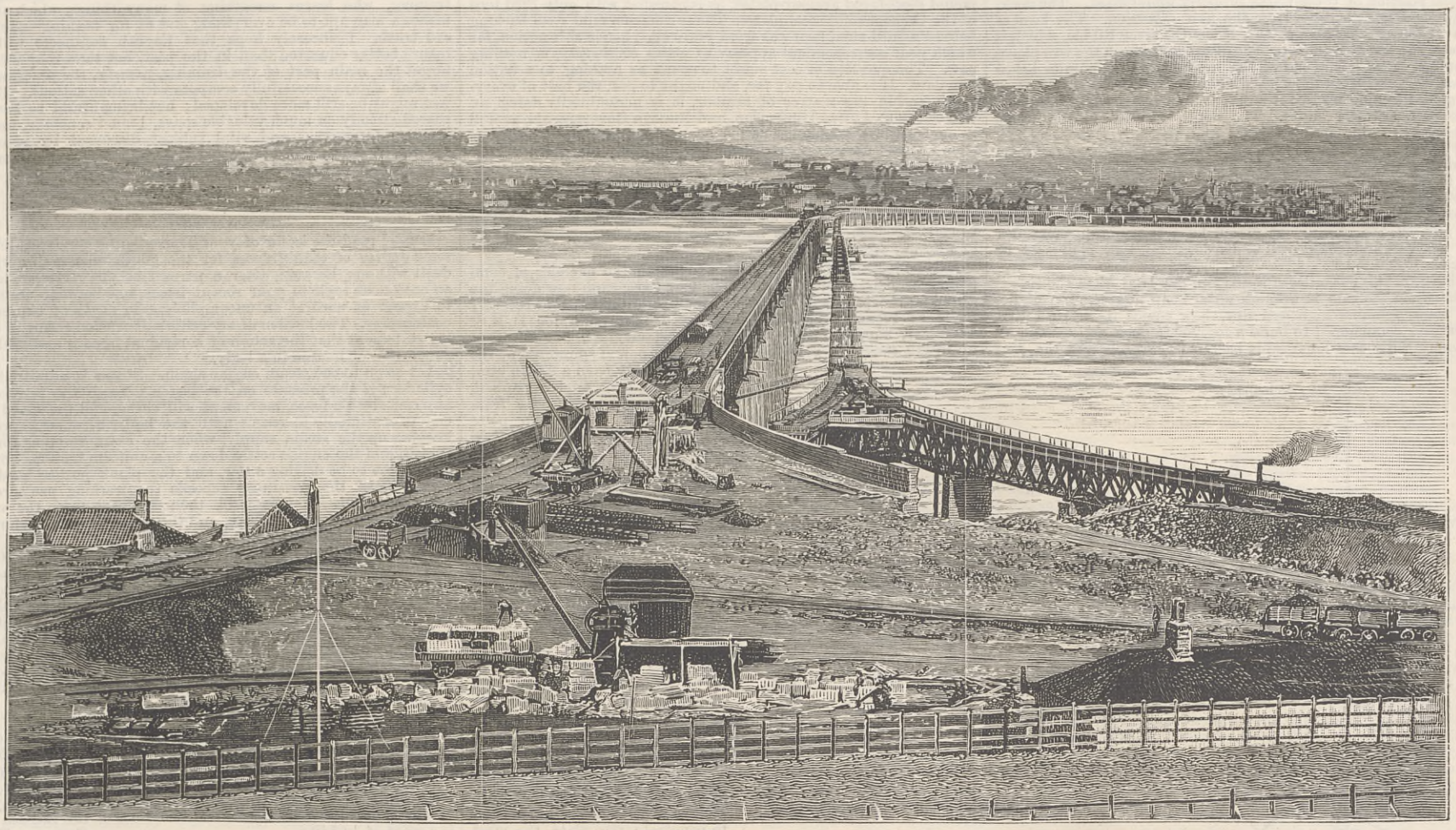
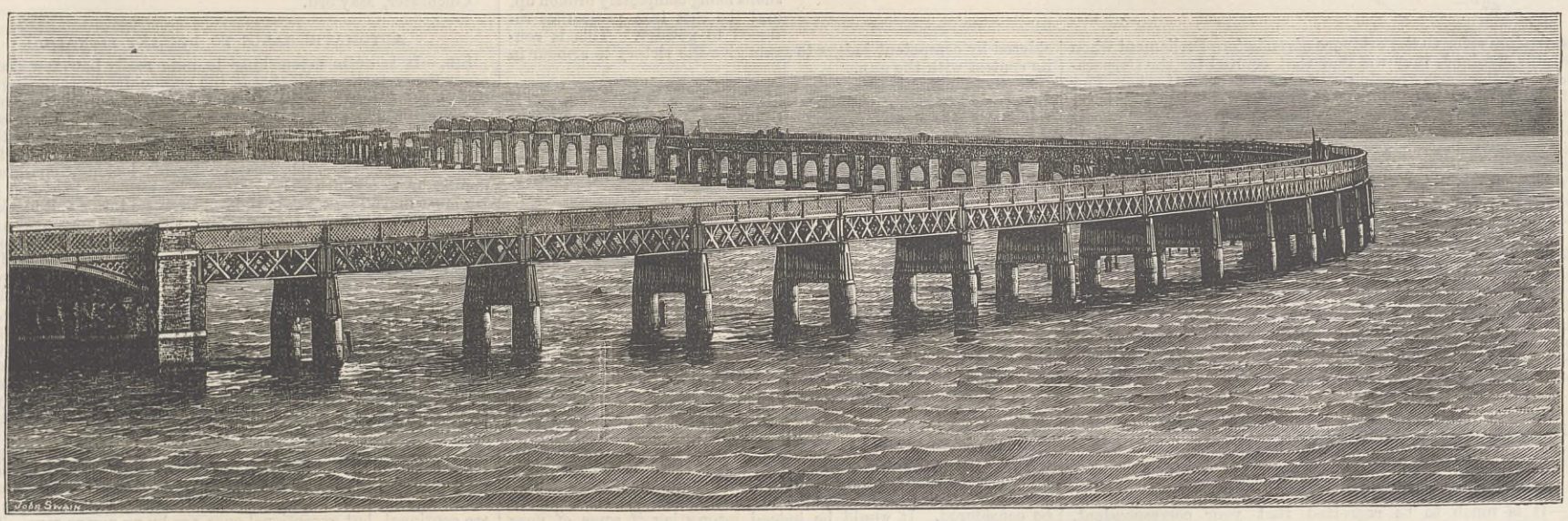
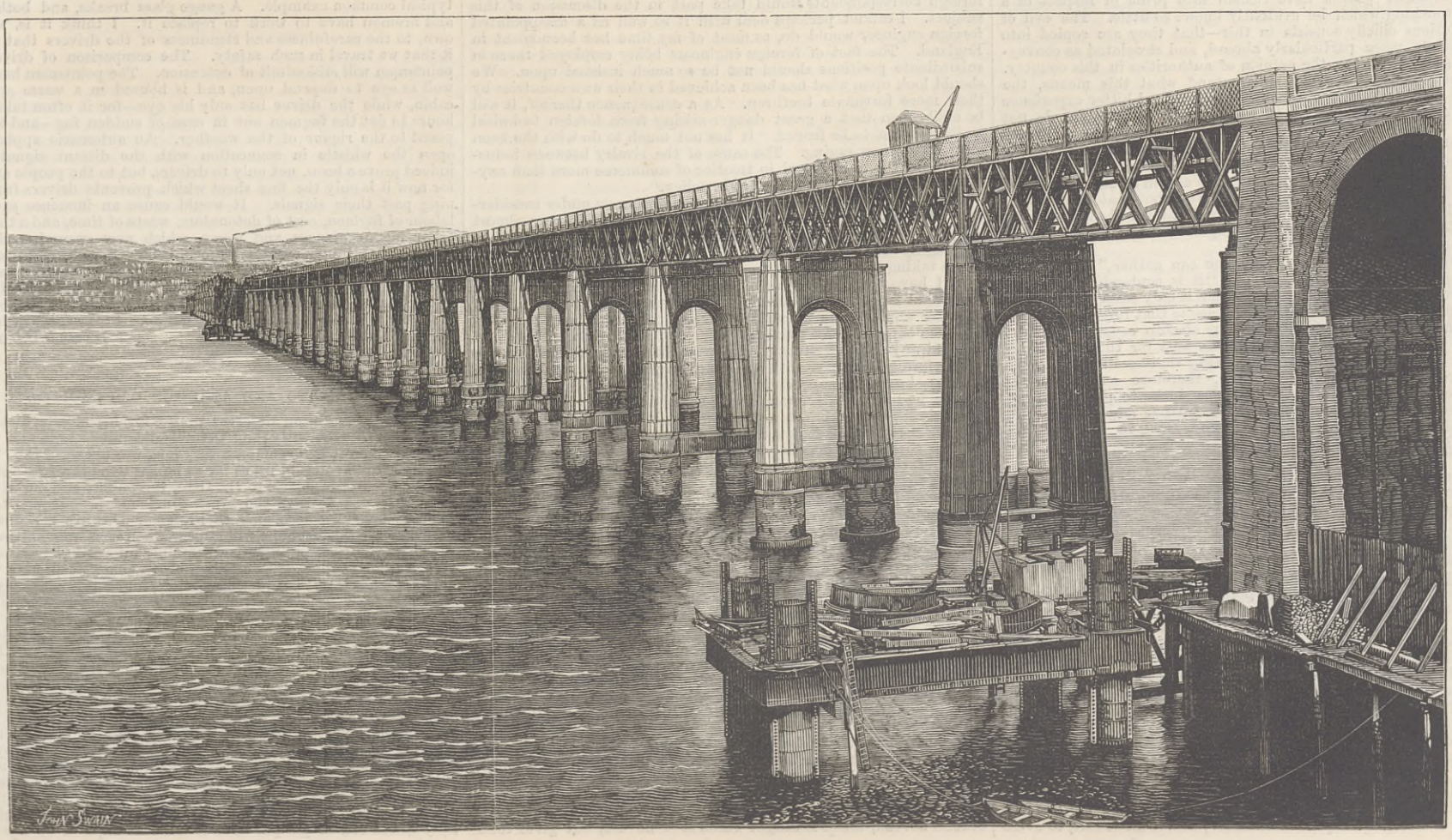
THE NEW TAY BRIDGE.

MR. W. H. BARLOW, M.I.C.E., F.R.S., ENGINEER.

(*For description see page* 370.)







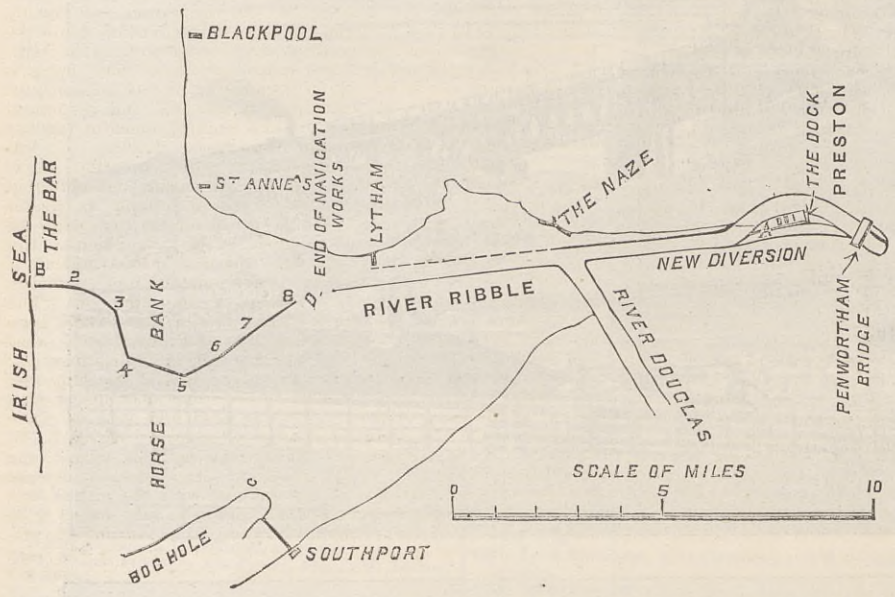
LETTERS TO THE EDITOR.

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

PRESTON AND THE RIBBLE NAVIGATION WORKS.

Sir,—The accompanying map of the Ribble estuary will perhaps make the position of these works properly understood. The dock, you will observe, is entered from the new diversion. The level of new diversion at A on plan is 20ft. below the river Ribble, which is 4ft. above the bar at B on plan. The distance between the two places is seventeen miles. The end of the works is about a mile below Lytham Pier, and from there to the bar across the Horse Bank is seven miles; in a direct line it is about five miles. The numbers on the plan are the buoys. The depth of water in the Ribble channel at low-water spring tides is such that a boat drawing 3ft. cannot get from Lytham to the sea. The bed of the river from Lytham Pier to the new diversion is a length of nine miles; at Lytham depth to be lowered from 10ft. to 12ft.; at new diversion, 20ft.; and 100 yards wide, and as the dock sill is only 4ft. above the bar, that length from Lytham to the dock will be virtually a dead level; and as the channel at No. 8 buoy is something like 6ft. above the bar, and composed of hard gravel, how is this to be dredged?

As there are this five miles of sands and dry land when the tide is out, and when the tide is up high-water neap tides the top of the Horse Bank remains high and dry, how comes it to pass that Preston ever commenced to build a forty-acre dock and expend all this money with this impassable barrier between it and the sea?



If your readers refer to the evidence given before Parliament when the Bill was obtained, they will find that counsel for the Corporation said that the south training wall—a mile below Lytham Pier end of these works—ended in deep water. Mr. Garlick, C.E., engineer of the works, gave evidence that a large vessel could come up from the sea to Lytham at low-water spring tides certainly. Captain Richardson gave positive evidence that the depth of the low-water channel from Lytham to the sea was from four to five and six fathoms; and Sir John Coode, K.C.M.G., C.E., told the Committee that the channel from the south training wall to the sea would not require any dredging, ["so far as neceasary; but comparatively little dredging would be necessary"] as Captain Richardson had already told the Committee the channel was 30ft. deep. How all this is to be reconciled I do not know. The actual facts and the evidence given before Parliament are diametrically opposite. Why talk of 30ft. deep, when there is one length at least between the buoys that has not 3ft. The fact is that at the end of these works is a barrier five miles long of impassable sandbanks out in the Irish Sea.

The Admiralty chart corrected up to 1885, No. 1826, Lancashire coast, confirms my plan of the Ribble estuary.

G. Henry Roberts, C.E.

87, Fishergate Hill, Preston, May 3rd.

ARMOUR-PLATES.

Sir,—It is much to be regretted that your correspondent, "Sheffieldiensis," should have rushed into print in respect of a matter touching which he evidently knows so little. The evil of such effusions chiefly consists in this—that they are copied into hostile prints, more particularly abroad, and circulated as conveying facts and reflecting the opinion of authorities in this country. If "Sheffieldiensis" does not understand what this means, the Sheffield manufacturers concerned do, having had bitter experience of the unscrupulous tactics to which their competitors do not hesitate to resort. But your correspondent ought to have known better than to assume the accuracy of a statement as to the Government going to France for solid steel armour. The Government knows better. They have tried to obtain a solid steel plate from Schneider and Co. for purposes of test, but that firm knows better than to send one. They are well aware that the result would do themselves infinite damage, and the Sheffield manufacturers equal good.

"Sheffieldiensis" says, "so far as he can gather," the Creusot plates are made wholly of steel, and "it is contended they give better results on trial than ours," which is only what might have been expected." He then proceeds to argue that because steel has taken the place of iron for the purpose of ship construction, and also for boilers, therefore it must be the best for the purposes of defence. It would be as reasonable to say that because the substitution referred to has taken place, therefore steel must be better for everything in which iron has hitherto played a part, which is an obvious absurdity. He further adds that as the result of a "conglomerate" of iron and steel in the manufacture of armour, "our plates are beaten in the test, and well they may be."

It is difficult to treat with patience such rash and haphazard statements as these. No evidence is produced to support them, and they are made as if with the deliberate and malignant object of doing an injury to the Sheffield manufacturers. So far from the compound plate being beaten in the test, the exact contrary is the fact, and reports accessible to your correspondent, as well as to others, are conclusive upon the point.

I would recommend your correspondent to read an article in the New York *Army and Navy Journal*, of the 12th March, pages 653 and 654, containing information concerning the behaviour of the solid steel plates, made by Schneider and Co., which ought to give him a different impression of the merits of the two systems, and of the conduct of the Government in continuing the use of the steel-faced plates. As a matter of fact, solid steel plates were made by Sheffield firms so far back as 1878, of quite as good a quality and as suitable for the purpose as can be, or are being, made at the present day, but the results of the official tests were unsatisfactory. The French firm have since made no advance in the manufacture, and the weaknesses inherent in the solid steel plate remain as pronounced as then. A large proportion of the Creusot plates crack before they are put upon the ship's side when made hard in the attempt to resist the impact of the shot; and if made soft, to avoid cracking, they are perforated by the shot as easily as the wrought iron plates were before the adoption of the compound plate created a revolution, and once more wrested the superiority from the gun.

Finally, if anything will convince "Sheffieldiensis," this fact surely will, that the French Government, according to a recent statement, have ordered since the year 1880 15,196 tons of compound steel-faced armour-plates, as contrasted with only 7986 tons of the Creusot solid steel plates. The system of a mild steel backing behind a hard steel face was tried years ago; hence this notion, for which your correspondent appears to claim originality, is nothing new. The question of cost ought to count as nothing to a nation like ours. It is able to pay for, and ought to get, the best of everything, and in the matter of armour, it is undoubtedly doing so. The German, Austro-Hungarian, and Russian Governments, as well as our own, use compound plates exclusively, and the French, as shown above, use compound plates to practically twice the extent of solid steel.

I cannot conclude without expressing contempt for the cowardice of "Sheffieldiensis," in vilifying the motives of a man now dead, and who therefore cannot answer him. It seems to me disgraceful to make accusations of the nature he has written under the cloak of a *nom de plume*.

As an illustration of the devices to which the enemies of compound armour resort, I may refer to a paragraph now going the round of the papers to the effect that in an experiment recently made as 10½in. "Cammell" steel-faced iron plate for H.M.S. Trafalgar, supposed to be able to withstand the fire of any guns up to 110 tons, was completely smashed up and splintered at the first discharge from a 25-ton gun, which had been twelve years in the service. This is false from beginning to end. The plate referred to was not for H.M.S. Trafalgar, but an experimental plate made by Messrs. Cammell, and the highly satisfactory results obtained from it were reported in the *Times* of the 9th April. A 10½in. plate could not be expected to withstand the fire of any guns up to 110 tons. The plate in question was not completely smashed up and splintered at the first discharge, but after successfully resisting the impact of the usual service test of three chilled projectiles fired at a range of 30ft., disposed at the points of a triangle, which produced no penetration whatever, the projectiles being broken up into small fragments, the plate was attacked at its edges by a forged steel shell, a cast steel shell, and a cast iron shell, all of foreign manufacture. None of these managed to penetrate the plate, the steel shells being completely broken up, and the cast iron projectiles reduced to powder. This is considered by competent judges to again give the victory to armour in its contest with the gun.

Sheffield manufacturers do not require any spur from "Sheffieldiensis" to keep pace with the times. If solid steel ever comes to behave better under proof than compound armour, they will make it, but neither they nor the British Government are prepared to adopt the worst in lieu of the, at present, best known defence for ships at the bidding of mere doctrinaires. W. B. G.

Sheffield, May 7th.

THE EDUCATION OF ENGINEERS.

Sir,—I am glad to see that in an interesting leader of your last week's number you take up again this important subject. You had, however, directed, from time to time, the attention of your readers on this matter, and I remember having contributed to your correspondence columns some years ago on this very same subject. I do not, however, see any cause to alter the opinions I then expressed, and I think they were in perfect harmony with those you advanced in your last issue. The growing tendency there is to create in every English university courses of engineering for the purpose of delivering to successful students certificates or diplomas, does not seem to meet with much favour on the part of the practical members of the profession. It is not the thing itself which is to be objected to so much, but the way it has been carried out. No cause can be found in referring to what is done on the Continent. The fruit of technical education as it is given abroad should alone be considered. It would be indeed interesting if some of your foreign correspondents would take part in the discussion of this subject. I cannot perhaps deal with it so well as a disappointed foreign engineer would do, as most of my time has been spent in England. The fact of foreign engineers being employed there in subordinate positions should not be so much insisted upon. We should look upon what has been achieved in their own countries by their more fortunate brethren. As a consequence thereof, it will be easily seen that a great danger arising from foreign technical training is not to be feared. It has not much to do with the keen competition now raging. The cause of the rivalry between industrial nations is to be found in treaties of commerce more than anything else, and in a blind free trade policy.

Since I wrote my first letters on the subject now under consideration, I have been a good deal on the Continent. Being almost daily in contact with foreign engineers, I had opportunities to thoroughly study the ills wrought by a system which I am not afraid to see taking root in England.

As I have been myself a greatly disappointed man, nobody will think that I am writing without knowing the subject. No English engineer would be considered abroad as a competent man if he has not been through some university course of engineering. He could not find any suitable situation any more than we should entrust the young foreign engineer with a responsible post in our workshops, if he has not served an apprenticeship as we understand it in England. I have had some bitter words with some foreign stuck-up professional brethren; it is often exceedingly difficult to manage with inexperienced men, but it is far worse when these think that owing to their theoretical training nobody else is right but they. As a result of the system we do not find many English engineers in foreign companies, nor many foreign engineers in English concerns. Let me add also that the high technical education now given at engineering schools and universities have had for results to keep away from the business a great number of men who had special predilection for it, but who, although intelligent, did not grasp sufficiently higher mathematics, for, as you know, it is erroneously believed abroad that mathematics are the basis of engineering. It is undeniable at the same time that these same universities have turned out first-rate men in other careers of a more scientific nature.

The foreign engineers have not created anything remarkable, and one may say, without exaggeration, that they borrow English ideas rather freely. Let us also note that the greatest mechanical engineers—not to speak of other branches—are nearly all Englishmen, who, besides, have not had the privilege of a very special schooling, if they had any.

However, it cannot be denied that apart from a thorough acquaintance with their business, many English engineers are in a state of deplorable ignorance. It is not necessary to know much to be on the same footing as a foreign engineer, only this knowledge consists of sound principles, for I am aware that in technical schools abroad, much is taught which is of no use, but gives false ideas to the future engineer. I do not exactly agree with the saying that an engineer should know three or four languages and the rule of three, and not bother about logarithms. I think this an exaggeration. I maintain that an engineer should know both; the use of logarithms is so easy that a boy of thirteen could master it. It is not a bad help in some calculations of a lengthy character. But still we are far away from the foreign engineer's training, who learns something of many things, which after all makes a man apt to be everything and fit for nothing—such is the sad truth. I sincerely hope that English engineers will be in future better educated than in the past, but that they will never forget the main part of the training, namely, the practical; thus we shall always successfully compete with other nations. This subject might be still more developed; but being afraid to have trespassed already on much valuable space, I must conclude, hoping to see this interesting and vital subject discussed by pens more authorised than mine. Ed. Gobert.

7, Ducie-street, Longsight, Manchester, May 10th.

NEWTON'S THIRD LAW.

Sir,—I read the letter of your Transatlantic correspondent with some degree of thankfulness for the gentle manner in which he dealt with me, because, after a perusal of the correspondence on an analogous topic in your recent issues, one becomes accustomed to expect as natural an uncomplimentary mode of expression in controversy. The burden of my critic's dissension seems to be with my statement that the action of a residual force is essential to the generation of motion in a body.

Let us go to the steam engine again. Steam is admitted to the cylinder; if the pressure on the piston exceeds the resistance by any conceivable force, movement will ensue, and the speed of the engine continually increases until the boiler becomes incapable of keeping up the steam supply, when the extra starting force will vanish, and the engine settle down to a uniform motion. Suppose the engine to be driving a saw, and the plank pushed harder and harder until the resistance exceeds the working pressure; this additional resisting force will then subtract from the velocity attained by the starting force, and the speed of the machines will fall from uniformity to zero.

I maintain therefore that the resistance is an imaginable fraction greater than the power during the stopping of the apparatus. But further on your correspondent says that, "If the power be constant and inertia is the resistance, acceleration is required to enable them to equal each other," and here I see the fundamental difference between us. Mr. Lancaster finds the missing force in the inertia—in other words, the power proper + residual force = resistance proper + inertia. Want of space constrains me to leave the matter at this point, merely expressing a doubt as to the scientific propriety of classifying inertia as a force.

I ventured to call the third Newtonian statement a "mystic law" because of the extreme difficulty in grasping its meaning, compared with the easy understanding of the other two. No sane being would doubt the truth of the law, but there is plainly a lack of clearness in conceiving its true meaning. Perhaps it may to an extent prove the declaration Mr. Matthew Arnold made a year or two ago, that the great characteristic defect of the English people is a want of lucidity. Stephen Eddy.

Colchester, May 3rd.

AUTOMATIC CALLS TO DISTANT SIGNALS.

Sir,—It is quite astonishing to note really how few accidents occur through the negligence of the engine-drivers in paying attention to their signals, when we take into consideration the number of things which occupy constantly his undivided attention. A pointsman is constantly having his attention called by bells, telephones, and other contrivances, besides being prevented from making any considerable mistake by his locking apparatus. A pointsman to make a mistake must be either a knave or a fool. He must indeed be careless to let a train go into a full block when he has "line blocked" before him. Automatic apparatus are also being from time to time brought out to remove this possibility also, small as it is. The driver has only his sight to depend upon, although his attention is being continually called to the working of his engine. He has, as everyone knows, to instruct his fireman—for whose work he is responsible—attend to gradients, keep looking back to see that the whole of his train is following, keep his hand and mind on his reversing lever or wheel, to work his engine economically and to time, besides hosts of other matters which are always tending to engross his attention. When we add to this the rule, "that he is to keep his attention constantly fixed on the road, and to keep a sharp look out for signals," I think that we have something more put down for his attention than is generally comprised in the whole duty of man. A man travelling some three hundred miles a working day, as many do, and keeping his eyes continually on the *qui vive*, so to speak, has indeed a very severe tax on his eyesight. These, of course, are difficulties which are continual, but exceptional ones are by no means rare. Take a typical common example. A gauge glass breaks, and both driver and fireman have to work to replace it. I think it is, we must own, to the carefulness and steadiness of the drivers that we owe it that we travel in such safety. The comparison of driver with pointsman will still admit of extension. The pointsman has ear as well as eye to depend upon, and is housed in a warm and light cabin, while the driver has only his eye—for it often takes some hours to get the fogmen out in case of sudden fog—and that exposed to the rigour of the weather. An automatic appliance to open the whistle in connection with the distant signal would indeed prove a boon, not only to drivers, but to the people at large, for now it is only the fine sheet which prevents drivers from running past their signals. It would cause an immense saving in labour of fogmen, cost of detonators, waste of time, and a thousand other inconveniences, and worse, which now encumber the railways. Such things have, I believe, been before brought forward, and have only been discarded because—so it was said, forsooth—they would tend to make the drivers careless. On re-reading my letter it seems rather didactic, but I hope this will be pardoned, as it is only intended to stir up a discussion. I may seem rather prejudiced, but I am not a driver. Harold D. Smith.

Crewe, April 6th.

THE OTTO AND ATKINSON GAS ENGINES.

Sir,—Mr. Atkinson deserves praise for his efforts in the gas engine field. Obviously the "Otto" is difficult to beat, and though in our opinion it still remains a very long way ahead of the "Atkinson," yet to have crept up so far as he has done is a feat not to be despised. But in justice to Dr. Otto, the public, and ourselves, we must ask you to give the same courteous prominence to what follows as you are according to Professor Unwin's account. The necessity for this we hope will appear when it is remembered that the tests you have published are mainly interesting because they record results supposed to be superior to those at present obtainable from our latest productions; while, impossible as it may seem, they rely for comparison on trials made a number of years ago in Germany, or on others made by competitors in this country behind our backs and under circumstances of which we know nothing. It seems to us that before putting forth statements of this kind it would have been better to have inquired what the other side had to say; but that is a point we can safely leave to your readers.

We cannot go into long particulars at this moment. We confine ourselves to a few salient facts. We shall compare one of our recent 4-horse power engines with the 4-horse power Atkinson referred to. Our engine has a 7in. diameter cylinder by 15in. stroke. The Atkinson has a 7½in. diameter cylinder by 9½in. or 10½in. stroke alternately. We used one of the former here lately for electric lighting, and made some very careful tests at the end of last March. In comparing these with the Atkinson engine, we have added 5ft. of gas per hour to the consumption of the latter

as the amount required for igniting purposes was neglected in Professor Unwin's tests, but included in ours:—

	I.H.P.	B.H.P.	Gas per hour per brake H.P.	Gas running idle per hour.
New Otto 4-H.P. ..	7·5	6·3	24·5ft.	28ft.
New Atkinson 4-H.P.	5·811	5·25	23ft.	42·42ft.

