria.*)—19*th January*, 1885.
4124. Electrical Igniter, C. D. Abel.—(*J. Jenc, Austria.*)—19*th January*, 1885.
4125. Producing Upcast Draught, S. Low, jun., London.
4126. Wheels for Velocipedes, &c., W. P. Hoblyn, London.
4127. Polishing Material, F. Cooper and J. C. W. Stanley, London.
4128. Mineral Oil Lamps, T. W. Shaw and T. M. Harvey, London.
4129. Rotary Engines, I. P. Dillé, London.
4130. Intensifying Electrical Currents, F. P. E. de Lalande, London.
4131. Dust Bins, H. Walker and G. Clark, Brixton.
4132. Lamps or Lanterns, C. Crastin, London.
4133. Steam Boilers, W. Fairweather.—(*G. H. Babcock and the Babcock and Wilcox Co., United States.*)
4134. Steam Generators, W. Fairweather.—(*N. W. Pratt and the Babcock and Wilcox Co., United States.*)
4135. Adjustable Fuel Charging Apparatus for Steam Boilers, P. Jensen.—(*A. Teichmüller, Germany.*)
4136. Dishes or Tureens with Revolving Covers, J. W. Dixon, London.
4137. Transforming, &c., Electric and Magnetic Force, J. S. Williams, Riverton, U.S.
4138. Sodium Aluminate, &c., Compounds, F. M. Lyte, London.
4139. Loading and Discharging Coal and other Cargoes, G. Taylor, London.
4140. Attaching Carriage Springs, &c., to Carriage Axles, J. Stevenson, jun., London.
4141. Connecting, &c., Cables, Wires, and Conductors used in the Transmission of Electric Currents, O. March, London.
4142. Knitting Machines, C. A. Day.—(*W. B. Medlicott and J. and W. Bramley, United States.*)
4143. Rotary Pumps, &c., C. T. Colebrook, London.
4144. Girthing Attachments of Harness Saddles, H. Studdy, London.
4145. Writing Machines, J. H. Johnson.—(*Marquis de Camarasa, France.*)
4146. Heat Resisting Fabric, G. P. Chiles, London.

2nd April, 1885.

