THE

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## THE ELECTRICAL REVIEW.

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## THE VAGARIES OF THE PROFESSION.

WE have so often dealt with the ethics of electrical engineering, or rather the general laxity regarding them, that we hesitate to speak again on the subject. Our excuse for this persistency will be that of considering the question from a more material standpoint than we have previously adopted. Hitherto we have spoken mainly of that line of conduct which should regulate the action of men of decent feeling towards one another. We assumed, perhaps too hastily, that every electrical man was that, and therefore took what we may term the higher moral tone. It has been borne in upon us that such a method might have been the correct one before the era of town lighting by electricity, but it is now antiquated, and completely out of line with the later developments of electrical engineering.

It is to some extent the misfortune of the electrical engineering profession that it is composed of heterogeneous materials. It has no boundary line, its laws are unwritten, and for the most part unobserved. It is the most inexclusive profession under the sun, and contains in its ranks more destitute aliens than all other professions combined. "Consulting engineer" is perhaps the widest and most cosmopolitan term in the English language. It will cover anything from a great scientific engineer to a clerk out of a berth. In this respect we are glad to learn that an earnest effort is being made to improve, by means of night schools and continuation classes, the lot of those who have to draw up specifications for town lighting. However, we do not propose to discuss the manner in which specifications and reports are made, but to gently draw attention to the way in which an electrical engineer may retard the advance of electric lighting and indirectly injure his own pocket. Whether he may ultimately hurt his reputation does not concern us here, for, as we have already pointed out, it is the material aspect which alone interests us at present.

On one or two occasions we have drawn attention to the unfortunate state of affairs which prevailed at Cardiff. We had there the Corporation carrying out a scheme of electric lighting which was vehemently and bitterly opposed by a faction headed by a ratepayer who happened to be an electrical engineer. It was in this latter capacity that the person, who shall be nameless, attacked the scheme. Its supposed fallacies and what not, were pointed out, and insisted upon again and again. We are not going to say here whether or not the attack was based on good grounds, but if the scheme had been the worst ever devised, the personal feeling and bitterness imported into the controversy ought to have alienated all sympathy from its opponent. The unfortunate result of such attacks is that local authorities become unsettled, and the ratepayers, judging the loudest disputant to be most right, form erroneous opinions. We firmly believe that such may have happened at Cardiff. The laymen would naturally think that a scheme which provoked the attack of a local electrical engineer, who must of necessity be unbiassed, was wholly bad. The position of an engineer who makes these wanton attacks must surely be an unsatisfactory one. He not only harms himself, but the whole industry suffers. We are not suggesting that he will injure his reputation; that is his own to do with as he wills. But surely the retardation of electrical business which may result from his vituperation must ultimately affect his pocket. We cannot conceive medical men, legal men, and other members of learned professions, pouring abuse on each other in public prints, and we come to the mournful conclusion that electrical engineering, in spite of its great accomplishments, is not yet invested with the dignity which is a marked characteristic of the older professions. Possibly this dignity will not be achieved until the profession is more defined.

If electrical engineering had been an organised profession, we might have been spared the painful exhibition which was recently enacted at Folkestone. The spectacle of two electrical men pitted against one another before the town authorities is a melancholy one, but the harm which may be done is incalculable. The facts briefly, are as follows:—The Folkestone Corporation obtained from an engineer a scheme which would have involved an expenditure of some £30,000—a reasonable sum for a town of the size of Folkestone. Mr. Baker, a town councillor, in the exercise of his privileges, objected to this expenditure on the ground that it was unduly high. To aid him in his investigations, Mr. Baker obtained the help of a consulting electrical engineer. This adviser stated that a scheme of lighting could be carried out for £12,000. The consequence of this is, that the two engineers are put into rivalry with one another, and their merits are discussed with painful minuteness by the Town Council. The result is simply disastrous. The Town Authorities cannot, by their own unaided efforts, decide which is the better of the two schemes, and the introduction of the electric light into Folkestone may be postponed indefinitely. It is quite evident that there has been no keen regard for etiquette on the part of the second engineer. He may not be wholly to blame; indeed, he may have been unwittingly led into a false position; but without dwelling on the fact that two educated engineers have been placed in the position of rival hucksters, we would ask who gains by such incidents? The consulting engineers are discredited by one party or the other, and by the postponement of the question great harm is done to the electrical industry. The enemies of electric lighting are not slow to make the most of these episodes. They need no help, but the internal dissensions of electrical men provide them with a dangerous weapon.

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The City Electric Lighting Breakdown.

It will have been noticed that the cause assigned to the unfortunate extinction of the incandescent lamps on the circuit of the City of London Company on Tuesday the 9th inst., given in our columns by Mr. Cecil Bull, the secretary, is very different to the version contained in the *Electrician.* One must be utterly wrong, and the question is, which? So far as we can gather from enquiries amongst city men the extent of the breakdown seems to us greater than could possibly have been due to the failure of a temporary machine, and the real cause of the mishap appears much more likely to be that given on the authority of our contemporary. But which ever way it is there can be no question that the two reports are as unlike as can well be imagined, so that somebody is to blame for giving reasons to the technical press which cannot be in any way reconciled one with the other. These accidents are becoming much too frequent, and the City company will have to look to its laurels, or its customers will yet return to gas because it is more to be relied upon. When we had to depend on gas alone people often speculated upon the effect of London being suddenly put into darkness during a fog; they have now had an instance, and luckily we have not heard that anything beyond inconvenience was the result. But if, when a sudden and extra demand is put upon the capacity of the city stations, this kind of thing is to be expected, then we may at any moment suffer something more than mere annoyance. It does not require any great stretch of imagination to conjure up in one's mind such little affairs as possible bank robberies, &c., when these establishments have suddenly to fall back upon candles and ginger-beer bottles to contain the composite dips. Assuredly, as our contemporary justly remarks, mischief must inevitably result, not only to the company responsible for the breakdown, but also to other companies which have hitherto been exempt from accidents or hitches of any sort, by the reaction on the public confidence.

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Electric Lighting at Folkestone.

The regrettable incidents that have occurred at Folkestone concerning the electric lighting are referred to in our leading article. For some months the original scheme has been attacked with too much vehemence and bitterness to be convincing. Ratepayers have assembled in public meeting, and an organised opposition created. It was stated by the most active opponent of the original scheme, Mr. Baker, that the lighting could be done for £12,000. At a meeting of the Town Council on September 26th, Mr. Baker set forth more or less of this cheaper scheme, which it appears had been prepared by Mr. Medhurst. Now, we are not going to compare the two schemes in any way. We have no knowledge of the original one, and the details of the second proposal are two meagre for us to form an opinion. But we do protest most emphatically against the exaggeration which was the most marked feature of Mr. Baker's introduction of his special scheme. We pass over the doubtful honours which he confers, and merely note the importance in the proposal of cast-iron pipes. It is suggested in the new scheme that a 19 H.P. gas engine will suffice for the day load. It may or not; of this, however, Mr. Baker says "that this is a feature which Medhurst initiated at Shrewsbury, and since then it has been adopted by engineers wherever a scheme has been laid down." We do not know what Mr. Medhurst did at Shrewsbury; whatever he did was on a small scale, but we deny *in toto* that the use of gas engines for a day load has been adopted in every scheme. The rest of Mr. Baker's remarks are of the same unconvincing, exaggerated nature, and savour too much of the reckless partisan. It is impossible to follow him further, but we may conclude with the hope that his statements were not all justified by his electrical adviser.

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Alternator Curves.

The methods of arriving at the shape of the curves of current and pressure have verily increased in complexity since the days of Joubert. The latest method is due to Dr. Crehore, and involves the use of two nicol prisms, a quartz rotator, a tube filled with bisulphide of carbon and surrounded by a helix carrying the current to be analysed, a spectroscopic prism, and a photographic apparatus. The method depends on the well known rotation of polarised light when passing through bisulphide of carbon and acted on by a current, and is exceedingly ingenious and likely to give interesting results in the hands of an expert, but cannot be explained in a few words without figures. It is difficult to see how the pressure curves can be got, owing to the necessity of having a high magnetic potential difference on the coil, with a consequent large number of turns in it, and a high self-induction. It is also difficult to see why a purely physical paper of this description (although very interesting and original) finds place in the *Proceedings* of a body like the American Institute of Electrical Engineers.

## THE DISEASES OF DYNAMOS.

I.

Under this title Lieut. Parkhurst, of Fort Monroe, Va., has issued a copyright sheet in which he describes the troubles met with in dynamos, their cause and cure.

While we admire the arrangement on the sheet and appreciate the ingenuity it displays, we think that the diseases of dynamos, their causes and cures, can be better adapted for publication in our columns in a paragraph form, and hence we have not reproduced the sheet as issued, although we have his courteous permission to do so, but have taken the subject-matter pretty much as it stands, adding comments on the various causes of trouble for the purpose of distinguishing those which are fairly to be considered as troubles, and those which are not so much troubles as defects in original design or in workmanship, and also to enlarge upon some of the subjects.

A dynamo designed by an experienced expert and constructed in a first-class machine shop, works for years without any trouble, and when troubles do arise they are chiefly due to old age; that is, to parts wearing out and requiring renewal.

On this side dynamo designs have arrived at comparative uniformity, and as sound workmanship is now the rule, dynamo troubles are exceedingly rare and of a very simple nature, but in America the designs are numerous, many of them displaying inexperience and ignorance on the part of the designers, while cheapness prevents the best of workmanship being always used; hence the American dynamo tender and his manager or employer are pretty well acquainted with "all the ills that dynamos are heir to."

But while the sheet of Lieut. Parkhurst is particularly useful to Americans, we find it of considerable interest in considering the "Diseases of Dynamos."

Prevention is always better than cure, so that by acquiring a knowledge of the troubles to which dynamos are subject when badly designed and constructed, we may know how to avoid the errors and be guided to faultless design.

The diseases of dynamos are six in number :—

A. Sparking at brushes.

B. Heating of { armature. / field coils. / bearings.

C. Noise.

D. Speed { too high. / too low.

E. Motor { stops. / fails to start. / runs backwards.

F. Dynamo fails to generate.

We shall treat each separately in order under these headings, giving the causes and cures, with remarks.

### A.—Sparking at Brushes.—Faults of Brushes.

*Cause* 1.—*Not set diametrically opposite.*

*Remedy.*—Should have been properly set before starting up by use of reference marks on commutator.

If run is to last for a considerable time adjust by moving rocker until one set of brushes is sparkless, and then adjust brushes on other side, one at a time, using rubber mat and rubber gloves if dynamo of high pressure.

*Cause* 2.—*Not set at Neutral Point.*

*Remedy.*—Move rocker to and fro slowly until sparkless position is found.

*Cause* 3.—*Not Properly Trimmed.*

*Remedy.*—If sparking begins from this cause remove the badly trimmed brushes one at a time and trim them, or cut off any loose wires or ragged edges as close as possible without removal. To retrim the brushes file them up to standard jig and thoroughly clean them of oil or dirt by benzine or soda solution.

*Remarks.*—The importance of providing two or more brushes on each side will be obvious in all these cases; with more than one brush, adjustments and corrections can be made while machine is working; therefore never work a machine with only one brush a side.

*Cause* 4.—*Not in Line.*

*Remedy.*—Adjust each brush until they are in line along one commutator bar.

*Cause* 5.—*Not in Good Contact.*

*Remedy.*—Clean off all dirt, grease, oil, and grit from commutator, and tighten up tension springs until a light but firm contact is made.

### Faults of Commutators.

*Cause* 6 *and* 7.—*Rough, worn into grooves, or out of round.*

*Remedy.*—File up while running slowly, and polish with fine glass paper. In all large machines a rest should be provided with holes and bolts for fixing, so that commutators can be turned up in place.