It will be seen that while running idle the "Otto" 4-horse power uses, say, 33 per cent. less gas than the Atkinson, but while running fully loaded the Atkinson uses, say, 6 per cent. less than the "Otto." As in practice engines rarely work beyond one-half to three-fourths of their maximum power—see report made on a great number of Birmingham steam engines referred to in Sir F. Bramwell's address before the Inst. of Civil Engineers in 1885—it will appear that the balance of economy lies largely with the "Otto." This is apparently borne out by Professor Unwin's statement in regard to the action of the governor of Atkinson's engine which while running idle gave gas once and "suppressed" it twice. In the "Otto" the "suppressions" are often twice as numerous as this. But even if the gas consumption were against the Otto, it would require a very marked saving to warrant the cumbrous contrivances which Mr. Atkinson has been obliged to introduce. Their weight, appearance, and cost of manufacture are points which force themselves upon the attention, and must leave the "Otto" an easy winner.

The gas used for our trials was that supplied by the Manchester Corporation Works at Bradford. We have found it inferior to what we had when our works were situated in Great Marlborough-street, in the heart of this city, and on sending some to be analysed by Professor Dewar at the Royal Institution, London, he reported it as inferior to the gas he obtained there from a London company.

Openshaw, Manchester, May 11th. CROSSLEY BROTHERS, Limited.

PROFESSORS AND STUDENTS.

SIR,—Your correspondent "J" supports his employment of the phrase "rate of acceleration," by references to "Rankine on the Steam Engine." His reference is certainly rather far fetched. Not to mention that the "Steam Engine" was published more than a quarter of a century ago, since which time our scientific phraseology has been thoroughly revised by Thomson and Tait, and other logical writers; the weakness of "J.'s" case is shown by his requiring to refer to a treatise on the steam engine for the definition of a term in kinematics. He takes care not to indicate what Rankine says about the matter in his later treatise dealing especially with that department, the "Applied Mechanics." I have no doubt he has already consulted paragraph 361 of that work, where Rankine states that "rate of variation of velocity is called acceleration," and not rate of acceleration; "J.," however, was desirous of winking at this. If "J." will refer to Clerk Maxwell's "Matter and Motion," he will find that a whole article—33—is devoted to the very subject under discussion, being headed, "On the Rate of Acceleration;" he will there read the dismissal of this phrase from the terminology of science. For the last words of the article are these:—"In future, therefore, when we use the word acceleration without qualifications, we mean what we have here described as the rate of acceleration."

I do not think there is anything else in "J.'s" letter which requires answering. I completely fail to understand what Mr. Shairp means. If "Dynamics and Kinetics" take cognisance of mass, and mass means quantity of matter, I fail to see how "Dynamics and Kinetics" do not take cognisance of matter. J. T. N.

Edinburgh, May 10th.

STREET-PAVING.

SIR,—I have often noticed with pain the suffering endured by horses in our streets during wet weather, in consequence of their slippery state, especially if the road is at all inclined; and is it not strange that so little is done to remedy this state of things? Would not some good be done if the following plan was adopted—*i.e.*, to construct at the upside of the roadway, wherever there is an incline, a causeway, the width of an ordinary vehicle, paved in the centre with small rough stone blocks, and at the sides with long smooth ones; thus, while no opposition is offered to the wheels, just what is needed—a foothold—is afforded to the horses. Only heavy laden vehicles need use this causeway; others could run on the ordinary pavement of wood, asphalte, granite, or macadam. Surely considerations of kindness should warrant the adoption of this plan, and as it is in operation on Westminster Bridge, why not elsewhere, where more needed? Perhaps some of those who see this, and who have influence in these matters, will do all they can to secure its adoption. Surely they will not object, if they pity the suffering of poor dumb creatures. H. S.

49, Southampton-street, Camberwell, May 2nd.

TOOTHED *v.* ROPE GEARING.

SIR,—In your issue of the 6th, inst. in your notice of the Manchester Jubilee Exhibition, you make some remarks respecting the use of ropes as against tooth weels for main driving purposes in cotton mills, &c., and you go so far as to say that the days of tooth gear for this purpose are ended. It is, however, too soon as yet to make this assertion. On the grounds of first cost, economy when working, convenience, steadiness and trustworthiness, good tooth gearing will hold its own—indeed, in the places where rope and strap driving have had the longest trial, the tendency is now to go back to wheel gearing. I know a leading firm of wheel makers here who have in hand at the present time some half dozen main driving wheels or the tooth rims for them. Of course a great deal depends on the kind of wheels people buy; in this, as in other things, there are good and indifferent articles. MANCUNIENSIS.

May 9th.

THE ASSOCIATION OF MUNICIPAL ENGINEERS.—The following gentlemen, having satisfied the examiners at the examination held in London on the 22nd and 23rd ult., have been granted certificates of competency by the Council of the Association, viz.:—C. Adcock, Livetpool; F. E. Cooper, Liverpool; H. Dearden, Leeds; S. W. Franks, West Bromwich; A. E. Nichols, Leeds; F. J. Nichols, Leeds; E. W. Rich, Poplar; J. Saunders, Newark-on-Trent; B. Verschoyle, Liverpool. The next examination will be held in Manchester in October.

INSTITUTION OF CIVIL ENGINEERS.—The Association of the Birmingham Students of this institution held their usual fortnightly meeting on the 5th; Mr. E. Pritchard, C.E., presided. Mr. W. B. Purser, in reading his paper upon "Leamington Waterworks," explained that previous to the year 1832 Leamington depended upon private wells entirely for its water supply. From that year until 1879 the water supply to the town was obtained by pumping from the river Leam. In 1879 the present waterworks were opened. The water, as supplied to the town, is now obtained from an artesian well 112ft. deep, from whence it is pumped into two covered service reservoirs, each capable of storing 500,000 gallons; the scheme is the system known as constant service at high pressure. Leamington experienced a three years' drought in the years 1883, 1884, and 1885, when adits were driven for a distance of about 300ft. from a small well—about 50ft. from the artesian well—in search of new fissures to increase the supply; such driving did not, however, materially increase the quantity of water obtainable. To ensure greater pressure for special circumstances in times of fire, &c., a standpost 40ft. high has been erected. The present consumption is upon an average of 24 gallons per head per diem.

LEGAL INTELLIGENCE.

QUEEN'S BENCH DIVISION.

(*Before the* LORD CHIEF JUSTICE *of* ENGLAND *and a Special Jury.*)

SHAW, SAVILL, AND ALBION COMPANY *v.* BELL-COLEMAN REFRIGERATING COMPANY.

THE trial of this action took place a short time ago, and ran through ten days. It was brought to recover damages which it was alleged the plaintiffs had sustained owing to a breach of contract by the defendants. The defendants denied the alleged breach.

The Attorney-General—Sir R. E. Webster, Q.C., M.P.—Mr. Bigham, Q.C., and Mr. Robson appeared for the plaintiffs; Sir Henry James, Q.C., M.P., Mr. Bucknill, Q.C., and Mr. Witt were for the defendants.

The manner in which the present action arose was shortly as follows:—It appeared that the plaintiffs, who are a well-known London firm owning a large fleet of steamers employed in carrying meat from New Zealand to this country, in October 1883, by letters, entered into a contract with the defendants, under which the latter undertook to fit up, on board a vessel called the Florida, belonging to Nelson, Donkin, and Co., and chartered by the plaintiffs, two of their refrigerating meat chambers, complete, as to fittings, piping, connections, &c., in every respect. The chambers were placed immediately above the waterways of the vessel, one in No. 1 and the other in No. 2 hold. These chambers were surrounded on all sides by a wooden casing, about 10in. through, containing charcoal, which is employed for purposes of insulation. Connected with these chambers are two engines, placed on the 'tween decks, which are used to pump cold air into their respective chambers, and so to keep down the temperature. The Florida sailed from the Thames for New Zealand in January, 1884, and, having arrived out there in due course, returned to this country with a cargo of frozen meat in her refrigerators. All went well, apparently, until, on April 10th, an excessive amount of water in the main hold was reported to the ship's engineer, whose duty it was to pump out, with his engines, all accumulations of water in the bilge bottoms. It was found that the pumps failed to extract the water, which ultimately rose and flooded the charcoal insulating cases, and in the result a large quantity of the meat in the refrigerating chambers was so spoilt that it was thrown overboard. The cargo-owners had recovered heavy damages from the plaintiffs in a former action, and it was now a part of the plantiff's case that they had defended that action in the interests, and with the acquiescence and assistance, of the present defendants, and the plaintiffs now claimed in addition to damages, the costs—viz., £3000—incurred by them in defending it. The plaintiffs alleged that the damage in question was the direct result of the defendants' negligence in fitting up the two refrigerating chambers. They alleged that the defendants had hurried over and scamped their work in connection with the woodwork of the charcoal casing around the chambers, and that this work was so inefficiently done that large quantities of charcoal dust had found its way through chinks and cracks, and so finally down into the ship's bilge bottoms. It was also alleged that the scupper pipes which were fitted by the defendants to their refrigerating engines in order to carry off from them refuse oil, water, &c., were discharged direct into the ship's bilge, which was unusually narrow—the vessel being a tank ship—instead of in the manner usual with tank ships, through the engine room or direct overboard. The consequence of this alleged negligence was, the plaintiffs contended, to cause a coagulated and conglomerate greasy mass, which so completely choked up the strum of the pipes by which the bilge bottoms were pumped dry that the pumps could not do their work, and hence the flooding of the refrigerators, as described above. On the other hand, the defendants denied entirely that they had inefficiently or improperly fitted up these chambers, either as to woodwork, piping, or engines. If the wood casing gaped at the joints, and so let out the charcoal, it was suggested by them that it was due to abnormal straining of the vessel and chambers while on her outward voyage to New Zealand, owing to her having carried a cargo of heavy iron bars or rails. It was also stated that it was the duty of the ship to have cleaned out her bilges before leaving New Zealand—which it is alleged had not been done—and so to have started clean, and it was suggested that the choking of the pipes which led to the damage had been caused by an old accumulation of dirt, coal dust, &c. The ship's logs showed clearly that up to the date of the flooding the pumps had been regularly worked and had done their work. As the learned judge put it when summing up, the damage was no doubt caused by some refuse in the bilge bottoms choking up the strum of the pipes leading to the pumps. Whether its presence was due to the fault of the plaintiffs or the defendants was for the jury to determine. The defendants also denied that they were substantially the defendants in the former action by the cargo owners against the present plaintiffs, as alleged, or that they—the defendants—had assisted at or acquiesced in it. The evidence was of a very voluminous nature, and at the close of the case,

The LORD CHIEF JUSTICE summed up at considerable length and with great care, dealing with the case in a twofold form, first, as to the claim for damages on the breach of contract, and, secondly, on that as to the costs incurred by the present plaintiffs in defending the former action. The questions were entirely for them, and he would express no opinion beyond saying that as to the latter point he did not think the evidence was conclusive either one way or the other. His Lordship finally left the following questions to the jury, viz.:—(1) Were the defendants guilty of negligence in fitting up the refrigerators? Answer.—Yes. (2) Was the damage to the cargo caused by the defendants' negligence? Answer.—Yes. (3) Was the damage caused or contributed to by the negligence of the plaintiffs? Answer.—None that caused, but only such as contributed to the damage. (4) Was the former action defended by the instructions of the present defendants? Answer.—No. (5) Was it defended with the knowledge and consent of the present defendants? Answer.—Yes. (6) Was the defence of that action by the present plaintiffs reasonable? Answer.—Yes.

After an absence of nearly two hours the jury returned into court and answered the questions as above stated, upon which

Lord COLERIDGE said he would allow either party to move for judgment, and added that at the moment he could not say what was the legal effect of the findings. His Lordship certified for a special jury.

On the 6th inst. the case came on again before Lord COLERIDGE and Mr. Justice A. L. SMITH.

The ATTORNEY-GENERAL and Mr. ROBSON argued for the plaintiffs, urging that the effect of the findings was virtually in their favour, the finding as to their negligence having conduced to the damage being, they contended, immaterial.

Sir HENRY JAMES and Mr. BUCKNILL, Q.C.—with Mr. Witt—argued for the company, the defendants, contending that if any cause of action was shown, which they denied, as all the company had contracted for was to set up their machinery, which they had done, there could not be, according to the findings, any judgment for damages.

In the result, after long arguments which occupied the whole of one day and part of the next, the Court came to that conclusion—that is in favour of the company, the defendants, except as to nominal damages.

Lord COLERIDGE, who had tried the case, said he had himself desired that a motion should be made for judgment that it might be argued and discussed, as he had felt himself somewhat embarrassed by the findings of the jury in the case. These findings, he considered, were abundantly supported by the evidence, and their findings were these—That there was negligence on the part of the defendants, which had produced damage to the cargo; but that though no negligence on the part of the plaintiffs had caused the damage, still that such negligence had "contributed" to the damage. Now, the plaintiffs claimed £12,000 damages, and upon these findings it was impossible to enter a verdict for that amount; and, if not, then for what amount was it to be entered? The findings came to this—that though there had been a breach of contract, yet that the damages had not been entirely caused by the breach of contract by the defendants. What was the result? It was for the plaintiffs to make out their case, and they had not made out any damage resulting from the breach of contract—that is, to any particular amount, it was all left uncertain. That being so they could only be entitled to nominal damages, and as he did not think they were entitled to recover the costs of the prior action, there could only be a verdict for the plaintiffs for a farthing damages.

Mr. Justice A. L. SMITH concurred.

THE INSTITUTION OF CIVIL ENGINEERS.

THE twelfth annual dinner of the students of this Institution was held at the Holborn Restaurant last Friday evening, about 125 being present. Mr. Edward Woods, president, who occupied the chair, proposed the health of "The Queen and the Prince of Wales," and was followed by Mr. F. Walter Scott, chairman of the students' committee, who proposed "The Institution of Civil Engineers," and in doing so referred to the growth of its numbers from 128 all told in 1828 to over 5000 at the present time, including the not unimportant body of 900 students. He asked Mr. Woods to describe his own progress in the profession, and concluded with a few remarks about the students' meetings, the attendance at which, he pointed out, was capable of improvement. Mr. Woods, in reply, said he owed a debt of gratitude to the members of the Institution for placing him in his present position. The success of the Institution was mainly dependent on the early training of its members, and no doubt the present students would do credit to it. The advantages for learning were now much greater than in his early days, when, owing to the absence of special schools of engineering, it was necessary for a young man to pick up knowledge in the field and by private study. He himself had had no special training when he was first appointed on the Liverpool and Manchester Railway. It was becoming more and more necessary to apply scientific knowledge, instead of following routine and using cut-and-dried formulæ; and although students could not hope to master every science, they might obtain a moderate knowledge of most. "The Guests" was proposed by Mr. R. Skelton, and replied to by Mr. W. Anderson, who said that it was difficult to represent the numerous guests of the new generation of engineers, but engineers were frequently obliged to undertake jobs which their hearts sank at. Powers of speech, he said, were almost more necessary than some scientific knowledge, and referring to what had been said concerning the students and their meetings and papers, said both this knowledge and the power of speaking well upon a subject were to be attained by attending meetings, writing papers, and meeting criticism. No one knew how little he knew of a subject until he commenced to write upon it. Mr. E. L. W. Haskett-Smith then proposed "The Secretaries," and spoke of the great interest they took in the students. Mr. Forrest compared the present great privileges of the students with the very modest requests of the first members of that class, who only wished to be allowed to use the rooms of the Institution; and concerning the success or failure of an engineer, said, in the words of the very artistic invitation card which the students' committee had sent out—*Aid toi et le ciel t'aidera.*

Mr. J. Wolfe Barry then proposed what he claimed was the toast of the evening, namely, "The Students," and traced the development of the class from the time of its starting in 1866 up to the present time, mentioning as one feature the growth of a feeling of good fellowship among them. He said the Council had considered the subject of an examination for students, and he himself hoped they would decide to have one. Mr. F. W. Scott replied, giving some facts about the present state of the class and the work of their committee. "The Local Associations of Students" was proposed by Mr. F. W. S. Stokes, in the absence of Sir E. J. Reed, who Mr. Stokes said, was unfortunately a Member of Parliament. He referred to the four local associations of Glasgow, Manchester, Liverpool, and Birmingham. Mr. Pickering, of Birmingham, replied.

TORPEDO BOAT TRIALS.

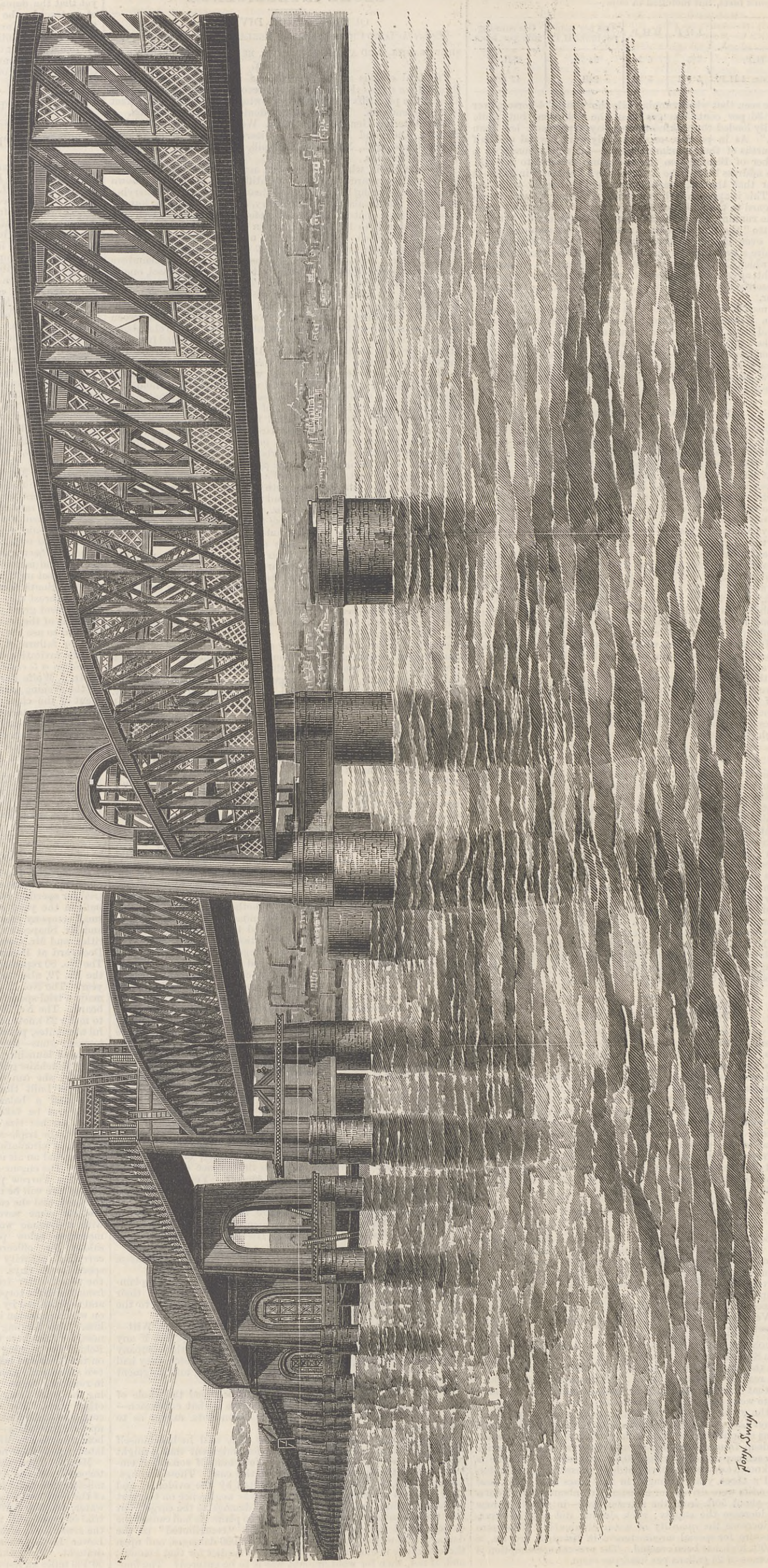
ON Tuesday the largest, and, it is believed, the fastest of the new torpedo boats built for the British service underwent her first trial for speed in the waters of the Lower Hope. The No. 80 was built in the yard of Messrs. Yarrow, of Millwall. There was a small company present to inspect the boat on her trial. Mr. Smale and Mr. Shapcott were present on behalf of the Admiralty authorities, and Mr. Gowings and Mr. Maystone on behalf of the Royal Dockyard at Portsmouth; Mr. Crohn represented the builders. The No. 80 represents an advanced type in every particular upon the No. 79, also turned out of this yard, and officially tried last year. The No. 79 was 125ft. in length, with 13ft. beam, and she made a trial speed of 22·39 knots an hour with ten tons of coal on board. The No. 80 is 135ft. long, has 14ft. beam, and is expected to make 23 knots an hour. She is of special build, and has powerful attributes, possessing a stem torpedo gun, two stern broadside torpedo guns—these guns, otherwise tubes, being the special means of launching torpedoes against the enemy—and five quick-firing Hotchkiss guns, together with all the means and appliances whereby she can carry on offensive and defensive action. The vessel is built throughout of mild steel, and has a cutaway stern and a balanced rudder. She has, too, a bow rudder, which can be taken up at will. The vessel is powerfully engined for her size, and in her engine-room are seven engines—namely, the triple-expansion engines of 1500-horse power, a donkey engine, a circulating pump engine, a fan engine, a compressor engine, and an air engine to work Dr. Normandy's distilling apparatus. The engine-room is protected by coal bunkers, and is fitted with the Yarrow patent stokehole, a contrivance by which the boilers' fire will be maintained, even with a hole in the bottom of the boat, and she could steam under the circumstances of such a disaster some seventy or eighty miles. She is fitted below with a dynamo working an electric search light. The accommodation below provides for a crew of sixteen all told, a saloon for officers, not large, but sufficient, and a coal carrying capacity sufficient to carry the vessel at half-speed for six days. The deck gives the great outward features of the vessel. Her front torpedo tube, or the gun, as it is called, from which the torpedo is fired, is built in the boat; it is stationary, and is protected by a turtle back, surmounted by a conning tower, on which provision is made for a quick firing and powerful Hotchkiss. This conning tower is protected by plates of an extra thickness, for from here the torpedo gun is worked and the boat steered. Behind the conning tower are two quick firing guns in *échelon*, that on the starboard being in advance of that on the port. There are two aft torpedo guns, which being intended for broadside use, are in revolving tubes. They are protected by a conning tower possessing the quick firing guns. This tower is of thicker steel than in other parts. The displacement of the vessel is 105 tons with a complete armament. The speed attained on the trial fully came up to expectations—namely, 23 knots per hour—and when the boat returned to Millwall the inventors and builders were congratulated upon their new success.

Messrs. Thornycroft and Co. on Tuesday tried a new large torpedo boat, the Ariete, one of a pair which they have been commissioned to build for the Spanish Navy. The principal dimensions of the boat are:—Length, 147ft. 6in.; beam 14ft. 6in.; draught of water, 4ft. 6in. After a run from Westminster, the boat made a trial of speed with natural draught at Long Reach, and realised the remarkable mean of 15·84 knots. She then proceeded to the Lower Hope, where a series of trials were made with forced draught. The mean of five runs gave the result of 26·18 knots, or 30·133 miles an hour.

THE NEW TAY BRIDGE

MR. W. H. BARLOW, M.I.C.E., F.R.S., ENGINEER.

(For description see page 370.)



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THE ENGINEER, May 13th, 1887.

TO CORRESPONDENTS.

Registered Telegraphic Address "ENGINEER NEWSPAPER, LONDON."

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

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

P. H. S.—*The Galloway boilers at the Manchester Exhibition will give off steam enough for 400-horse power each, assuming that 20 lb. of steam per hour will suffice for a horse-power.*

BOILER (Lancaster).—*A large factor of safety, say five to one, should be provided in all boilers set in brickwork, to compensate for the reduction of strength due to moderate corrosion.*

J. R. (Stalybridge).—*Good ordinary engine brass answers perfectly. Make the brasses narrow—about 4in. wide is sufficient—and the length of the roll neck. Lubricate well with hot neck grease.*

J. S.—*We have been assured that an atmospheric engine with a leather-lined cylinder was at work not many years ago at one of the Horsley Company's collieries, so that the statement to which you refer is probably true.*

CLYDE.—*It is impossible to calculate the quantity of steam consumed by the aid of an indicator alone, because the indicator takes no account of the steam lost by condensation in the cylinder. You say that the pair of diagrams you send "can be taken to show where economy ends and waste begins." Not so; your cards show pretty well where waste ends, because they are about the worst we ever saw. The valves have not sufficient lead, and the exhaust is throttled. You must be wasting every year in coal what would go far towards the purchase of a new and fairly economical engine.*

ROLLING MILL ENGINE.

(To the Editor of The Engineer.)

SIR,—Referring to the description and illustrations of a rolling mill engine designed by me, in last week's ENGINEER—see pages 349, 352, 360, and 361—it is but right to state that Messrs. Westgarth, English, and Co., engineers, of Middlesbrough, were the constructors, and the success of the engine was largely due to their good work and careful attention to details.

JEREMIAH HEAD.

Middlesbrough, May 7th.

THE MANCHESTER EXHIBITION.

(To the Editor of The Engineer.)

SIR,—All the ironwork shown in your issue of May 6th, in the dome of the Manchester Exhibition buildings, was made by us. We also made all the ironwork in the nave, and other principal roofs. We do not see that you have mentioned our name in your account of the building. Perhaps you will be good enough to do so in any future notice you may have, and we enclose circular giving an account of our exhibit and manufactures.

Bristol, May 7th. JOHN LYSAGHT, LIMITED.

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Session 1886-87. Tuesday, May 17th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion:—"On the Manufacture of Salt near Middlesbrough," by Sir Lowthian Bell, Bart., F.R.S., M. Inst. C.E.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY.—Wednesday, 18th inst., at 6.30 for 7 p.m., at the Holborn Restaurant: Annual dinner.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C. — Monday, May 16th, at 8 p.m. Cantor Lectures: "The Chemistry of Substances taking part in Putrefaction and Antisepsis," by J. M. Thomson, F.C.S. Lecture III.—Methods of retarding and preventing putrefaction—Physical conditions least favourable to putrefaction—General classification of chemical methods adopted for the prevention of putrefaction. Tuesday, May 17th, at 8 p.m. Foreign and Colonial Section: "The West Indies at the Colonial and Indian Exhibition," by Sir Augustus Adderley, K.C.M.G. Wednesday, May 18, at 8 p.m.: Ordinary meeting. "Progress in Telegraphy," by William Henry Preece; Sir Frederick Bramwell, D.C.L., F.R.S., will preside.

CHEMICAL SOCIETY.—Thursday, May 19th, at 8 p.m. Papers to be read:—"The Formation of Hyponitrites," by Wyndham R. Dunstan and T. S. Dymond; "Ozone from Pure Oxygen," by W. A. Shenstone and J. T. Cundall; "On Thermal Results of Neutralisation and their Bearing on the Nature of Solution, and the Theory of Residual Valency," by S. U. Pickering; "The Action of Metallic Alkglates on Mixtures of Ethereal Salts and Alcohols," by Professor Purdie.

METEOROLOGICAL SOCIETY.—Wednesday, 18th instant, at 7 p.m., by permission of the Council of the Institution of Civil Engineers, at 25, Great George-street, Westminster: Ordinary meeting. Papers to be read:—"Brocken Spectres and the Bows that often Accompany them," by H. Sharpe; "Results of Thermometrical Observations made at 4170 and 260ft. above the Ground at Boston, Lincolnshire, 1882-86," by William Marriott, F.R. Met. Soc.; "Snow Storm of March 14th and 15th, 1887, at Shirenewton Hall, near Chepstow, by E. J. Lowe, F.R.S., F.R. Met. Soc.

DEATH.

On the 3rd May, RICHARD LADD, F.R. Met. Soc., F.R.A.S., late Navigating Officer of the Anglo-American Telegraph Company's s.s. Minia, aged 38.

THE ENGINEER.

MAY 13, 1887.

THE NAVAL DOCK AT BOMBAY.

IT is somewhat singular that so little public attention has been directed to what we may term a *fiasco* as to docking accommodation for our ships of war at the great naval port of the East. It has only been when the question relative to the existing deficiency has been mooted, as it has been very recently only, in the House of Commons that the facts relative to the failure have received that mention which it might naturally have been expected to receive at the time that it occurred. To what cause this immunity from public comment may be due it is exceedingly difficult to divine. It would almost seem as if there must have been parties implicated by the failure whom it was sought to screen, for it was not, as we have said, until the explanation was dragged from the Admiralty by the searching query addressed in the House of Commons that the facts in any way became generally known; and yet, what was stated during the course of the explanation given reveals a very astonishing condition of things. An hydraulic dock, similar in principle and, we believe, in general design to that which has been so successfully worked at the Victoria Docks for many years, had been fully erected and made ready for the reception of vessels. At the very first trial made of its capacity, it appears, to judge from the statements made in the House of Commons, to have come to entire grief. The site for it had been so injudiciously selected that currents, we presume comparatively strong only, absolutely prevented safe entry between the columns and over the pontoon upon which the vessel making the first essay was to be raised. It was found impossible so to direct the course of the ship as to prevent her fouling the columns; and several of these were carried away, or at least so deranged that they were rendered incapable of fulfilling their legitimate function. We must conclude, as we cannot learn that any attempt was ever made to repair the dock, that this first instance of failure had convinced those in charge of it that the difficulty experienced as to safe entry at this first trial must for ever remain insuperable. That is the natural conclusion to be arrived at is made certain by the further statement in Parliament that the dock was in course of removal.

