AMERICAN BRIDGE DESIGN.

By ROBERT HUDSON GRAHAM.

No. I.

IN a comparatively new and progressive Republic, such as that of the United States of America, where the construction of highways of communication, the crossing of rivers and valleys by means of bridges and viaducts, must keep pace with the rapid industrial development of the country, bridge design has had opportunities of advancement which it has never enjoyed in Great Britain. Whether American engineers have taken advantage of these propitious circumstances to form bridge-building into a perfect science; or whether, as frequently happens in this country, bridges are made to subserve the purposes of costly and lavish experiments whence engineers seek to evolve what first principles they have neglected in their school-days, is a question upon which it would be impossible to pass an opinion in the absence of a closer and more intimate knowledge of American structures. The two or three papers which I propose to write upon this subject will contain an account of the impressions derived from the perusal of a work,* recently placed in my hands, dealing with the latest phase and development of American bridge design. For some years past Professor Waddell, presumably an American, has taught the branch of Civil Engineering in the Imperial University of Tôkiô, Japan, and before his resignation of that post, he wished, as we gather from his preface, to leave behind him some professional record of his stay, which ultimately took the shape of a theoretical and practical exposition of the most approved type of American bridge. In the execution of this project, he confidentially informs us in the introduction, he had no ulterior motive beyond a laudable desire to instruct and edify Japanese engineers and engineering students, or, to use the learned professor's own metaphor, he had in the preparation of this treatise no such mean thing as "an axe to grind." A purely disinterested motive, if such a thing there be, at once commands respect and admiration, and therefore it was with a full sense of sympathy with the author that we entered into his account of Transatlantic bridge-building. It would be idle for me to dwell at greater length upon the question of motive, but it seems necessary to state that my faith in the author's sublime disinterestedness was somewhat rudely shaken by stumbling upon such significant passages as the following :—"That the United States of America lead the world in bridge-building is a fact undisputed even in Europe." Then, again, in the reproduction of an allusion to the Tay Bridge, repeating Mr. Thomas Clarke's opinion—"that its construction was so palpably erroneous that a common carpenter might have seen its unsafe condition"—we seem to catch a second glimpse of that *arrière-pensée*, which unconsciously animated the author. It is not my intention to defend the design of the first Tay Bridge—a project abortive alike in its original conception as in the fruitless inquiry which followed its collapse ; but at the same time it is far from self-evident that a common carpenter, or even an intelligent blacksmith, would have straightway put his finger upon the serious defects which finally brought about its destruction. Further on, after a careful explanation that all existing Japanese bridges were the work of European engineers, Professor Waddell declares that "if an American engineer were sent to inspect and pass judgment upon a Japanese railroad truss bridge, he would condemn it before getting within a hundred yards of the structure." Once more, "the trouble with most English bridges, and consequently with those of this country, is that they are designed by railroad engineers, who have not made a special study of bridge designing, and are therefore incompetent to do the work entrusted to them." This extract would lead us to imagine that, in Professor Waddell's opinion, British civil engineers are disqualified in virtue of the single fact that they are "railroad engineers;" a reason which does not impress itself upon our minds as being either very cogent or conclusive. Nevertheless, it would be useless to deny that there is in British, and probably also in American, railway structures ample intrinsic evidence that they were built, not by railway engineers, but by rule-of-thumb practitioners, who knew little or nothing of structural anatomy, and the strict laws which govern the strength of materials. Therefore egregious blunders of this nature are to be ascribed, not to British engineers as a class, but to such of them only as are imbued with a sense of the infallibility of empiric formulæ or are branded with the unmistakeable mark of dogmatic charlatanism. Lastly, to cut the matter short, here is a remarkable quotation from the closing page of the author's preface :—"It would be out of place for me to recommend you in this work any particular manufacturers, though I have no objection to give you individually my opinion as to what shops in America do the best work." It is perfectly unnecessary further to explain the aim and significance of these side-thrusts at British engineers. I have merely brought them together lest our disinterested author should still labour under the strange delusion that in preparing this treatise he had no such thing as "an axe to grind;" nor had he the slightest intention to raise the value of American over the depreciated reputation of British engineering.

Taken as a whole, Professor Waddell's book conveys the impression of being a conscientious and successful effort to describe and explain the general type of American bridge, as exemplified in the Whipple truss. Commingled with what is good there is, however, a large admixture of error, peculiar, perhaps, to Professor Waddell rather than to the system he describes, to which it may be well to draw immediate attention. First, in his introduction, page 4, there appears the curious statement that the lightness of American bridges is due (secondarily), "to the greater height of truss, which throws less lever ge on the upper and lower chord system, and hence require less iron in their members." The inference drawn in this passage is perfectly true; but the reason assigned for it is none the less false, because the leverage of the flange stresses increases directly as the depth of the truss, and of course it is this very increase of leverage that reduces the flange stresses, and thereby the cross sectional dimensions of the girder. On page 53 we find it stated as a general principle "that it is not considered good practice to vary the thickness of the top chord plate or increase the number of thicknesses towards the middle of span, for the proper place for the larger part of the material in a top chord is in the channel, and not in the plate." I conclude from this passage that, apart from all questions of convenience, American engineers deem it wiser to widen than deepen the cross-section, despite the fact that the moment of resistance increases with the depth. Again, on page 64, the author remarks "that the live load stresses in floor beams, track stringers, and in all plate girders not exceeding 25ft. in length, are to be increased by 25 per cent., in order to provide for shock." He then annexes a table according to which girders over 60ft. in length require the live load stresses to be increased only by 8 per cent.—a limit that comes as a new revelation when we remember that the theoretical increase is exactly 100 per cent. I here use the term "theoretical" advisedly, because other circumstances tend considerably to diminish the percentage of theoretical increase. The general principle enunciated on page 72, "that the sum of the working bearing resistances of all the rivets on either side of the joint must not be less than the stress in the main member on that side," is based on the assumption that each rivet has but one section of rupture, which is false. Later, I shall have occasion to return to this subject ; but in order to prepare the minds of British engineers for a radical revolution of their ideas, it may be better to state at once that our author, in conformity with what he tells us is the best American practice, designs all his rivets to resist bending moment. According to this theory it would appear that the shearing action of a pair of scissors, no matter how closely the blades may be rivetted together, or how infinitesimally small the lever arm, in ultimate ratio resolves itself into a case of bending moment. On page 82 there is a table specifying the uniform live load in pounds per "lineal"— linear ?— foot, to be substituted for rolling load, in spans varying from 12ft. to 60ft. These equivalent loads are all too small, being undoubtedly affected by the small percentage allowed by the author for shock, and probably also by a faulty deduction from values less than the *maxima maximorum* of all central bending moments. On pages 84-5 there is a concise statement of the wind loads adopted by the best American authorities, which it may be of interest to quote at length :—"Empty bridges are proportioned to resist from 50 lb. to 40 lb. per square foot according to the length of span. C. Shaler Smith, C.E., one of the highest American authorities upon bridge building, proportions all his bridges under 200ft. span to resist a pressure of 50 lb. per square foot, and considers that 30 lb. upon the loaded bridge will be large enough for all greater spans. Thomas Cooper, C.E., the author of the best American bridge specifications, provides for a wind pressure of 150 lb. per lineal—linear—foot for upper lateral bracing in through bridges and lower lateral bracing in deck bridges. The author uses 150 lb. for spans of 100ft. and under, from that to 200 lb. for spans between 100ft. and 200ft., and from 200 lb. to 240 lb. for spans from 200ft. to 300ft. as the pressures per lineal foot for upper lateral bracing. The pressures per lineal foot on trusses only for the lower lateral system were calculated to be from 290 lb. for spans of 100ft. to 320 lb. for those of 300ft. for empty bridges, and from 170 lb. for spans of 100ft. to 240 lb. for those of 300ft. for bridges covered by the moving load. The pressures per lineal foot upon upper lateral system with an intensity of 30 lb. per square foot are about 90 lb. for spans of 100ft. and under, and from 90 lb. to 130 lb. for spans between 100ft. and 200ft., and from 130 lb. to 180 lb. for spans between 200ft. and 300ft. Wind loads upon empty bridges are treated as moving, for it is possible for one part of a bridge to be protected while the remainder is exposed ; besides, the centre of the whirlwind has a motion of translation which would cause the pressure to really act as a moving load. This method of treatment affects principally the lateral rods and struts near the middle of the span. The pressure upon the train is undoubtedly a moving load, but the co-existing pressure upon the trusses must be treated as static ; for it would be highly improbable that a maximum wind and a train could advance together, and with the same velocity, upon a bridge."

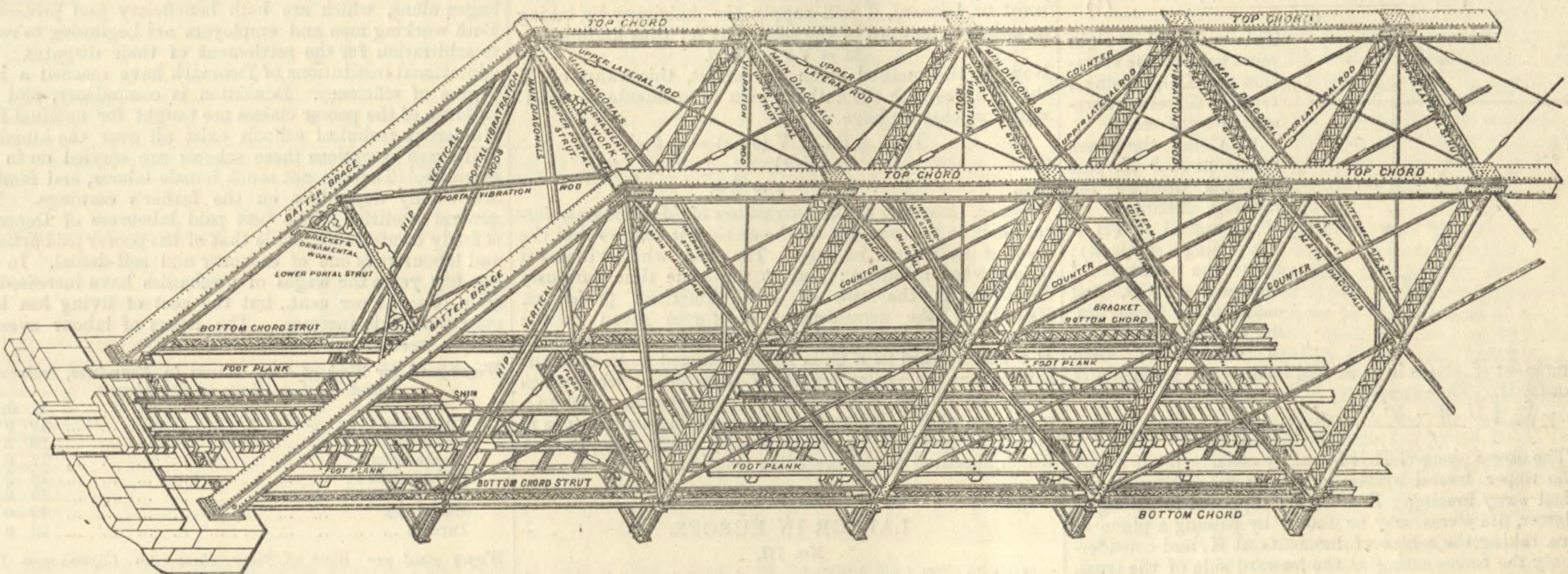


Fig. 1—ISOMETRICAL VIEW OF AMERICAN TRUSSED BRIDGE.

The above extract—saving the sage dogmatic assertion made in the last paragraph, which would teach us that concurrent moving loads must always "advance together, and with the same velocity"—gives us a clear idea of how American engineers distribute their wind loading. The subject of wind pressure, as affecting the lateral stability of structures, is becoming daily more and more a question of importance ; and yet, so far as we are aware, no definite steps have been taken by the railway inspectors of the British Board of Trade to insure the lateral stability of structures. True, following the Report of a Royal Commission, a rule or precept, or whatever else it may be called, was once issued that all bridges must be designed to withstand a lateral pressure of 56 lb. per square foot. But what steps have been taken to give effect to this rule or precept? None at all; and yet it is positively certain that a solemn procession of heavy locomotives, granting—which, in fact, is very doubtful—that it adequately tests the vertical stability, affords no criterion of the lateral strength of a bridge.* Indeed, it would seem to be a comparatively easy task so to design a bridge that it should receive the formal approval of the Board of Trade, and yet be most assuredly upset by the first strong gale of wind.

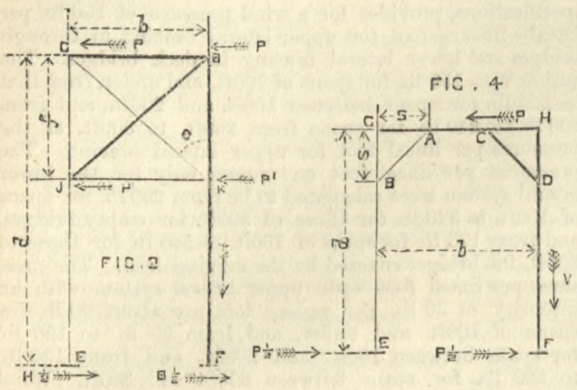
Leaving the question of wind pressure, Professor Waddell then proceeds to deal with the calculation of stress, and the interesting matter of the relative strength of the various members of a structure; and it is very remarkable that the author, who has some pretence to be ahead of all British engineers, should, in apparent ignorance of the new graphic methods, adhere to the long, tedious, analytical processes of the early part of the century. Moreover, in order, as he supposes, to lighten the work of calculation, Professor Waddell separates the difference of load per linear foot of engine and car, which difference he calls the "engine excess," and treats it independently of the other loads. This separation is perfectly irregular and superfluous, insomuch that the engine excess, or for that matter half-a-dozen engine excesses, can be included with the other loads, and their effect evaluated in one and the same stress diagram.

In Chapter IX. the treatment of transverse bracing for

* *Memoirs of the Tôkiô Daigaku* (University of Tôkiô): "A System of Iron Railroad Bridges for Japan." By J. A. L. Waddell, C.E., B.A.Sc., Ma.E., Professor of Civil Engineering in the University of Tôkiô, Japan ; Consulting Engineer for the firm of Raymond and Campbell, Council Bluffs, Iowa ; &c. &c.

* Not so long ago a Government official, lately deceased, informed me that, finding the central pier of an arched bridge which came under his inspection "fairly wabbled," he had recommended the engineers to insert a tie-rod (*sic*) between the haunches, in order that one arch might "shoulder-up" the other. The engineers of the scheme followed his advice, and the "wabbling" finally disappeared. Here, then, is a structure with unstable piers, depending upon the imperishability of a single compression rod, which may any day fail through the setting-in of rust, or buckle under unequal settlement. Moreover, one might fairly expect that a bridge, which "wabbled" on its piers, was not altogether insured against collapse both in a forward and lateral sense, by being stiffened merely in the plane of its longitudinal axis.—R. H. G.

wind pressure, ascribed by the author to Professor W. H. Burr, but approved and expounded by him, is so far original, and will serve such a good purpose as a warning to us what rocks to avoid in dealing with the difficult problem of finding the stresses in an upright braced cantilever, that we venture to insert it at length, with additional comments:—



"In Fig. 2, let P be the pressure concentrated at the upper panel point on one side of the bridge, and P^1 be the pressure concentrated at one end of the intermediate strut J K. Let d, f, b, θ represent the measurements indicated in Fig. 2. The total pressure $2(P + P^1) = H$ is assumed to be equally resisted by the feet of the posts. Taking the centre of moments at E, the moment of the pressure is

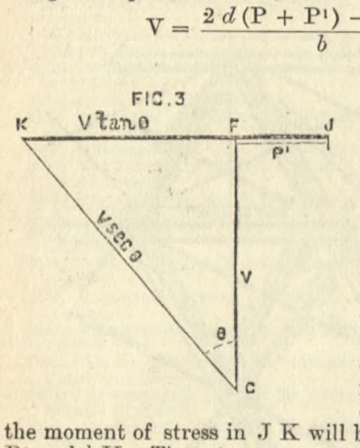
$$2P.d + 2P^1(d - f),$$

which can be resisted only by the moment of a released weight V upon the foot F; thus—

$$V = \frac{2d(P + P^1) - 2P^1.f}{b} \quad . \quad . \quad . \quad (1)$$

This released weight must pass up the vibration rod K G, causing a tension therein, represented by V sec. θ.

FIG. 3



"To find the stress in the strut J K, pass a plane through the bracing, cutting G H, G K, and J K (H J not being strained); take the centre of moments at G, and consider the forces acting on the leeward side of the truss; then the moment of stress in J K will balance the moments of P^1 and $\frac{1}{2}$ H. Thus stress

$$(J K) = \frac{\frac{1}{2}H.d - P^1 f}{f} = \frac{d}{f}(P + P^1) - P^1. \quad . \quad (2)$$

"The stress along G H is found by considering it a part of the upper lateral system, and not to belong to the vertical sway bracing. But if it be supposed to belong to the latter, its stress may be found by passing a plane as before, taking the centre of moments at K, and considering only the forces acting at the leeward side of the truss, so that the moment of the stress in G H will balance the moments of the horizontal reaction at E, and the pressure at G, the moment of the increase of weight at E balancing the moment of the increase of vertical reaction at that point; thus stress

$$(G H) = \frac{\frac{1}{2}H(d - f) + P.f}{f} = \frac{d}{f}(P + P^1) - P^1 \quad . \quad . \quad (3)$$

or equal to the stress in J K."

Such, then, is Professor Waddell's luminous treatment of an upright braced cantilever. With regard to the value of V in equation (1) there is nothing to remark. But when our author proceeds to resolve V along G K, to obtain the tension therein equal to V sec. θ, it is necessary to tell him that the tension along the post F H is not a constant quantity, but varies from the value V at the foot to a much less value in the neighbourhood of the joint K. It is, therefore, impossible for the tension along G K to be equal to V sec. θ. But further, with regard to this point, the method can be shown to fall under the sheer force of its own weight; for, taking the case of the double intersection bridge, we have $d = 2f$, and by formula (2) the stress in $(J K) = 2P + P^1$. Then, constructing the reciprocal stress-diagram J F G K J of the joint K, we obtain

$$\frac{FK}{FG} = \frac{JK - FJ}{FG}$$

$$= \frac{JK - P^1}{V}$$

$$= \tan.\theta;$$

or, substituting the value of J K given by the formula, viz., $JK = 2P + P^1$,

$$\frac{FK}{FG} = \frac{2P}{V} = \tan.\theta;$$

that is, V tan. θ = 2 P, where tan. $\theta = b \div \frac{1}{2}d = 2b \div d$.

Now, for the same case, we find from formula (1)

$$V \tan.\theta = V.\frac{2b}{d} = 2P(2P + P^1);$$

whereas we have just seen that the stress-diagram of joint K, constructed so as to agree with formula (2), gives V tan. θ = 2 P, and is, therefore, in open rebellion against formula (1).

Concerning the value of the stress (J K) given in equation (2), I need only observe that it is in direct contradiction to the principle that the shearing force at any section of a cantilever is represented by the sum of all external forces applied between the section itself and the free end of the girder. The value of the stress in G H as given by equation (3) is on the face of it highly improbable, for let $d = 2f$, which is the case in American double intersection bridges, then we find by the formula that the stress in $GH = 2P + P^1$, or equal to the whole load upon the truss minus P^1. The learned professor then turns his attention to the example, Fig. 4, where the transverse system is replaced by a pair of gusset braces A B and C D. His treatment of this case is still more extraordinary, and is certainly worthy of reproduction:—Let the notation be as shown in Fig. 4, V being as before the released weight at F. P is in this case the sum of the pressures at H and G. Taking the centre of moments at at E gives

$$V.b = P.d \text{ and } V = \frac{Pd}{b}.$$

Again, taking the centre of moments at A gives the value of the bending moment M on the strut at that point, thus

$$M = V(b - s) - \tfrac{1}{2}Pd = \frac{Pd}{2b}(b - 2s).$$

Let h = the distance between centres of gravity of the two channels of which the upper lateral strut is composed; then the bending stress will be

$$C = \frac{M}{h} = \frac{Pd}{2bh}(b - 2s)$$

"The stress in A B is found by taking the centre of moments at G, and making the moment of its stress R equal to the moment of the horizontal reaction at E; thus

$$R s\sqrt{\tfrac{1}{2}} = \tfrac{1}{2}Pd,$$

or

$$R = 0{\cdot}707\frac{Pd}{s}."$$

The first remark I have to make upon the treatment of this case is that Professor Waddell, in taking the moments of forces lying to windward, instead of to leeward, of the section, and suddenly forgetting his previous admission that "the moment of the increase of weight at E balances the moment of the increase of vertical reaction at that point," has suddenly changed his tack from the course he followed in the last example. Now, as it ought to be perfectly immaterial whether moments be taken to windward or leeward, I will supply the deficiency by taking moments to leeward of the section at A; thus finding

$$M = Vs - \tfrac{1}{2}Pd.$$

Now, if the method given be correct, this value of M should agree with the author's sum of moments to windward; so that we have

$$Vs - \tfrac{1}{2}Pd = V(b - s) - \tfrac{1}{2}Pd;$$

or,

$$(b - s) = s$$

and,

$$s = \tfrac{1}{2}b.$$

Whence, inasmuch as the two values of M agree only fortuitously in one position of the section, it follows that the method itself must be false. The error which vitiates it is somewhat insidious; and at the same time curiously deceptive in the case of two American professors. Examining the arrangement of forces given in the figure, it will be seen that the force V, downward in H F and upward in E G, is again assumed to be constant throughout the entire length of these lines; whereas, as before mentioned, it varies from a maximum at F to a minimum at H. Wherefore, the error in this instance is merely a repetition, but under a more subtle form, of that which appeared in the preceding solution.

LABOUR IN EUROPE.

No. III.

Austria.—The working classes of Austria are steady and trustworthy. The relations between employer and employed are good; when strikes take place no damage is ever done to property. The greater portion of field labour and much of the labour of factories, mills, and mines, is done by women. The hours of female labour are longer than the hours of male labour, while the wages are from 25 to 50 per cent. less. An infrequent circumstance in the usual relation of male labour and wages to those of females in Europe is observable in the spinning and weaving mills near Prague, where women are paid the same as men. The hours of labour are sixty a week, though in the textile trades and mines they often reach seventy-two, and in the former ninety-six is not uncommon. The new Labour Bill fixes the hours so as not to exceed eleven a day. This Bill was opposed by the textile manufacturers, on the grounds that if the hours were reduced they would not be able to compete with other nations. Although some years back all restrictions upon trade and its exercise were abolished, many of the old guilds have been re-established. Membership is compulsory, and they exercise considerable trade control. The test system of examination for proficiency of apprentices and journeymen prevails in some trades. Much attention is paid to technical education, and the system of school workshops carried on by the Austrian Government is the most complete in Europe. These schools are of two classes—those in which a sound theoretical instruction is imparted, with a certain number of hours daily in the workshop for practical work, and those where the greater part of the time is spent in the workshop, and the theoretical work consists mainly of drawing. Wages vary much in the different parts of the empire. In Carinthia, Carmola, and Styria, they are much lower than in Lower and Upper Austria, Salzburg, and the Tyrol. In a subsequent impression we shall return to the consideration of Austrian labour, which presents several peculiarities which we cannot deal with now.

Wages Paid per Week of Sixty-six Hours in Ironworks in Austria.

	s.	d.
Strikers by the piece	25	0
Head rollers	21	8
Rollers	12	6
Engineers, by the shift	17	9
Boilermen	10	5
Turners	21	6
Locksmiths	14	7
Head smiths	13	9
Smiths	8	4
Male labourers	6	8
Female labourers	6	3

Wages Paid per Week of Sixty Hours in Foundries and Ironworks in Trieste.

	s.	d.
Foundries	15	10
Ironworks	15	5
Machine shops	24	2

Wages Paid per Week of Sixty Hours in Machine Shops and Rolling Mills.

	s.	d.
In smelting houses:		
Ore washers	9	9
Labourers	6	10
In refining works:		
First puddlers	24	5
Assistant	14	4
Welders and squarers	15	9
Forgers, stokers, and stretchers	12	9
Bloom rollers	12	0
In the rolling mills:		
Head rollers	16	9
Second rollers	13	1
Catchers and runners	7	2
Bench binders	12	8
File forgers	9	11
File-grinders	11	7
File-cutters	11	10
Nail smiths	6	10

Wages Paid per Week of Sixty Hours in Mines in Austria.

	s.	d.
Iron mines:		
Job miners and first diggers	9	3
Miners	7	4
Labourers	6	10
Kaolin mines:		
Miners and diggers	9	1
Miners' barrowmen	6	6
Ore washers	7	0
Pressers	7	6
Smiths	10	0

Wages Paid per Week of Sixty Hours in Shipyards.

	s.	d.
Iron shipbuilders in Trieste	35	0
General Austrian Shipbuilding Company in Linz:		
Smiths	15	0
Locksmiths	13	6
Labourers	9	0

Denmark.—Denmark has no mining population, and its factories are of little importance. Co-operative societies have no existence. Labour organisations were inaugurated in 1871, and there are over forty trade unions in Copenhagen alone, which are both beneficiary and protective. Both working men and employers are beginning to resort to arbitration for the settlement of their disputes. The educational institutions of Denmark have reached a high degree of efficiency. Education is compulsory, and the children of the poorer classes are taught for nominal fees. Numerous technical schools exist all over the kingdom. With rare exceptions these schools are carried on in the evenings. There is not much female labour, and families are wholly dependent on the father's earnings. The general condition of the best paid labourers of Denmark is fairly comfortable, while that of the poorer paid artisans and labourers is one of economy and self-denial. In the last few years the wages of mechanics have increased by from 10 to 15 per cent., but the cost of living has kept pace with this increase. The hours of labour average sixty a week.

Wages paid per Week of Sixty Hours in Foundries, Ironworks and Machine Shops in Copenhagen.

	s.	d.
Tin-smiths	19	9
Moulders	23	3
Blacksmiths	17	6
Boilersmiths	16	3
Coppersmiths	19	9
Machinists	19	0
Turners	20	6

Wages paid per Week of Sixty Hours in Copenhagen Iron Shipbuilding Yards.

	s.	d.
Ship-smiths	17	0
Workmen	14	0

Wages paid per Week of Sixty Hours in the Government Navy Yard, Copenhagen.

	Lowest.		Highest.	
	s.	d.	s.	d.
Blacksmiths	13	9	17	9
Machinists	13	9	25	6
Locksmiths	13	9	17	4
Labourers	13	9	14	6

Workmen in the Navy-yard have permanent employment for life, and a pension when incapacitated for work through age, illness, or infirmity. They receive in addition tools, and are allowed houses to live in at a low rent.

Russia.—The labour conditions of Russia are peculiar to that Empire, and must not be measured by the standard of other countries. The feudal relationship between employer and employed still exists, notwithstanding the abolition of serfdom, to such an extent as to render comparison difficult. The system of boarding and lodging workmen in factories prevails largely. Its object is to provide steady workers, and to keep men aloof from other industries, and to preserve a certain amount of secrecy about the work. It has the effect of rendering the workmen completely dependent upon the employers. Wages throughout Russia are much lower than in the rest of Europe, with the exception of Italy, and it is not easy to arrive at average rates. Wages in St. Petersburg are regulated more by individual bargaining than by any trade rate, workmen being paid at one time 1s. a day, and at another 2s. 5d. The rules governing the relations between employer and employed are numerous, but they are by no means strictly carried out. There are a few trade schools in St. Petersburg where children are taught various trades, chiefly mechanical. These schools are but recently established, and are still in the experimental stage, but there is little doubt of their ultimate success. One distinguishing feature of Russian industry is the Artel, or Associative Labour Society. Artels are associations of several persons who unite either their capital and labour or the latter only for the purpose of carrying on trades or work with an individual and collective responsibility. All the members are upon an equality and receive the same wages. Artels have a fixed tariff, beyond which they may not go, but they usually accept rates much lower. These Artels perform their work in the most conscientious manner, and the particular Artel is collectively responsible for any injury or loss caused by any of its members. As an instance, in the Government of Vladimir several villages unite their capital to purchase iron, which is then made into scythes at a smithy. The scythes are then given to a member to be sold in the neighbouring towns and villages. The goods sold are promptly delivered, and the profit made is divided equally among all the members. Artels are more completely organised in the Government of Moscow. Villages in which the blacksmiths, joiners, and locksmiths form a large proportion of the inhabitants unite and determine the amount of capital they intend operating with. The amount so decided upon is raised by voluntary contributions of the villagers. Only inhabitants of those villages who take part in the association can become members. After deducting the cost of the raw material, 70 per cent. of the remainder is divided amongst the industrious members, and the remaining 30 per cent. put aside as a reserve fund. Idle members are either expelled or must submit to a deduction determined on by a vote of all the members. All business transactions are conducted by word of mouth,

Average Wages Paid per Week of Seventy-two Hours.

	Riga. s.	Riga. d.	Warsaw. s.	Warsaw. d.
Blacksmiths	16	0	15	0
Strikers	11	6	11	4
Brassfounders	20	0	15	0
Horseshoers	20	0	11	3
Millwrights	20	0	7	6
Nailmakers (hand)	20	0	10	5

* Piecework.

Portugal.—Wages in Portugal are very low compared with those in England and France. The hours of labour are from sunrise to sunset, with two hours interval for meals and rest. Women do much active work, such as stevedores and other outdoor labour. Out of a population of four millions and a-half, only one hundred and eighty-

Table showing Comparative Average Weekly Wages, according to the Reports of 1879 and 1885.

Occupations.	Germany. 1879. s.	d.	Germany. 1885. s.	d.	France. 1879. s.	d.	France. 1885. s.	d.	Belgium. 1879. s.	d.	Belgium. 1885. s.	d.	Italy. 1879. s.	d.	Italy. 1885. s.	d.	Denmark. 1879. s.	d.	Denmark. 1885. s.	d.	Switzerland. 1879. s.	d.	Switzerland. 1885. s.	d.	England. 1879. s.	d.	England. 1885. s.	d.
Blacksmiths	16	3	16	8	22	9	24	3	18	4	22	5	16	5	15	0	16	3	20	1	20	0	21	8	33	10	30	9
Brassfounders	23	0	18	3	—		27	3	—		25	1	22	11	19	2	17	6	20	1	19	2	20	6	30	10	31	2
Cutlers	16	3	16	3	19	4	21	6	—		22	0	16	3	15	10	16	1	25	5	19	2	20	7	33	4	29	2
Horseshoers	14	7	15	1	22	6	24	7	—		23	5	14	7	21	8	16	1	20	1	19	2	19	5	30	0	26	4
Labourers	10	10	13	0	—		16	0	12	6	15	9	—		10	0	—		17	11	—		15	1	20	10	19	7
Millwrights	29	8	17	5	—		28	2	—		20	10	16	3	19	2	16	8	24	6	25	0	26	3	31	3	29	1

Table showing the Rate of Wages in Ten of the Principal Cities of Europe.

Occupations.	London, 54 hours. s.	d.	Antwerp, 60 hours. s.	d.	Bremen, 66 hours. s.	d.	Berne, 63 hours. s.	d.	Vienna, 60 hours. s.	d.	Amsterdam, 60 hours. s.	d.	Rouen and Marseilles, 60 to 84 hours. s.	d.	Copenhagen, 60 hours. s.	d.	Turin, 60 hours. s.	d.	Riga, 72 hours. s.	d.
Blacksmiths	32	6	22	11	17	10	22	6	14	7	20	0	25	0	20	1	15	0	16	0
Strikers	25	0	10	3	14	11	19	1	14	0	15	0	20	10	20	1	14	2	11	6
Brassfounders	33	9	29	0	17	10	20	6	16	8	16	8	31	3	20	1	19	2	20	0
Cutlers	33	4	19	5	16	4	18	0	12	6	—		24	2	25	5	15	10	18	0
Horseshoers	29	7	—		12	6	15	0	14	6	18	6	24	2	20	1	21	8	20	0
Labourers	20	4	14	6	15	2	15	9	13	4	13	4	20	10	17	11	15	0	11	10
Millwrights	36	3	—		14	11	26	6	12	11	20	0	40	10	24	6	—		20	0
Nailmakers (hand)	—		—		14	11	11	0	—		—		20	2	20	1	13	4	20	0
Tinsmiths	29	2	14	6	17	9	15	3	17*	8	16	8	25	0	27	11	27	6	18	0

* Though given as the wages of Vienna in the comparative table, they are evidently the wages of other towns—Prague and Trieste—these trades being blank as to wages in the detailed Vienna return.

Table showing the Average Rate of Wages in Ten Countries of Europe.

Occupations.	England, 54 hours. s.	d.	Belgium, 69 hours. s.	d.	Germany, 66 hours. s.	d.	Switzerland, 67½ hours. s.	d.	Austria, 68 hours. s.	d.	Holland, 66 hours. s.	d.	France, 68 hours. s.	d.	Denmark, 60 hours. s.	d.	Italy, 60 hours. s.	d.	Russia, 72 hours. s.	d.
Blacksmiths	30	8	22	6	16	8	21	8	13	3	20	0	24	3	20	1	15	0	15	6
Strikers	22	1	13	9	12	5	18	6	13	1	15	0	19	8	20	1	14	2	11	4
Brassfounders	31	2	25	1	18	3	19	5	15	0	16	8	27	3	20	1	19	2	17	6
Cutlers	29	2	22	0	16	3	20	7	12	6	—		21	6	25	5	15	10	16	4
Horseshoers	26	4	23	5	15	1	19	5	14	6	18	4	24	7	20	1	21	8	15	8
Labourers	19	7	15	9	13	0	15	1	12	6	13	4	16	5	17	11	15	0	12	0
Millwrights	29	1	20	10	17	5	26	3	12	11	20	0	28	1	24	6	—		13	9
Nailmakers (hand)	24	7	—		13	0	11	0	—		—		20	2	20	1	13	4	15	3
Tinsmiths	27	4	18	4	14	10	18	5	15	5	16	8	22	9	27	11	27	6	12	4

The following Table gives the Retail Prices of the Principal Articles of Food Consumed by the Labouring Classes in Seven European Countries.

Articles.		England (Liverpool). s. d. s. d.	Germany (Berlin). s. d. s. d.	Switzerland (Berne). s. d. s. d.	France (Marseilles and Rheims). s. d. s. d.	Austria (Vienna and Prague). s. d. s. d.	Belgium (Brussels). s. d. s. d.	Holland (Amsterdam). s. d. s. d.
Meats:								
Bacon	per lb.	0 6 to 0 10	—	—	0 7½ to 0 10	0 7½ to 0 9	0 8 to 0 10	0 8 to 0 9
Ham	,,	— ,, 1 0	1 0½ to 1 3	— to 1 3	1 8 ,, 2 6	1 3 ,, 1 7	— ,, 1 3	0 8 ,, 1 1
Beef	,,	0 7 ,, 0 10	0 8½ ,, 0 10	0 7½ ,, 0 9	0 7 ,, 1 3	0 5 ,, 0 5	0 7½ ,, 0 8½	0 7½ ,, 1 4½
Mutton	,,	0 8 ,, 0 10	0 8½ ,, 0 10	— ,, 0 7	0 7 ,, 1 0½	0 4½ ,, 0 8	— ,, 0 9	0 8 ,, 1 0
Veal	,,	0 8 ,, 0 10	0 11 ,, 1 0½	0 8 ,, 0 9	1 0½ ,, 1 5½	0 4½ ,, 0 9	— ,, 0 9	0 7 ,, 0 11
Pork	,,	0 8 ,, 0 10	0 8 ,, 0 10	0 9 ,, 0 10	0 7½ ,, 0 10	—	— ,, 0 8	—
Sausage	,,	0 8 ,, 0 10	—	—	—	—	—	—
Horseflesh	,,	—	—	—	0 2½ ,, 0 6½	—	—	0 4½ ,, 0 6½
Groceries:								
Sugar	,,	0 2 ,, 0 3½	0 4 ,, 0 6½	— ,, 0 4	0 3¼ ,, 0 6	0 3½ ,, 0 4	— ,, 0 6	0 4½ ,, 0 6½
Tea	,,	1 4 ,, 3 9	2 11 ,, 8 4	4 2 ,, 6 3	4 2 ,, 5 10	—	—	0 8½ ,, 2 3
Coffee	,,	1 0 ,, 1 8	0 10 ,, 1 8	0 9 ,, 1 4	1 5½ ,, 2 6	—	— ,, 0 8	0 6½ ,, 1 1
Butterine	,,	0 6 ,, 1 0	—	—	—	—	—	0 8 ,, 0 11
Butter	,,	1 0 ,, 1 4	0 10 ,, 1 7	— ,, 1 3	1 4 ,, 2 6	{1 0½ ,, 1 3½ / 0 8 ,, 1 2}	— ,, 0 10	0 6 ,, 1 4½
Dripping	,,	0 6 ,, 0 8	—	—	—	—	—	—
Lard	,,	0 6 ,, 0 8	— ,, 0 9	— ,, 0 10	0 6 ,, 0 8	0 6 ,, 0 8	—	0 8 ,, 0 11
Cheese	,,	0 6 ,, 0 11	— ,, 0 10	—	0 7 ,, 1 0	—	—	0 6½ ,, 0 11½
Rice	,,	0 2 ,, 0 4	0 2½ ,, 0 5	— ,, 0 3	0 2½ ,, 0 5	— ,, 0 3	0 2 ,, 0 2½	0 1¾ ,, 0 3
Flour	,,	0 1¾ ,, 0 2	0 2¼ ,, 0 2¾	0 2 ,, 0 3	0 2½ ,, 0 5	0 1½ ,, 0 2½	—	0 2 ,, 0 3
Corn meal	,,	—	0 2¾ ,, 0 3	—	0 1½ ,, 0 2½	—	—	—
Bread	,,	0 1¼ ,, 0 2	0 2½ ,, 0 4½	0 2 ,, 0 2½	—	— ,, 0 1½	0 1½ ,, 0 2½	0 1¼ ,, 0 2¾
Oatmeal	,,	0 2 ,, 0 4½	0 2¾ ,, 0 3	—	—	—	—	—
Potatoes	,,	0 0⅔ ,, 0 0½	— ,, 0 0½	— ,, 0 4	0 0½ ,, 0 1	0 0½ ,, 0 1	— ,, 0 0½	— ,, 0 0½
Codfish	,,	0 4 ,, 0 6	— ,, 0 4½	—	—	—	—	—
Cabbage	each.	0 1 ,, 0 2½	—	—	0 2 ,, 0 6	—	— ,, 0 1	—

and at the close of the yearly accounts the same round is begun again, the Artels renewing and reconstructing themselves. Artels exist in all branches of trade and commerce, and those of the labourer are no less important than those of the craftsmen. Were Artels to be all suddenly dissolved or suppressed, the business of the country would be very seriously embarrassed. The hours of labour are from sixty to seventy-eight a week.

Wages Paid per Week of Sixty-eight Hours in Ironworks in Russia.

	s.	d.
Casters	19	3
Moulders	19	3
Apprentices	6	0
Labourers in foundry	9	6
Locksmiths	21	3
Blacksmiths*	22	3
Strikers	12	0
Chisellers	24	0
Tin-smiths*	21	8
Solderers*	28	3
Coppersmiths*	36	10
Grinders*	17	5
Polishers	17	5
Bronze workers	19	3
Metal workers	20	5
Turners*	22	10
Planers*	24	0
Labourers	9	0

five thousand are mechanics and artisans. Wages in and around Lisbon are—general trades, 2s. 6d. to 3s. 4d. a day, some running up to 5s. 3d. in exceptional cases, and others falling to 2s. 1d. Wages in the country districts are lower.

Turkey.—Turkey is not usually considered in a comparison of the labour conditions of the commercial and manufacturing nations. The want of internal communications has had the effect of localising industries, and each community has conditions of trade, hours of labour, and rates of wages peculiar to itself. Statistics relating to labour and wages, either official or other, are few. The working classes are industrious and steady, and strikes are very rare. The hours of labour are from sunrise to one hour before sunset, with an hour for dinner. Nearly everything is done by hand, and consequently manual labour is in great demand. The wages of general trades in Constantinople are about the same as those in other large cities of Europe; if anything, a little higher. In distant villages and country districts they are extremely low. A comparison with the report of 1879 shows that a slight advance in the rate of wages, but still an important one, when the relation of the cost of living to the amount of money earned, is generally noticeable in every country, except in England, where a general decrease has taken place, as shown in the above tables.

FALL OF ELECTRO-MOTIVE FORCE WITH DISCHARGE OF A BATTERY.

By PAGET HIGGS, LL.D.

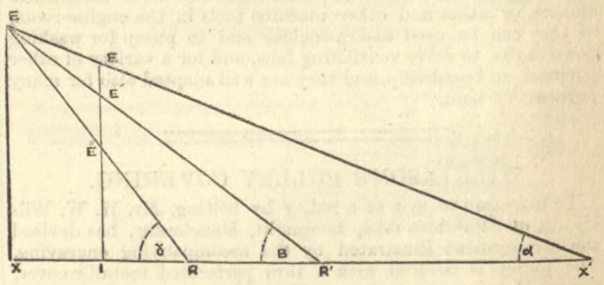
DR. LODGE, in a recent number of THE ENGINEER, pointed out a difficulty that beset the student in experiments with batteries, and explained one of those practical phenomena of which the reason why is not always apparent *primâ facie*. I would like to add some remarks about the discharge of batteries, with regard to a stumbling block that I have found a good many tripping over.

It is customary to give the electro-motive force of a battery as obtained on open circuit. This for comparison is sometimes serviceable, but practically the figures have little value. What the practician (to borrow a word from our French neighbours) requires to know is the electro-motive force when the battery is producing current. This is frequently a very different result, as many a poor amateur has found to his cost. It is not at all an unusual thing in an amateur's calculations for him to take the electro-motive force on open circuit as the working electro-motive force, and then for him to find that his incandescent lamps (an amateur generally fails here) are only red hot instead of white hot. And I am sorry to have to say it, but not always is this oversight confined to the amateur.

The best batteries are considered impolarisable (another word from the French, but perhaps we have left them too long in possession of the field), that is, the hydrogen evolved at the positive electrode is supposed quite consumed in the reduction of a metal, or by its oxidation or chlorination. If this consumption is not perfect, an unknown factor is introduced into our problem, and one that no economist will allow. However, all batteries *are* polarisable at a certain limit, where the production of hydrogen exceeds either the rate of contact of the consuming material, or the capacity of that material; in the latter case the battery is said to be exhausted; in the former a larger cell generally avoids the difficulty, or a larger surface of positive electrode. Yet this point is sadly neglected in nearly all battery construction. There is scarcely an ordinary form of battery in the market in which the positive electrode and amount of hydrogen-consuming material are not too small, with relation to the surface of zinc, to produce the best results. This, then, is the constructive difficulty, that does not, however, beset the amateur unless he builds his own battery; it is, however, a trade oversight.