A dead smooth file only should be used on a commutator.

If commutator is out of round nothing but turning will remedy it.

Armatures should have end play to prevent grooving in commutators, where this is not permissible the proper thing to do is to shift the brushes sideways at intervals.

*Cause* 8 *and* 9.—*High Bars and Low Bars.*

*Remedy.*—Set high bars down gently with hammer and piece of wood, without bending or marking the bars, then tighten ring clamp, if this is not possible file carefully down to level; better still, tighten up commutator and turn it true if a rest is handy; for low bars the only remedy is turning up true.

*Remarks.*—High and low bars in commutators indicate bad design and want of magnetic symmetry in the armature; in some cases it is due to the bars being made of different metal; a low bar is a softer one than the rest and a high bar is a harder one. In the case of bad design this disease is chronic and the turning up is required at regular intervals during the whole life of the machine. In the case of bad commutator bars this disease will last as long as the commutator and is finally cured only by a new commutator.

*Cause* 10.—*Not Exciting Properly.*

*Remedy.*—As this must be due to broken field coil or a short internal circuit a search must be made for the fault by testing; a break will be shown by want of continuity; no current can pass; a short circuit can be found by resistance measurements; a joint will remedy a break, rewinding only will remedy a short circuit.

*Cause* 11.—*Overload.*

*Remedy.*—Reduce the load; but as a machine may be overloaded by short circuits and leaks, test for these and remove them.

Motors must be run only on circuits of the pressure for which they were made, and must be worked with resistance in series if the pressure is too high. A common cause of failure in small motors, sparking, heating, and so on, is due to being improperly geared to their work. The gearing must be carefully calculated from the full speed of the motor, the size of motor wheel or pulley, and the speed of the driven shaft of the machine to be driven. With these three figures it is easy to find the right size of pulley and intermediate pulleys.

### Faults of Armature.

*Cause* 12.—*Short Circuits.*

*Remedy.*—Clear away all copper dust, grease, and dirt from commutator and its connections; examine the insulation between the plates carefully for anything that may bridge across from plate to plate.

*Remarks.*—Examine, also, the insulation of brush holders; if these are all right then the fault is internal and must be located by passing a large current through the whole armature and measuring P.D. between the plates of commutator—the short-circuited plates will show very little or no P.D.—then disconnect these plates from the armature connection. Test the commutator plates after disconnecting, if the insulation between them is good then the fault is in the armature coils which have been disconnected, if bad the fault is inside the commutator. To remedy the armature coils they must be rewound if the fault is not visible and easily repaired.

To remedy the commutator it must be clamped together by insulated rings and the end insulation renewed, but a faulty commutator can only be properly dealt with by a maker.

*Cause* 13.—*Broken Circuit.*

*Remedy.*—Easily located by tests with cell and galvanometer. Temporary remedy is to solder across the commutator plate of the broken coil to the next one, that is connect the two between which no current is found on testing, but rewind as early as possible.

This concludes Section A, sparking causes and remedies. In our next we will take up heating and its remedies under Section B, $B_1$ and $B_2$.

## THE INFLUENCE OF ARC LIGHT CARBONS ON THE CANDLE-POWER.*

By W. F. Stine.

The London Electrical Review commenting on the statements made at the Philadelphia meeting of the Institute of Electrical Engineers, concerning the actual candle-power of arc lamps, says :—"It has long been known that the quantity of light from an arc materially depends upon the quality of the carbon used, though we are not aware that any comparative experiments have ever shown anywhere as great a difference as here mentioned. We have been informed, however, by an arc light station superintendent of wide experience, that it is not unusual to come across carbons that will show a difference of 50 per cent. in the amount of light produced. As this is a matter of much importance to superintendents of arc stations and users of arc lights, we trust that one of our college laboratories will take advantage of the excellent opportunity it offers for investigation and experiment." There is, in fact, too little reliable data obtainable on this subject, and this is all the more singular since it is a matter of such moment. The same percentage of variation in incandescent lamps would cause much dissatisfaction amongst consumers.

The above quotation has caused me to refer to a report of a careful test, made in the laboratory of Armour Institute during the past year, on the comparative candle-power of a number of brands of arc carbons. All the tests in the table were made with the same lamp, under the same conditions, and similar photometric measurements. The carbons were all $\frac{7}{16}$ths." (See table.)

| Make of carbon. | Class. | Average current. Ampères. | Average E.M.F. of arc. Volts. | Average watts. | Average mean horizontal C.P. | Variation of C.P. in brand of carbon. | Variations of make. | Variations in watts. | Variations in percentage of watts. | Variations in percentage of C.P. |
|---|---|---|---|---|---|---|---|---|---|---|
| A 1 | Solid | 9·83 | 48·6 | 477 | 454 | 99 | ... | 100 | 0 | 1 |
| A 2 | Solid | 9·6 | 48·9 | 463·4 | 442 | 97 | ... | 97 | 3 | 3 |
| A 3 | Solid | 10·1 | 45·9 | 463·4 | 456 | 100 | ... | 97 | 3 | 0 |
| B | Cored solid | 9·8 | 46·3 | 453·7 | 335 | ... | 73 | 95 | 5 | 27 |
| C | Solid | 9·6 | 47·3 | 454 | 372 | ... | 82 | 95 | 5 | 18 |
| D | Solid | 9·9 | 46·1 | 456·3 | 372 | ... | 82 | 95 | 5 | 18 |
| E | Solid | 9·8 | 45·4 | 445 | 359 | ... | 79 | 93 | 7 | 21 |
| F 1 | Cored solid | 9·54 | 43·5 | 414·9 | 293 | 93 | 64 | 87 | 13 | 36 |
| F 2 | Solid | 9·52 | 49·52 | 423·6 | 316 | 100 | 70 | 89 | 11 | 30 |

These tests show that the carbons A (1), A (2), A (3), both upper and lower solid, out of the same lot, were practically uniform, as were also carbons F (1) and F (2) both taken from the same lot. When the different brands were compared, a variation of from 18 per cent. to 36 per cent. with a watt variation of 5 per cent. and 13 per cent. was found. Assuming that the variation in candle-power with varying watts is about proportional, the greatest variation between different brands is not far from 30 per cent. Were it not for the fact that the great brightness of the arc renders the eye a poor photometer, such a marked variation as 30 per cent. would be ruinous. As it is, the makers of arc light carbons, we are inclined to believe, pay too little attention to their photometric value under the condition of practical use.

There is probably no one thing connected with electric lighting so unsatisfactory as the carbons with which the market is generally supplied, and the improvement in them has by no means kept pace with that in the lamps in which they are burned. Perhaps the cause for this lies in the fact that the physics of the voltaic arc is so little understood. If it were clearly proved that the carbon was actually volatilised, or that it was simply carried from the positive carbon to the negative mechanically, and rendered incandescent during its passage, the makers would have a definite aim in their selection of materials and methods of manufacture.

* New York *Electrical Engineer*.

## THE WORKING EXPENSES OF ELECTRIC AND CABLE RAILWAYS.*

### II.

Having considered in our first article the results obtained down to the year or half-year ending June 30th last in the working of the principal electric railways and tramways in this country, we turn now to cable tramways, of which there are only two with which we can deal, viz., Birmingham and Edinburgh. Separate accounts for the Brixton line in London are not published, while the Matlock line has only a kind of holiday traffic, though even with that it promises to pay. Taking Birmingham first, the fragmentary nature of the figures, and the amount of the expenses in the year ending June, 1888, are explained by the fact that only part of the present three double miles was constructed, and that part was only opened on March 24th, 1888. The line was operated over its full extent for the first time on April 20th, 1889. The result of working a larger instead of a smaller cable tramway from one power-station is shown by the immediate drop in the expenses per mile run for the year ending June 30th, 1890.

Birmingham Cable Tramway.

Table I.—Per Car Mile—Pence.

| Year ending | Cable haulage. | Cables and machinery. | Car repairs. | Traffic expenses. | Permanent way and buildings. | General charges. | Total. |
|---|---|---|---|---|---|---|---|
| June, | | | | | | | |
| 1888 ... | 3·98 | ... | ·39 | 2·21 | ... | 2·89 | 9·47 |
| 1889 ... | 3·38 | 1·8 | ·14 | 1·64 | ·02 | 1·53 | 8·51 |
| 1890 ... | 2·55 | ·96 | ·39 | 1·22 | ·08 | ·9 | 6·1 |
| 1891 ... | 2·41 | ·95 | ·83 | 1·3 | ·13 | ·71 | 6·33 |
| 1892 ... | 2·39 | 1·11 | ·62 | 1·25 | ·17 | ·64 | 6·18 |
| 1893 ... | 2·41 | 1·35 | ·46 | 1·23 | ·17 | ·7 | 6·32 |
| 1894 ... | 2·19 | ·9 | ·47 | 1·27 | ·37 | ·63 | 5·83 |

Table II.

| Year ending | Expenses per car mile. | Receipts per car mile. | Percentage of expenses to receipts. | Total expenses. | Total receipts. | Miles run. | Passengers carried. |
|---|---|---|---|---|---|---|---|
| June, | | | | £ | £ | | |
| 1888 ... | 9·47 | 17·41 | 54·34 | 1,534 | 2,820 | 38,900 | ... |
| 1889 ... | 8·51 | 15·96 | 53·1 | 6,958 | 13,053 | 196,307 | 2,206,168 |
| 1890 ... | 6·1 | 13·16 | 46·35 | 11,681 | 25,212 | 459,806 | 4,261,050 |
| 1891 ... | 6·33 | 12·83 | 49·33 | 13,795 | 27,961 | 522,876 | 5,241,362 |
| 1892 ... | 6·18 | 12·2 | 50·65 | 16,001 | 31,585 | 621,210 | 5,922,304 |
| 1893 ... | 6·32 | 12·69 | 49·8 | 16,878 | 33,893 | 641,161 | 6,341,753 |
| 1894 ... | 5·83 | 12·39 | 47·05 | 16,963 | 36,074 | 698,850 | 6,699,476 |

One peculiarity about these accounts in comparison with general experience with cable tramways is, that though the miles run and the passengers carried have steadily gone up since 1890, there has not, on the whole, been a falling off in the expenses per car mile. The year just closed, however, does show a considerable improvement, amounting, in fact, to a saving of practically a halfpenny per car mile, while the receipts have fallen by only ·3d. per mile run. We are strongly of opinion that, considering the large mileage run, the expenses per car mile might be lower than they are. The present figures may, however, to some extent be accounted for by the large Corporation charges for maintaining the

* The *Railway World*. The first of these articles appeared in our issue of September 7th.

permanent way. It will be noted that this is the only item in Table I. which shows a steady increase as years go on. Such an increase is not a necessity of the case, as cable tramway experience elsewhere has shown. The Birmingham Company, however, are to be congratulated that in spite of the very heavy charge for maintenance of permanent way and buildings—more than double that of the previous highest on record—their total expenses show a falling off of a halfpenny per car mile. The important items of cable haulage and cables and machinery show substantial savings, while car repairs, traffic expenses, and general charges, remain almost stationary. We cannot help thinking that if the Birmingham Company would at once largely increase their mileage on the cable road by the simple process of putting on two or three more cars, they would be substantial gainers. Doubtless, their receipts per mile run would fall off a little, but in accordance with universal experience of the cable system, the expenses per car mile should fall off still more. The net profit per car mile would thus be greater, and in addition to this the greatly increased mileage run would largely add to the total profits. This would be the case even though the net profit per car mile remained as at present. Such a process of increasing the mileage cannot of course be carried on indefinitely, even with the cable system; but with the receipts standing at present at over 1s. per car mile, it is obvious that an increased service is the thing wanted. But even as it is the three miles of cable track form the stronghold of the company. There is a profit upon them of £19,000, while the great steam lines of the company running nearly double the mileage show a profit of only about £24,000, though the receipts there amount to 1s. 4d. per car mile. The horse lines have only given a profit of £1,500, while the electric lines, as shown in the previous article, balance on the wrong side.