Now, it is no concern of ours to ask who was responsible for the selection of a site for this dock, which it should have been known from the first must prove to be totally unsuitable for docking accommodation of any kind. We have written "of any kind;" but still more serious was the mistake in the case of a dock consisting of almost isolated columns, each one of which contained intricate and easily deranged hydraulic machinery. It is certain that with no professional requirement are engineers more generally familiar than that the entrance to a dock should be free from causes likely to make that entrance dangerous. We all know the caution that has to be exercised in entering a walled dock from a tidal river; yet in such a case, if damage does arise from incompetent handling, it is caused mainly, if not entirely, to the ship. But in the case of the hydraulic dock it is the vital parts of the structure itself that receive injury, and therefore the greater should have been the care shown in determining the position for it in the particular instance of the Bombay hydraulic dock or lift. It may not be within our province, as we have above declared, to seek to fasten responsibility on any individual, but nevertheless must it be evident to all who learn the facts that in some quarter or another there has been most unaccountable laxity and carelessness. It is not as if Bombay was a harbour but little known or not thoroughly surveyed. We may believe, and indeed we are aware, that few harbours in the world have had their features more accurately ascertained and recorded than has Bombay. How, therefore, was it, we may ask, that those responsible gave preference to a site which the charts must have recorded to be, at some period or other in each year, exposed to currents sufficient to prevent safe entry to the dock being made? The result of the error has been that the national purse is to be called upon to defray a very large expenditure, in substituting a substantial walled dock in lieu of the lift, which, had it been properly placed, would have fulfilled every need of our royal and mercantile marine.

We recollect that a good many years back a company was formed with the object of erecting a lift, similar to that which has now to be removed from Bombay harbour, in that of Trincomalee on the eastern coast of Ceylon. Although that design was, for financial reasons, never carried out, a careful search was instituted to find a place for the lift which would be free from the causes which have wrought such ruin at Bombay. It was found in Nicholson Cove in that harbour, a place absolutely free from every current. Had the same prevision been exercised by those responsible for the misfortune we have referred to, it could never have occurred. We are glad to learn that, warned by this experience, the present Admiralty authorities are showing no imprudent haste as to obtaining the fulfilment of their present requirements at other eastern ports. A dock suited to the reception of our largest vessels of war is greatly needed at Colombo, and an admirable site exists for it. But it unfortunately happens that the approach to this is exposed at certain seasons to the action of disturbed water. This can only be stayed by the construction of a breakwater additional to that which now gives the harbour such full protection during the south-west monsoon. Such a breakwater formed part of the original design, but it has been left uncarried out for financial reasons, as to which we understand the several authorities are in dispute. This must be arranged before a dock can be built at Colombo, and it is not likely the Admiralty will come to terms with the Government of Ceylon until the requirement of quiet entrance is assured. They have had too grave a lesson in the case of the failure at Bombay lightly to incur future risk. But it is to be hoped that accommodation between the home and colonial Governments will not be long delayed, for the need for the dock is urgent.

THE LONDON COAL DUTY.

THE prospects of the London Coal and Wine Duties Continuance Bill in the present session of Parliament are by no means brilliant. The state of public business in the House of Commons threatens to delay the Bill beyond all hope of passing, and the prejudice excited against the duty on coal makes it only too probable that the measure will meet with rejection. Next year would not be too late to renew the effort; but unless Parliament at once agrees to a renewal of the coal duty, the effect will be felt in the rates of the metropolis next year. What this means will be learned when the Budget of the Metropolitan Board makes its appearance somewhere about next Christmas. Dismissing the wine duty from consideration as involving only a small amount, we may observe that the coal duty expires in July, 1889, but the proceeds of the year ending at that date are all hypothecated to the purpose of paying off an account due in respect to the abolition of bridge tolls. Clearing off this old score leaves nothing available for any other purpose. Unless the Bill for the continuance of the coal duty is passed in the present session of Parliament, the Metropolitan Board and the Corporation of the City must shape their finances as if the coal duty came to an end in the Midsummer of 1888. It is true, that if Parliament does not renew the tax this year it may do so in the next, but it will not be safe to presume on future success. Consequently, unless the Bill speedily passes it will only be practicable to reckon on the proceeds of the coal duty for the first half of 1888, so far as concerns the levying of the local rates. Thus the people of London will have a foretaste of what awaits them in the event of the coal duty being entirely extinguished. Either a check must be given to the progress of public works, or there must be an addition to the rates levied by the Metropolitan Board and perhaps by the Commissioners of Sewers. The result will be certainly apparent in the rates levied by the former authority. Out of the total duty of thirteen pence per ton on coal, ninepence goes to the Board and the remainder to the Corporation. The total net revenue now derived from the coal duty is about £450,000 per annum, of which, accordingly, rather more than £300,000 goes to the Metropolitan Board, and something less than £150,000 to the Corporation. To raise an equivalent amount on the present basis of rateable value would require an average rate over all London of nearly fourpence in the pound. In reality, the incidence would be rather different. The Metropolitan Board, in order to get £320,000, would levy a rate of 2½d. in the pound over all London; while the people of the City, in order to raise £130,000, would have to bear a rate of nearly 9d. in the pound. As the Board's rate extends over the civic area, the City ratepayers would have to pay both parties, making their total burden nearly 1s. in the pound—a serious impost on highly-rated warehouses. The rateable value of the City is only one-eighth that of all London; but the City takes nearly one-third of the coal duty. The loss of the coal tax would therefore be felt more acutely by the Corporation than by the Metropolitan Board. There is a further reason why the City should feel keenly in this matter. A sum of £700,000 is required in order to balance the Holborn Viaduct account, even allowing the value of the land to be realised. This debt has to be borne whatever else may happen, and the outlay for the important improvements in the Holborn Valley has been hitherto specifically charged on the coal duty of 4d. per ton received by the civic body. The charge for this debt must fall on the rates levied by the Commissioners of Sewers, if the coal tax is allowed to cease, or else it must come out of what is called the "City cash," which means the private or special resources of the Corporation. In that case the ratepayers would escape, except that the Corporation would have less money to expend for public purposes, and would possibly leave certain works to be undertaken by the Commissioners of Sewers, who would levy rates to defray the cost.

It has to be remembered that the rates which will be rendered necessary in the absence of the coal tax are additional to those which already exist. Thus if the Metropolitan Board levy 2½d. in the pound to make up for the loss of the coal tax, their total demand on the ratepayer will become 9d. where otherwise it would be 6½d. The chairman of the Finance Committee of the Board, in bringing up the estimates for the present year, calculated that in the absence of the coal duty the Board's Consolidated rate might rise nearly to 1s. in the pound.

We advert to these financial considerations in order to prepare for that which more immediately concerns our readers. Having so far entered into the finance of the coal tax, we may now proceed more directly to consider its utility. It has been described as a burden on manufacturing industry in the area in which it is levied. The area is that of the City and Metropolitan Police districts, and extends in some directions as far as fifteen miles from Charing Cross. Certainly we should not be disposed to favour a tax on manufacturing industries, unless we saw some counterbalancing advantages. The coal duty is a tax on steam and a tax on gas. Unfortunately, society is so constituted that rates and taxes are necessary evils. All taxes, local and imperial, are objectionable in themselves. A police tax is a burden, yet it is better than paying blackmail to burglars and highway robbers. The coal tax in London has conferred extraordinary benefits on local trade and manufactures. New thoroughfares have been opened up, bridges have been purchased and freed from toll, the Thames has been fringed with noble embankments, and the entire aspect of London may be said to have been changed, as the result of an outlay which never could have been borne but for the aid of the coal duty. The execution of these enormous public works has given employment to an army of workers, whose wages have sustained a corresponding amount of retail trade, the money raised in the form of a duty on coal being returned to the metropolis in the form of permanent public improvements and in the shape of wages and salaries, mainly spent in the metropolitan area. We cannot but conceive that engineers, contractors, manufacturers, workpeople, and labourers have all benefited by the outlay which has thus taken place, while the works which have been constructed remain to facilitate trade, and to add to the comfort of all who either dwell in the metropolis or occasionally visit it. Acknowledging all this, it may be said that London is so far improved by this time as to be able to dispense with the fiscal aid of the coal duty. But there is more yet to be done. Unfortunately, there are debts to be borne, which will be troublesome if they fall on the rates. Also there are works urgently demanding execution which can only be carried out at great cost. The sewage purification works at the outfalls will entail an annual charge of £120,000. The Blackwall tunnel, if sanctioned by Parliament, will cost £1,250,000, and will not satisfy all demands for communication across the Thames below the Tower. The preservation of open spaces and the formation of public parks are matters which constitute the basis of many appeals in the present day. Even if it be found that the need for great works of improvement in the metropolis is now to some extent met, so that the outlay in the future may be lessened, the ratepayer may find sufficient cause to welcome the coal tax, as affording him a substantial measure of relief.

Supposing the London coal duty to be abandoned, it may be well to consider who will be the better for the change, and to what extent. Will the benefit be at all proportioned to that which the tax itself has conferred? Will it be equal to the extinction of bridge tolls? Will the relief to traders and manufacturers who employ horseflesh be as great as that afforded by the Holborn Viaduct? Who can estimate the constant pecuniary benefit accruing from a spacious thoroughfare, furnishing a direct route where formerly the streets were narrow and circuitous? Does anyone remember what London was at one time along the routes now traversed by Cannon-street and Queen Victoria-street? Of course, the gas companies will save a large annual sum if the coal duty ceases to be levied. The benefit will be apportioned between the shareholders and the public, so far as the latter are actual consumers of gas. But the ratepayer might prefer having all the money to himself. We confess we are prepared to see the coal tax go, in deference to the notions that are now popular. The opponents of the tax are striking hard at the Corporation, and prejudice is naturally excited by tales of misappropriated money and bogus petitions. The problem of London government is mixed up with the question of revenue, and it is argued that the coal tax is not safe in the hands of men elected after the manner of the Metropolitan Board. But Parliament and the Treasury hold as tight a check over the Board at Spring-gardens as ever the ratepayers are likely to exercise, let the form of local government be rendered as perfect as it may. We fancy that the most zealous reformers of metropolitan local government would be glad of the coal tax, if only the form of government were altered to suit their ideas. That a coal tax is by no means peculiar to the constitution of the metropolis, is shown by the fact that it prevails extensively in the provinces, amidst various forms of local government.

THE COAL TRADE STRIKE AND LONDON COAL.

The figures which are compiled by the registrar of the London Coal Market show conclusively how slight has been the effect of the strike in Northumberland on the coal trade. In the first four months of the present year there were imported into London, from coalfields sending their produce by sea, about 1,506,856 tons, which is 903 tons more than in the same period last year. Thus, the strike has not diminished the quantity sent into London by sea, though it is certain that Northumberland has sent much less. But Durham and other places have fully made up the deficiency. On the other hand, there has been brought into London during the same period of four months, a total of 2,534,107 tons; whilst in the same period of last year, the imports in that manner were 2,511,095 tons. There was thus a falling off in the tonnage of railway-carried coal of about 23,000 tons. Out of the total coal brought into the metropolis, a portion is sent out again for use elsewhere. This quantity was increased in the present year, and thus there was an apparent decrease in the London consumption in the present year of some 49,000 tons. It is this decrease in the consumption of coal this year which prevents the strike in the coal trade having the effect that the men had anticipated. A year ago we had one of the fiercest winters that have been known for long, and it was a prolonged one also. All over the country the consumption of fuel was increased, and the stoppage, for a time, of railway traffic only affected partially the supply, and did not adversely affect the consumption. This year we have had mild weather, and, in consequence, there has been a much smaller use of fuel, not only for house but for gas, and allied uses. And thus a coalfield, which employs some 25,000 miners, has been idle for over three months, without apparently affecting the trade as a whole. It is to be hoped that the lesson will not be lost upon miners as a body. Coal is now procured from so many coalfields in the United Kingdom, that the effect of a partial strike is slight, and local in its character. At present the effect of the strike is more noticeable in Northumberland than it has yet been, but this is because from that district a very large quantity of coal is sent to Cronstadt in the season, and the season has just commenced. It is now that the loss of the Northumbrian coal is found, but the loss is being met, and is likely to be met, more fully from Durham and from Yorkshire. Possibly, some orders may be held back in hopes of a settlement in the more northern county; but the fact that there has been such a meeting of the demand for coals at the beginning of the season is remarkable, and it is another proof of the folly of the strike. The enlarged production of coals abroad has also its effect in the same direction; and the more that the coalfields of the world are opened out, the less prospect will there be in ordinary times of the success of any sectional suspension of labour.

THE NEW RUSSIAN IRON AND STEEL IMPORT TARIFF OF THE 7TH OF MAY, 1887.

All metallic or mineral ores, with the exception of graphite or blacklead in lumps, copper dross and iron in powder, 7 gold kopeks per pud; cast iron in bars—pigs—scrap and turnings brought by sea, 25 gold kopeks, and by land, 30 gold kopeks per pud; iron of all sorts in flat or other shaped bars, except that named below, further, "Krimtzen," puddled lumps—blooms—or "Bolwanken" in pieces and millbars, 50 gold kopeks per pud; iron plates above 18in. wide, bars above 18in. wide or high or more than 7in. thick, like bar iron, and that ¼in. to ½in. broad or thick, 70 gold kopeks per pud; steel in bars and shaped, in pieces and scrap, except that named below, 50 gold kopeks per pud; steel in sheets and plates above 18in. wide, steel fashioned into shape above 18in. wide or high and 7in. or more thick, as also bars ¼in. to ½in. thick inclusive, 70 gold kopeks per pud; fashioned cast iron, castings unwrought, as fire-bars, plates, pipes, beams, columns, fittings for steam vessels, dredgers, railroads, and for their working, 70 gold kopeks per pud; cast iron manufactures, wrought, filed, polished, ground, ornamented, bronzed, galvanised with zinc or coated with any other ordinary metal, combined with wood, copper, bronze or without such, 140 gold kopeks per pud; iron or steel manufactures, forged or cast, raw or filed on the edges and corners but not further worked, as anchors, chains, wire ropes, nails, hooks, bells, mortars, likewise fittings for steam vessels, dredgers, railways and their working materials, 120 kopeks per pud; boiler-smiths' work, as tanks, bowls, boxes, bridges, tubes, &c., 140 gold kopeks per pud; wrought iron and steel manufactures, except those particularly named, with or without parts in wood, copper and bronze, when the articles weigh more than 5lb., 140 gold kopeks per pud; scythes, sickles, chaff-cutters, garden knives, sheep shears, spades, shovels, hoes and forks, 140 gold kopeks per pud; hand tools and instruments for artisans, artists, and for factories, 140 gold kopeks per pud; machines and apparatus, except agricultural and patterns for them, locomobiles—portable engines—tenders, steam and fire-engines, and other fire-extinguishing apparatus, and all other apparatus not specially mentioned; apparatus, machines of cast iron, iron or steel destined for factories, with or without parts made of other metals, mechanical standards and their fittings, as also all parts of machines, excepting those made of copper or such whole parts as are chiefly of copper, 140 gold kopeks per pud; locomotives, 200 gold kopeks per pud. The import duty on pig-iron, scrap and turnings of 25 gold kopeks and 30 gold kopeks respectively, shall not be reduced before January, 1898.

SLAG AS MANURE.

Some interest has recently been excited by reports that slag could be utilised as manure, and imperfectly-informed people have therefore rushed to the conclusion that the unsightly accumulations at ironworks would be immediately turned to useful ends. It is disappointing to find, on the authority of Mr. A. H. Allen, the borough analyst of Sheffield, that the slag which has recently been found valuable as a manure is not the blast furnace slag, but a kind which has been produced only within the last few years, and is not made at any works within 100 miles of Sheffield. "It is, in fact," says Mr. Allen, "a secondary product of the manufacture of steel in the Bessemer converter by the basic process, in the manner devised by Messrs. Thomas and Gilchrist." This slag contained 15 to 20 per cent. of phosphoric acid, and Mr. Allen says that no ingenuity has been spared in rendering this important secondary product partly useful as a manure, though the difficulties have been so considerable that the various processes devised have all been abandoned in favour of a method of finely grinding the slag, and removing particles of metallic iron magnetically.

A NEW PATENT FUEL.

At the Birley Collieries, near Sheffield, an interesting experiment is being tried in the production of "briquettes," which are to be retailed at one penny and one halfpenny. In this way it is hoped to usefully and profitably utilise coal-dust or "slack" brought out of the pit. The briquette is a hard, black substance, a mixture of coal dust and pitch. A briquette of 10 lb. weight will burn from six to eight hours. Though this new patent fuel does not burn so brightly as coal, it lasts much longer than pieces of coal of the same size, while the heat given out is equal to that of an ordinary coal fire. At present, coal-dust is a drug in the market, and if briquettes can be successfully placed on the market, a great difficulty will be met. On the Belgian railways briquettes are extensively used in lieu of the ordinary fuel, and the Admiralty have already recognised their value.

LITERATURE.

The Mechanics of Machinery. By Alex. B. W. Kennedy, Professor of Engineering and Mechanical Technology in University College, Mem. Inst. C.E., &c. &c. Macmillan and Co. London: 1886.

The title of this book, an octavo of 639 pages, has a curious sound, yet it is well selected, and expresses as clearly as a title can the speciality of the work. There is in existence a vast number of treatises on dynamics and kinetics, while the number of really useful volumes on applied mechanics is very small. It would seem that there is a cycle in the tendencies of technical authorship. Some years ago we had nothing but treatises on geometry, of all manner of sizes and shapes, merits and demerits. The market must have been glutted with them. Next came books on strains and stresses, and girders, and roofs, and bridges; and now in these latter days printers and publishers are kept busy in giving the world treatises on dynamics pure and simple, principally remarkable for the fact that the modern author seems to find the English language quite inadequate to express his ideas, and so invents strange, weird barbarisms to supply his wants. Meanwhile the engineer has been left comparatively uncared for. There is consequently plenty of room for Professor Kennedy's book.

In his preface he explains that it is to a large extent made up of lectures delivered by him at University College to his students; and he defines the plan on which the work has been constructed. "I have confined myself," he writes, "entirely to the mechanics of constrained motion." At first sight this seems rather vague, for it is not easy to see under what conditions unconstrained motion could possibly take place. As matter is postulated to be wholly inert, it is at all times the mere creature of circumstances, and all motion of every kind does take place and can only take place within certain limiting conditions. Professor Kennedy goes on to explain what he means. "It is an essential characteristic of every machine that the path of motion of every one of its points is absolutely known at every instant. The *absolute* motion of any point can be altered, or its motion entirely stopped, but *relatively to any other point* of the machine, neither the direction of motion nor velocity of any point can be in the slightest degree altered except by forces which involve the practical destruction of the whole apparatus. All the motions occurring in machines are thus conditioned by an absolute geometric constrainment which renders it not only possible but very easy to treat them by themselves, and in this fashion to separate the mechanics of machinery from the general science of mechanics, of which it forms a portion." The proposition to which Professor Kennedy gives so much weight is, however, only generally true; it is not always true. Thus, for example, if we take the governor balls of a steam engine, it will be found that the velocity with which they describe their circular path may and does vary continually with regard to the velocity of rotation of the crank shaft; but this does not involve the practical destruction of the machine, and other examples of this rotative variation of velocity will easily suggest themselves to our readers. It is, however, quite easy to understand what Professor Kennedy means; and we admit at once that the truth he has enunciated in the foregoing quotation makes an excellent basis on which to work.

The book is divided into twelve chapters, each treating of a different subject, and by giving a list of the subjects we shall impart a fair general idea of Professor Kennedy's method. The first chapter is devoted to The Machine, the second to Plane Motion, the third to The Constrainment of Plane Motion, the fourth to Virtual Motion in Machines, the fifth to Relative Velocities in Seconds, the sixth to Mechanism not Crank Work, the seventh to the Dynamics of Mechanism, the eighth to Static Equilibrium, the ninth to Problems in Machine Dynamics, the tenth to Miscellaneous Mechanisms, the eleventh to Non-Plane Motion, and the last chapter to Friction in Mechanisms and Machines. Each of these chapters is subdivided. Thus, for example, the first begins by defining (1) what a machine is; (2) the principal forms of constrained motion; and (3) relative motion. In the same way the sixth chapter deals with (1) spur-wheel trains; (2) wheel teeth; (3) compound spur gearing; (4) epicyclic gearing; (5) other mechanisms with spur wheels; and (6) cam trains. It will be seen that the area which Professor Kennedy has undertaken to cover is not only very large, but that he has covered it very closely. Indeed, it is not quite easy to suggest any possible form of mechanism, however recondite, concerning which he has not said something. It is much in favour of the book that the author makes a profuse use of diagrams, and that these are all well chosen, well drawn, well engraved, and well printed. In order to impress facts on the student's minds our author uses both italics and large black-faced type, and this, combined with remarkable lucidity of expression, will go far to extend the utility of the volume. We note also with great pleasure that Professor Kennedy, like Professor Rankine, has found the English language quite sufficient to satisfy all his wants, and the student has not to make himself acquainted with new and strange words as well as facts novel, as a matter of course, to every student. He finds, for example, that the old word "pressure" answers every purpose as well as "surface density." He even retains the phrase "centrifugal force," and he talks of the good old English "ton," and "pound," and "foot," and "inch," just as though there was no such thing as a centimetre, a gramme, or a dyne.

Those who are most accustomed to the construction of machines will soon see that the direct utility of many of the problems which Professor Kennedy solves is very small. This follows as a natural consequence of the fact that machinery is, on the whole, very simple. Many machines seem to be extremely complicated only because of the duplication and reduplication of parts. So patent is the truth that our author would have found it impossible to fill the space which he has actually filled had he confined himself to what we may term practical or applied mechanics; and we find that a large portion of the volume is, after all, devoted to the consideration of pure dynamic and kinetic problems. On the other hand, however, Professor Kennedy always hastens to show, when possible, how pure mechanics will apply. Thus, having laid down various propositions about force, momentum, *vis viva*, and so on, he then shows how all this applies to the fly-wheel. The engineer who could carry in his head all the information that Professor Kennedy gives should never be at a loss if called on to solve a mechanical problem, or design the parts of a really intricate machine. But the class who make or design intricate mechanisms is limited. If, then, we have a fault to find with Professor Kennedy, it is that he covers too much ground—teaching, so to speak, too much. This, however, is a point on which opinions

will differ; and it is pleasant to note the thoroughness with which our author has done his work, at a time like the present, when there is no end to the production of slip-shod, carelessly written books.

Perhaps the most interesting chapter in the volume is the eleventh, dealing with non-plane motions. The reader may very naturally ask what non-plane motion is? A witness in an assault case stated that one of the parties was drunk at the time, and being asked how he knew, replied, "Well, sir, I know, because he went down the street two ways at once." The same general idea has perhaps called into existence the well-known name, "drunken saw." Under the head of non-plane motions come all these curious movements common to universal joints and spherical engines. Professor Kennedy has dealt with the recondite and puzzling problem presented by universal joints and Mr. Tower's well-known engine. The former he classifies as belonging to the "conic crank train" type, and we really cannot sufficiently admire the indomitable patience and skill with which our author has investigated the action of the universal joint. Our agricultural engineering friends who make horse gears will hardly believe it possible that no less than nineteen pages have been written concerning two jaws, a centre block and two crossed pins, yet so it is; and very stiff reading the same nineteen pages are. It is not too much, we think, to say that there is not another man in England who knows as much about the universal joint as Professor Kennedy. It seems strange that the world should have gone on all these years making and using universal joints with fair success and yet was densely ignorant about them, and after all the thing is so simple when you know all about it. Thus men have gone on blindly making universal joints for horse gears without ever calculating the stresses in the parts; and yet, as Professor Kennedy tells us, "For the balance of forces on different links, whether adjacent or non-adjacent, it is frequently most simple to determine the relative angular velocity of the links, and to calculate the balanced forces from these, remembering that the turning moments on any links which are in static equilibrium must have magnitudes inversely proportional to the angular velocities of the links." The only excuse which can be urged for prevailing ignorance on such matters is that after all life is short, and the profit to be made out of horse gears is at present very small.

The action of the Tower engine is one of those things which no one is expected to understand, unless he has one taken apart for him. Professor Kennedy has, we think, done all that a man can do by the aid of type and diagrams to make it clear. Yet we venture to say that not one person in a hundred who reads what he has written could, unless he saw the engine taken apart, tell where the turning moment comes in. There is at the bottom of the action of all mechanism of this kind a curious law, "which may be termed, for want" of a better title, the law of augmenting capacity, which may be worth noting. Professor Kennedy does not refer to it. It is this: If in any combination of mechanism put in motion by a fluid or liquid, it is possible for the capacity of a chamber to augment by the motion of the walls of that chamber, then motion will be produced, no matter how apparently complex and inadequate to the intended purpose the character of that motion is. In the ordinary steam engine the most obtuse can see that the capacity of the cylinder is augmented by the motion of the piston; but in several forms of mechanism, such, for example, as Bishop's disc engine and the Tower spherical engine, it is impossible at first sight to see how any motion of rotation can be produced, because all the forces seem to be balanced, and the engine as likely to run one way as the other, or not at all. But on examination it will be found that the rotation of the engine must be followed by an enlargement of the volume of the chamber to which steam is admitted; and this being so, on the other hand, the effort of the steam to enlarge the chamber will cause the parts of the engine to assume the only motion which is consistent with that enlargement. This motion is one of rotation. In scheming engines of this kind, using recondite combinations, it will often be a matter of doubt whether a given combination can or cannot produce rotation. The question can be solved in a moment by ascertaining whether rotation will or will not cause an augmentation in the volume of the chamber containing the working fluid. If it will the engine will work, as far as the principle is concerned; if not, it will not work. Some years ago an inventor submitted to us drawings of a very beautiful modification of the disc engine. It was well thought out, with ample wearing surfaces, &c.; on examination, however, it turned out that the engine could not work, as there was only an apparent not a real change in cylinder capacity produced by the rotation of the shaft. Our readers will perhaps better understand what we intend to convey if we suppose that, at a certain point in the stroke of an ordinary engine, the cylinder cover began to follow the piston. It is a mistake to assume that the number of possible ways of carrying out the idea of a disc engine is very limited; there are, on the contrary, many ways; and this is one reason why we have dwelt on the point; for example, we may cite the Fielding engine, and West's ingenious multi-cylinder engine, both of which are really disc engines in disguise.

Returning after this apparent digression to Professor Kennedy's book, we may say in conclusion that we have not the least hesitation in recommending it as a thoroughly good work; and it is so because the work done by Professor Kennedy has been good. The worst fault it has is that it tries to teach too much; but, on the other hand, it is not necessary that the engineer should master its entire contents. With the volume on his shelves, he may rest confident that he has close to him an adviser and teacher who will help him out of many a difficulty, even if consulted at the last minute; while those who can spare time to study its contents can scarcely fail to find their powers of mechanical vision augmented, and their minds opened to many things of which perhaps they have never before dreamed.

ATKINSON'S NEW GAS ENGINE.

(*Concluded from page* 361.)

Efficiency of the mechanism.—The difference between the indicated and brake horse-power is the work expended in driving the engine. The ratio $\frac{\text{B.H.P.}}{\text{I.H.P.}}$ is called the efficiency of the mechanism. In this case we get

		Efficiency.
Trial V. ..	Maximum load	0·903
,, I. ..	Normal full power	0·879
,, II. ..	¾ full power	0·800

These efficiencies are high, which no doubt is attributable in part to the absence of any slide valve and gear. They show that there is no exceptional friction in the peculiar arrangement of linkwork adopted. On the average 0·7-H.P. is used in driving the engine. This result is confirmed by the amount of gas used when the engine was running without load, if some allowance is made for the less efficiency of the explosions under such conditions.