Supposing a properly constructed battery, there is yet another obstacle, and this is the one to which I refer as commonly neglected—the unavoidable and inherent internal resistance. Him who doubts my statement as to this neglect I would refer to the columns of any of our technical papers, where teem inquiries as to failures to light incandescent lamps with such batteries as the Leclanché, intended for a totally different work. Even when, too, the amount of this resistance is understood by the student to depend upon size and upon distance apart of the electrodes, I have known failure to be incurred in the attempt at reduction of resistance, by bringing the electrodes so close together as to prevent circulation of a sufficient amount of the hydrogen-consuming material. With accumulators it is not at all uncommon to have the plates too close together to admit of the bulk of sulphuric acid necessary for the proper formation of sulphate; the space having been reduced with the single view of reducing the internal resistance of the cell. But the internal resistance of a battery varies also with the liquid employed, and with so many other causes as to prevent generalisation. What has to be now attempted is the explanation of the effect of this resistance.

Any explanation that can be referred to a geometrical consideration has an advantage in being apparent to the

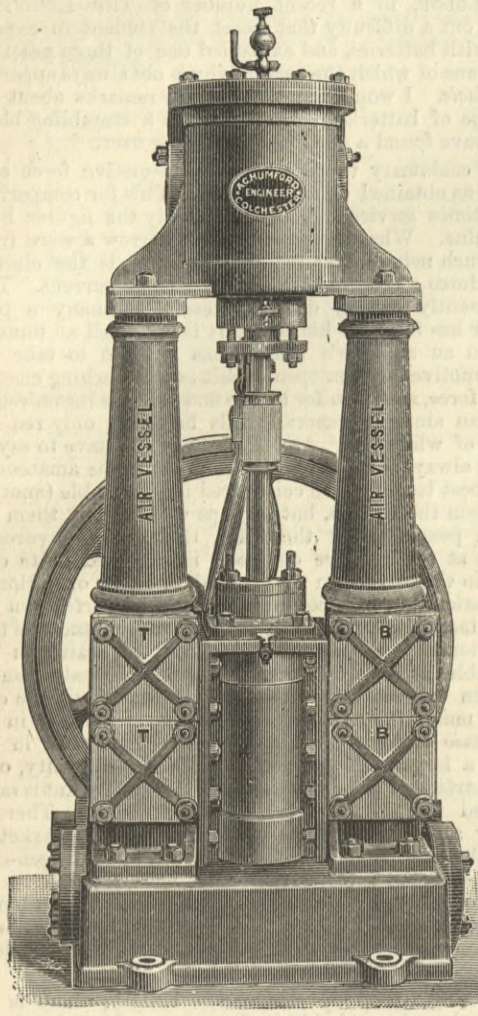


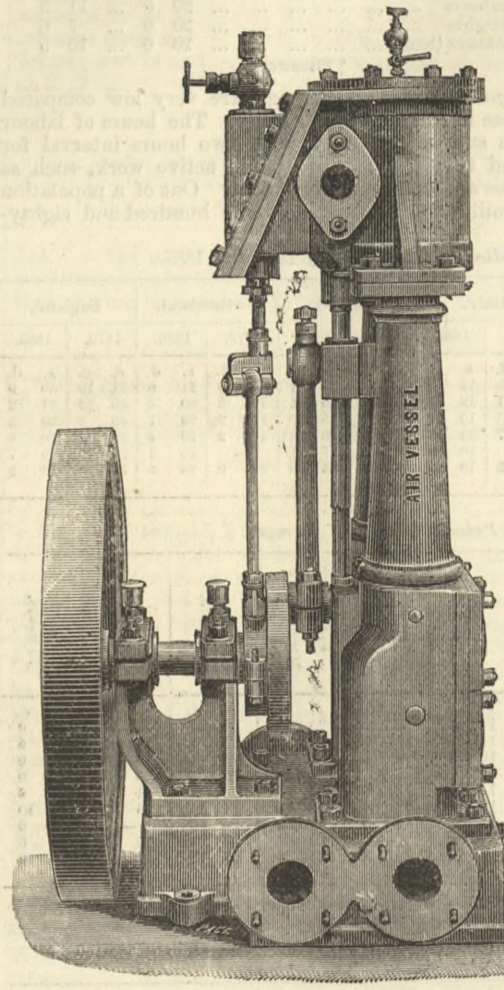
physical eye, as well as to the mind's eye, to which alone figures and symbols appeal. Therefore let X I in the horizontal line $X X^1$ represent the internal resistance of the battery, and let $I X^1$ be the resistance of the voltmeter. The vertical line E will be taken to represent the internal electro-motive force of the battery, and then the line E^1 at the other extremity of X I will be the electro-motive force at the terminals of the battery when only the voltmeter is in circuit. Let us now set the battery to work on a resistance represented by I R, and we see that the line joining E and R—corresponding to the line joining E X^1 when only the voltmeter was in circuit—now makes a greater angle with the horizontal line of resistance, and cuts the line giving the electro-motive force at the terminals at E^{11}, which is now the electro-motive force appearing on the voltmeter or, if I R represent lamp-resistance, at the terminals of the lamps. If I R^1 be the lamp-resistance giving the electro-motive force E_1 proper to the requisite brightness of the lamps, then, although we have a greater angle γ than at β—the currents are proportional to the tangents of these angles, not to the angles themselves—and a greater current flowing out with the lesser electro-motive force E^{11}, the lamps—in parallel—have not each the electro-motive E_1 at their terminals necessary to drive the proper current through them. With the highest electro-motive force we have the lowest current, tan α.

This little diagram based on the simplest reasoning shows at once the fallacy of giving the electro-motive force without the corresponding current.

MARINE PUMPING ENGINE.

MR. A. MUMFORD, COLCHESTER, ENGINEER.

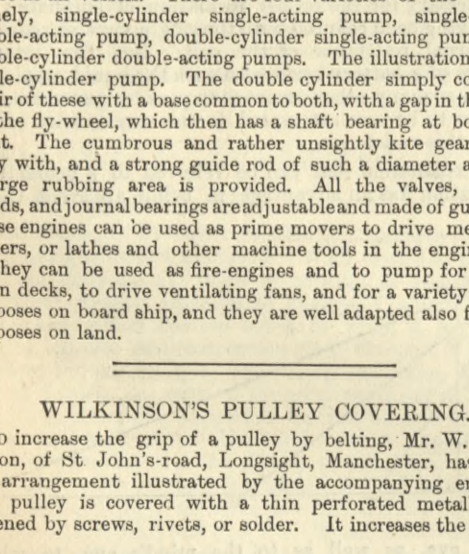




THE accompanying illustrations show front and side elevations of a pumping engine designed and manufactured by Mr. A. G. Mumford, engineer, of Colchester. Although well adapted for other purposes, it has been specially designed for use on board ship, and it has therefore been so arranged as to economise space to the uttermost, whether as regards height or floor space, in proportion to amount of work done. Care has also been taken to make every part readily accessible. An inspection of the front elevation will show that the suction and delivery can be used conjointly at either the right or left side, or the suction can be used at the right and delivery at left, or *vice versâ*; hence every condition of locality is provided for. Blank flanges or cover plates are supplied for the suction and delivery not in use. The standards supporting the cylinders are ingeniously utilised to act as air vessels. There are four varieties of the design—namely, single-cylinder single-acting pump, single-cylinder double-acting pump, double-cylinder single-acting pumps, and double-cylinder double-acting pumps. The illustration shows a single-cylinder pump. The double cylinder simply consists of a pair of these with a base common to both, with a gap in the centre for the fly-wheel, which then has a shaft bearing at both sides of it. The cumbrous and rather unsightly kite gear is done away with, and a strong guide rod of such a diameter as affords a large rubbing area is provided. All the valves, seatings, glands, and journal bearings are adjustable and made of gun-metal. These engines can be used as prime movers to drive mechanical stokers, or lathes and other machine tools in the engine-room, or they can be used as fire-engines and to pump for washing down decks, to drive ventilating fans, and for a variety of other purposes on board ship, and they are well adapted also for many purposes on land.

WILKINSON'S PULLEY COVERING.

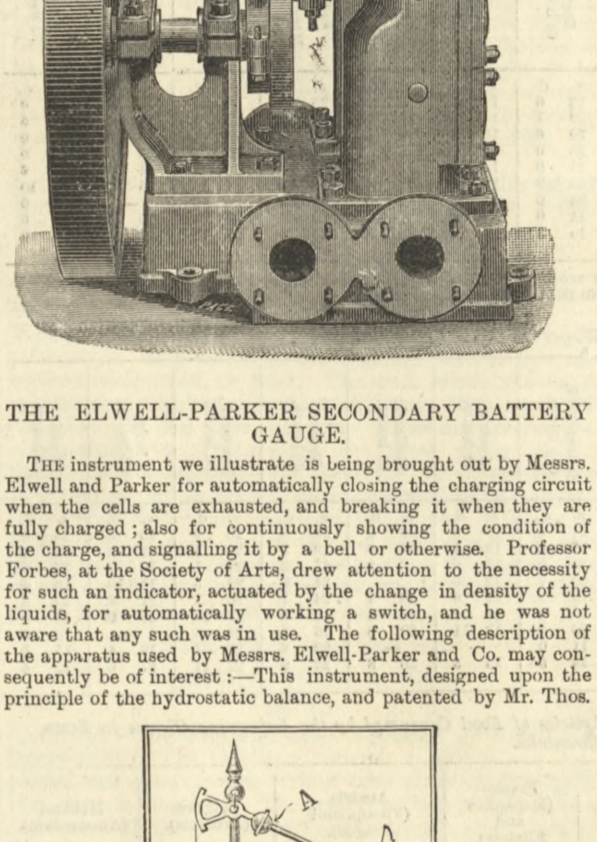
To increase the grip of a pulley by belting, Mr. W. W. Wilkinson, of St John's-road, Longsight, Manchester, has devised the arrangement illustrated by the accompanying engraving. The pulley is covered with a thin perforated metallic cover, fastened by screws, rivets, or solder. It increases the strength



of the pulley if properly applied, increases the hold of the belt, and makes it possible to run with slack belts. It remains to be seen whether the wear of the belt is greater in any noticeable degree than with an ordinary pulley, but it may be assumed that as the necessary tension is less, the life of a belt will not be decreased unless it is too small for its work. The advantages of being able to run with a slightly slack belt are obvious.

THE ELWELL-PARKER SECONDARY BATTERY GAUGE.

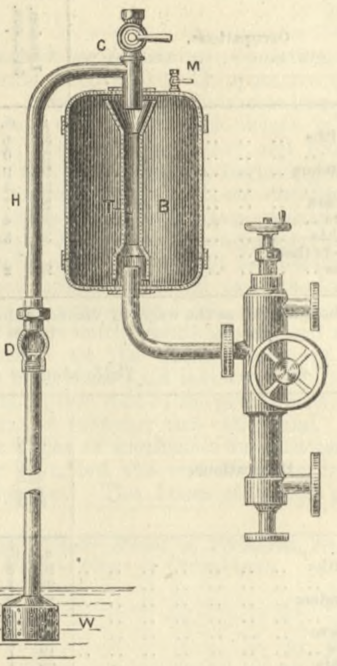
THE instrument we illustrate is being brought out by Messrs. Elwell and Parker for automatically closing the charging circuit when the cells are exhausted, and breaking it when they are fully charged; also for continuously showing the condition of the charge, and signalling it by a bell or otherwise. Professor Forbes, at the Society of Arts, drew attention to the necessity for such an indicator, actuated by the change in density of the liquids, for automatically working a switch, and he was not aware that any such was in use. The following description of the apparatus used by Messrs. Elwell-Parker and Co. may consequently be of interest:—This instrument, designed upon the principle of the hydrostatic balance, and patented by Mr. Thos.



Parker, has been used in connection with the Elwell-Parker accumulators during the past two years with perfect success. It is unaffected by the level of the solution, and does not require a special cell. It consists of a vertical brass pillar, from which projects a horizontal arm, carrying by two silk cords, the beam, at one end of which is the segment of a wheel, the axis of the beam forming the centre, and at the other end is an ivory pointer and an adjustable balance weight. A glass bulb B, hermetically sealed and loaded, so as to just sink in the solution when at its greatest density, is suspended in the centre of the cell by a platinum wire attached within the gauge case to a silk cord hanging from the segment in the beam. The gauge, entirely enclosed in a glass case, is placed upon a shelf directly above the cell, so that the glass bulb hangs in the solution without touching the plates. It will be at once seen that as the battery is being charged, and the specific gravity of the solution increases, the bulb B will rise and the angle formed by the arm bearing the balance weight A with the vertical pillar will become more acute until the pointer reaches the bottom of the scale, when a cross-bar, formed by a fine piece of platinum wire at the end of the pointer, comes into contact with two upright platinum terminals, and so closes the circuit either of an electro-magnetic switch—for automatically cutting the battery out of the general charging circuit—or of an electric bell in the engine-house—to show that the charging is complete—or where a gas engine is used to cut off the gas and so stop the engine. A similar contact may be made when the cells are exhausted—to any desired extent—and the charging circuit thrown in again, or a bell sounded by the pointer reaching the top of the scale. As the capacity of a secondary battery, when always discharged in series, depends upon that of the weakest cell it contains, and as every cell will require exactly the same amount of current to re-charge it, a single indicator placed over any cell is all that is required.

HAWKE'S INJECTOR AUXILIARY.

THE accompanying engraving illustrates a new appliance for increasing the efficiency of boiler injectors, patented by Mr. S. R. Hawke, Hayle, Cornwall, and awarded a silver medal at the last annual Polytechnic Exhibition at Falmouth. It obviates the uncertainty often attending the starting of injectors, and also imparts to the injector—of all sizes—a lifting power of from 20ft. to 25ft.; and the injector will lift water of a higher temperature than when worked in the usual manner, viz., 140 deg. The illustration shows it attached to an ordinary injector. B is an air-tight chamber filled with water. Thus, on opening the water regulator, the injector becomes at once flushed with water, and consequently instant action is secured—the steam not having first to exhaust the air from a long suction



pipe, as in the ordinary way of working. The injector continuing its action, gradually creates the necessary vacuum in chamber B to lift water up the suction pipe H, thus becoming replenished with water as fast as it is being withdrawn by the injector. The water, rushing through the cones and tube T, carries with it any air which might enter B; thus the necessary vacuum is maintained. The cock C is for conveniently charging the appliance with water—previous to first working, air escaping through pit pet tap M—and may also be utilised for introducing boiler composition from any suitable vessel attached. The auxiliary has, we are informed, proved of great advantage to injectors which were inadequate for the lift required.

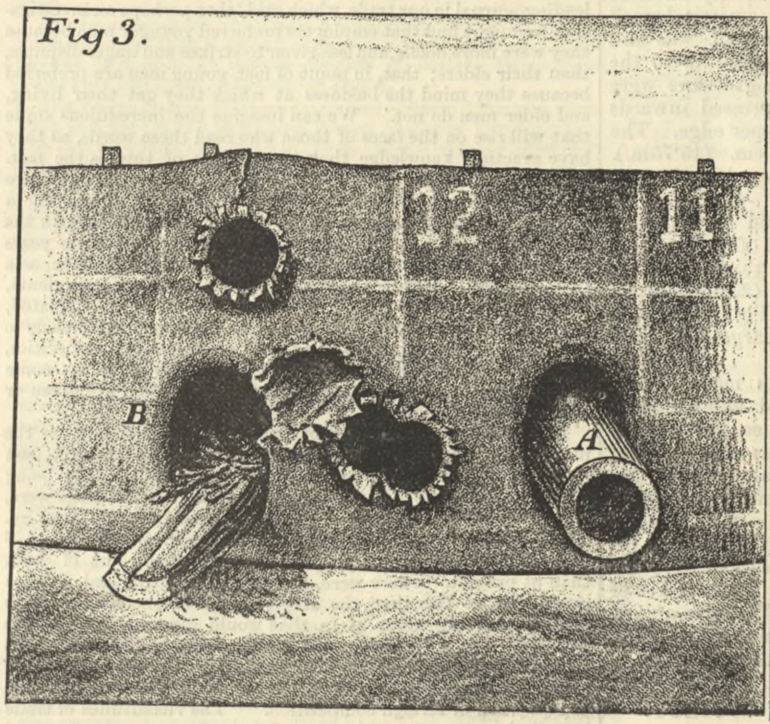
NAVAL ENGINEER APPOINTMENT.—The following appointment has been made at the Admiralty:—Edward Jackson, engineer, to the Pembroke, for service as instructor in working of machinery of torpedo boats.

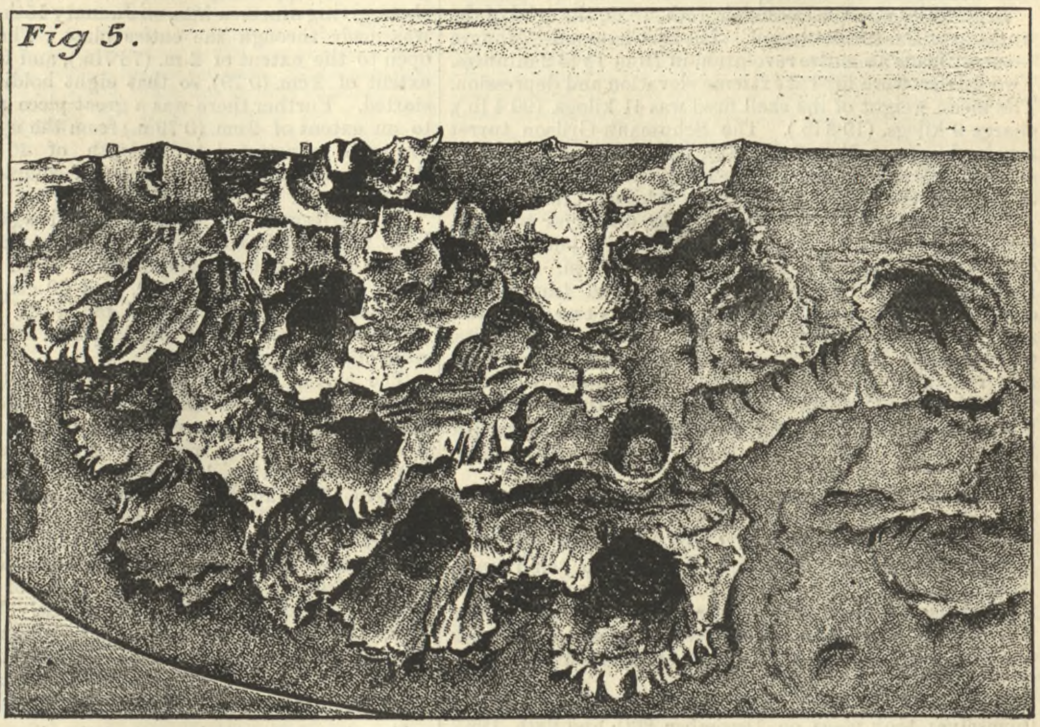
MARBLE STATUE OF THE LATE MR. THOMAS ORMISTON, M.I.C.E., C.I.E.—Mr. John Mossman, R.S.A., our well-known local sculptor, has at present on view in his Mason-street premises a life-size statue in marble of the late Mr. Thomas Ormiston, civil engineer, who in his early professional career was a much-esteemed servant of the Clyde Trust, while in its later portion he was the chief resident engineer to the Bombay Port Trust. The statue is intended to perpetuate the memory of Mr. Ormiston in Bombay, and is to be regarded as a recognition of the eminent services which he rendered to the city and port of that name. The commission to Mr. Mossman was backed by a subscription entered into to defray the whole of the expenses by merchants and other citizens of Bombay, and it is expected that it will eventually find a resting-place in the Bombay Town-hall. Since the statue was finished it has been viewed by a number of persons in this city who knew the deceased when he resided in our midst, and the opinion which they have universally expressed in regard to it is that Mr. Mossman has reproduced the lineaments of his subject in a most faithful manner, while he has also impressed upon it a highly artistic feeling. Referring briefly to the career of Mr. Ormiston, we may mention that he served under the late Mr. John F. Ure, who was for a long time the engineer to the Clyde Trust. He was subsequently engaged under the late Mr. James Walker, F.R.S., President of the Institute of Civil Engineers, in the construction of various lighthouses and dockworks, chiefly in England. His most important work, however, which was also his last, was the designing and construction of the great dockworks at Bombay, which were commenced by the Elphinstone Land and Press Company, whose interests were in course of time taken up by the newly-constituted body, the Bombay Port Trust. The works in question have as their chief feature the Prince's Dock, the foundation-stone of which was laid by the Prince of Wales on the occasion of his memorable visit to India, when he was made Companion of the Indian Empire (C.I.E.) This dock, the first wet dock of any extent in India, has 30 acres of water space, and a depth of 28ft. of water on the sills at ordinary spring tides. Alike as to the length and substantial character of the dock walls, the extent of its sheds and warehouses, its equipment of hydraulic machinery, forty-three portable cranes, and one crane capable of lifting 100 tons, the Prince's Dock, Bombay, is really a great engineering work; and we can well conceive that the merchants and other citizens may desire to perpetuate the memory of the eminent engineer whose name will for ever be associated with it. Mr. Ormiston died in the year 1882, when he had almost completed the fifty-sixth year of his age. We understand that Mr. Mossman will be glad to show the statue to any former friends and acquaintances of Mr. Ormiston who may call at his premises within the next week or two.—*Glasgow Herald.*

THE COMPETITIVE TURRET TRIAL AT BUCHAREST.

BEFORE dealing with the actual competitive trial of the rival turrets or cupolas at Bucharest, which is the object of this article, it may be well to give a short introductory explanation, and to describe briefly the structures which formed the subject of the trial, using the illustrations and facts given in M. Claude Manceau's interesting paper in *Le Genie Civil.*

Bucharest being a strategic point of the highest importance, it was determined to fortify it in the most formidable manner possible, and to this end it is now necessary to employ iron forts even for land defences. Earth is by no means discredited, but earthworks to be secure against assault require revetments, and much space is necessary to allow them to be of sufficient thickness to resist the fire of modern guns. It is necessary at salient points to use more compact defences; and with curved fire, and with the accuracy of modern guns, such defences would be liable to be destroyed if made of granite, and hence iron becomes a necessity. France adopted Grüson's chilled iron for inland forts as well as for coast works for a time, but in 1882 it was concluded in France that the effect of steel projectiles against these shields, especially the effect of forged steel projectiles, was so great that it was better to limit the use of Grüson's cupolas and forts to coast defence, where they would not be exposed to a systematic breaching attack. M. Manceau gives us an illustration of a Grüson's cupola demolished by the attack of a 32 cm. gun (12·6in.) We give this sketch—Fig. 7—as characteristic of the final destruction of a shield of hard armour. It exemplifies General Inglis' idea of the distribution of overpowering blows performing wholesale shattering, but we need to know the details of dimensions and the striking energy of the projectile before we can judge of the power of resistance of the shield. In France it was concluded that Schneider's steel had beaten the English steel-faced plates, and yet Schneider's steel was thought to be better suited to the requirements of ships than forts. Steel is liable to fracture, but fracture on a ship's side may be the best form the injury can take, for extended fracture represents the stoppage of a very powerful shot, and it is hardly likely that a second blow will fall on the same plate. To resist continuous breaching wrought iron was thought to be best, simply because it is very difficult to break it up, wrought iron being the softest kind of armour known. Partial penetration then has little or no effect, for the resisting power of a shield is but little diminished by having a number of holes extending partly through and plugged up very likely by the heads of the shot that made them. It was considered that it was but seldom that a larger gun than a 6in. piece would be employed in siege batteries; consequently it would follow that wrought iron of no extravagant thickness ought to defy the attack of siege guns for an indefinite time, for it may be seen that a little over 14in. would, if properly constructed, keep out a single blow of the 15 cm. gun, and repetition adds very slowly to the effect on the shield. In the meantime, Grüson had greatly improved the resisting power of his shield against steel projectiles by altering the profile and shape of the walls, as noted by us in the recent trials at Buckau. The design, however, for Bucharest is made on a plan of Major Schumann, of compound plates—that is, wrought iron with a steel face. The rival turrets may be briefly described as follows:—The Schumann-Grüson cupola is for two 15 cm. (5·9in.) guns. The form is shown in Fig. 8. It offers a very small mark to horizontal fire, but the diameter has to be large, the interior diameter being 6 metres, or 19·7ft., and it is the more open to attack by high angle fire. It is intended to resist the fire of the 27 cm. (10·3in.) mortar. The dome curve has a radius of 5 metres (16·4ft.) and it is 20 cm. (7·87in.) thick. It rests on a pivot and runs on rollers round under the circumference on a circle—*r* in figure. The port, passing through a very oblique wall, is, consequently, very oval, and the curve is modified and the gun is fitted with a spherical collar. The port plate is of wrought iron. The gun pivots in the vertical plane about the spherical collar. To accomplish this its breech is made to move in arc-shaped guides—*h* in Fig. 8. Counterweights are used—Z in Fig. 8—to balance the gun, which is thus hung and clamped at any required elevation. As its recoil is checked the shock of discharge is transmitted into the turret, and as each gun is a short distance on one side of the axis of the turret, a couple is formed by which the turret is caused to revolve slightly by the shock of discharge of either piece. A gun can be taken out in thirty minutes and put back again in forty-five minutes. The cupola performs an entire revolution in thirty seconds. Elevation is given to the gun by means of an endless screw. Three means are provided for laying the pieces :—(1) A tangent sight in the top of the cupola between the two guns viewed by putting the head through a manhole —shown at A in Figs. 8, 2, and 6. (2) A tube pierced in the roof of the cupola in the opposite direction to the ports—*vide* B in Figs. 2 and 6—by which the desired direction can be obtained while the ports are turned away from the enemy. (3) For short distances it is possible to lay the gun by looking through the bore. The *avant cuirass*, or glacis shield, is made of cast iron protected by a mass of cement—*vide* Fig. 8—covered further by sand.





THE MOUGIN TURRET.

Fig. 9 shows the French turret. It is made by the establishment of St. Chamond, on the design of Major Mougin. The general principle of the structure is apparent. The turret consists of a thick walled cylinder 4·8 metres (15ft. 9in.) diameter, of three layers of wrought iron 45 cm. (17·7in.) thick in all. It is made additionally strong by deep plates beneath the cheeks of the carriage, which are brought down to a centre piston A on which the whole turret revolves. There are rollers under the iron framework beneath the armour wall, but this part is made separate from the wall in order to keep it from dislocation caused by the bending of the latter under impact of shot.

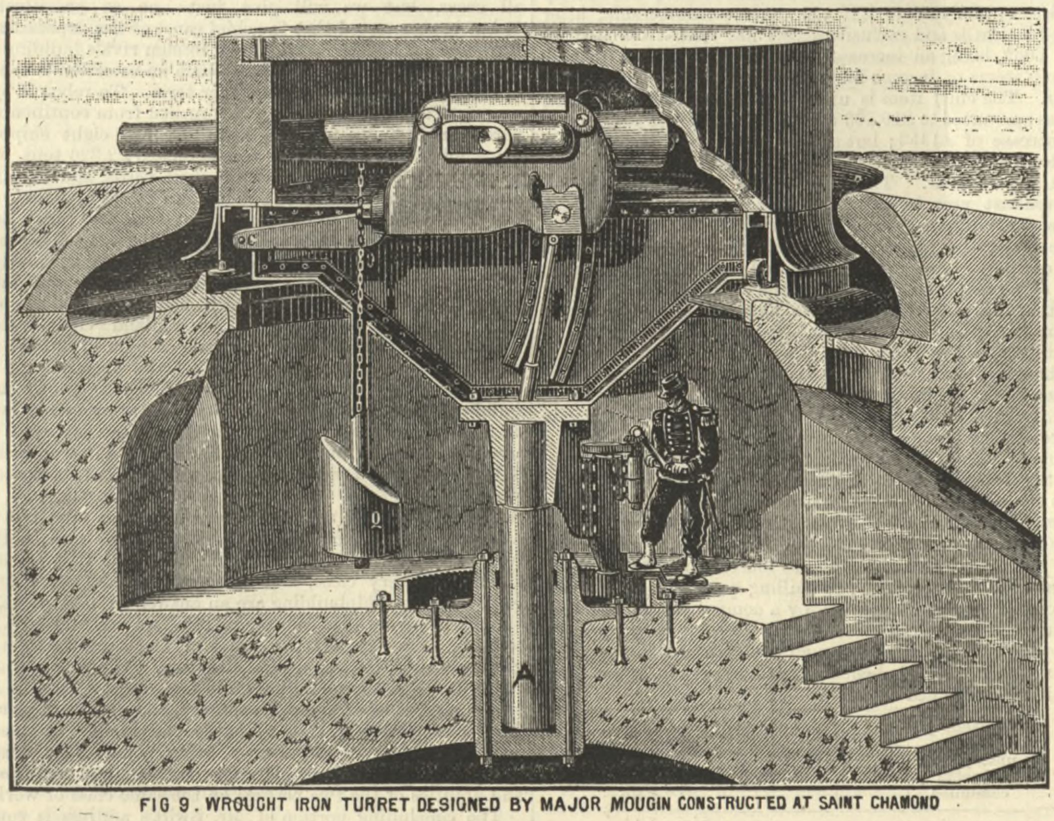


FIG 9. WROUGHT IRON TURRET DESIGNED BY MAJOR MOUGIN CONSTRUCTED AT SAINT CHAMOND

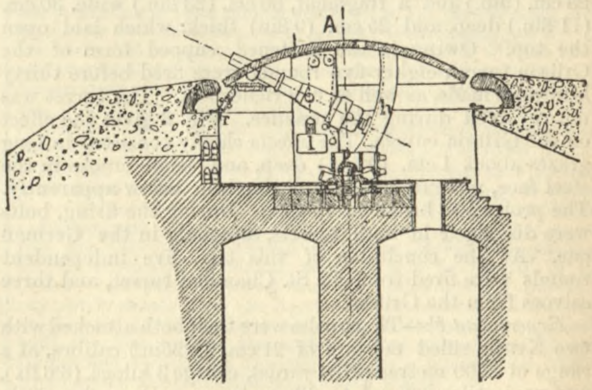


FIG 8: SCHUMANN GRÜSON CUPOLA

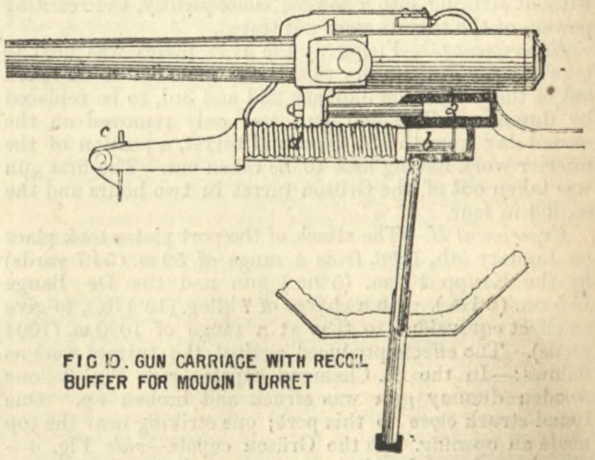


FIG 10. GUN CARRIAGE WITH RECOIL BUFFER FOR MOUGIN TURRET

The turret is moved by very simple hydraulic machinery worked by a man placed beneath, as shown in Fig. 9. The wall of the turret stands about a metre (39·37in.) above the glacis, which offers a much greater mark for horizontal fire than the Schumann-Grüson curved dome. On the other hand, more interior space is given in proportion to the diameter, and the ports passing directly through the vertical wall weaken the plates less than if the direction were oblique.

FIG 7. EARLIER PATTERN OF CHILLED IRON CUPOLA IN FINAL CONDITION OF DESTRUCTION

In order to save the turret from the shock that would be felt if all recoil were stopped, a recoil arrangement, depending on the use of hydraulic cylinders and powerful springs, is employed—*vide* Fig. 10. *a b* are the hydraulic cylinders of bronze, *d* is the spring arrangement, and *c*—*vide* Figs. 9 and 10—a front pivot or bolt so placed that the axis of the gun is always directed nearly through the centre of the port or embrasure, which may therefore be made very small. A lift brings the projectiles to the breech of the gun. The guns are taken in and out through an opening made behind each. Each vertical armour-plate weighs about 19 tons. The roof is in a single plate; its thickness is 18 cm. (7in.).

In the record made of the experiments the examination of the construction and arrangements of the turrets is classified under the heading A.

Experiment B.—On December 15th, 1885, the trial of the working of the turrets began. The St. Chamond—Mougin—turret made an entire revolution in from 1½ to 2 minutes. Two salvoes were fired at extreme elevation and depression. The mean weight of the shell fired was 41 kilogs. (90·4 lb.), charge 9 kilogs. (19·8 lb.). The Schumann-Grüson turret revolved in from 2½ to 3 minutes, and fired two salvoes at extreme elevation and depression, with projectiles of 38·7 kilogs. (85·3 lb.), and charge of 9 kilogs. (19·8 lb.).

Experiment C.—On December 19th, and 21st to 23rd, firing was carried on from the turrets at a butt 2500 m. distant (2734 yards); height of butt, 6·5 m. (21·3ft.); breadth, 8 m. (26·2ft.). The St. Chamond turret fired eighteen rounds, making nine hits, as well as two miss-fires; and the Grüson turret, 20 rounds, making fifteen hits. On December 21st and 22nd the St. Chamond turret fired fifty rounds in salvoes, making forty hits; and the Grüson turret forty-one rounds in salvoes, making thirty-two hits, besides nine miss-fires owing to awkwardness in pulling the friction tubes. The French turret had the advantage in speed.

Experiment D.—Finally, on December 24th, firing single guns from each turret, making a complete revolution between each round, the St. Chamond turret fired ten rounds, making four hits, and the Grüson ten rounds, making six hits. Salvo firing for speed resulted in the St. Chamond turret firing three salvoes in twenty-one minutes, and the Grüson in thirteen minutes. This work was facilitated by the employment of the manhole above-mentioned for taking aim.

Experiment E.—The bombardment, or attack of the turrets themselves, took place on December 26th and 28th, 1885. The firing took place with two Krupp 15 cm. (5·9in.) guns and one De Bange gun, 15·5 cm. (6·1in.); range, 1000 metres (1094 yards); charge, 9 kilogs. (19·8 lb.); steel projectiles, Krupp, 38·7 kilogs. (85·3 lb.), and St. Chamond, 41 kilogs. (90·4 lb.). The attack was made at the plates at the side of each turret opposite or on the reverse side to the ports. At the St. Chamond turret were fired fifty-one rounds, making thirty hits, the turret being moved so that the hits were distributed over an arc of about 90 deg.—*vide* Fig. 1, taken from a photograph. The penetration amounted to about 23 cm. (9in.) and a fragment, 60 cm. (23·6in.) wide, 30 cm. (11·8in.) deep, and 25 cm. (9·8in) thick, which laid open the top. Owing to the flattened, cupped form of the Grüson turret, eighty-five rounds were fired before thirty hits were made, as well as five richochets. The turret was not revolved during the practice. Fig. 2 gives the effect on the Grüson cupola. The effects chiefly consisted in long grazes about 1 cm. (0·4in.) deep, and small cracks in the steel face, not extending into the iron below apparently. The projectiles broke on impact. During the firing, bolts were dislodged in both turrets, especially in the German one. At the conclusion of this test, five independent rounds were fired from the St. Chamond turret, and three salvoes from the Grüson.

Experiment F.—The cupolas were then both attacked with two Krupp rifled mortars of 21 cm. (8·26in.) calibre, at a range of 2500 metres (2734 yards), charge 3 kilogs. (6·6 lb.), and projectiles 2·8 and 4 calibres long, on December 29th, 1885, and January 1st, 1886. In all, 163 shots were fired without striking either tower; consequently, the resisting powers of the turrets were not tested.

Experiment G.—Firing at the port plates was next to take place. Preparatory to this the guns had to be taken out of the turrets, on January 2nd and 3rd, to be replaced by dummies. The first gun was only removed on the second day from the St. Chamond turret, a portion of the interior work having first to be taken out. The first gun was taken out of the Grüson turret in two hours and the second in four.

Experiment H.—The attack of the port plates took place on January 5th, 1886, from a range of 50 m. (54·7 yards) by the Krupp 15 cm. (5·9in.) gun and the De Bange 15·5 cm. (6·1in.), with a charge of 7 kilog. (15·4 lb.), to give an effect equivalent to that at a range of 1000 m. (1094 yards). The effects produced against the turrets were as follows:—In the St. Chamond cupola—*vide* Fig. 3—one wooden dummy gun was struck and broken up. One round struck close to this port; one striking near the top made an opening. In the Grüson cupola—*vide* Fig. 4—iron dummies replaced the guns; one (? "socket") trunnion was struck. The wrought iron port plates received seven hits, of which four were nearly in line, the last cutting to a depth of 7 cm. (2·76in.) The iron dummies were uninjured.

Experiment J.—An attack of glacis plate—*vorpanzer, avant cuirasse*—took place on January 7th and 8th, 1886. Owing to the fact that the St. Chamond turret stood on much higher ground than that of Grüson, the guns were fired with 48 min. elevation at the former and 1 deg. 22 min. depression at the latter. The St. Chamond turret glacis received nine shots on the concrete; consequently, ten shots struck the iron thus exposed, distributing themselves on the middle and upper part of it. The shots did not strike so as to bite with their points, but glanced off, producing only slight grazes and hair cracks. The concrete on the glacis of the Grüson turret was struck off by fifteen shots entering to a great depth, and six hits were concentrated on the under part of the iron wall, the deepest being 15 cm. (5·9in.) from the under edge. The projectiles, in consequence, struck the shoulder with their points. The result was that a vertical crack and a fragment detached 5 cm. (1·97in.) thick, about 40 cm. (15·7in.) long, and 20 cm. (7·9in.) broad from the inner side, and projected into the interior of the turret.

Experiment K.—An attack of the turrets, with the object of breaching it with the 15 cm. (5·9in.) Krupp gun, on January 11th, 14th, and 15th, 1886. Range, 1000 metres (1094 yards); charge, 9 kilog. (19·8 lb.), with steel shot of Krupp and St. Chamond. The portion fired at was the hinder part of the cupolas already attacked on December 26th and 28th, 1885. The point of mean impact on the St. Chamond turret was 1·3 metre (51·2in.) to the right of the joint—*vide* Fig. 5. On January 14th, 1886, seventeen rounds were fired, giving thirteen hits, by which a great piece of the upper edge was detached. By twenty-six more shots, giving nineteen hits, on January 15th, a vertical crack was made through the entire plate. The roof was laid open to the extent of 2 m. (78·7in.), and forced up to the extent of 2 cm. (0·79), so that eight holding screws were started. Further there was a great piece pressed inwards to an extent of 2 cm. (0·79in.) from the upper edge. The projectile penetrated to a depth of 40 cm. (15·75in.). Another shot might have opened a complete breach, so it was estimated by the Germans.

The Grüson turret being attacked again at the same joint was struck with twenty-two hits out of thirty shots on the same spot. A piece about 7 cm. thick (2·76in.), about 120 cm. long (47·2in.), and 60 cm. (23·6in.) broad was peeled off from the steel face (*vide* Fig. 6), so that the wrought iron below was exposed. Large bolt heads were also detached.

The shield further bore fourteen hits made out of eighteen rounds on the same place, and another shot might have opened a complete breach, so the French thought (L). Firing from the turrets was again carried out on January 19th, 1886, when twenty salvoes were discharged. On January 16th the guns were not yet replaced in this turret. The Grüson turret fired a series of twenty salvoes on January 16th, the guns being by this time replaced, and on January 19th ten more salvoes were discharged from it. We reserve a review of the features of this important trial for another article. We have a mass of matter and strong conflicting opinions to deal with. The official report has just come to this country.

THE STEAM ENGINE MAKERS' SOCIETY.

THE sixty-first annual report of the above Society has been issued to the members this week. Our Lancashire correspondent in his "Notes" last week briefly intimated what the purport of the report would be as regards the position of the Society, and we are now enabled to make a few extracts from the address of the general secretary, Mr. James Swift, which will be of interest to our readers. In the first place the members are congratulated that with the heavy tax upon the Society's funds during the past year, the actual loss upon the twelve months' working has not been more than £636. At the close of 1884 the Society's worth in funds was £11,071; the income from all sources during 1885 amounted to £11,335, and the expenditure to £11,972, thus reducing the balance of funds held by the Society at the close of the year to £10,435. As to membership, after allowing for deaths and exclusions, this has risen from 4910 in 1884 to 5062, being an increase of 152. With few exceptions the various items of income have shown an increase during the past year. The chief item is under the head of contributions, which has amounted to £10,103 as against £8650 last year, showing an increase of £1453; but at least £1200 of this sum may be put down to extra levies which it has been necessary to raise during the past year. The expenditure, which in 1884 was £9940, rose last year to £11,972, being an increase of £2032, which has been almost entirely caused by the extra calls made upon the Society for the support of out-of-work members. This item of expenditure alone has amounted to £4886, which is an increase of no less than £1824 upon the previous year. Another benefit that has shown an increase has been that of superannuation to aged members, which last year absorbed £1438 as against £1319 paid in 1884. On one important item of expenditure there is a decrease, and that is in working expenses, which have been brought down to an average cost per member of 5s. 11¾d., or about 12¾ per cent. of the total income, which is the lowest average ever before experienced by the Society.