It should be noted here that, as in the case of the Birmingham electric line, the Corporation charges for maintenance of permanent way are not included this year in the working accounts of the company, but they are included in the tables we give. Those charges for the cable line amount to £465 4s. 2d., while the company's expense for maintenance stood at £614 19s. 1d. The latter sum figures out in the working accounts at ·21d. per car mile, but the addition of the Corporation charges raises this to ·37d., as shown in the preceding tables.

For purposes of comparison with the accounts of other tramways, we present, as in the case of the accumulator line, a table showing the amount per car mile for directors' fees, secretary's salary, &c., and giving the grand total of expenses and the percentage of these to the receipts, as in the previous instance. On this table it need only be remarked that the company have for the second time succeeded in getting the percentage of expenses to receipts under 50. Let this be compared with the 70, the 80, and even the 90 per cent. of horse and steam tramways.

Corrected Birmingham Expenses.

Cable Line.

Per Car Mile.—Pence.

| Year ending | Total as in preceding table. | Additional expenses. | Grand total. | Percentage of expenses to receipts. |
|---|---|---|---|---|
| June, | | | | |
| 1888 | 9·47 | ·27 | 9·74 | 55·95 |
| 1889 | 8·51 | ·27 | 8·78 | 55·01 |
| 1890 | 6·1 | ·28 | 6·39 | 48·56 |
| 1891 | 6·33 | ·27 | 6·6 | 51·44 |
| 1892 | 6·18 | ·22 | 6·4 | 52·46 |
| 1893 | 6·32 | ·25 | 6·57 | 51·77 |
| 1894 | 5·83 | ·2 | 6·03 | 48·67 |

We now come to the cable tramways in Edinburgh. It is probably safe to say that, taking into account the small volume of traffic to be dealt with, the slow speed of the ropes, which is not allowed to exceed six miles an hour, the mountainous nature of the gradients, and the fact that the cars are not allowed to run on Sundays, this system of tramways shows an economy of working which is not exceeded by any tramway, cable or other, in the world. Any tramway man having first investigated the route, and watched the comparatively small amount of traffic going, and then being shown the accounts of the company, for the first time, would be struck with amazement. We confidently put forward the assertion that the financial results of the operation of these lines is sufficient once and for all to sweep away the statement so zealously put forward in America, that no cable tramway will pay unless it has an excessive traffic to deal with. The profits made by the company owning the lines are at the present time sufficient to pay a dividend at the rate of 5 per cent. per annum on the enormously inflated capital of the company. That capital, as is well known, is about double what it would take to establish the system for hard cash. It is unnecessary here to repeat the various good reasons which exist for what may be called the initial watering of the stock. The fact remains that the profits at present would pay a dividend of about 10 per cent. per annum on a capital of, say, £70,000, for which these tramways could be constructed and equipped. Without further prefix we submit our tables:—

Edinburgh Northern Cable Tramway.

Table I.—Per Car Mile.—Pence.

| Half-year. | Motive power. | Traffic. | Maintenance of road, cars, and plant. | General charges. | Total. |
|---|---|---|---|---|---|
| June, 1890... | 1·4 | 3·55 | 2·25 | 1·7 | 8·9 |
| Dec., 1890... | 1·36 | 3·1 | 2·5 | 1·98 | 8·94 |
| June, 1891... | 1·26 | 2·92 | 1·83 | 1·52 | 7·53 |
| Dec., 1891... | 1·3 | 2·62 | 2·19 | 1·95 | 8·06 |
| June, 1892... | 1·08 | 2·47 | 2·15 | ·86 | 6·56 |
| Dec., 1892... | ·93 | 2·52 | 2·0 | 1·67 | 7·12 |
| June, 1893... | ·97 | 2·6 | 2·04 | ·86 | 6·47 |
| Dec., 1893... | ·76 | 2·47 | 1·5 | 1·58 | 6·31 |
| June, 1894... | ·73 | 2·3 | 1·61 | ·69 | 5·33 |

Table II.

| Half-year. | Expenses per car mile. | Receipts per car mile. | Percentage of expenses to receipts. | Total expenses. | Total receipts. | Miles run. | Passengers carried. |
|---|---|---|---|---|---|---|---|
| | | | | £ | £ | | |
| June, 1890 | 8·9 | 13·32 | 66·82 | 3,721 | 5,570 | 100,319 | 1,169,628 |
| Dec., 1890 | 8·94 | 13·27 | 67·37 | 4,563 | 6,776 | 122,503 | 1,412,366 |
| June, 1891 | 7·53 | 12·24 | 61·52 | 3,828 | 6,215 | 121,827 | 1,316,681 |
| Dec., 1891 | 8·06 | 12·09 | 66·66 | 4,516 | 6,770 | 134,383 | 1,428,368 |
| June, 1892 | 6·56 | 11·12 | 58·99 | 3,922 | 6,648 | 143,443 | 1,421,192 |
| Dec., 1892 | 7·12 | 11·3 | 63·01 | 4,467 | 7,088 | 150,516 | 1,498,904 |
| June, 1893 | 6·47 | 12·0 | 53·92 | 3,921 | 7,270 | 145,400 | 1,549,259 |
| Dec., 1893 | 6·31 | 11·21 | 56·29 | 4,510 | 8,005 | 171,352 | 1,714,531 |
| June, 1894 | 5·33 | 10·89 | 48·94 | 3,862 | 7,885 | 173,791 | 1,697,639 |

The above statistics begin with the half-year ending June 30th, 1890. Part of the system was opened two years earlier, but no figures of any value could be given for the first short section. The second portion was opened on February 17th, 1890. The total length of the two portions is practically three double miles, and is thus almost identical in extent with the Birmingham cable road. Further, to increase the similarity, two cables are worked in each case, though Edinburgh has the disadvantage that the nearest point of one of the lines to the power-house is some 200 or 300 yards away. These things being so, we would specially ask the reader to compare the miles run in the year on the Edinburgh line with those performed in the same period on the Birmingham road. It will be seen, that taking the two last half-years in Edinburgh, the mileage made was less than 350,000, while for the past year in Birmingham it was practically 700,000. Similarly, the passengers carried in Edinburgh numbered less than 3½ millions, while in Birmingham it approximated to 6¾ millions. These points are here noted because, in the case of Edinburgh, half-yearly reports are issued, while in that of Birmingham, the directors only submit their statement of affairs once a year. For the purposes of comparison with Birmingham, it is somewhat unfortunate that the accounts of the two companies are differently stated, but it is plain that in nearly every item the advantage in economy lies with Edinburgh. Another point worth noticing in the Scotch figures is, that they include the expenses and receipts from omnibuses which the company are obliged to run in connection with their cars to certain suburban points. The working of these omnibuses during the past year produced an absolute loss of £249 3s. 5d. In spite of this, and of all the unfavourable circumstances mentioned above, the working expenses for the whole year ending June 30th last came to only 5·82d. per mile run. This is ·21d. better than the total expenses at Birmingham. There are no additions to be made to these Edinburgh figures, as in the case of the capital of the Midlands, for all maintenance charges, directors' fees, salaries, &c., are included in the tables, which are founded upon the revenue account of the company. As a rule, the receipts for the half-year ending December 31st are higher than those for the six months ending June 30th in each year. A profitable comparison may therefore be made between the past half-year and that ending June 30th, 1893. This shows that the increased mileage run has produced a falling off in receipts per car mile of 1·11d., while the saving in expenses has amounted to 1·14d. Owing to the increased mileage, however, the total receipts have actually risen by £615, while the total expenses have fallen by £59. This, it will be admitted, shows extremely careful judgment on the part of the management, and also shows how, as we suggested in the case of Birmingham, the mileage may be increased, the receipts and expenses per car mile diminished, and the total profits increased, while at the same time great benefit is conferred upon the public by the increased frequency of the service.

We would call attention in particular to the way in which the expenses per mile run are gradually going down as the car mileage increases. This is the grand characteristic of the cable system. Let it be noted that even the total expenses have increased from £3,721 in the half-year ending June, 1890, to only £3,862 in the six months just closed. On the other side the total receipts have gone up from £5,570 to £7,885, the miles run from 100,319 to 173,791, and the passengers carried from 1,169,628 to 1,697,639. Taking it in another way, the percentage of expenses to receipts has fallen in the same period from 66·82 to 48·94. These are marvellous results, and the value of the cable system, not only to tramway companies, but to the public, never had a more splendid vindication. A year ago, when we gave a less complete view of the expenses of the Edinburgh line, the Electrical Review, in a leading article, expressed astonishment that the cost for motive power should for three half-years have averaged so low a figure as 1·1d. per mile run. It will be matter for still further astonishment that during the past year this item amounts to only ·74d., or practically three farthings.

We may here give a comparison of the expenses and the receipts per ton mile of the various lines which have been considered. We do not attach any great importance to a comparison between the statistics of cost of dragging each ton weight one mile as between the two electric railways and the three tramways. The conditions on the railways are altogether different from those obtaining on the tramways. On the former roads there are no stoppages except at stations at least half-a-mile apart, and above all the unit dealt with is, in comparison with a single tramway car, very large. The proportion of dead weight of train to the weight of the passengers carried is also very much larger in the case of the railways than in that of the tramways. We would therefore invite comparison simply between the Liverpool and the London electric railways, and then between Birmingham electric, the Birmingham cable, and the Edinburgh cable tramways. The Liverpool train when empty weighs about 31 tons, and its seating capacity is for 114 passengers. With full load the weight is therefore about 38 tons. The London train empty also weighs about 31 tons, and with the full complement of 96 people on board, it runs to some 37 tons. The Birmingham accumulator cars, with their batteries in place, scale 8 tons each, and with all the seats occupied by 50 passengers, they reach 11 tons each. Every Birmingham cable car weighs 5 tons when empty, and with 50 passengers 8 tons. In Edinburgh two sizes of cars are used, one weighing 6 tons empty and carrying 56 passengers, and the other scaling 4 tons, and accommodating 40 passengers. The average weight therefore, with all seats occupied, is 8 tons. The following tables are based upon these figures, and go upon the assumption that all seats are always filled. Manifestly this is not the case in reality, but the assumption made is perhaps the best way by which anything like a comparison can be instituted. The real cost per ton mile is doubtless considerably more than given below, but for purposes of comparison the relation would be the same. It will be noted that though the expenses per ton mile are so low on the railways, the receipts are correspondingly low in comparison with the tramways. The half-yearly blanks in the Birmingham columns are explained by the fact that the reports of the company are only issued annually, while the other blanks are antecedent to the dates at which the respective railways and tramways came into operation.