TRIAL I.—*The Engine Run at Normal Full Power.*

Time.	Load on brake in lbs.	In five minutes' interval.			Temperature of cooling water.			Indicator diagrams.		
		Revolutions of counter.	Gas used in cubic feet.	Jacket water in lbs.	Discharged F. deg.	Initial F. deg.	Rise of temperature, F. deg.	Maximum initial pressure above atm. in lbs. per sq. in.	Terminal pressure above atm. in lbs. per sq. in.	Mean effective pressure in lbs. per sq. in.
h. m.					deg.	deg.				
10.40	Engine started									
11.0	68·25	—	—	—	147·5	47·0	—	159	14	37·7
11.5	68·00	733	9·00	10·37	146·5	—	—	157	16	35·3
11.10	68·00	739	9·40	10·75	149·0	—	—	144	15	33·5
11.15	68·12	736	9·10	10·63	150·0	—	—	151	15	31·3
11.20	68·00	733	9·45	10·63	150·0	—	—	135	13	32·8
11.25	—	738	9·18	10·50	—	—	—	—	—	—
11.30	68·12	739	9·19	10·50	154·5	—	—	145	13	32·4
11.35	68·12	738	9·43	10·50	153·5	—	—	146	13	33·0
11.40	68·00	740	9·50	10·25	155·0	—	—	139	15	33·8
11.45	68·12	742	9·30	9·75	159·0	—	—	153	15	32·5
11.50	68·12	743	9·15	10·50	160·0	—	—	152	15	32·5
11.55	68·12	744	9·45	10·50	160·0	—	—	129	16	32·5
12.0	68·25	743	9·23	9·50	162·0	47·0	—	141	16	32·5
		per min.	per hour	per min.						
Means	68·10	147·80	111·38	2·09	153·9	47·0	106·9	145·9	15	33·32

TRIAL II.—*The Engine Run at Two-thirds Full Power.*

Time.	Load on brake in lbs.	In five minutes' interval.			Temperature of cooling water.			Indicator diagrams.		
		Revolutions of counter.	Gas used in cubic feet.	Jacket water in lbs.	Discharged F. deg.	Initial F. deg.	Rise of temperature, F. deg.	Maximum initial pressure above atm. in lbs. per sq. in.	Terminal pressure above atm. in lbs. per sq. in.	Mean effective pressure in lbs. per sq. in.
					deg.	deg				
12.15	46·0	—	—	—	153	47	—	108	14	31·5
12.20	46·0	745	7·13	10·0	150	—	—	74	14	27·2
12.25	46·0	746	7·19	10·5	147	—	—	110	17	33·5
12.30	46·0	746	7·55	10·5	145	—	—	80	15	—
12.35	45·9	745	8·43	11·0	145	—	—	88	15	—
12.40	45·9	746	7·80	9·5	145·5	—	—	102	15	30·0
12.45	45·7	750	7·80	9·5	145·5	—	—	87	14	—
12.50	45·7	747	8·00	10·75	146	—	—	101	15	30·8
12.55	45·7	748	7·50	11·0	144	—	—	95	15	32·8
1.0	45·7	746	7·35	10·75	142·5	47	—	130	15	—
		per min.	per hour.	per min.						
Means	45·86	149·31	91·68	2·08	146·3	47	99·3	97·5	15·4	30·95

TRIAL III.—*The Engine Run at One-third Full Power.*

Time.	Load on brake in lbs.	In five minutes' interval.			Temp. of cooling water.		
		Revs. of counter.	Gas used in c. ft.	Jacket water in lbs.	Discharged F. deg.	Initial F. deg.	Rise of Temp. F. deg.
2.30	22·75	—	—	—	120°	48°	—
2.35	—	750	5·37	9·25	118	—	—
2.40	22·50	761	5·13	11·00	115	—	—
2.45	22·50	739	4·96	9·5	111	—	—
2.50	22·50	758	5·07	10·5	109	—	—
2.55	—	737	5·09	10·25	111	—	—
3.0	22·50	750	5·05	10·0	111	—	—
3.5	22·50	749	5·24	11·0	111	48	65·2
		per min.	per hour.	per min.			
Means	22·54	149·9	61·56	2·04	113·2	48	65·2

TRIAL IV.—*The Engine Run without Load.*

Time.	Load on brake in lbs.	In five minutes' interval.			Temp. of cooling water.		
		Revs. of counter.	Gas used in c. ft.	Jacket water in lbs.	Discharged F. deg.	Initial F. deg.	Rise of Temp. F. deg.
3.20	0	—	—	—	107°	48°	—
3.25	—	752	3·28	9·75	104	—	—
3.30	—	748	3·01	10·00	102	—	—
3.35	—	753	3·08	10·0	99	—	—
3.40	—	750	3·13	10·25	98	—	—
3.45	—	751	3·24	11·0	97	—	—
3.50	—	750	2·98	9·25	96	—	—
3.55	—	749	3·11	10·0	96	47·5	—
		per min.	per hour.	per min.			
Means	—	150·1	37·42	2·01	99·8	47·75	52·05

TRIAL V.—*The Engine Run with Maximum Load.*

Time.	Load on brake in lbs.	In five minutes' interval.			Temperature of cooling water.			Indicator diagrams.		
		Revolutions of counter.	Gas used in cubic feet.	Jacket water in lbs.	Discharged, F. deg.	Initial, F. deg.	Rise of temperature, F. deg.	Maximum initial pressure above atm. in lbs. per sq. in.	Terminal pressure above atm. in lbs. per sq. in.	Mean effective pressure in lbs. per sq. in.
4.5	74·0	—	—	—	—	—	—	130	16	35·6
4.10	74·0	729	9·89	9·75	121·5	47·5	—	119	15	35·1
4.15	74·0	732	9·88	8·25	131·0	—	—	125	16	35·6
4.20	Engine	began	to slow	13·0	137·0	—	—	129	15	35·3
4.25	74·1	732	9·69	10·0	143·0	—	—	130	15	34·8
4.30	74·2	728	9·73	9·0	148·0	—	—	150	16	35·3
4.35	Engine	began	to slow	—	—	—	—	—	—	—
		per min.	per hour	per min.						
Means	74·08	146·04	117·6	2·00	136·1	47·5	88·6	132·1	15·5	35·22

Gas consumption per effective or brake horse-power.—The consumption of London gas in the trials was as follows:—

	Brake Horse-power.	Total gas used in c. ft. per hour.	Gas used in c. ft. per hour per brake horse-power.
Trial V.	5·255	116·20	22·11
,, I.	4·889	110·04	22·51
,, II.	3 326	90·58	27·24
,, III.	1·642	60·82	37·04

Also running without load the engine used 37·42 cubic feet per hour. That this is a very remarkably low consumption may be judged by comparison with the following results of published trials of other engines of about the same size. Taking first full power trials to compare I. and V. of the trials above.

Make of Engine.	Authority.	C. ft. of gas per hour per brake H.P.
Otto 4-H.P.	Slaby	32·0
,, 6-H.P.	Thurston	29·1
,, 4-H.P.	Schöttler	32·4
,, 4-H.P.	,, ...	33·4
Clerk 4-H.P.	Garrett	37·3

Again, taking trials of an engine run without load to compare with trial IV. above:—

Maker of engine.	Authority.	Rev. per minute.	Gas used in c. ft. per hour.
Otto 3½-H.P.	Clerk	166	43
,, 4-H.P.	Schöttler	160	42
Clerk 4-H.P.	Garrett	190	58

Very few results of trials of the gas consumption of engines run at less than normal full power have been published, and there is at least a general impression that when working at less than full power most gas engines are extravagant in gas consumption. In a paper by Witz published in the "Proc. Inst. Civil Engineers," vol. lxxvi., 1884, I find the following results for an Otto engine:—

Otto 4-H.P. Engine tried by Schöttler.

	Actual power developed.	Gas used per H.P. in c. ft. per hour.
(1)	3·98	37·7
(2)	3·96	32·0
(3)	1·62	64·0
(4)	0·34	188·0

The third of these is nearly in similar conditions to trial III. above.

Number of ignitions.—This was not determined very exactly but the following figures are approximate:—

Full power	147 (every revolution)
¾ full power	119
½ full power	75
No load	54 (every third revolution)

The governor has therefore ample control of the engine and the speed is kept regular even with no load.

Disposal of the heat.—Taking first trial I., which was the longest trial and the one in which normal conditions of working were most nearly present. In one minute 1·834 cubic feet of gas were used, which, at 628·7 thermal units per cubic foot, would furnish altogether 890,000 foot-pounds of work if it could all be rendered available. For this there is obtained

	Foot-pounds.
On brake 4·889-H.P. or	161,337
Engine friction 0·674-H.P. or	22,242
In cooling water 2·09 × 106·9 × 772 or	172,500
Leaving for exhaust waste and radiation	533,921

Summary of Results of Trials.

Duration of trial.	Load on brake in lbs.	Revs. of engine per min.	Gas used by meter in cub. ft per hour.	Gas used per hour, corrected for probable error of meter.	Jacket water.		Pressures in cylinder, lbs. per square inch above atmosphere.			Indicated horse-power.	Brake horse-power.	Gas used per hour in cub. ft.	
					Quantity in lbs. per min.	Rise of temp. F. deg.	Mean initial.	Mean terminal.	Mean effective.			Per indic. H.P.	Per brake H.P.
h.m. to h.m.													
I. 11.0 to 12.0	68·10	147·80	111·38	110·04	2·09	106·9	145·9	15·0	33·32	5·563	4·889	19·78	22·51
II. 12.15 to 1.0	45·86	149·31	91·68	90·58	2·08	99·3	97·5	15·4	30·95	4·160*	3·326	21·78	27·24
III. 2.30 to 3.5	22·54	149·9	61·56	60·82	2·04	65·2	—	—	—	—	1·642	—	37·04
IV. 3.20 to 3.55	0	150·1	37·42	36·97	2·01	52·05	—	—	—	—	0	—	—
V. 4.5 to 4.35	74·08	146·04	117·6	116·2	2·00	88·6†	132·1	15·5	35·22	5·811	5·255	20·00	22·11

* From a five minutes' count, I found there were 119 ignitions per minute.

† The temperature of jacket water was rising, and did not become constant.

ATKINSON'S NEW GAS ENGINE.

THE BRITISH GAS ENGINE AND ENGINEERING COMPANY, LONDON, ENGINEERS.

FIG. 2

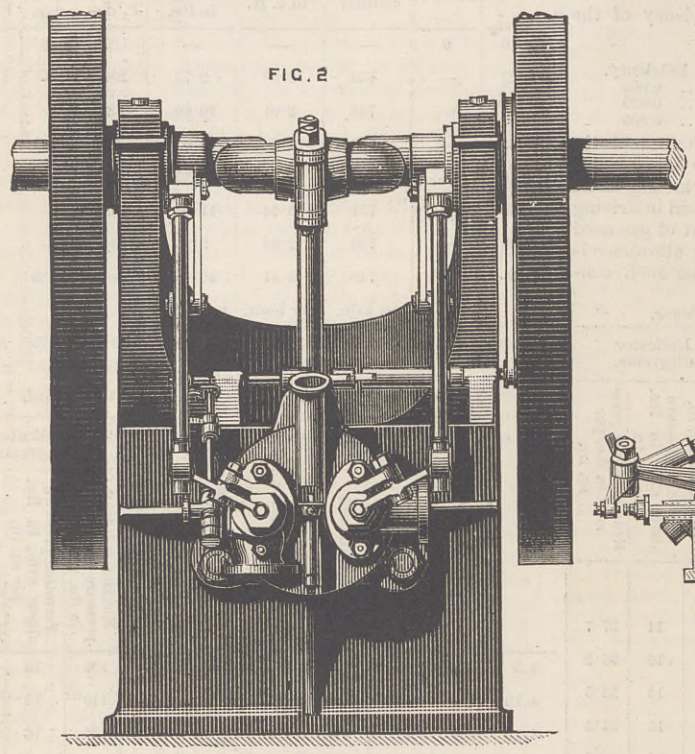


FIG. 1

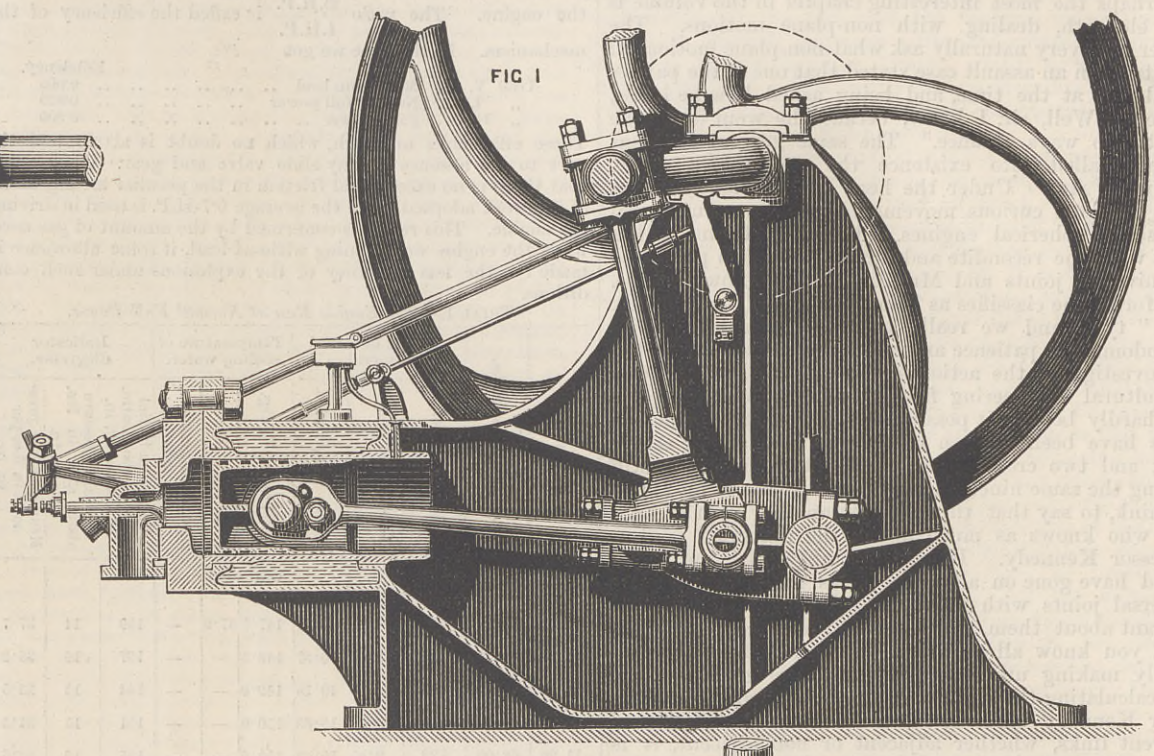


FIG. 4

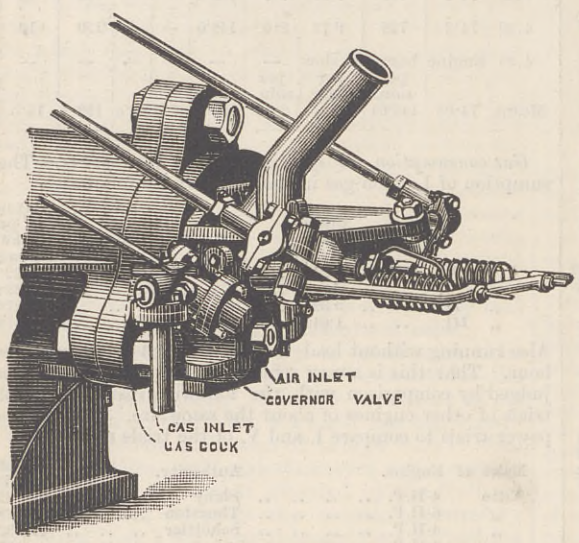
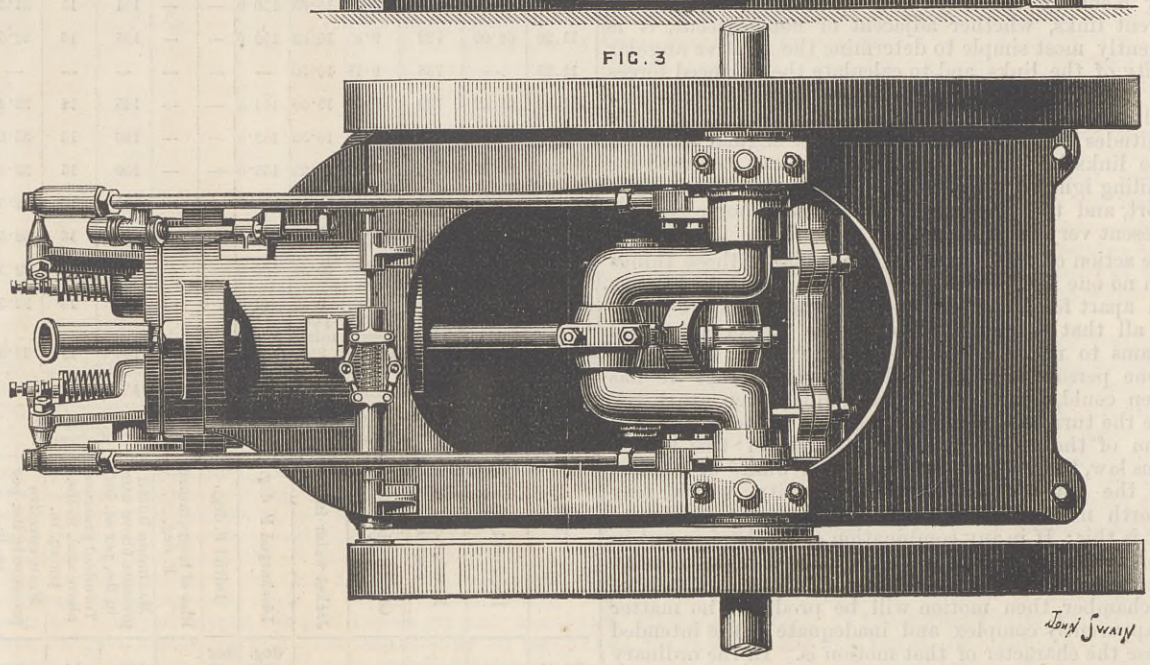


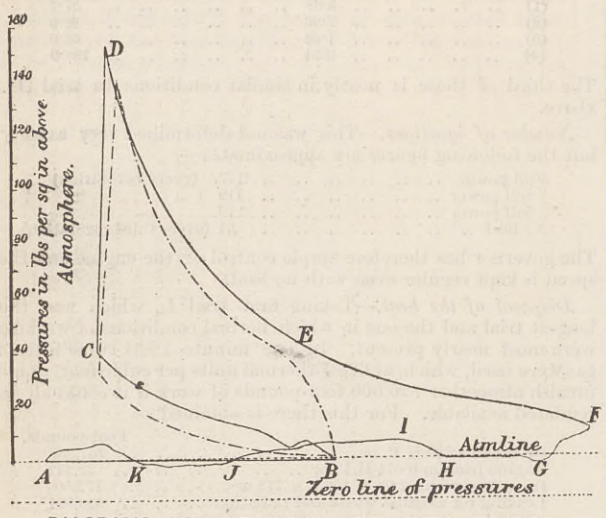
FIG. 3



On reducing these numbers to percentages of the heat of combustion:—

Per cent.	given by brake	18·12
,,	lost in engine friction	2·50
,,	accounted for in indicator diagrams	20·62
,,	given to jacket water	19·37
,,	lost in exhaust, &c.	60·00

Comparing these figures with those obtained in previous trials of other engines it will be found that (1) the efficiency of the Atkinson engine is about 3 per cent. or 4 per cent. greater. That is, 3 or 4 per cent. more heat is converted into work in the cylinder. (2) Less heat is given to the jacket water and more carried into the exhaust. This is due probably partly to the gas



DIAGRAMS FOR ATKINSON AND OTTO ENGINES.

picking up more heat from the cylinder during the compression stroke. Then also the complete cycle is performed in half the time in which it is performed in the Otto engine, and therefore less heat is given to the cylinder during explosion and expansion. That the gases retain the heat instead of its being given to the jacket water increases the efficiency of the expansion. It will be seen presently that the form of the indicator diagram is in accordance with the deductions stated above.

Form of expansion and compression lines.—Taking card No. 10 I get the following values of the pressures and volumes in the cylinder:—

	Pressures absolute.	Volumes in c. ft.
Beginning of compression	14·7	0·1888
End of ,,	54·7	0·0738
Beginning of expansion	167·7	0·0802
End of ,,	28·7	0·3102

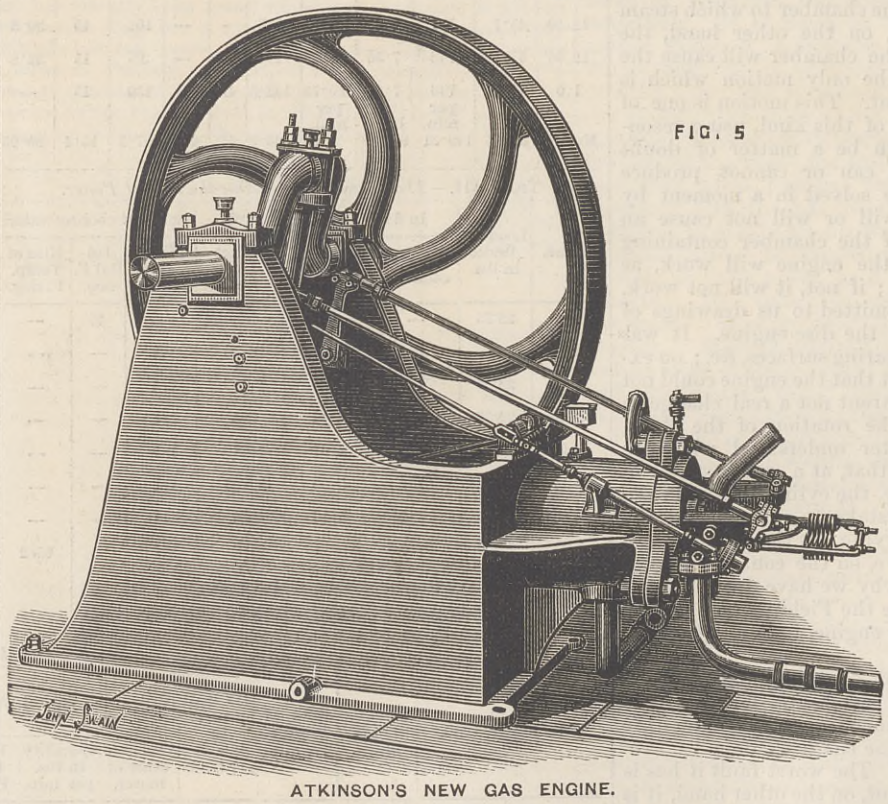
Hence since these curves are of the form pv^m = constant, we get for the value of m:—

For compression curve $\left(\frac{54{\cdot}7}{14{\cdot}7} = \frac{0{\cdot}1888}{0{\cdot}0738}\right)^m$ $m = 1{\cdot}399$.

For the expansion curve $\left(\frac{167{\cdot}7}{28{\cdot}7} = \frac{0{\cdot}3102}{0{\cdot}0802}\right)^m$ $m = 1{\cdot}305$.

For an adiabatic curve $m = 1{\cdot}375$ and for an isothermal curve

FIG. 5



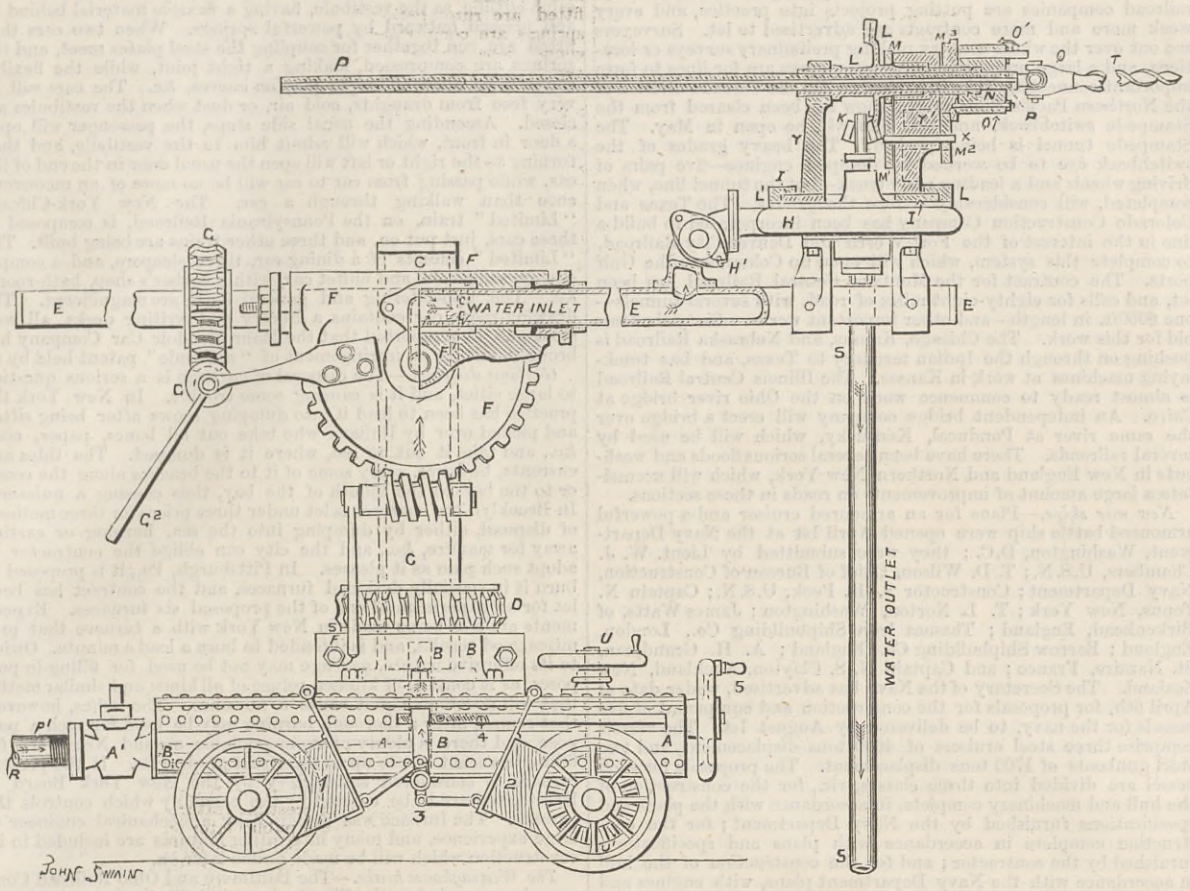
ATKINSON'S NEW GAS ENGINE.

$m = 1{\cdot}0$. The compression curve is probably within the limit of error of measurement of the diagram, an adiabatic curve rising, if anything, a little more steeply, which would mean that the gas gained heat slightly during compression from the cylinder sides. I take it therefore that the cold gas and air coming into the cylinder and during the slight pause at the dead point of the stroke must be heated to such a point that the transfer of heat to or from the cylinder sides during compression almost ceases. The expansion curve lies between an adiabatic and an isothermal, being nearer to an adiabatic. Hence the loss of heat to the jacket must be rather less than the heat developed during expansion. This is conformable to the fact observed of the rather low percentage of heat given to the jacket. In the Otto engine the curve is nearly adiabatic, so that the gain and loss of heat are equal.

General indications of the indicator diagrams.—I append to this a tracing showing an enlargement of diagram No. 10, of the full-power trial taken at 11.50. It is merely a good average diagram of that trial. It shows the general form taken by all the diagrams, except when from any cause the ignition was retarded. The wave form of the back-pressure line is a peculiarity already discussed. On this I have plotted the Otto engine diagram given in Dr. Slaby's report. The diagrams are plotted so that the compressing stroke is identical in the two diagrams. The comparison of the two diagrams shows very clearly the better utilisation of the work generated by the explosion in the Atkinson engine. The expansion line is higher, and the work done by the expansion very considerably greater. The ratio of expansion is $3\frac{3}{4}$in. in the Atkinson engine, and only $2\frac{1}{2}$in. in the Otto.

General conclusions.—It appears therefore that the Atkinson engine works satisfactorily through a day's trial, with regularity of speed, and without requiring attention. It realises an exceptional economy of gas at full power, and at least an equally exceptional economy at reduced power. The linkwork, though novel, is of a simple kind; and I see no reason why it should give trouble. The valve gear is particularly simple and easy to work, and it is an advantage that there is no slide valve. The friction of the engine is rather less than usual. The high piston speed, without exceptionally high crank-shaft speed, tends to economy in working and cheapness in manufacturing. The fact that an impulse is given in normal working at every revolution increases the steadiness of running, and facilitates the control of the engine by the governor. We add to the foregoing report by Professor Unwin, the engravings of the new engine which will be found above, and which show the

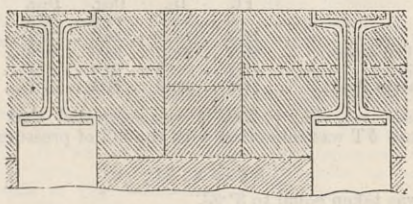
STEAVENSON'S HYDRAULIC DRILL.



m^3. From this description it will be seen that the position of the drill with reference to the stone to be pierced may be adjusted by three distinct movements: 1, round the vertical axis; 2, round the horizontal axis; 3, round the axis of the tube *e*. In addition to these there is a supplementary adjustment round the vertical axis of the turbine, which permits the drill to assume any desirable angle with the bar *e*. All the motions are under the control of the attendant, who has all the necessary handles within reach. The machine has been in operation at the Lumpsey mine since 1884, and has given great satisfaction. Eighty, and sometimes 100 holes, each 4ft. 6in. deep and 2½in. in diameter, are drilled per shift of eight hours, producing 170 tons of ironstone. The water used each day is pumped to the surface by the mine pumps in twenty minutes.

Another interesting exhibit is a model of an improved trough and rake, coal-washing machine. This consists of a long semicircular trough of iron, hung at one end so that the other end may be depressed. Above the trough is a longitudinal shaft to which the rakes are fixed, and which imparts to them a backward and forward movement. At suitable intervals are plate iron stops, fitting the bottom of the trough. The crushed coal is admitted at the top, and with it a stream of water, the flow of which is so adjusted as to carry the coal over the top of the stops, while the heavy particles of shale, &c., sink to the bottom and are caught. When sufficient impurities have collected, the trough is lowered so as to leave a gap below the stops, and a stream of water then removes the dirt, when the operation commences again. One man and a lad are able to attend to three such washers.

The annexed cut shows a coal wedge, also exhibited by Messrs. Bell Brothers, which is intended to do the work now accomplished by powder. It has been in practical operation at Tursdale for several months, and has proved fully equal to the work for which it was intended. The

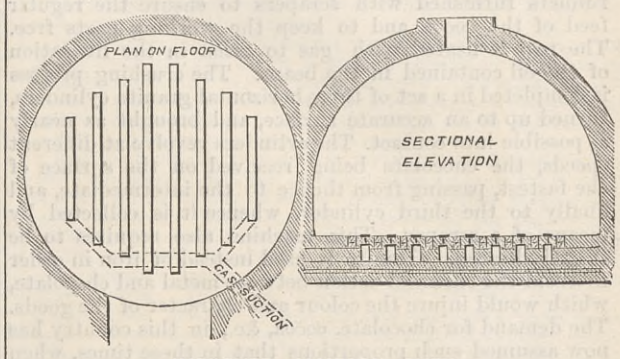


BELL'S COAL WEDGE.

apparatus is very simple, consisting of a long wedge which, by means of ratchet gear, is drawn between two pieces of steel, and by forcing them apart puts an enormous pressure upon the coal. Two ratchets are provided, only one being used in ordinary work. The coal is prepared by cutting or hewing out the lower part of the seam, as is usual when blasting.