Turning from matters of detail and the year 1885 in particular, Mr. Swift deals with the Society's finances as a whole, and refers to the necessity that had existed for a change, which has now been decided upon. With regard to this subject an exhaustive report was submitted to the branches during the year, and the result had been a decision to increase the future contributions of the members to one shilling per week. The need for this change was demonstrated by a comparison of the cost in certain benefits as the present time to what they were say twenty or thirty years ago, and as an evidence of this the total cost per member of certain benefits for three periods of ten years is given in the subjoined table:—

	Travelling and unemployed benefits combined.	Sick benefit.	Funeral benefit.	Superannuation benefit.	Miscellaneous or working expenses.	Total average expenditure.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
From 1855 to 1864	6 13 9¾	4 2 10	1 1 5¾	0 6 4	4 12 3¼	16 16 8¾
1865 to 1874	5 12 10¼	4 16 6	1 11 1	1 3 5¼	3 16 5½	17 0 4
1875 to 1884	7 19 8½	5 1 7¼	1 9 2½	2 6 4¾	3 6 1	20 3 0

Extended comment on these figures, Mr. Swift remarks, would be superfluous, as they carry their own moral, but it may be pointed out that the Steam Engine Makers' Society has had to face much the same difficulty that has recently occupied the serious attention of the Amalgamated Society of Engineers—the enormously increasing claims for superannuation benefit. From the above table it will be seen that whilst from 1855 to 1864 these claims were covered at a cost of 6s. 4d. per member, that item had, in the period from 1875 to 1884, increased to £2 6s. 4¾d. per member. This increase in superannuation, Mr. Swift explains, is due to two causes. The first of these is, of course, the Society's greater liability each year owing to the extended period since it was founded, but as the Society has existed for sixty-one years, some other contributory cause has to be sought for to account for it having risen at such a rapid rate within the past ten years, and for the explanation of this contributory cause as it presents itself to Mr. Swift we quote his own words in the address:—

"In our last report we ventured to express our views on this point, to the effect that employers in olden times took a pride in retaining their old servants, and grey hairs or weaker vision was not a crime in their eyes. This is now changed, as numbers in our trade can tell to their cost, for they are not only turned away from the firm where they have given the best of their life's labour, but they are by the rules of many establishments (notably railway companies) debarred from entering there, because the hard-and-fast rule is laid down that no fresh engagements are to be made where the men are over forty or forty-five years of age. As a consequence these men, although willing and able to work, are unable to secure it on this account, and as a result are compelled to claim the superannuation as a help to their existence. This is not theory, it is a stubborn fact, and we have many to-day who would willingly be at work if they could secure it, and who would be at work if they could be transposed, as it were, to the first period to which our table alludes. For giving such an opinion last year we were taken to task by the leading journal in our trade, which said 'that perhaps on investigation we might find that employers preferred younger men because they were more docile, and less given to strikes and wages disputes, than their elders; that, in point of fact, young men are preferred because they mind the business at which they get their living, and elder men do not.' We can imagine the incredulous smile that will rise on the faces of those who read these words, as they have practical knowledge that the reverse of this is the fact. The elders have gained knowledge by experience, and it is a rare occurrence to see one of this class agitating or advocating a strike or extreme measures, as they know full well that in the event of failure they are the greatest sufferers, as their years prevent them getting other situations. The young men, as a rule, are not burdened with any family, or any dependents, consequently can advocate a cessation of work, and if defeated, can move on to the next town, as their age is not an obstacle to securing fresh employment. With all deference to our critics, we do not accept their theory of the change that has come about in recent years as to the age at which men are given or refused employment.

In reviewing the question of trade and employment for the masses, Mr. Swift says they are free to confess that the past twelve months have not been satisfactory, and for the time being the clouds look black and dismal. But bad as things were, they felt satisfied they had been even worse in years gone by. Their own returns showed that during the depression of 1879 they had a much larger proportion of members out of work than at present. There were, however, some signs and definite proof that at this time the staple trades of the country were not in that prosperous state that would give comfort to the workmen, whilst the surest sign of depression was the onslaught capitalists were continually making on the wages of labour.

Mr. Swift next, in his characteristic style, proceeds to tackle the question of foreign competition. "The vicissitudes of trade have," he says, "within the past twelve months brought forth opinions from all classes and creeds, and the causes, effects, and remedies have been put forth with the most confident assumption, and amongst the number, the resurrection of our old friend 'foreign competition' has caused him to be placed in the front rank of the invading army that has added to our troubles. On former occasions he has been pilloried and pelted with all kinds of rebutting arguments until his friends have decently interred him, and we have been in hopes he would not be restored to animation again. We admit we are deceived, for recently it has gone forth the great work he is performing, and the havoc he is going to play with the British industry of the future. We have not space to deal with all cases, but we will give just one as an illustration. It has been asserted that the chief cause of the depression in the shipbuilding centres is due to our foreign rivals building for us as well as themselves. To make such an assertion is the height of confidence, not to use a stronger term. To rebut it by facts, we quote the returns of vessels launched from continental shipyards in 1885 as follows:—Germany has eight shipbuilding firms, and from these there were launched 22,326 tons of shipping. France has a number of small yards, and the Government has given bounties to builders or owners of ships, yet they have only been able to put into the water 10,000 tons; Belgium, with one yard, has built 5312 tons; Holland, with three yards, has added 2651 tons to the ocean traffic; Denmark, 3515 tons; Norway, 2413; Sweden, 667; and Russia put into the water 7867 in war ships, which had been under construction for some years past. At Finland eight vessels of various sizes were launched, and no weight given, yet making an allowance for these, the whole of the vessels built on the Continent in 1885 was a little over 50,000 tons, whilst our shipbuilding yards on the River Tyne in the same period launched 102,998 tons alone, and this at a time when trade was looked upon as being in such a deplorable state, that workmen must submit to reduced wages. As we have said on former occasions, we believe if ever we have a severe competitor, it will be America, and they are of our own kith and kin; but so long as they keep up their present fiscal policy we have nothing to fear in neutral markets. We are now told that Germany is running us very close, and in some cases defeating us. The returns as to shipbuilding are an answer on this point, whilst the exports from that country in 1885, we are told by a leading journal, "have caused the press of Germany to take a very gloomy view of the commercial situation. The figures show that there has been a large falling off in the export of textile fabrics, ready-made clothes, sugar, machinery, and ironwork generally." The most practical test to prove the reality of cheap continental labour would be to bring some of it over here, and place the individuals alongside our men, and test the vigour and abilities of the two persons on the same class of work."

The concluding portion of Mr. Swift's address is somewhat ominous in its tone. Although from force of circumstances the men, he says, had been compelled to accept a lesser rate of wages under protest, they had not done so from any fear of "foreign competition" in the engineering trade. "The present reduction," he adds, "has been enforced on the contracts which have been secured on the old rates of wages, and such contracts were in many instances Government work, for which the payment is generally good. This reduction will have to be returned at the first available opportunity, no matter on what rates the contracts may then have been based. Force of circumstances has placed us in our present position, and although acting in a passive manner at this time, the feeling is general that we should reserve our strength, vitality, and power for the day when we can utilise them to good effect, and in other directions than that of increasing our weekly wages. The present time is in favour of capital making encroachments, but it cannot always remain so. There must be a change, and that at an early date, when labour can obtain some of the ground recently lost; and not only do this, but insist on a rearrangement of the working hours, to prevent, if possible, these continuous panics and depressions in the labour market. We believe the present action of capital has created a feeling that will take a long time to obliterate, and when labour has its day severe conflicts will be the result, unless concessions are as freely given as they are now being extorted from the working classes."

RAILWAY MATTERS.

SEVERAL new railways are proposed by the Russian Government in the Crimea.

CANADA has the longest line of continuous rails, running east and west, on the American continent, and has therefore the largest railway in the world.

IT is thought that the dissolution of the Steel Rail Makers' Association will result in a competition which will bring the price of rails down to £3 17s. 6d. or £3 15s. per ton.

THE State Railway Directorate of the Berlin and Hamburg Railway has recently begun to run elegant sleeping cars of its own, and the extra price of a first-class berth is about 6s.

THE locomotive works of Krauss and Co., of Munich, are engaged on locomotives, for the Arlberg Railway, with eight coupled wheels, 1646 square feet of heating surface, and weighing 1180 centners each.

BY the opening of the Dacca-Mymunsingh line an important addition to the Indian railway system has just been made. This railway will open up several districts of Eastern Bengal, and eventually form part of the line to Assam.

THE Cavehill and Whitewell—Ireland—Steam Tramway Company and the Dublin and Lucan Steam Tramway Company have declared dividends of 5 and 4 per cent. respectively, the latter company's working expenses per train mile being 1s. 0½d., of which locomotive power cost 7·28d.

TWO of the main 164ft. spans for the new Charing Cross Bridge are now delivered by the Horseley Engineering Company, of Tipton, and satisfactory progress is being made in the completion of the contract. The firm is also getting on well with the extensive order for wrought iron pipes, 6ft. diameter, intended for the Sydney water supply. About one-third of the order is so far delivered.

MANY people come to town in the evening for theatres by the London, Chatham, and Dover Railway, and at Ludgate Hill are disgracefully treated by the company's servants, who, even in this severe weather, force ladies in evening costume to go outdoors by a side way to reach the front entrance before they can get into a carriage or cab. Probably no other company's servants are permitted to do this.

IT is understood that the steel bridge contracts for the Indian States Railways, which was referred to last week as involving in all something like 6000 tons of bridge and roofing work, have now been placed. The Patent Shaft and Axletree Company, Wednesbury, has got four spans, while other portions of the work have gone to firms in Glasgow and London respectively. Two of the tenders, it is stated, have not yet been decided.

A REPORT on the collision which occurred on the Great Southern and Western of Ireland in December last has been published by the Board of Trade, and the writer, Major-General Hutchinson, says the collision would have been prevented if the continuous brake with which the train was fitted had been automatic, and the report and evidence both show how thoroughly a continuous brake which is not in every respect automatic may prove, under common circumstances, the most fatal of broken reeds.

THE third annual general meeting of the Railway and Canal Traders' Association was held last week. The following resolution was carried unanimously:—"That the present system on which the railway traffic of the country is conducted has contributed largely to the existing depression in agriculture and trade, and that immediate legislation is imperative with the object of securing that the traffic of the country be conducted on a system reasonable and fair both to the traders and the railway companies."

LOCOMOTIVE drivers in Germany spend rather more time on the sick list than any other of the railway servants. The average number of days of illness per man in 1884 was:—Enginemen, 13·60; trainmen, 12·60; trackmen, 8·16; station men, 9·02; others, 6·48. So that although the average driver or fireman was sick one-third oftener than the other trainmen, 2½ times as often as the trackmen, and twice as often as the stationmen, he was sick but one-twelfth more than the other trainmen, and one-half more than the track and station men.

THOSE of the Ambleside Railway proposal who wish to induce the London and North-Western or the Furness railways to extend their system to Ambleside receive but scant encouragement, and have since discussed the proposed private line from Greenodd Station on the Furness Railway to Force Forge, a place which lies between Coniston and Windermere Lakes, and it was proposed to negotiate with the promoters of this undertaking with a view to amalgamating with them for the extension of the line from Force Forge to Ambleside, a distance of about seven miles.

REFERRING to the accident due to a platform being thrown by the wind on the track of an American line, as referred to by us on the 5th ult., the *Railway Age* says—"In the recent terrible accident on the New York, New Haven, and Hartford road near Pelhamville, N.Y., the efficiency of the Westinghouse automatic brake was emphatically proven. The engine and mail car were hurled from the track and precipitated down an embankment a distance of 60ft. All the rest of the cars, which were heavily laden with passengers, were derailed, but were prevented from going over the embankment by the instantaneous working of the air brakes."

THE Belgian Society of Engineers has arranged an international exhibition of metal sleepers for all classes of iron-way—that is to say, railways, secondary lines or light railways, and tramways—in the rooms of the Metal Bourse, Brussels. The opening, which has been postponed from time to time on account of fresh applications for admission constantly being made, was definitely fixed for yesterday—Thursday. It is believed that all the leading systems will be represented, including those about to be adopted, by way of trial on a large scale, on the Belgian State Railways. We are informed that Mr. F. W. Webb, of Crewe, has also sent his form of sleeper. Lectures demonstrating the value of the different systems are to be followed by discussions.

THE length of railways open for traffic in Europe, on the latest date to which complete statistics are available, according to a statement in a recent *Revue Generale des Chemins de Fer*, as compared with the mileage open at the same date in 1883, Germany heads the list with 36,737 kilos. of railway, as against 35,908 kilos. in December, 1883; increase during the year, 829 kilos., or 2·31 per cent. Next follows France with 31,216 kilos., against 29,714 kilos.; increase 1502 kilos., or 5·05 per cent. Great Britain and Ireland, 30,514 kilos., against 30,179 kilos.; increase 1·11 per cent. Russia and Finland, 25,391 kilos., against 24,888 kilos.; increase 503 kilos., or 2·02 per cent. Austria, 22,016 kilos., against 20,857 kilos.; increase 1249 kilos., or 5·99 per cent. Italy, 9925 kilos., against 9445 kilos.; increase 470 kilos., or 4·97 per cent. Spain, 8663 kilos., against 8251 kilos.; increase 412 kilos., or 4·99 per cent. Sweden and Norway, 8162 kilos., against 7960 kilos.; increase 202 kilos., or 2·54 per cent. Belgium, 4319 kilos., against 4273 kilos.; increase 46 kilos., or 1·08 per cent. Switzerland, 2761 kilos., against 2750 kilos.; increase 11 kilos., or 0·40 per cent. Holland and Luxemburg, 2654 kilos., against 2521 kilos.; increase 133 kilos., or 5·28 per cent. Denmark, 1944 kilos., against 1813 kilos.; increase 131 kilos., or 7·23 per cent. Roumania, 1602 kilos., against 1520 kilos.; increase 82 kilos., or 5·39 per cent. Portugal, 1527 kilos., against 1494 kilos.; increase 33 kilos., or 2·21 per cent. Turkey, Bulgaria, and Roumelia do not show an increase in the mileage of their railways during 1884 which had a length of 1395 kilos. in December, 1883; nor do the railways of Servia, with 244 kilos. Greece, on the contrary, increased her railways from 22 kilos. in 1883, to 175 kilos. in 1884. The total length of European railways on December 31st, 1884, was 189,334 kilos., compared with 182,999 kilos. on December 31st, 1883. The aggregate increase was 6335 kilos., or 3·46 per cent.

NOTES AND MEMORANDA.

THE old Tour St. Jacques la Boucherie, Paris, celebrated in connection with Pascal's experiments on atmospheric pressure, is now the site of a Laboratory of Physics.

THE deaths registered during the week ending February 27th in twenty-eight great towns of England and Wales corresponded to an annual rate of 24·2 per 1000 of their aggregate population, which is estimated at 9,093,817 persons in the middle of this year. The six healthiest places were Derby, Leicester, Bradford, Halifax, Hull, and Brighton.

THE severity of the weather the last few days has made even Berlin complain. A *Times* correspondent says: During the night the temperature has stood from 15 to 20 degrees Réaumur below zero, and at noon it has never risen much above 5 deg. from the freezing point. This cold, too, has been intensified by a most bitter and cutting east wind, against which no fur is proof.

IN London last week, 2712 births and 1988 deaths were registered. Allowance being made for increase of population, the births were 147 below, while the deaths exceeded by 201, the average numbers in the corresponding weeks of the last ten years. The annual death rate per 1000 from all causes, which had steadily increased in the five preceding weeks from 21·9 to 25·6, declined last week to 25. In greater London, 3566 births and 2453 deaths were registered, corresponding to annual rates of 35·1 and 24·1 per 1000 of the population.

FROM the results of electrolytic experiments by A. Renard—*Compt. Rend.*, 101—with aqueous solutions of various salts containing from 0·0001 to 0·1024 gram-equivalent of the metals in 100 grams of solution, the author concludes (1) that if the solution be sufficiently dilute the quantity of metal precipitated is proportional to the concentration of the solution; (2) that if the same current is passed through several solutions, the quantities of the different metals precipitated are in the ratio of their equivalents; (3) that, according to Faraday's law, the quantity of metal precipitated being proportional to the intensity of the current, the conductivity of all solutions containing equivalent proportions of the different metals is the same, as Bouty has shown by direct experiment.

AT a recent meeting of the Paris Academy of Sciences, remarks on the 172 tornadoes recorded in the United States during the year 1884 were communicated by M. Faye. From the scientific point of view, the author considers that it seems established that there is a definite portion of an area of low pressure within which the conditions for the development of tornadoes is most favourable. The special tornado reporters for the Signal Service are now endeavouring still more accurately to determine this "dangerous octant," as it is called in America. February 19th, 1884, is mentioned as memorable in the history of these destructive phenomena. On that day no less than forty-five were recorded in the South-Eastern States, attended with a total loss of 800 lives, 2500 injured, 10,000 houses and buildings destroyed, and from 10,000 to 15,000 people left homeless.

IN the Dortmund district of the Westphalian coalfields, an account has been kept of the wear of the ropes of the different collieries since 1871, from which the following table has been compiled for the thirteen years, 1872-1884. During this period 2669 ropes have been laid aside as worn out, and of these 186, or 7·85 per cent., broke suddenly while at work. Classified according to shape and material, the results were as follows—"Proceedings" Institution of Civil Engineers:—

	Total.	Broken suddenly.	Per cent.
Flat cast steel rope	207	19	9·18
" soft iron "	147	19	12·9
" aloe fibre "	74	6	8·11
" hemp "	8	0	0
Round cast steel rope	1118	42	3·75
" soft iron "	815	100	12·3

Whence it appears that from 1872, with a few interruptions, the proportion of failures of pit ropes by sudden breakage, to those regularly worn out, has continuously diminished during the thirteen years that the operations have been carried out.

FOR twenty-seven years at least, February has not been so cold as in 1886. Mr. J. G. Symons says, "The average temperature in London at 9 a.m. on every day in February from 1859 to 1878 was 40·3 deg., and the seven subsequent years, 1879 to 1885, give nearly the same value, so that 40·3 deg. may be regarded as the temperature to be expected. In 1886 it has been only 32·9 deg., and this has followed a December and a January each below the average. As regards February, there have been since 1858 only two years in which the average was below 35 deg., viz., 1875, when it was 34·8 deg., and 1873, when it was 34·6 deg. A fall of 1·7 deg. in mean temperature below the lowest previous value is of great agricultural and social importance, for it is self-evident that, with a mean temperature of very nearly freezing-point, outdoor labour, as ordinarily carried on in this country, must be at a standstill. The low mean temperature has not been due to intense frost. In 1864 and 1865 the frost was more intense than on any day in last month, but it did not continue. February, 1886, is specially remarkable as the only February in 27 years in which the temperature never once reached 50 deg., the highest having been 47·7 deg. There were only eight days in the month on which the temperature even rose to 40 deg., and the ground was frozen every night but two."

AN electrolytic cartridge for blasting is described by the *Scientific American*. The cartridge consists of a glass tube of a diameter to fit easily into the borehole, which should be small. "The tube is very strong, the thickness of its walls being about equal to the diameter of the bore. Two wires are fused into this tube, which is hermetically closed after being nearly filled with water rendered conductive with a little acid or some metallic salt. When this cartridge has been inserted into the borehole, and the latter tamped or stemmed in the usual way, its projecting wires are connected with cables serving as leads from a source of electricity. All being ready, the current is put on, and the current from the generator passes between the ends of the wires within the glass tube, and decomposes the water, oxygen being liberated at one pole and hydrogen at the other. This explosive mixture continues to accumulate as the decomposing action of the current goes on. It is to withstand the increasing pressure of these gases that the thick glass is required. So long as the ends of the wires are covered by the liquid, no spark can be produced to ignite the gaseous mixture; but when these—or one of them—are laid bare by the conversion of the water into gas, the current has to pass through the latter, which is then fired. The resulting explosion is extremely violent."

SOME experiments on the flow of water through a 1in. lead pipe, by Sig. G. Sacheri, are described in the "Proceedings" of the Institute of Civil Engineers. The length of the pipe was 3419ft.; the gradient for a length of 102ft. was 1 in 10·5, and for the remaining distance 1 in 142·86. The pipe conveys water from a reservoir to a village, and was quite new when the experiments were made; its diameter was 0·984in. The head of water was 29·2ft. The discharge was found to be 0·01236 cubic foot per second, giving a mean velocity of 2·338ft. per second. Hawksley's formula $Q = 4{\cdot}71 \sqrt{\frac{h\,D^5}{L}}$ gives the delivery as 0·00636 cubic foot per second. The author attributes the difference between the result of his experience and the formula to the perfectly smooth surface of the pipe and its freedom from granular structure. Another experiment was tried with the mouth of the pipe closed by a thin diaphragm having a hole in it 0·197in. in diameter. In this case the actual discharge was found to be 0·00346 cubic foot per second, whereas the discharge should have been according to formula 0·0054 cubic foot; whence it appears that when the velocity is very small the resistances in such cases as that under consideration produce a greater effect than is generally supposed.

MISCELLANEA.

A NEW fortnightly engineering journal, *The Indian Engineer*, is announced to appear in Calcutta in April.

THE *Dundee Advertiser* is publishing articles descriptive ot past and present Scotch engineering projects. No. 1 refers to the Forth Tunnel.

THE Government of France has decided to maintain the international character of the proposed National Exhibition to be held at Paris in 1889, and it will consequently be open to all nations.

IT is stated that a new method of manufacturing wood screws has so cheapened the cost of production that wages in works making screws under the old system, must be reduced, or improved methods invented.

THE New South Wales Government have just placed a contract with Messrs. R. Dempster and Sons, of the Rose Mount Ironworks, Elland, Yorkshire, for the manufacture of a complete plant required to supply the railway carriages with compressed gas.

THE *Miller* publishes an article proposing the establishment of State Granaries in which one year's wheat supply should be stored. It gives figures to show that it is impossible the present low prices can continue, and that the time of plenty should not be allowed to pass without making provision against any contingency.

THE prospectus and regulations of a Mechanical and Scientific Exhibition to be held under the Engineering Association of New South Wales, in July and August next, in the Exhibition building, Prince Alfred Park, Sydney, has been issued. Mr. G. Fischer, is the honorary secretary, Bank-chambers, Jamieson-Street, Sydney.

THE Liberal Government intends to discharge 800 hands from the Enfield Small-arms Factory in April. We are not told whether the work is to be done in Germany instead of Enfield, but if it is the wages of 800 men the Government wishes to save, they might most easily save the amount by removing half a dozen officials who have nothing to do in the Patent-office, Admiralty, or Parliamentary offices.

THE centenary of Arago was celebrated on the 25th ult. at Perpignan. The Paris Municipality having refused to grant 2500f. towards a proposed reception at the Observatory and a banquet at the Hôtel de Ville, the Paris celebration has been abandoned, but a subscription will be opened for a statue. The avowed reason for the refusal of the Municipality was that Arago did not side with the Red Republican rising of June, 1848.

SOME fussing bees of Bristol have been knocking themselves against the glass they cannot see and which fills an opening not covered by their knowledge. The Docks Committee have had to buy a dredger, and of course had to go to a firm with whom dredger building is a speciality, but the fussy ones cannot understand why just anyone cannot make a dredger and why it should not be built in Bristol. Bristol firms did not even tender.

A CASE of some importance to colliers has been decided in Aberdare County-court, showing that there is liability of employed as well as of employers. Two men were working in a pit, when through the negligent use of a naked light by one of them, named John John, an explosion occurred in which his fellow workman William Williams was seriously injured. The latter brought an action to recover damages, and after a lengthy hearing, the judge gave a verdict for £50, the full amount claimed.

AN action by the proprietors of the *Builder* against the printers and publishers of the *Building News*, in respect of the copying, by a photo-lithographic process, of the *Builder's* plates of the Liverpool Cathedral, was settled last week. Since the notice of motion the defendants had confessed that they had been doing that which was wrong, and Mr. Swinfen Eady was instructed to consent to a perpetual injunction in the terms of the notice of motion, and to pay all costs, the plaintiffs waiving the question of damages.

MR. THOMAS FAIRLEY, in his last report on the Leeds gas, says the proportion of total sulphur contained in the gas averaged 18·87 grains per 100 cubic feet. The average illuminating power—the tests being calculated to a uniform consumption of 5ft. per hour, and corrected for variations in temperature and pressure to a temperature of 60 deg. Fah., and a barometric pressure of 30in.—was in standard candles—burning 120 grains of sperm per hour: Standard Argand, 24-hole, 19·7; standard Argand, 15-hole, 17·3; standard batswing, 19·9; Sugg's illuminating power meter, 19·7.

MESSRS. HOLDEN AND BROOKE, of Manchester, have recently applied one of their large injectors for feeding a range of boilers in connection with a winding engine at one of the South Wales Collieries with very successful results. As the winding engine runs for only twenty seconds at a time, it was essential that perfect automatic re-starting action should be insured in the injector, and after a thorough trial the results obtained have been completely satisfactory, the injector, which is constructed to feed at the rate of 2000 gallons per hour, re-starting into operation with the first beat of the engine. I understand that Messrs. Holden and Brooke are now applying these injectors for similar requirements at other collieries in South Wales.

ON the 25th ult., the s.s. Fishtoft, built and engined by Earle's Shipbuilding and Engineering Co., to the order of the Boston Deep Sea Fishing and Ice Co., made her trial trip. The following are the particulars of the vessel:—Length between perpendiculars, 85ft. by 19ft. 9in. beam by 10ft. depth of hold, with flush deck aft and small raised forecastle forward. She is built to class 90 A1 at Lloyds, and has accommodation for captain and officers aft and for crew in forecastle, the whole of the remaining space clear of engines and boiler being fitted for the storage of ice and fish. She is ketch rigged with pole masts, and is fitted with a steam winch of Earle's special design, and made for working the trawl gear. Her engines are inverted, direct acting, with cylinders 12in. by 22in. diameter by 20in. stroke, and are supplied with steam of 90 lb. pressure from a steel boiler fitted with one of Fox's corrugated furnaces.

MESSRS. CROSSLEY BROTHERS have introduced a small power gas engine and dynamo combined, which has been specially designed to meet the requirements of small business establishments where it will answer the double purpose of driving light machinery during the day-time and lighting up the premises by electricity at night. The engine is a vertical one of 5-man power, and to this is attached by a pivot a small shunt wound dynamo capable of running about eight 20-candle power incandescent lamps. This dynamo carries a leather friction pulley which works against a fly-wheel on the engine, and there is also a high-speed fly-wheel to insure regularity of running. The frictional driving arrangement is controllable by a spring, and can be thrown in or out of gear as the engine is required for electric driving or for other purposes. The whole plant is very compactly arranged, occupying a space of not more than 4ft. square by 4ft. 8in. in height.

LAST week the Secretary of the Treasury received a deputation from the Belfast Chamber of Commerce respecting the Ulster Canal. Sir J. P. Corry said they desired to press upon the Government the desirability of their introducing a Bill for the transfer of the Ulster Canal to the Lagan Navigation Company. Major Saunderson pointed out that the Board of Works had advanced £30,000 for the purpose of improving the navigation of Loch Earne by removing the shoals; but unless the transfer of the canal were made to the Lagan Navigation Company, the removal of the shoals would be perfectly useless, as there would be no traffic between the East and West of Ireland. All that was wanted was £10,000 to make available the canal which was the connecting link between the North-East and West of Ireland. Both political parties were in favour of it, but the Bill had been blocked on previous occasions by Messrs. Callan, Biggar, and Arthur O'Connor. The Nationalists were not opposed to it as a body. The scheme would at once give employment to a number of people, and in fact it was becoming absolutely necessary to have a cheap waterway for the conveyance of coal, as the turf, the principal fuel of the country, was being exhausted. Mr. Fowler promised that he would introduce a Bill on the subject.

THE MOUGIN AND GRUSEN TURRETS AT BUCHAREST.

(For description see page 183.)

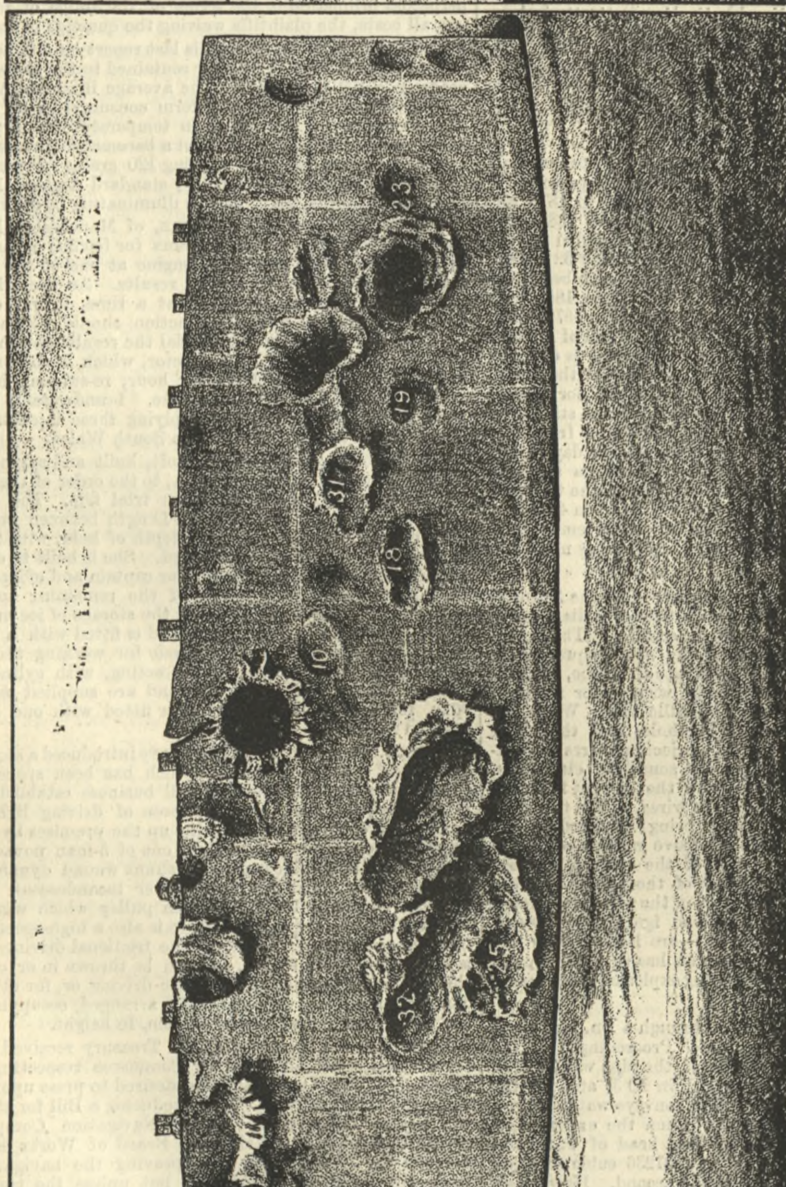


Fig. 1.

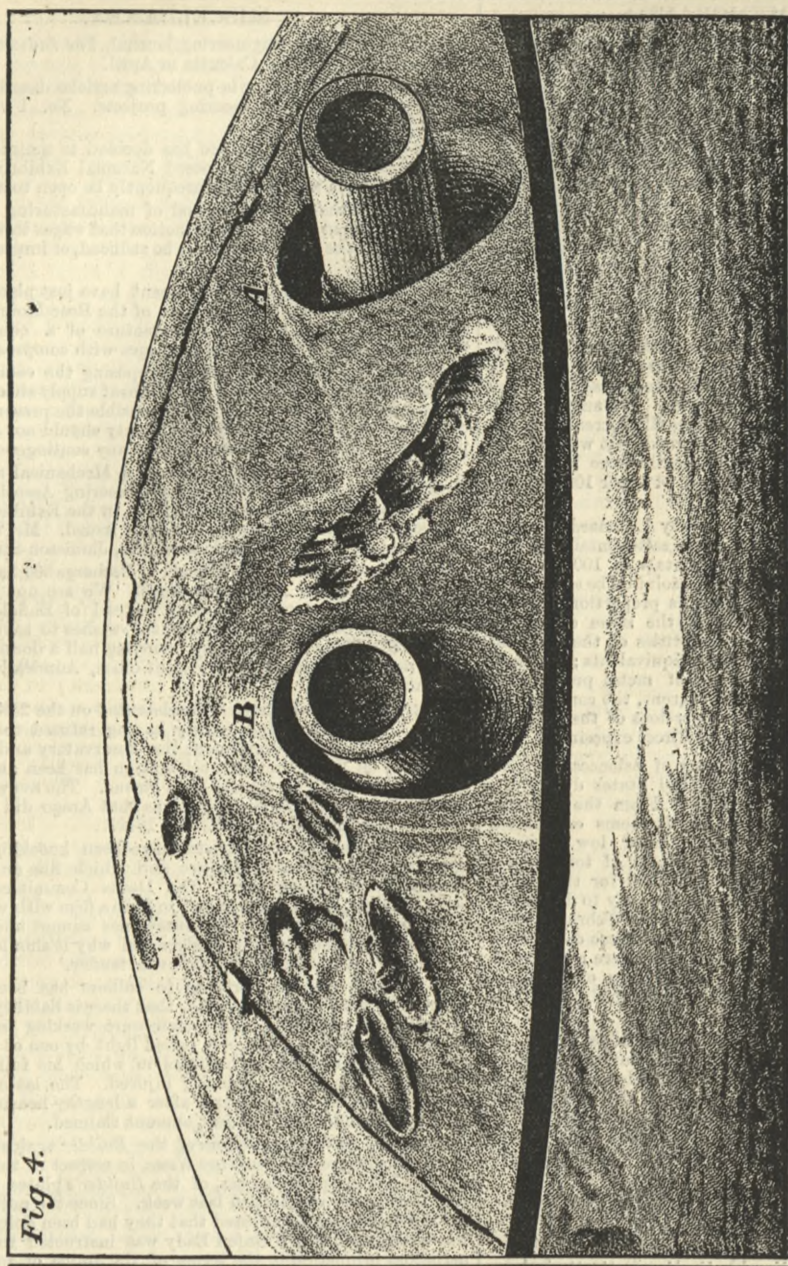


Fig. 4.

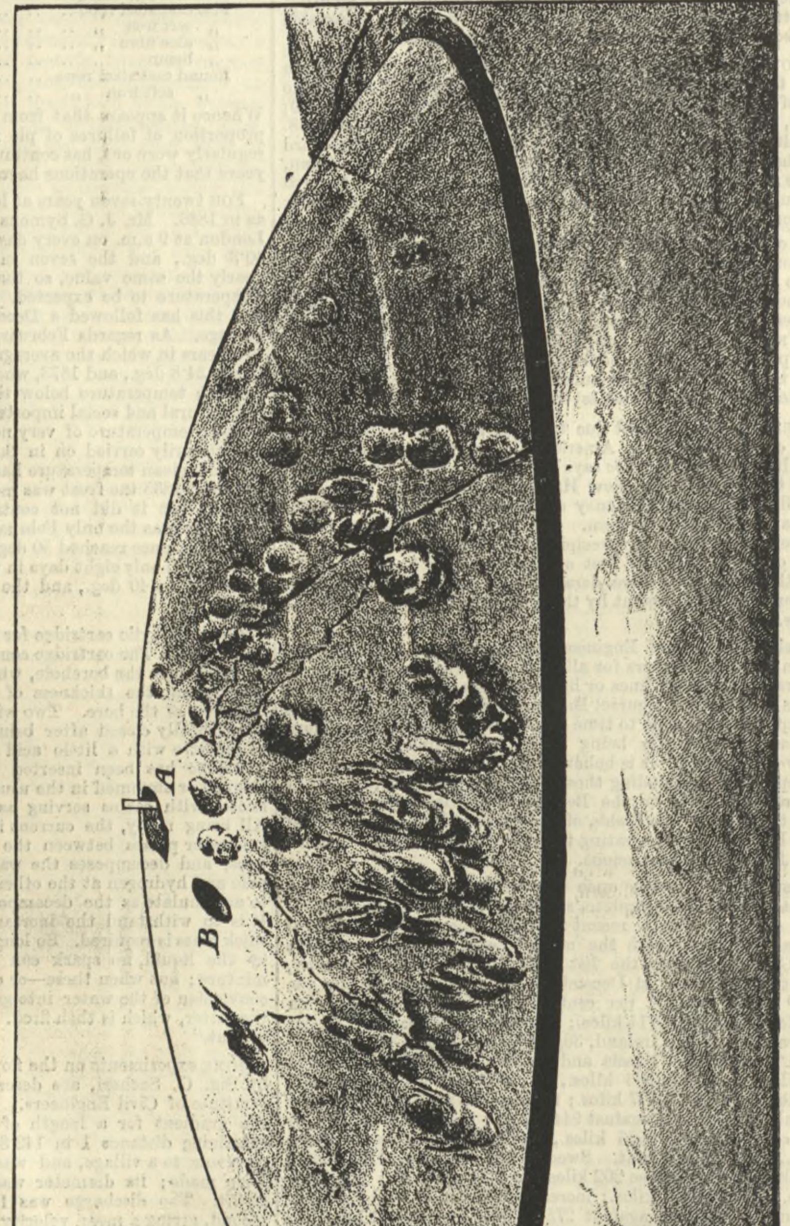


Fig. 2.

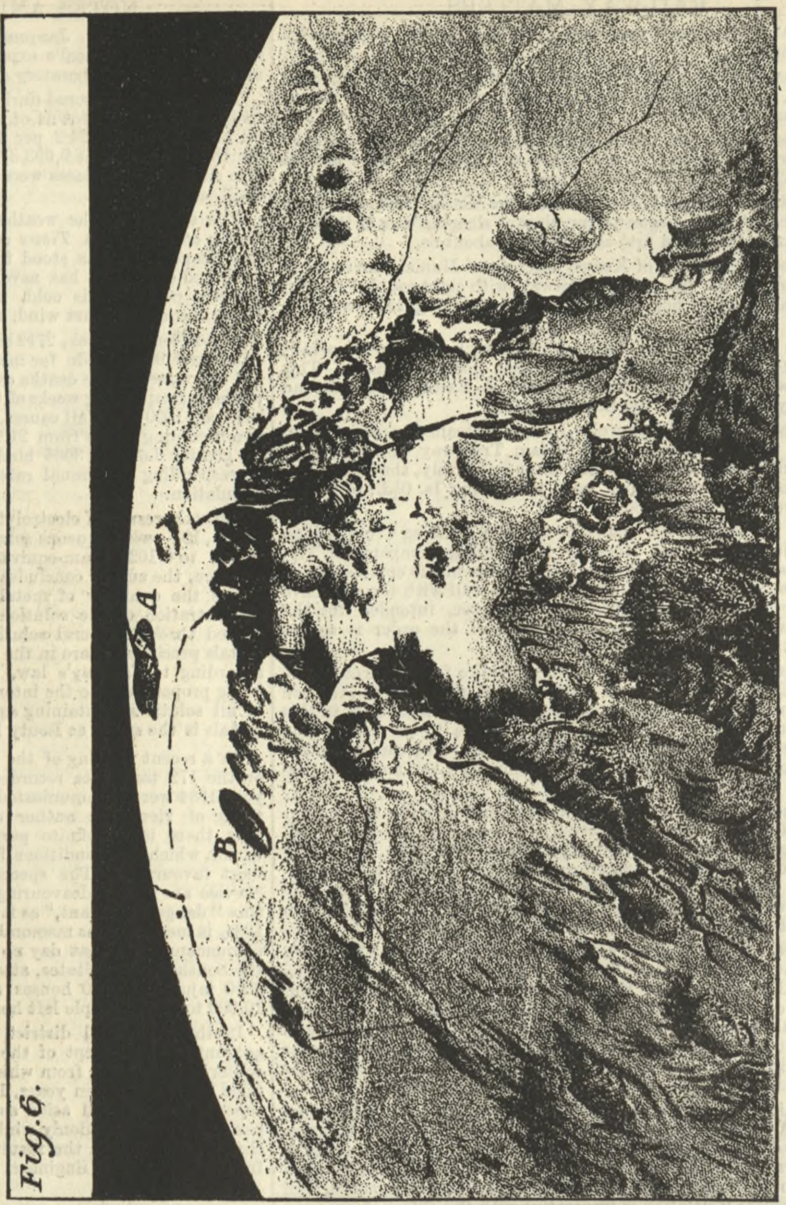
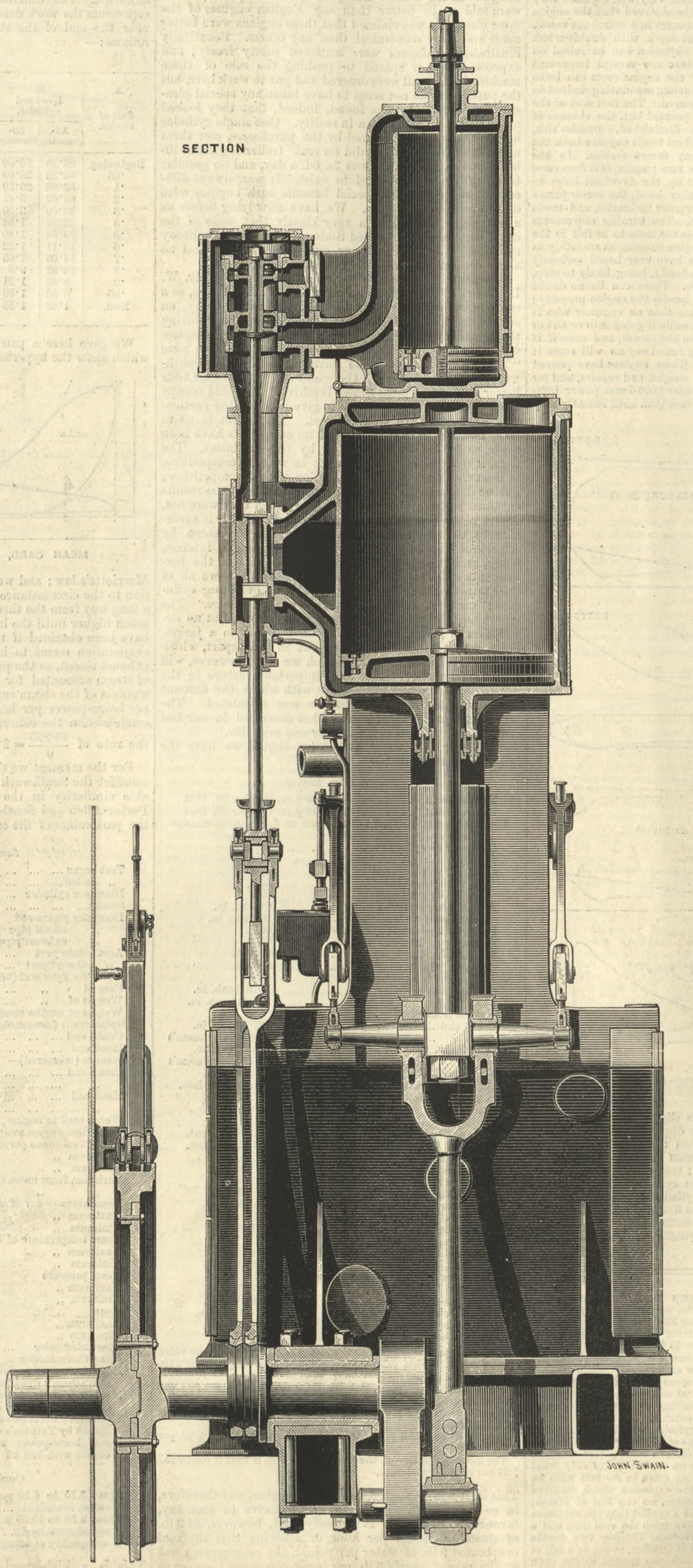


Fig. 6.

COMPOUND ENGINE OF THE S.S. PROMETHEUS.

MESSRS. R. STEPHENSON AND CO., NEWCASTLE-ON-TYNE, ENGINEERS.



COMPOUND ENGINE OF THE S.S. PROMETHEUS.