COMPARATIVE EXPENSES PER TON MILE—PENCE.

| Year or half-year. | Liverpool Electric. | London Electric. | Birmingham Electric. | Birmingham Cable. | Edinburgh Cable. |
|---|---|---|---|---|---|
| June, 1888 ... | ... | ... | ... | 1·22 | ... |
| June, 1889 ... | ... | ... | ... | 1·09 | ... |
| June, 1890 ... | ... | ... | ... | ·8 | 1·11 |
| Dec , 1890 ... | ... | ... | ... | ... | 1·12 |
| June, 1891 ... | ... | ·58 | ·92 | ·82 | ·94 |
| Dec., 1891 ... | ... | ·53 | ... | ... | 1·01 |
| June, 1892 ... | ... | ·52 | 1·42 | ·8 | ·82 |
| Dec., 1892 ... | ... | ·47 | .. | ... | ·89 |
| June, 1893 ... | ·4 | ·45 | 1·53 | ·82 | ·81 |
| Dec., 1893 ... | ·35 | ·43 | ... | ... | ·79 |
| June, 1894 ... | ·35 | ·43 | 1·55 | ·75 | ·67 |

COMPARATIVE RECEIPTS PER TON MILE—PENCE.

| Year or half-year. | Liverpool Electric. | London Electric. | Birmingham Electric. | Birmingham Cable. | Edinburgh Cable. |
|---|---|---|---|---|---|
| June, 1888 ... | ... | ... | ... | 2·18 | ... |
| June, 1889 ... | ... | ... | ... | 1·99 | ... |
| June, 1890 ... | ... | ... | ... | 1·64 | 1·66 |
| Dec., 1890 ... | ... | ... | ... | ... | 1·66 |
| June, 1891 ... | ... | ·73 | 1·38 | 1·6 | 1·53 |
| Dec., 1891 ... | ... | ·7 | ... | ... | 1·51 |
| June, 1892 ... | ... | ·74 | 1·2 | 1·5 | 1·39 |
| Dec., 1892 ... | ... | ·69 | ... | ... | 1·41 |
| June, 1893 ... | ·72 | ·69 | 1·49 | 1·59 | 1·5 |
| Dec., 1893 ... | ·48 | ·64 | ... | ... | 1·4 |
| June, 1894 ... | ·48 | ·69 | 1·53 | 1·55 | 1·36 |

In America some street railway men favour an analysis which shows the receipts and expenses per passenger carried. It is of considerable value in some aspects, but for general purposes we do not consider that it is at all equal to the figures for each car mile or train mile run. It depends altogether on how the cars are filled, while the car mile figure of expenses is to a large extent independent of that condition, especially with cable haulage. However, at considerable labour we have compiled the following tables, which show the expenses per passenger carried, and also the receipts for the various lines dealt with, from the dates they commenced working down to the present time:—

EXPENSES PER PASSENGER CARRIED—PENCE.

| Year or half-year. | Liverpool Electric. | London Electric. | Birmingham Electric. | Birmingham Cable. | Edinburgh Cable. |
|---|---|---|---|---|---|
| June, 1889 ... | ... | ... | ... | ·78 | ... |
| June, 1890 ... | ... | ... | ... | ·69 | ·76 |
| Dec., 1890 ... | ... | ... | ... | ... | ·77 |
| June, 1891 ... | ... | 1·54 | 1 23 | ·66 | ·69 |
| Dec., 1891 ... | ... | 1·35 | ... | ... | ·76 |
| June, 1892 ... | ... | 1·29 | 2·13 | ·67 | ·66 |
| Dec., 1892 ... | ... | 1·15 | ... | ... | ·72 |
| June, 1893 ... | 1 22 | 1·14 | 1·88 | ·66 | ·61 |
| Dec., 1893 ... | 1·33 | 1·15 | ... | ... | ·63 |
| June, 1894 ... | 1·25 | 1·06 | 1·82 | ·63 | ·55 |

RECEIPTS PER PASSENGER CARRIED—PENCE.

| Year or half-year. | Liverpool Electric. | London Electric. | Birmingham Electric. | Birmingham Cable. | Edinburgh Cable. |
|---|---|---|---|---|---|
| June, 1889 ... | ... | ... | ... | 1·42 | ... |
| June, 1890 ... | ... | ... | ... | 1·42 | 1·14 |
| Dec., 1890 ... | ... | ... | ... | ... | 1·13 |
| June, 1891 ... | ... | 1·95 | 1·83 | 1·28 | 1·13 |
| Dec., 1891 ... | ... | 1·77 | ... | ... | 1·13 |
| June, 1892 ... | ... | 1·84 | 1·81 | 1·28 | 1·12 |
| Dec., 1892 ... | ... | 1·69 | ... | ... | 1·13 |
| June, 1893 ... | 2·16 | 1·77 | 1·84 | 1·25 | 1·13 |
| Dec., 1893 ... | 1·78 | 1·71 | ... | ... | 1·12 |
| June, 1894 ... | 1·68 | 1·72 | 1·79 | 1·29 | 1·11 |

The fractions are carried to only two places of decimals, which is sufficient for the purpose. It will be observed that the order of things in the ton-mile tables is now reversed, and that the tramways, apart from the Birmingham Electric line, stand lower than the railways. This, of course, arises from the fact that the number of passengers in proportion to the weight of the vehicles is much greater in the case of the street car than in that of the railway carriage. It is also worth remarking that of late the Edinburgh cable line is lowest in the list as to expenses per passenger, while all along it has been lowest as to the receipts per passenger. The latter circumstance partly arises from the fact that there are two sections of the Edinburgh cable roads, so that the through journeys are short, and partly from the fact that the fares are very low. It should be stated that as regards the expenses per passenger on the Birmingham lines, the extra expenses for salaries and fees before referred to are included, as are also the Corporation charges. It may further be noted that the receipts per passenger in all the columns do not represent the average fare per passenger. The latter sum would be a trifle lower, as the figures in all the tables include the whole of the receipts, which, besides passenger fares, embrace revenue from advertisements and one or two other minute items.

Taking it over all, it will be seen as regards the two electric railways that there is as yet little to choose between them. When the Liverpool line has been running as long as the one in London, it may show better results than the latter now does. It certainly is doing better than the London line did at first, though scarcely so well, from the percentage point of view, as the Metropolitan electric road is now doing. On the other hand the London expenses per train mile are higher than those in Liverpool. In the case of the tramways the unapproached position of the Edinburgh cable line, in view especially of the lightness of the traffic, is plainly manifest.

So far as the figures we have given go, the conclusion will be drawn that in the domain of railways electric traction for short local lines, where the traffic is sufficient, can compete favourably with steam locomotives, while in the case of street tramways it will be difficult to find any method of haulage which, with a fair traffic, can be operated more economically than the cable system.

## OFFICIAL INAUGURATION OF ELECTRIC TRACTION AT HAVRE.

In this first article, says M. Emile Dieudonne, in *Revue Internationale de l'Electricité*, we have to mention merely the circumstances of the inauguration. In a future number we shall enter upon the technical details of this important installation. We have now not to do with a simple line of a few kilometres in extent. An entire system has been transformed. Yesterday, horse-traction; to-day, electro-mechanical methods. The system includes three great lines of the respective lengths of 5,350, 4,860, and 3,770 metres.

The inaugural ceremony was quite successful in spite of the unfavourable weather. The visitors from Paris were received at the arrival platform by M. Mulsart, the general director of the tramway company, and conveyed to the Hotel Frascati. At 2 p.m., after a violent storm accompanied with a deluge of rain, the visitors were conveyed in ten of the company's cars to Greville, after a short halt at the Town Hall to take up M. Brindeau, the Mayor of Havre, and the local authorities. After stopping for a few moments at the terminus of the line, the procession resumed its way in two divisions. The one part took its way to the heights of Saint-Adresse by the line of the boulevard of Strasbourg and the street of Etretat, whilst the other part visited the central station where the visitors were received by MM. Berthier and Bricart, of the Electric Energy Company.

We were on the front platform of a car conducted by M. Leblanc, of the Thomson-Houston Company. We could perceive that a great part of the journey can be effected very economically by a skilful employment of the momentum acquired by the vehicle without using the current.

In the evening a banquet for 250 visitors took place in the saloon of the Hôtel Frascati.

The speeches made were often inaudible on account of the violent thunder. M. Rostand pointed out that on February 1st, 1874, the first system of tramways in France was opened at Havre. Twenty years subsequently electric traction has been installed by the co-operation of the Thomson-Houston Company. The speaker acknowledged the enlightened support which the undertaking had received from the Mayor and the Municipal Council. He concluded by proposing the health of the Mayor, M. Louis Brindeau.

## SPRATT'S ELECTRICAL SPEED AND DIRECTION INDICATOR.

The general arrangement and connections of the speed indicator is shown by fig. 1. A is the contact maker; it consists of a metal ring, A, fixed round the shaft, the number of revolutions of which it is desired to record. Four pieces

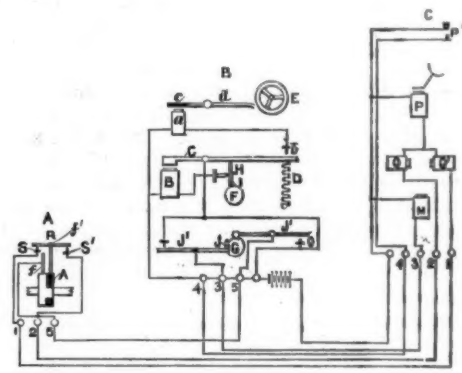


Fig. 1.

of insulating material are let into the periphery of the ring, which, passing under the metallic brush, R, break the circuit four times for every revolution of the shaft. A second brush, *f*, is continuously in contact with the metal part of the ring. The control box, B, contains a self-winding electrical clock, which makes and controls the duration of the necessary contacts. The counter or indicator arrangement is shown at C; it contains the counting mechanism and the indicator for showing whether the shaft is running ahead or astern; there is also the necessary mechanism for automatically putting the counter to zero before the counting mechanism commences its operation. When it is desired to know the revolutions at which the shaft is running, the button, $P^1$ (fig. 2), on the right-hand side of the indicator, is pressed;

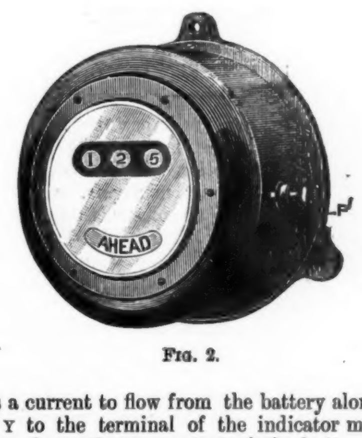



Fig. 2.

this causes a current to flow from the battery along the wire marked B Y to the terminal of the indicator marked B Y; thence by a wire to the top contact of the button, $P^1$, and to bottom contact, and by a wire to terminal 4; from there by the wire 4 to terminal 4 on the control box; from there through the large magnet, B, which winds up the clock by pulling on the left-hand end of the arm, C, thus extending the spring, $D^1$, which is the driving spring of the clock.

Directly this is done the spring catch, H, jumps over the projection, I, on the wheel, F, and breaks the circuit through B. At the same instant a current is sent through the small magnet, $a$, by the right-hand end of the lever, C, coming against the contact, $b$; the magnet, $a$, now attracts its armature, $c$, and pulling the lever, $d$, gives the escapement wheel, E, a flick and starts the clock; the above cycle of operations is almost instantaneous. The clock being started the cam wheel, G, revolves, the pin, J, presses down one end of the lever, $J^1$, and closes the contact at the other end of it. The current now flows from the battery again along the wire, B Y, through the magnet, M, which operates the zero-setting mechanism and brings the counter to zero. The pin, J, having passed over the end of the lever, $J^1$, the circuit is broken. The cam wheel, G, next lifts the end of the lever, $J^{11}$, and closes the contact, O, at the other end; this is the counting circuit and is kept closed exactly 15 seconds. (This period, however, may be shortened, if desired, by increasing the number of contacts on the shaft ring). The current now flows through B Y, again through the magnet, P, then through the magnet, $Q^1$, down the wire marked I to the terminal, $l$, of contact maker; thence to the contact, S, on to the cross piece of the brush, R, then where the metal part of the ring comes under, across to the brush, $f$, and thence by wire 5 back to control box and to battery. The counting circuit being closed for 15 seconds, and this circuit being broken by the ring four times for every revolution, the number of revolutions per minute are thus recorded. The brush, R, in the contact maker is pivoted at $f^1$ and is thus carried over by the friction of the brush rubbing on the ring, and the contact S or $S^1$ is closed according to which direction the shaft is running; the current thus flows either through the magnet, Q or $Q^1$, in the indicator, and by means of an armature pivoted between them turns a disc showing either ahead or astern, as the case may be.