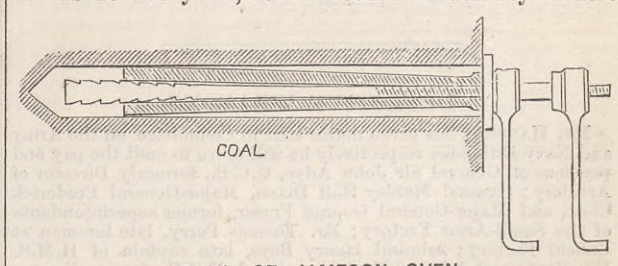
In the same section Messrs. Bolckow, Vaughan, and Co. have a large stand and case rising to a height of 12ft. On the top is a model of a blast furnace, with hot-blast stoves, &c., complete, made to a scale of ¾in. to 1ft. This furnace has a bosh 24ft. diameter, crucible 10ft., and throat, 15ft., the height being 93ft., and the yield of Cleveland pig iron 520 tons per week. A similar furnace making hematite pig iron, but only 72ft. high, produces 1000 tons per week. Behind this model is a large steel plate 21ft. long, 7ft. wide, and $\frac{11}{16}$in. thick, weighing two tons. Round the bottom of the platform are shown samples of all the minerals used in the manufacture of iron and steel, such as coal and coke, limestone—mountain and magnesian—and Cleveland ironstone from Eston mines. This stone in a raw state contains 30 per cent. metallic iron, and when calcined 41 per cent. Samples of Spanish hematite ores, used in the manufacture of Bessemer pig iron, are also exhibited, containing 50 per cent. metallic iron. Above the samples of minerals are specimens of the various descriptions of iron obtained from them, including all the qualities of Cleveland and hematite pig iron, spiegeleisen, containing up to 30 per cent. manganese, and ferro-manganese, with up to 80 per cent. manganese. Several ingots are shown in Siemens-Martin, Bessemer, and basic steel of the various sizes required for the manufacture of rails, sleepers, plates, angles, bulbs, girders, &c. These are from 1½ tons to a plate ingot of 4½ tons. A rail ingot, broken through the centre when cold, is exhibited to show the fracture and absence of blow holes. The specimens of finished products from the ingots are very numerous, and include rails of all sections, fish-plates, steel sleepers with rails keyed in position, boiler plates, ship plates up to 3in. thick, similar to those made for H.M.S. Orlando and Undaunted, and various sizes of angles and bars. The company manufactures plates up to 5 tons in weight, 40ft. long, 8ft. wide, and 4in. thick. A great variety of cold test pieces are shown, among which are a number of steel plates and angles made from Cleveland iron by the basic process and tested under Admiralty supervision. The cold test pieces are bent until the diameter inside is not more than three times the thickness. The temper bends were heated to cherry red, plunged into water not exceeding 82 deg. Fah., and bent to the same radius. Several pieces of plate are exhibited which have been subjected to the "shot" test. In this test a shot 2¼in. diameter placed on a 1in. plate requires a 1 ton weight falling 30ft. before it penetrates the steel. Other samples shown are butt straps punched and bent across the holes, and drifting tests. Altogether this is an admirable exhibit of the kind, and is well worth careful examination.

In the West Court the Jameson Patent Coking Company exhibits models of coke ovens and plant adapted to the recovery of bye-products of coal. This process, from which so much was at one time expected—as set forth in our pages—produced great disappointment, and fell almost into desuetude from the fact that in all the large installations the results in actual practice fell far short of those obtained with similar coal in the experimental ovens at the works of Messrs. H. L. Pattinson and Co., at Felling. For a long time the cause of difference of yield was not discovered. Many efforts were made by the company and by persons working the process to establish the identical conditions in the large installations which had been so successful in the experimental ovens; but such efforts were for a long time absolutely unproductive of benefit. The company therefore ceased to advertise or to recommend the adoption of the process, and concentrated their attention upon one installation only for the purpose of discovering, and, if possible, remedying the defect. After long, very costly, and patient investigation the causes of failure were demonstrated to be two—first, the inadequacy of the provisions in the false bottom to permit the proper passage of gas; and secondly, the defective construction in the true bottom, which permitted considerable in-leakage of air. These matters in the Felling ovens had occasioned no trouble or anxiety, by reason of the fact that during the experiments made there the ovens were very frequently altered. At first the false bottoms were made of firebrick laid dry, then of side wedges laid dry, then of quarls with small circular orifices widening downwards, then of quarls with longitudinal orifices widening downwards, then of special bricks of various kinds, the object being to preserve free openings for gas, and to prevent the passage of small coal to the channels under the perforated floor. With these continual changes and frequent coolings the floors never got into a bad state. The passages in the false bottom continued free, and the true floor of the oven being made of bricks set in fireclay and tar, remained impervious to air, and so prevented any discovery of the vital importance of the effect thus incidentally secured. In result, it was found from a great many repeated experiments that each variety of coal gave at different times a close approximation to the same yield of products, so that it was supposed that the conditions of success were fully ascertained. When, however, the arrangements adopted at Felling were applied on a large scale in ovens worked continuously, defective performance very quickly showed itself, and where a yield of five gallons of oil per ton was expected, frequently two gallons only were permanently obtained. The main pipes occasionally got red hot opposite particular ovens, and the whole produce from the ovens beyond the spot at which the heating occurred was burned. The small openings for suction in the false bottom became either unduly enlarged, and thus allowed small coal to get into the passages, which were thereby choked up, or they sealed themselves up with hardened pitch. By degrees also the tar and fireclay



IMPROVED JAMESON OVEN.

cement of the true floor burned out, and in-leakage of air took place, forming, with the coal gas, a mixture which was capable of ignition, and which, at a certain stage of the coking process, was almost sure to ignite. The remedy for one defect, viz., increased suction, aggravated the other. Along with these practical difficulties the value of oil fell to about a quarter of what it had been at first, and a good many of the installations were abandoned. The causes of failure were not, as we have said, at once apparent. A meter had been used at Felling to measure the quantity of gas taken from the coal, but this was impracticable when the volume of gas to be measured was large, and when the gases of each oven were not separately cooled. One of the first indications which would have revealed the defect was therefore not available until an arrangement was devised by which, without actual measurement, the quantity of gas passing in any pipe, whether hot or cold, could be approximately ascertained. This arrangement we propose to describe separately, as it is one of much value for many purposes. By the application of this gauge it was found that instead of obtaining about 12,000ft. to 15,000ft. of gas from a ton of coal during its coking, many ovens with extremely small suction indicated as much as 120,000ft., the great bulk of this being air, which leaked into the channels through the oven foundations from which the tar cement had been burned away. Many experiments were then tried with various cements for the oven floors, and much time was necessarily consumed in ascertaining whether they would bear the test of time, and if the quenching water and the dry heat could be continuously endured. The closing up of the suction orifices or their undue enlargement was also investigated and dealt with, and in result the ovens illustrated by the exhibited model have been devised and practically tried for about two years, first at South Medomsley—where



DETAIL OF JAMESON OVEN.

progress was unfortunately stopped by a long strike—and next at Tudhoe, where the process has been continuously worked for upwards of three years. The perforated floor is made of special bricks and H iron, as illustrated in the engravings. The H irons are tied by cross-bolts in the centre, and by the movement due to expansion and contraction against the bricks maintain constantly an open passage for gas while practically impervious to the passage of coal. The actual floor is constructed of, first, a fireproof cement containing silicate of soda, forming the air-tight layer, and above it in the well of the oven a cement intended merely to keep the quenching water off the silicate cement. By these means the difficulties of the process have been met, and it is believed that the same results as at Felling will now be obtained in installations of any size. The irons in the oven bottom have been at work for a year, and so far as can be seen, will be quite capable of lasting three years at least.

The Great Northern Railway Company shows a very beautifully finished locomotive and tender of the type used for the passenger traffic between King's Cross and York. These engines were designed by Mr. Stirling in 1869, since which date upwards of forty have been built to take the place of old engines worn out. They have been fully illustrated in THE ENGINEER portfolio of working drawings, and it is therefore unnecessary to more than briefly state some of the leading particulars. The cylinders are outside, and are 18in. diameter and 28in. stroke. The engine is on eight wheels, four of which are in the bogie, and are each 3ft. 1in. diameter. The driving wheels are 8ft. 1½in. diameter. The boiler has a total heating surface of 1045 square feet, and the furnace is adapted to burn coals. The tender is on six wheels, each 4ft. 1½in.

diameter. The tank capacity is 2900 gallons. The engines were designed to take the heaviest and fastest passenger traffic in the east coast route to Scotland, and all those who have travelled on the Great Northern line know how well they have fulfilled their purpose. Their train load is usually 140 tons, exclusive of passengers and luggage, and speed fifty to fifty-two miles per hour. The weight of the engine in working order is 45 tons, and of the tender 37 tons, including water.

Chocolate making, pure and simple, hardly comes within the scope of an engineering article, but the attention of engineers will no doubt be attracted by the very well finished machinery in operation at the stand of Messrs. J. S. Fry and Sons, Bristol, the bulk of which, we regret to say, is of French manufacture. The pan for crushing the cocoa beans and combining the crushed material with sugar consists of a granite bed, revolving at a proper speed, and two granite edge runners furnished with scrapers to ensure the regular feed of the cocoa and to keep the working parts free. The pan is heated with gas to assist in the liberation of the oil contained in the beans. The crushing process is completed in a set of three horizontal granite cylinders, turned up to an accurate surface, and brought as nearly as possible into contact. The cylinders revolve at different speeds, the chocolate being received on the surface of the fastest, passing from thence to the intermediate, and finally to the third cylinder, whence it is collected by means of a scraper. This machine also requires to be slightly heated. Granite is used instead of iron in order to avoid the chemical action between metal and chocolate, which would injure the colour and character of the goods. The demand for chocolate, cocoa, &c., in this country has now assumed such proportions that in these times, when orders are so difficult to procure, it would surely be to the interest of some firm of manufacturing engineers to take up the making of chocolate machinery as a speciality. We are aware that in one or two instances machinery has been made here, but we are quite correct in stating that the bulk of the finished work in the chocolate factories in this country has come from France. This to us seems a most extraordinary state of affairs, inasmuch as there is nothing special in the machinery to render its manufacture more suitable to one country than to another.

In the West Court, Mr. Jonathan Pickering, Stockton-on-Tees, exhibits his specialities in light hoisting machinery. In an erection some 25ft. high will be found a complete lift on the "Standard" self-sustaining principle, previously illustrated and described in The Engineer. A new feature about this is the addition of a screw brake in connection with the automatic sustaining gear. By this the cage can be lowered at any desired speed, yet it is optional on the part of the attendant to use the brake, or lower by hand over hand in the usual way, as in hoisting. The cage is built with angle iron frames, and enclosed with galvanised wirework, which has a good appearance, and wastes but little space. Another novelty is a 7 cwt. hand crane, with a hollow pillar down which the chain passes on to a cup drum instead of the usual winding barrel. This arrangement considerably reduces the gearing, and makes it compact, while the length of lift is practically unlimited. The load is self-sustained on leaving hold of the lifting handles, and to lower, all that is necessary is to release the brake, this action throwing out the pawl at the same time. The crane can be swung entirely round, but can be fixed at any point by means of a screw. Other exhibits consist of power friction hoists, with the usual excentric friction barrel driven by a pinion, some of them having a hand-lifting arrangement, consisting of a spur wheel and pinion with a V-rope driving wheel, and self-sustaining gear.

DEFECTIVE WEAPONS.

Mr. Hanbury has given notice that in Committee on the Army and Navy Estimates respectively he will move to omit the pay and pensions of General Sir John Adye, G.C.B., formerly Director of Artillery; General Manley Hall Dixon, Major-General Frederick Close, and Major-General George Fraser, former superintendents of the Small-Arms Factory; Mr. Thomas Perry, late foreman at Enfield Factory; Admiral Henry Boys, late captain of H.M.S. Excellent; and Admiral Sir Arthur Hood, K.C.B., former director of Naval Ordnance; these officials being the persons among whom, as the Secretary for War stated in this House, the responsibility must be shared for the issue to the men of her Majesty's Navy of disgracefully defective weapons. We propose to notice this more fully by-and-bye.

The facts of the case briefly are as follows:—It was decided to alter the pattern of the cutlass and cutlass sword bayonets of the Navy in 1872, the new patterns to be shorter and straighter. It was decided that this change could be effected by altering the arms then in the service. This was done to the cutlass-bayonet by heating it to a cherry red, and straightening and shortening to 25½in. length. The blades were then raised to blue heat and plunged in water. They were tested by bending across a bridge 3⅝in. high. It was found impossible to heat the blades after straightening to red heat and then cool them down to the final blue temperature, because of the liability to distortion in such thin metal. There was, however, a considerable measure of hardness imparted to them. We propose to give the figures on a future occasion. The cutlass-bayonets did not fail on service, but on board ship one failed, and several were tested by pressing the point till the blade shortened 6in., being bent laterally 7in. in this process. Under this test some of them failed to come back to the straight line. The operation of conversion was sanctioned in 1872, when General Dixon was superintendent at Enfield. It was continued for many years, no fault having been found with the weapons until a few months since. General Fraser, General Close, and Colonel Arbuthnot all continued it during their terms without raising any objection until the recent complaints were made, when it was discontinued. The blades are many of them without question objectionable, but it is not true that when sharp they will not transfix a sheep clothed in a military cloak. It is curious that no complaints have come in of the cutlasses, but only of the cutlass bayonets, so far as we know. We may say at once the evil appears to us to have been in the first sanction of the process. Subsequently it rather furnishes one more example of the evil of the five years' system. It is hardly reasonable to expect that a superintendent coming to a department would attack a process carried on by those preceding him, sanctioned by high authorities, and for a gradually increasing number of years apparently found to give good results in the Navy.

AMERICAN ENGINEERING NEWS.

(*From a Correspondent.*)

Railroad work.—With the gradual opening of the season the railroad companies are putting projects into practice, and every week more and more contracts are advertised to let. Surveyors are out over the whole country making preliminary surveys or locations, and a large proportion of these surveys are for lines to form important connecting links in systems. On the Cascade division of the Northern Pacific Railroad the snow has been cleared from the Stampede switchback, and this line will be open in May. The Stampede tunnel is being pushed. The heavy grades of the switchback are to be worked by decapod engines—five pairs of driving wheels and a leading pony truck—but the tunnel line, when completed, will considerably reduce the grades. The Texas and Colorado Construction Company has been incorporated to build a line in the interest of the Fort Worth and Denver City Railroad, to complete this system, which will open up Colorado to the Gulf ports. The contract for the Montana Central Railroad has been let, and calls for eighty-eight miles of road, with several tunnels—one 6000ft. in length—and other important works. Sixty-six firms bid for this work. The Chicago, Kansas, and Nebraska Railroad is pushing on through the Indian territory to Texas, and has track-laying machines at work in Kansas. The Illinois Central Railroad is almost ready to commence work on the Ohio river bridge at Cairo. An independent bridge company will erect a bridge over the same river at Ponducal, Kentucky, which will be used by several railroads. There have been several serious floods and washouts in New England and Northern New York, which will necessitate a large amount of improvements on roads in these sections.

New war ships.—Plans for an armoured cruiser and a powerful armoured battle ship were opened April 1st at the Navy Department, Washington, D.C.; they were submitted by Lieut. W. J. Chambers, U.S.N.; T. D. Wilson, Chief of Bureau of Construction, Navy Department; Constructor S. H. Pook, U.S.N.; Captain N. Tonns, New York; T. L. Norton, Washington; James Watts, of Birkenhead, England; Thames Iron Shipbuilding Co., London, England; Barrow Shipbuilding Co., England; A. H. Grandjean, St. Nazaire, France; and Captain N. S. Clayton, Auckland, New Zealand. The Secretary of the Navy has advertised, under date of April 6th, for proposals for the construction and equipment of five vessels for the navy, to be delivered by August 1st. The vessels comprise three steel cruisers of 4000 tons displacement, and two steel gunboats of 1700 tons displacement. The proposals for each vessel are divided into three classes, viz., for the construction of the hull and machinery complete, in accordance with the plans and specifications furnished by the Navy Department; for the construction complete in accordance with plans and specifications furnished by the contractor; and for the construction of the hull in accordance with the Navy Department plans, with engines and machinery on the contractor's designs. The cost of one of the cruisers is not to exceed 1,300,000 dols., and 3,000,000 dols. in aggregate for the other two; the cost of the gunboats is limited to 550,000 dols. each. Contracts will be awarded separately for each vessel. The proposals are to include the construction, equipment, and armament of the vessels, complete in every way and ready for service. The vessels may be built on the Pacific coast, Gulf coast, or on the Mississippi, and Atlantic coast, and are to be entirely of domestic material and manufacture; maximum speed specified, 19 knots per hour.

Rapid transit in New York City.—The capacities of the elevated and horse railroads are being tried to the utmost, and the trouble increases with the growth of the city. The down-town trains and cars in the morning, and the up-town trains in the evening are crowded to suffocation, so much so that the brakemen can hardly move to open the gates owing to the crowds on the platforms of the cars, while the street cars carry as many passengers as can get a hold. Recognising the urgent need for further rapid transit facilities the Mayor has appointed a Rapid Transit Commission to consider the various projects, and report on the best means of relieving the pressure. Several schemes are put forward for feeders to the elevated roads, and for new elevated roads, including one "boodle" scheme, and, a justly denounced one, for an elevated road on Broadway. The most advantageous method for rapid transit would be a system of underground railroad, several charters for which are in existence. The main scheme includes a four-track line under Broadway, two tracks for express and two for way trains, with branches to the most important railroad ferries and accommodating the suburban districts.

A large river cargo.—The largest load ever taken by a single steamboat down the Mississippi reached New Orleans, La., recently. The Joseph B. Williams had the tow made up on the Ohio river, consisting of 39 boats and barges loaded with coal; the load, 826,011 bushels of coal, or 31,388 tons. The steamer is attached to the rear of the tow, guiding and controlling it in the current. It would take about 2000 freight cars and 50 engines to bring the load by rail.

Regulation of temperature.—The National Electric Service Company operates, and is introducing very widely the Johnson heat regulating apparatus. The object of this system is the maintaining of an even temperature in houses, offices, and all buildings, and electricity is employed as the means to this end. In the room is placed a thermometer, to which is attached a thermostat; this consists of a long and narrow strip of hard rubber fastened to a similar strip of brass; the lower end hangs between two metallic points beneath the thermometer. The thermostat is provided with a thumbscrew, by which the temperature is set at any required degree. Should the temperature fall, even to an imperceptible extent, the rubber strip contracts more rapidly than the brass, warping the strip and bringing it into contact with one of the points; this closes the electric circuit and sends a current over a wire to an electro-pneumatic valve, which opens to allow the escape of a small quantity of compressed air from a reservoir, moving a lever which opens the furnace register in the room. When the temperature returns to the required degree, the thermostat moves to the other point, the valve opens the other way, and the register is closed. This description applies to rooms heated by hot air from a furnace in the basement, a very common method in this country, but the apparatus is applicable to any method of heating. The furnace needs only to be shaken and cleared once in twenty-four hours. The electro-pneumatic valve opens communication between the compressed-air chamber and the chamber above the diaphragm of a diaphragm valve on the supply pipe, or between this latter chamber and the electric valve for an exhaust, when the diaphragm returns to its normal position. Telephone batteries are used, with from three to six cells, according to the number of valves. The apparatus is very efficient, and it is applied to many buildings in New York, Boston, Chicago, St. Louis, Milwaukee, and other cities.

Naval contracts.—The Secretary of the Navy awarded the steel contracts on April 14th. Both contracts were awarded to the Bethlehem Ironworks Company, of Pennsylvania, and included 1400 tons of steel gun forgings and 4500 tons of steel armour-plates. The total amount is 4,512,938·29 dols.

Street railroad tracks.—There is a Bill pending in the New York State Legislature requiring street railroads—tramways—to be laid with grooved rails. The forms of rails now in use are the centre-bearing or T rail, of somewhat similar section to the English bridge rail, and the side-bearing rail, which is L-shaped. Both of these forms cause considerable irregularity in the surface of the street paving, and are very inconvenient, more especially the former, to vehicular traffic. How a grooved rail would answer in heavy snow-storms, &c., remains to be seen. Truckmen and others petition for the new rails, and street car *employés* protest against them.

An improved Pullman car.—The Pullman Palace Car Company has brought out an improvement which will make travelling even more comfortable than at present. The improvement consists in making a closed passage way or vestibule between the cars. At present, to pass from one car to another, the passenger has to walk across the platforms exposed to the wind and dust, from which the overhanging canopy is no protection; but on the new plan a passageway is built across the platforms, with side doors for access to the steps. At the end of the passageway is a steel frame of the same outline as the vestibule, having a flexible material behind it, and pressed outward by powerful springs. When two cars thus fitted are run together for coupling the steel plates meet, and the springs are compressed, making a tight joint, while the flexible connections allow of ample play on curves, &c. The cars will be very free from draughts, cold air, or dust when the vestibules are closed. Ascending the usual side steps, the passenger will open a door in front, which will admit him to the vestibule, and then turning to the right or left will open the usual door in the end of the car, while passing from car to car will be no more of an inconvenience than walking through a car. The New York-Chicago "Limited" train, on the Pennsylvania Railroad, is composed of these cars, just put on, and three other trains are being built. The "Limited" consists of a dining car, three sleepers, and a composite drawing-room and buffet car, with a barber's shop, bath-room, &c. The upholstering and general finish are magnificent. The drawing-room car contains a library and writing desks, all well stocked. It is reported that the Mann Boudoir Car Company has brought suit for an infringement of "vestibule" patent held by it.

Garbage disposal.—The disposal of garbage is a serious question to large cities, and it is causing some trouble. In New York the practice has been to load it into dumping scows after being sifted and picked over by Italians who take out all bones, paper, coal, &c., and take it out to sea, where it is dumped. The tides and currents, however, carry some of it to the beaches along the coast, or to the bars at the mouth of the bay, thus causing a nuisance. In Brooklyn the contract is let under three prices for three methods of disposal, either by dumping into the sea, burning or carting away for manure, &c., and the city can oblige the contractor to adopt such plan as it pleases. In Pittsburgh, Pa., it is proposed to burn it in specially designed furnaces, and the contract has been let for an experimental one of the proposed six furnaces. Experiments are also being made in New York with a furnace that promises good results, and is intended to burn a load a minute. Owing to its offensive nature, garbage may not be used for filling-in purposes, as it consists of kitchen refuse of all kinds and similar matter that will decompose and cause a nuisance. The ashes, however, that remain after a thorough burning may be used for such a purpose, and there is plenty of room available around New York for filling in vacant blocks up to the street grades, &c. If the present furnace is considered satisfactory by the New York Board of Health, ten are to be erected by the company which controls the patents. The furnace was designed by a mechanical engineer of large experience, and many interesting features are included in its construction which will be made public later on.

The Westinghouse brake.—The Baltimore and Ohio Railroad Company has awarded to the Westinghouse Air Brake Company a contract for the equipment of all its passenger cars with the Westinghouse brake. The contract is so large that the company will have to devote itself exclusively to the manufacture of brake apparatus, and has notified the Philadelphia Natural Gas Company that it will manufacture no more gas regulators and other appliances. The company has had fifty box cars built for it at the Altoona shops of the Pennsylvania Railroad, and has fitted them up with the latest improvements, including a new form of coupling, in the air brake, and has made sundry tests with very satisfactory results. The train has been sent to Burlington, Ia., to take part in the "brake tournament" on the Chicago, Burlington, and Quincy Railroad, in competition with the American, Eames, and other brakes. The train includes an "emergency" car, fitted up for the use of the persons making the records in all the dangerously quick stops which will be made while the brake is under trial; it is fitted with sliding seats, padded walls, braces, handrails, &c., as it has not unfrequently happened that the persons making the tests have been injured where such safety appliances have not been adopted.

Iron production in 1886.—Mr. James M. Swank, of the American Iron and Steel Association, gives the following figures in his annual statistical report for 1886:—Pig iron, 6,365,328 tons; steel rails, 2,968,989 kegs of 100 lb.; Bessemer steel rails, 1,763,667 tons; open-hearth steel rails, 5255 tons; iron rails, 23,679 tons; total rails, 1,792,601 tons; iron and steel street rails, 48,009 tons; Bessemer steel ingots, 2,541,493 tons; open-hearth ditto, 245,250; crucible ditto, 80,609; blister and patented steel, 2651; total steel production, 2,370,003 tons; iron blooms, 41,909 tons; domestic production of iron ore, 10,000,000 tons; imports of iron ore, 1,039,433 tons. Iron and steel ships, 26. Exports of iron and steel, 14,865,087 dols.; imports of iron and steel, 41,630,779; production of anthracite coal, 32,236,362; total coal production, 106,780,033 tons. Miles of railroad built, 8648.

TEMPERATURE AND PRESSURE IN JAMAICA

The following table of elevations and averages—given by Mr. Maxwell Hall in *Nature*—is not as perfect as might be wished, but as some years must pass before it can be greatly improved, it is here given as one of many results obtained by the Meteorological Service in Jamaica:—

Station.	Elevation. Ft.	Pressure. In.	Max. Deg.	Mean. Deg.	Min. Deg.	Range Deg.
Kingston	0	30·00	87·0	78·2	71·0	16·0
Kempshot	1773	28·20	80·5	72·7	68·0	12·5
Cinchona Plantation	4907	25·27	68·5	62·6	57·5	11·0
Portland Gap	5477	24·71	69·0	59·7	54·6	14·4
Blue Mountain Peak	7423	23·14	71·1	57·7	46·3	24·8

In *Nature*, vol. viii., p. 200, it was suggested that the fall of temperature δT was connected with the fall of pressure δP by the equation

$$\delta T = \lambda . \delta P,$$

where λ was taken equal to 3°·23.

We can now correct this expression and take

$$\delta T = \lambda . \delta P + \mu (\delta P)^2,$$

where $\lambda = 2°{\cdot}92$, and $\mu = 0°{\cdot}08$. But these values relate to mean temperatures; for minimum temperatures $\lambda = 0°{\cdot}96$, and $\mu = 0°{\cdot}40$.

These expressions and their connection are important, and it would be interesting to know whether similar results have been found in India and elsewhere within the tropics, or may yet be obtained.

Computing δT by means of these formulæ, and applying the results to the temperatures at Kingston, we have:—

	Mean. Deg.	Min. Deg.
Kempshot	72·7	68·0
Cinchona Plantation	62·6	57·5
Portland Gap	60·5	54·7
Blue Mountain Peak	54·4	45·6

which are fairly satisfactory.

Putting $\delta P = 30$in., the minimum formula gives $-311°$ as the temperature of space, the thermometer being shaded from the sun by any spherical body such as the earth or moon.

Putting $\delta P = 30$in., the mean formula gives $-81°$ as the mean temperature of a body devoid of atmosphere, such as a meteorite pursuing its course in space, or the moon, at the mean distance of the earth from the sun.

An expression for maximum temperatures cannot be as easily deduced; but if the surface of the meteorite or the moon which is turned from the sun be $-311°$, and if the mean temperature be $-81°$, it follows that the maximum temperature of the surface turned towards the sun must be about $+149°$.

LAUNCHES AND TRIAL TRIPS.

ON the 5th inst. a series of experiments were made with the machinery of the new iron twin screw tug and salvage steamer the Earl, built for Sir William Thomas Lewis, of Cardiff, for the Bute Dock Estate by Messrs. Edward Finch and Co., marine engineers and shipbuilders, of Chepstow. The large centrifugal marine salvage pump first underwent its trial. This pump is capable of discharging from 2800 to 3000 gallons per minute on a lift of 27ft., drawing through five 6in. bore suction pipes leading away from the tug to any place within the range of suction that it may be desired to clear of water. The suctions are made operative simultaneously or otherwise, as required, by means of Finch and Co.'s improved quintuple sluice suction chest, secured to the central intake of the pump, which is also fitted with an improved self-acting seal valve on its discharge. The salvage outfit is of an extensive description, consisting of steel galvanised pipes and bends, flexible rubber hose with steel nozzles, retention valves, &c., the whole having fastenings of the most approved description for the successful execution of salvage operations under all conceivable conditions. A few seconds after working the air ejector the water rushed into the pump, which at once commenced to perform its maximum duty of passing 3000 gallons per minute, the force with which the water came pouring out of the 13in. discharge bearing witness to its volume as it dashed burying itself far into the depths of the river. After thoroughly testing the capabilities of the pump, the vessel steamed out of the river to run her official trial trip. She proceeded for a cruise down channel and then returned to Beachley Bay, and was there run at full power with and against the tide, the mean speed attained being 13⅛ knots per hour, the engines developing 514 indicated horse-power, and working most satisfactorily. On the vessel's return to Chepstow her fire pump, one of the largest and most powerful extant, was put on trial, and through four long jet pipes sent up columns of water to a vertical height of 122ft., at which height the jets burst into feathery clouds of mist. The combined pumping power of the two pumps for salvage work is about 275,000 gallons per hour, and without question the vessel will be a most valuable acquisition to the Port of Cardiff, apart from its services as a fire float and tug.