4147. Driving Mechanism for Velocipedes, &c., W. H. Pugh, London.
4148. Washing, &c., Woven Fabrics, J. Farmer.—(*A. Lalance, Germany.*)
4149. Washing or Purifying Smoke, G. L. O. Davidson, Manchester.
4150. Securing Door Knobs, J. B. O'Callaghan, London.
4151. Manufacturing Fire and Waterproof Boards and Paper from Asbestos, W. E. Heys.—(*E. Ladewig, Germany.*)
4152. Corsets, R. A. Young and R. Neilson, Bristol.
4153. Tube Piping and Rod Cutter, J. B. Adams, Liverpool.
4154. Chandeliers, R. H. Best, Birmingham.
4155. Cells for Primary or Secondary Batteries, C. Moseley, Manchester.
4156. Bicycles, Tricycles, &c., S. Martin, Birmingham.
4157. Marble Shooting, T. H. Brigg, Bradford.
4158. Waterproof and India-rubber Goods, H. H. Waddington, Manchester.
4159. Wiring Corks in Bottles, T., F., and L. Lydon, Galway.
4160. Measuring and Photographing Spectra, L. Saunderson, Dublin.
4161. Pencil Holders, W. P. Thompson.—(*J. Trebentscheck, Austria.*)
4162. Penholders, W. P. Thompson.—(*J. Trebentscheck, Austria.*)
4163. Caustic, &c., Drum Lids or Closers, H. W. Todd, Liverpool.
4164. Preventing Down Draught in Chimneys, W. Stobbs and E. L. White, London.
4165. Adjustable Screw Key Spanner, J. Parker, Derby.
4166. Separating the Water of Condensation from Steam, J. Laidlaw, Glasgow.
4167. Valve Gear of Motive Power Engines, H. Jack, Glasgow.
4168. Swimming Propellers, W. W. Crawford, Glasgow.
4169. Window Fasteners, G. L. Holloway and H. Stanning, London.
4170. Collapsing Wardrobe, F. Robinson, London.
4171. Smoke Consuming Furnaces, J. W. Hubber, London.
4172. Photographic Lenses, &c., G. P. Smith, Tunbridge Wells.
4173. Steering Apparatus for Ships, E. Braubach, London.
4174. Candlesticks, A. Evans, London.
4175. Carbonic Acid, F. J. B. Raken.—(*H. and J. F. Beins, Holland.*)
4176. Treating Gypsum or Sulphate of Lime, &c., W. Manning, London.
4177. Coal Vase, W. Sames, Birmingham.
4178. Railway Chairs and Sleepers, J. F. and W. H. Wright, London.
4179. Lamps for Burning Paraffine, &c., Oils, G. Rayner, London.
4180. Adjusting Carts, &c., W. Wade, London.
4181. Securing the Iron Frames of Pianos, C. J. Coxhead, London.
4182. Boxes for the Transmission of Patterns, &c., T. Christy, London.
4183. Tool-holders, W. H. Berry, London.
4184. Flatting Furnaces, G. F. Redfern.—(*E. Masquelier, Belgium.*)
4185. Rotary Engines, J. A. Wade and J. Cherry, London.
4186. Coupling and Uncoupling Railway Carriages, &c., F. J. Adams, London.
4187. Fire-escapes, &c., F. T. C. Crump, Sydenham.
4188. Working, &c., Points and Signals on Railways, S. T. Dutton, London.
4189. Metallic Rims of Wheels of Bicycles, &c., T. Warwick, London.
4190. Sewn-through Linen Buttons, J. R. Green, London.
4191. Obtaining Copies of Drawings, &c., J. H. Johnson.—(*C. Z. Joltrain, France.*)
4192. Hoisting Machinery, G. Henkel, London.
4193. Heating Apparatus, W. R. Lake.—(*J. T. Scholte, Netherlands.*)
4194. Curling Tongs, W. R. Lake.—(*C. G. Bac, France.*)
4195. Packing Tobacco, &c., F. G. Lloyd, London.
4196. Producing According to Signal Copies of Plans or other Marks, B. H. Melville, London.
4197. Raising, &c., High Posts Carrying Lights, F. Bolton, J. Saxby, and J. S. Farmer, London.
4198. Railway or Tramway Wheels, J. K. Sax, London.
4199. Slide Valve and Gear, J. Fielding, London.
4200. Motor Apparatus, M. F. D. Cavalerie, London.
4201. Instantaneous Shutters, A. J. Boult.—(*W. Damry and A. Leduc, France.*)
4202. Folding Rests, P. Rothermel, London.
4203. Adjusting and Holding Stockings, &c., in Position when in Wear, E. Bealey, London.
4204. Clutch, W. Heatley and G. Hutchins, London.
4205. Stoves and Fire-grates, F. J. Vergard, London.
4206. Butter, B. M. Plumb and T. I. Richman.—(*E. R. Levy, United States.*)
4207. Treating Sewage, &c., W. H. Beck.—(*H. Wagener and Prof. Dr. A. Müller, Germany.*)
4208. Bird Fountain Feeders, &c., F. H. Smith, London.
4209. Flushing Apparatus, F. J. Henderson, London.
4210. Inducing Electric Sparks for Gas-lighting, &c., A. R. Molison, London.
4211. Injectors, A. Budenberg.—(*Schäffer and Budenberg, Germany.*)

SELECTED AMERICAN PATENTS.

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

312,734. Brake Shoe, *John Joseph Lappin, Toronto, Ontario, Canada.—Filed November 20th*, 1884.

Claim.—A brake shoe A, with chilled portions B on each side in the face of the shoe, each chilled portion B being opposite to an unchilled portion C, the soft metal being on each side and around the inner edge of

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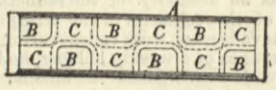

the chilled portion, thereby providing a continuous waved rib of soft metal running along the middle of the shoe, and thereby strengthening the shoe, substantially as shown and described, as a new manufacture.