WE give this week engravings of the engines and boilers of the s.s. Palamid, Prometheus, Palinurus, and Dardanus. These vessels were built by Messrs. Leslie and Co., of Hebburn, to the order of the "Ocean Steamship Company," of Liverpool, are of the following dimensions, viz.:—Length between perpendiculars, 320ft.; beam moulded, 36ft. 4in.; depth moulded, 27ft. 9in., and will carry about 3000 tons on a mean draft of 23ft. The engines, built by Messrs. Robert Stephenson and Co., of Newcastle, are of the compound surface condensing Holt's tandem design, having cylinders 27in. and 58in. diameter, with a stroke of 5ft., the high-pressure cylinder being placed immediately over and concentric with the low-pressure cylinder.

The high-pressure piston rod is attached to an overhead crosshead, from which side rods come down outside of the high-pressure cylinder, and passing through glands in the low-pressure cover are attached to the low-pressure piston. This arrangement obviates the necessity of having glands to pack between the two cylinders and consequently considerably reduces the height from bed-plate to top of cylinder. The low-pressure piston rod is fitted with a wrought iron crosshead and cast iron adjustable shoes as shown, and through its connecting rod transmits the power of the two cylinders to the crank pin. All the piston rods and the slide spindles are of steel. The low-pressure slide valve is of the ordinary type, the high-pressure cylinder having a piston valve fitted with Buckley's patent springs and rings; both valves are worked by the same pair of excentric rods, and the usual Stephenson's link motion. The reversing is effected by a steam cylinder controlled by an oil cataract fitted to the back of the column as shown.

A special feature of these engines is the crank shaft, which is of the "overhung pin" description. The shaft itself is of Vickers' steel, 14in. diameter, having the excentric sheaves forged on solid immediately behind the thrust collar. The crank cheek is of wrought iron, contracted and keyed on the shaft and fitted with a crank pin also of Vickers' steel contracted in and further secured by a strong steel key as shown. It is anticipated that by the adoption of this form of overhung crank, the many vexatious and costly breakages of crank shafts will be very much minimised, and the delays and dangers occasioned thereby correspondingly reduced. The engines are fitted with a 5 ton fly-wheel of somewhat novel construction; the heavy outside rim is of cast iron suitably bored and faced to receive the centre, which consists of one large steel plate 8ft. 4in. diameter by 2in. thick. This plate is turned and faced up and bolted to the inside of the wheel rim, and secured between the two large couplings of the shafts as shown, by tight fitting taper bolts, each shaft coupling having spigots which meet in the centre of the plate. This wheel, besides being an excellent governor to the engines, is used for turning and overhauling the engines when cold by means of a steam cylinder and oil cataract attached to the bulkhead just over the fly-wheel.

The piston rod of this heaving round engine is square in section at the centre, and slotted through to receive strong steel pawls, which gear into suitable teeth cast in the rim of the fly-wheel for go-ahead or go-astern motion as required. The screw shafting is of wrought iron cased with brass where working in *lignum vitæ* bearings in the stern tube, and fitted with a four-bladed right-handed screw propeller of cast iron, 15ft. 9in. diameter, and 20ft. 6in. mean pitch. The condenser is of the usual form, of cast iron, fitted with brass tube plates and tubes. The length between the tube plates is 7ft. 10in., and the diameter of the tubes is 1in. outside, with a total cooling surface of 1925 square feet. The tubes are divided into three boxes, through each of which the water must pass, thus coming thrice in contact with the steam before being delivered overboard. The water is forced through the tubes by one double-acting circulating pump, 13½in. diameter by 22½in. stroke, attached to the back of the condenser, and so arranged that all or any of the valves may be examined or overhauled without interfering with each other, or with any other part of the machinery. The air-pump is of the usual single-acting description, 18in. diameter by 22½in. stroke. The feed and bilge pumps are placed in line on the back of the condenser, the feed pumps above and the bilge pump below the pump crosshead, the top part of the condenser being utilised as a hot-well into which the air pump delivery is conducted, and from whence the feed pump draws for the boiler. The feed and bilge pumps are each 5½in. diameter by 22½in. stroke, their valves also being arranged for instant and easy access. A single-acting plunger pump for supplying water to the fresh-water condenser is fitted to the after side of the condenser column and worked from the air pump lever as shown.

A double-acting donkey pump for feed and deck-washing purposes is attached to the forward side of the column and also fitted with connections for delivery through the condenser in case of necessity. The starboard column besides carrying the reversing engine and gear, is further utilised as an oil tank. At the level of the starting platform a 6in. Gwynne engine is fixed, and connected to draw from the bilges, and deliver overboard, being supplied with steam from either the main or donkey boilers, so as to be available in case of emergency; supposing the pumps on the lower platform should be disabled or drowned out, this engine gives great additional security to life and ship.

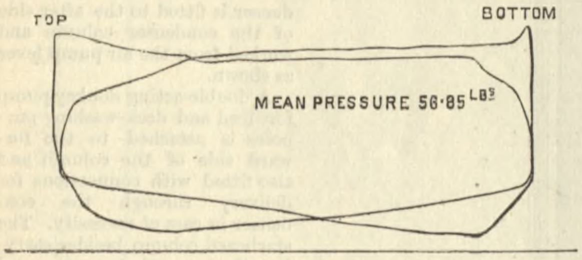
Steam is supplied by one double-ended steel boiler 16ft. diameter by 24ft. long, working at 80 lb. pressure per square inch, fitted with six Fox's corrugated steel furnaces. These furnaces, three at each end, lead into a central combustion chamber, thence by return tubes to the smoke-box and chimney. The shell of the boiler is butt-jointed, with double butt straps, double rivetted in the longitudinal seams, and lap jointed and double rivetted in the circumferential seams. The holes are all drilled, then properly rimed in place after the plates are fitted together.

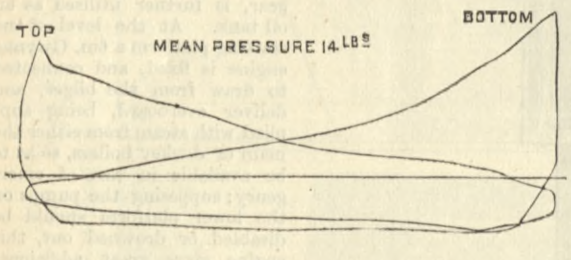
The heating and grate surface of the boiler is as follows:—Heating surface in tubes, 4in. outside diameter, 9ft. long, 4015 square feet; heating surface in furnaces, 420 square feet; heating surface in flues and tube plates, 580 square feet; total heating surface, 5015 square feet; total grate surface, 153 square feet. Chimney, 7ft. 6in. diameter by 65ft. high from the grate bars. The total weight of the boiler with water in and fittings complete, in working trim, is 157 tons. The engines in regular running develope on the average about 1350 indicated horse-power, with a very moderate consumption of fuel, and an average speed of about twelve knots an hour.

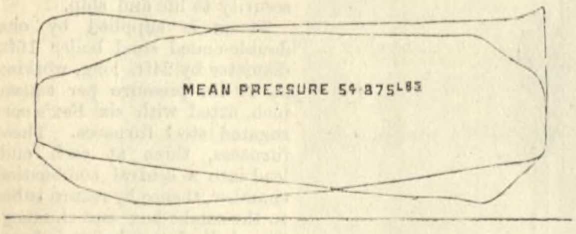
The engravings supplied give a very clear idea of the whole of the general arrangements, which, carried out under the supervision of Mr. S. W. Wiles, the superintendent engineer for the Ocean Steamship Company, are of the most complete and satisfactory description, both as regards efficiency and safety, and comfort to those in charge of the machinery.

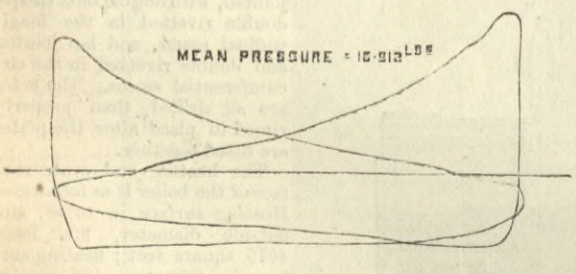
The single type of marine engine has long been a speciality with Mr. Holt. Years ago we illustrated the engines of the ss. Teniers. That which we now illustrate here and on pp. 190, 194 is the latest development of the design, and was in its main features described by Mr. F. C. Marshall in his celebrated paper

"On the Marine Engine," read before the Institution of Mechanical Engineers in Newcastle in 1881. It has slowly made its way into favour by dint of its intrinsic merit. Mr. Holt's view is that a marine engine is very like any other engine, and that as single-crank engines answer very well on land, they ought also to answer at sea. It will be observed that the engine is very lofty, but this is of no consequence in a merchant vessel, and there are numbers of ships at work with double-crank double-tandem engines, so that no objection can be raised on this score. On the other hand, there are several important advantages gained. The length of the engine-room can be so much reduced that a considerable saving, amounting indeed to 200 or 300 tons of cargo space, is secured. The first cost of the engine is reduced, and as we have pointed out, the chances of breaking a crank-shaft are much diminished. Besides this, there can be no doubt that the fly-wheel tends to spare both the engine and the propeller shaft many severe strains. In the first place, the engine is less likely to race; again, if it does race, instead of being suddenly brought up, the fly-wheel helps to keep the screw going. If, on the other hand, the screw jumps out of the water, the fly-wheel interposes its inertia, and tends to prevent the engine running away. The turning movements are, of course, irregular, but this does not seem to be felt in the engine-room or by the screw, the engine running as smoothly as any other. The only objection we have ever heard seriously raised is that the engine is very unhandy, being likely to stop, to stick on the top or bottom centre. There can be no doubt that some practice is necessary to handle the engine properly; but we know by personal experience that an engineer who is familiar with the Holt engine can handle it going into or out of port without ever getting it stuck on the centre, and even if it did stick, one stroke of the heaving round engine will start it again without a perceptible delay. These engines have proved themselves economical in fuel, dead weight, and repairs, and for moderate power—that is to say, under 1500-horse power indicated—they deserved more full adoption than until recently they had received.









We give above a set of diagrams slightly reduced from the originals courteously placed at our disposal by Messrs. Robert Stephenson and Co. They are from the s.s. Telamon. The first and second were taken with steam at 80 lb; the vacuum 24½in.; revolutions 58½ per minute; temperature of sea 72 deg.; of feed 130 deg. The high-pressure cylinder indicated 566·8-horse power; the low-pressure cylinder 655·6-horse power; total 1222·4-horse power. Diagrams 3 and 4 were taken with steam at 74 lb.; vacuum 26in.; revolutions 57½. The indicated horse-power in the high-pressure cylinder was 548; in the low 750·553; total 1299·246.

DEATHS FROM MINING EXPLOSIONS IN 1885.—The deaths resulting from colliery explosions in 1885 were much more numerous than for several years previously, being 325 against 65 in 1884 and 134 in 1883. In 1884, indeed, the number was the lowest recorded in our mining annals, the next lowest to it being 1864, when the killed numbered 94, but at that time the number of persons employed in and about the mines was only 307,542, while in 1884 the number was 520,376. With respect to the fatal explosions which took place in 1885, it appears that nearly all of them resulted from the use of naked lights and blasting with gunpowder; and may, therefore, be considered as preventable. At the Clifton-hall Colliery in Lancashire, where the explosion which took place on the 18th of June resulted in the deaths of 178 persons, blasting and naked lights were allowed, while smoking in some places was also tolerated. Under such circumstances an explosion was only what might be expected, a naked light having come in contact with an explosive mixture. With respect to the explosion which occurred at the Usworth Colliery, North Durham, on the 2nd of March, killing forty persons, the jury returned a verdict that the explosion was caused by the firing of a shot acting upon the coal dust and a small percentage of gas. At the Tredegar Colliery two deaths resulted from an explosion on the 1st of October, owing to a fall of roof liberating a quantity of gas, which was ignited by the open paraffin lamps which were allowed to be used. Two firemen were killed at the Strangeway Colliery, near Wigan, in February, owing to the blowing out of a shot, causing some gas to ignite.

AMERICAN STEAM ENGINES.

NOT long since a somewhat determined effort was made to introduce into this country steam engines made and designed in the United States, of moderate power, which were said to be better than any English engines of the same class. It was claimed that these engines were better made and more economical than any others. Beautifully illustrated catalogues were scattered pretty freely; and expense was not spared in pushing the sale of these machines. Several were ordered and put to work here, but the purchasers do not seem to have taken any special pleasure in them. It was found, indeed, that they looked much better on paper than in reality. One single cylinder horizontal, we were assured by the purchasers, cost them much more for oil than it did for coal. Indicating about 10-horse power, the oil bill was 3s. 6d. a day, and no peculiar economy in fuel was found to exist. It was always difficult to see whence the special benefits such engines were said to confer could come. We have now lying before us a pamphlet which shows very clearly that some of the crack engines of the United States are really very ordinary machines after all, and our own makers need feel no alarm concerning rivalry in this quarter.

The pamphlet to which we refer is a report by Mr. W. D. Marks, Charles E. Ronaldson, and W. B. Le Van, as a committee, with Mr. W. H. Spangler as secretary, on certain engines submitted for test to the committee during the Electrical Exhibition held in 1884, under the auspices of the Franklin Institute. The engines in question were "The Porter-Allen," "The Buckeye," and "The Southwark." No engineers in the world carry out engine tests better than our United States brethren. It would occupy more space than we can spare to give in detail the particulars of the mode of tests adopted. They seem to us to leave nothing to be desired; and no complaints have been made, so far as we are aware, by the exhibitors. The tests, it must be understood, were in no way competitive, at least there was no official sanction given to competition; but no doubt capital would have been made of the results obtained had they been satisfactory, which they were not. Apart altogether from the circumstance that it is agreeable to us to find that we have not been beaten by American engines, the report possesses much interest, going, as it does, into very complete details of the performance of steam in the engines. These last were all of the horizontal single-cylinder type, with overhung cylinders; none of them had jackets or condensers. The report contains pictures of the three engines, but no description is given, and no allusion is made to a jacket. Some very curious facts come out in the report, which deserve further elucidation, which we fear, however, will not be forthcoming. The most important feature in the test is the care and completeness with which the amount of condensation in the cylinders was calculated. The method adopted was, of course, that described in our last impression. Indeed it is the only one available.

Beginning with the Porter-Allen engine, we have the following particulars:—

Porter-Allen Engine.

Test began	1.10 p.m. October 23, 1884
,, ended	11.10 p.m. October 23, 1884

The engine was stopped 2·9 minutes at 6.15 p.m. to change indicators.

Diameter of cylinder	11½in.
Stroke...	20in.
Diameter of piston-rod	1¾in.
,, steam pipe	5in.
,, exhaust pipe	5in.
Area steam ports	6·75 sq. in.
,, exhaust ports	10·94 sq. in.
Diameter fly-wheel (belt drum)	66in.
Face of ,, ...	15in.
Weight of ,, ...	1000 lb.
,, engine complete	8500 lb.
Displacement (measured)—	
Crank end of cylinder	2018·3 cub. in.
Head ,, ,, ...	2070·14 cub. in.
Clearance (measured)—	
Crank end	127·87 cub. in.
,, ...	6·33 °/₀ displacem't
Head end	136·94 cub. in.
,, ...	6·61 °/₀ displacem't
Water used in engine	27,849·07 lb.
Total time engine in operation	9 hours 57·1 min.
Mean revolutions per minute...	227·51
Maximum ,, ,, ...	230·2
Minimum ,, ,, ...	221·8
Variation from mean speed	+1·18 per cent.
,, ,, ,, ...	−2·51 per cent.
Mean horse-power (indicated) of engines	69·34
Maximum ,, ,, ,,	76·16
Minimum ,, ,, ,,	63·16
Mean temperature of steam at engine.	329·33 deg.
Maximum ,, ,, ,,	338· deg.
Minimum ,, ,, ,,	306·5 deg.
Mean pressure ,, ,,	90·5 lb.
Maximum ,, ,, ,,	101·6 lb.
Minimum ,, ,, ,,	59·0 lb.
Mean ,, ,, at boiler.	92·8 lb.
Maximum ,, ,, ,,	104·3 lb.
Minimum ,, ,, ,,	61·0 lb.
Mean barometer	30·059in.
Mean temperature of air	47·4 deg. Fah.
Mean power required to run engine with load off	5·16-H.P.

An attachment was made to the steam pipe just above the valve chest for the Barrus calorimeter, and the following results were obtained from its use:—

From 4.40 to 6.40 p.m., October 23, steam contains 13·36 per cent. moisture.

From 6.40 to 8.40 p.m., October 23, steam contains 3·23 per cent. moisture.

From 8.40 to 11.10 p.m., October 23, steam contains 6·44 per cent. moisture.

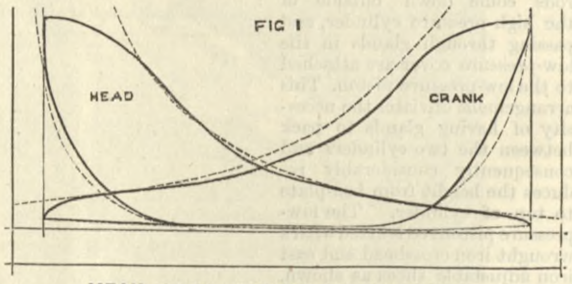
The average quality of the steam from this is that it contained 7·56 per cent. of moisture.

This is, it will be seen, a high-speed engine, and therefore, in so far as high speed can be conducive to economy, favourably situated. It actually used, however, 44·3 lb. of steam per horse per hour, or allowing that the coal evaporated 9 lb. of water per pound, the consumption was at the rate of nearly 5 lb. per horse-power per hour, or at least 50 per cent. more than a good English engine of the same power requires. The quantity of steam needed by the indicator was only 23·38 lb., and deducting this from the weight actually used, we find that over 46 per cent. of the whole was condensed. When the cut off valve closed only 19·87 lb. of steam remained in the cylinder for each 43 lb. admitted. The difference between this and 23·38 lb. represents the work done by re-evaporation in the cylinder near the end of the stroke. The precise figures are as follows:—

TABLE I.

A. Part of stroke.	B. Head end cylinder. Advancing	B. Head end cylinder. Returning.	C. Crank end cylinder. Advancing	C. Crank end cylinder. Returning.	D. Steam accounted for in both ends of cylinder.
Beginning.	86·28	70·00	87·82	81·63	Clearance, 6·3107 lb.
·05	86·22	38·00	87·72	59·86	
·1	83·88	20·79	85·30	36·42	
·2	69·62	5·47	77·10	11·12	
·3	46·60	2·00	54·72	3·18	19·8733
·4	32·80	1·64	39·70	2·58	20·0799
·5	24·04	1·40	30·42	2·38	20·3880
·6	18·11	1·22	24·40	2·40	20·8786
·7	14·03	1·05	20·18	2·42	21·5601
·8	10·92	9·6	17·06	2·63	22·2940
·9	8·92	1·21	14·84	3·18	23·3827
·95	6·82	1·60	12·74	3·36	
End.	1·88	1·85	6·82	4·32	

We give here a pair of diagrams, the dotted lines in which show the hyperbola for the theoretical expansion on



MEAN CARD, PORTER-ALLEN ENGINE.

Marriotte's law; and we desire to draw particular attention to the circumstance that the compression line departs a long way from the theoretical curve. The pressure being much higher until the last moment than that which could have been obtained if the steam had been quite dry, re-evaporation seems to have begun almost the moment the exhaust closed, as the pressure rose. The largest quantity of steam accounted for by the indicator, allowing for the wetness of the steam supplied to the engine, was 25·295 lb. per horse-power per hour. If there had been no cylinder condensation the consumption of fuel would have been at the rate of $\frac{25·295}{9} = 2·81$ lb. per horse-power per hour.

For the moment we shall skip the Buckeye engine, and consider the Southwark engine, because there is considerable similarity in the behaviour of the steam in the Porter-Allen and Southwark engines. The following are the particulars of the engine:—

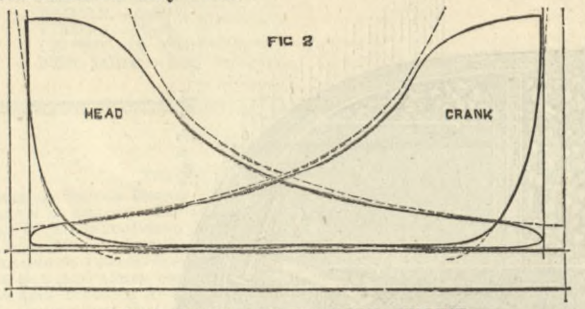
Southwark Engine.

Test began	1.00 p.m., November 8, 1884
,, ended	12.02 a.m., November 9, 1884
Diameter cylinder	9in.
Stroke...	10in.
Diameter piston-rod	1½in.
,, steam pipe	3in.
,, exhaust pipe	3½in.
Area steam port	5·7 sq. in.
,, exhaust port	5·7 sq. in.
Diameter fly-wheel (belt drum)	40in.
Face of ,, ...	8½in.
Weight of ,, ...	400 lb.
Weight of engine complete	2600 lb.
Displacement (measured)—	
Crank end	606·03 cub. in.
Head end	633·31 cub. in.
Clearance (measured)—	
Crank end	66·1 cub. in.
,, ...	10·91 °/₀ displacem't
Head end	70·42 cub. in.
,, ...	11·12 °/₀ displacem't
Water used in engine	14,792·07 lb.
Total time engine in operation	11 hours 2 min.
Mean revolutions per minute...	305·06
Maximum ,, ,, ...	309·87
Minimum ,, ,, ...	301·
Variation from mean speed	+1·57 per cent.
,, ,, ,, ...	−1·33 per cent.
Mean horse-power of engine	29·11
Maximum ,, ,, ...	46·82
Minimum ,, ,, ...	14·97
Mean temperature of steam at engine.	329·16 deg.
Maximum ,, ,, ,,	335· deg.
Minimum ,, ,, ,,	315· deg.
Mean pressure ,, ,,	87·58 lb.
Maximum ,, ,, ,,	96·0 lb.
Minimum ,, ,, ,,	68·5 lb.
Mean ,, ,, at boiler.	92·97 lb.
Maximum ,, ,, ,,	101·3 lb.
Minimum ,, ,, ,,	73 0 lb.
Mean barometer	30·256
Mean thermometer	—
Mean horse-power delivered, as shown by Tatham's dynamometer...	23·44
Maximum horse-power delivered, as shown by Tatham's dynamometer ...	43·15
Minimum horse-power delivered, as shown by Tatham's dynamometer ...	9·13
Mean horse-power required to run engine with belt off	4·68

Quality of the Steam.

From 3.10 to 4.10 p.m., November 8, steam contained	6·7 °/₀ moisture
From 9.50 to 10.55 p.m., November 8, steam contained	9·15 °/₀ moisture
Mean quality of steam, containing ...	7·92 °/₀ moisture

This is a high-speed engine, and of very small size for the power developed. It was even less economical than the Porter-Allen engine, using no less than 46 lb. of steam per horse-power per hour, of which the indicator accounted for only 24 lb.



MEAN CARD, SOUTHWARK ENGINE.

TABLE II.

A. Part of stroke.	B. Head end cylinder. Advancing	B. Head end cylinder. Returning.	C. Crank end cylinder. Advancing	C. Crank end cylinder. Returning.	D. Steam accounted for in both ends of cylinder.
Beginning.	86·80	87·56	84·99	67·14	
·05	86·08	66·21	84·99	50·55	
·1	83·90	47·38	84·32	35·02	
·2	76·69	25·56	71·05	16·92	
·3	62·58	14·25	52·62	7·00	20·781
·4	47·51	6·36	39·40	2·44	21·201
·5	37·97	2·17	31·84	1·36	22·155
·6	32·06	0·44	25·60	1·08	23·107
·7	26·75	0·07	20·90	·69	23·676
·8	22·38	0·11	17·08	·42	24·045
·9	18·24	0·49	9·74	·58	
·95	11·20	1·46	5·27	1·16	
End.	3·47	2·77	1·98	1·80	

The table above gives complete figures. It will be seen from the accompanying diagram that the compression is very great. The vertical lines at each end denote clearance spaces. The back pressure is far above that proper to Marriotte's law. The consumption of fuel in this engine would be $\frac{46}{9} = 5·11$ lb. per horse per hour; so that it is a little worse than the Porter-Allen engine. We beg our readers to compare the diagrams from these two engines. It will be seen that they closely resemble each other, except that the exhaust closes a little sooner in the Southwark engine than in the Porter-Allen engine.

We now return to the Buckeye engine, which is dealt with second in the report. Its performance was much better than that of the others. The following table gives the particulars :—

Buckeye Engine.

Test began	6 p.m. October 31, 1884
,, ended	4 a.m. November 1, 1884
Diameter cylinder	10in.
Stroke	20in.
Diameter piston-rod	$1\frac{1}{2}$in.
,, steam pipe	$3\frac{1}{2}$in.
,, exhaust pipe	4in.
Area steam ports	$\frac{5}{8} \times 8\frac{3}{4}$in.
,, exhaust ports	$\frac{7}{8} \times 8\frac{3}{4}$in.
Diameter fly-wheel	84in.
Face of ,, ...	19in.
Weight of ,, ...	3200 lb.
Weight of engine complete	9800 lb.
Displacement (measured)—	
Crank end	1464·48 cub. in.
Head end	1557·36 cub. in.
Clearance (measured) to face of cut-off—	
Crank end	47·95 cub. in.
,, ...	3·27 °/。 displacem't
Head end	53·57in.
,, ...	3·44 °/。 displacem't
Water used in engine	16,803·30 lb.
Total time engine in operation	10 hours
Mean revolutions per minute	201·11
Maximum ,, ,, ...	205·6
Minimum ,, ,, ...	194·4
Variation from mean speed	+2·23 per cent.
,, ,, ,, ...	−3·33 per cent.
Mean indicated horse-power	54·32
Maximum ,, ,, ...	56 27
Minimum ,, ,, ...	52·35
Mean temperature of steam at engine.	332·83 deg.
Maximum ,, ,, ,,	390 deg.
Minimum ,, ,, ,,	304·5 deg.
Mean pressure ,, ,,	98·04 lb.
Maximum ,, ,, ,,	107·30 lb.
Minimum ,, ,, ,,	89·80 lb.
Mean barometer	30·012
Mean temperature of air...	46 deg.
Mean power required to run the engine with the load off	5·26-H.P.

The quality of steam from one observation, lasting from 7.35 to 9.00 p.m., showed the steam to contain 7·6 per cent. of moisture.

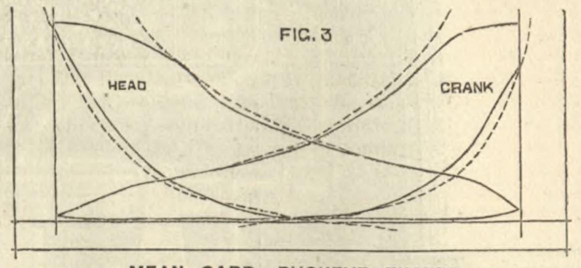
TABLE III.

A. Part of stroke.	B. Head end cylinder. Advancing	B. Head end cylinder. Returning.	C. Crank end cylinder. Advancing	C. Crank end cylinder. Returning.	D. Steam accounted for in both ends of cylinder.
Beginning.	90·58	78·72	90·95	76·52	
·05	90·49	21·82	90·95	20·34	
·1	89·46	6·94	89·86	6·40	
·2	76·76	1·79	80·42	1·39	
·3	49·25	1·62	52·94	1·14	17·310
·4	35·04	1·50	37·40	1·08	17·743
·5	26·32	1·38	28·18	·94	18·270
·6	20·40	1·00	21·64	·90	18·713
·7	16·29	·56	16·98	·92	19·226
·8	13·12	·42	13·40	1·04	19·689
·9	10·39	·52	10·65	1·22	20·062
·95	8·28	·68	9·26	1·49	
End.	1·95	1·95	3·76	2·40	

This engine is nearly the same size as the Porter-Allen. Its speed a little slower; its power a little less. The total amount of water used was 30·93 lb. per horse per hour, of which the indicator accounted for 20 lb. The consumption of fuel would be at the rate of $\frac{31}{9} = 3·44$ lb. per horse-power per hour; so that it is a very much more economical engine than either of the others. To what is this due?

The preceding table gives the precise figures.

So far as we know there is nothing about the construction of the engine to make it more economical. We are compelled therefore to turn to the diagrams for a clue. We give the diagrams here cut. It will be seen that they are very different from the others. At the crank end the expansion curve is very nearly the theoretical; at the other end it falls below it. The amount of compression is very much less than in either of the other engines, and the curve is identical, or nearly so, with the theoretical. The ratio of expansion is about 5. In the Allen engine it is about the same, but the action of the cut-off valve is less perfect. It is difficult to say what it is in the Southwark engine, but apparently it is about 7. Now, it is known that the best point of cut-off for a non-condensing engine working with about 100 lb. pressure lies between one-fourth and one-seventh, and it is hard to say that the superior economy of the Buckeye engine is due to a greater admission. The clearance is very much less in the Buckeye than in the others. The difference in economy of this engine is by no means small, and, as we have said, it is highly desirable that some explanation should be given of the cause of it. The whole set of experiments is extremely interesting, and very little more is needed to make it eminently instructive as well.



MEAN CARD, BUCKEYE ENGINE.

As to regularity of speed, very elaborate measures were taken to record minute variations. The Porter-Allen engine was fitted with Porter's high-speed governor. The maximum error was 3·69 per cent. The Buckeye engine had a governor in the fly-wheel, or rather on the crank shaft. Its maximum error was 5·56 per cent.—a bad performance. The Southwark engine also has a governor on the crank shaft. Its maximum error was 2·90, by far the best performance of the three.

AWARDS TO ARTISANS FOR INVENTIONS.

To encourage the exercise of the inventive faculty amongst workmen, and to give them a share in the benefits resulting, schemes are now in operation in several shipyards and engineering works whereby inventions of new machines, or appliances or improvements made upon those existing, or upon existing methods of work, are met by the employers with awards in money; or, in the case of important ideas, with monetary and professional assistance in securing letters patent. The first scheme of this sort, it will be remembered, was instituted by Messrs. Denny Bros., shipbuilders, of Dumbarton, in 1880, and was shortly after copied by Messrs. Denny and Co., engineers, of the same town, as well as by Messrs. Edward Withy and Co., shipbuilders, of West Hartlepool. Amongst others who have since adopted this system of awards for invention we may mention Messrs. J. and G. Thompson, the eminent shipbuilders and engineers of Clydebank, and Messrs. the Carron Ironworks Company, of Falkirk; while, as the result of a tentative application of the same principle, Mr. J. Harrison Carter, the well-known flour mill engineer, of Mark-lane, London, has paid one or two large sums to foremen who have invented automatic arrangements of such merit that they have since been patented, and steps are being taken to formulate a more detailed scheme having more special application to milling mechanics.

The committee acting in connection with Messrs. Denny and Bros.' scheme, also that in connection with Messrs. Denny and Co's., have recently issued their annual reports. The former report that 134 claims have been considered during the year, 107 of which were new claims, and twenty-seven were carried forward from last year. Of the total number, fifty-seven have been found worthy of award, fifty-eight have been rejected, four withdrawn, and fifteen deferred for further consideration. The expenditure on behalf of the scheme for the year amounts to £289, being £9 more than last year. Of this sum £209 was paid in the form of ordinary awards, and £80 in four premiums of £20 each. The ratio of the number of successful claims, during the past year, to the number of decisions, is higher than in the previous year, being ·42 in 1884 and ·49 in 1885. From the results of an investigation made into the working of the scheme from its commencement, the committee state that 97·7 per cent. of the total awards made were for claims which have proved practically successful.

The rules, as recently revised, for Messrs. Denny and Bros.' scheme, show that the minimum award is £2 and the maximum £15. The regulations as to the granting of premiums bear that "whenever any workman has received as many as five awards from the committee, reckoning from the time the scheme came into force, he shall be paid a premium equivalent to the total amount of money paid to him for these five awards; for every succeeding five awards which he may earn he shall be paid a similar sum, but with the addition of £5 in the case of the second set of awards, of £10 in the case of the third set of awards, and so on by sets of five."

The committee, in concluding their report, refer to the continued success of the scheme, and express themselves confident that from the beneficial changes in the rules, and from a continuance of the same hearty interest and appreciation on the part of the workmen, the results in the future will be equally satisfactory and encouraging.

The report of the committee acting on behalf of Messrs. Denny and Co. is couched in a like encouraging strain. The scheme in this case is almost similar although quite distinct from Messrs. Denny Bros.' The report states that thirty-five claims have been considered during the year. Of this number ten have been successful, eighteen unsuccessful, one withdrawn, and five postponed for further consideration. Three claimants received awards above the minimum, one of whom received the maximum award of £12. This claim, the committee state, deserved the maximum award most highly, the subject of it being the modification of an hydraulic rivetting machine, to do a large quantity of work hitherto done by hand labour. They add, with regard to the other claims for which awards were given, that so far as yet ascertained they are nearly all proving practically useful.

As indicating the nature of some of the inventions and improvements for which awards have been given during the past year, the following may be extracted from the reports of both schemes, which have been freely circulated amongst all who took part in the year's work. From Messrs. Denny and Co.'s report: "For an improved hand-boring machine for boring holes inside of pump chambers, £3;" "for an improvement in tool used for facing cylinder chambers, £3;" "for a method of screwing threads of rods where gripped by machine by means of left-handed dies, £4;" "for a combined drill and cutter for boring and cutting holes in condenser flanges, £5;" "for fitting shear-blades to smaller hydraulic rivetting machine for paring front ends of furnaces, &c. &c, £12." From Messrs. Denny and Bros.' report: "For a new method of fitting upper cargo derricks to masts, £4;" "for an appliance for holding the ratchet when boring holes in the beams or ceilings of ships, £5;" "for a new method of pressing jalousie mouldings together while being glued, £7;" "for a new method of making bilge rose boxes, £4;" "for a new method of cutting the gutters in skylight bearers £5;" "for making alterations in Kirke's patent wood-boring machine, £5;" "for a new method of cramping ships' chains, £4."

By an arrangement made during 1884 with Messrs. Edward Withy and Co., shortly after they had adopted the scheme as in force at Messrs. Denny's, it was provided that if either firm desired to adopt any invention or improvement made in the yard of the other, they might do so by paying to the claimant a sum equal to that which had been awarded by the committee of the yard to which he belonged. The prospect was in this way opened up of claimants receiving a double award for inventions of merit; and in at least one instance this has been realised, Messrs. Denny having duplicated an award of £3 to one of Messrs. Withy's workmen for an improved sand-papering machine.

The results attending the institution of the awards scheme in other establishments besides those referred to above are not as yet fully reported; but it is understood the measure of success attained has more than justified its adoption. The benefits accruing both to employers and employed are not to be measured simply by the record of claims received and rewarded. The system acts as an incentive to successful and to non-successful claimants as well, to take a keen and intelligent interest in all the work that passes through their hands, or in the existing appliances and methods for doing that work, and to measure the success of their operations by other than a mere quantitative or £ s. d. standard. Not only so, but the widespread institution of schemes of this sort will be found to be a strong factor in promoting that cordiality and good-faith between employer and employed which all who have at heart the industrial and commercial prosperity of the nation desiderate. We hope to hear of the adoption of schemes of this nature throughout the industrial establishments of the whole kingdom.

SEWAGE POLLUTION.—IMPORTANT ACTION AGAINST THE MAGISTRATES OF GLASGOW.—An important action against the magistrates of Glasgow was before the Court of Session, Edinburgh, on the 26th ult. Mr. Robert Bruce claims £10,000 on the ground that his business as a papermaker has been ruined by the pollution of the river Kelvin, for which he holds the defenders responsible. He states that the pollution is caused by the discharge of the sewage not only of the riparian district, but of the populous districts of St. Rollox, Port Dundas, Springburn, and Cowcaddens. The defenders deny liability, and state that they took steps, by means of an intercepting sewer, to mitigate the alleged nuisance.

ROYAL INSTITUTION OF GREAT BRITAIN.—On Monday, March 1st, 1886, Warren de la Rue, Esq., D.C.L., F.R.S., manager and vice-president, in the chair, John Abercrombie, sen., M.D., F.R.C.P., William Henry Barlow, Esq., F.R.S., M. Inst. C.E., Alfred Carpmael, Esq., Henry Doetsch, Esq., John Piggin Fearfield, Esq., R. Gent-Davis, Esq., M.P., John Hopkinson, Esq., M.A., F.R.S., John Inglis, Esq., Major E. Cecil Johnson, Mrs. T. C. Leitch, Mrs. S. Joshua, George Palmer, Esq., Sir Ughtred Kay-Shuttleworth, Bart., M.P., Silvanus P. Thomson, Esq., Sir William Thomson, D.C.L., LL.D., F.R.S., and Walter Tomlinson, Esq., M.A., were elected members of the Royal Institution. Seven candidates for membership were proposed for election. The Actonian prize of one hundred guineas was awarded to Professor G. G. Stokes, Pres. R.S., for his lectures on "Light," in conformity with the Acton Endowment Trust Deed. The following alteration has been made in the lecture arrangements:—Professor Dewar will begin a course of four lectures on "Electro-Chemistry" on March 25th, in place of Professor Tyndall on "Light."

CITY AND GUILDS OF LONDON INSTITUTE: CENTRAL INSTITUTION, EXHIBITION-ROAD, S.W.—A course of six lectures on some of the industrial applications of electricity, by Professor Ayrton, F.R.S., will be given from 5 p.m. to 6 p.m., on Friday afternoons, March 12th, 19th, 26th, April 2nd, 9th, and 16th, of which the following is a syllabus:—March 12th, Electric Lighting: The lighting of houses, streets, trains, ships, lighthouses, and large areas with arc and incandescent lamps; cost of electric lighting compared with that of using gas or oil; construction and regulation of arc lamps; current, potential difference, electro-motive force, resistance, and electric power; mode of measuring electric power; cost of a watt hour; candle power and efficiency of lamps; mode of measuring; life of incandescent lamps; most economical potential difference to use with incandescent lamps. March 19th, Electricity as a Motive Power: Construction and action of an electro-motor; starting, stopping, and reversing; power and efficiency of a motor; mode of measuring; effect of the speed on the power and efficiency; action of an electro-motor compared with that of a dynamo; governing of motors to run at constant speeds; alternate current motors; practical examples of machinery driven by electro-motors. March 26th, Electric Storage of Energy: Accumulators; power, weight, and efficiency; mode of measuring; life of accumulators; use of accumulators as regulators; use as converters of electric power supplied with high potential difference and small current into power supplied with low potential difference and large current. April 2nd, Electric Transmission of Power: Waste of power in the conductors; advantages and disadvantages of the parallel system of supplying electric power; economy effected by the use of the series, or the parallel-series system; most economical size of conductors; heating of conductors; uniform potential difference or uniform current along the mains; use of accumulators, secondary generators, and motor-dynamos, in electric transmission of power; utilisation of natural sources of power; practical results already obtained with electric transmission; comparison of electric with hydraulic and wire-rope transmission of power. April 9th, Electric Meters: Principles employed in constructing meters to measure current electro-motive force, resistance, and power; direct reading meters; common faults in existing meters; meters to record the total quantity of electricity, or the total amount of electric energy; equitable modes of regulating the price of electric energy. April 16th, Electric Locomotion: Tramcars carrying a store of electric energy; electric launches; methods of conveying electric power to moving vehicles; electric, steam, horse, and wire-rope traction; absolute blocking with electric railways; telpherage; and probable future developments in the applications of electricity.

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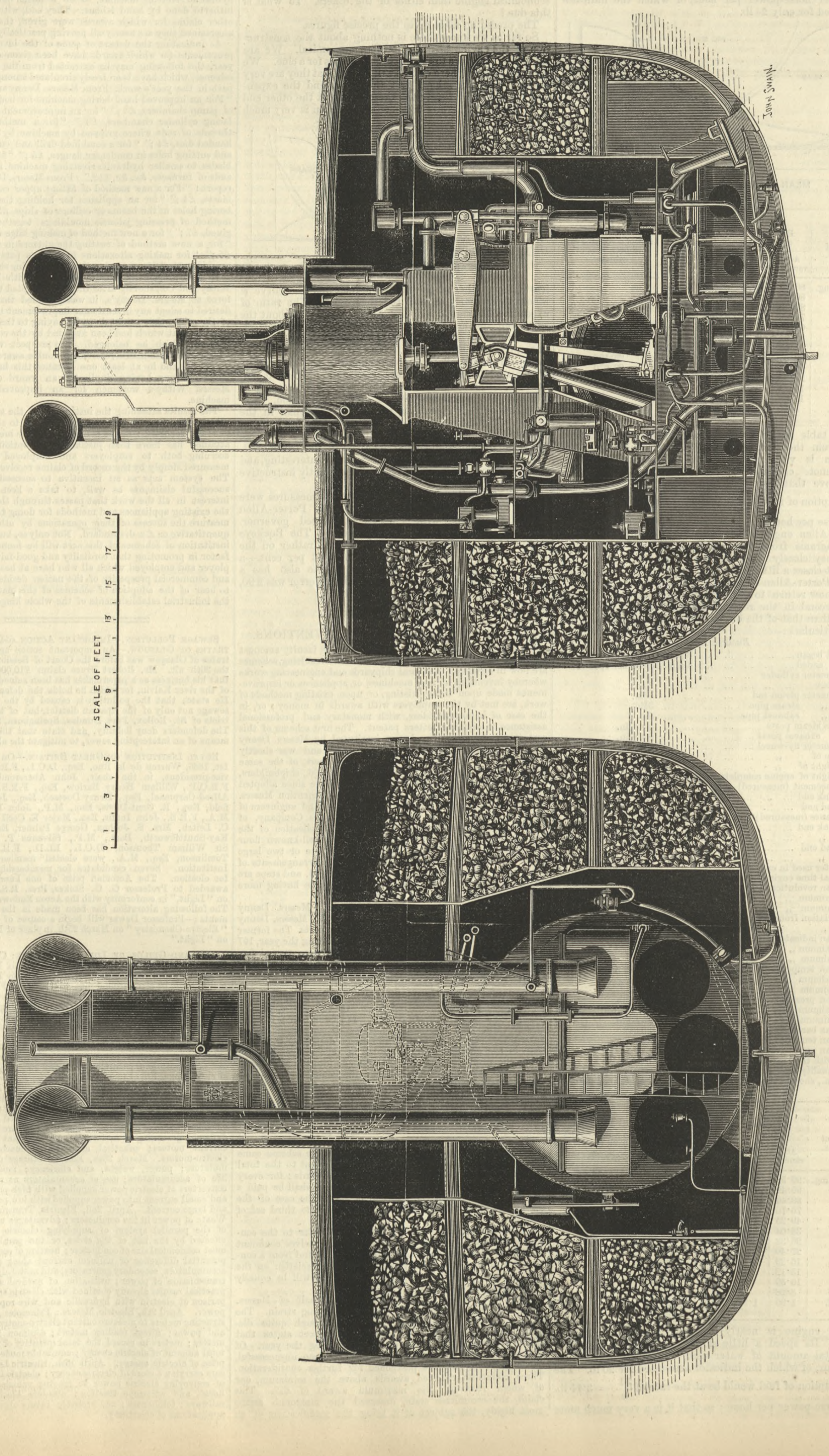
(For description see page 101.)