On Saturday, May 7th, Messrs. Edward Withy and Co., of West Hartlepool, launched an iron screw steamer named Lydie from their yard. The vessel has been built to the order of Messrs. Burdick and Cook, of London, and will carry a large dead weight cargo. She has a long raised quarter deck with a short raised poop, long bridgehouse and top gallant forecastle, and is fitted with double bottom for water ballast on the McIntyre principle. The vessel has four watertight bulkheads, and the main, quarter, bridge and top gallant forecastle decks, bulwarks and rails are of iron. She is fitted with Blake's patent donkey boiler, four steam winches and patent windlass by Clarke, Chapman, Parsons, and Co., patent hand and steam steering gear amidships by Davis and Co., Hastie's right and left steering gear aft, and Wasteneys Smith's patent stockless anchors hauling up into hawse pipes. The vessel is rigged as a two-masted fore and aft schooner with iron pole masts, and is built under Lloyd's special survey for the 100 A 1 class, and under the personal superintendence of Mr. Cook. She will be fitted with triple expansion engines of 155 nominal horse-power by Messrs. Blair and Co., of Stockton-on-Tees.

Messrs. Craig, Taylor, and Co., of South Stockton, launched on Monday afternoon a new steel screw steamer for Mr. Joseph Hoult, Liverpool. This vessel is constructed with a bottom on the cellullar principle, and is fitted with four large steam winches, patent donkey boiler, steel masts, Pepper's steam steering gear, Emmerson's patent windlass, lighthouses, and all the latest improvements. She has a capacity for 2500 tons of cargo. Accommodation for captain, officers, and engineers is on deck. Everything is arranged for the rapid shipment and discharging of cargo. She will be fitted with triple-expansion engines by Messrs. Carr and Co., Sunderland. Engines, 18in., 29in., 48in., by 36in. stroke, with two boilers. The vessel was gracefully christened Benholm by Miss Edith Taylor, daughter of Mr. Thomas Taylor, J.P., Oakwell Hall, Birstall, near Leeds. The builders have a similar ship also under construction for Mr. Hoult.

The screw steamer Haverstoe was launched from the yard of Messrs. William Doxford and Sons, at Pallion, on the 10th inst. She has been built for Messrs. Bennett and Co., of Grimsby, for the general trades, but with special adaptability for their timber trade. She is entirely of steel, built to Lloyd's 100 A 1 class, with considerable additions, having double sheer and side plating, and an iron centre bulkhead. The principal dimensions are:—Length between perpendiculars, 275ft.; breadth, 39½ft.; depth, moulded, 21ft., with cellular bottom fore and aft. The engines are triple-expansion three crank, the cylinders being 21in., 35in., and 57in. diameter respectively, and the stroke 39in., and they are supplied with high-pressure steam from exceptionally large boilers. She is fitted with Pepper's steam steering gear and Hastie's screw gear aft, and four winches by Messrs. Rogers, of Stockton, lighthouses on forecastle, and all the most recent improvements for cargo purposes. The cabins are most tastefully constructed in hard wood in the poop aft, and give most comfortable quarters for captain and officers, and a few passengers.

THE HAVRE EXHIBITION.—The Maritime Exhibition at Havre was officially declared to be open by M. Goblet on Saturday last, but only a small part of the exhibits are in their places.

THOMAS STEVENSON.—The death is announced of Thomas Stevenson, at his residence in Heriot-row, Edinburgh, on Sunday. He had been in ill-health for some time. Born in 1818, Mr. Stevenson was a son of Mr. Robert Stevenson who built the Bell Rock Lighthouse. He was engineer to the Commissioners of Northern Lighthouses from 1855, and during his career he made many improvements in the illumination of lighthouses. He was the author of "The Design and Construction of Harbours" and "Lighthouse Illumination." Both works are acknowledged text-books on these subjects. A large number of papers on other scientific matters, especially relating to meteorology, proceeded from his pen. Mr. Stevenson was a member of the Institution of Civil Engineers, a president of the Royal Society of Edinburgh in 1885, and was also connected with several other scientific societies.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The spring meeting of 1887—fifteenth—of the American Society of Mechanical Engineers, will be held in the City of Washington, D.C., beginning Tuesday, May 31st, and ending Friday, June 3rd. The following papers are to be presented and discussed at this meeting:—"Tests of the Comparative Value of different kinds of Belting," by Samuel Webber; "Should a Piston Packing Ring be of the same Thickness at every Point," by L. H. Rutherford; "The Education of Intuition in Machine Designing," by John T. Hawkins; "Systematic Testing of Turbines in the United States," by R. H. Thurston; "Notes for Discussion on the Limit of Steam Pressure in Marine Engines," by Chas. E. Emery; "Notes for Discussion on Cylinder Condensation," by Charles E. Emery; "A Method of Evaporation by Means of Exhausted Steam," by Albert Stearns; "Methods of Determining Cost and Distribution of Power and Heat," by Henry R. Towne; "A Problem in Profit Sharing," by Wm. Kent; "Comparative Value of Steam and Hot Water for Transmitting Heat and Power," by Chas. E. Emery; "Direct-acting Steam Veneering Cutter," by Thos. S. Crane; "What are the Needs of our Navy," by H. A. Ramsay; "Notes on Helical Seams in Boiler-making," by R. H. Thurston; "National Defence and the Mechanical Problems which it Involves," by Jos. Morgan, jun.; "A New Method of Making Tubes from Solid Bars," Geo. H. Babcock. The programme also includes several excursions and visits.

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

(From our own Correspondent.)

DISTRICT ironmasters are in receipt this week of rather better orders from merchants, on account chiefly of Australia, but South American inquiries are also slightly more numerous. The mills and forges are employed somewhat more regularly, and the feeling of the market is more hopeful. Forward orders are, however, at present placed sparingly.

Specifications in the sheet trade are less difficult to secure. This is occasioned by a little increased activity among the galvanisers. The demand is still insufficient to afford full work to the mills, but it is hoped that the change for the better will develope into something substantial. Prices of plain sheets are £5 17s. 6d. upwards for 20 w.g., £6 to £6 5s. for 24 w.g., and £7 easy for 27 gauge. Galvanised corrugated sheets are mostly quoted £9 17s. 6d. to £10, f.o.b. Liverpool, for 24 gauge, but some buyers assert that they are placing business at £9 15s. Sheets of 26 gauge are £11 5s. to £11 10s. at Liverpool, and 28 gauge is £12 5s. to £12 10s. Where packed in felt cases, 24 gauge is charged £11, f.o.b. Mersey. An advance in prices is greatly needed by the galvanisers, and considering the large extent of the exports, such an advance should occur. Last month's shipments were 2430 tons in excess of those of April, 1886.

Messrs. Morewood and Co., of the Lion Galvanising Works, Birmingham, have supplied a large quantity of galvanised sheets, over 200 tons in all, for roofing the American Exhibition at West Kensington.

Prices in the best bar trade are irregular, as a result of the competition of second and third-class houses. A few firms there are who will accept nothing below the £7 standard. The bulk, however, are doing business at £6 10s.; and for second branded qualities £6 is the open market figure. Between this last price, and £4 15s. for common bars, all sorts of rates are quoted, according to the quality of material and the necessities of the seller. Middlemen were freely stating this afternoon that they could place orders at £5 5s. delivered in the Thames, which is equal to £4 15s. at Staffordshire works. The North Staffordshire makers are accepting less prices than the South Staffordshire proprietors.

Colonial orders are also coming forward for hoops. Prices are about £5 to £5 5s. per ton. Gas tube strip is tame at £4 15s. upwards. Plates sell slowly at £6 10s. to £7 10s.

Some surprise is expressed this week by agents that the prices of steel blooms and billets keep up so well. They report that it is impossible to get makers to accept less than the Association £4 10s. figures. Orders for basic steel are being executed at local works in increasing numbers, and the output is steadily going up. The metal is finding a good market among constructive engineers. Orders are also being filled on account of the Indian Government.

In the Shropshire iron trade some firms report a shade more activity. The wire rod business is looking up slightly, orders from India and elsewhere being rather better. This industry furnishes additional illustration of the manner in which steel is superseding iron. The proportion of steel rods rolled is steadily encroaching upon that of iron, even as the same transformation is going on in Germany. Wire rod prices are quoted at—Nos. 4 and 5, £5 10s. per ton, delivered Liverpool; No. 6, £5 15s. For best screw drawing purposes much higher figures are being obtained, some firms commanding at date £6 17s. 6d. per ton.

The Snedshill Iron Company, Shropshire, are manufacturing basic steel and rolling it down into small sizes for rod making, and they report the sale to be fairly good. Of late they have been quite busy upon orders for steel and iron, but just now some falling off is observable. The Shopshire Iron and Wire Company, who manufacture all classes of merchant iron and wire, are quiet, the Indian demand being slow, and South American business having fallen off. It is very gratifying that though Messrs. Nettlefolds, who until recently occupied the Castle Ironworks, at Hadley, near Wellington, have transferred their iron and steel making operations from Shropshire to Monmouthshire, yet the extensive Castle Works are to be kept going. They have passed into the hands of Messrs. Benjamin Talbot and Sons who will manufacture all classes of merchant iron and steel.

Pig iron keeps tame, and some difficulty is experienced in getting consumers to accept deliveries. Northampton pigs are selling at 36s. 6d. to 37s. delivered to consumers' works; Derbyshires, at 37s. 3d. to 37s. 6d.; and Lincolnshires, at about 39s. to 40s.; Staffordshire all-mine pig is selling at 50s. to 52s. 6d.; 40s. to 45s. for part-mines; and 30s. for common; hematites are without change at 52s. 6d. for Welsh forge sorts; and 55s. to 57s. 6d. for West Coast makes.

Some splendid examples of roll casting practice have lately been turned out at the Highfields Engineering Works, Bilston, of Messrs. T. Perry and Son. I have previously had occasion to notice the large rolls cast at these works to be used in the manufacture of linoleum in Scotch mills. During the past few months Messrs. Perry have despatched other examples of these castings, and at the present time they are engaged upon one which is 13ft. long on the barrel, and 32in. in diameter. The roll weighs over 18 tons.

To meet the growing demand for steel over iron castings, Messrs. Perry are about to lay down a steel casting plant. The Siemens-Martin method has been adopted on account of its trustworthiness. Provision will be made for castings up to 4 tons in weight.

The Great Eastern Railway are inviting tenders for a supply of galvanised ironwork, cast iron pipes, and hardwares, including nails, tools, locks, &c.

The proposal to improve the waterway from Birmingham to the Bristol Channel is being favourably received by all the public bodies interested in its adoption. The Worcester Chamber of Commerce has given its concurrence to the scheme, regretting only the apathy shown by the large manufacturers; and a deputation from the Gloucester Town Council has had a conference with the Birmingham Ship Canal Enquiry Committee, when the matter was fully discussed. Among the suggestions of the deputation was that the South Staffordshire Canal system should be included in the scheme—an addition which, in view of the large output of the Black Country, would, it was pointed out, do much to ensure the prosperous working of the enlarged canal.

The dispute in the Cradley Heath chain trade is believed to be coming to a head. Several orders are said to be coming into the district, and the employers having reduced their stocks, some arrangement must of necessity by made with the men. Some firms have already conceded the 4s. list and their operatives have resumed work.

NOTES FROM LANCASHIRE.

From our own Correspondent.)

Manchester.—The aspect of trade throughout the iron and various allied branches of industry in this district continues discouraging. In the iron trade there is a persistently falling market, which destroys confidence in the future and checks business wherever buyers are in a position to hold back, as they naturally believe they have nothing to lose by waiting, but possibly something to gain. This applies all round, both to common and hematite pig iron, and to manufactured iron, and the tone of the market is despondent.

There was about an average attendance at the Manchester 'Change meeting on Tuesday, but only a very slow business doing. Occasional transactions are reported in pig iron, but these are mostly at very low cut prices. There are one or two buyers who are prepared to operate pretty largely for long forward delivery at the very lowest prices that are being quoted, but makers are not disposed to commit themselves over any very extended period on this basis, although some of them are prepared to sell for short delivery at very low figures. The actual business doing is consequently for the most part restricted to transactions of comparatively very small weight, and consumers, who are apparently adopting the policy of holding back from renewing contracts of any importance, with the view of forciug makers to come nearer to their terms, are able to pick up cheap parcels sufficient for hand-to-mouth requirements. So far as quoted list prices are concerned, they are for the present little more than nominal. In occasional small special sales they are perhaps being got, but apart from these they are quite out of the market. For Lancashire pig iron makers still ask about 38s. 6d. to 39s., less 2½ per cent., for forge and foundry qualities delivered equal to Manchester, and on this basis odd sales are made to customers in the immediate vicinity of the works, where they have a considerable advantage in the rate of carriage, but at their list rates local makers are quite unable to compete in the open market, and they are prepared to entertain offers. In district brands prices are very irregular; there are sellers of Lincolnshire iron at as low as 35s. 6d. to 36s., less 2½ per cent., delivered here, whilst other makers hold out for 1s. to 2s. per ton above these figures. Outside brands offering in this market are easier to buy. Middlesbrough iron can be bought at lower prices than last week, and in Scotch iron there is continued underselling at very low figures.

In hematites there is still only a very small business doing, and prices are so irregular that it is scarcely possible to arrive at any definite quotation. In some instances there is a margin of quite 2s. to 3s. per ton between what makers are asking, and the prices that middlemen are prepared to take, and all that can be said definitely is that the market is in favour of buyers.

Business continues very slow, so far as the manufactured iron trade is concerned, and the tendency seems to be in the direction of a still further falling off in the demand. Quoted prices remain much the same, makers holding to about £5 per ton for good qualities of bars, £5 5s. to £5 7s. 6d. for hoops, and £6 5s. to £6 10s. for sheets delivered into the Manchester district, and for open contracts over any period they are not disposed to come below these figures. They are, however, most of them in want of specifications, and for prompt delivery there is a more or less general disposition to accept orders at under the quoted prices.

So far as the engineering branches of industry are concerned, the reports of the trades union organisations—which are, however, not supported by the reports I receive from the employers' side—continue to show an improvement as regards employment, and a more hopeful tone as to the prospects for the future. The monthly report of the Steam Engine Makers' Society, just issued, shows a decided improvement in the returns from some districts, and a continued decrease in the number of unemployed members, representing a reduction of more than one-half per cent. upon the returns of the previous month, the number of members now on the books actually in receipt of out-of-work donation being slightly under 3 per cent. of the total membership. For stationary engine work I understand there is a difficulty in securing good qualified men, and in this branch of industry makers are reported to be busy. The returns from districts in which an improvement was reported last month continue of an encouraging tone, and others which were despondent last month show better hopes of an improvement in trade. Throughout Lancashire, with about three exceptions, of which the important district of Manchester is one, trade is returned as good, with considerable activity in some centres. From the North of England a temporary lull is reported in the shipbuilding trade, but up to the present it has not been felt in any increased number of out-of-work members being thrown upon the Society. The reports I receive from employers continue very unsatisfactory, both as regards the weight of work coming forward and the prices at which it has to be taken.

It will no doubt be remembered that when, at the commencement of last year, the employers in the engineering trade were compelled, by the continued depression in this branch of industry, to put in force a reduction in the rate of wages they were then paying, the men, although they were not in a position to resist the reduction, made a sort of reservation in accepting it that they would not work overtime except under a return to the old rate of wages. This has since been a constant source of friction between the employers and the men, and now seems likely to culminate in a conflict in the Bolton district. The engineering firms in the above district have posted notices to the effect that on and after Saturday, May 14th, the men engaged in the respective works will be required to work overtime when necessary, and any workman refusing will be at once discharged. For some time past, as I have previously pointed out, the men have been in a very unsettled state, and it is only with great difficulty they have been restrained from attempting to enforce an advance of wages; they are consequently in no temper to comply with the overtime notice which has been posted in the Bolton district, and it is more than probable it may be made the pretext for the commencement of an agitation for an advance of wages.

Mr. James Swift, the general secretary of the Steam Engine Makers' Society, has just completed the twenty-fifth year of his connection with the above organisation, for more than half of which period he has filled the post he now holds; and this has been made the occasion for presenting him with some suitable recognition of the services he has rendered. By the present and past council members he has been presented with a gold chain, timepiece, and bronze ornaments as "a token of esteem and admiration for services rendered to the Society," and by the branch secretaries and past or present members of the executive council with an illuminated address, in which they record the high esteem in which Mr. Swift is held, and give expression to their keen re-appreciation of the many valuable services he has rendered to the cause of labour for a period of twelve years.

The important question of coal dust in mines was discussed at a meeting of the Manchester Geological Society, held at Wigan on Friday last. What appeared to be the most efficient means of dealing with dust in coal mines that were brought out in the discussion were first an improvement in the construction of the colliery tubs so as to make them as nearly as possible dust proof, and then to adopt some method of watering the roadways. With regard to watering the mine, several methods were proposed, one by means of perforated water pipes laid along the roadways, and another by specially-constructed water-carts that could be drawn along the roadways; but it was pointed out that to attempt to saturate the dust would be quite impracticable, and that the object aimed at in watering a mine was to create a very fine spray which could be carried along in the air. Mr. Hall, Inspector of Mines, said the dust question was very important, and would have to be tackled in some shape or another, and he thought that colliery managers made too much of the difficulties connected with the watering of the mines.

In the coal trade there is the usual quieting down owing to the season of the year, but there is generally a very fair business doing, and although the supplies of all descriptions of fuei are plentiful there is no great pressure to sell. In house coals prices have given way about 6d. per ton since the commencement of the month, and at the pit mouth average 8s. 6d. for best house fire coal, 7s. seconds, and 5s. 6d. to 6s. per ton for common; the lower qualities of round coal for steam and forge purposes are moving less freely, the shipping demand having falling off considerably, and prices are decidedly easier. At the pit mouth 5s. to 5s. 6d. per ton are about the average figures for steam and forge coal, and for shipment they can be got at 6s. 9d. to 7s. per ton delivered at the high level, Liverpool, or the Garston Docks. Engine classes of fuel are only in moderate demand, and notwithstanding the lessened quantity of round coal now being screened, slack is rather plentiful in the market. Prices, if anything, are easier, and at the pit mouth average 4s. 3d. to 4s. 9d. for burgy, 3s. 6d. to 3s. 9d. for best slack, and 2s. 3d. to 2s. 6d. for the common sorts.

Barrow.—The improvement which was reported last week in the position of the hematite pig iron trade of this district has not been maintained, and this week has witnessed a return to the position the market held a fortnight ago. With this exception makers are

firmer in their dealings, and are resisting with more activity the efforts on the part of consumers to pull down prices. Second-hand dealers, who were firm in their business quotations last week, are now asking 43s. per ton, although business has actually been done as low as 42s. per ton. Makers, however, have not done any trade at so low a price, and it is probable that before they have disposed of the large orders they have in hand prices will advance. Stocks are large, and are not being reduced, although large deliveries are being made both on home and foreign account. There is a steady tone in the steel trade, and the demand for steel rails is especially brisk, although buyers are endeavouring to bring down prices to a point comparatively as low as that of iron. Steel makers are, however, very busy, and they are not disposed to sell at lower rates, but, on the contrary, are advancing quotations—on the one hand, because they know there is a good demand; and on the other, because sales have been largely made forward, and the activity at works assured for several months to come practically throughout the remainder of the season. The rail trade is especially brisk, but while business has been done as low as £4 per ton net f.o.b., makers are now asking more money. There is a steady tone in the trade in billets, and some very heavy orders are offering. Makers are also busy on bars, and there is a good demand for tin-plate descriptions. Blooms show a quieter market. Shipbuilding material in steel is in fuller inquiry, and there seems reason to believe that the anticipations of activity in this department will be justified. There are no new orders for ships or steamers, but builders are very hopeful of good contracts coming to hand, as numerous and *bonâ fide* inquiries are being made which are likely to lead to the acceptance of orders of some magnitude. The engineering trade is steadily employed, but if engineers had as much more work in hand as they have, they could get through it. Iron ore quieter at from 8s. 6d. to 10s. 6d. per ton net at mines. There is still much steadiness in the coal and coke trades. Shipping is not so well employed as it has been.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

The pig iron market held at Middlesbrough on Tuesday last was decidedly flat in tone. Consumers evinced a strong determination to withhold their orders until further concessions could be obtained from producers. Nevertheless, the latter were able to maintain their position fairly well; as they are not in immediate need of orders, and hope for better things as the season advances. Merchants' price for No. 3 g.m.b. was 33s. 6d. per ton for prompt delivery, which is 6d. per ton less than it was a week previously. As this is considerably below what makers will entertain, no sales were, as a matter of course, made by the latter. For delivery over next month, 3d. per ton more is asked, but there is little disposition apparent among either buyers or sellers to commit themselves for the future.

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

Shipments between the 1st and 9th inst., inclusive, have amounted to 21,871 tons, as against 18,226, and 15,155 tons, in the corresponding portions of April and March respectively. These statistics, together with the fact that stocks seem to be decreasing more rapidly than last month, are considered satisfactory.

Warrants are offered at from 33s. 4½d. to 33s. 6d. per ton, but scarcely any transactions in them have lately taken place. Grey forge quality is offered at 32s. 9d. Railway chairs are quoted at £2 12s. 6d. per ton, the demand having slightly improved both for them and for pipes.

Finished iron continues in poor request. Bars and plates are to be had at £4 10s.; angles at £4 5s.; and sheets at £6, all free on trucks at maker's works, less 2½ per cent. discount. Steel makers complain that a lull has overtaken their trade, though for the present they have satisfactory order books. Rails of heavy sections are still £4 2s. 6d., and ship plates £6 2s. 6d. at works.

The Roseberry Steel Works, Middlesbrough, are about to undergo a change of constitution and of management. The proprietors have formed it into a limited company, the business of which will henceforward be to make steel castings of all kinds, and fit and machine them where required. To the old works, which have been purchased by the new company at a very moderate price, will be added new ones, which will gradually be built upon land recently purchased. The total area of land owned by the new company will be about four acres. It is understood that Mr. James Butler, who has hitherto been practical manager, will retire, and will be succeeded by Mr. Shaw, who for the last twenty-five years has been identified with similar works at Stanner's-close, near Wolsingham. Mr. Herbert Fox, commercial manager in the old firm, will continue in a similar position in the new company. Two new Siemens furnaces will be erected, and it is expected that the output will be brought up to 50 tons per week. As Middlesbrough is now an excellent market for the purchase of hematite pig iron, hematite ore, and scrap of all descriptions, and as its export facilities are considerable, there seems no reason why a thriving business in this speciality should not be carried on. The local demand also for steel castings is large, and increasing year by year.

The Northumberland miners have again been recording their votes by ballot. Notwithstanding that the employers informed them at the outset of the strike that they would not, under any circumstances, submit the question in dispute to arbitration, the colliers decided, by a large majority, again to propose that mode of settlement. Accordingly a deputation, headed by Mr. Burt, M.P., waited upon the owners, and informed them of the wishes of the men. They were reminded of the owners' original declaration, and were told that nothing short of the reduction claimed would enable the owners to reopen the collieries. Meanwhile, the men are suffering terribly, and are begging for relief in all directions. At one of the collieries some of them have even recommenced operations, and have not been interfered with by the remainder. The end cannot now be far off. Meanwhile, statistics show how severely all connected with the Northumberland coal trade have been punished. The foreign coal exports from the Tyne last month were 167,000 tons less than a year ago, and the sea ports of Blythe and Amble exported 49,000 tons less. In the coastwise shipments the loss of trade was 32,000 tons from the Tyne, and 15,000 tons from Blythe and Amble. The trade lost to Northumberland seems to have been gained to some extent by Sunderland and Hartlepool, where an increase of 55,000 tons has taken place; and by Hull, Grimsby, and Goole, where increases of 36,000 tons, 22,000 tons, and 5000 tons respectively have been reported. There have also been considerable increases at the various centres of export in Scotland and Wales.

The new bore hole for salt which was commenced a few weeks since at Southbank, near Middlesbrough, on land belonging to the proprietors of the Imperial Ironworks, has now attained a depth of 500ft. The strata which have been successively perforated consist of clay, marl, gypsum and red sandstone. The hole is now being lined with wrought iron tubing, and meanwhile other operations have been suspended. Arrangements are being made for erecting the necessary pumps, salt pans, and buildings as soon as the salt is proved.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

Several South Yorkshire ironfounders have proceeded to Genoa, where they have accepted engagements with an iron and steel firm. These workmen have been employed at the Parkgate Ironworks as plate rollers, and furnacemen from the same establishment have also gone to Genoa. Mr. Griffiths, formerly of Parkgate, is the manager of the Genoese works, and Mr. J. Matthews, who was at one time with Messrs. John Brown and Co., at Swinton, has charge of the plate mills. The firm at Genoa had a large number of Belgians in their employ, but have decided to replace them by Englishmen, regarding the latter as the most skilful and trustworthy workmen. The tonnage rates paid are said to be about double those paid in the South Yorkshire district.

All hope of Sheffield firms undertaking the production of swords and sword-bayonets is now at an end. I have already stated in The Engineer the chief reasons which have led to this decision. It is still strongly urged that as the Government cannot give a guarantee to local establishments which would induce them to lay down the special plant required for the purpose, the authorities should themselves undertake the work at Sheffield, where they would enjoy all the advantages of abundance of skilled labour and technical experience necessary for the satisfactory manufacture of military weapons of this sort. I do not anticipate, however, that the wishes of Sheffield firms will be met in this respect, any more than in the other.

The Yorkshire Miners' Council—which is really the executive of the association—have confirmed the amendments to the Mines' Bill passed at the Manchester Conference.

The cutlery and plated industries continue to be rather languid both on home and foreign account.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

The pig iron warrant market has been comparatively quiet in the past week. No fresh orders from abroad of any consequence were announced, and as the current shipments are small in amount, there was a rather despondent tone in the market, which contrasted sharply with the more confident feeling evoked by the recent upward turn in prices.

The week's shipments of pigs were 6649 tons, as compared with 9735 in the corresponding week of 1886. They embraced 1460 tons to the United States, 1202 to Canada, and 350 to Australia, there being smaller quantities despatched elsewhere. Pigs have been quoted at from 41s. 1½d. to 40s. 10½d. cash under warrant. There are eighty-one furnaces in blast, as there were a week ago, and the additions to stocks in Messrs. Connal and Co.'s stores are about the usual amount.

Current values of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, No. 1, 47s. 6d., No. 3, 44s.; Coltness, 54s. and 44s. 6d.; Langloan, 50s. 6d. and 46s.; Summerlee, 52s. and 43s.; Calder, 50s. and 42s.; Carnbroe, 43s. 6d. and 40s. 6d.; Clyde, 46s. 6d. and 41s. 6d.; Monkland, 42s. 6d. and 38s. 6d.; Govan, at Broomielaw, 42s. 6d. and 38s. 6d.; Shotts, at Leith, 48s. 6d. and 45s. 6d.; Carron, at Grangemouth, 52s. and 44s. 6d.; Glengarnock, at Ardrossan, 47s. and 41s.; Eglinton, 42s. 3d. and 38s. 3d.; Dalmellington, 43s. 6d. and 40s.

The two vessels of 8500 tons each, which Messrs. J. and G. Thompson, of Clydebank, have been commissioned to build for Transatlantic passenger service of the Inman and International Steamship Company, will help to improve the shipbuilding and steel trades in Glasgow and the neighbourhood. Each vessel is to have accommodation for 1000 passengers.

It is reported that a firm of tubemakers in the Coatbridge district of Lanarkshire is about to erect rolling mills for the purpose of making the iron strips, &c., that are used in the manufacture of tubes.

The Scottish Miners' Federation, which consists of the paid agents of the different districts in union, has been endeavouring to initiate a movement for the shortening of the hours of labour. But so far the response of the miners has been poor and half-hearted. In the West of Scotland only a small proportion of the colliers have kept the idle day once a week. In Fifeshire papers were issued to the men requesting them to state whether they were in favour of giving notice to the masters of a termination of their contracts, so that they might be in a position to go on short time, but a large majority of the men have failed to sign the notice papers. The secretary of the district, Mr. Weir, has issued a circular, in which he says—"In my opinion we never had a better opportunity than the present to effect an improvement in the conditions and regulations of employment. The vote thus given must be accepted as indicating clearly the wishes of the men, and must dispose of the question at least, for the present. It will rest with you now to consider whether or not you can consistently continue members of the Scottish Miners' National Federation." It would seem quite plain that the miners have taught their agents that they are not prepared to enter on a policy at present which could hardly fail to bring about another strike.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

There have been several cases in the district during the last few days of collier recklessness, and in each case proper punishment has been meted out. In one case two colliers were working near, and the lamp of one went out, upon which the other took off the top of his with a stick to relight it. In a fiery pit such as this was, every man of several hundred might have been destroyed. In another case, a charge having failed, the collier proceeded to "unram" the powder. In this case no time was given, and the charge might have gone off, destroying all near.

The coal trade still shows a good deal of vitality. Looking at the totals of the last few weeks, it is evident that Wales has had a large share of the Tyne coal trade owing to the strike there.