312,737. Hoisting Apparatus, *William H. Maddock, Allegheny, and Albert Michaels, Pittsburg, Pa.—Filed August 20th*, 1884.

Claim.—In a hoisting apparatus, the shells or scoops 37, having a suspension and fulcrum bar, in combina-

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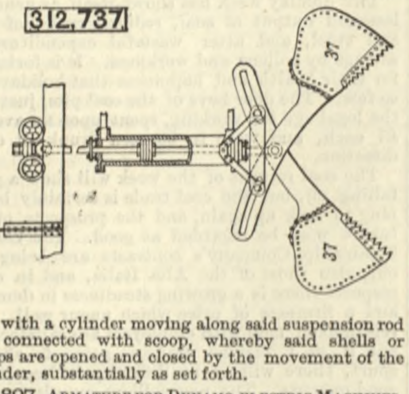

tion with a cylinder moving along said suspension rod and connected with scoop, whereby said shells or scoops are opened and closed by the movement of the cylinder, substantially as set forth.

312,807. Armature for Dynamo-electric Machines, *C. F. Brush, Cleveland, Ohio.—Filed May 13th*, 1884.

Claim.—(1) An armature formed of superposed layers of band iron having interposed between them laterally projecting cross pieces that form the side walls of the bobbin spaces, and separable filling-in strips interposed between the cross pieces, substantially as set forth. (2) An armature ring formed of superposed layers or convolutions of band iron with laterally projecting cross pieces interposed between the same, said cross

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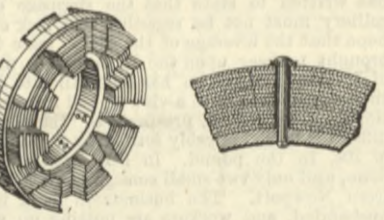

pieces forming the side walls of the bobbin spaces, and rivets or bolts extending through both bands and cross pieces, and insulated in whole or in part therefrom, substantially as set forth. (3) An armature ring having its central part made up of superposed layers of band iron, and having lateral extensions forming the bobbin spaces, said extensions consisting of interposed cross pieces extending from bobbin to bobbin the full thickness of the ring, substantially as set forth.

312,887. Loose Pulley Lubricator, *William J. Ormsby, Cincinnati, Ohio.—Filed October 20th*, 1884.

Claim.—(1) In a loose pulley lubricator, the independent collar secured in position by means of a set screw provided with openings having therein oilers communicating with a series of veins opening beneath the pulley on the opposite side of the shaft from the

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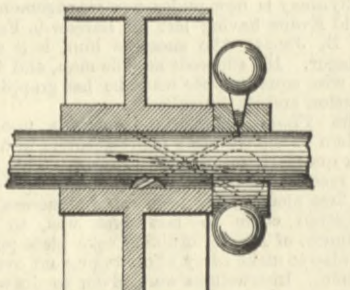

oiler, substantially as herein set forth. (2) The combination of the collar having therein threaded openings with oilers, the said collar secured in position upon the shaft by means of a set screw, with the veins opening on the shaft on the opposite side from the oiler, with the shaft and pulley, the whole arranged as and for the purpose substantially as herein set forth.

312,900. Tire Tightener, *Tyree Rodes, Tenn.—Filed October 1st*, 1884.

Claim.—(1) In a tire tightener, the combination, with the bolt D, held in one end of the tire, and passed

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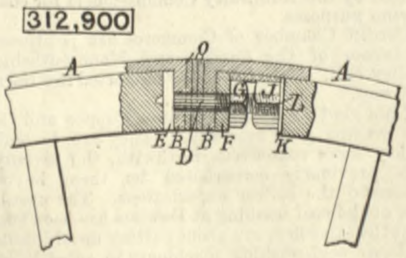