The operation of taking a record is, therefore, as follows:— On pressing the button, $P^1$, at the side of the indicator (fig. 2), the last indication is automatically cleared away and the wheels set to zero. As soon as this operation is completed the counting commences and lasts for 15 seconds, at the end of which time figures appear at the circular openings of the indicator showing the number of revolutions per minute, and at the large opening is indicated the direction. Thus, if the figures 1, 2, 5 (ahead) appeared at the openings it would indicate the engines are working 125 revolutions ahead. Whilst these operations are going on, all instruments in the circuit are automatically locked, so that it is impossible for anyone, by pressing the button of any other indicator, to upset the record being taken.

## HOW TO PREVENT ELECTROLYSIS AND MAKE A COMPLETE METALLIC CIRCUIT FOR ELECTRIC RAILWAYS.*

By H. R. KEITHLEY.

The one problem of paramount importance in electric railway engineering, and one which has for the past two years received the careful attention of the foremost electrical engineers and electric railway managers, is the problem of preventing electrolysis, and the destruction of water pipes, gas pipes, and underground electric cables of cities and towns which is caused by the electrolytic action of the heavy underground currents of electric railways. It is now generally accepted by the ablest electrical engineers, who have given the problem the practical, experimental, and scientific investigation which its importance demands, that the most practical, feasible, and permanent solution of the problem is to provide a "complete metallic circuit for electric railways," and to abandon, as far as possible, the "earth return." Up to a period within the past two years, the universal practice in electric railway construction, has been to rely principally upon the "earth" to complete the circuit from the cars in operation on the road, to the power house, the bonding of the rails being considered of so little importance that only the crudest forms of No 4 iron or copper bonds were used. In the early stages of the electric railway, the expert electrician made his estimates and calculations with the utmost accuracy and scientific precision for the overhead half of the electric railway circuit, and spared neither money, time, labour, copper, or "midnight oil," to bring the overhead half of the circuit up to the highest standard of construction. But the practical results which he aimed to obtain, viz.: a low percentage of loss or drop on the line, and economical consumption of coal at the power house, were seldom, if ever, realised, and all of his elaborate calculation and supposed accurate estimates came to naught, simply because he trusted to Mother Earth and good luck to complete the other half of the railway circuit, and neglected to complete the metallic circuit by utilising the abundance of metal in the rails, by properly bonding them together at the joints. This neglect has brought about the disastrous results of electrolysis of gas and water pipes and underground cables, and the high percentage of loss of power on the line, and enormous consumption of coal, has set at naught the supposed high standard of engineering perfection aimed at (but missed) in the overhead construction.

To complete the metallic circuit of electric railways by utilising the abundance of metal in the rails, is simply a question of the application of just as much care and just as much skilled labour, and the same scientific accuracy in construction by bonding the rails properly, that is given to the overhead half of the circuit; for the rails are the other half of one continuous circuit, and unless each half of the circuit receives the same careful work of the engineer and the skilled workman in its construction, the practical results obtained in the completed, or whole circuit, will exactly correspond to the inefficient work of construction on either half of the circuit, and it does not matter which half receives the inefficient work, the result will be just as disastrous in the end.

To utilise the metal of the rails for completing the metallic circuit is simply a question of properly bonding the rails. And to properly bond the rails is simply for the engineer to select the most perfect rail-bond in the market—both electrical and mechanical perfection should be combined—and to employ skilful workmen to do the bonding, and have accurate and uniformly drilled holes in the rail for applying the bonds; and last, but not least, to distribute the rail bonds on the different lines of a railway system by making accurate estimates for the number and size of the rail bonds used at the joints, so that the total cross sectional area of the rail bonds will exceed the cross sectional area of the overhead half of the circuit at any given point on the line of the railway.

The careful observation of these principles in the construction of a complete metallic circuit for electric railways, will produce the desired results and prevent electrolysis of gas and water pipes and electric cables, reduce the percentage of loss of current on the line, and result in a great saving in the consumption of coal, for this is the inevitable deduction from the well-established law, that electric currents follow the path of lowest resistance, and with the thorough system of bonding above described, the rails will be the path of lowest resistance and the amount of current which would leave the rails, thus heavily bonded, to follow gas or water pipes, or lead cables, would be so small that electrolysis would be reduced to a minimum, and all corrosion of pipes at the joints or elsewhere be prevented.

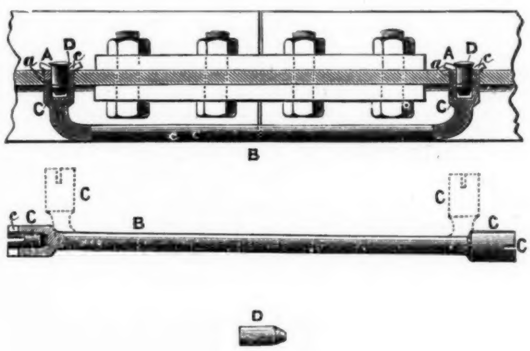
The problem is now narrowed down to the selection of a rail-bond for making the most complete and perfect metallic circuit of the rails. For there is an abundance of metal in the rails of any road for the construction of a complete metallic circuit, if they can only be perfectly bonded together, for four 70 lb. rails of a double track railway, if bonded so as to utilise all of the metal, will have conductivity equivalent to that of four solid copper conductors, each one inch in diameter; and this amount of copper is rarely ever strung for a great distance over a line of railway. Hence it is obvious that the construction of a "complete metallic circuit for electric railways" is purely a problem of distribution of copper, and the use of the most perfect rail-bond, designed for both electrical and mechanical perfection, and thorough work in construction. The requirements of a rail-bond, designed for both electrical and mechanical perfection, are: first, a one-piece rail-bond; second, absolutely solid and perfect contact of the metallic surfaces in the connection between

* *Street Railway Review.*

the bond wire and the rail; third, a rail-bond having its terminals enlarged in diameter at least 1·9 times the diameter of the bond wire itself. This provides for an area of surface contact in the connection equivalent to seven times the cross sectional area of the bond wire itself. This ratio of 7·1 is required to overcome all electrical resistance in the connection between the two metals, iron and copper, the ratio of the resistance of iron and copper being as 7 is to 1. The mechanical requirements are that the design and structure of the rail-bond shall be such that it cannot be broken or have its connection with the rail broken loose by the vibration of the rail joint caused by heavy traffic.

The types of rail-bonds now in general use need only be described to determine whether they come up to this standard.

1. *The Rivet Bond.*—It is composed of a piece of wire soldered to a rivet on each of its ends. Its fatal defects are, first, it will corrode and break loose at the point where it is soldered to the rivet. Second, these soldered connections with the rivet, introduce resistance which limits the conductivity of the bond to that of the soldered connection, and



since the current is forced through 352 of these soldered connections in a mile of rail, the resistance must be very great, thus limiting the conductivity of a No. 0 rivet bond to about that of a No. 4 solid copper wire. Third, a riveted connection with the rail is nearly always imperfect in its contact of the metallic surfaces in the connection. From this it is evident that nearly two-thirds of the copper in rivet bonds is an absolute waste, for no matter how large the wire is, the conductivity of the bond is limited by the soldered connection.

2. *The Channel Pin Bond.*—This is a piece of copper wire having each of its ends secured directly into the rail by iron channel pins. The defects are: The surface contact of the wire in the connection in the rail is always imperfect, and admits moisture, rust and corrosion, causing great resistance to the passage of the electric current, and eventually causing electrolytic action which destroys the connection. The area of the surface contact in the connection is very little more than the cross section of the wire. These defects make the resistance of 352 such connections per mile of rail very great.

3. *The One-Piece Rivet Bond*, which consists of a wire having shoulders upset on each end, and is secured to the rails by having its ends riveted into them. This is an improvement on the old style three-piece rivet bond, but is subject to the same defects, caused by the impossibility of making perfect metallic contact between the surfaces of a riveted connection; also the defect of having its terminals very little, if any larger, than the wire itself, making the area of surface contact in the connection very little greater than the cross section of the wire, whereas, it should be seven times the cross section of the wire. Hence, a large proportion of the copper in this rail-bond is a total waste, for its conductivity is limited by the conductivity of the connection with the rail. And, as there are 352 of these imperfect connections to a mile of single rail, the resistance is correspondingly great.

The only rail-bond in the market which fulfils all the requirements of a perfect rail-bond, is the rail-bond having large tubular terminals (see fig.), and which is secured to the rail by the means of drift pins. This is practically a one piece rail-bond, C B C, having large tubular terminals, A, A, which are connected into a rail by inserting them into holes drilled to fit them, and permanently expanding such tubular terminals by stretching or swaging of the metal, *a*, *c*, composing them into contact with the holes. This expansion of the terminals is accomplished by driving drift pins, D, D, into them, said pins being about $\frac{1}{16}$th of an inch larger than the openings in the tubular terminals. This makes an absolutely perfect and solid contact between the two metallic surfaces, in the connection, and permanently excludes all air and moisture, and renders corrosion or electrolytic action in the connection absolutely impossible, and makes a connection which will remain perfect as long as the bond wire or rail will last. The tubular terminals are 1·9 times as large in diameter as the bond. This gives an area of surface contact, in the connection with the rail, equivalent to seven times the cross section of the bond, and eliminates all electrical resistance from the connection. A single line of rail, carefully bonded with No. 0000 rail bond, having these tubular terminals, will have its conductivity made equivalent to that of a No. 0000 solid copper wire of the same length. Therefore, this bond utilises every particle of copper composing it for conductivity, and makes it possible to utilise any amount of metal in the rails required, according to the number and size of the bonds used to a rail joint.

It is a clearly established law of electrical conductors that the carrying capacity of a conductor is limited by the amount of resistance of any one part of that conductor. Then it is clearly evident that the conductivity of the four rails of a double track railway, double bonded at each joint with No. 0000 bonds having tubular terminals, will be equivalent to the conductivity of eight No. 0000 solid copper wires, of an equal length, if the rail-bonds are perfect, according to the standard above given, and all the connections are perfectly made. But this is too high a standard of perfection to be obtained in practice, on account of careless work in applying the bonds. But with ordinary care in bonding, and by bonding with cross wires across the track every four or six rail lengths, the four rails can be so bonded, with the tubular terminal bond, that their conductivity will be equivalent to that of seven solid copper wires, of the same size of the bond, and the same length of the tracks so bonded. This is equivalent to a copper conductor of 1,481,200 circular mils. Only about one-tenth as much copper is required for making a complete metallic circuit by this system of bonding as would be required for a complete metallic circuit, completed by solid copper conductors, or "track feeders," as they are called. Therefore, it is evident that a complete metallic circuit of high conductivity can be constructed at far less expense for first cost of copper and construction by thoroughly bonding the rails with the tubular terminal rail-bond, referring to the principles above laid down.

The above described rail-bond and system of bonding has lately been adopted as the standard for all construction by the three great street railway systems of Chicago, on 450 miles of electric lines now under construction, and is rapidly being adopted by the various leading electric railway systems throughout the United States. It is popularly known as the "Chicago" rail-bond.

## NOTES ON THE STEAM TURBINE.

By KENELM EDGCUMBE.

(*Concluded from page* 454.)

Now, with regard to the apparent value of superheating, it may be said that, theoretically, it is quite immaterial so long as T has a certain value, whether the working substance be high pressure saturated steam or low pressure superheated steam. Practically, however, the work obtained from a lb. of steam depends on its pressure and volume. Since steam expands approximately 0·002028 of its volume for every degree Fahrenheit, it follows that for 100° of superheat the volume will be increased by about $\frac{1}{5}$th, and hence, also, the work obtained from it. It appears, however, to have a more important function to perform. In the cylinder engine superheating is employed, as has been already said, in order to reduce condensation, both in the steam pipes and cylinders. Although condensation in itself is attended by no such drawbacks in the turbine as in other forms of engine, yet it appears that the friction experienced by gaseous steam is considerably less than if it is saturated with water. The whole question is, however, somewhat obscure. In order to determine the actual advantage gained by its use, Prof. Kennedy carried out a separate test with superheating to about 400°, and the conclusions arrived at were, that up to 35 H.P. the advantage was inappreciable, while at 100 H.P. it amounted to 8 per cent., which at the same rate would imply a gain of 10 per cent. at full load.