The Northumbrian ports lost, it seems, 250,000 tons of coal trade last month. Wales so far has been fortunate, for beyond some trifling disputes, such as Plymouth and Werndda, the men are working with excellent spirit. Prices remain low. In some cases an advance of 3d. has been maintained, but no amount of effort has been able to lift the figure for best steam above 8s. 6d. f.o.b. Cardiff. Present sale prices are numerous at 8s. 3d., and Monmouthshire coals at 7s. 9d. This means respectively 5s. 9d. and 6s. 3d. at pit. Coalowners are again looking to quantity for some amount of benefit. Small steam is a glut in the market, and sales at 4s. are common. I fear that if the output continues to increase, as seems likely, less than 4s. will have to be accepted.

A meeting of the Sliding-scale Committee was held at Cardiff on Saturday, when instructions were issued to auditors with reference to the price of coal for the four months ending April 30th.

Mr. Herbert has been appointed manager of "Nixon's Navigation," and the appointment has been well received.

The poorest industry in connection with coal is now confessedly that of pitwood, prices being down to 12s. 6d., and at the best not more than 13s. can be obtained.

The coke trade is tolerably good, and prices are sustained for both kinds.

Wales has seen some remarkable changes. At one time iron was king. Now it is coal, while tin-plate figures as a weak adjunct in the rear. Of late, iron and steel rails have fallen from their proud position, and it is tin-plate that ranks next to coal. But for the requirements of tin-plate manufacturers the large steel works would only do an insignificant trade. They are kept going in a great part by these requirements.

Swansea last week imported 630 tons of pig iron, and 431 tons tin-plate bars, while as regards the latter a considerable increase on this total was brought in by rail from the Glamorgan and Monmouthshire works. In tin-plate Swansea exported more last week than in any week during the year. The total was 81,825 boxes. The quantity brought down from the works was only 2649 boxes, so the stocks have been eaten into considerably.

The tin-plate trade is now firm again. Prices are low, and at these figures, orders are being put in vigorously. Present quotations:—Cokes, 12s. 9d. to 13s. 3d.; Bessemer steels, best, 13s. 6d.; Siemens, 14s. Coke wasters are being bought up freely for 12s. 3d. and 12s. 4½d. Charcoal sheets are about the dullest in the market. Altogether, if prices could be moved up, the tin-plate trade would be very satisfactory. As for present prices, with the increased works of Monmouthshire coming into rivalry, no advance can yet be expected.

Another new works in the Swansea district is to be erected on more important lines than any existing.

Mr. Sothern, favourably known in the Aberdare Valley for his conduct of the Miners' School, has been appointed deputy inspector of mines for Derbyshire and adjoining counties, vice Mr. Stokes, promoted.

As indicated, the steel rail trade is slow, and as northern competitors are offering for £4, prospects are by no means favourable. Even at £4 10s., unless the specification is a tempting one, makers are not disposed to accept orders very readily.

NOTES FROM GERMANY.

(*From our own Correspondent.*)

The demand in general is slackening in the Rhenish-Westphalian iron market; nevertheless, prices could be upheld in most cases. The Silesian market, on the other hand, thanks to the great momentary export of pig iron and a hope of the junction of the wrought iron convention with that of Rheinland-Westphalia, is still most satisfactory. M. 50 p.t. has been easily obtainable for prompt delivery of forge pig for Russia, and during the week several other new contracts have been entered into and otherwise larger lots sold, and this state of things appears likely to continue for some little time yet to come. Also, as a consequence of the powerful Convention, the rolling mills have been able to place all their make for the current quarter at the high base-price of M. 120 p.t. Also the wire rod works are nearly fully engaged till the end of July, and new orders are only taken at eight weeks' term of delivery.

The Belgian iron market continues quite satisfactory. The works have orders on hand for all the summer months, and new ones keep dropping in, so quotations can be kept up, though not raised. Pig iron is firm at 40f. to 50f. for the various sorts, and ordinary bars are quoted 100f. p.t. The demand for girders is so large that an elevation of price has been mooted. The machine shops have some heavy orders in prospect. Belgium is making strenuous efforts to create a business with Turkey, and their representative at Constantinople has ordered a very museum of products and manufactures of the country to be forwarded to him, as a means of introducing trade into the East.

The French market is less animated; still the trade is stable, and the prices have kept their late level. In order to favour the competition of the French collieries du Centre and du Midi against the English, the railways have just lowered their coal freights 25 p.c., the consequence of which has been that the mines at Aubin, of the Steel Works de France, have been able to secure a large contract for the arsenal of Tarbes against the English coals.

Iron ores in the Rhenish-Westphalian district are much slower of sale than a time back, and prices have become lower, as also have Spanish in the course of the week, though the export was pretty brisk, and Campanil have been sold for 6s. 9d. a ton. In the Siegerland prices range from M. 8·60 for raw to 12 for calcined steel stone, and for brown oxides 9 to 9·30 p.t. on trucks at the mines, which is a fall of about 3d. p.t. The condition of the market for pig iron has not altered much during the week. The blast furnaces are busy working off former contracts, but in some sorts the demand is not so good as it was. In Spiegel the sales continue satisfactory, and the demand for forge pig in Westphalia is brisk and prices are firm, but in the Siegerland this is not the case, and the trade is lifeless. Of foundry sorts there is nothing to remark, except that stocks seem to be accumulating, and that prices nominally are unchanged. On the 2nd inst. at a meeting of the ironmasters it was agreed to further maintain the present prices of pig iron, and at the same time to establish a common office for the sale of all the output of the several furnaces on the lines of the one in Luxemburg and the wrought iron Bureau of Silesia. This may be taken as a sign that cut-throat competition is again thrusting itself to the front, but would it not be much more reasonable to curtail production? It must strike an independent observer that, in a country with comparatively only a very limited export trade, where an extensive system of railway is, so to say, completed, and where enterprises consuming large quantities of iron are of a very insignificant character, there is in reality more iron produced than there is capability in the country to absorb or get rid of. But instead of looking at the matter in that light, the production has recently been actually increased, so that more pig iron will be produced this year than last, when there was a reduction from former yoars. In March, 315,713 t. were made, which would equal 3¾ million tons per annum without reckoning the quantity imported, which certainly seems a very large amount under the circumstances. Spiegel costs from M. 52 to 56, forge pig 45 to 48, and foundry 49 to 56, basic 43, Bessemer 50 to 52, Luxemburg forge 32 to 33 p.t. free on trucks. The rolling mills were less busy, but they are still turning out a good quantity of bars of all sections, and there is no general complaint, but still a few works are crippled somewhat for want of fresh specifications; indeed, at the Westphalian Works alone in March there was a diminution of orders to the extent 2000 tons. As to prices, base price of merchant bars is M. 110, angles 112 to 115, girders 108 to 112, hoops 105 to 110, but these prices cannot always be obtained, as a good deal in dealers' hands can be bought for less money, so buyers are hanging back, but if the Coalition Convention can really be vitalised this waiting attitude must soon give way. However, it is a question if the Convention will succeed, for it seems as if the Government officials, presumably the railway administrators, are disposed to look upon it with an evil eye. Still, it is the only means, except restriction of make, for combatting the prevailing competition. The plate convention met on the 23rd ult., and agreed not yet to alter the ground price of boiler and thick plates, the former for boiler plate of 5½ mm. and above remaining at M. 145, in iron and in steel 140 to 160 p.t. Thin sheets have fallen in price and are now M. 130 to 135, which could be realised in conjunction with a quiet business. A large new sheet mill has just been started in Westphalia, which is keeping prices down to secure a footing in the trade. Last July the wire rod convention lapsed, so now efforts are being made to revive it, which again shows that the trade is becoming weak again. Iron wire rods cost M. 112, steel 108 to 112, drawn wire, steel or iron, 125 to 130 p.t. There is little to note in railway material. Some crucible steel tires were awarded at Carlsruhe delivered at M. 340, some in Martin steel at 230, in Bessemer at 215, and in iron at 184 p.t. Steel rails are noted M. 120 to 125, sleepers 117 to 125, light rails 105 to 112, wheels and axles complete 300 to 325, steel billets 112 to 125 p.t. Here and there the machine shops have had an accession of orders, which will keep them employed some time, and the domestic demand seems improving, whilst for export there is little doing. The wagon works have received a few export orders, which, added to the recent inland ones, make them rather more busy, but the prices are, as usual, below par.

Like every new thing which comes up in this country, it looks as if basic slag as a fertiliser would soon become a drug in the market, for another works, "The Rothe-Erde Co.," near Aix-la-Chapelle, has just started a mill to grind 300 sacks of 100 ks. each in ten hours, or thirty tons a day.

It has just been announced here that the new law in Russia has been published, which again raises the duties on imported pig iron, iron, steel, and iron manufactures. They may almost be called prohibitory duties. At the same time, the Domain and Finance Minister is instructed to get out as soon as possible a law to prevent the further development or establishment of new smelting and iron works on the western borders, which are carried out with foreign materials or foreign workmen. This will be a blow to the Silesian iron industry.

NEW COMPANIES.

THE following companies have just been registered:—

Argentine Great Western Railway Company, Limited.

This company proposes to purchase from Juan Eduardo Clark, Mateo Clark, or others, the railway from Villa Mercedes of San Luis, to the City of San Juan, constructed by the Argentine Government and sold to Mr. J. E. Clark, and to complete and work the said railway. It was registered on the 29th ult., with a capital of £1,000,000, in £20 shares. The subscribers are:

	Shares.
[illegible] Riddoch, 93, Leadenhall-street, ship and insurance broker	1
J. Gibb, 93, Fenchurch-street, merchant	1
E. C. Gartner Smith, 54, The Chase, Clapham	1
F. H. Rapley, 16, Maurey-road, Stoke Newington, engineer	1
J. M. Macalister, 14, Trebovir-road, S.W.	1
A. Scott, Lloyds', underwriter	1
C. Lock, 283, Upland-road, East Dulwich, clerk	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first, and act *ad interim;* qualification, 25 shares; remuneration, £2100 per annum.

Bloxwich Iron and Steel Company, Limited.

This company was registered on the 4th inst., with a capital of £20,000, in £5 shares, to trade as iron and steel manufacturers, and to work coal, ironstone, and other mines. The subscribers are:—

	Shares.
W. Brownhill, Walsall, ironmaster	1
G. Williams, Walsall, coalmaster	1
J. Williams, Walsall, coalmaster	1
E. Brownhill, Walsall, accountant	1
J. W. Robinson, Walsall, commercial traveller	1
W. Hendrick, Walsall, mill manager	1
E. Johnson, Bloxwich, mill manager	1

The number of directors is not to be less than three, nor more than seven; the subscribers are to appoint the first; qualification, 25 shares. The company in general meeting will determine remuneration.

Darwen and Mostyn Iron Company, Limited.

This company proposes to acquire the business, assets and liabilities of the Darwen Iron Company, and of Messrs. Thomas Storey and Joshua Lancaster, trading as the Mostyn Coal and Iron Company. It was registered on the 30th inst., with a capital of £80,000, in £100 shares, with the following as first subscribers:—

	Shares.
T. Storey, Westfield, Lancaster, manufacturer	10
Edwd. Storey, Crosslands, Lancaster, manufacturer	10
H. L. Storey, White Cross Mills, Lancaster, manufacturer	10
Edgar Storey, Newton-le-Willows, Lancaster, coal merchant	10
W. J. P. Storey, White Cross Mills, Lancaster, manufacturer	10
F. E. Warbury, 5, Dowgate-hill, merchant	10
J. Lancaster, Mostyn, North Wales, engineer	10

The number of directors is not to be less than five, nor more than seven; qualification, 10 shares; the subscribers are the first. The company in general meeting will determine remuneration.

John Powell, Limited.

This company was registered on the 30th ult., with a capital of £50,000, in £10 shares, to take over the business of anvil manufacturer, &c., carried on by John Powell, sen., in Oxford-street and Freeth-street, Birmingham, and the business of bellows manufacturer, &c., carried on by John Powell, jun., of Birmingham. The subscribers are:—

	Shares.
*John Powell, sen., 118, Moseley-road, Birmingham, anvil manufacturer	1
*J. Powell, jun., Moseley-road, Birmingham, bellows manufacturer	1
*J. Cooper, Moseley, Birmingham, merchant	50
O. Williams, 163, Moseley-road, Birmingham, clerk	30
W. H. Harris, 47, New-street, Birmingham, solicitor	1
*T. Gilbert, Edgbaston-lane, Birmingham	500
*J. Ford, J.P., Leamington	500

The number of directors is not to be less than three, nor more than eight; qualification, 50 shares; the first are the subscribers denoted by an asterisk; remuneration, £52 per annum to the chairman, and a sum not exceeding three guineas to each other director for every board meeting attended.

South India Ship Canal, Port and Coal Station, Limited.

On the 29th ult. this company was registered, with a capital of £1,060,000, divided into 200,000 7 per cent. preference shares of £5 each, and 60,000 deferred shares of £1 each, to construct, work, and administer a ship canal across the Island of Ramisaram, in the Indian Ocean, with a coaling station and harbour accommodation in connection therewith; and to construct other public works in Southern India. For such purposes the company will adopt an agreement of the 11th February, between Burton Grindrod, Elliott Bradbridge, and Hy. Jenkins, of the first part, François Deloncle of the second part, and Isidore Spielman (for the company) of the third part, for the purchase of a concession granted by the Secretary of State for India in Council, for making such canal. The subscribers are:—

	Shares.
*Lord Napier and Ettrick, Selkirk	50
*General Sir J. Stokes, K.C.B., Hayward's Heath	50
*General Sir F. P. Haines, G.C.B., United Service Club	50
Admiral Sir G. H. Richards, K.C.B., 56, Lexham-gardens, W.	50
*J. Sebag Montefiore, 40, Westbourne-terrace	50
Sir E. W. J. Reed, K.C.B., M.P., Broadway-chambers	50
Isidore Spielman, C.E., 3, Westbourne-crescent	20

The number of directors is not to be less than five, nor more than nine; qualification, £250 of nominal capital. The remuneration of the board will be determined by the company in general meeting, provided that £4000 per annum be the minimum.

Charles Clifford and Son, Limited.

This is the conversion to a company of the business of Charles Clifford and Son, of the Fazeley-street Mills and Dog Pool Mill, Birmingham, metal merchants, brass manufacturers, rollers of brass, copper, zinc, tin, and other metals, wire drawers, and manufacturers of tubes, rods, and bolts. It was registered on the 28th ult., with a capital of £60,000, in £5 shares, whereof 6000 are preference shares. The subscribers are:—

	Shares.
*S. Sanders, 79, Colmore-row, Birmingham, metal broker	1
*F. W. Bond, 177, Leadenhall-street, metal broker	1
*A. Clifford, Edgbaston, Birmingham, manufacturer	1
H. L Smith, Edgbaston, Birmingham, solicitor	1
*T. Cumberland, Edgbaston, Birmingham, manager	1
W. Laken Smith, Edgbaston, Birmingham, solicitor	1
C. G. Beale, Edgbaston, Birmingham, solicitor	1
J. Robson Turnbull, 130, Colmore-row, Birmingham, metal merchant	1

The number of directors is not to be less than three, nor more than five; qualification, 100 shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration.

Manchester Oxygen (Brins' Patent) Company, Limited.

This company proposes to acquire a license to manufacture and deal in oxygen and oxygen water, under Brins' patent. It was registered on the 29th ult., with a capital of £20,000, in £100 shares, with the following as first subscribers:—

	Shares.
*G. B. Dewhurst, Great Marlborough-street, Manchester, merchant	1
*G. L. Dewhurst, Great Marlborough-street, Manchester, merchant	1
*J. C. Melville, Great Marlborough-street, Manchester, manager	1
F. Selby Moore, Great Marlborough-street, Manchester, accountant	1
J. D. MacIver, Great Marlborough-street, Manchester, cashier	1
J. Oakes, Great Marlborough-street, Manchester, manager	1
W. J. Crighton, Great Marlborough-street, Manchester, manager	1

The number of directors is not to exceed three, the first being the subscribers denoted by an asterisk; qualification, five shares. The company in general meeting will determine remuneration.

SOUTH KENSINGTON MUSEUM.—Visitors during the week ending 7th May, 1887:—On Monday, Tuesday, and Saturday, free, from 10 a.m. to 10 p.m.: Museum, 8687; mercantile marine, Indian section, and other collections, 2988. On Wednesday, Thursday, and Friday, admission 6d., from 10 a.m. to 6 p.m.: Museum, 1000. Mercantile marine, Indian section, and other collections, free, 1760. Total, 14,435. Average of corresponding week in former years, 16,849. Total from the opening of the Museum, 25,588,584.

FAILURE OF FOUNDATIONS IN AMERICA.—The failure of the foundations of the capitol of Albany has again been made the subject of an engineering investigation, this time by Mr. W. H. Slingerland, who reports as follows:—The cracking of walls is due to inequality in the settlement of the various parts of the building. At the north-west corner the settlement from the bench marks of 1882 is 0·079ft.; from this point eastward it gradually decreases until, at the Washington avenue entrance, it is only 0·013ft.; at the north-east corner it is 0·071ft.; at the south-east corner, 0·179ft.; and 28ft. south of this last it is 0·198ft., the maximum sinking on the exterior. At the south-west corner it is 0·079ft., with a slightly irregular line between this point and the last-named. In the interior depressions below the same bench marks are found of ·041, ·164, ·150, ·038, &c. The deflection outward of walls and piers has increased since 1881 to the extent of ½in. in the north wall of the central court. As to the stone ceiling of the Assembly-room, which is now causing considerable apprehension, new cracks have appeared. The sandstone used in the construction of this ceiling is condemned as unfit material for the stresses put upon it; repair has so far failed, and the report recommends its removal as the only safe course to pursue.

THE BIDS FOR STEEL ARMOUR-PLATES AND GUN FORGINGS IN THE UNITED STATES.—On March 22nd four bids were opened by Secretary Whitney. These tenders referred to the supplying of "about 1310 tons of steel gun forgings" and "about 4500 tons of steel armour-plates and appurtenances." The following is the abstract of the companies competing and of the terms agreed to:—

Name of Company.	Armour-plate. Dols.	Gun steel. Dols.
Cambria Iron Co.	—	851,513·90
Midvale Steel Co.	—	1,397,240·00
Bethlehem Iron Co.	3,610,707·50	902,230·79
Cleveland Rolling Mill Co.	4,021,560·00	—

The Bethlehem Iron Company agrees to provide the necessary plant to begin the delivery of the gun forgings within fifteen months—five months in advance of the requirements. It asks for the preference agreed to be given to the bidder who furnishes both classes of forgings, according to the naval department circular of August 21st, 1886. The company, to prove its ability to carry out the contract—a condition exacted by the Government—states that it has expended between 300,000 dols. and 400,000 dols. on its forging plant, and has on hand contracts amounting to 500,000 dols. It states that financial arrangements have been made for 1,500,000 dols. additional capital, and special engagements for the use of patents and for superintendence have been provided for with the largest European firms. The latter clause is said to refer to the great French works at Le Creusot. It is a source of the greatest gratification to find our American firms ready to undertake this work. It gives an additional proof of what always has been very patent—that the inventive and engineering genius of the country are able to cope with all of its needs and emergencies.—*Scientific American.*

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Application for Letters Patent.

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

May 3rd, 1887.

6422. AXLE CAPS of CARRIAGES, &c., J. W. Widdup, Keighley.
6423. IMPROVEMENTS in KNAPSACKS, H. C. Merriam, Paris.
6424. PIANOFORTES, ORGANS, and HARMONIUMS, E. A. Locke, Manchester.
6425. APPARATUS for ATTACHING to STREET CARS, J. Rhodes, Manchester.
6426. IMPROVED HEEL DIES, C. Heron and W. Ridd, London.
6427. LADLE for TREATING FLUID METAL, W. R. Hinsdale, Stockton-on-Tees,
6428. FASTENER for GATES, J. Fletcher, Stockton-on-Tees.
6429. SHUTTLE CARRIERS, E. Shepherd, F. Rothwell, J. E. Hough, and T. Rothwell, Oldham.
6430. INSTRUMENT for RECORDING VIBRATIONS, W. H. Douglas, Birmingham.
6431. APPARATUS for CUTTING SUGAR, S. Vickess, Liverpool.
6432. INCREASING the HUMIDITY of AIR, J. Rawlinson, Manchester.
6433. MACHINES for OPENING and CLEANING COTTON, J. Elce, Manchester.
6434. IMPROVED STEAM CONDENSERS, J. C. Aitken, Glasgow.
6435. IMPROVED DOOR FASTENINGS, J. Woodfield, Birmingham.
6436. SAFETY CARGO SPAN GRIP, R. Nixon, Liverpool.
6437. RAILWAY RAIL JOINING, S. H. Derby, Manchester.
6438. IMPROVED FOUNTAINS, S. L. Bapty and I. Levinstein, London.
6439. DRAWING, A. Parkin, Birmingham.
6440. TRACING WHEEL, T. Ballantyne, Lanarkshire.
6441. ADVERTISING MEDIUM, J. S. Akerman, Walthamstow.
6442. TREATING GOAT SKINS, G. Delfos, London.
6443. HAT BOXES, A. H. Storey, London.
6444. CONTROLLING the FLOW of GAS, J. D. Noble, London.
6445. STOPPERING BOTTLES, E. J. Pike, London.
6446. BOOT MACHINERY, W. Ross and J. Bilbie, Middlesex.
6447. DRIVING GEAR of WASHING MACHINES, T. T. Mercer, and T. Woolfall, London.
6448. HOBBY HORSES, S. Kellett, London.
6449. ROTARY MOTION, J. C. Sellars, Liverpool.
6450. STEAM GENERATORS, J. Griffiths, Liverpool.
6451. VELOCIPEDES, A. Angior, Liverpool.
6452. FROCK, S. Stern, London.
6453. ENLARGING TUBES, J. T. Dann.—(*R. and M. Mannesmann, Germany.*)
6454. STOPPERING BOTTLES, G. H. Jones, London.
6455. COMPRESSER, J. E. Leuty, London.
6456. JOINTING STAVES, S. Wright, Glasgow.
6457. CASKS, S. Wright, Glasgow.
6458. STEERING ENGINES, C. Henderson, Glasgow.
6459. TRIPOD HEADS, W. D. Johnson, London.
6460. HARROW, A. M. Clark.—(*S. Rothchild, United States.*)
6461. DRIVING ATTACHMENT for SEWING MACHINE TREADLE MOTIONS, L. W. McClung, London.
6462. PRINTERS' CHASES, H. Megorden, London.
6463. PEDAL COVERS for ORGANS, J. S. Foley and J. Ruse, London.
6464. TREATMENT of RAMIE, &c., C. C. Kauffman, London.
6465. REPLACING RAILWAY ROLLING STOCKS upon the RAILS, A. Durieu, London.
6466. ROTARY ENGINES, M. H. Simpson, London.
6467. PNEUMATIC PUMP, L. J. P. Pontallie, London.
6468. DOLLY used in WASHING CLOTHS, R. Hartley, Bradford.
6469. BOTTLE STOPPERS, F. Trotman, London.
6470. SPINDLES, &c., used in GILLS, &c., P. Smith, jun., London.
6471. PROTECTORS for BOOTS, J. Nunn and E. O. Eaton, London.
6472. HAND FIRE EXTINGUISHER, E. G. Maxwell.—(*W. Druff, United States.*)
6473. FURNACE BARS, J. Green and J. Shipston, Old Basford.
6474. ELASTIC BRAID, E. P. Alexander.—(*B. Goodman, United States.*)
6475. CANDLES, S. Willoughby, London.
6476. SAFETY APPARATUS for WHEELS, G. Nobes and H. Chard, London.
6477. ORNAMENTATION of EARTHENWARE, W. P. Thompson.—(*M. C. Stone, United States.*)
6478. WOOD-WORKING MACHINES, W. P. Thompson.—(*T. Walker, United States.*)
6479. FOOD or MEDICINE for CATTLE, &c., G. Gilmour and R. I. Runciman, Liverpool.
6480. TREATMENT of COTTON SEED, W. H. Stead, Liverpool.
6481. COUPLINGS for TUBING, E. C. Converse, London.
6482. JOINTS for GAS, &c., MAINS, E. C. Converse, London.
6483. CLOTHES-HORSES, J. Martin, London.
6484. COOKING RANGES, W. C. Butler, London.
6485. STEAM MOTORS, J. Bureau and H. Hendlé, London.
6486. METALLIC BUCKETS, &c., G. Hill, London.
6487. MINERS' SAFETY LAMP, R. L., J., and J. B. Short, London.
6488. PESSARY, H. A. Dow, London.
6489. AZIMUTH APPARATUS, F. S. and A. W. Reynolds, London.
6490. TAP for WATER or other FLUIDS, P. Hart, Tottenham.
6491. SMOKING PIPES, H. G. Schramm, London.
6492. PENCIL CASES, A. M. Myers, London.
6493. METALLIC WEATHER BOARDING, L. L. Sagendorph, London.
6494. SHEETS for METALLIC ROOFING, L. L. Sagendorph, London.
6495. AURIPHONES, J. A. Maloney, London.
6496. BRICK-MAKING MACHINES, C. Chambers, jun., London.
6497. CRUSHING or PULVERISING SOIL, H. H. Lake.—(*D. Lubin, United States.*)
6498. CAR WHEELS, J. Rigby, London.
6499. COUPLING RAILWAY VEHICLES, H. H. Lake.—(*H. Tamm and L. Bührlen, Switzerland.*)
6500. CURLING IRONS or TONGS, H. H. Lake.—(*R. P. Dunn, United States.*)
6501. ENGINES WORKED by EXPLOSIVE MIXTURES, H. T. Dawson, London.
6502. CUPS and SAUCERS, &c., R. N. Langton, London.
6503. PREPARING FILAMENTOUS MATERIALS, T. Watson, London.
6504. CLUTCHING or LOCKING DEVICES, J. Y. Johnson.—(*A. G. Smyth, United States.*)
6505. MAKING PAPER, &c., J. Scherbel and T. Remus, London.
6506. HARVESTERS, W. M. Cranston.—(*The Walter A. Wood Mowing and Reaping Machine Co., United States.*)
6507. SELF-BINDING MECHANISM of HARVESTING MACHINES, W. M. Cranston.—(*The Walter A. Wood Mowing and Reaping Machine Co., United States.*)
6508. GEAR for HARVESTERS, W. M. Cranston.—(*The Walter A. Wood Mowing and Reaping Machine Co., United States.*)
6509. FISHING RODS, H. J. Haddan.—(*E. Horton, United States.*)
6510. SHUTTLE CARRIERS for SEWING MACHINES, H. J. Haddan.—(*G. G. and J. C. Beitzel, Denmark.*)
6511. HOLDING, &c., BLINDS, A. Theyskens, London.
6512. TREADLE MECHANISM, P. L. Gerischer and F. W. M. Schröder, London.
6513. FACING BRICKS, &c., A. W. Itter, London.
6514. FILES, M. Weerth.—(*A. aus'm Weerth, Leipsic.*)
6515. AUTOMATIC DELIVERY BOXES, W. H. James, London.

4th May, 1887.