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THE ENGINEER, March 5th, 1886. PAGE

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.*

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

A. M.—*We hope to supply the information you ask for in due time.*

F. W. D.—*Messrs. Crosby Lockwood and Co., Stationers'-hall-court, E.C., publish a book of the kind.*

MARKER-OFF.—*You must take both diameters. The larger one for the length of the liner outside, and the smaller one for the length of it inside. If you want the mean, or middle length, add the two together and divide by two.*

A STUDENT.—(1) *There are a couple of dozen different rules for calculating the nominal horse-power of marine engines, all giving different results.* (2) *We must refer you to any treatise on the steam engine for information regarding the use of the indicator.* (3) *Quadruple expansion engines are in use.* (4) *The determination of the size of each cylinder is a matter of calculation. One phase of the question has already been fully dealt with in our impression for November 27th,* 1885.

L. J.—(1) *The Cornish engine was patented by James Watt in* 1769. *It has, of course, undergone many improvements in detail since.* (2) *Jonathan Hornblower patented what is commonly known as the Woolf engine in* 1781, *but it is said to have been invented in* 1776. *There has always been a doubt as to the parentage of this type of engine.* (3) *It is not easy to say by whom the receiver compound engine was invented. It was not used to any extent until about* 1870. *In* 1838 *a small steamer—the Era—had a high and low-pressure cylinder with a pipe connecting them, the cranks being placed at right angles. In* 1857 *a pair of* 60-*horse engines with high and low-pressure cylinders at right angles had a steam-jacketted receiver fitted to them by Mr. E. A. Cowper.*

WIRE WEAVING MACHINERY.

(*To the Editor of The Engineer.*)

SIR,—Can any of your readers inform me who are the makers of wire weaving machinery? G. P.

London, March 2nd.

MOULDERS' BLACKING.

(*To the Editor of The Engineer.*)

SIR,—Will some of your readers kindly tell me through your paper where moulders' blacking can be obtained that will do for heavy or light castings, and which will not run before the metal, swim or burn, and give the castings a skin of good colour, and cause them to be easily fettled?

Alfreton, February 25th. IRONFOUNDER.

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

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

MEETINGS NEXT WEEK.

THE INSTITUTION OF CIVIL ENGINEERS, 25, Great George-street, Westminster, S.W.—Tuesday, March 9th, at 8 p.m.: Ordinary meeting. Paper to be read with a view to discussion. "On the Explosion of Homogeneous Gaseous Mixtures," by Mr. Dugald Clerk, F.C.S. Friday, March 12th, at 7.30 p.m.: Students' meeting. Paper to be read, "The Process of Coining Gold, as carried on at the Melbourne Branch of Her Majesty's Mint," by Mr. V. W. Delves-Broughton, Stud. Inst. C.E. Mr. Joseph Newton, Assoc. M. Inst. C.E., in the chair.

SOCIETY OF TELEGRAPH ENGINEERS AND ELECTRICIANS, 25, Great George-street, S.W.—Thursday, March 11th, at 8 p.m.: The following papers will be read:—"Economy in Electrical Conductors," "Note on Magnetic Resistance," by Professors W. E. Ayrton, F.R.S., and John Perry, F.R.S., Members.

KING'S COLLEGE ENGINEERING SOCIETY.—A general meeting will be held on Tuesday, March 9th, at 4 p.m., when Mr. F. M. Long will read a paper "On Submarine Vessels."

LIVERPOOL ENGINEERING SOCIETY, Royal Institution, Colquitt-street, Liverpool.—Wednesday, March 10th, at 8 p.m.: A paper will be read "On the Manchester Ship Canal" by Mr. A. G. Lyster, M. Inst. C.E.

SOCIETY OF ARTS, John-street, Adelphi, London, W.C.—Monday, March 8th, at 8 p.m.: Cantor Lectures. "Petroleum and its Products," by Mr. Boverton Redwood, F.I.C., F.C.S. Lecture I.—Historical account of petroleum, and of the development of the petroleum and shale-oil industries. Geographical and geological distribution. Chemistry. Wednesday, March 10th, at 8 p.m.: Fourteenth ordinary meeting. "The Experiments with Lighthouse Illuminants at the South Foreland," by Mr. E. Price Edwards. Lord Rayleigh, Secretary to the Royal Society, will preside. Thursday, March 11th, at 8 p.m.: Applied Chemistry and Physics Section. "Films and Paper as Substitutes for Glass in Photography," by Mr. Leon Warnerke. Captain W. De W. Abney, F.R.S., will preside.

DEATH.

On the 14th Jan., at Rio, Brazil, aged 41, CHAS. WM. CHALMERS, C.E., eldest son of the late Chas. Boorn-Chalmers, of Cults, County Aberdeen, and grandson of Sir Chas. Wm. Chalmers, Bart. (N.S.), of Appledore, Devon, Captain R.N. Canadian papers, please copy.

THE ENGINEER.

MARCH 5, 1886.

WORK AND WAGES.

IN another page will be found a summary of the sixty-first annual report of the Steam Engine Makers' Society. It will be seen that the friendly work of this Society has been done efficiently and in a very satisfactory way. The members of the body appear to work harmoniously together; and we search in vain for evidence that they are handled like puppets by their leaders. On the contrary, we gather that the steam engine makers are a shrewd, intelligent body of men able to act and think for themselves, respectable, and respected—a good type in fact of the British workmen—as they ought to be, considering that their avocations are of a nature to develope intelligence. The report is prefaced by a long and very well written address by Mr. Swift, the general secretary, with whom we have had the pleasure of crossing swords ere now; and we find in the report under consideration matter which we cannot suffer to pass without a word of comment, it may be of criticism.

Mr. Swift very naturally deprecates proposals that wages should be reduced, and he has some very pertinent arguments to adduce on his side—arguments which we do not think employers ought to dismiss without careful consideration. "It is," writes Mr. Swift, "the old story; numbers are out of employ, and capital at once asserts it is labour that has brought about the depression, and the only remedy is to reduce wages and increase the hours of work. The remedy for depressed trade is proclaimed in this strain in all the capitalist's organs; yet no improvement is perceptible after the operative has been starved into subjection, as trade keeps in its normal condition, no matter how cheap the production may be." We are not of those who hold that low wages will secure plenty of work; and there is some force in the statement in the passage we have just quoted, to the effect that trade has not been improved by reductions in wages. On the other hand, however, Mr. Swift goes a great deal too far when he asserts—as he practically does—that wages have no effect on the volume of trade. It is impossible to assign to any isolated cause the fluctuations which always have and always will take place in the volume of commerce of every manufacturing country. We hold that although reductions in wages may be found to be not only desirable, but necessary, yet that such reductions must be comparatively inoperative unless they are combined with something else, and that something is a re-organisation of methods of doing work. We are entirely opposed to the notion that technical education is going to revolutionise the trade of this country. But we also hold that shop management is by no means what it ought to be, and that it is to this reason more than any other that the failure of many capitalists to draw a profit out of present prices is due. Some firms make money freely enough under conditions which mean bankruptcy to others. To speak plainly, we want more men who combine commerce with engineering, in control of our national workshops. We find, for example, a firm turning out excellent work, but at such a price that profits are impossible. Then a cry is raised that wages must be reduced. In too many cases this is the cry of incompetency. It must not be forgotten that the easiest of all ways to save money is to cut down wages. This requires no mental ability of any kind. The greatest blockhead that ever took charge of a foundry or a fitting-shop can see that, if he can get his men to work for 25s. a week instead of 30s., he may make a profit instead of a loss on his transactions. It is not remarkable that a remedy which can be prescribed by any unqualified practitioner is very popular. We do not for one instant assert that the men do not just as readily fall into a similar error, and entirely fail to see that wages must give way under given conditions. But for the moment we shall leave the wisdom or unwisdom of the men on one side, and continue to speak of the masters. Before any question of reducing wages should be raised, the employer ought to consider whether he is or is not working to the best advantage in other respects. The inquiry should begin at home. Does the master employ himself to the best advantage? We met with one case some years ago, where the master, himself a good engineer, spent almost his whole time in looking for orders, which were carried out by the foreman, who played the part of works' manager when the master was away—that is to say, about four days a week. The result was quite unsatisfactory, and a very small profit was realised instead of a large one. The establishment was not gigantic. It gave employment to fifty or sixty hands, and work in great variety was carried out, from casting cog wheels for roll trains to putting new fire-boxes in portable engines. The work cost a great deal more than it ought to cost, discipline was lax, and there was neither system nor method. The master would have been worth £1000 a year in his shops as a manager; he was not worth £150 a year as a traveller. In another instance there were three partners. Two remained at home, the other travelled. Unfortunately the two first were totally devoid of the commercial element, and spent so much time and money in scheming and altering patterns, and introducing petty so-called improvements, that in a couple of years they lost a good business and all their capital. We could multiply examples of this kind, were it necessary. We have no doubt whatever that the administration, so to speak, of works in this country is not what it should be, and what it must become if profits are to be made at future prices. There are notable exceptions to this statement; shops where the management is as nearly as possible perfect, and others where it is simply marvellous that any money at all is earned. The average struck between these two is too low. We do not say that matters are always pushed to such extremes as those we have named; but we do say that able shop managers do very often waste their skill and their energies abroad, in hunting up and dealing with foreign contracts, when they ought to stop at home; or in trying to recover debts due in France, Germany, or Italy, while three times as much is lost at home in their absence. Again, how many employers seriously consider the host of sundry expenses which run away with profits, and do little or nothing to help on business? How much is spent on clerks and agents which need not be spent? How much on foreign agencies, printing, stationery, and branch establishments got up magnificently in sheer rivalry of others? These things, are, however, but as a drop in the ocean, compared with the waste of time and money incurred in making engines and machinery designed on wrong principles and manufactured in the wrong way. If we take up any list of tenders we shall find an astonishing difference between the highest and lowest. The man who has sent in the highest is certain to say, "Well, how on earth A is to get a profit out of that job, I do not know"—and he does not know. This is the key to the whole position. In well-managed works a profit can be got which is quite impossible in badly-managed establishments, and even first-rate management may cost too much. As soon as it can be shown that in well-conducted shops a profit cannot be made, then wages must come down. Mr. Swift and the Engine Makers' Society have good grounds for complaint if wages are reduced to compensate for errors in management and absence of business aptitude. If twice as much money is spent on patterns, for example, as need be spent, it is hard that the pattern-makers should be made to pay the difference. We think that all dissassionate men will agree with us thus far.

On the other hand, however, Mr. Swift must remember that no efforts that a master or a manager can make will compensate for incompetent or lazy workmen. We do not believe in "driving" shops, and the work turned out from such shops is not, as a rule, the best, having a strong tendency to be of the "sloppy" or Brummagem order. Neither do we believe in the shops where a man is permitted to take his own time over every job he has in hand. Unfortunately it is the practice among steam engine makers, as well as other trades, for the quick man to wait on the slow; and one of the reasons why masters desire to reduce wages is found in the fact that the trade societies assume that all men are equal, the equality being based on the slow, not the fast, end of the scale. If Mr. Swift could show that all the men in his society were really highly competent, he would have a very strong case indeed against reduction of wages. But this is just what he cannot do; and we do not hesitate to say that the idleness and incompetence of workmen has done quite as much to reduce profits and pull down wages as the want of skill, and tact, and commercial knowledge, manifested by employers. Mr. Swift knows as well as we do that the dismissal of a man for incompetence which is not glaringly manifest, may, and probably will, bring on a strike at any moment; and he also knows that the best man very frequently cuts loose from Unions simply because it is quite impossible for him to avail himself of his own natural and acquired powers while he remains in them. The great mistake made in all Unions is the admission of almost any type of man. All is fish to the Union net. Numbers give power and mean money. It is enough that a man shall have served an apprenticeship and that he is not a notorious drunkard to get him admitted to the Union. This is not as it should be. If Mr. Swift wishes to keep up wages, let him also keep up the skill, energy, and reputation of the members of the Steam Engine Makers' Society. Lest it should be said that we exaggerate, and that great care *is* taken to get only good men on the books, we quote the following passage:—"To be a propagandist does not in all cases mean the need of being an orator, and everyone can perform a part of the work. Those who are now silent, but 'support the trade' by monetary payments, should give their moral aid in striving to bring within our ranks *all those who are now outside the pale of combination.*" The italics are ours. Nothing can be more sweeping. Not a syllable is said concerning the *quality* of the men who are to be induced to enter the ranks. *All* those outside the ranks are to be brought in, good, bad, and indifferent. We venture to say that there never was a time when more incompetence and want of skill were apparent than now. There has been a gradual process of deterioration going on for years past, and the Unions have only themselves to thank. If a first-class man can earn no more than one utterly incompetent, who spends his time tramping from shop to shop, what is the good of being sober, steady, industrious, and skilful? The Unions—we do not address Mr. Swift in particular—should make it their special study to enlist none but good men. The fact that a man belongs at all to a Union ought to be a direct guarantee that he is steady and competent. With the picture of the Steam Engine Makers' Society, as set forth by Mr. Swift there is much reason to be satisfied. We know that its policy has been—and we have no doubt will be—an exception in many respects to that of other Trades Unions, but we should have been still better pleased had we discovered some evidence in Mr. Swift's report that the Executive Council appreciate the necessity for quality as well as quantity in the ranks of the Society.

Mr. Swift has a good deal to say on foreign competition, which we shall not consider now, we may return to it at another time.

THE LOADING OF SHIPS.

THE art of loading a merchant vessel so as to enable her to pursue her voyage with the least possible risk of straining or capsizing should, by this time, be well understood by the maritime population of these islands. The seamen of a country which for so long a period has claimed dominion of the seas, and which now conducts fully three-fifths of the world's carrying trade thereon, should, one would suppose, be taught all that it is necessary to know in order to load a ship safely and well. And yet, if we follow the proceedings of the Wreck Commissioners' Court, our confidence in the qualifications of those who make the loading of ships their business is sometimes very rudely shaken. Stevedores and shipmasters do, without doubt, to a large extent possess and act upon the surest of all possible sources of information—viz., experience; and in the great majority of cases their work is satisfactory. But now and again experience with them does not lead to correct results, simply because they have deduced erroneous inferences therefrom. In these cases it too often happens that no opportunity is afforded for a discovery of the error that has been made, and in consequence the mistake may be frequently repeated before it is exposed. Such as this is more likely to occur in these days of rapid change in the type, form, and proportions of ships than was at all probable years ago, when very few types prevailed, and those which existed were well understood. New departures in naval design are continually being taken at the instance of both shipowners and shipbuilders; and each of these innovations must needs be studied by those who have to handle them before their knowledge of the latter can be trustworthy. But the period of experimental study must inevitably be one of risk; for it is only by failures, or tendencies to failure, that the school of experience teaches us anything at all worth knowing. Is it, then, too much to suppose that much valuable property, with even more valuable lives, have been lost in the course of this tentative process of acquiring information regarding the proper loading of ships?

It is not creditable to us, as the first maritime nation of the world, that towards the close of this nineteenth century we should still tolerate rule-of-thumb procedure in regard to the production and control of our merchant shipping. Knowledge upon all such questions is at hand, but, unfortunately, it is possessed by but a few. Those who are acquainted with the first principles of physical science which relate to the strength and stability of ships are, it is to be feared, those who have the least to do with the practical operations in regard to the safety of vessels which are governed by those principles. The average stevedore's knowledge of naval science is immeasurably small, while his contempt of it is as immeasurably great. He professes to proceed upon considerations affecting the vessel's safety, while his chief regard is for the immobility and well-being of the cargo. It is true that the seaworthiness of the vessel is largely dependent upon both these conditions; but it is also dependent upon many others which are not so obvious to the uneducated mind. While it is most important that the cargo should not move, so as to give the vessel a permanent list, or even damage her structure, it is no less important that it shall not be stored so as to unduly strain her, or to render her stability unsatisfactory. With homogeneous cargoes, such as grain or sugar, the stevedore has no other duty than to pack closely and prevent movement; for as the ship will carry her full capacity, her stability and the strains upon the various parts of her structure are determined by her form and proportions, which are, of course, wholly beyond his control. It is when dead-weight cargoes, and those composed of materials having very various densities, are to go into a vessel that the skill of those superintending her lading is most severely taxed. In such a case the stevedore should know at what height the centre of gravity of the cargo ought to be, in order that the vessel may (1) be safe against capsizing, and (2) be not unduly stable. He ought further to know how the cargo should be arranged in the hold and 'tween decks, in order that its centre of gravity may be at the height required.

If we closely question this responsible official in regard to the principles upon which he proceeds, we shall generally find that, up to a certain point, they are sound, even though he may not be able to give a sound reason for them. But beyond this the basis of his procedure is too often very unstable. For instance, he will tell you that a certain ship stands up without ballast when discharged, even with every spar aloft, and therefore he keeps a dead-weight cargo as high as possible when loading her, because she shall not be too stiff. He tells you, very truly, that this vessel is well adapted for carrying a grain cargo. Of another ship, which requires a large quantity of ballast when her cargo is out, he will tell you that she is tender, and that he has not so much trouble in stowing her with a dead-weight cargo on that account. It will be observed that these are qualitative statements, and that is very often the full measure of information which can be obtained. But of vessels which will shift without ballast there are all shades and degrees of stiffness, and of those which require ballast when their cargoes are out there are all shades and degrees of tenderness. To stow all stiff vessels of a certain size with the centres of gravity of their cargoes at the same height would obviously not give the same results at sea, unless they were all of the same stiffness. The popular criterion of a vessel's stability among seamen and stevedores is the relation of her breadth to her length. Because a vessel is broad, it is taken for granted that she must be stable, and in judging of her breadth the length is placed in comparison with it. It is surprising how widely this fallacy prevails. The ratio of breadth to depth is that which primarily governs the initial stability of a vessel, so far as her form and proportions are concerned; and adding to the length of the midship body of a ship increases her stability. So that, as will be seen from this, the popular conception is blind to the principles which really govern the whole matter, and falsely interprets others which are subordinate to them. Only a short time ago an intelligent stevedore—and, indeed, a superior man of his class—stated in evidence before the Wreck Commissioner, that by concentrating heavy weights, such as pig iron, at the centre line of the lower deck of a vessel she was made to roll slower and easier than if these weights were moved out on the same level towards the sides. Strange to say, even the Wreck Commissioner accepted the statement, and agreed with it. Now one would have thought no fact in naval science is more clearly established that that what is termed "winging the weights"—*i.e.*, moving them out from the axis of rotation—tends to increase the period of rolling, and, therefore, having regard to the ordinary period of the waves, to diminish its amplitude.

While such erroneous notions as these prevail, not only among stevedores, but those who often have stevedores under examination, it cannot be a matter of surprise that accidents are very frequent through the improper stowage of ships. It is open to question whether overlading is a greater source of disaster than improper lading. Ships are often designed, or their dimensions are fixed, by men who are in no way competent to do so; and when built they are laden by other men who are as ignorant of the hydrostatical qualities of the vessel as was he who determined what her dimensions and form should be. It is scarcely necessary to call certain disasters of recent years to remembrance in order to enforce the truth of this assertion. Every vessel has a certain amount of stability or instability, due to her form, when immersed to her load line, and the function of the stevedore should be to so dispose the cargo put into her that the resulting stability due to both her form and the position of her centre of gravity may be neither so great as to make her uneasy, nor so small as to make her unstable. If she be unduly stable she will strain herself through the violence of her rolling motion, and the rapid changes in its direction. Sailing vessels are sometimes dismasted through this cause, and such casualties are often either attended with or followed by even more serious disasters. But if stiffness is a source of danger, what shall be said of instability? That a well-built and equipped vessel should ever capsize, without even her cargo shifting, is most discreditable in view of the advances which have been made, and the knowledge acquired up to the present time, in naval science.

There are, however, other sources of danger due to improper loading besides those which have been considered. When a cargo is so dense that only a fraction of a vessel's stowage capacity is equal to her displacement, it becomes a difficult matter to dispose it, not only in regard to the question of stability, but also with reference to the vessel's strength. In order to keep the centre of gravity of such a cargo high, it is evident that it must be concentrated at one place, or else that a larger proportion than usual must be placed in the 'tween decks. There is, of course, the alternative of fitting a strong platform in the bottom of the ship, such as for many years has been adopted in the copper ore carrying trade. But such platforms are expensive, and although they may be economically used when a vessel is always carrying one description of cargo, it becomes a serious tax upon the freight when the very dense cargo is only carried at rare intervals. After laying as much dunnage as is necessary for levelling the foundation of the cargo, the only course open to the stevedore is to pack it openly and firmly. It is in this respect that the stevedore has opportunities of helping the vessel to bear her burden. The 'tween deck beams can only carry a fair share of the total load, and the remainder must be laid in the hold. To place it all in a heap under the main hatchway is only to set up enormous bending moments and shearing stresses, which may permanently cripple the ship, or even break her asunder in a seaway; and yet this is often done, the excuse being that a similar cargo was similarly stowed before, and the ship took it out in safety.

While stevedores work by the piece and competition prevails, it is hopeless to expect better results except under close and trained supervision. But where is the supervision to come from? It is to this question we would address a few closing remarks. Mr. John Corry, the chairman of the General Shipowners' Association, in his recent presidential address, spoke of the necessity of not only training our seamen by the apprenticeship system, as in the olden time, but also of training our mercantile officers in a naval college somewhat similar to that at Greenwich. Is it not time that we took energetic steps of this kind to avoid the dangers which must ever be associated with the exercise of enormous responsibility without previous preparation and training? It is astounding that the loading of ships should be habitually handed over to men who do not clearly understand what they are doing. If the elementary principles underlying the whole of these things were so disseminated that shipmasters, mates, and stevedores were made acquainted with them as part of their ordinary training, there can be little doubt that marked improvements would soon be discerned in the statistics of losses and other casualties at sea. Greater care is now exercised by naval architects and engineers in the determination of stability and stresses than at any previous time, but all this extra care and cost is useless unless the work of which we have written is performed with some intelligence.

THE RAIL TRADE ASSOCIATION.

THE statements which have appeared respecting the probable collapse of the International Steel Rail Makers' Association have created a profound sensation in the North of England. Although it is understood that, so far, the only action taken has been to give six months' notice of withdrawal on the part of two firms, still it is thought that the Association cannot survive the blow, and that neck-and-neck competition will shortly ensue. While the combination lasted in full force, merchants found themselves quite unable to do any business in buying and selling rails. If they obtained orders from consumers and endeavoured to place them with manufacturers they were at once referred to a central officer, who informed them on what terms the orders could be accepted, and dictated who should execute the same. Anything like the pleasant and profitable practice of pitting one needy maker against another until a good margin for the merchant was obtained was for the time being impracticable. Now, however, this elaborate system for preventing competition seems likely to end. It has become manifest to the stronger and better situated rail makers that they at all events have not benefitted by the combination. They are still subject to the competition of weaker and worse-situated firms who could not otherwise have survived so long. They have found out that working fully without profit, or even at a slight loss, would have been more beneficial to them during the last two or three years than working fitfully with an apparently good profit but insignificant output. There is, therefore, no doubt but that it is the larger and stronger, and better situated makers, who are now dissatisfied with the combination, and who are determined to have nothing more to do with it. This is only one more instance of the impossibility of interfering with economic laws without eventual punishment. Such interference is always tempting at first, but it never stands the test of time. The immediate effect of the announcement has been the withdrawal of almost all rail orders in the market or in prospect. Buyers naturally argue that if the combination is to come to an end in six months there must be present weakness, and eventually lower prices. This hesitation on the part of buyers affects prices adversely in the meantime, and puts rail makers into a dilemma. Either they must be prepared for extreme slackness until the termination of the notices, or they must arrange voluntarily to break up the combination at once, and let the market find its level. The latter course would probably be the best for them. It is said that great efforts are being made to reconstitute the syndicate upon the basis of reduced figures to meet all outside competition. It is difficult, however, to imagine that these efforts can be successful. It is clear that the most influential firms cannot now be in love with syndicates on any terms. That a reconstructed syndicate would hold together better than the present one is not likely, and if it did, it is scarcely probable that it would suit the interests of the more influential makers any better than open competition.

GAS PRODUCTION.

WE gave, some months ago, in THE ENGINEER, a series of figures to show the cost and profit of gas production in one of the large boroughs of the North. It may be interesting now to supplement these figures with others relating to the same question for the past year, and for the Bishop Auckland district. It is exceptionally situated for the purposes of comparison, because it is in the very heart of the Durham coalfield, and the company does not engage in any other trade beside the distribution of gas. In the past year it sold for ordinary purposes rather over 24,000,000 cubic feet of gas, and a considerable—but not specially named—quantity for public lighting. From the sale of gas it received £4644, and from the sale of residuals £951; whilst there were other and smaller incidental receipts. The cost of the manufacture of gas was £2247, and that of the distribution £185; whilst taxes, management, &c., brought up the expenses to £2996, leaving a profit on the manufacture and sale of £2672 for the year. In the year there were 3663 tons of coal carbonised, and the estimated quantity of coke made was 2496 tons; that of tar, 188 tons; and that of ammoniacal liquor 306 tons. It would appear that, roughly speaking, the cost of the coal deposited at the works averaged about 7s. per ton; and as the gas was sold at 3s. 6d. for the larger part, and 4s. for that of the remainder—except that sold for public lighting, of which there is no detailed price—the result of the work may be fairly said to be lessened by the rather high price charged for the gas. Had the price been lower it is probable that there would have been a much larger consumption. The company pays for the year dividends on the two classes of its shares of 8 per cent. on the original, and 5 per cent. on the additional capital, so that its return to its shareholders is a substantial one, though it is one which would probably have been materially increased had a lower price been charged so as to stimulate the consumption of gas instead of discouraging it by a price which is high. It would be well if the proprietors of gasworks would learn that the proper plan is to enlarge the production and sale by cheapening the price, so as to allow the use for many purposes for which gas is usable, but is scarcely used when the price is so high. The utilisation of the means of distribution in the daytime is one of the things which the proprietors of gasworks are only slowly learning, but it is one that they would find of the utmost advantage to themselves as well as to their customers. It is true that the receipts from residuals are very seriously less than they were, but that might have been expected after the great growth in the production of gas, and after the enlargement of the production of ammonia in other industries; and the practical result of the change should be to induce the owners of gasworks to devote their time more and more to the primary object of their undertakings—that of the manufacture and sale of gas for the many uses to which it may now be fitly applied.

ACCIDENT TO TORPEDO BOATS.

Two of the first-class steel torpedo boats recently arrived in Canton, supplied by the Vulcan Shipbuilding Company of Stettin, Germany, for the Chinese Government, and were being reviewed, near Canton, by His Excellency the Viceroy of Kwang-tung and His Excellency Pang Yu Lin, the Imperial Commissioner for Coast Defence, when a sad accident happened to one of them. The boats were steaming full speed past the Viceroy when the fly-wheel of the fan flew into a dozen pieces, striking the second engineer, and wrecking the engine-room. Mr. J. A. Betts, C.E., who was in attendance on the Viceroy, was sent for to see if he could do anything for the wounded man; but as he found the man's skull was fractured, and that he was otherwise fearfully injured, he at once saw the case was hopeless; the man died almost immediately. The engine-room looked as if a shell had burst in it; the crank-shaft was bent, some of the guides broken, and a hole some 6in. square knocked through the skin of the boat. The boat was afterwards beached to prevent her filling. On examining the pieces of the wheel no flaw could be found, but the iron was of very coarse grain and common quality, with many small air holes in the casting. The several boats supplied to China by the Vulcan Company have been particularly unfortunate—one at Tientsin ran into the steamship Wenchow, and was badly injured; and another sank at her anchorage near Chefoo, but was afterwards raised. Nine more boats are going to Canton in halves, supplied by the same company, and it is to be hoped that they will turn out a greater success than their predecessors.

TOOLS FOR THE COLONIES.

COMPLAINT has long been made of the unsuitable character of many of the tools exported to such of our colonies as largely employ native labour. It is strange that even now, after years of experience in the trade, we should continue to hear of shipments made of tools, well-suited enough to the English, Irish, or Scotch navvy or agriculturist, but which are perfectly useless in the hands of the relatively weak Indian coolie or Malay labourer. We have seen one of the former endeavouring to use a shovel of the ordinary English type. Nearly the whole of his strength was taken up in the handling of the formidable implement, and small enough was the balance of it available for actual work. The result has been that it has become almost impossible to get native labourers to work with the spade, and they will, whenever they can, use the far less efficient mamoty or native hoe instead. It is useless for European superintendents to try and insist on spades—with which double the work can be done—being used so long as those which our manufacturers export are unsuited to the strength of native workmen. And the case of the spade is but typical of many other tools sent to our Eastern colonies. The huge carpenter's plane is an instrument quite beyond the capacity of native workmen, as we may be convinced by watching the operations of the Japanese artificers at the Japanese Village, Albert-gate. It would be desirable if patterns of native tools in use in the countries referred to were obtained, and further shipments modelled more upon the basis of the power they show to be really available.

THE PATENT OFFICE.

IT is satisfactory to know that there is no fear of a temporary shelving of the important question of reorganising this department. In consequence of the change of Government, it has become necessary to consider what steps ought to be taken with regard to the Departmental Committee which was appointed by the late President of the Board of Trade—Mr. Stanhope—to inquire into the present constitution and working of the Patent Office. This Committee consisted originally of three members, viz., Baron H. De Worms, M.P.—the then Secretary to the Board of Trade—Sir Farrer Herschell—now Lord Chancellor—and Lord Crawford and Balcarres, and it has been decided that the most expedient course will now be for the Lord Chancellor, in conjunction with the present President of the Board of Trade, to appoint a new Committee. They have appointed a new Committee, which will be presided over by the Lord Chancellor as chairman, and will consist of the following members:—The Lord Chancellor, Lord Crawford and Balcarres, Baron H. De Worms, M.P., Sir B. Samuelson, Bart., M.P., Sir R. E. Webster, Q.C., M.P., and Mr. C. T. D. Acland, M.P. The return of the Lord Chancellor to the Committee is reassuring, and it may be hoped that the incompetency and absence of business capacity which has for some time characterised the procedures of this office will soon be things of the past. We understand that somewhat sweeping changes are contemplated, though not more than are urgently necessary.

SANITATION IN LONDON SUBURBS.

THE ever-extending growth of London beyond the metropolitan drainage area must soon bring into prominence the question of dealing with sanitary requirements. Each year sees what are at first but isolated villages, so to term them, planted in localities which seem to promise continued isolation for years to come, but which rapidly approach embodiment in the great area of London itself. We have had our attention but lately directed to the system of cesspits adopted in all such cases, and we fear that there is not only an absence of supervision over their construction, but a want of attention to their proper cleansing, which is likely in the not-distant future to prove a serious cause of contamination and disease. In the case of a house which for years stood alone on Barnes Common, but which has now become surrounded by a crowd of buildings extending in an unbroken line from the Putney High-street, we learned that the cesspit had never been cleansed during the whole of the tenant's residence of ten years. No inconvenience, it was alleged, had been experienced; but, as a matter of course, this immunity could only have been secured by percolation into the soil surrounding.

TENDERS.

FOR two steel boilers of the Lancashire type, put down for the Bedford Brewing and Malting Company, made to the specifications and under the inspection of the Manchester Steam Users' Association. Mr. R. Greenough, engineer, Leigh.

	£
John Musgrave and Son, Bolton	378 per boiler
Thomas Beeley, Hyde	345 per boiler
W. Adamson and Co., Hyde	360 per boiler
J. Adamson and Co., Hyde	614 per two boilers
W. and J. Galloway, Manchester	780 per two boilers
E. Heaton, Holt Town, Manchester - accepted ..	720 per two boilers

For the construction and fixing of a pair of wrought iron entrance gates 12ft. wide by 10ft. high, and a wicket-gate 3ft. wide by 6ft. 9in. high, at the Borough Lunatic Asylum, Humberstone, near Leicester, for the Corporation of Leicester. Mr. J. Gordon, M. Inst. C.E., Borough Surveyor.

	Boro' surveyor's design.			Contractor's designs.		
	£	s.	d.	£	s.	d.
Jones and Willis, Birmingham, first design £106, accepted (two designs)				106	0	0
				89	0	0
Richardson, Ellson, and Co., London ..	99	5	0			
Joseph Stone, London	88	0	0			
Gimson and Co., Leicester	105	0	0			
Winfield and Co., Birmingham	100	0	0			
F. Ashwell, Leicester	100	0	0	85	0	0
T. Brawn and Co., Birmingham	106	14	6	87	10	0
Elgood Brothers, Leicester (two designs)..	90	0	0	91	0	0
				83	0	0
Benham and Froud, London (fixing not included)	126	10	0			
Steven Brothers, London	150	15	0			
Hart, Son, Peard, and Co., Birmingham ..	110	0	0	95	0	0
F. A. Skidmore, Coventry (two designs) ..	150	0	0	135	0	0
				100	0	0
Hardman, Powell, and Co., Birmingham, fixing not included (three designs) ..				113	0	0
				121	10	0
				109	10	0
W. T. Burbidge, Leicester	79	6	0	59	10	0

TESTING THE COMMERCIAL EFFICIENCY OF DYNAMO MACHINES.

By GISBERT KAPP.

ONE of the main features by which sound scientific engineering is distinguished from mere rule-of-thumb work on the one hand and from abstruse theorising on the other hand, is the application of rigorous methods of measurement to all problems connected with it. Until we know how to accurately measure, and express in well-known physical units the forces and quantities we have to deal with in any piece of machinery, we cannot hope to thoroughly understand, and much less to improve, that particular piece of machinery. Dynamo machines have for some years past formed the subject of experimental investigation all the world over; and the amount of reliable information which has thus been accumulated is very considerable. Early experimenters laboured under the disadvantage that the physical units on which their measurements had to be based were themselves not accurately known; and even the units of the present day are only approximately correct, though the possible error is so exceedingly small that for all practical purposes we may consider the present legal units for resistance, current strength, and electro-motive force, as absolutely accurate. It is probable that the personal error of observation in reading measuring instruments is greater than the possible error in the accepted value of these fundamental units, and therefore no single reading could be made more accurate, even if the accepted units were absolutely correct. Of course errors of observation can be greatly reduced by taking a large number of readings and correcting the differences by the method of least squares; and if that be done, the accuracy of our calculations would increase as the real values of the fundamental units became known. But it is never done in practical engineering work. We take as a rule single readings only, or at best the mean between two or three readings, and then the personal error is greater than the possible error in the accepted value of the unit. It is customary to regard 746 watts—that is the electrical energy represented by a current of one ampère flowing for one minute under a difference of potential of 746 volts—as the electro-dynamic equivalent of 33,000 foot-pounds work done in one minute; in other words, 746 watts represented one horse-power. This value of the electro-dynamic equivalent is deduced as follows: We know that the dyne is that force which accelerates the mass of one gram by one centimetre in one second. Gravity accelerates the mass of one gram by g centimetres in one second, and the dyne can therefore be expressed as the product of the weight of one gram and the ratio of these two accelerations. If we express g in metres per second, we thus find that one dyne equals $\frac{10^{-5}}{g}$ kilograms. This is the unit of force. The unit of energy, the erg, is represented by the force of one dyne acting through a distance of one centimetre, and can be similarly expressed as $\frac{10^{-7}}{g}$ kilogrammetres. Since the unit of current is 10 ampères and the unit of electro-motive force 10^{-8} volts, and since the product of the two must be equal to the erg, we find that one watt equals 10^{7} ergs, and that one kilogrammetre is equal to $\frac{1}{g}$ watt, and thererefore 75 kilogrammetres, or one horse-power, is represented by $g \times 75$ watts. Now g, the acceleration of gravity, can be taken as 9·81, and hence $75 \times 9{\cdot}81 = 736$ is the number of watts representing one horse-power of 75 meter kilograms per second. That is the usual French horse-power of 32,500 foot-pounds. The equivalent of the standard English horse-power of 33,000 foot-pounds would therefore be larger in the proportion as 33 is larger than 32·5. That gives the figure 746 above mentioned.

After these preliminary remarks we may confront our subject a little more closely. In the early days of dynamo machines efficiency was quite a secondary question, and the output of a machine was hardly ever expressed as so many volt-ampères or so many electrical horse-power, but it was simply stated that it could drive, say, three good arc lights, or four lights not quite so good. This was a rough-and-ready way of describing the machine, and although the output could be approximately guessed from the number of lamps, the size of the carbons, and the brilliancy of the arcs, nobody could form the least opinion on the question of power absorbed, even if he cared for it, which might be doubted. As long as the dynamo could be kept running, and as long as some light was produced, it was considered satisfactory. The question of efficiency was first broached in connection with the electric transmission of power, but it was brought forward in a somewhat misleading way. In all probability M. Marcel Deprez is to a great extent responsible for the loose way most electricians got into when talking about the efficiency of dynamos, and for the many absurd statements relating to the transmission of energy by dynamo machinery which are found in many of our best standard text-books. M. Marcel Deprez, in his lecture delivered at the Paris Congress of Electricians in 1878, and after him nearly every writer on the subject, argued in this manner: If we have two identical machines, one acting as a generator and the other as a motor, the energy required by the former and that given out by the latter is in either case equal to the product of current and electro-motive force. Since the current is the same in both machines, the proportion between the electro-motive force in the armature of the generator and the counter-electro-motive force in the armature of the motor represents also the proportion between the energy expended and recovered. If both machines are identical, the electro-motive forces are proportional to the speeds, and hence the ratio of speeds represents the efficiency of the system. Nothing could be more beautifully simple, but at the same time nothing could be so absurd as this statement. Say the two machines are series wound. Then the speed of the motor will be the greater the smaller the current flowing through it, because a reduction of current results of necessity in a reduction of the intensity of the magnetic field, and that necessitates an increase of speed in order that the counter-electro-motive force may balance the electro-motive force of the generator, proper allowance being of course made for the loss of electro-motive force occasioned by the resistance of the two machines and the line connecting them. Now assume this line to be leaky. In this case, part of the current sent out by the generator does not reach the motor at all, and consequently the field of the motor will be weaker than that of the dynamos. Thus the speed of the motor will be greater than would be the case were the insulation of the line perfect, and the very fault which naturally reduces the efficiency of the system has the effect of making the ratio of the speed higher than it would otherwise be. To determine the efficiency by simply taking the proportions between the speed of the motor and that of the generator is therefore absolutely wrong. But even if the line be perfect this method is misleading. It will be evident that the ratio of speeds will be the nearer unity the smaller is the loss of electro-motive force occasioned by the resistance of the two machines, and of the line, that is, the smaller the current passing. But in this case the total amount of energy transmitted is also very small, and it may well happen that after deducting the energy required to overcome the mechanical and magnetic friction of the motor, nothing is left for useful external work. The actual efficiency of the whole system would therefore be zero, whilst the efficiency as estimated from the speeds appears to be a maximum.

The anomalies here set forth are all due to the fact that the commercial efficiency of the machine, whether generator or motor, has not been sufficiently distinguished from the purely electrical efficiency. It is very easy to determine the electrical efficiency of a dynamo. We have only to ascertain what is the electrical energy given out and what is the electrical energy developed in the armature, and to take the ratio between the two. All this is extremely easy, and requires no other apparatus than a Wheatstone bridge to measure the resistance of the different parts of the dynamo, and the usual current and potential indicators. The resistances once ascertained, the other measurements can be taken without in any way interfering with the working of the dynamo; and it is therefore but natural that the makers of these machines often make use of the term, "electrical efficiency." But to the practical engineer the term has no meaning. He wants to know how much power he must provide to produce a given electrical output, inclusive of all losses, and he can only ascertain the power beforehand if he knows the actual commercial efficiency of the dynamo he is going to employ.

The usual way of measuring the commercial efficiency of a dynamo machine is by employing some kind of transmission dynamometer placed between the prime mover and the dynamo, and taking simultaneous readings of the energy transmitted and the electrical energy obtained. Now, every engineer knows that measurements of that kind are difficult to make, and require costly apparatus, especially if the power to be transmitted is considerable. Only the very best and most expensive forms of transmission dynamometer—such as Tatham's or Brackett's—give fairly accurate results, and a cheaper class of instrument would be perfectly useless, as its own error would probably exceed the difference between electrical and commercial efficiency which we wish to ascertain. It must be remembered that the commercial efficiency of the modern dynamo is far greater than that of any other machine intended to convert energy from one form into another, and that the difference between an excellent dynamo and a fairly good one is reckoned by but a few per cent. in the efficiency. Hence a transmission dynamometer which may have an error of a few per cent. would be useless for our purpose, besides being, on account of its price, beyond the reach of most private individuals.