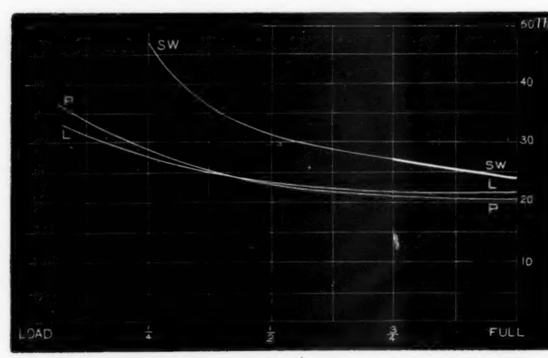
It is obvious, that if carried to excess, superheating will be the reverse of advantageous, as it will only serve as a means of conveying heat to the condenser. Just so much heat must, in fact, be supplied to the steam as can be imparted to the wheel during expansion. Thus, the motor under consideration is capable, as we have seen, of extracting $\frac{1}{27}$th of a unit, or about 127 B.Th.U. from a lb. of steam. Now, steam at 115 lbs. (abs.) contains 1,102 B.Th.U. from 32°, and at 1 lb., the pressure of the exhaust, it contains 1,051 B.Th.U., and hence, during expansion 51 units will be given up, so that to make up the required 127 units another 76 units will have to be supplied by superheating. Since the specific heat of steam at constant pressure, $k$, $= 0{\cdot}48$, the required number of degrees is $\frac{76}{0{\cdot}48} = 160$. The temperature of steam at 115 lbs. is 338°, and, therefore, we could superheat to advantage up to nearly 500°. It must, however, be remembered that additional heat is required for the generation of superheated steam. In the above case it was 76 units, or, say, 6 per cent. of the total heat required. Also the hot gases will reach the chimney at a high temperature, namely, that of the superheated, instead of the saturated steam, thus wasting additional heat. The high temperature also presents certain difficulties in the cylinder engine, such as increased friction, destructive chemical action in the cylinder and packing, and difficulty of finding a lubricant—should such be required—to withstand the heat, &c., and though it is probable that these evils have been somewhat exaggerated, they are entirely absent from the turbine, which is from its construction eminently suited to working with superheated steam.

The "reaction engine" of Mr. Morton, of Glasgow, is based, as its name would imply, upon the principle of Hero's Eolipile. It consists of two distinct wheels in the same steam-tight compartment, and keyed to the same shaft. The steam enters at the centre of the first wheel through an annular opening round the spindle, and thence flows through a ring of outward flow nozzles into an annular space, separating the latter from another ring of nozzles, through which it flows into a third, and from thence into the casing. From here it returns through two rings of inward flow jets, forming the second wheel, to its centre, expansion being thus completed in five stages. In order to oppose the tendency of the steam to circulate in the contrary direction to that in which the discs revolve, thus reducing the effective torque, fixed guide blades are placed at intervals round the annular spaces between the rings.

A motor constructed on this plan has been described by Mr. Morton,* in which, with 90 lbs. (abs.) pressure, and 20 in vacuum, the low pressure wheel gave 4½ B.H.P., and the high pressure 6½ B.H.P., or with the two in place and driving a dynamo direct at 4,000 revolutions, the output was 11 B.H.P. Although the steam consumption was somewhat high, it must be remembered that this form of turbine is still in its experimental stage, and hence it is probable that with an increased number of stages of expansion and other improvements suggested by the author, a much higher efficiency will soon be recorded. Amongst other things, it would seem that, with only five stages of expansion and so low a speed as 4,000 revolutions, considerable loss must occur from steam blowing through the clearance spaces, &c., without acting on the blades. With the addition of a few more jets also, a higher steam pressure would probably add considerably to its economy. It would be of interest, also, to try the effect of super-heating on the steam consumption. In the meantime, it is chiefly remarkable as being an adaptation, in an eminently practical form, of the ancient reaction engine.

A remarkably light motor, working also on the reaction principle, was described in 1889 by Mr. Dow,* of Cleveland, U.S.A. This turbine, which developed 10 H.P., weighed but 68 lbs. complete, and the moving parts but 2 lbs. 3 ozs. The steam entered at the centre and passed outwards through two outward flow wheels in parallel, expansion being performed in six stages. At 70 lbs. pressure this motor required 47 lbs. of steam per H.P. hour, running at the high speed of 16,000 to 20,000 revolutions per second. It was at first employed to operate hoists and elevators and for driving dynamos, since then, however, it has been adopted for use with the Howell torpedo by the U.S.A. Navy. The turbine is coupled by a clutch to a shaft on the torpedo, carrying a heavy fly-wheel, and so soon as the latter has been brought to a speed of 10,000 revolutions per minute the clutch is uncoupled and the torpedo launched in the required direction by a small charge of powder. On reaching the water it is propelled to the desired distance by twin screws driven through bevel gear by the stored up energy of the fly-wheel. The turbine, which develops 30 H.P. at 120 lbs. steam pressure, weighs under a cwt. Under these conditions it is impossible to determine its economy in working, and this is, in fact, of small importance compared with small size and weight, for power developed.

It may be of interest to compare the steam consumption of two of the turbines described with that recently given for a 300 E.H.P. Siemens-Willans non-condensing steam dynamo, having a combined efficiency of 88 per cent, which appears to be the highest yet recorded. The curves (fig. 4) are taken from the following table :—




S W = Siemens-Willans 300 H.P. non-condensing set; P = Parsons 200 H.P. turbo generator (condensing); L = de Laval 60 H.P. steam turbine (condensing).

FIG. 4.—LBS. STEAM PER E.H.P. HOUR AT VARIOUS LOADS.

| Load. | Lbs. steam per E.H.P. generated per hour. | | |
|---|---|---|---|
| | 300 E.H.P. Siemens-Willans. | 200 E.H.P. Parsons. | 60 E.H.P. De Laval. |
| Full | 23 lbs. | 20 lbs. | 21½ lbs. |
| ¾ | 27 „ | 21 „ | 22 „ |
| ½ | 31½ „ | 23 „ | 23¾ „ |
| ¼ | 47 „ | 29 „ | 27½ „ |

Mr. Willans† was the first to point out that the steam consumption per hour of an engine working at constant speed, and cut-off could, if the losses be assumed constant at all loads, be represented by the equation

$$W = a + b\,HP,$$

where $a$ and $b$ are constants for any particular engine and HP is the load. It may be of interest to discover $a$ and $b$ approximately for the three sets above-mentioned. We have $W = a + b\,HP$ and hence the weight of steam used per

* "Rotary and Reaction Steam Engines," paper by Alex. Morton December 19th, 1893, before Institution of Engineers and Shipbuilders of Scotland.

* Paper before Civil Engineers Club of Cleveland, U.S.A., October 8th, 1889.

† *Proceedings Institute Civil Engineers*, Vol. cvi., p. 62.

E.H.P. hour is $w' = \frac{a}{E} + b$, where E = load in E.H.P.

Now, from the table, by substituting values for $w'$ and E, we find that for Parsons's turbo-generator, $a = 600$, $b = 17$; for de Laval's motor, $a = 120$, $b = 19{\cdot}5$, while for the Siemens-Willans set, $a = 2{,}400$, $b = 15$.

From the equation, $W = a + b\,E$, it will be seen that whether the motor be loaded or not, $a$ lbs. of steam will be expended per hour in overcoming friction, back pressure, and other approximately constant losses. We may thus obtain what might be called the "practical" efficiency

$$\eta = \frac{b\,E}{a + b\,E},$$

which is the ratio of the total lbs. of steam used less those wasted (*i.e.*, $a$) to the total amount used. It must be borne in mind that the usual "efficiency," *i.e.*, $\frac{\text{B.H.P.}}{\text{I.H.P.}}$, takes no account of back pressure losses, or, in fact, of any but those due to friction, so that it is but little guide to the working of the engine; in fact, it is probable that where it not for the remarkable ease with which a permanent record of the "indicated work" can be obtained, the term would fall into disuse. Its misleading nature will be evident when it is remembered that a low steam consumption is absolutely opposed to a "high efficiency." To obtain the latter a small single cylindered non-condensing engine, and consequent small friction, is required, whereas for the former a large cylinder, high ratio of expansion and condensation, are necessary.

What we have called the "practical" efficiency would, for the engines considered, be:—Siemens-Willans, 67 per cent.; Parsons generator, 85 per cent.; and de Laval's, 90 per cent. Here we see the cause of the rapid increase in economy of the two turbines, and especially the de Laval, over the cylinder engine. It must, however, be remembered that the Siemens-Willans set is non-condensing, whereas the turbines are condensing, and therefore, perhaps, the comparison is hardly a fair one.

In conclusion, it may be remarked that if uniformity of design is a criterion of perfection, the steam turbine is at present very far from perfect. The vast difference noticeable would seem, in fact, to indicate that the principles underlying its action are still but imperfectly understood, and it is probable, therefore, that with a clearer insight into its action a still further economy will be recorded. At any rate, it must be admitted that the steam turbine has many good points in its favour, and that it is no longer safe to regard it as a mere scientific toy.

## CAPACITY OF CONDUCTORS.*

A Correspondent writes to *Electric Power*, of New York, as follows:—

Having occasion recently to calculate the electrostatic capacity of various conductors, both bare and insulated, in connection with an alternating installation, and being somewhat rusty on this particular point, I consulted the books and found such a wide difference in the formulæ given, although, with some exceptions, the results are the same, that I write to ask you to kindly explain them. To make the statements definite, I will give the following examples:—

*Example No.* 1.—What is the capacity of a mile of No. 0. B. and S., lead covered cable, with insulation of India-rubber ·15 inches thick? The same insulated with gutta-percha?

*Example No.* 2.—What is the capacity of a mile of single bare overhead wire of No. 0. B. and S., 10 feet above the ground, with earth return?

*Example No.* 3.—What is the capacity of each of two bare overhead parallel wires of No. 0. B. and S., a mile long, 10 feet above the ground and 12 inches apart?

I have consulted Clark & Sabine; S. P. Thompson's text book; W. E. Ayrton's "Practical Electricity"; Kempe's Pocket Book; Munro and Jamieson's Pocket Book; Houston's Dictionary, and various others. Now, while I have a taste for, I have little training in mathematics, but by close application I can usually dig out a formula that may be used. If in your answer you will kindly bear this in mind, and not go too deep into abstruse mathematics, I may be able to understand what you are driving at. Thanking you in advance for your courtesy, I am, &c., &c.

We are always glad, says our correspondent, to receive inquiries like the above, so evidently from one who takes a quite practical interest in his work, and in reply the answers to his examples will first be given with the shortest and most available formula for the purpose that may be considered correct. Following this will be treated the formulæ of the different writers he has mentioned, which, it must be admitted, are quite puzzling to a beginner.

*Example No.* 1.—The diameter of No. 0. B. and S., is ·325 mils., call this $d$; the diameter over the insulation is ·625 mils., call this D.