6516. STEAM ENGINES, W. Payton, Larkfield.
6517. MOVABLE TOECAP PROTECTOR for BOOTS, M. Williams, Aberdare.
6518. CURING VARIOUS AILMENTS with OILS, B., W., and J. Weale, Ludlow.
6519. RAILS, W. H. Fallows, Stoneclough, near Manchester.
6520. PROMOTING the COMBUSTION of LIQUID FUEL, J. Hargreaves, Liverpool.
6521. PAPER FASTENERS, &c., E. V. Bailey, Birmingham.
6522. STEERING of SHIPS, W. Welford, Sunderland.
6523. ROLLER BEARINGS, W. Smith, D. Marks, and R. Watson, Keighley.
6524. TURNSTILES, G. Lowry, Barnsley.
6525. AUTOMATIC LIFTING INJECTORS, W. McElroy and H. Connett, Halifax.
6526. TAPEING MACHINES, J. Sugden and H. Colburn, Bradford.
6527. WARP BEAMING MACHINES, J. Sugden and H. Colburn, Bradford.
6528. FIRE-PLACES, &c., J. Balbirnie, Sheffield.
6529. FIRE-GUARD PROTECTOR, H. S. Cooper, London.
6530. LAMPS and STOVES, D. Ballardie and Messrs. the Cera Light Company, Glasgow.
6531. VELOCIPEDES, T. Tommasina, London.
6532. MEAT CHOPPING MACHINES, G. Macaulay-Cruikshank.—(*Messrs. P. Wachtel and Co., Germany.*)
6533. LAMPS for BURNING SOLID HYDRO-CARBONS, P. Denniston, Glasgow.
6534. COMBINED CORSET and BRACES, J. Mackintosh, Glasgow.
6535. TRAP for CATCHING VERMIN, R. Murray, Glasgow.
6536. GLASSES for MINERS' SAFETY LAMPS, R. and R. Chapman, London.
6537. METALLIC KNOBS for CORNICE POLES, E. Cox and E. Cox, jun., Birmingham.
6538. SHARPENING SLATE PENCILS, T. Macdonald, London.
6539. LEVELLING INSTRUMENTS, F. St. G. Caulfeild, Earley.
6540. STOPPERING BOTTLES and JARS, A. H. Storey, London.
6541. CALENDAR, J. P. Stubbs, London.
6542. BILLIARD CUE SUSPENDER, F. R. Wright and J. H. Smith, London.
6543. COMPOSITION ROLLERS, J. F. Haskins.—(*L. S. Hoyt, United States.*)
6544. DOUBLE-ACTING REST, T. H. Martin, London.
6545. PELERINE MACHINES, J. D. Harris and A. W. C. Shuttlewood, London.
6546. FASTENINGS for HANDLES of BROOMS, N. Browne.—(*A. Muller, Germany.*)
6547. PRESERVING the FRESHNESS of PLANTS, T. Reinherz, London.
6548. WALL COVERINGS, S. Fisher, London.
6549. CHANDELIERS, R. A. McGregor, London.
6550. MATCH LIGHTS, D. Campbell, London.
6551. CONNECTING FISHING LINES to FISH HOOKS, J. Morgan, jun., London.
6552. BOLT for REVOLVING FIRE-ARMS, D. W. Wilson, London.
6553. CHESSMEN, J. J. Keevil, London.
6554. MAGAZINE PISTOLS, J. Hayman.—(*L. de la Bastide, France.*)
6555. LIGHTING SAFETY LAMPS, J. Blackburn and F. Mori, London.
6556. LAMPS or LANTERNS, G. Brewer.—(*L. Hivet, France.*)
6557. ROLL and PINION HOUSINGS, J. W. Schofield, Sheffield.
6558. OBTAINING ROTARY MOTION in MACHINES, J. C. Sellars, Liverpool.
6559. DEVICE for CLOSING the LIDS of BOXES, J. Cook, Birmingham.
6560. BUTTONS, W. Corah, Birmingham.
6561. HAMMER, H. Russell and J. Plows, London.
6562. SUSTAINING SLIDING DOORS, J. H. Goodwin, Sheffield.
6563. DANDY ROLLS of PAPER-MAKING MACHINES, R. Brown, Glasgow.
6564. HOOKS and EYES, T. J. Hewson, London.
6565. DYEING VEGETABLE FIBRES, O. Delhaye, London.
6566. CANDLE LAMPS, E. Moore, London.
6567. SCORING for LAWN TENNIS, F. Perry, London.
6568. LAMPS, J. C. Mewburn.—(*F. D. Cambessédès, France.*)
6569. CLOSE ANNEALING IRON and STEEL SHEETS, &c., J. E. East, London.
6570. MACHINE-GUNS, A. J. Boult.—(*A. N. Russell and A. Brill, United States.*)
6571. DISINFECTANTS, J. W. Hamilton, Liverpool.
6572. DRIVING BELTS, J. Lechat, London.
6573. PREVENTING the ESCAPE of NOXIOUS GASES from DRAINS, J. Kiell and W. Garland, London.
6574. GENERATION of STEAM, E. N. Barnard, London.
6575. RAILWAY WHEELS, T. T. Craven, London.
6576. SEWING MACHINE TREADLES, L. H. Hart, London.
6577. COUPLERS for RAILWAYS, A. J. Boult.—(*T. L. McKeen, United States.*)
6578. CLOSING BOTTLES, &c., A. M. Clarke.—(*La Société Vilmorin-Andrieux et Compagnie, France.*)
6579. STOVES, J. Lowe, London.
6580. TARGETS for RIFLES, &c., G. A. French, London.
6581. HOLDERS for ELECTRIC LAMPS, E. Manville and W. L. Madgen, London.
6582. PAINT or COATING, P. Molyneux, London.

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6583. POLISHING POWDER, R. Hutchinson, London.
6584. ELECTRIC-MARINE GOVERNOR, R. B. Maddison, Sunderland.
6585. PICKER for LOOMS, E. Y. Walsh, Manchester.
6586. DRIVING CARDING ENGINE CYLINDERS, G. Ashworth and E. Ashworth, Manchester.
6587. ENGINES, W. Thom and J. E. Wilding, Manchester.
6588. REMOVING OBSTRUCTIONS from the PATH of TRAM ENGINES, E. C. Bellamy, Birmingham.
6589. ACTUATING HEALDS, J. Spencer, London.
6590. MAGNETO-ELECTRIC CUT-OUT, W. H. Scott and E. A. Paris, London.
6591. SEED PROTECTING CLIP, T. O. Clark, Addlestone.
6592. PICKING BOSSES and PICKING PLATES in LOOMS for WEAVING, W. E. Whittaker and D. Bury, Halifax.
6593. CUTTING MEAT by means of CIRCULAR KNIVES, G. R. Kaye, Leicester.
6594. OVEN for BAKING BREAD, &c., I. Abrahams and B. Wine, Leeds.
6595. REVERSING the MOTION of the PATTERN CARDS in LOOMS, S. Wood and W. Shaw, Halifax.
6596. LIGHTING RAILWAY TRAINS with GAS, G. Johnston, Glasgow.
6597. BREECH and MUZZLE-LOADING GUN for THROWING PROJECTILES with LINE ATTACHED, R. Low, Dundee.
6598. INCANDESCENT GAS FIRES, J. C. Bent, Birmingham.
6599. CARRYING PARCELS by HAND, A. Gent, Cricklewood.
6600. ELBOWS, TEES, CROSSES, &c., FITTINGS for TUBES, T. Foster, Birmingham.
6601. BUTTON HOLE ATTACHMENTS for SEWING MACHINES, A. Anderson.—(*The Singer Manufacturing Company, United States.*)
6602. EMERY WHEEL, H. J. West, London.
6603. EQUILIBRIUM SLIDE VALVES for STEAM ENGINES, D. Robertson and J. A. McKie, Glasgow.
6604. COMBINED BATTERY and CIRCUIT CLOSER, M Bailey and J. Warner, London.
6605. CISTERNS, J. D. Tucker, London.
6606. ASHES-PANS, R. M. Somers, London.

6607. Plough Coulters, J. G. Bailey and W. McIntosh, Canada.
6608. Stoppering Bottles and Jars, W. H. R. Kelly, Apperley Bridge.
6609. Lawn-tennis and other Shoes, M. L. Lion, F. Cutlan, and E. C. Barron, London.
6610. Safety Lamps, S. A. Johnson, London.
6611. Propeller, W. Hamilton, London.
6612. Raising Water, &c., C. Burnett, London.
6613. Detective Camera for Artists, S. W. Rough, London.
6614. Philosophical Toys or Automatons, A. J. Boult.—(*A. A. Lagane, France.*)
6615. Safety Ink-pots, R. W. Martin, Liverpool.
6616. Novel Vitro-metallic Material, L. C. A. Marguerie, London.
6617. Studs and Buttons to Neckties, &c., J. J. Garrard, London.
6618. Operating the Slide Valves used in Marine and other Engines, H. Tipping, London.
6619. Treating Sulphate of Baryta, &c., C. J. Martin, London.
6620. Telegraph Wire Insulators, &c., H. Koster, London.
6621. Electro-motors, J. D. F. Andrews, London.
6622. Steam Traps, E. Buisson, London.
6623. Plates for Voltaic Batteries, W. H. Tasker, London.
6624. Holophotal Projectors, J. G. Statter and S. L. Brunton, London.
6625. Carding Engines, T. S. Whitworth, Manchester.
6626. Automatic Recording Tills, H. T. Davis, London.
6627. Cleaning Knives, T. Wolstencroft and C. Cutforth, London.
6628. Regulating Valves, H. McLaren, London.
6629. Hydrostatic Disappearing Turret, J. Y. Johnson.—(*F. A. Sourian, France.*)
6630. Kitchen Ranges, C. B. Winstone, London.
6631. Screws, L. E. Sunter, London.
6632. Converting Natural Phosphates into Products Assimilable by Vegetables, W. L. Wise.—(*E. Solvay, Belgium.*)

6th May, 1887.

6633. Producing Ornamental Designs, W. H. Osborn, Birmingham.
6634. Cutting-off Table, F. and C. Mitchell, Guildford.
6635. Perforated Block Fire Lighter, R. N. Clifford, Sparkbrook.
6636. Woven Wire Mattress, A. McIlquham, London.
6637. Safety Tyre for Wheels, C. T. W. Piper, Devonport.
6638. Grip Hook for Removing Elevated Articles, J. T. Godfrey, Sheffield.
6639. Automatic Weighing Machines, R. W. Brownhill and G. M. Duncan, Birmingham.
6640. Ventilating Pipes, G. Browning, Farnworth-in-Widnes.
6641. Driving the Cylinder of Washing Machines, J. Greenall and T. T. Heaton, Manchester.
6642. Kettles, G. Olliver, Brighton.
6643. Looms for Weaving, J. H. Brierley, Halifax.
6644. Signal Lamp, J. Wall, Bristol.
6645. Hay Making Machines, J. Hocky, Chard.
6646. Carding Engines, J. Dugdale, Manchester.
6647. Beams for Warp Polishing Machines, J. Burn and W. H. Shepherd, Bradford.
6648. Apparatus for Doors to Exclude Draughts, &c., J. and C. Severs, York.
6649. Ventilating Sashes, W. Anderson, Glasgow.
6650. Securing the Perfect Combustion of Gas, J. Pointon, Liverpool.
6651. Water-closet Pan, H. Bensted, Maidstone.
6652. Combustion of Oil Spray, B. H. Thwaite, Liverpool.
6653. Cinder Sifter, W. F. Storey, London.
6654. Mooring Breakwaters, J. Holms, London.
6655. Gloves, J. B. Petter and W. J. Waterman, London.
6656. Heating Apparatus, D. J. Northwood, London.
6657. Plant Tubs, D. J. Northwood, London.
6658. Making Sheet Metal Articles, R., and A. Read, and F. J. Taylor, Liverpool.
6659. Wiring the Rims of Sheet Metal Articles, R., and A. Read, and F. J. Taylor, Liverpool.
6660. Mixture for Curing Neuralgia, W. J. Shepherd, London.
6661. Hand Lockstitch Sewing Machines, G. Pennick and E. J. Munday, Acton.
6662. Winding-up Keyless Watches, J. Robinson, London.
6663. Winding-up Keyless Watches, J. Robinson, London.
6664. Retailing Liquors, H. N. Morgan, London.
6665. Purifying Gases, B. C. Badham, London.
6666. Cylinders, L. J. Todd, London.
6667. Hand Measuring Instruments, J. C. Mewburn.—(*L. P. Valiquet, United States.*)
6668. Pocket Wallets, W. J. Downes, London.
6669. Stencil Copying Machines, A. J. Boult.—(*J. F. Lash, Canada.*)
6670. Locks and Keepers, A. J. Boult.—(*S. A. Dunbar, Canada.*)
6671. Reception of Coin, &c., R. W. Vining, London.
6672. Window-sash Balances, A. J. Boult.—(*J. Cooney, Canada.*)
6673. Photographic Instruments, A. J. Boult.—(*J. R. Connon, Canada.*)
6674. Treating Resins, &c., S. Banner, Liverpool.
6675. Hangers for Sliding Doors, A. J. Boult.—(*R. Clarke, Canada.*)
6676. Electrical Appliances, A. J. Boult.—(*E. McEvoy, United States.*)
6677. Pianofortes, A. Craig, Belfast.
6678. Portable Leg Rests, W. Alexander, London
6679. Steam Engines, P. Haddan.—(*The Dake Engine Manufacturing Company, United States.*)
6680. Checking the Drawing of Liquids, L. de M. G. Ferreira and W. Winfield, London.
6681. Secondary Batteries, R. E. B. Crompton, Chelmsford, and J. C. Howell, Llanelly.
6682. Electrical Distribution, J. Swinburne, Chelmsford.
6683. Brakes for Bicycles, G. D. Leechman, London.
6684. Supporting Stockings, &c., G. D. Leechman, London.
6685. Extinguisher Mechanism for Lamps, H. and J. Hinks and Son, London.
6686. Weigh Bridges, &c., J. Y. Johnson.—(*P. Guillaumin, France.*)
6687. Production of Azo Colours, C. D. Abel.—(*The Actiengesellschaft für Anilin-Fabrikation, Germany.*)
6688. Production of Colours, C. D. Abel.—(*The Actiengesellschaft für Analin-Fabrikation, Germany.*)
6689. Nail, J. McDouall and E. C. F. Otto, London.
6690. Haycock Weather-shields, J. A. and L. R. Symmes, London.
6691. Extinguisher Appliances for Flat Wick Oil Lamps, F. V. Smythe, London.
6692. Platen Printing Press, W. Clark.—(*L. F. A. Quernell, France.*)
6693. Candle-holders, G. H. Phillott, London.

7th May, 1887.

6694. Tools for Opening the Mouths of Earthenware Bottles, &c., T. Sutcliffe, London.
6695. Window Sash Fasteners, J. G. W. Fairbairn, London.
6696. Gathering Fruit from Trees, R. Norton, London.
6697. Sulphide of Zinc Paint, J. Wilson, Leith.
6698. Chalk-holders for Billiard Tables, W. Pottinger, Bristol.
6699. Wire Ropes for Cycles, &c., C. W. Hathaway, Brixton.
6700. Milk-scalding Cooking Ranges, R. H. Williams, Liskeard.
6701. Portland Cement, B. H. Thwaite, D. L. Collins, and D. Wilson, London.
6702. Universal Feed Sewing Machines, W. Jones, London.
6703. Case-hardening the Surfaces of Iron Plates, E. Zohrab, London.
6704. Peat, E. Zohrab, London.
6705. Economical Production of Steam, R. Fergusson, Liverpool.
6706. Weighing Balance for Indicating the amount of Moisture in Tobacco, R. Young and J. R. Houghton, Bolton.
6707. Cleansing Dogs, &c., A. S. Tyler and H. J. Clements, Birmingham.
6708. Sheet Metal Buckets, J. Stevens, Birmingham.
6709. Chambers for Drying Timber, G Shepherd, London.
6710. Pad for Reception of Coin, O. Imray.—(*M. J. Kraus, United States.*)
6711. Carbon Rods for Electric Arc Lamps, F. von Hardtmuth, London.
6712. Sheet Metal Baths, J. Stevens, Birmingham.
6713. Fusible Safety Plugs for Boiler Furnace Tubes, E. H. Parry, Manchester.
6714. Reversible Carpet, J. Crabtree, Halifax.
6715. Crank and Excentric Gearing for Velocipedes, &c., C. K. Welch, London.
6716. Bicycles and Tricycles, W. Phillips, London.
6717. Steam Boilers, W. Wright, Airdrie.
6718. Production of Zinc and other Sulphides, H. Grimshaw and H. Kenyon, Manchester.
6719. Engine Valve Gears, J. B. Pitchford and W. T. Garratt, London.
6720. Tea-pots, &c., W. Newell, London.
6721. Rotary Engine, T. Jones, Birmingham.
6722. Bell and Whistle Attachment for a Skipping Rope Handle, F. W. Mole and T. W. Taylor, Birmingham.
6723. Slab or Ingot Tilting Gear, A. Lamberton, Glasgow.
6724. Bleaching, &c., Woven Fabrics, T. A. Crook, London.
6725. Boots, A. Greer, London.
6726. Distributing Oil, &c , upon Wool, &c., P. Bairstow and J. Bairstow, London.
6727. Valves, A. Beldam, Liverpool.
6728. Wheeled Vehicles, J. Brown and J. Howard, Liverpool.
6729. Atmospheric Temperatures, J. Pinker and A. Pryce, Liverpool.
6730. Objects Endowed with the Property of Changing their Colours, M. Himler, F. Leiser, and J. Bartholdt, London.
6731. Presses, A. H. Reed.—(*A. Dolye, United States.*)
6732. Billiard Tables, J. Kendal and M. Laval, London.
6733. Four-wheeled Cabs, &c., A. Mackenzie, London.
6734. Splicing Cables, B. J. B. Mills.—(*Messieurs A. Teste, fils, Pichat, Moret, and Cie., France.*)
6735. Motor, C. Possi, London.
6736. Type-writers, J. R. Robinson, London.
6737. Textile Fibres, C. Collin and L. Bemoist, London.
6738. Speaking Tube, W. W. Horn —(*G. A. Beach, United States.*)
6739. Adjusting Strings in Musical Instruments, F. A. Serbser, London.
6740. Station Gas Governors, J. K. Bartlett, London.
6741. American Sliding Square, J. Klif, Lampeter.
6742. Screw Propellers, H. Grafton.—(*W. R. Grafton, Egypt.*)
6743. Removing Deposits of Sand or Mud from Rivers, &c., B. Tydeman, London.
6744. Steam Boiler Fire-box and Boiler, W. Walkington, Leeds.
6745. Checking Instructions on Board Ships, H. P. Sherlock, London.
6746. Tension Devices, E. Maertens, London.
6747. Circular Suction and Force Pump, L. J. P. Pontallié, London.
6748. Telephone Transmitters, H. J. Maclure and R. D. Bowman, London.
6749. Coating Metals with Tin, &c., E. Morewood, London.
6750. Sand and other Moulds, O. Jones —(*S. P. M. Tasker, United States.*)

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6751. Reredoses or Altar Pieces, T. A. Bennett, Manchester.
6752. Weighing Machines, T. Warsop, Nottingham.
6753. Coupling, &c., Railway Rolling Stock, T. Ellis, London.
6754. Dynamo-electric Machines, R. E. B. Crompton and J. Swinburne, Chelmsford.
6755. Compositions for Coating the Bottoms of Navigable Vessels, &c., H. A. Harvey, Liverpool.
6756. Filtering Spent or other Oils, T. Turner, Preston.
6757. Safety Lamps, C. Kaberry and L. Hope, Liverpool.
6758. Printing as applied to Earthenware, &c., W. R. Renshaw, Kidsgrove.
6759 Connecting, &c., Gear for Ships' Boats, G. Rockliffe and W. Key, Sunderland.
6760. Girder and Solid Bar Stern-post for Steamers, &c., J. H. Laidman, Hull.
6761. Transporting Casks, &c., J. Brown and J. Howard, Liverpool.
6762. Driving Nails into Boots, &c., J. M., J., A. J., and S. A. Gimson, Leicester
6763. Cutting Pile Fabrics, J. H. Smith, A. Goddard, L. Higginbottom, and T. Mannock, Longsight.
6764. Brake Cylinders, G. P. Dawson and G. P. R. Fell, Manchester.
6765. Ball Carrier for Lawn Tennis, R. C. Hope, Scarborough.
6766. Folding Chair, R. C. Hope, Scarborough.
6767. Spouts for Kettles, &c., G. Dodd, Birmingham.
6768. Smelting and Converting Furnace, C. Bramall, Oughtibridge.
6769. Decorating China, &c., T. Stanway, Hanley.
6770. Extinguishing Fires in Factories, R. Hinchliffe, Halifax.
6771. Putting Together Brooches, Ear-rings, &c., T. Watkins, Birmingham.
6772. Facilitating the Starting of Tram-cars, F. Marsh, Cambridgeshire.
6773. Indicators, J. Buchanan, Glasgow.
6774. Burning of Oils as Fuel in Furnaces, J. Lyle, Glasgow.
6775. Stretchers, J. Milarvie, Glasgow.
6776. Injectors, E. Körting, London.
6777. Churns for Making Butter, L. Knoblauch.—(*R. Knoblauch, Berlin.*)
6778. Breaking Flax, J. C. Mewburn.—(*E. Gavelle, France.*)
6779. Ornamenting Glass, W. Lutwyche.—(*J. Valere, Paris.*)
6780. Music Stands, J. W. Deans, London.
6781. Fountain Pen, F. Pudney, London.
6782. Life-saving Collars and Belts, &c., R. Coulter, Manchester.
6783. Wire Ropes, F. C. Guilleaume, London.
6784. Blast Pipes, H. Appleby and J. G. Robinson, London.
6785. Holder and Ash Suspender for Cigars, W. H. Percival, London.
6786. Wiring Corks in Bottles, H. J. Allison.—(*N. B. Abbott, United States.*)
6787. Stoppering Bottles, J. J. Varley, London.
6788. Fixing Tips to Billiard Cues, W. Breach, London.
6789. Damping Copying Paper, W. C. Hearn, New Malden.
6790. Fixing Overhead Wires for Telegraphs, &c., G. A. Grindle, London.
6791. Mountings, &c., for Photographic Operations, C. Brunner, London.
6792. Dredging and Transporting Materials, A. Vogt, London.
6793. Caulking Casks, S. Klein and A. Schattels, London.
6794. Automaton applicable to Money Receivers, C. H. Russell, London.
6795. Fastening for Pocket Memorandum Books, A. M. Clark.—(*I. C. Kiggins, United States.*)
6796. Closing or Stoppering Bottles, &c., P. Tissier, London.
6797. Pressed or Forged Sleepers for Railways, J. Howard and E. T. Bousfield, London.
6798. Grill, &c., for Grilling and Frying, J. B. Colbran, London.
6799. Carrying Device for Vehicles, L. Maignen, London.
6800. Magazine Fire-arms, S. and K. Krnka, London.
6801. Cone-grooved Axle for Ball Bearings, E. de L. Bird, London.
6802. Burning Cement and Lime, J. Hoyle, London.
6803. Weft Cutters for Looms, P. Haddan.—(*J. N. Cáltart and H. Rénault, France.*)
6804. Sawing or Cutting Stone, J. Y. Johnson.—(*A. August, France.*)

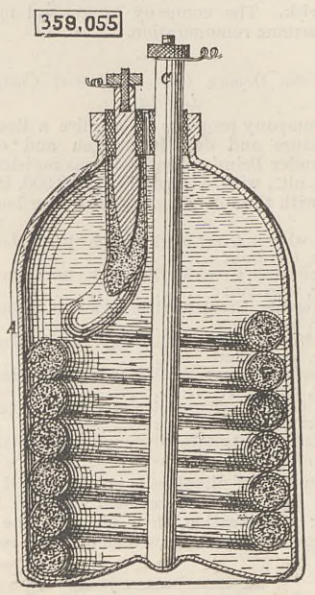
SELECTED AMERICAN PATENTS.

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

359,055. Galvanic Battery, *H. J. Brewer, New York, N.Y.—Filed May 20th*, 1885.

Claim.—A flexible electro-negative element for a galvanic battery, consisting of a porous sack filled with granulated electro-negative material, combined with a carbon plug in electrical connection with one end only of the sack, and serving as a connector for the electro-negative material, substantially as described. The

359,055

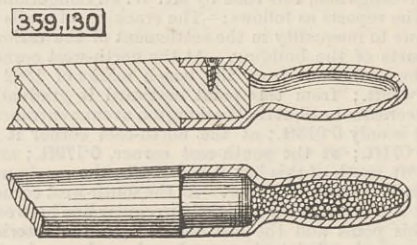


combination of the corrugated jar A, the spiral sack B, coiled therein, the zinc C, and the stopper D, provided with openings F and E for the passage of the zinc and carbon connections, substantially as described. The combination of a battery jar, having a less diameter at its neck than in the body of the jar, with a long sack containing electro-negative material inserted through the neck and spirally coiled against the inner surface of the jar, substantially as described.

359,130. Balanced Oar Handle, *E. W. Case, Fenton, Mich —Filed October 30th*, 1886.

Claim.—(1) A hollow metallic oar handle, the outer end of which is of an elongated egg shape and adapted to contain either shot or other heavy material, and the inner end is formed into a socket and adapted to receive the end of the oar. (2) The combination of an

359,130

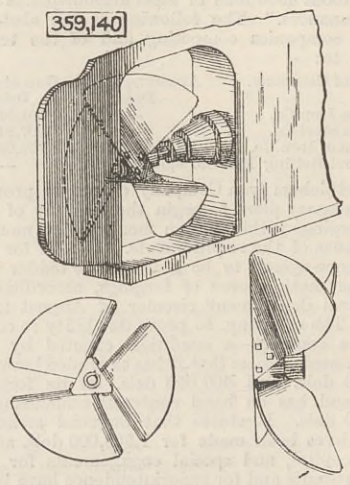


oar having a reduced and shouldered end, a hollow metallic handle having a socket at its inner end communicating with the hollow interior of the handle and fitting upon the reduced end of the oar, secured upon the same by bolts, and a filling of shot or similar heavy material, as and for the purpose shown and set forth.

359,140. Screw Propeller, *A. Desgoffe and L. de Georges, Odessa, Russia.—Filed November 29th*, 1886.

Claim.—(1) In a screw propeller, the combination of a hub having flat faces, a shoulder at one end of each of said faces, and a blade secured upon each face, the inner portion of which bears against said shoulder. (2) In a propeller, the combination of a hub having flat faces, an oblique shoulder at one end of each of

359,140

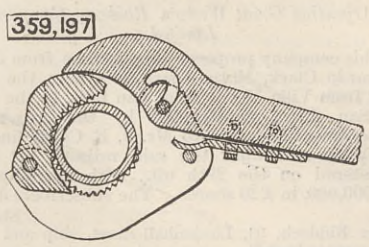


said faces, and a blade secured to each of said faces, the inner end of which is triangular and bears against said shoulder. (3) In a screw propeller, the combination of a hub having flat faces, a triangular blade secured to each of said faces, the rear edges of which are in a plane with each other and with the rear face of said hub and the forward edges are pointed, and the intermediate portions of said plates are bent or curved at an obtuse angle.

359,197. Pipe Wrench, *I. Anderson, Saginaw, Mich. —Filed August 10th*, 1886.

Claim.—(1) The combination, with the lever provided with the integral cam-shaped arm, having the arc-slot extending laterally through it, and the curved

359,197

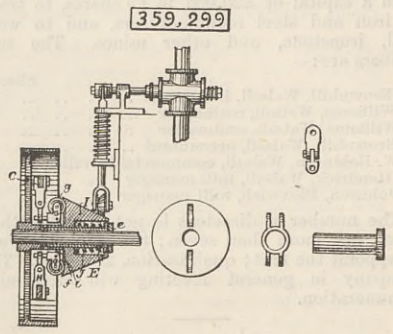


spring secured to the lower end of the lever by hangers, of the toothed slotted jaw-head pivotted adjustably in the arc-slot, and the curved, shouldered, and toothed jaw having the integral guard-arm, said curved, shouldered, and toothed jaw and guard-arm being pivotted between the outer ends of the jaw-head, substantially as specified.

359,299. Engine Governor, *E. Verstraete, Chicago, Ill. —Filed December 14th*, 1886.

Claim.—In a speed-governor, the combination, with main shaft, fly-wheel, and pivotted weighted arms C, of the cone I, mounted upon said shaft and provided with a spring J, for normally holding said cone in the direction of the fly-wheel, a pair of friction rollers pivotally mounted upon the shaft and bearing against

359,299

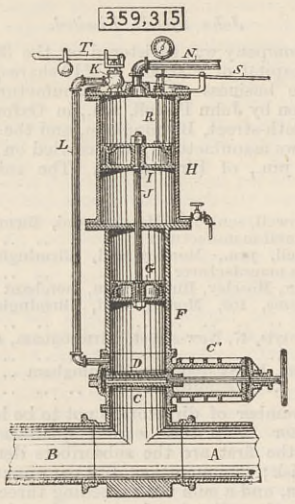


the upper end of the cone, and connections between the pivotted pulleys and the lever arms C, whereby the cone is forced away from the fly-wheel by the centrifugal action of said arms, and power-regulating devices actuated by the longitudinal motion of said pulley, substantially as described.

359,315. Pressure Regulator for Water-supply Mains, *D. C. Cregier, Chicago, Ill.—Filed August 16th*, 1886.

Claim.—(1) The combination, with the receiving and discharge pipes A B and base M, of the water cylinder F, air cylinder H, and pistons G I, substantially as described. (2) The air piston I, in combination with the cylinder H, connecting rod J, and piston G, substantially as and for the purpose specified. (3) The combination of the cylinders F H and pistons G I with the pipe L, substantially as and for the purpose described. (4) The combination and arrangement of the cylinders F H, pistons G I, and rod J with the relief valve K T and pipe L, substantially as set forth. (5) The combination of the piston I with the rod R and lever or rod S, substantially as and for the purpose specified. (6) The combination, with the cylinders F H, pistons G I, and pipe L, of the air pump O and pipe N, substantially as described. (7) The combination of the stop-gate D with the section or case C C[1]

359,315

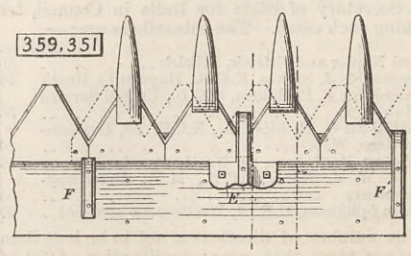


and water cylinder F, substantially as described. (8) The stop-gate D and section C C[1], in combination with the cylinders F H, pistons G I, and rod J, substantially as set forth. (9) The combination and arrangement of the gate D, section C C[1], cylinders F H, pistons G I, connecting rod J, and pipe L, with the air pipe N and water pipe or main A B, substantially as and for the purposes specified. (10) The herein-described method of regulating the pressure of water in mains or pipes for the water supply of cities, preventing the effects of pulsations in said mains and pipes, and aerating the water therein, which consists in forcing a regulated supply of air into the air cylinder of a water-pressure regulator and conducting the excess of air from said air cylinder into the main or into the water cylinder of the pressure regulator, substantially as described.

359,351. Attachment for Mowing Machines, *W. S. Fox, Short Creek, Ohio.—Filed October 18th*, 1886.

Claim.—The combination, with the finger-bar and the cutter-bar, of the keeper E, fixed to the finger-bar and bearing upon the cutters near the front and rear

359,351



edges thereof, and the keepers F and F', located one upon each side of the keeper E and bearing upon the cutters at different points in the length thereof, substantially as and for the purpose set forth.