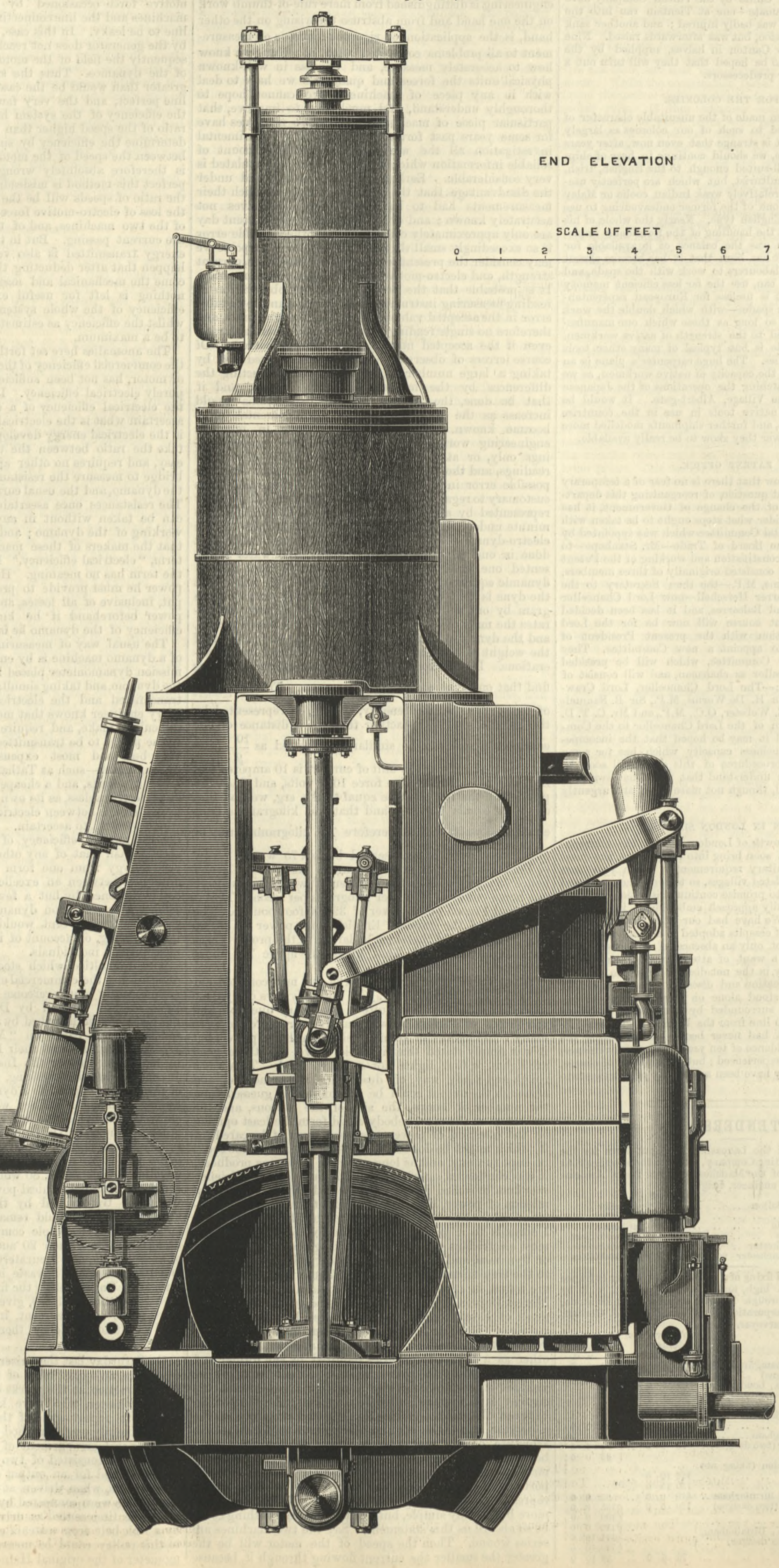
The difficulties which stood in the way of accurately determining the commercial efficiency of dynamo machines have recently been overcome in a most ingenious manner by a method devised by Dr. John Hopkinson. This method was first described by its inventor in the discussion following the paper on "Modern Continuous Current Dynamo Machines and their Engines," read by the author in November last at the Institution of Civil Engineers. It consists, broadly speaking, in measuring not the whole of the power supplied to a dynamo, but the power wasted by two similar machines which are mechanically and electrically coupled, the one acting as a generator and the other as a motor. Dr. Hopkinson said:—"Supposing 100 to be applied mechanically to the first machine, a power of 90 might be delivered by that machine to the second machine. Of that 90, 80 would in the second machine be converted into mechanical power, which mechanical power would be transmitted by the shaft to drive the first machine. There would remain then to be supplied only 20 for driving the whole combination. The quantities to be measured are then 20 and 90. Suppose that instead of measuring quite accurately the measurements were 91 and 19·8. That 19·8 waste is divided between two—9·9 for each. Consequently the first machine, apparently with an expenditure of 100·9, gives 91, so that although errors were made of 1 per cent. in each determination, in the final result of efficiency there is only an error of ·2 per cent."

On Saturday last the writer had, in company with other engineers, an opportunity of seeing this method put into actual practice at the works of Messrs. Mather and Platt, in Manchester, who were kind enough to allow their visitors to repeat some of the experiments in order that this eminently useful method may be properly understood. The general arrangement of the plant may be thus described. It consisted of two Edison-Hopkinson dynamos, each designed for an output of 320 ampères at a pressure of 105 volts, when driven at 750 revolutions per minute. The shafts were connected by a flexible coupling which at the same time served as driving pulley, receiving motion by a link belt from a steam engine. The power supplied to this pulley could be measured by a transmission dynamometer of the original Hefner-Alteneck type, represented

COMPOUND ENGINE OF THE S. S. PROMETHEUS.

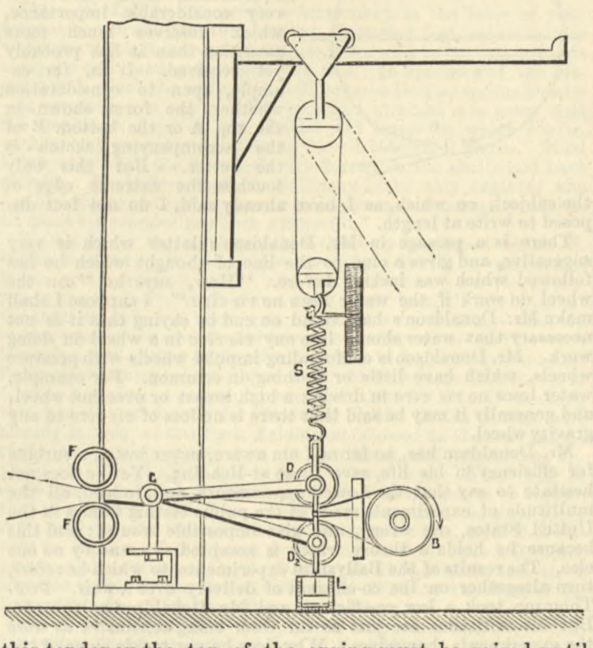
MESSRS. R. STEPHENSON AND CO., NEWCASTLE-ON-TYNE, ENGINEERS.

(*For description see page 187.*)



diagrammatically in Fig. 1, where B is the pulley connecting the shafts of the two dynamos. D_1 D_2 are loose pulleys supported by a frame, which is pivotted at C, and S in an adjustable spring suspended from a crane overhead. The vibration of the frame is reduced by a dash-pot L. The two ends of the belt are taken through guide pulleys F F so as to bring them parallel to the dynamometer. If motion takes place in the direction of the arrow it will be evident that the strain in the lower belt must exceed the strain in the upper belt, and there will be a tendency to displace the frame downwards. To counteract

Fig. 1



this tendency the top of the spring must be raised until the pointer attached to the frame again returns to a zero mark which had been made whilst the system was at rest. It is easy to see that in this position the difference in tension between the two sides of the belt must, under all circumstances, be proportional to the increase of tension in the spring, which can be read off by an upper pointer and scale as shown.

The constant of the dynamometer is simply dependent on the geometrical proportions; it is 2·705—that is to say, to each division on the scale corresponds a tangential pull of 2·705 lb., acting at a radius equal to that of the pulley plus half the thickness of belt. To avoid the possibility of error in the geometrical determination of the constant, the latter was verified by combining the transmission dynamometer with an ordinary Prony brake, and comparing the power registered on the dynamometer with the power measured on the brake. One revolution of the pulley represents 3·63ft. advance of belt; hence $\frac{S \times 2{\cdot}705 \times 3{\cdot}63\, n}{33{,}000}$ = H.-P, where S represents the tension of the spring in divisions on the scale, n the number of revolutions of the pulley per minute, and H.-P. the horse-power. We have also

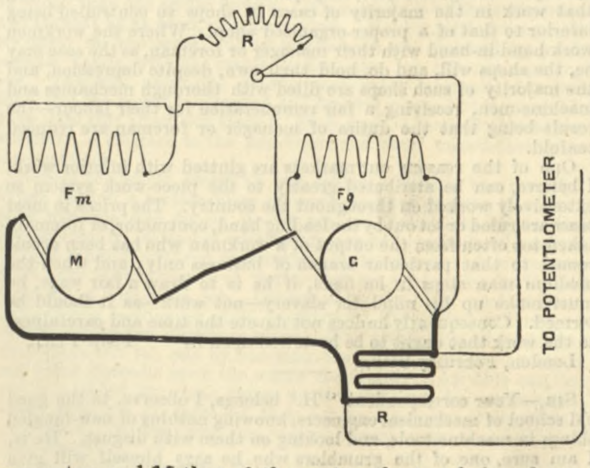
$$\text{H.-P.} = {\cdot}000298\, n\, \text{S}.$$

It will be seen that n and S are the only mechanical data required. The electrical data are the current in the two armatures, and the electro-motive forces created in the armature coils. We can, of course, only measure the external electro-motive forces, and must compute the internal electro-motive forces by adding the loss due to the resistances of the armatures. The two dynamos are shunt wound, and their resistances are as follows :—

	Ohms.
Armature of generator...	·009947
Armature of motor	·009947
Field magnets of generator	16·44
Field magnets of motor	16·93
Resistance of leads, including platinoid coil ...	·00777

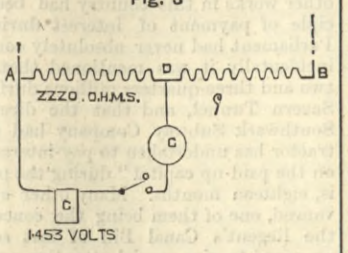
The electrical connections will be understood from the diagram, Fig. 2, where G represents the armature of the

Fig. 2



generator, and M that of the motor, the two being drawn side by side for clearness of illustration, and not in line one behind the other—which is their actual arrangement. F g represents the field magnet coils of the generator, and F m those of the motor, both being supplied with current from the brushes of the generator. Now, it will easily be seen that if the exciting current were alike in both cases, the counter electro-motive force created in M would be equal to the electro-motive force created in G, and no current would pass from one armature to the other. To allow a current to flow it is necessary to slightly lower the counter electro-motive force of M, and this is done by reducing the exciting current in F m. The more we reduce the power of this magnet, the more easily will the armature of the motor be overpowered by the armature of the dynamo, and the more current will flow through both armatures, and the circuit shown in thick lines. In order to regulate the exciting power of the motor field magnets, a rheostat r is inserted into the circuit, and by turning the handle of this rheostat one way or the other we can increase or decrease the main current flowing through the system, and therefore the total amount of mechanical energy supplied to the armature of the generator. The main current is measured by observing, on a potentiometer placed in a distant room, the difference of potential existing between the terminals of a platinoid resistance R. This resistance is so low—·0058 ohms—that the strongest current which is used during the range of experiments does not sensibly heat it. Moreover, the temperature correction of platinoid is so small that this resistance can be considered to be practically constant. We therefore find the current by dividing the potential at the terminals of R by ·0058. The potentiometer is arranged according to Poggendorff's method. Let in Fig. 3 a b represent the terminals of the two wires leading from the platinoid resistance R, let C represent a standard cell of known electro-motive force — 1·453 volts—and let G be a galvanometer connected by a key K to a variable resistance ρ. The current flows from a through a fixed resistance of 2220 ohms past the point d where the galvanometer is connected and through the resistance ρ to b. By suitably varying the latter resistance we can vary the strength of the current, and therefore the difference of potential between a and d. If that difference be exactly 1·453 volt, then no deflection of the galvanometer will be observed upon depressing the key, because the standard cell just balances the electro-motive force between a and d. The difference of potential between a and b is in that case

Fig. 3



$$\text{E} = \frac{1{\cdot}453\,(2220 + \rho)}{2220}.$$

It will be noticed that this method can only be used if E > 1·453. For smaller values a similar method is employed, but the standard cell is replaced by a secondary battery of known electro-motive force. It would be beyond the scope of this article to enter in detail into the different arrangements necessary. Those who wish for more information will find it in Mr. Kemp's excellent book on "Electrical Testing." The experiments were carried out in the following manner :—The two dynamos were first run with the brushes off, neither of the two fields being excited. This gave the power necessary to overcome the friction in the bearings, the resistance of air and that used up in the dynamometer itself. The next experiment was to excite the two fields separately and run the dynamos still with the brushes off. This gave the power required to overcome the resistances just specified plus the energy absorbed by revolving the two armatures in magnetic fields, or as it might be termed the power absorbed by magnetic friction. Roughly speaking the magnetic friction was found to increase the power required for running empty by 50 per cent. The field coils were then coupled up as shown in Fig. 2, and the proper power tests were made. In the following table are given some of the results obtained :—

Dynamometric Experiments on two similar Edison-Hopkinson Dynamos.

Scale divisions on spring balance ...	21·6	30	60	48·5	44
Revolutions per minute	808	802	764	808	808
Electro-motive force at brushes of generator	—	—	110·12	118·87	124·41
Electro-motive force at brushes of motor	—	—	107·34	116·86	122·97
Electro-motive force in armature of generator...	—	—	113·79	121·56	126·40
Counter electro-motive force in armature of motor	—	—	103·78	114·29	121·12
Main current in ampères...	—	—	358	258	186
Shunt current in field of generator	—	6·9	6·72	7·21	7·57
Shunt current in field of motor ...	—	6·7	5·23	5·92	6·53
Current in armature of generator...	—	—	370	271	200
Current in armature of motor ...	—	—	358	258	186
Horse-power registered on dynamometer	5·18	7·17	13·66	11·70	10·60
Horse-power converted in armature of generator	—	—	56·20	44·00	34·00
Horse-power converted in armature of motor	—	—	49·80	39·60	30·20

The horse-power converted in the armature of the generator is that actually appearing in the form of internal electrical energy. The power which has to be supplied to the spindle is somewhat greater than the horse-power converted, and the problem is to find how much greater; in other words, we want to find the efficiency of conversion. Similarly the horse-power converted in the armature of the motor is the electrical energy disappearing in the process of conversion into mechanical energy, which flows through the coupling back into the spindle of the generator. This power is somewhat smaller than that given in the table, because a certain loss occurs during conversion, and we want to find how great this loss is. Since the two machines are similar in size, we shall not commit any great error if we assume that the unknown loss in conversion is the same in both armatures. Let X represent the horse-power thus lost. Then we have the following relation in reference to the experiment given in the third column :—

Power supplied from the external source	13·66
Power supplied by the motor...	49·80 − X

The sum of these two must be equal to 56·20 + X, which represents the power actually supplied to the spindle of the generator. We have therefore the equation—

$$13{\cdot}66 + 49{\cdot}80 - \text{X} = 56{\cdot}20 + \text{X},$$

whence $2\,\text{X} = 13{\cdot}66 + 49{\cdot}80 - 56{\cdot}20$

$$\text{X} = 3{\cdot}63$$

It should here be remarked that in taking 13·66 as the power actually supplied to the whole combination we have made no allowance for the loss occurring in the dynamometer itself. Now from the first column it appears that 5·18-horse power are required to overcome the purely mechanical resistance of the dynamometer, the friction of armature spindles in their bearings and the air resistance of the armatures. The latter two must properly be charged to the dynamos when determining their commercial efficiency, whereas the former should be deducted. It is extremely difficult to separate these losses, and we shall have either to neglect the loss in the dynamometer altogether, which would make the dynamos appear less efficient than they really are, or we must deduct the losses due to the dynamometer and the mechanical friction of the armatures together, which would make the dynamos appear more efficient than they really are. In the latter case the power applied externally would be $13{\cdot}66 - 5{\cdot}18\,\frac{764}{808} = 8{\cdot}76$, and the unknown quantity X = 1·18.

This value agrees fairly well with the tests in the first and second column where the increase of power due to the magnetisation of the iron core of the armature had been directly ascertained. But there is one point which has not been taken into account, and which would slightly modify the efficiency when either of the dynamos were used in actual practical work. This is the increase of mechanical friction in the bearings due to the strain of the belt. It is a very different thing to transmit 10-horse power through a belt embracing three-fourths of the pulley and to transmit 60-horse power through a belt embracing say only four-tenths of the pulley. The strain in the driving end of the belt will, in the latter case, be probably ten times greater, and therefore the pressure of the spindle against its bearing and the power absorbed by friction will also be considerably increased. In order to make an allowance on this head, probably the fairest thing to do is to take the mean between the two values for X, and in this case we have :—

Horse-power in the belt driving the dynamo... ...	58 60
Horse-power delivered electrically at the terminals	53 60
Commercial efficiency, 91·5 per cent.	
Similarly we have for the motor :—	
Horse-power delivered electrically to the terminals	53·60
Horse-power obtainable at the belt	47·40
Commercial efficiency, 88 5 per cent.	

In this case the commercial efficiency is somewhat lower for the motor, which is probably due to the fact that the field magnets were not fully excited.

In the same manner we find the average value of X for the figures in the fourth column to be 2·36 and that for the figures in the last column to be 2·10. This gives for the dynamo :—

Horse-power in belt driving the dynamo	46·36	and	36·10
Horse-power delivered electrically at the terminals...	42·00	,,	30·40
Commercial efficiency	90·6°/o	,,	84°/o
And for the motor :—			
Horse-power delivered electrically to the terminals...	42 00	and	30·40
Horse-power obtainable at the belt ...	37·24	,,	28·10
Commercial efficiency	88·7°/o	,,	92°/o

The method here adopted by the writer in analysing the experimental results is somewhat different from that adopted by Messrs. Mather and Platt, but the results arrived at by either method agree fairly well. The commercial efficiency determined according to the makers' way of reckoning is 93·23 per cent. for the tests recorded in the third column, and the discrepancy of 1·7 per cent. is due to the fact that in the calculation which gives the higher efficiency, no allowance was made for the increase of friction in the bearings due to the greater pull of the belt where the latter is transmitting the full power, instead of only that portion of the power which is wanted. These results are very instructive. In the first place they prove that an actual commercial efficiency of 90 per cent. and more can be obtained with a high class dynamo. They also show that the dynamo, when designed on sound scientific principles, is equally efficient, whether used as generator or motor, a point which has been much discussed of late in the columns of the scientific press. A very important result of the experiments is also that it has been proved to be possible to electrically transmit energy over short distances with a total loss not exceeding 20 per cent.

PRIVATE BILLS IN PARLIAMENT.

WHAT is called the contentious business in connection with the Private Bills of the session has at last commenced, a Select Committee of the House of Lords, with the Earl of Limerick as chairman, having met on Wednesday to consider a group of five Bills. The first of these was the Brighton, Rottingdean, and Newhaven Direct Railway Bill. This is one of two schemes which to some extent are rivals, the other being the Brighton, Rottingdean, and Newhaven Railway Bill, and both follow very much the same course. The *direct* route scheme begins by two junctions with the Kemp Town branch, a short distance from the Kemp Town station, and thence pretty much parallel with the coast, meets the Lewes and Seaford branch about half a mile away from the Newhaven Town station. The effect of this line will be to bring Brighton and Newhaven within half an hour's journey of each other. The other schemes before this Committee are the Bristol Corporation Docks Bill, the Bristol (Totterdown Bridge) Bill, the Morecambe Tramways Bill, and the Swansea Harbour Bill. None of them involve any very serious conflict, and they are likely to be quickly disposed of.

In the House of Commons the General Committee on Railway and Canal Bills have formed these schemes into groups, and appointed Committees upon them, the first of which will meet on April 6th; among the Bills to be taken earliest being the Ship Canal Bill. This session the Railway and Canal Bills only constitute seven groups, whereas last year there were ten. Three of the seven relate to Lancashire and the North. Although these Committees will not begin their investigations until next month, some of the miscellaneous measures will be taken into consideration on Monday next. In the meanwhile the Highgate and Kilburn Open Spaces Bill is the first private measure of the session to pass the Committee stage in the Commons, it having become unopposed. The object of the Bill is to enable the Ecclesiastical Commissioners to transfer certain lands at Highgate and Kilburn, to be maintained as open spaces for the public. The land at Highgate which it is proposed to convey to the Corporation comprises about sixty-nine acres of Highgate Woods. The Kilburn land contains about thirty acres. By the Bill the Corporation bind themselves to preserve, as far as possible, the natural aspect of Highgate Woods, and powers are also conferred to enable the Corporation to borrow, if necessary, £15,000 on the security of the grain duty, or on the residuary estate of the late Mr. William Ward.

A new departure in Private Bill procedure has been taken, a Committee of nine members of the House of Commons having been appointed at the instance of Mr. Broadhurst, to whom will be referred all Bills promoted by municipal and other local authorities in which it is proposed to create powers relating to police or sanitary regulations differing from, or extending, the general existing law. This method, side by side with the separate classification of railway and canal schemes, is likely to materially facilitate this branch of legislation; and in this connection should be mentioned another form of distinct treatment adopted this year, viz., the appointment of a hybrid Committee—that is, a Committee half selected by the House itself and half by the Committee of Selection—to consider the various Metropolitan Water Bills of this session. This course has been taken on the motion of Mr. Thorold Rogers, and to this Committee the Lambeth Water Company's Bill, the Lambeth and Vauxhall Water Company's Bill, and the East London Water Company's Bill have already been referred.

The condition of the river Lea, and the necessary measures for its purification, are to be dealt with by a special Committee appointed on the motion of the Attorney-General.

Since our last notice, the following Bills, with others, have been read a second time in the House of Lords:—Chatham and Brompton Tramways Bill, Charterhouse Bill, Tyne Improvements Bill, Dore and Chinley Railway Bill, Rhymney Railway Bill, Oswestry and Llangynog Railway Bill, Barry Docks and Harbour Bill, Kingstown and Kingsbridge Junction Railway Bill.

In the House of Commons the following measures have been read a second time, and now await Committees:—Railways: Eastern and Midlands, London, Tilbury, and Southend, East and West Yorkshire Union, Exeter, Teign Valley, and Chagford, Forth Bridge, Great Northern (Ireland), Pewsey and Salisbury, Rastock, Wrington, and Congresbury Junction (abandonment), Seacombe, Hoylake, and Deeside, Uxbridge and Rickmansworth, Felixstowe Railway and Dock, Great Western, Gravesend and Northfleet Docks and Railway, London and South-Western Railway, Great Western, Brighton and Dyke. Miscellaneous: Hampstead Heath Enlargement, Metropolitan Street Improvements Act (1877) Amendment, Bridlington Gas, Burgess-hill Water, Liverpool United Gas, Wrexham Gas, Charterhouse, Cambridge University and Town Water, South Shields Gas, Nuneaton Gas, Solihull Gas.

The Rhymney Railway, Mersey Railway, Barry Docks and Railway, and Plymouth, Devonport and District Tramways Bills were found to have not fully complied with the Standing Orders of the House of Lords, but the Standing Orders Committee have allowed them to proceed.

Besides the defunct Bills we have previously mentioned, there are now to be named the Beaconsfield, Uxbridge and Harrow Railway, the Chesterfield, Hasland, North Wingfield, and District Tramways Bills.

It appears that the Electric Lighting question is to be dealt with, after all, in both Houses this year, apart from the Bill of the West London Company. Lord Rayleigh, on behalf of the Electric Lighting Bill Committee, has introduced a Bill in the House of Lords; while in the House of Commons Mr. Mundella has announced his intention to propose a Bill for the amendment of the Electric Lighting Act Bill of 1882. At present nothing is known as to what form his Bill will take; but the mere intention is important, in view of the great discontent caused by the existing Act.

Besides resolving, if allowed by Parliament, to invest a quarter of a million of money in the Ship Canal work, the Salford Corporation have now decided to petition Parliament in support of the Canal Company's Bill for paying interest during construction.

The Bill of the Metropolitan Board of Works, empowering them to defend the ratepayers where Bills imposing vexatious restrictions are promoted by any of the water companies, has been hung up somewhat indefinitely, for its second reading having been moved by Sir James McGarel Hogg, the debate was stopped abruptly by the Wednesday quarter-to-six rule. Whether it will be revived is very uncertain, for not only is there strong general objection to the Bill in the House, but the Government are opposed to it, on the ground that as they themselves intend to consider a proposal for a system of representative government for the whole of London, it would not be in the interest of the ratepayers to accept this Bill.

The Metropolitan Board of Works have decided to assent to the South Metropolitan Tramways Bill, on condition that the whole of the road along which the line is to be laid is widened up to 47ft., and they will also agree to the Cricklewood, Kilburn, and Harrow-road Tramways Bill, if the promoters undertake not to lay a line along Cricklewood to Cambridge-road, and agree to the insertion of clauses providing that the tramway in Harrow-road is not carried further south than Lock Bridge, and also engage that the rails of the tramways shall not be at a less distance from the kerb than 9ft. 6in.

The Liverpool and Birkenhead Subway Bill has been rejected by the Standing Orders Committee this session; but as it was only an additional powers Bill, its failure will not prevent the prosecution of the undertaking authorised by Acts in 1880 and 1885. Active steps are now being taken for the construction of the subway, a fresh impetus having been given to the project by the success of the Mersey Railway. A general contract for the work has been entered into, the amount for the whole undertaking being £625,000, leaving £40,000 for engineering and administrative charges. Sir Wm. Armstrong and Co., Messrs. Wilsons, Pease, and Co., of Middlesborough, and Messrs. Baldry and Yarborough, of London, are among those who have tendered for sub-contracts. The work will be commenced almost immediately, the beginning probably being on the Liverpool side. The object of the subway is to provide what the Mersey Railway Tunnel does not supply, viz., across-river communication for pedestrians and ordinary vehicles. Something over £200,000 of the capital has been, or shortly will be, subscribed; negotiations are approaching completion for the taking up of another £100,000; and the Corporation of Liverpool and the Mersey Docks Board are authorised to subscribe £125,000 each. Looking at the general nature of the traffic to be accommodated, and to the results so far of the Mersey Tunnel, the company anticipates a gross annual earning of £45,000, which will enable it to pay 5 per cent. on the whole capital.

The promotion of the Ship Canal—payment of interest during construction—Bill has assumed a new character. Owing to the threatened opposition to the proposal, both in the House of Commons and in Committee, the company recently sent a deputation to the President of the Board of Trade, to solicit his assistance in passing the Bill. The deputation was a remarkably strong one, including a large number of Members of Parliament and leading commercial men in Lancashire and Cheshire. It was explained to Mr. Mundella that this Bill was necessary to carry out the Act of last year, and that the conditions limiting the proposed payment of interest out of capital during construction were that the rate of interest should not exceed 4 per cent., and should be paid only during the authorised time for construction; that no interest should be paid to any shareholder until the company had obtained a certificate from the Board of Trade that two-thirds of the share capital authorised by the Act had been issued and accepted, and were held by the shareholders; that the total amount of interest to be paid should not exceed £752,000, and that the borrowing powers should be reduced by an amount equal to one-fourth of the sum expended in the payment of such interest—such reduction to be made from the last instalment of £500,000. Among other things stated during the interview, it was explained that a similar proposal to this had wrecked the Canal Bill in two sessions, and was not renewed last year, first because it might again jeopardise the Bill, and secondly because the time available for the Bill, minus that element of contention, was extremely limited. Mr. Mundella was also reminded that most of the great railways and other works in this country had been constructed on the principle of payment of interest during construction, and that Parliament had never absolutely condemned the practice; and incidentally it was mentioned that interest had been paid on two and three-quarters millions during the construction of the Severn Tunnel, and that the directors of the London and Southwark Subway Company had announced that "the contractor has undertaken to pay interest at 4 per cent. per annum on the paid-up capital" during the period of construction—that is, eighteen months. Many other strong arguments were advanced, one of them being the concession made in the case of the Regent's Canal Bill of last session, and Mr. Mundella promised to give special attention and examination to the question. The company expects to complete the Canal in four years, which is some years less than the period allowed by its Act. It is worth noticing that as a first consequence apparently of the mere passing of the Act the railway rates on manufactured goods from Manchester have been reduced, in one instance from 10s. a ton to 8s. 4d., and in another from 10s. to 6s. 6d.

What is practically, though not absolutely, a new movement has been made for the promotion of inland navigation, which is coming into prominence in all directions. The Ulster Canal, which connects Belfast with Lough Erne, has long been virtually disused, partly by reason of defective condition, and partly because it has not sufficient capacity for large craft. It is the only means existing of water competition with the railway at and from Belfast, and is at the same time a connecting link between the North, East, and West of Ireland, but its value is *nil* for the reasons mentioned. In Ireland, as elsewhere, the cost of railway transit is severely felt, and as more than a million tons of coal alone are annually imported into Belfast for inland towns as well as for Belfast, the railway monopoly is a special grievance. Efforts are therefore being made to render the canal useable, as a matter of public convenience and as an engine for bringing down transit rates. The proposal is to transfer the canal by sale to the Lagan Navigation Company, and for this purpose the Government are about to introduce a Bill, with the distinct intention of passing it this session. Two or three years ago Mr. Courtney, who was then a member of the Government, brought in a similar measure; but although it reached the Select Committee stage, it was dropped. In the following session a like Bill was to have been introduced by the Government, but the intention was abandoned. Now, however, the transfer scheme is to be revived, and as the people in the district affected are in its favour, and there is scarcely any opposition from any quarter, the canal is likely soon to pass into the hands of the Lagan Navigation Company, by whom it will be deepened and put into working order. For this purpose something like £10,000 will be required over and above the purchase money.

The Mersey Railway Bill of this session contains, among others, a provision for an extension of the line from Birkenhead to Rock Ferry, in Cheshire, between which place and Liverpool there is a large and growing traffic; and also to build a central station in Liverpool, near the existing central station, to accommodate, besides the company's own traffic, the traffic of the other railways which are expected to use the line. Meanwhile it has been found necessary, good as the ventilation of the river tunnel is, to construct a new air-way, and to provide additional accommodation for passengers at the present Liverpool terminus. Efforts are being made to carry out the connection arranged for between this line and the Wirral Railway, by which New Brighton, Hoylake, and the banks of the Dee will obtain direct communication with Liverpool. At the recent meeting of the company, objection was taken to the re-election on the directorate of Mr. Hubbard and Mr. Mott, on the ground that there was too large a Great Western Railway element on the board. In the end Mr. Hubbard was re-elected—by the aid of proxies held by the chairman—but Mr. Mott was rejected, he declining to have the chairman's proxies used in his behalf.

LETTERS TO THE EDITOR.

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

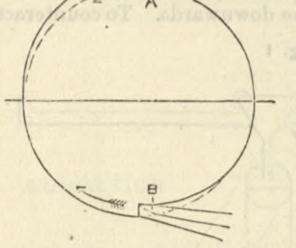
GOOD AND BAD CHAINS.

SIR,—In reply to your request for prices of cables and chains, we think it better to give you a cost price rather than a selling, as that depends so much upon circumstances. The cost to us of our Special Best Best Cables, 2in. diameter, proved to the statutory test in a public machine, and delivered to a ship at Liverpool, is 17s. per cwt., and for ½in. Special Best Best Crane or Traction Chain, short link, also public tested, 21s. per cwt., whereas chains and cables are being sold at the present time, made of common iron, at less than the iron costs that is used in the above articles. The only way that we are to find out the real value of these spurious articles is to have them retested periodically. It may be urged that retesting does a chain some injury; with this we perfectly agree if it is made of inferior iron. If the iron and workmanship, however, are really what they ought to be, the injury, if any, is very small. For instance, we purchased an old cable of our special best best quality from a customer some short time ago, part of which we sent to the public machine to be broken for experiment. The statutory test to which it was originally submitted by one of Lloyd's superintendents was 72 tons; it withstood a test of 123 tons before it broke the last time, being over 70 per cent. beyond the original test. We shall be glad to show it to anyone at any time. HENRY P. PARKES AND CO.

Tipton-green Chain and Anchor Works, Tipton, March 2nd.

REACTION WHEELS.

SIR,—Mr. Donaldson has in your last impression occupied a tremendous amount of space in refuting an assumption which no one had made. I stated in a former letter that it was possible so to curve the arms of a reaction wheel that the water could move from the centre to the circumference of the circle described by the adjutages without acquiring any rotary motion. That, in other words, each molecule could follow a radius of the circle. This Mr. Donaldson no longer disputes, although he failed at first to see how it could be done. "But," says your correspondent, "in that case the wheel cannot be made to revolve by the water, because it should issue along a tangent instead of along a radius." Well, no one said it would revolve. The *arm* of a reaction wheel is one thing, the adjutage at the end of that arm is quite another. I am a busy man, with neither the time nor the will to write treatises on turbines, and it must suffice, so far as I am concerned, to say that the forms which shall be given to adjutages at the ends of the arms, or their equivalents, is a matter of very considerable importance, which deserves much more attention than it has probably yet received. It is, for example, open to consideration whether the form shown in the top A or the bottom B of the accompanying sketch is the better. But this only touches the extreme edge of the subject, on which, as I have already said, I do not feel disposed to write at length.



There is a passage in Mr. Donaldson's letter which is very suggestive, and gives a clue to the line of thought which he has followed which was lacking before. "How," says he, "can the wheel do work if the water loses no *vis viva*?" I suppose I shall make Mr. Donaldson's hair stand on end by saying that it is not necessary that water should lose any *vis viva* in a wheel in doing work. Mr. Donaldson is confounding impulse wheels with pressure wheels, which have little or nothing in common. For example, water loses no *vis viva* in driving a high breast or overshot wheel, and generally it may be said that there is no loss of *vis viva* in any gravity wheel.

Mr. Donaldson has, so far as I am aware, never tested a turbine for efficiency in his life, save those at Reading. Yet he does not hesitate to say that the Lowell experiments, and, indeed, all the multitude of experiments made at the public testing flumes in the United States, are wrong, and give impossible results; and this because he holds a theory which is accepted as sound by no one else. The results of the Ballysillin experiments, to which he refers, turn altogether on the co-efficient of delivery over a weir. Prof. Thomson took a low co-efficient, and Mr. Donaldson a high one. But his criticisms are just as far from being conclusive as were the experiments themselves. Why does he not tackle some of the Lowell experiments and prove that they are wrong.

Here I stop. When I ventured to write a few words about curved arms I had not the least notion that I should have been drawn into a lengthy correspondence such as this has been. To save Mr. Donaldson further trouble and more letter writing, I am willing to say as the coon did to Crockett, "Don't shoot, Colonel, I'll come down." I am willing to admit that I know no more about turbines, or curved arms, or *vis viva*, or relative velocities, than did my ancestor—*tempus* 72 B.C.—whose name I have adopted. PYNX GRYPH.

Aberdare, March 1st.

GOOD AND BAD WORK.

SIR,—I have read with interest the letter on "Good and Bad Work" by "A Worker." I agree with him on some points, and vastly differ on others, and will try to explain them to the best of my ability.

(1) He says good work can be turned out for precisely the same amount as bad work. On this point I maintain that he is wrong. Take, for instance, an interchangeable speciality of any kind—which means that each part has to be carefully fitted in all points so as it can be fitted into any machine of the same class without skilled labour—and I contend that duplicate work costs from 10 to 15 per cent. over ordinary work, admitting at the same time an inferior fitted job. The eye of an expert fails to detect any fault with the workmanship until it is called upon to perform the work for which it has been constructed. Then the accurate and inaccurate fitted machines speak for themselves, although they may have been of equal cost to the employer. On this I will point out the reason. The accurate fitted machine was, say, done by a skilled mechanic, but devoid of education, the inaccurate machine being fitted by a mechanic of good education, but devoid of ability and accuracy, therefore taking the same amount of time to perform an inferior task.

(2) Respecting shops that turn out bad work, it is, I admit, often the fault of the foreman's inability for the post he has been appointed to; but on the other hand, he maintains his post simply because he performs the part of a slave driver to the approval of master and manager, and therefore I contend that such conduct in a workshop causes many a good workman to become careless with his work, because the motto is "quantity not quality."

(3) I contend that the mechanic brought up in any workshop, and whose ambition is to elevate himself by his own workmanship, is just the man to be placed in the position of foreman, and to receive a fair remuneration for filling such post. "A Worker" contends that remuneration should be thrown aside for sake of position. I am sorry to have to admit that there are too many book and office-made foremen and managers altogether without practical ability for the post they often occupy, remuneration on their part being no object, only position; hence the result being that work in the majority of cases in shops so controlled being inferior to that of a proper-organised shop. Where the workmen work hand-in-hand with their manager or foreman, as the case may be, the shops will, and do, hold their own, despite depression, and the majority of such shops are filled with thorough mechanics and machine-men, receiving a fair remuneration for their labour—the result being that the duties of manager or foreman are reduced tenfold.

One of the reasons our markets are glutted with inferior work, I believe, can be attributed greatly to the piece-work system so extensively worked on throughout the country. The prices in most cases are ruled or set out by the leading hand, contractor, or foreman, taken too often from the output of a workman who has been accustomed to that particular branch of business only; and when the medium man steps in he finds, if he is to draw a fair wage, he must make up his mind for slavery—not work—as it should be termed. Consequently he does not devote the time and carefulness to the work that ought to be bestowed upon it. FAIR PLAY.

London, February 24th.

SIR,—Your correspondent "H." belongs, I observe, to the good old school of mechanical engineers, knowing nothing of new-fangled things in machine tools, and looking on them with disgust. He is, I am sure, one of the grumblers who he says himself will give a title to the present age.

If he had had any experience in really accurate work, he would have known that there would be no measuring the eye in a fly-wheel, no spring tool, or anything like it. For so small a hole as he speaks of one cut ready to size would be taken—a slashing cut, to use his own words—and then a rose cutter, or milling tool, dead true as to diameter, would be run once through, and the thing to be done would be done.

Your correspondent seems to think that gauges and templates are used to measure holes and shafts. Well, so they are, but they have a different and far more important use, namely, to measure and set tools, which if properly fixed cannot help turning out accurate work. Why the very beauty of accuracy is that there is no fitting so-called required. The parts cannot help going together. Take, for example, the locks of rifles as made at the Enfield Works. A barrow load of separate parts may be thrown on a bench, and in five minutes a man will have a lock put together, every part of any one lock fitting any other lock, and this without adjustment of any kind by hand. Waltham watches made by machinery are just the same; any part of any one watch will fit any other watch.

I do not say that steam engines should be made interchangeable. I have cited gun locks and watches only as examples to show that first-class tools render fitting by hand unnecessary; and this must be a great saving, because, as you, Sir, have already pointed out, it is just as easy to turn a bar to the right size as not. It is all a question of using the proper tool in the proper way.

If "H." will pay a visit to the Royal Gun Factories here, I think he will find some things done that will open his eyes as to mechanical possibilities. FUSE.

Woolwich, March 2nd.

SIR,—We find to our great astonishment, in the issue of your estimable journal for the 18th of December last, appreciations which we think it our duty to refute if we wish to be just towards everyone and render to Cæsar his due. In speaking of the precision with which the work of M. Bollinckx—a Belgian engine builder—is executed, you say:—"The precision attained is so great that the cranks are fixed on the shafts, and levers on weigh shafts, without any keys, the parts being forced into their places. More noteworthy still, the fly-wheels are forced on the shafts and have no keys. We believe that M. Bollinckx is the only engineer who has had the hardihood to pursue this system so thoroughly, and in all cases his practice has been successful."

We think, on the contrary, that the only hardihood which M. Bollinckx has ever shown always has been and still is—and so far it has pretty well succeeded with him, we must own—to appropriate the applications of others and to call them his own without the least scruple. We are only surprised at one thing—that up to the present time he should have been allowed to do this with impunity. We think it therefore as well to let you know that M. Bollinckx has simply copied that which M. P. van den Kerchove, of Ghent, has done for many years, and that he himself in doing this has only followed in the steps of Mr. G. H. Corliss, who already in 1867, at the Paris Exhibition, showed us the first engine of his build which appeared on the Continent, and which had fly-wheel, crank, and all its levers fixed without keys. What will be said of the hardihood of these engine builders when it is known that the pistons of all their engines are simply forced upon their rods, without the least key or nut to retain them, and this not only in engines of 200-horse power, but of 2500 and 3000-horse power, such as those of G. H. Corliss at Philadelphia, and those supplied by M. P. van den Kerchove, in 1875, to the Société La Lys, at Ghent, which have these applications.

Mr. G. H. Corliss does not proceed otherwise, and even with his largest fly-wheels, such as that of the 2500-horse power engine exhibited at Philadelphia was fixed in this manner. In making this little correction I am none the less disposed to admire all those who push the excellence of their work to such a degree as to be able to follow this system, which, when well executed, offers less danger than any other. On the other hand, to put a fly-wheel when in two halves upon its shaft by bolting them together without the use of keys, and by simply making the hole smaller in diameter than the shaft itself as M. Bollinckx has done, and to boast of it, this should not be termed a work of precision, but simply a deformation of a piece which might have been round, thereby compromising its solidity by producing in the object strains which should not exist, and laughing at the public. X.

March 4th.

SIR,—Your article on the above subject is a step in the right direction. I sincerely hope that both manufacturers and workmen may obtain profit from its perusal, as I believe that bad work has largely influenced the competition—and that to our disadvantage—between us and the foreigner. Bad work is not always the result of incompetence. There are two conditions under which bad work may and does exist. The first is the result of want of ability. The second is far more serious, as it involves us in criminal responsibility affecting the best interests of our nation. It is to the latter condition I wish to refer my remarks. Good work may be done at a reasonable cost, whilst the same class of work may be done badly at an increased cost.

This apparent anomaly will be easily recognised as a condition under which a great amount of our work is produced, and to this condition may be ascribed much of our loss of prestige as a manufacturing people. Bad work may be considered hurried work; if hurried work, it should be cheap. That this is not so many will agree with me. If not necessarily cheap, then—under similar conditions—good work must be dear. That this is too true of many of our productions is alike a sorrow and disgrace. Foreign competition has produced fairly good work at reasonable rates, under what circumstances it is our business to inquire. English workmen all the world over are noted for general ability, intelligence, and industrial push, "and, be it understood," under no favourable technical training. This capability is due to national characteristic. Barely can the foreigner approach the standard of British manufactures; their success is small, in spite of educational facilities and the technical training afforded them, and encouraged by their respective Governments. If this is true, why are our prospects waning whilst they are advancing? The cause is bad work at fair prices and good work at dear. By all means let us have technical training; but this alone will never bring back to us our lost trade, and place us in the foreground as the first manufacturing nation in the world.

We must have good work at fair rates. Some will say we have tried and failed. I think not. Foreign competition has set a price at which they can entice buyers. We must do it at the same rate, and it must be as good, or better, work. Having settled the price, we must do the work. It is commenced and finished by good, capable hands, with the result—a first-class job, but not a paying one. This will never do. So the next batch is completed in less time, and the result is scamped and hurried work; but it has paid. How does this affect our trade? Such work is discreditable to the workmen, a disgrace to the employer, and most unsatisfactory to the customer.

Here is the whole secret of our failure. What's the remedy? When we find a certain class of work does not pay us—though it pays someone else to do it—we are too inclined to reduce the labour upon it, instead of adopting means and methods to produce it more rapidly, without depreciating its excellence. A few of our firms have always plenty of work; they get a fair price for it, and turn out a first-class job. Others enter the field against them without any facility for rapid production; they either will not, or cannot, afford the necessary plant. The consequence is evident; they make the job pay by hurrying the work through the shops and bring discredit upon the whole community. All this can be, and is, avoided by doing things in the right way by proper tools. These men get no more—if they get as much—as those who do good work. In the long run, we are bound to say that bad work does not pay.