through the other end, of two nuts mounted on the bolt between the latter end of the tire and the adjacent end of the felly, substantially as herein shown and described. (2) In a tire tightener, the combination, with the bolt D, held in one end of the tire, and passed through the other, of the nut G, through which the bolt D passes, and of the nut J, into which the end of the bolt is screwed, the free end of the nut J resting against one end of a felly, substantially as herein shown and described. (3) In a tire tightener, the combination, with the tire A, having bent ends B, of the screw bolt D, having a head E, between one bent end B of the tire and the adjacent end of the felly, the U-shaped washers O, between the ends of the tire, and the nuts G J on the bolt between one end of the tire and the adjacent end of a felly, substantially as herein shown and described. (4) In a tire tightener, the combination, with the tire A, having bent ends B, of the screw bolt D, having a head E, the U-shaped washers O, the washer F, the nuts G J, and the plate K, having a stud L, substantially as herein shown and described.

312,951. Vacuum Pump, *Raymond F. Barnes, Brooklyn.—Filed January 12th*, 1884.

Claim.—(1) The combination, with the vacuum chamber of an air pump of the kind described, of a mercury reservoir connected therewith, devices for varying the pressure of air in said reservoir, electro-magnets for operating said devices, and circuits controlled by the movements of the mercury, as set forth. (2) The combination with the vacuum chamber of an air pump of the kind described, a mercury reservoir, and tube connecting the same, of devices for admitting air to and withdrawing it from said reservoir, electro-magnets for operating the said devices, and circuits

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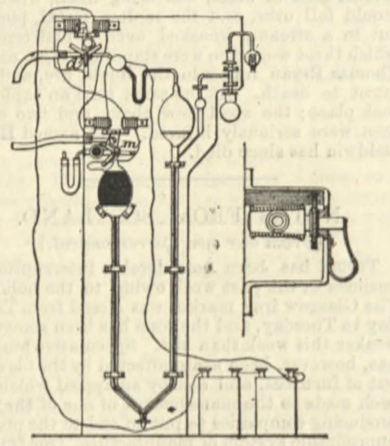

controlled by the movement of the mercury, as set forth. (3) The combination with the vacuum chamber of an air pump, a mercury reservoir, and tube connecting the same, of a tube for the escape of air from the vacuum chamber, and a cock or valve therein, an air inlet tube and exhaust tube connected to the mercury reservoir, a two-way cock for controlling the same, electro-magnets for operating the valves, and circuits controlled by the movements of the mercury, all as set forth. (4) The combination, with the valves or cocks *d m*, of electro-magnets and intermediate mechanism for operating the same, circuits including said magnets, and connected with contact points extending into the pump, so as to be brought into contact with the mercury, as and for the purpose specified.

312,985. Automatic Cut-out for Electric Apparatus, *James Du Shane, South Bend, Ind.—Filed May 15th*, 1884.

Claim.—(1) The combination, in an electric switch, of stationary contact pieces forming part of a short circuit connecting with the line circuit maker and breaker, and the flat springs and lever arm to hold the contact maker and breaker away from or against the contact pieces when initially started in proper direction, substantially as specified. (2) The combination, with the springs secured to a suitable support, of the

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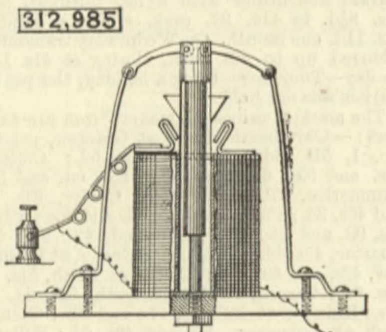

arms pivotted to the same, the vertical bar pivotted to said arms and extending into a vertical guide tube, the contact pieces secured to said tube and connecting with the line circuits, the bevelled lugs on the bar, and the operating rod having an adjusting nut, the whole arranged to be operated to short-circuit the current or send it through the carbons, substantially as specified. (3) The combination, with the springs, the pivotted arms, and the dependent bar and adjusting rod and its lugs, of the tube, its contact pieces connected with the line circuit, and the solenoid or helix surrounding the tube and connecting with the line circuit, whereby the rod is initially moved and operated in connection with the springs to short-circuit the current when the resistance at the carbons becomes excessive, substantially as specified.

313,091. Automatic Cut-out for Electric Circuits, *John B. May, Watertown, Wis.—Filed May 6th*, 1884.