The formula is:

$$\frac{{\cdot}03883 \times \text{specific inductive capacity}}{\text{logarithm of } \dfrac{\text{diameter outside of insulation}}{\text{diameter of conductor}}} = \left\{ \begin{array}{l}\text{microfarads per}\\ \text{mile of cable,}\end{array}\right.$$

or, for the example,

$$\frac{{\cdot}03883 \times k}{\log. \dfrac{{\cdot}625}{{\cdot}325}} = \frac{0{\cdot}3883 \times k}{{\cdot}2834}, \text{ or, } {\cdot}137\,k,$$

where $k$ = the specific inductive capacity; from a table of specific inductive capacity, on page 561, Munro and Jamieson, we get 2·94 as that for vulcanised India-rubber; and for gutta-percha 4·2. (See also Table IV.) Then for India-rubber the capacity in microfarads per mile of the above cable is $\cdot137 \times 2{\cdot}94 = \cdot403$, and for gutta-percha $\cdot137 \times 4{\cdot}2 = \cdot575$.

*Example No.* 2.—The capacity of a single bare overhead wire with earth return is determined by the formula:

$$\frac{{\cdot}03883}{\text{logarithm of } \dfrac{4 \times \text{height above ground}}{\text{diameter of conductor}}} = \left\{ \begin{array}{l}\text{microfarads per}\\ \text{mile.}\end{array}\right.$$

The height above ground and diameter must both be expressed in the same units, it matters not what units, as it is a simple ratio; in this case we will reduce them both to centimetres as corresponding to the units used in most of the other formulæ. 10 feet = 304·8 centimetres and diameter of No. 0. B. and S. Wire = ·325 mils. = ·8255 centimetre.

The formula then is:

$$\frac{{\cdot}03883}{\log. \dfrac{4 \times 304{\cdot}8}{{\cdot}8255}} = \frac{{\cdot}03883}{\log. 1477} = \frac{{\cdot}03883}{3{\cdot}1674} = \left\{ \begin{array}{l}{\cdot}01225 \text{ micro-}\\ \text{farads,}\end{array}\right.$$

or, the capacity of a mile of single bare overhead conductor 10 feet above ground is ·01225 microfarads.

Table I.

Capacity of Insulated Lead Protected Cables.

$k$ = specific inductive capacity of insulating material, see Table IV., from Ayrton's "Practical Electricity."
D = diameter of cable outside of insulation.
$d$ = diameter of conductor.

| | |
|---|---|
| Microfarads per centimetre length ... ... ... | $\dfrac{{\cdot}000{,}000{,}241{,}5\,k}{\log \frac{D}{d}}$ |
| Microfarads per inch length ... ... ... ... | $\dfrac{{\cdot}000{,}000{,}613{,}4\,k}{\log \frac{D}{d}}$ |
| Microfarads per foot length ... ... ... ... | $\dfrac{{\cdot}000{,}007{,}361\,k}{\log \frac{D}{d}}$ |
| Microfarads per 1,000 feet length ... ... ... | $\dfrac{{\cdot}007{,}361\,k}{\log \frac{D}{d}}$ |
| Microfarads per mile length ... ... ... ... | $\dfrac{{\cdot}038{,}83\,k}{\log \frac{D}{d}}$ |

*Example No.* 3.—The capacity of each of a pair of No. 0 B. and S. wires, 12 inches apart, a mile long.

The formula for this is very much the same as that for example No. 2, excepting that each wire has one-half the capacity it would have, if considered alone in relation to earth, and the formula therefore becomes:

$$\frac{{\cdot}01942}{\text{logarithm of } \dfrac{\text{distance between centres of conductors}}{\text{radius of the conductor}}} = \text{microfarads}$$

and for the above example, No. 3,

$$\frac{\cdot 01942}{\log.\ \dfrac{30\cdot 48}{\cdot 4127}} = \frac{\cdot 01942}{\log.\ 72\cdot 9} = \frac{\cdot 01942}{1\cdot 862} = \cdot 01042 \text{ microfarads,}$$

or, the capacity of each of a pair of No. 0. B and S wires a mile long, placed parallel, 12 inches apart, 10 feet above the ground, is ·01042 microfarads.

The distance above the ground of two parallel conductors is so small a factor as to enter into the result to no appreciable extent; but the proximity of other wires does affect the calculated capacity, sometimes increasing it to the extent of double the figured capacity, somewhat in proportion as the neighbouring conductors leak to earth.

### Table II.

#### Capacity of Single Overhead Wires with Earth Return.

$h$ = height above ground in mils or centimetres.
$d$ = diameter of conductor in mils or centimetres.

| | |
|---|---|
| Microfarads per centimetre length ... ... ... | $\dfrac{\cdot 000{,}000{,}241{,}5}{\log \frac{4\,h}{d}}$ |
| Microfarads per inch length ... ... ... ... | $\dfrac{\cdot 000{,}000{,}613{,}4}{\log \frac{4\,h}{d}}$ |
| Microfarads per foot length ... ... ... ... | $\dfrac{\cdot 000{,}007{,}361}{\log \frac{4\,h}{d}}$ |
| Microfarads per 1,000 feet length ... ... ... | $\dfrac{\cdot 007{,}361}{\log \frac{4\,h}{d}}$ |
| Microfarads per mile length... ... ... ... | $\dfrac{\cdot 038{,}83}{\log \frac{4\,h}{d}}$ |

### Table III.

#### Capacity of Each of Two Parallel Bare Aerial Wires, Insulated.

D = distance apart from centre to centre.
$r$ = radius of wire = $\frac{1}{2}$ of diameter.

| | |
|---|---|
| Microfarads per centimetre length ... ... ... | $\dfrac{\cdot 000{,}000{,}120{,}8}{\log \frac{D}{r}}$ |
| Microfarads per inch length ... ... ... ... | $\dfrac{\cdot 000{,}000{,}306{,}7}{\log \frac{D}{r}}$ |
| Microfarads per foot length ... ... ... ... ... | $\dfrac{\cdot 000{,}003{,}681}{\log \frac{D}{r}}$ |
| Microfarads per 1,000 feet length ... ... ... | $\dfrac{\cdot 003{,}681}{\log \frac{D}{r}}$ |
| Microfarads per mile length ... ... ... ... | $\dfrac{\cdot 019{,}42}{\log \frac{D}{r}}$ |

### Table IV.

#### Specific Inductive Capacity, from "Practical Electricity," Ayrton.

| Substance. | Specific Inductive Capacity. |
|---|---|
| Air, at about 760 mm. pressure ... ... | 1 |
| Paraffin wax, clear ... ... ... ... | 1·92—1·97—2·32 |
| " " milky ... ... ... ... | 2·47 |
| India-rubber, pure ... ... ... ... | 2·34 |
| " vulcanised ... ... ... | 2·94 |
| Resin ... ... ... ... ... ... | 2·55 |
| Ebonite... ... ... ... ... ... | 2·56—2·76—3·15 |
| Sulphur... ... ... ... ... ... | 2·88—3·21—3·84 |
| Shellac ... ... ... ... ... ... | 2·95—3·73 |
| Gutta-percha ... ... ... ... ... | 4·2 |
| Mica ... ... ... ... ... ... | 5· |
| Flint glass, very light ... ... ... | 6·57 |
| " " light ... ... ... ... | 6·85 |
| " " dense ... ... ... ... | 7·4 |
| " " double extra dense ... ... | 10·1 |

Above are three tables giving simple formulæ for cases similar to the above three examples, for different units of length, viz.:—per centimetre, per inch, per foot, per 1,000 feet, and per mile; the last being in each case the formula used in the examples given. Following the above-mentioned tables is one copied from Prof. Ayrton's "Practical Electricity," which will be found convenient for use with the formulæ given.

It is interesting to note the different methods of expressing a formula by the different authorities, although the result be the same. There are a few errors in the books and to point out these as well as the different methods of expression, below will be found the formulæ suggested by the authorities mentioned in the letter at the head of this article, with the example given worked out for each case by the formula suggested.

*For example No.* 1.—

Clark & Sabine.

$$K = 1{,}384.\ k.\ \frac{\text{lengths in knots}}{\log \frac{D}{d}}$$

and example No. 1 becomes

$$1\cdot 384.\ k.\ \frac{\cdot 8694}{\log \frac{D}{d}} = \frac{1.2.k.}{\cdot 2834} = 4\cdot 24.k.$$

$k$ in this case = the capacity per 1 square foot of the material ·001 inch thick; for India-rubber = ·0904, and for gutta-percha = ·1357, therefore

for India-rubber the answer is 4·24 × ·0904 = ·383
and for gutta-percha „ 4·24 × ·1357 = ·575

practically the same as the answers given in the text above.

S. P. Thompson:

$$K = \frac{\text{length in centimetres} \times k}{2 \log_\epsilon \dfrac{\text{radius outside of insulation}}{\text{radius of conductor}}} =$$

Electrostatic units ÷ 900,000 = microfarads.
For the above example this becomes

$$\frac{160{,}934.k}{2 \log_\epsilon \dfrac{\cdot 312}{\cdot 162}} = 123{,}321\ k \div 900{,}000 = \cdot 137.k.$$

and for India-rubber = ·137 × 2·94 = ·403 mfds.
„ gutta-percha = ·137 × 4·2 = ·575 „

W. E. Ayrton, "Practical Electricity":

$$K = \frac{2\cdot 413 \times l \times k.}{10^7 \log \dfrac{\text{radius outside}}{\text{radius conductor}}}$$

and for example No. 1 the result is the same in every way as that of S. P. Thompson's formula next above,

*i.e.* ·137 × 2·94 = ·403 mfds. for India-rubber.
and ·137 × 4·2 = ·575 „ gutta-percha.

Kempe's Pocket Book:

For wire insulated with gutta-percha $K = \dfrac{\cdot 147}{\log \frac{D}{d}}$

and for example No. 1 would be $\dfrac{\cdot 147}{\cdot 2834} = \cdot 518$ mfds., a quite different result from all the other writers. As this result is almost exactly 10 per cent. less than the others, it may be quite reasonable to suppose that Mr. Kempe has deducted that amount for difference in quality of this material, in which case his formula is probably as nearly correct as occurs in practice.

He states that the capacity of conductors insulated with India-rubber will be from 10 to 15 per cent. less than that for gutta-percha, giving for this example ·518 less 10 per cent. = ·4662 mfds.

*For Example No.* 2.—

Kempe's Pocket Book:

K. per mile $= \dfrac{\cdot 061637^*}{\log \frac{4\,h}{d}}$ which for the example becomes

* We may mention that this formula is the correct one for English telegraph lines, as the constant ·061637 is not a theoretical one but a value obtained as the result of a great number of actual measurements.—Eds. Elec. Rev.

$$\frac{\cdot 061637}{3\cdot 1674} = \cdot 0194 \text{ mfds.}$$

A result differing not only from the answer given above but from the result by the formula following this.

Munro & Jamieson :

$$\text{K} = \frac{l}{\log_\epsilon \frac{4\,h}{d}} = \text{E. S. units} \div 900{,}000 = \text{mfds.}$$

For example No. 2 this becomes

$$\frac{160{,}934}{7\cdot 29} = 22{,}076 \text{ E. S. units and } \frac{22{,}076}{900{,}000} = \cdot 02453 \text{ mfds.}$$

per mile.

This result is also different from the true answer, and it seems quite evident that it is due to a typographical error in leaving off the "2" before "$\log_\epsilon$."