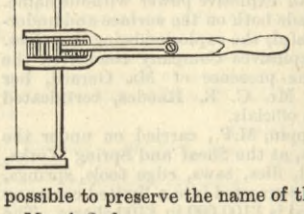
It is really lamentable to see good workmen striving to do first-class work without tools, so that it may pay. Either of two things occur—the work may be good and high-priced, or else hurried and fair-priced. The result is, the first begets a name for high charges, the other for bad work, both cause loss of custom and destroy trade, hence the customer must seek other markets in which to buy. Unfortunately this condition of things is not local, and nearly becomes national. Makeshift seems to be the order of the day in the majority of our works. Lathes that will not turn a spindle parallel give more work for the file: the result, untrue work, more time, and high charge. Planing machines that are unable to produce a surface without ridges, digs in and general unevenness, means more work, more files, and high rates. Drilling machines that cannot drill a vertical hole or withstand the smallest of blow-holes, means small holes, then the inevitable file, next the rimer—the result, as before. Screwing machines, unable to cut a thread without stripping, brings in the stock and dies, to finish—result, as before. Slotting machines make work for the everlasting file. Correspondingly the charges are high, the work badly done, and disgust all round.

The work attempted by many engineers on lines as above, is and must be one of the prime factors against our success as an engineering community. If every firm of manufacturers carried over from their profit account a sufficient sum as a reserve fund, its accumulation would enable them to add to their plant as occasion required, to meet the exigencies of their business; the result would be one of the best investments they ever made. There need be no occasion for turning out bad work. Their trade would increase, their profits likewise; there would be fewer heart-burnings, greater comfort and satisfaction all round. I am afraid, Sir, this letter is already too long, but you asked for opinions as to the cause of bad work affecting trade. I have given my experience. I firmly believe that our depression has its remedy, and it will be largely influenced by departing from the pernicious system of attempting to make good work pay at fair rates without proper tools.

Dublin, March 3rd. G. B.

WHO INVENTED THE RATCHET BRACE?

SIR,—In the *Mechanics' Magazine* for September 5th, 1835, there is a sketch of "a simple drill," said to be the invention of a workman in Mr. Hague's manufactory. Hague was a well-known engineer half a century ago, his shops being somewhere near the Tower, I think. I send a reduction of the sketch, and should like to know whether this is the first ratchet brace. The date of the introduction of that useful tool may be within the recollection of some of your older readers, and it may also be possible to preserve the name of the inventor. ENQUIRER.



March 2nd.

PROFESSOR HUGHES' PAPER ON SELF-INDUCTION.

SIR,—In your interesting leading article in your last week's paper on this subject, I think the paragraph in which you refer to lightning conductors may be slightly misleading, as your readers might infer that a conductor for such purpose made of stranded copper wires would be greatly superior to a solid rod of the same material—lightning rods being usually made of copper; but Professor Hughes' experiments prove that this would only be true if the material used were iron, there being little, if any, difference between a copper rod and a copper strand, where both have the same sectional area. Professor Hughes, I think, clearly shows that the best form of lightning conductor is a flat strip of copper, made as thin as may be considered consistent with durability and strength for connections. ALFRED S. BOLTON.

Oakamoor Mills, near Cheadle,
March 3rd.

AMERICAN NOTES.

(*From our own Correspondent.*)

NEW YORK, February 20th.

BROKERS in railway material succeeded in placing large orders for steel rails this week on a basis of 34 dols. to 34·50 dols. The reported business for the week is 35,000 tons. The business hanging fire to-day is put by reputable brokers at 35,000 tons. The trunk lines are in the market for between twelve and fifteen thousand tons in all to enable them to build about a dozen short lateral lines for the development of traffic. The additional 150,000 tons of rails allowed by the makers will be taken up by the middle of March or 1st of April at latest. The rail making capacity is 1,500,000 tons. At least 1,350,000 tons will be required for this year, and it is not at all improbable but that the entire capacity will be kept busy in meeting orders that favourable conditions will send in. Quotations range from 34 dols. to 35 dols. The prospects for the year continue to improve. The trunk lines have failed once more to agree upon traffic rates, and their meeting the day before yesterday broke up with mutual defiances. Cowen of the Reading laughs at the efforts of the opposing combination to carry out their programme of snuffing him out. He is in New York at this hour arranging with bankers to advance sufficient money to lift him out of his trouble, and a good deal of cabling has been going on between this city and London, with what result it will be impossible to say for a few days. Everything is lively at our exchanges. An immense volume of business is counted on. We do not fear much from the legislative tinkers at Washington. Not one in fifty of the several thousand bills will ever reach debate. Within the past few days, iron and steel brokers have received inquiries for elevated railroad material for New England and Western projectors footing up between seven and eight thousand tons. The structural iron makers are doing but little new business, and are quoting angle iron as shading from two cents per pound, with beams and channels at three cents. The Pennsylvania plate mills with their enormous capacity are barely kept busy. There are no indications of a downward tendency in prices. Very little foreign material was purchased this week, but there is plenty of inquiry. There are probabilities of heavy shipments from your side of Bessemer pig and spiegeleisen, of steel and iron wire rods and tin-plates. Some of our pig iron makers are talking of 18 dols. forge iron by the 1st of April, 19 dols. No. 2 foundry, and 20 dols. No. 1 foundry. Prices are everywhere strong, and the heavy increase in production of both crude and finished material as compared to twelve months ago is all going into consumption, and there are hosts of buyers yet to be heard from.

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

(*From our own Correspondent.*)

BIRMINGHAM 'Change this—Thursday—afternoon, and Wolverhampton 'Change yesterday, were not lively meetings. Orders continue of the minimum extent and number, and it is becoming general for not a few of the mills to commence for the week only on Wednesday night. Consumers are content with satisfying present necessities, though here and there some encouraging export lines are coming to hand. One firm is reported to have just secured orders aggregating 3000 or 4000 tons of nail rods, baling hoops, and bars, on account of China, Japan, and America. Other orders of this sort would be very welcome.

Sheets, which up to a little while ago maintained a better position on the market than other descriptions, have now to be classed in the general slackness of orders. The demand from the galvanisers is sensibly smaller than a while ago. Merchant sheets of 20 gauge are £6 and on; galvanising sheets of 24 gauge, £6 5s.; and 27 gauge, £7 5s.

The marked bar people keep up their official list price of £7 10s., with £8 2s. 6d. for Lord Dudley's iron, but for inferior bars the value fluctuates between £5 5s. and £6 10s., according to quality.

Gas strip and nail strip are quoted £5 5s.; common hoops, £5 10s.; and hinge strip, £6 5s. Better qualities of hoops are quoted £6 5s. for 19 w.g., £6 15s. for 20 g. of $\frac{7}{8}$in., and £7 5s. for 20 g. of $\frac{3}{4}$in.

The current prices of Messrs. E. T. Wright and Son, of the Monmoor Works, are:—Monmoor bars, £6 10s.; best, £7 10s.; double best, £8 10s. Best rivet iron, £8; double best, £9. Angles, £7, £8, and £9, according to quality; and tees, £7 10s., £8 10s., and £9 10s. Hoops of 16 to 19 w.g. are £7; 20 w.g. of $\frac{7}{8}$in., £7 10s., and $\frac{3}{4}$in. £8. Sheets the same firm quote as £7 10s. for Monmoor singles, £8 10s. for best, £9 10s. for best best, and £15 for charcoal qualities. Boiler plates of 5 cwt. each are £8 to £9; treble best to 4 cwt. each, £11; special quality for flanging to 3 cwt., £14 10s.; and charcoal qualities, £16. The "Wright" qualities of the same firm are 15s. less than the above quotations.

Contracts for pig iron are entered into with only very limited earnestness, and makers complain of the profitless prices offered them. Producers of common pigs have in some cases no alternative but to accept 30s. Other firms are getting 31s. 3d., and the general market quotation is still 32s. 6d. Part-mine pigs are anything from 39s. to 40s. Northampton and Derbyshire pigs were never lower, and some Derbyshire firms have retired from soliciting orders. Northamptons are to be had freely, at something less than 37s., delivered to railway stations, or 37s. 6d. to 37s. 9d. delivered to works. Derbyshires are 38s. to 38s. 3d. at works. The Thorncliffe brand—South Yorkshire— is quoted 50s.

Minerals are dull. Northampton iron ores are 5s. 6d. upwards, delivered here, and native ironstone is 10s. to 12s. 6d. per ton long weight. Welsh furnace cokes are changing hands at 12s. 6d. per ton delivered here. Sellers of Derbyshires ask 13s. 3d. to 13s. 6d., but buyers only offer 12s. 6d.

Common Staffordshire forge coal is 5s. to 6s., and best 7s. Furnace coal is 7s. to 9s. Picked best house coal is 8s. for shallow and 10s. for deep, but the bulk is selling at 6s. 6d. for shallow and 8s. 6d. for deep.

A strike, accompanied with riotous conduct, which threatened to seriously interfere with activity at Messrs. Nettlefold's screw works at Smethwick, was begun on Friday of last week, against a notice for the reduction of 10 per cent. in wages. The occasion for the notice was the reduction of 17 per cent. in net selling prices which Nettlefold's recently announced, to meet the increasing German competition. The workpeople employed at Smethwick number altogether some 2000. Happily the strike has now subsided, and the works are again on. The managing director, Mr. C. Steer, explained to the workpeople that no reduction less than 10 per cent. would meet the case, and in refusing to accept it they were playing the game of the Germans.

The employer members of the Wages Board having consented to receive from the operative section any draft scheme which they may have to propose, with a view to the possible establishment of a new sliding scale, the operative section have recently been engaged in attempting to formulate a basis. This basis has been laid before a meeting of the Brierly Hill men this week, and has been adopted by them. It provides that, to be satisfactory, the basis must include all classes of iron, made by some twelve firms to be mutually selected by both sides of the Board, with 1s. per ton in advance of the equal shillings to pounds as representing the average selling price, together with a minimum fixed at 7s. 6d. per ton for puddling. Thus the men are averse to any new sliding scale which shall have as its basis merely the average price of bars as has hitherto been the case. Sheets having become so important a branch of the Staffordshire trade, the men are particularly anxious that these should be taken into account.

Knowing only too well how greatly many of the colliery proprietors would desire a return to the nine hours' system, the colliers are just now holding meetings in several parts of South Staffordshire, and are protesting against any departure from the present eight hours' system. No combined action by the coalmasters is at all likely to be taken yet awhile.

Orders for dynamos, accumulators, and other electrical machinery are being received in large numbers by the Wolverhampton Electric Light and Engineering Company. The men are working overtime, and the firm is still considerably increasing productive capacity.

Engineers engaged in the pump trade continue to complain of severe American competition. It is seen mostly in pumps of the lighter descriptions for operation by hand or wind or engine power. The Americans keep a firm hold upon the Australian and some other colonial markets, notwithstanding the undoubted excellence of the goods which our manufacturers offer in competition with them. And the U.S. light pumps are being increasingly pushed into the English market. The prices at which they are offered to purchasers are very tempting, and are for some sorts lower than our makers care to attempt to follow. As to steam pumps, in the manufacture of which a good deal of skilled labour is expended, our makers have no fear whatever of the American competition.

German competition is increasingly coming to the front in the Australias and South Africa in pumps for wind and other easy power. The prices which the Germans are prepared to take are exceedingly low.

Messrs. Joseph Evans and Sons, Culwell Foundry, Wolverhampton, have amongst their other foreign work just despatched a steam pump to China to be employed, it is anticipated, for irrigation purposes. It has 24in. steam cylinder, 10in. water cylinder, and is provided with condensers. Other orders are also in hand for the same market. Powerful steam pumps are being supplied for colliery drainage purposes at home by Messrs. Evans.

The Birmingham Corporation Waterworks have resulted in a loss for the past year of £7642, which succeeds a loss of £8940 in 1884, and a loss also in 1883. Such undertakings it is, however, urged are necessarily to a very large extent commercial in all their attributes, and are effected by the general circumstances which prevail from year to year. The elements of the increase of the revenue are shown to be strong and vigorous. The amount received from water rents, for example, is rapidly increasing. The losses are attributable to an expenditure on capital account since the Corporation acquired the works ten years ago of £446,242, on which the interest is £16,000 per annum; and to important reductions in water rents. The committee believe that the loss will gradually rectify itself, and they have a reserve fund of £50,000.

NOTES FROM LANCASHIRE.

(*From our own Correspondent.*)

Manchester.—Business throughout all branches of the iron trade in this district continues to drag on from week to week without material change; a general tone of depression, unrelieved by any prospect of improvement, persistently overhangs the market, and gives a very gloomy outlook for the future. Even the proposed combination for a restriction of the output in Scotland, to the probability of which I referred in my "Notes" a couple of weeks back, and which it is sought to extend to the North of England, Cumberland, and other important iron-making districts, produces very little effect upon the market here. Buyers evidently do not believe that the blowing out of furnaces will be carried to such an extent as to give any permanent appreciable upward movement to prices, and consumers generally are quite indifferent about anticipating possible future requirements. What buying there is going on in the market is still for the most part confined to hand-to-mouth requirements; and although, on the other hand, makers are not anxious to commit themselves to long forward engagements, this does not arise so much from any anticipation that prices are likely to be higher, but rather because transactions at the present unremunerative rates offer no advantage, except that they enable works to be kept going at probably a less loss than would be entailed by an absolute stoppage of production.

The Manchester iron market on Tuesday brought together only a moderate attendance, and business throughout was very flat. In pig iron there is a small weight of business doing, and for some of the better class local and district about 38s. to 38s. 6d., less $2\frac{1}{2}$, delivered equal to Manchester, is got on occasional sales; but there is Lincolnshire iron in the market which could be bought readily at quite 1s. per ton under these figures; and good Middlesbrough foundry brands are to be got at about 39s. net cash, delivered here, with Scotch iron offering at under the current quoted rates.

In hematites there is extremely little business stirring, and where sales are made transactions are so much a matter of bargain between buyer and seller that prices are scarcely quotable; but that the tendency is in the favour of buyers is only too evident from the readiness with which concessions are made where there is the possibility of orders being secured.

The manufactured iron trade continues excessively quiet, forges are with difficulty kept going upon about half their output, and prompt specifications are eagerly sought after at extremely low prices. For delivery into the Manchester district the average quoted rates remain at about £5 2s. 6d. for bars, £5 10s. for hoops, and £6 12s. 6d. for sheets, but for immediate delivery makers do not adhere at all firmly to these prices, and in some instances 2s. 6d. per ton less money is taken for favourable specifications.

I hear that some of the boiler-making firms in this district have been getting a fair weight of orders recently, but these have been so keenly competed for that the prices at which they have been taken are extremely low. In other branches of the engineering trade there is no material change to notice from what I have reported recently.

The utility of the "warnings to colliers," which for several years past have been published in the daily newspapers when changes of barometrical pressure are supposed to render mining operations more than ordinarily dangerous, was very seriously questioned at the meeting of the Manchester Geological Society on Tuesday. Mr. Joseph Dickinson, H.M. Chief Inspector of Mines, said that taking all the information that was obtainable with regard to mine explosions in the past, it was very difficult to trace any direct connection between those explosions and changes in the barometrical pressure; and with regard to the "warnings" which were now periodically published in the newspapers to use extra care under certain conditions, he was not sure whether these spasmodic efforts were not doing more harm than good. It required constant care in the pits, and the utmost care at all times; but to use extra care for the next two or three days as they were told in the newspapers that morning meant less care in several days after; there ought to be no laxity in the management of a mine at any time. Mr. Miles Settle said that his experience of these warnings had been that whilst they upset the minds of the men they were of little or no practical service. In most instances the danger had come before they got these warnings, and many a time they were down in the pit before they knew anything about them. With regard to the effect of the atmospheric pressure on the issue of fire-damp, he had found that they had more gas given off with a falling or rising barometer than they had with an ordinary standing barometer. Mr. S. Garside thought it was a great mistake to publish these warnings in the newspapers; they ought always to be using all the care they possibly could in a mine.

The progress of electric lighting in mines was also brought before the Geological Society at the meeting on Tuesday in an address delivered by Mr. Thomas Conolly. For the last two or three years, he said, very successful results had been obtained in lighting up the main roads of collieries in the South Wales and North of England districts on the incandescent principle, and he thought it might now be carried still further to all the stations where the men lit their lamps, if not actually to the face of the coal. The chief difficulty to contend against was the liability to a rupture of the electric current by falls of roof, but Mr. Conolly exhibited a specially constructed cable, similar to those in use for ship lighting, which he thought would preserve the current intact even under a fall of roof, and which in the case of such an accident would not only afford a light to the men behind the fall of roof, but also a means of communication to the colliery officials in the other portions of the mine. Mr. Conolly saw no difficulty in distributing electric illumination about a colliery by means of graduating cables according to the lights required, in much the same manner as gas was distributed about a house, and he thought the progress now being made in electrical science brought the question of the electric lighting of mines near to its practical realisation.

The exceptionally severe weather of the last few days has given a strong tone to the coal trade, and so far as all descriptions of house fire coal are concerned, the month has opened with prices very firm at late rates. Common round coals are, however, still a weak point in the market; for steam and forge purposes the demand continues extremely poor, and these classes of fuel are a drug, with excessively low prices taken for anything like sales in bulk. Engine classes of fuel are generally in fair demand, with prices steady, but there are still plentiful supplies in the market. At the pit mouth prices average 8s. 6d. to 9s. for best coals, 7s. to 7s. 6d. seconds, 5s. 6d. to 6s. common house coals, 5s. to 5s. 6d. steam and forge coals, 4s. to 4s. 6d. burgy, and 2s. 6d. to 3s. 6d. per ton for ordinary slack, according to quality.

In the shipping trade there is a tolerably good business doing in house coals, but steam coals are in slow demand, and offered at low prices both at Garston and Liverpool.

The heavy fall of snow this week has considerably interfered with operations at the collieries; at some of the collieries all railway access to the pits has been temporarily completely blocked, and generally there has been very great difficulty in getting deliveries of coal away.

Barrow.—There is a quiet demand for all classes of hematite pig iron, and the position of affairs is not improved from last week. There is, in fact, not so much disposition to buy iron as was the case a month or two ago, and makers, on the other hand, are not disposed to sell in any heavy parcels at present values. It is not thought probable that the reduced tariff on iron imported into America will be carried. If this should be the case, it would make a capital opening for West-coast hematites. Belief is general that any improvement which is brought about in the trade of this district must come first from America, and many are hopeful that the next few months will establish an improved tone from that quarter. On the other hand, it is difficult to see what will be the effect if the Steel Rail Makers' Association is broken up, as seems to be probable, and the value of steel declines from £4 15s. and £5 per ton to £3 17s. 6d. or £3 15s., which it is thought likely would be the case if makers were not combined. This week pig iron is again quoted at easier rates. Mixed parcels of Bessemer iron are quoted at 43s. per ton net at makers' works for prompt delivery.

Steel makers are only busy in the tin-plate, ship steel, and general merchant departments. If no new contracts for steel rails are placed shortly, the works will have to be put on short time. There is nothing new to note in the shipbuilding trade, orders being very few in number. The marine department of engineering is the only one that is busy, and that is but of a temporary character. Iron ore quiet, with a few orders for Scotland and a prospect of business with America.

The output of the forty-five furnaces in blast in this district is about 25,000 tons per week of Bessemer iron, and 1500 tons of spiegel iron.

THE SHEFFIELD DISTRICT.

(*From our own Correspondent.*)

A RUMOUR has again been started that the Yorkshire Miners' Association contemplate a second experiment in coalowning. It was hinted that the colliery they were after was Streethouse—belonging to Messrs. Briggs, Son, and Co., at Whitwood. I think it is extremely improbable the Yorkshire Association officials would attempt anything of the kind. In better times they tried the business at Shirland, in Derbyshire, and the result was not a success. A late alderman of Sheffield did his best to restore order out of chaos, but his efforts were fruitless—the experiment was a costly failure. The officials are too wise to repeat that error, especially in such times. Anyone who has a fancy for becoming a coalowner could buy a pit cheap at present.

Mr. H. R. Batson, of London, whose letter to the Society of Architects' Conference at Sheffield last week, on English *versus* foreign iron, excited a good deal of interest, invites assistance in his "efforts to convince architects and engineers that English manufacturers can and will successfully compete with foreign manufacturers, especially in quality, which is, after all, the test of cheapness." Having convinced them of this fact, he would then endeavour to gain their assistance by binding clauses in their specifications to the effect that no goods of foreign manufacture be used in or upon these works unless specially described, or by the express order of the architect in writing; and in the event of any such goods being used unless under the terms before named, the contractor to forfeit the goods, and be subject to a fine of, say, £50. This is a drastic remedy which would require a good deal of consideration.

The manufactured iron trade of the district shows very little improvement. Recent railway orders have necessitated additional employment in light iron work; but other manufactured irons are dull, and threaten to continue so. Steel is also languid, and though there is more doing in certain descriptions of cutlery, generally there is not full work in any department. Edge tools are feeling German competition more keenly than ever, and the plated industries, with files, saws, and hardware, partake of the general depression.

A series of experiments have been carried out at Aldwarke Main Colliery, the property of Messrs. John Brown and Co., to show the power of Mr. Miles Settle's water cartridges for the ordinary purposes of blasting in mines. The cartridge consists of nitro-glycerine inclosed in water, the quantity and explosive power of which can be adapted to requirements. The nitro-glycerine is surrounded with a waterproof casing filled with water and exploded by a detonating cap. This is fired by means of an electric current, the object aimed at being to secure an explosive power without flame. The experiments, which were made both on the surface and underground, were stated to be successful, the explosion being flameless. A representative of Nobel's Explosives Company conducted the trials, which were made in the presence of Mr. Gerard, her Majesty's Inspector of Mines, Mr. C. E. Rhodes, certificated manager of the colliery, and the officials.

The business of Mr. F. T. Mappin, M.P., carried on under the title of Thomas Turton and Sons, at the Sheaf and Spring Works, Sheffield, manufacturers or steel, files, saws, edge tools, springs, wire, mining tools, &c., has been converted into a limited company under the same title. The capital is £100,000 in £100 shares. The purchase is regulated by an agreement of the 20th January, the consideration being £87,386, payable as to £19,000 in fully paid shares, and the balance in cash. The company is limited to Mr. Mappin, his three sons, and several leading officials in the concern.

THE NORTH OF ENGLAND.

(*From our own Correspondent.*)

THE Cleveland iron market, held at Middlesbrough on Tuesday last, was well attended, and the tone was certainly firmer than it has been for some time past. The amount of business doing, however, was small. A rumour prevails to the effect that a combination of Scotch, Cleveland, and Cumberland smelters is about to be formed for the purpose of restricting production. Prices have, consequently, advanced, and 30s. 3d. per ton was the lowest figure accepted on Tuesday for No. 3 g.m.b. for prompt delivery, and several sellers refused to take less than 30s. 6d. For forward delivery 30s. 9d. per ton was the price usually quoted. The demand for forge iron has somewhat improved now that work is being gradually resumed at the shipyards, and prices are stiffer.

Messrs. Connal and Co. had on Monday last, in their Middlesbrough stores, 180,143 tons of Cleveland pig iron, representing an increase of 12,914 tons during the week. At Glasgow their stock is 692,208 tons, or an increase of 2252 tons.

Notwithstanding the great augmentation of stocks, warrants have advanced to 30s. 6d. per ton.

The shipping returns for February show that the total quantity of iron of all classes shipped during that month was 84,780 tons, or an increase of 11,295 tons on the January shipments. Out of the total quantity, 52,854 tons were pig iron, whereof 25,510 tons went to Scotland, 6710 tons to Holland, 5149 tons to Wales, 2650 tons to Italy, 2632 tons to France, 2060 tons to Germany, 1285 tons to Spain, and 1300 tons to America.

There is no change for the better as regards the manufactured iron trade. The deliveries to shipyards are very small, owing to stoppage of work through inclement weather. Quotations on Tuesday were as follows:—Ship-plates, £4 10s. per ton to £4 12s. 6d.; angles, £4 7s. 6d. to £4 10s.; and common bars, £4 12s. 6d. to £4 15s.—all free on trucks at makers' works, less 2½ per cent. discount. Steel rails are offered at £4 15s. at makers' works, steel ship-plates at £6 10s., and steel angles at £6 5s., all less 2½ per cent. discount.

Messrs. Bolckow, Vaughan, and Co.'s directors recommend a dividend at the rate of 2½ per cent. for the year ending December 31st, 1885.

The Moor Steel and Iron Company, Stockton-on-Tees, started its Siemens-Martin steel-making plant last week. It is making slabs and ingots to pass Lloyd's and Board of Trade tests, and will soon be in a position to supply steel plates.

NOTES FROM SCOTLAND.

(*From our own Correspondent.*)

FEELING has run somewhat high in the Scotch iron trade this week in consequence of the efforts that are being made to bring about a curtailment of production. On some days the belief has been strong that the ironmasters will succeed in attaining something approaching unanimity on the subject, while on other days serious doubts have been expressed. As a consequence the market has been unsettled, although it is satisfactory to note that the general tendency has been in the direction of improvement. This tendency was assisted by the shipments, which were slightly larger than of late, amounting to 7699 tons, as compared with 5866 in the preceding week and 8575 in the corresponding week of 1885. About 2800 tons were added during the week to the stock in Messrs. Connal and Co.'s stores.

Business was done in the warrant market on Friday at 38s. 8½d. A large quantity of iron changed hands on Monday at 38s. 7½d. to 39s. 2½d. and down to 38s. 9½d. On Tuesday business took place up to 39s. 4d. cash, receding at the close to 39s. 1½d. Business took place on Wednesday up to 39s. 2½d. cash, but the market was flat in the afternoon, with a decline to 38s. 9d. To-day—Thursday—transactions occurred at 38s. 4½d. to 38s. 1½d. cash, closing with buyers at 38s. 3½d. cash.

The current values of makers' iron are:—Gartsherrie, f.o.b. at Glasgow, per ton, No. 1, 43s.; No. 3, 41s.; Coltness, 47s. and 43s. 6d.; Langloan, 44s. 6d. and 42s. 6d.; Summerlee, 47s. 6d. and 42s. 6d.; Calder, 47s. and 41s.; Carnbroe, 43s. and 40s. 6d.; Clyde, 43s. 6d. and 40s. 6d.; Monkland, 39s. 6d. and 36s. 6d.; Quarter, 39s. and 36s.; Govan, at Broomielaw, 39s. 6d. and 36s. 6d.; Shotts, at Leith, 45s. and 44s. 6d.; Carron, at Grangemouth, 48s. 6d. and 45s. 6d.; Kinneil, at Bo'ness, 43s. and 42s. 6d.; Glengarnock, at Ardrossan, 43s. 6d. and 41s. 6d.; M. and C., 39s. and 37s. 6d.; Eglinton, 39s. and 36s. 6d.; Dalmellington, 42s. and 38s. 6d.

Since the beginning of the year there is a comparative reduction of 16,833 tons in the imports of Cleveland pig iron into Scotland; but as there was a very large quantity of this iron in store at Glasgow at the end of the year, it would be a mistake to assume that the consumption in Scotland has fallen off to anything like this extent.

Negotiations have been proceeding between the Scotch and English ironmakers, with the view of reducing the output of pig iron. The Scotch masters were not unanimous on the subject, several firms owning a considerable proportion of the blast furnaces having declined to enter such a combination. The others were understood to be very anxious that something should be done in the direction indicated, and they will put forth every effort with the view of attaining their object.

The first result of the break-up of the Steel Conference in Scotland has been that makers have reduced prices by 5s. a ton. This brings them to within 2s. 6d. of the rates prevailing before the masters joined the Conference. As a number of orders had to be declined, owing to the artificial rates maintained, the Scotch steelmakers are understood to be well pleased at having again obtained liberty of action. Of the monetary advantage of the combination little has, however, transpired, and this is an element that must enter largely into the consideration of any future united action that may be proposed. On the face of the question, it seems as if the Scotch makers had everything to gain by a policy of isolation.

Messrs. P. and W. McLellan, of Glasgow, have this week obtained an order to supply a number of wagons for the Indian railways.

The Gas Committee of Glasgow Corporation has placed a contract for a large gasholder for the Tradeston Gasworks with Messrs. Clayton and Co., of Leeds. The sending of this work away from the district in these dull times has given occasion for some animadversion, but as the Leeds firm is quite qualified to execute the work, and as its tender was hundreds of pounds below those of local makers, the committee had really no option but to give them the contract.

There has been rather more doing in the shipping department of the Scotch coal trade. The past week's shipments embraced 40,262 tons from Glasgow, 891 tons from Greenock, 10,506 tons from Ayr, 2718 tons from Irvine, 6525 tons from Troon, 2791 tons from Leith, 3810 tons from Grangemouth, and 4208 tons from Bo'ness. In the inland department there is a great want of activity, although the recurrence of very cold weather has improved the inquiry for household sorts. There is no improvement in prices.

The reduction of 10 per cent. in the wages of the Fyfe and Clackmannan miners has been the subject of a conference this week at Dunfermline between seven representatives of the coalmasters and as many delegates of the miners. Both sides of the question were ably submitted, and a conciliatory spirit appeared to mark the proceedings, although the masters declined to make any concessions. In the past month the shipments of coals from Burntisland were 27,382 tons, a very small amount, but yet 3586 tons greater than in February, 1885. It is expected that the trade will improve in the course of a few weeks; but in the meantime it is in a very unsatisfactory state.

A considerable number of miners have been discharged in the Denny district of Stirlingshire on account of the depression in the coal trade.

About 100 pipe-moulders have come out on strike at the Grahamston Ironworks, as a result of a curtailment in the rates of wages.

During February eight vessels were launched from the Clyde shipyards, with a total tonnage of 11,250, as compared with fourteen of 13,985 in the same month last year, 28,730 tons in February, 1884, and 33,560 in the second month of 1883.

WALES AND ADJOINING COUNTIES.

(*From our own Correspondent.*)

THE coal trade still remains depressed, and Cardiff exports show this by a falling off last week to the extent of 30,000 tons. Newport totals are less also by 6000 tons; but Swansea appears to have maintained a tolerable average. To add to existing depression, the coal district this week is literally barricaded by snow, and the total at the end of the week will be a sorry one all round.

"Hard times" prevail in the iron trade, and there is a whisper abroad, how far true I cannot say, that the syndicate of steel makers is doomed, and that, like the tin-plate makers, each one will have to do the best for himself. In the matter of steel, and as far as Wales is concerned, this could be safely done, as the steel makers are fairly equal, and the "weak ones" few in comparison to those of the tin-plate trade. Another fact, too, is to be noted, that one or two of the steel makers are forging ahead of the rest, and doing better business. It was reported publicly last week at Tredegar that good work was being done, owing to the skill exercised in getting business.

Cyfartha, too, continues briskly at work, and from its one converter, the other having broken down, turned over 1500 tons of steel last week. America claims to have exceeded this, and we must allow America credit in doing most of the big things of life; but in this country this is the largest yield on record, and proves several things. First, that the plant is of the best, as we described at the start; secondly, that it was well arranged by Mr. Edward Williams, himself the owner of a most compact and successful works in the North; and, thirdly, that in the manager, Mr. Wm. Evans, the Messrs. Crawshay have the very man they needed. He is turning out a capital steel rail, one of the best I have seen, and that it is approved is shown by the fact that even in these bad times a large make is cleared. The only drawback is that the price is low, and thus the margin of profit small, and out of all character compared with the great expenditure of capital in building and transforming Cyfarthfa Works.

The rail and bar trade generally is slack, and if men work four days a week it is regarded as satisfactory.

At the Rhondda steam coal monthly meeting the assembly commended the Government strongly for appointing a labour representative, Mr. Broadhurst, to a ministerial position. In the matter of local inventions they also commended highly Mr. Kirkhouse's two inventions, one the harbour lamp station, and the other the apparatus for working collieries. This latter is the joint invention of Mr. Henry W. Lewis, Treherbert, and Mr. Kirkhouse, and if the coal trade improved would no doubt be widely adopted. An important discussion at the meeting was the Employers' Liability Bill, and there was general anticipation that a complete Bill will soon be legalised. The report, too, of the Mines Commission, a most important production, may soon be expected.

At the election of workmen's representatives—Monmouthshire and South Wales Sliding Scale Committee—this week—Mr. David Morgan was rejected.

The Rhondda and Swansea Bay line, though only partially opened, pays 3 per cent.—a hopeful fact for shareholders.

The Penrhiwceiber colliers, in proof that they are well employed—an exceptional fact—have contributed £25 15s. 10d. to the Mardy Colliery Fund.

The tin-plate trade is moderately brisk, and a demand is setting in for spring business, which looks promising, especially as sales are now in increase of make, and consequently prices are firmer. Ordinary cokes are stiff at 13s. 6d. The shipments to New York, France, and Germany last week amounted to 44,523 boxes.

Mr. Guion, of the Guion Line, visited Swansea a few days ago to see the feasibility of running steamers direct from Swansea to America with passengers and tin-plates. The total make of tin at Swansea last week was close upon 40,000 boxes, and with the maturing of foreign trade, and a good to-and-fro line of steamers direct, prospects appear to be decidedly improving.

Messrs. Peckett and Sons, locomotive engine builders, Bristol, have commenced building new shops for storing locomotive engines when completed. They usually keep a number in stock, but with the additional premises they will be able to keep from thirty to forty locomotives of different types and sizes, so that customers will be able to select those most suitable for their requirements. They are building new store rooms for finished duplicate parts, so that any part can be sent off at a moment's notice, their engines all being made to standard gauges and templets, also new paint shops and stores, hydraulic wheel shop, stables, lavatories, &c. With these extensive additions to their works, Messrs. Peckett and Sons hope to be able to turn out a larger number of locomotive engines than before, so as to be able to meet the demands made upon them by their increasing trade.

NEW COMPANIES.

THE following companies have just been registered:—

Appleby Brothers, Limited.

This company proposes to acquire the business of Messrs. Appleby Brothers, manufacturing engineers and contractors, with the leasehold land, workshops, and buildings held by them on the River Thames, at East Greenwich, together with the plant, machinery, and other assets of the firm. It was registered on the 20th ult. with a capital of £50,000, in £10 shares. The subscribers are:—

	Shares.
*Thomas Greenwood, Dacres-road, Forest-hill	100
*John Wallace, 81, Gracechurch-street, iron merchant	100
*W. Robert Green, Great Dover-street, Southwark, engineer	100
*Charles Appleby, 89, Cannon-street, engineer and agent	10
Percy V. Appleby, 1, Laurence Pountney-hill, engineer	10
T. Greenwood, jun., 3, Rutland Park Villas, Catford, Baptist minister	50
G. Higgs, Upton Cottage, Upper Tulse-hill, coal merchant	100

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 minimum remuneration of the directors (other than Mr. C. J. Appleby, or any managing director) will be £300 per annum, and a further sum equal to 10 per cent. of the balance of the annual net remaining after 6 per cent. has been paid upon the ordinary capital. The remuneration of Mr. Appleby will be such sum as may from time to time be agreed upon between him and the board.

J. E. H. Andrew and Co., Limited.

This company proposes to manufacture, buy, sell, and deal in gas and electrical engines and motors of all kinds and all apparatus used in connection therewith, and for such purpose will acquire the goodwill of the business of J. E. H. Andrew and Co. It was registered on the 20th ult. with a capital of £30,000, in £20 shares. The subscribers are:—

	Shares.
*C. H. Andrew, Stockport, Cheshire, engineer	1
Mrs. E. H. Andrew, Stockport, Cheshire, widow	1
*H. H. Andrew, Sheffield, steel manufacturer	1
*J. A. A. Andrew, Sheffield, steel manufacturer	1
*Hugh Williams, C.E., Stockport	1
T. Nicholson, Sheffield	1
E. Robinson Walker, Manchester, solicitor	1

The number of directors is not to be less than three nor more than eight; qualification (except for Mr. H. Williams), £1000 in shares or stock; the first are the subscribers denoted by an asterisk; the company in general meeting will determine remuneration.

Abbots Langley Waterworks Company, Limited.

This company proposes to construct waterworks for supplying the village and neighbourhood of Abbots Langley, Hertfordshire. It was registered on the 23rd ult. with a capital of £3000, in £10 shares. The subscribers are:—

	Shares.
*G. Turnbull, Abbots Langley	20
*H. Gilliat, Abbots Langley	50
*Rev. F. H. Hodgson, Abbots Langley	30
*J. E. Littleboy, Hunton Bridge, miller	7
*Rev. E. T. Vaughan, Hunton Bridge	2
*E. H. Lloyd, Langleybury	50
A. F. Phillips, C.E., St. Albans	1

The first six subscribers are appointed directors; qualification, five shares.

Derbyshire Chemical Company, Limited.

This company proposes to acquire chemical works situate at Killamarsh, near Chesterfield, and to carry on business as chemical manufacturers and refiners, tar distillers, cement manufacturers, lime burners, &c. It was registered on the 22nd ult. with a capital of £10,000, in £10 shares. The subscribers are:—

	Shares.
*J. Abbott, Braemar House, Lancaster-gate, chemical manufacturer	1
*J. Forbes, Grand-avenue Mansions, West Brighton, chemical manufacturer	1
*F. Lennard, Elderslev, Redhill, chemical manufacturer	1
*F. Ince, 17, Fitzjohn's-avenue, Hampstead, solicitor	1
F. H. Tildesley, 6, Hadfield-terrace, Maxted-road, S.W., clerk	1
G. C. Parnaby, 40, Beresford-road, N., accountant	1
W. Russell Jackson, 141, Plimsoll-road, Finsbury Park, shorthand writer	1

The number of directors is to be five; the first are the subscribers denoted by an asterisk. The directors, including the managing director, will not be entitled to any remuneration other than expenses out of pocket, and such further sum for special services as the company in general meeting may determine.

Eli Tricycle Company, Limited.

This company proposes to acquire and work patents relating to velocipedes, and for such purposes will adopt an agreement entered into with Alexander James Eli. It was registered on the 24th ult. with a capital of £2000, in £1 shares, with the following as first subscribers:—

	Shares.
N. Robinson, 105 and 106, Charlton-street, Euston-road	1
A. Rayner, 26, Francis-street, W.C., artist's colourman	1
S. E. Lambert, 40, Chancery-lane, solicitor	1
J. M. Johnston, Tooting Junction, auctioneer	1
E. Horsey, Tooting Junction, stationmaster	1
E. Freemantle, Merton, builder	1
H. Follett, 49, Barrett's grove, Stoke Newington, clerk	1

The number of directors is not to be less than three nor more than seven; qualification, shares or stock of the nominal value of £10.

Moulding and Artists' Materials Manufacturing Company, Limited.

This company proposes to take over the business of a moulding and artists' canvas and materials manufacturer and dealer, carried on by Messrs. Alfred Jeffries, Max Otto Hübner, and Arthur Wellesley Maxwell, at 107, New Oxford-street, the Grove Works, Este-road, Battersea, and at Woodbridge, Suffolk. It was registered on the 24th ult. with a capital of £10,000, in £1 shares. The subscribers are:—

	Shares.
H. J. Blackham, 147, Huddlestone-road, Holloway	1
J. S. Downes, 3, Gray's-inn-road	1
W. Maxwell, 37, Mark-lane, flour factor	1
W. A. Maxwell, 8, Bell-yard, Temple-bar, law publisher	1
W. F. Robinson, 34, Mostyn-road, Brixton	1
A. H. P. Snow, 36, Tremlett-grove, Holloway, chartered accountant	1
W. H. W. Moss, 20, Park-road, Manor Park, Essex, commercial traveller	1

The number of directors is to be six; the subscribers are to appoint the first and act *ad interim*; qualification, 20 shares. Messrs. A. W. Maxwell and Max Otto Hübner are appointed managers at salaries of £4 per week each.

Thomas Turton and Sons, Limited.

This is the conversion to a company of the business of manufacturers of steel, files, saws, edge tools, springs, wire, mining tools, and other articles, carried on by Mr. Frederick Thorpe Mappin, trading as Thomas Turton and Sons, at the Sheaf and Spring Works, Sheffield, the buildings, machinery, plant, and stock-in-trade being included in the transfer. It was registered on the 18th ult. with a capital of £100,000, in £100 shares. The purchase is regulated by an agreement of the 20th February, the consideration being £87,386 9s. 6d., payable as to £19,000 in fully-paid shares, and the balance in cash. The subscribers are:—

	Shares.
*F. Thorpe Mappin, Thornbury, Sheffield, merchant and manufacturer	1
*Frank Mappin, Thornbury, Sheffield, merchant and manufacturer	1
*Wilson Mappin, Abbeydale Grange, Sheffield, merchant and manufacturer	1
*Samuel Wilson Mappin, Scampton, Lincoln, farmer	1
*Thomas Waterhouse, Claremont-place, Sheffield, traveller	1
R. Churchill, Kitching, Sharle-hill, Sheffield, clerk	1
W. J. Thompson, 6, Higham-crescent-road, Sheffield, clerk	1

The number of directors is not to be less than three nor more than six; qualification, 10 shares; the first are the subscribers denoted by an asterisk. The remuneration of the ordinary directors will be £50 each, or such other sum as the company in general meeting may determine. The managing director will be entitled to a remuneration of £1000 per annum, or such other sum as the shareholders may vote in general meeting.

Reddish Pottery Company, Limited.

This is the incorporation as a limited company of the business of stoneware potters, manufacturers and merchants, carried on by Mr. Edwin Johnson, Mrs. Rose Ann Johnson, and Robert Auld Mathieson, trading as R. A. Mathieson and Co., at Reddish, near Stockport, Lancashire. It was registered on the 18th ult. with a capital of £100,000, in £10 shares, with the following as first subscribers:—

	Shares.
*Edwin Johnson, 10, Old Corn Exchange, Manchester, commission agent	1
*Robert A. Mathieson, Heaton Moor, potter	1
*Thomas Glover, Crewe, grocer	1
F. Walmsley, 49, Hanging Ditch, Manchester, accountant	1
G. H. Russell, 49, Hanging Ditch, Manchester, accountant	1
Mrs. R. A. Johnson, Heaton Chapel, Manchester	1
J. W. Sayer, 63, Higher Ardwick, Manchester, fruit preserver	1

The number of directors is not to be less than three nor more than five; qualification, 50 shares; the first are the subscribers denoted by an asterisk. The company in general meeting will determine remuneration; Mr. R. A. Mathieson is appointed manager for five years at a salary of £150 per annum, and subject to the previous payment of 10 per cent. dividend, he will be further entitled to a commission of 10 per cent. of the net profits.

Wigram and Co., Limited.