Claim.—(1) In an electric cut-out, the combination of the spring branches F, the disc C, with stem K, the spring k^1, and the cord k, substantially as shown

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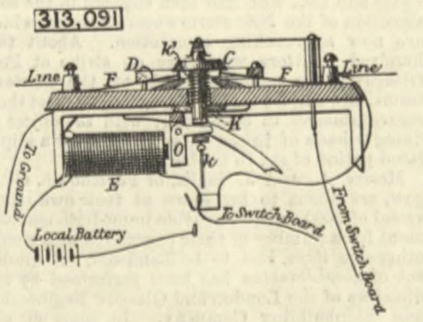

and described. (2) In an automatic electric cut-out, the combination of the spring branches F, the disc C, with stem K, the lever O, and electro-magnet E, substantially as shown and described. (3) In an automatic electric cut-out, the combination of the spring branches F, the disc C, with the stem K, the helical spring k^1, the lever O, and the electro-magnet E, substantially as shown and described. (4) An electric cut-out having a circuit maker common to branches from two or more electric lines, in combination with means common to all the branches, by which the distances between the contact points of the branches and the circuit maker may be adjusted at one operation. (5) An electric cut-out having a circuit maker common to branches from two or more electric lines, in combination with a ring of insulating material in contact with all the branches, and which serves by its pressure thereon to preserve a uniform distance between the contact point of the branches and the circuit maker. (6) The combination of the spring contact branches F F, &c., with the ring D and means—such as the set screws *d*—for ranging the spring contact branches in one plane by pressure of the ring D.

313,088. Tuyere, *William I. Mann, Benwood, W. Va.—Filed May 5th*, 1884.

Claim.—(1) In combination with the tuyere of a converter or other furnace, the plug provided with the stem, a spring and wedge, and a suitable bridge, substantially as described, and for the purpose set forth. (2) The combination, with the tuyere, of the plug and its stem, connected to the pipe *x*, and suitable mechanism for operating the plug, as set forth. (3) In combination with the tuyere, the perforated plug and stem, the coupling having the sight opening *g*, and

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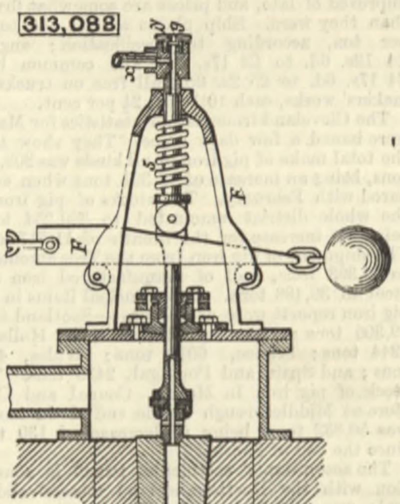

transparent diaphragm *y*, with mechanism, substantially as described, for operating the plug. (4) The combination, with the wind box, of the plug and its stem, and means for operating the same, and an adjustable stuffing box, substantially as described. (5) The combination, with the tuyere and the wind box, of the perforated plug and stem, the bridge E, provided with anti-friction rollers, a collar and rollers upon the stem, the spring 5, and the wedge F, all substantially as described.

313,299. Thrashing Machine, *Riley H. Coon, Canastota, N.Y.—Filed February 20th*, 1884.

Claim.—(1) In combination with the racks R R^1, grain tables O O^1, sieve shoe L, and rock arms T and U, the rock arm V, rod M, and the rock arms N and N^1, connected, respectively, with the grain table and

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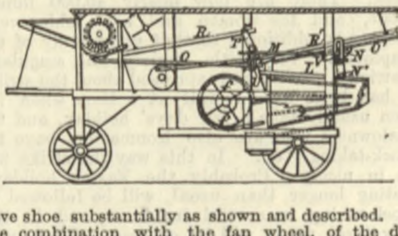

sieve shoe substantially as shown and described. (2) The combination with the fan wheel, of the diaphragms *f f*, arranged equidistant from the centre of the length of the wheel, and formed with central apertures, substantially as described and shown.

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