This company was registered on the 20th ult. with a capital of £10,000, in £10 shares, to trade as ironmasters, colliery proprietors, coke manufacturers, miners, smelters, engineers, steel converters, and metallurgists. The subscribers are:—

	Shares.
E. F. E. Wigram, Oak-hill House, Hampstead	194
W. H. Witnall, 19, Great George-street, S.W., solicitor	1
Miss L. K. Wigram, 14, Bolton-gardens	1
Rev. W. Gray, 24, Barnsbury Park, N., clerk in holy orders	1
Rev. R. Lang, 4, Roxborough-place, Harrow, clerk in holy orders	1
Rev. F. E. Wigram, Oak-hill House, Hampstead, clerk in holy orders	1
Major-General George Hutchinson, 19, Carlton-road, Putney	1

Mr. Edmund Francis Edward Wigram is appointed first director, and may retain office so long as he remains entitled to 600 shares. Most of the regulations of Table A of the Companies' Act, 1862, are adopted.

Stratford, Ilford, and Romford Tramway Company, Limited.

This company proposes to apply for Parliamentary powers for the construction of tramways, and for working the same by electrical, steam, mechanical, or animal power, in the county of Essex. It was registered on the 23rd ult. with a capital of £75,000, in £5 shares, with the following as first subscribers:—

	Shares.
Captain F. L. H. Penzore, 1, Beaumont Villas, Friern-road, Dulwich	1
G. Davis, 30, Coleman-street, solicitor	1
D. J. Gledden, 82, Bishopsgate-street, merchant	1
G. Plumbley, 1, Tokenhouse-buildings, stockbroker	1
H. J. Newell, 9, St. Lawrence-road, Brixton, clerk	1
J. Dixon, 62, Margaret-street, Cavendish-square, engineer	1
H. W. Atkins, 53, Bouverie-road, Stamford-hill	1

Registered without special articles.

THE PATENT JOURNAL.

Condensed from the Journal of the Commissioners of Patents.

Applications for Letters Patent.

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

23rd February, 1886.

2582. MANUFACTURE of EARTHENWARE JUGS, J. Rhodes, Burslem.
2583. PROPELLING STEAM VESSELS, R. Morris, Newcastle-on-Tyne.
2584. PORTABLE FOLDING BOOT STAND and DRIER, J. Platt, London.
2585. METHOD of ADMITTING the FLOW of WATER, &c., H. Aylesbury and J. Milne, Bristol.
2586. PUMPS, H. C. and W. H. Pretty, Leicester.
2587. MACHINERY for MAKING SKEWERS, T. L. Daltry, Manchester.
2588. WINDOW FASTENERS, G. F. Priestley, Halifax.
2589. PORTABLE BATH, T. M. Fenwick, Frimley.
2590. OPEN DOOR SPRING HOLDER, R. W. Roberts, Anglesey.
2591. SURFACING LITHOGRAPHIC STONES, C. N. Morris, London.
2592. TIRES for VEHICLES, W. Milner, London.
2593. FROST CALKS for HORSESHOES, C. B Rollings and R. Norbury, London.
2594. TUNING INSTRUMENTS, R. Boughton, London.
2595. PNEUMATIC COLLAPSE VALVES, J. Stringer, Staffordshire.
2596. REFRIGERATORS, J. Taylor, Cheltenham.
2597. SHEARS for LIFTING INGOTS, &c., J. Bowman, Glasgow.
2598. SCHOOL DESKS, S. Hanson and P. Smith, Birmingham.
2599. COMBINED STEAM and HYDRAULIC APPARATUS, A. B. Brown, Glasgow.
2600. CONSTRUCTION of SPANNERS, J. Brown, London.
2601. SASH FASTENER, S. Pardoe and F. J. Biggs, London.
2602. AXLE for VELOCIPEDES, H. Usher, London.
2603. MILK STRAINERS, J. Brendon, jun., and G. D. Brendon, Cornwall.
2604. DISTILLATION, J. Wright, London.
2605. RECLINING CHAIRS, W. P. Thompson.—(*G. K. Phillips and E. W. Dickerman, United States.*)
2606. DRILL PRESSES, O. Smith, London.
2607. PENHOLDERS, J. Trebentscheck, Liverpool.
2608. SIPHON RECORDS, W. P. Thompson.—(*C. Cuttriss, United States.*)
2609. PUMPS, W. F. Mattes, London.
2610. BREECH-LOADING GUNS, A. J. Boult.—(*H. M. Quackenbush, United States.*)
2611. BARBED WIRE, J. Westgarth, Liverpool.
2612. SHOES BUTTON, A. E. Müller, Germany.
2613. EXCENTRICS for OPERATING the SLIDE VALVES of ENGINES, J. and W. Peck, London.
2614. HOOKS for HANGING WEARING APPAREL, H. A. Williams, London.
2615. CONTINUOUS CURRENT DYNAMO-ELECTRIC MACHINES, C. J. Hall and W. Lowrie, London.
2616. TREATING TEXTILE FABRICS, &c., H. J. Haddan.—(*The United States Waterproofing Fibre Company, United States.*)
2617. TRAVELLING BAG with SLEEPING CUSHIONS, F. W. Senkbeil, London.
2618. APPARATUS for INJECTING PETROLEUM into FURNACES, C. Blagburn, London.
2619. COMBING MACHINES, J. H. Whitehead and J. Lister.
2620. AUTOMATIC COUPLINGS for RAILWAY WAGONS, W. Kitts, London.
2621. MACHINE for MAKING MATS, &c., W. P. O'Reilly, London.
2622. SLOW MOTION FOCUSSING ADJUSTMENT for MICROSCOPES, J. Swift, London.
2623. BELT PULLEYS, W. Pocock, London.
2624. COMPOSITORS' TYPE CASES, J. C. Mewburn.—(*L. K. Johnson and A. A. Low, United States.*)
2625. PRIMARY ELECTRIC BATTERIES, R. Harrison, London.
2626. LUGGAGE CARRIERS for VELOCIPEDES, M. Foley, London.
2627. TREATING GRAIN, A. W. Gillman and S. and E. S. Spencer, London.
2628. RAILWAY SIGNALS, A. Pidgeon and F. Fuller, London.
2629. STEAMING GRAIN, A. W. Gillman and S. and E. S. Spencer, London.
2630. ELECTRICAL INDICATORS, B. J. B. Mills.—(*J. W. Howell, United States.*)
2631. ELECTRIC BATTERIES, J. Y. Johnson.—(*L. A. W. Desruelles, France.*)
2632. ELECTRIC BATTERIES, J. Y. Johnson.—(*L. A. W. Desruelles, France.*)
2633. DISTRIBUTING WATER over ROADS, J. Smith, London.
2634. STEAM ENGINES, M. P. W. Boulton and E. Perrett, London.
2635. CAPSULES for BOTTLES, C. E. H. Cheswright, London.
2636. WINDLASSES, W. H. Harfield, London.
2637. DRESSING BAGS, &c., E. Pfeiffer.—(*Huppe and Bender, Germany.*)
2638. BOX OTTOMAN COUCHES, J. Trevallion, T. Lawes, and J. E. Randell, London.
2639. IMITATION INLAID WOOD, J. Ritzdorff, London.
2640. WEAVERS' SHUTTLES, H. H. Lake.—(*A. B. Taylor and G. F. Pinkham, United States.*)
2641. GAS LIGHTING, G. Delaporte, London.
2642. SEWING BUTTONS on BOOTS, &c., H. H. Lake.—(*J. Mathison, United States.*)
2643. SPRINGS for CHAIRS, &c., H. H. Lake.—(*American Braided Wire Company, United States.*)
2644. INDICATING STEAM PRESSURE, &c., H. H. Lake.—(*A. Shedlock and C. G. Singer, United States.*)
2645. GRINDING CUTLERY, R., F., and O. Kampfe, London.
2646. TREATING COFFEE, A. M. Clark.—(*A. L. St. Aubin, France.*)
2647. GALVANIC BATTERIES, L. N. Loeb.—(*J. H. Howard, United States.*)
2648. GALVANIC BATTERIES, L. N. Loeb.—(*J. H. Howard, United States.*)
2649. WIND MUSICAL INSTRUMENTS, E. Armitage, London.
2650. ROTARY PUMPS, F. Hochuli.—(*W. Nichaus, Germany.*)
2651. SURFACE CONDENSERS, A. Myall.—(*J. McIntyre, United States.*)
2652. SPEAKING TELEPHONE TRANSMITTERS, W. C. Turnbull, London.
2653. COMBINED STEAM and GAS ENGINES, M. P. W. Boulton and E. Perrett, London.
2654. FUSES for PROJECTILES, A. Noble, Newcastle-upon-Tyne.
2655. LINK MOTION of STEAM ENGINES, D. H. Williams, London.
2656. TREATING FIBRES, O. W. G. Briegleb.—(*J. F. Riep, Holland.*)
2657. CARTRIDGE LOADING MACHINES, O. F. Belcher, London.
2658. SAWING and FACING METALS, J. Hamilton, Derby.

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2659. PREPARING PORTLAND CEMENT, C. Spackman, Loughborough.
2660. MOTIVE POWER for TRICYCLES, J. T. and F Anyon, Manchester.
2661. FLEXIBLE PIPING, P. C. Lawless, Glasgow.
2662. MOULDING and PRESSING BRICKS, M. Shearer, sen., M. Shearer, jun., and J. Smith, East Dulwich.
2663. BREECH-LOADING SMALL-ARMS, H. Tolley, Birmingham.
2664. STEAM BLOWERS, J. Dawson, Bury.
2665. REGULATING the SUPPLY of WATER to CISTERNS, E. E. Bracher, Hanwell.
2666. SIZING YARN, K. T. Sutherland, Hulme.
2667. PREPARING WOOL, T. Redman, Bradford.
2668. ELECTRICAL ANNUNCIATORS, J. Poole and D. Sinclair, Manchester.
2669. FORCEPS and KNIVES, P. M. Walker, Halifax.
2670. PHOTOGRAPHIC CAMERAS, J. E. Thornton, Manchester.
2671. VENTILATING CAPS, C. Swindell and W. Clifford, Sheffield.
2672. PREVENTING AIR PASSING THROUGH HOLES in BEER CASKS, J. and T. H. Ring and S. Greenhough, Northwich.
2673. GLASS MOVEMENTS, J. J. Raggett, Birmingham.
2674. STOP or LOCKING ACTION for the WHEELS of PERAMBULATORS, A. Rush, Birmingham.
2675. ANTI-FRICTIONAL BEARINGS for FANS, R. H. Lea, London.
2676. BULLOCK HOLDER, C. A. Worth, London.
2677. SAFETY HOOKS, C. A. Worth, London.
2678. LEG GUARDS for CRICKET, L. H. Bruhl, London.
2679. DRAWING PEN, A. Pumphrey, Birmingham.
2680. DERIVING POWER from HEATED AIR, T. Hollings, London.
2681. VESSELS or SHIPS, H. Nickless, London.
2682. BOAT HOOKS, M. Jacob, London.
2683. JOINT and TONGUE for BROOCHES, &c., A. J Cheshire.
2684. INDIA-RUBBER, &c., TIRES, S. Green and B. K. Green, Manchester.
2685. LAWN TENNIS COURT-MARKING MACHINES, J. Hirst, J. Hirst, and A. Hirst, Halifax.
2686. COMBINED THUMB-SLIP and BOOK-MARK, F. Herbert and W. Horrox, Sheffield.
2687. CUPBOARD and other DOOR CATCHES, W. Sanderson, Birmingham.
2688. PROPS to PERAMBULATOR HOOD JOINTS, J. Hall, Birmingham.
2689. "TONKING" CANES, O. Muller, London.
2690. MINERS' and other PICKS, T. Dunn, Wallsend.
2691. ELECTRIC SWITCH, I. Probert, London.
2692. SHELL BURSTERS, D. L. Bain, London.
2693. ADVERTISING DEVICES, E. H. Edwards, Liverpool.
2694. SEATS with BACKS, W. P. Thompson.—(*L. Huguenin, France.*)
2695. REELS or FRAMES for HOLDING PILE and other FABRICS, C. Longbottom, Bradford.
2696. DOUBLE ARGAND WINDOW-LAMP, J. Williams, London.
2697. PISTON PACKING, H. Jack, Glasgow.
2698. APPARATUS for ELECTRIC LIGHTING, J. Roper, Bradford.
2699. ROLLERS for SPINNING MATERIALS, W. Tatham, Manchester.
2700. BIRD EXTINCTEUR and FIRE ENGINE, A. W. Bird, London.
2701. CHANDELIERS for ELECTRIC LIGHTS, &c., W. F. Stanley, South Norwood.
2702. CURING and RELIEVING DISEASES, G. H. Cooper, London.
2703. ADJUSTABLE HANDLE for PACKAGES, T. P. White, London.
2704. DYNAMO-ELECTRIC MACHINES, A. Thompson and J. G. W. Fairbairn, London.
2705. WASHING CLOTHES, E. Lommatzsch and B. Tauerschmidt, London.
2706. REGULATING DRAUGHT of CHIMNEYS, F. S. Lyle, London.
2707. MOUNTING GUTTERS of BUILDINGS, E. J. Hurley, London.
2708. GRIP for SASH LINES, J. E. Woodward, London.
2709. LIGHT VESSELS, E. A. Wood, London.
2710. SEWING MACHINES, M. H. Pearson, London.
2711. HATCHING APPLIANCES, J. J. Scott, London.
2712. LEMON SQUEEZER, A. Waddington and T. Mascall, London.
2713. APPARATUS for OBTAINING a CONTINUOUS MOVEMENT, A. J. Martial, London.
2714. CONSTRUCTING IRON, &c., SHIPS, H. P. Huthnance, London.
2715. EXPLOSIVE PROJECTILE for TOYS, G. F. Lutticke, London.
2716. FOG SIGNALLING APPARATUS, E. G. Brewer.—(*L. Schoentjes and A. Jess, Germany.*)
2717. BELT FASTENERS, W. P. Smith and J. T. Skelton, London.
2718. PERMANENT WAY, T. Wrightson and J. Mackenzie, London.
2719. KNITTING MACHINES, H. J. M. Mellor, London.
2720. EFFECTING COMBUSTION, R. J. Lee, London.
2721. FURNACES, R. de Soldenhoff, London.
2722. MAKING, &c., BERTHS, T. Morton, London.
2723. APPARATUS for SAVING LIFE, R. W. Archer and C. J. Dupree, London.

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2724. LASTS for BOOTS and SHOES, T. E. Mansfield, Bristol.
2725. BREECH-LOADING SMALL-ARMS, W. P. Jones and H. A. Smith, Birmingham.
2726. SLICING BREAD, J. Twyerould, Manchester.
2727. FIRE STOVES, A. W. Woodhead, Bradford.
2728. GAS and other OVENS, T. Fletcher, Manchester.
2729. AUTOMATIC INKSTANDS, A. E. Hancock, Birmingham.
2730. COUPLING for PIPE JOINTS, S. Kershaw, Glasgow.
2731. BRAKES, T. F. Smith, Halifax.
2732. MOUNTING ASTRONOMICAL and other TELESCOPES, J. J. Talman, near Canterbury.
2733. CUTTING TROUSERS, W. W. Crisp, Cheltenham.
2734. INJECTING or PROJECTING LIQUIDS, R. Kirk, Glasgow.
2735. CARVER FORK, T. Reynor, Dublin.
2736. PRESSING HIP TILES, A. Jones, Jackfield.
2737. COMPOSITION SCHOOL SLATES, R. Watts, Leavenshulme.
2738. SLATE PENCIL SHARPENER, I. Greenbury, Edinburgh.
2739. PUMPS, J. Merritt, Birmingham.
2740. WHEELS for VELOCIPEDES, E. C. Clarke, London.
2741. DRIVING CHAINS for VELOCIPEDES, E. C. Clarke, London.
2742. RENDERING TAPS PROOF AGAINST FROST, H. C. Coleclough, Hartlepool.
2743. MILLING MACHINES, J. Aimers, Galashields, N.B.
2744. TRAVELLING RUG, W. Jubb, Halifax.
2745. FASTENING IRON BANDS, &c., F. W. Goode, Twickenham.
2746. HELPING the ACTION of the RESPIRATORY ORGANS, A. Combault, London.
2747. FOLDING WOODEN BOX, G. Strong, London.
2748. COMPOUND SLIDE VALVES, J. and W. Peck, and J. Woods, London.
2749. CLEANING METAL PLATES or SHEETS, R. B. Thomas, London.
2750. PROPELLERS, G. S. Dodman, Liverpool.
2751. COMBUSTION of FUEL in FURNACES, J. C. Stitt, Liverpool.
2752 PURIFYING SEWAGE or DRAINAGE, F. H. Colley, Sheffield.
2753. PERPETUAL CALENDARS, W. A. Lever, London.
2754. SECURING and LABELLING the CONTENTS of BAGS, J. H. Kershaw, Brighouse.
2755. WATER-CLOSETS and URINALS, J. and A. Duckett, London.
2756. BALANCES or WEIGHING MACHINES, F. Tentschert and F. W. Minck, London.
2757. CHAIRS and SLEEPERS for RAILROADS, G. Edwards, London.
2758. AUTOMATIC VENTILATION of BUILDINGS, J. E. Bale, Colchester.
2759. TELEPHONIC APPARATUS, D. Sinclair, Glasgow.
2760. APPLYING ELECTRICITY for THERAPEUTIC PURPOSES, A. H. Bing, London.
2761. RAILWAY LAMP GLASSES, &c., J. F. Hoyne, London.
2762. SAPONIFICATION of FATTY BODIES, E. Edwards.—(*L. Rivière, France.*)
2763. VALVE GEAR for MOTOR ENGINES, A. le Comte de Dion, G. T. Bouton, and C. Trépardoux, London.
2764. AIDING the VISION in READING or WRITING, J. Imray, London.
2765. OBTAINING PURE SUGAR from MOLASSES, M. Kiefe, London.
2766. GAS, W. L. Wise.—(*F. J. Lothammer, France.*)

2767. ROTARY ENGINES, W. H. Scott and E. A. Paris, London.
2768. PERMANENT WAY of RAILWAYS, G. Buchanan and W. A. Keay, London.
2769. STEAM BOILERS, L. de Naeyer, London.
2770. RECEPTACLE for the DEAD, E. W. C. F. Schmidt, London.
2771. EMBROIDERING MACHINES, H. H. Lake.—(*F. Saurer and Sons, Switzerland.*)
2772. ROTARY PRINTING MACHINES, A. M. Clark.—(*A. H. Marinoni and J. Michaud, France.*)
2773. VOLTAIC BATTERIES, A. M. Clark.—(*C. R. Goodwin, France.*)
2774. BAG FRAMES, E. J. Frank, Birmingham.

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2775. SCREW VICES, J. H. Smiles, Stockton-on-Tees.
2776. SELF-REGULATING ELECTRIC PORTABLE BATTERY and LAMP, H. R. Fisher, London.
2777. LOCKS, C. Duncombe, Wolverhampton.
2778. CONDENSER BOBBINS or SPOOLS, D. S. Ingham, Dewsbury.
2779. MAKING BOILED, &c., SALT from BRINE, H. Whitehead, R. Hodgson, and W. H. Green, Stoke-on-Trent.
2780. SHEEP DIPPING COMPOSITION, J. G. Swan and R. M. W. Swan, Glasgow.
2781. OVEN, A. E. Edwards, London.
2782. TRAVERSED WARP MACHINE, W. Start, London.
2783. ELECTRO-MOTORS, A. J. Jarman, London.
2784. ELECTRO-AUTOMATIC FIRE-EXTINGUISHER, A. J. Jarman, London.
2785. SAFETY ELECTRIC LAMP, W. J. Smith, Elsecar, near Barnsley.
2786. COATING SHIPS' HULLS with GLASS, J. Blackburn, Manchester.
2787. LATCHES or LOCKS, A. Pilling, Manchester.
2788. WASHING and WRINGING MACHINES, J. Smith, Wigan.
2789. OBTAINING PIGMENTS D. Swan, Glasgow.
2790. STORING AERATED WATER, J. Mumford, Manchester.
2791. FASTENING for STUDS, &c., J. Clark, Bath.
2792. AUTOMATIC BREECH MECHANISM for GUNS, E. Maitland, H. W. Jones, A. S. Angas, and G. W. Brodie, London.
2793. MASHING POTATOES, F. Dakin and E. Blanchard, London.
2794. FLUSH HANDLES, P. Tyzack and A. Holmes, London.
2795. BOOTS and SHOES, W. Freeman, Leicester.
2796. PORTABLE PACKAGE for CARRYING MOLASSES, J. Lever, Heywood.
2797. TRICYCLES, G. J. Hills, London.
2798. TRICYCLES, C. J. Hart and D. C. Barton, Birmingham.
2799. CRYSTALLINED GLASS, A. W. Lake.—(*T. Hyatt, United States.*)
2800. CLEANSING FLUID, A. E. Scott, London.
2801. FLUSHING CISTERNS, S. H. Wright and R. Bate, Liverpool.
2802. DIVIDING the FLEECE into SLIVERS, A. C. Henderson.—(*N. J. F. Romanet du Caillaud, France.*)
2803. OVERFLOW PIPE, T. Panario, London.
2804. METALLIC PENS, J. L. Petit, London.
2805. TREATING WASTE FIBROUS SUBSTANCES, W. Pollitt, Chickenley, A. Stephenson, Ossett, and J. Priestley, Sandal.
2806. ARTIFICIAL FUEL, I. Lilley, London.
2807. ARTIFICIAL FUEL, S. W. Allen and G. Breffit, London.
2808. SELF-ACTING STOP MOTION for WINDING ENGINES, R. Broadbent, London.
2809. GARMENTS, T. Herb, London.
2810. ROTARY STEAM ENGINES, R. Haddan.—(—— *Ditsch, France.*)
2811. FOCUSSING ARRANGEMENTS of CAMERAS, W. F. Stanley, South Norwood.
2812. INTERNAL COATING for SUGAR MOULDS, C. D. Abel.—(*L. Märkle, Germany.*)
2813. FARE CHECKS in PUBLIC CONVEYANCES, &c., F. Pudney, London.
2814. SPINNING MACHINERY, E. Edwards.—(*O. Graf and V. Preusser, Germany.*)
2815. ALARM SIGNALS, J. Oxley and R. Hewlett, London.
2816. FLANGES, GAS-FITTINGS, and HOES, T. Longmore and J. Tibbitts, Walsall.
2817. TREATING FIBRES of PLANTS, G. W. H. Brogden and E. Casper.—(*E. Frémy and V. Urbain, France.*)
2818. COUPLINGS for RAILWAY, &c., CARRIAGES, W. Buckwell, London.
2819. YARNS, W. Whitaker, London.
2820. CONNECTING TOGETHER VARIOUS ARTICLES, B. Cars, London.
2821. TREATING and PURIFYING SPENT SOAP LEYS, &c., B. Nickels, London.
2822. SPEED INDICATORS, J. M. Napier, London.
2823. BUTTON-HOLDING and FEEDING ATTACHMENTS for SEWING MACHINES, A. G. Brookes.—(*H. H. Cummings, United States.*)
2824. CARBONS for ELECTRIC LAMPS, &c., G. Davidson, R. C. Jackson, and J. B. Duncan, London.
2825. ADJUSTING BRAKES to WHEELS, W. Davison, London.
2826. CONSUMING SMOKE, R. C. Sinclair and S. W. Snowden, London.
2827. BOTTLE FILLING MACHINES, W. A. Barlow.—(*H. E. Schrader, Germany.*)
2828. ROLLER SKATES, J. E. Evans, London.
2829. LUBRICATORS for AXLE-BOXES, &c., W. Daniel.—(*C. F. M. T. Lartigue, Spain.*)
2830. LETTER-BOXES, F. Lambert, London.
2831. COUPLING, W. Daniel.—(*H. Carpentier, France.*)
2832. BARRIERS for RAILWAYS, &c., W. Daniel.—(*C. F. M. T. Lartigue, Spain.*)
2833. COMPENSATING SPRING BALANCES, A. J. Boult.—(*E. Clarke, Canada.*)
2834. ELECTRIC SIGNALLING INSTRUMENTS, T. B. Sloper, London.
2835. BOILER TUBES, C. Wicksteed, London.

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2836. BUCKLES, R. H. D. Hart, London.
2837. SELF-ACTING LOOM, T. Hirst, Manchester, and J. Middleton, Poynton.
2838. TOOL for WEAVING OVERLOOKERS, J. Bentley, Bradford.
2839. BRAKES for PERAMBULATORS, &c., A. Rush, Birmingham.
2840. KNOTTING and TYING MECHANISM for SHEAF-BINDERS, W. Hornsby.—(*W. Burbage, South America.*)
2841. SELF-CLOSING DOORS, A. Pilling, Manchester.
2842. COPYING DOCUMENTS, J. P. Jackson, Liverpool.
2843. SEWING MACHINES, J. Forbes, Belfast.
2844. SHIPS' BERTHS, W. P. Hoskins, Birmingham.
2845. COMBINED SEAT and REST for TEACHERS, W. and F. H. Fisher, Birmingham.
2846. FACILITATING WINDOW - CLEANING, R. Baird, Glasgow.
2847. HANDLES of CROPS or WHIPS, A. Robertson, Glasgow.
2848. METALLIC RINGS or LINKS, J. Temple, Liverpool.
2849. PACKING GOODS in HERMETICALLY SEALED TINS, T. L. Pelling, Liverpool.
2850. CHIMNEY-TOPS, H. Owen, Liverpool.
2851. WASHING or DAMPING GRAIN, P. V. Gelder, Liverpool.
2852. EXPANDING HORSESHOE, J. W. H. Holt, Bovey Tracey.
2853. SECURING LIDS to METAL CANS, A. Neil and L. Jackson, Airdrie.
2854. FILTER TAPS, G. Teideman, London.
2855. DECORATING POTTERY-WARE, H. S. and S. Sant, Longton.
2856. PROJECTILES, A. Campbell, London.
2857. CUTTING-OFF the TRIMMINGS, &c., of PAPER-HANGINGS, J. E. Blanchard, Burgess-hill.
2858. LAMP BOWLS, T. C. J. Thomas, London.
2859. STRENGTHENING or SAFETY HOOPS for CRANKS, W. D. Allen, London.
2860. PREVENTING ELEVATION of TEMPERATURE in UNDERGROUND STOREYS, T. Fleitmann, London.
2861. WATER-WASTE PREVENTER, T. Panario, London.
2862. METAL SURFACE FINISHING MACHINE, G. Richards, London.
2863. SYPHONING LIQUIDS from BOTTLES, &c., F. Foster, London.
2864. REFRIGERATING APPARATUS, F. Windhausen, Halifax.
2865. EXTRACTING TIN from TINNED SHEET METAL CUTTINGS, F. Bosshardt.—(*S. Montagne, France.*)
2866. TREATING LIQUIDS PRIOR to BEING BOTTLED for KEEPING, F. E. V. Beanes.—(*E. Beanes, France.*)
2867. IRON and STEEL, J. H. Johnson.—(*La Société Anonyme de Commentry-Fourchambault, France.*)
2868. DREDGING and EXCAVATING MACHINES, A. Horenburger, Glasgow.
2869. GRIPPING and RELEASING APPARATUS, W. Muir, London.
2870. SMELTING, R. Stone, London.
2871. PRESERVING FRUIT, A. W. M. Leicester, London.
2872. WINDOW FASTENINGS, R. W. Thomas and P. Castle-Smith, London.
2873. MANUFACTURE of COFFINS, J. Musgrove-Musgrove, London.
2874. CIRCULATION of SOLUTIONS in ELECTRICAL BATTERIES, J. Musgrove-Musgrove, London.
2875. SMOKE CONSUMING APPARATUS, A. Milne, J. F. Gray, and A. S. Tomkins, London.
2876. PORTABLE PHOTOGRAPHIC CAMERAS, W. H. Payne-Gallwey, London.
2877. MUCILAGE HOLDER and BRUSH, L. N. Loeb.—(*C. Loeb, United States.*)
2878. MANUFACTURE of COLOURING MATTERS, A. M. Clark.—(*A. Müller-Jacobs, Germany.*)
2879. APPARATUS for SHAPING NUTS, H. H. Lake.—(*Messrs. A. Urban and Sons, Austria.*)
2880. UTILISATION of ELECTRICAL ENERGY, H. H. Lake.—(*G. E. Cabanellas, France.*)
2881. GAS-BURNERS, F. Leslie, London.
2882. STOPPING BOTTLES, W. W. Macvay and R. Sykes, Yorkshire, and H. Codd, London.
2883. RESPIRATORS, H. D. Varlo, London.
2884. MUCILAGE HOLDERS, C. S. Pinkham, London.
2885. DOORS for COVERING the OPENINGS of SEWERS, &c., G. F. Redfern.—(*X. Bailly, France.*)
2886. MACHINE for PRINTING from COPPER-PLATE ENGRAVINGS, A. M. Marcilly, London.
2887. SECURING METAL RAILS, J. F. Smith and A. Wright, Leicester.
2888. PLEATLESS SHIRT, G. J. Woodman, London.
2889. VALVES, W. Lockwood, Sheffield.
2890. EXHAUST FAN or AIR PUMP, V. L. E. Millar, London.
2891. ONE-WHEEL CENTRE GRAVITY VEHICLE of TRANSPORT, &c., J. Chaffaud and J. H. Konter, France.
2892. PURIFICATION of COAL GAS, H. Bowater, Cradley, near Brierley Hill.
2893. INSTANTANEOUS PHOTOGRAPHIC CAMERA SHUTTERS, W. J. Lancaster, Birmingham.
2894. PIPES for SMOKING TOBACCO, H. C. Hiller, Withington.
2895. COMBINED SLATE and DRAWING BOARD, A. Corney and E. Wallington, Warrington.
2896. WASTE WATER PREVENTERS, W. Ross, Glasgow.
2897. SPITTOON, W. R. Court, Carlisle.
2898. WHEELS for ROLLING STOCK, R. Huntley and R. Norbury, London.
2899. METAL GRATES for STREET SEWERS, H. J. J. Brownill, London.
2900. POWDER DISTRIBUTORS or SPRINKLERS, L. Binko, London.
2901. VELOCIPEDES, J. C. Robinson and E. J. Bayly, London.
2902. REVERSIBLE BACKS to SEATS, S. R. Lowcock, London.
2903. PREPARING HALF-SOLES, CLUMPS, &c., of BOOTS, G. T. Bone, London.
2904. GAS PRODUCERS, F. J. Jones, London.
2905. DRIVING MECHANISM for ELECTRIC TRAM-CARS, M. Immisch, London.
2906. COPYING PRESSES, D. E. Kempster and J. H. Currier, London.
2907. DOUBLE - ACTION SCREW TAP, C. W. P. Ford, London.
2908. PIPES, CIGAR and CIGARETTE HOLDERS, L. E. Liardet, London.
2909. TREATING RENNET, C. Hansen, London.
2910. CHURNS, J. Llewellin, London.
2911. INTERLOCKING LEVERS for RAILWAY POINTS and SIGNALS, J. P. O'Donnell, London.
2912. STEAM BOILERS, T. Moy, London.
2913. COUPLING RAILWAY VEHICLES, E. Patterson and W. H. Strype, London.
2914. OIL LAMPS, J. Roots, Tottenham.
2915. PREPARING MATERIALS for MAKING PAPER, &c., J. C. W. Stanley, London.
2916. HORSESHOES, R. McDougall, Glasgow.
2917. SIGNALLING by SOUND on SHIPS, A. G. Brookes.—(*H. Howard, United States.*)
2918. BOTTLE STOPPERS, J. Milling and F. Hipgrave, London.
2919. FUMIGATING GREENHOUSES, C. E. Osman and D. J. Northwood, London.
2920. PIPES for SMOKING TOBACCO, J. Pommer, London.
2921. FOOT COVERINGS, R. Haddan.—(*L. J. Alloo, France.*)
2922. STRETCHING LACE CURTAINS, W. Routledge, jun., London.
2923. FASTENERS for WINDOW SASHES, W. Martin, London.
2924. STEAM and BRAKE VALVES of ENGINES, M. W. Rollen, Durham.
2925. STOPPERING BOTTLES, D. Gallafent, London.
2926. STEAM TRAPS, P. M. Justice.—(*N. Curtis, United States.*)
2927. COOLING and CONDENSING APPARATUS, H. E. Newton.—(*E. Theisen, Germany.*)
2928. WARDROBES, M. H. Cazier, London.
2929. FRONT PORTIONS of TROUSERS, &c., L. F. Marsh, London.
2930. STEAM GENERATORS, H. Davey, London.
2931. LIGHTING SAFETY LAMPS in MINES, W. Thomas, London.
2932. GALVANIC BATTERIES, A. Schanschieff, London.
2933. BREECH-LOADING FIRE-ARMS, E. G. N. Salenius, London.

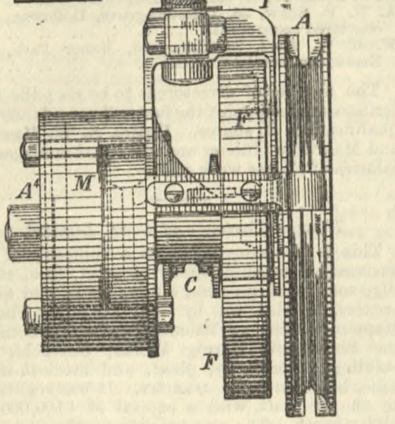
SELECTED AMERICAN PATENTS.

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

333,906. HOISTING MACHINE, *Thomas A. Weston, Stamford, Conn.—Filed November 27th, 1885.*

Claim.—(1) In a hoisting machine, the combination of a driving pulley exterior to the frame on one side, a driving shaft, and a friction brake or lowering device exterior to the frame on the other side, and operated by means of the said driving pulley through said shaft. (2) In a hoisting machine, a driving shaft passing centrally through the main hoisting sheave of said machine, and provided at one end exterior to the frame with a driving device or wheel, and at its other end exterior to the frame a frictional lowering and retaining device. (3) The combination, with a portable or pulley block frame, of a driving pulley exterior to the frame on one side, a driving shaft and a friction brake or lowering device exterior to the frame, and operated by means of the said driving pulley. (4) The combination, with a portable or pulley block frame, of a driving shaft passing centrally through the main hoisting sheave of the said hoisting machine, and provided at one end and exterior to the main frame with a driving device or wheel, and at the other end exterior to the main frame with a frictional lowering and retaining device. (5) The combination, with a portable or pulley block frame, of a driving and a counter shaft, and connecting gearing arranged approximately on the same horizontal plane. (6) In a hoisting machine, the combination, with an automatic safety friction brake or lowering device, of a frictional check wheel, as and for the purposes described. (7) In a hoisting machine, a frictional check wheel provided with rollers of disc form and parallel guiding surfaces therefor, as and for the purposes set forth. (8) In a hoisting machine, the combination of the screwed or helically-formed driving shaft A^1 A^2, the nut or abutment A^4, the pinion B, discs C^1 and B^3, disc box C, frictional check wheel D, and the cover or housing M, substantially as and for the purposes set forth. (9) In a pulley block or portable lift, a lifting sheave G, provided with a spur-toothed flange or rim F, and a driving pinion E^2, both placed inside the main frame, spur gears E and B on the exterior of the said frame on one side and a driving wheel exterior to the said frame on the other side, substantially as and for the purposes set forth.

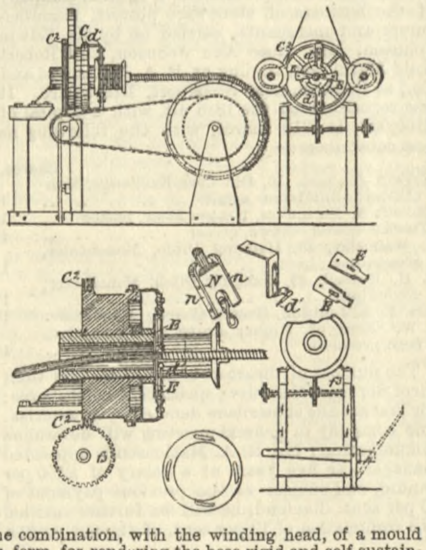
333,906



334,026. MACHINE FOR WINDING WIRE UPON HOSE, *Ives W. McGaffey, Chicago, Ill.—Filed October 12th, 1885.*

Claim.—(1) The machine for winding wire upon hose, consisting of an exterior mould or form adapted to render the hose self-sustaining and rigid, and forming the only support therefor, in combination with a winding head rotating around said mould and acting to lay the wire directly on the hose immediately after it has emerged from the mould, substantially as specified. (2) The machine for winding wire upon hose, consisting of an exterior mould adapted to render the hose self-sustaining and rigid, and forming the only support therefor, in combination with a winding head rotating around said mould and acting to lay the wire directly on the hose immediately after it has emerged from the mould, and positively actuated feeding devices, substantially as specified. (3) In a machine for winding wire upon hose, the combination of a stationary mould or form for the hose, a winding head for laying the wire upon the hose as it passes out of said mould, and a positively actuated receiving reel, substantially as and for the purpose set forth. (4) In a machine for winding wire upon hose, the combination of a mould or form for the hose, consisting of adjustable sections E and a winding head having adjustable guides for the wire, substantially as specified. (5) In a machine for winding wire upon hose, the combination, with the winding head, of a mould or form for rendering the hose rigid and self-sustaining, consisting of adjustable sections E, substantially as specified. (6) In a machine for winding wire upon hose, the combination, with the hose-receiving reel and its driving chain, of the gear f^4, supported in bearings which may be lowered, as set forth, and the worm C^2, substantially as specified. (7) In a machine for covering hose with wire, the combination, with the mould and the winding devices, of an interior support for the end of the hose, substantially as specified. (8) The combination, in a hose winding machine, of a hose-receiving reel, and a clamp for connecting the hose to the reel, consisting of a short interior plug N, and jaws n, substantially as specified. (9) The combination, with the winding head, of the laterally adjustable bush or eye d^1 for guiding the wire, substantially as specified.

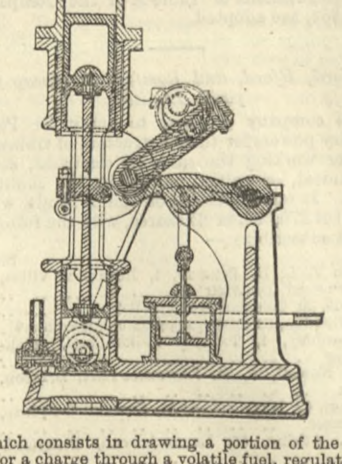
334,026



334,041. METHOD OF OPERATING EXPLOSIVE VAPOUR ENGINES, *Lewis H. Nash, Brooklyn.—Filed September 5th, 1885.*

Claim.—(1) The method herein described of operating explosive vapour engines by means of liquid fuel, which consists in drawing a portion of the air supply for a charge through a volatile fuel, regulating the quantity of such constituent so drawn in by a governor, and completing the charge by drawing into it a separate supply of air. (2) The method herein described of operating explosive vapour engines by means of a liquid, which consists in drawing a portion of the charge through a volatile liquid fuel into a chamber and admixing with it another portion of the air to complete the charge and compressing the mixture before its ignition. (3) The method herein described of operating explosive vapour engines by means of liquid fuel, which consists in utilising the suction of a compression pump to draw therein a portion of the air through a volatile liquid fuel, and forcing it therefrom with another portion of air to form the combustible mixture. (4) The method herein described of operating explosive vapour engines by means of liquid fuel, which consists in drawing a portion of the air charge through a heated volatile fuel to evaporate it, conveying it into a compressor, mixing it therein with another portion of the air charge, compressing the same, and regulating the supply of the fuel-laden air from the said heater by the controlling action of a governor.

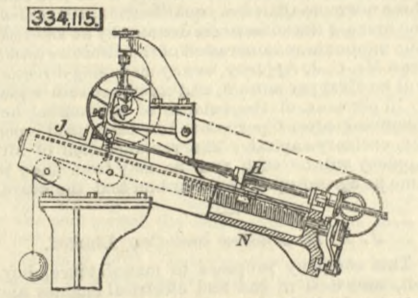
334,041



334,115. MACHINE FOR CUTTING FILES, *Crawford M. Fairbanks, Lincoln, R.I.—Filed May 7th, 1885.*

Claim.—(1) The combination of the rotatable arbor, a travelling block, a screw for working the travelling block, and devices, substantially as described, for varying the relative rotation of the screw and arbor. (2) The combination of the arbor H, screw N, intermediate block V, and mechanism, substantially as described, to give an independent feed motion to the independently rotating arbor H, for the purpose specified. (3) The combination, with a table or analogous supporting means having the slot W, of the rotatable arbor H, the slide J, the screw N, means for rotating the same, and the block V, engaging with said screw, and also engaging with the arbor, said block V and slide J resting and moving in slot W. (4) The combination, with the rotatable arbor H and rotatable screw N, of the intermediate block V, having a vertically movable screw-threaded portion, as described, and the cam X, for causing said movable portion to be engaged or disengaged with the screw N.

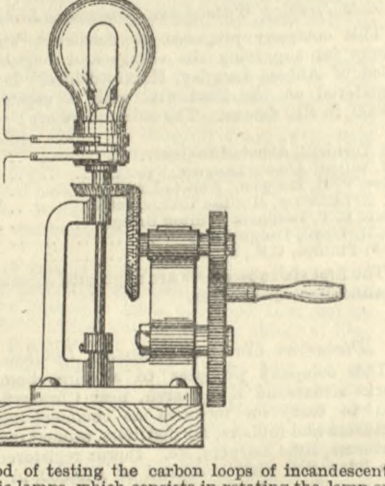
334,115



334,147. METHOD OF TESTING INCANDESCENT ELECTRIC LAMPS, *Edward Weston, Newark, N.J.—Filed October 13th, 1885.*

Claim.—(1) The method of testing the carbons of incandescent electric lamps, which consists in moving or rotating the carbons while incandescent at a speed that enables the weak or defective portions, when such exist, to be distinguished by the eye from the other parts of the carbon, as set forth. (2) The method of testing the carbon loops of incandescent electric lamps, which consists in rotating the lamp or receiver containing the loop on a vertical axis while the current is directed through the loop, whereby the weak or defective spots, when such exist, are made apparent to the eye, in the manner set forth.

334,147



334,247. MITERING MACHINE, *John G. Leffingwell, Newark, N.J.—Filed September 21st, 1885.*

Claim.—(1) In a mitering machine, the combination with a toothed wheel, having cutters and standards, one of which has teeth, the said wheel engaging toothed standard, and adapted, when rotated, to travel along the same, substantially as specified. (2) In a mitering machine, the combination, with a base or stand, of two opposite standards, one of which is provided with teeth, a wheel carrying cutters and teeth to engage the teeth of the said standard, and a pitman rod connecting the wheel, and a treadle to turn the said wheel, substantially as specified. (3) The combination with a base having stock-guides, of two opposite vertical standards, one of which has teeth, a wheel having teeth arranged between the standards, arc-shaped cutters extending beyond the periphery of the wheel, a pitman connected eccentrically with the wheel, and a treadle connected with the pitman, substantially as specified.

334,247