## MECHANICAL DRAUGHT.

With regard to our article on mechanical draught, and Mr. A. W. Steavenson's letter (p. 401) thereupon, it may be pointed out that the reference to the control of the fan speed by the steam pressure had a different meaning from that attached by Mr. Steavenson. The intention was not that an increase of pressure should cause the fan to run faster to supply air for the greater amount of coal he presumes to be being burned to cause the pressure, but just the reverse. The idea before the writer was that as the pressure approached the point of blowing at the safety valve, it should cause the fan to run slower in order to moderate the intensity of the draught and produce less steam. This is what is now actually done by the automatic steam damper, a contrivance we have known to succeed admirably or fail according to the quality of the engineer in charge. Our objection to running a fan at speed when the dampers were closed, was purely a matter of economy of power. The fan can perfectly well be run full speed, and the entire regulation be left to the dampers with results quite satisfactory as to the furnace, but why run the fan unnecessarily fast. With the case suggested of shutting down two boilers out of six, the regulation of the fan by the steam pressure would take effect exactly as before, and the speed of the fan engine would fall until such time as the fan would be revolving at such speed as would pass two-thirds the volume of gases that was turning out when six boilers were at work. It is a matter of detail whether regulation of the fan be effected by cut-off or by throttling of the steam, or in belted fans by conoidal long drums and shifting belt. It does not follow of necessity that the same speed of fan must always be made in order to maintain the same draught intensity. If for six boilers a fan is a little small and is run faster to pass more gas, it is quite possible that the capacity of the fan as a thoroughfare may prevent the formation of so severe a draught as would be secured by the same fan running more slowly on a two-thirds volume. It is well also to remember the fact that a fan, whose outlet is throttled, will at once run away, proving that the air and the fan blades are now running round as a solid cylinder and absorbing less power than when the fan is discharging air—the air, of course, absorbing energy from the fan and ceasing to do so when not allowed to move forward.

The ideal steam boiler is, of course, one where the draught, the fuel supply, and the motion of the fire bars are steam controlled. We have seen this done, but it was with a mechanical stoker of the sprinkler type, and satisfactory results did not follow—finances also being wanting to perfect the scheme. We do not, on our part, quite follow Mr. Steavenson when he says, "if you fire hard *and* increase the pressure, the fan will go faster and give more draught." If by firing hard the pressure can be increased, we would ask what need is there for the fan to go faster? Why, if such be the case, have a fan at all or even a chimney. When we fire hard *to* increase the pressure, we run the fan faster to keep the rate of combustion up to the rate of firing, and we fire hard to increase the pressure only when we see it falling or anticipate a demand, and in a hand-fired furnace with a fan or other draught regulated by the pressure, our efforts at firing should accompany the needle of the pressure gauge and keep up with the draught, which is being kept inversely proportional to the steam pressure. Obviously, therefore, we cannot leave the fan engine to run at such speed as a fixed cut-off would give it, and quickest with the highest pressure, for we want just the reverse action. This should not be difficult to secure. A sliding weight upon a lever weighting the governor of the fan engine would do this. Mr. Steavenson will now see that the writer was quite clear on the point, though he perhaps failed in presenting the point as well as it might have been presented.

## MEDICAL ELECTRICAL NOMENCLATURE.*

In the September number of the New York *Polyclinic* Messrs. Houston and Kennelly criticise the classification of currents usually employed by medical writers, and based upon former ideas in regard to different varieties of electrical fluids.

The classification now generally made of electric currents as employed for therapeutic purposes, is as follows:—1. Faradic currents. 2. Galvanic currents. 3. Galvano-Faradic currents. 4. Franklinic currents. 5. Static induced currents. 6. The static breeze.

The principal objection against the preceding classification of currents as generally employed in electro-therapeutics, lies in the attempt to characterise the current by the source which produces it. This would only be warranted if the electricity produced by any particular apparatus was exclusively generated by that apparatus. As based upon more rational grounds, Messrs. Houston and Kennelly offer the following classification to replace the one referred to:

| | | |
|---|---|---|
| Continuous currents ... | Uniform (1) ... | (Galvanic). |
| | Pulsatory (2) ... | (Some varieties of Galvano-Faradic). |
| Alternating currents ... | Symmetrical ... | Sinusoidal (3). |
| | | Non-sinusoidal (4). |
| | Dis-symmetrical (5) | (Faradic). |
| Intermittent currents | Oscillatory (6) ... | (Static induced). |
| | Non-oscillatory (7) | (Franklinic). |
| Convective currents (8) | ... ... ... | (Static breeze). |

Here it will be observed that all the different varieties of currents are included under the four main classes of continuous, alternating, intermittent, and convective.

Continuous currents may be uniform or pulsatory. A uniform current is produced by the action of a uniform

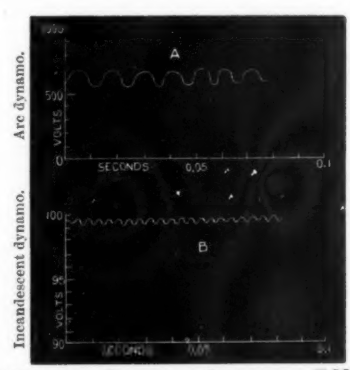



Fig. 1.—Diagrams of Pulsatory Continuous E.M.Fs. Capable of Producing Pulsatory Continuous Currents.

E.M.F. as that of a Leclanché cell or of a thermo-couple. Such E.M.Fs. as these would send a uniform current through the human body which corresponds to the galvanic current of the ordinary classification.

The pulsatory current is a variety of continuous current, which, although always flowing in the same direction, is not uniform in strength. The E.M.Fs. of most continuous current dynamos are of this type. Diagrams of pulsatory E.M.F. are shown in fig. 1, representing the E.M.Fs. produced by arc and incandescent dynamos, the pulsations being more marked in the former than in the latter cases. Such

* New York *Electrical World*.

pulsatory E.M.Fs. applied to the body would produce pulsatory currents.

Alternating currents, *i.e.*, currents which periodically reverse their direction, may be either symmetrical, or dis-

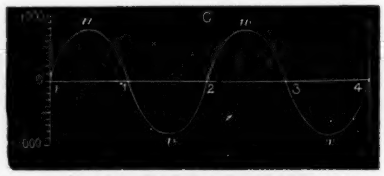


FIG. 2.—DIAGRAM OF SINUSOIDAL ALTERNATING E.M.FS. CAPABLE OF PRODUCING A SINUSOIDAL ALTERNATING CURRENT.

symmetrical. Symmetrical alternating currents may be sinusoidal or non-sinusoidal. Fig. 2 shows a diagram of a sinusoidal alternating E.M.F., capable of producing a similar

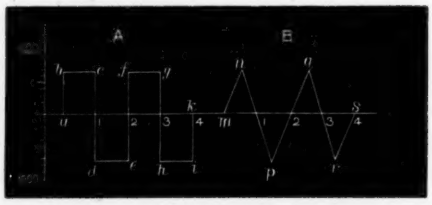


FIG. 3.—DIAGRAM OF NON-SINUSOIDAL ALTERNATING E.M.FS. CAPABLE OF PRODUCING NON-SINUSOIDAL ALTERNATING CURRENTS.

type of current. Fig. 3 shows a similar diagram of non-sinusoidal alternating E.M.F. Voltaic alternating currents are of this type.

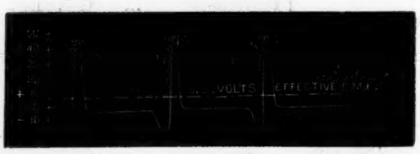


FIG. 4.—DIAGRAM OF DIS-SYMMETRICAL ALTERNATING E.M.F. PRODUCED BY A FARADIC COIL, CAPABLE OF PRODUCING A DIS-SYMMETRICAL ALTERNATING CURRENT.

The dis-symmetrical alternating current is the type of current produced by all faradic coils under the influence of vibrating contact breaker. Fig. 4 is a diagram of such an E.M.F.

Intermittent currents may be oscillatory or non-oscillatory.

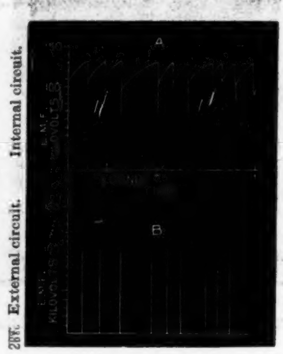



FIG. 5.—DIAGRAM OF INTERMITTENT E.M.F. AS PRODUCED BY FRICTIONAL OR INFLUENCE MACHINES, AND CAPABLE OF PRODUCING EITHER OSCILLATORY OR NON-OSCILLATORY INTERMITTENT CURRENTS ACCORDING TO THE NATURE OF THE DISCHARGING CIRCUITS.

An oscillatory current is an alternating current, usually sinusoidal in type, but decaying in amplitude, each wave being of smaller amplitude than the preceding. Oscillatory currents, produced by the discharge of a Leyden jar, correspond to the static-induced currents; they are usually of extremely brief duration, and of very high frequency, a whole series, of perhaps ten oscillations, being completed, in, say, the twenty-thousandth part of a second.

Non-oscillatory intermittent currents are produced by discharges from influence machines through circuits unfavourable to the development of oscillations. E.M.Fs. capable of producing intermittent currents are shown diagrammatically in fig. 5. Franklinic currents are of the non-oscillatory intermittent type.

The convective current, or convective discharge, is produced by the convection of electrified particles of air or other material. To this type belongs the static breeze.

## HARMONIC CALL BELLS.

I HAVE frequently been asked (says Mr. S. D. Mott in the *Electrical World*) if it is not possible to do away with the noisy clapper-stroke bell which grates so harshly on many ears, and why someone does not devise and introduce a better substitute for it than the buzzer, which makes the nervous ones in our homes jump when it signals by the suddenness of its noisy clatter, adding its quota to the general din of many modern appliances and conveniences. When loudness as a warning of danger or alarm, &c., is not a prime requisite, it would certainly seem that an agreeable musical tone would be far preferable in homes, banks and banking houses, hospitals and like institutions where quiet is desired. I believe to a majority of commercial users of call apparatus such a system would be appreciated, and would be given preference.

Acting on the hint, I herewith show sketches of a certainly simple and inexpensive, and possibly useful, harmonic system of signalling.

The sound producer or resonator may be fashioned bell shape, that is, fastened to one extremity of an electro-magnet, to the other extremity or pole of which is fixed rigidly an armature. The bell is made of magnetic material, and serves with the armature, also of magnetic material, to nearly close the magnetic circuit (fig. 1).

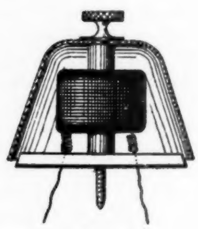


FIG. 1.

It is evident now to those acquainted with the general physical principle of harmonics that if an alternated or interrupted current be used having the same rate of vibrating

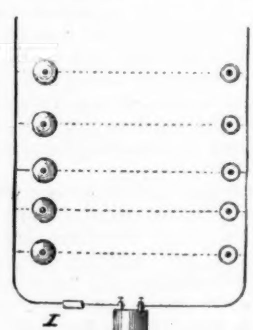



FIG. 2.

impulses as the musical pitch of the resonator, or an octave thereof, the bell will sound its note on the closing of the circuit through the magnet coil.

The system, though based upon a rather delicate principle of operation, may, I think, be roughly made after being accurately planned like many familiar devices in commercial use.

Such calls may be made highly ornamental, easy to instal, inexpensive and indestructible, having no clapper or moving parts.

Fig. 1 shows a complete bell, consisting of bell, in section, armature core, coil and fastening screw, the whole furnished in any fanciful or ornamental design.

Fig. 2 is a diagram of a call connection arranged in parallel circuit, and showing in the battery circuit an interrupter, I, properly proportioned and adjusted to the requirements of the bell.

When one bell only is required, the push button may be constructed to act as the interrupter or alternator of the battery current.

If operated with a suitable magneto device, no buzzer or battery is required, but only the magneto and push button to each bell circuit would be necessary. If a magneto of sharp snappy impulse and changeable period were used on a line of bells run in series, and having varying tones, it would be in an operator's power to cause any particular bell to respond when the magneto current reached the note of the particular bell selected, by varying the speed of the magneto or otherwise causing a uniformity and equality of electric pulsation, with acoustic vibration; in a word, when the acting and responding device were in concord.

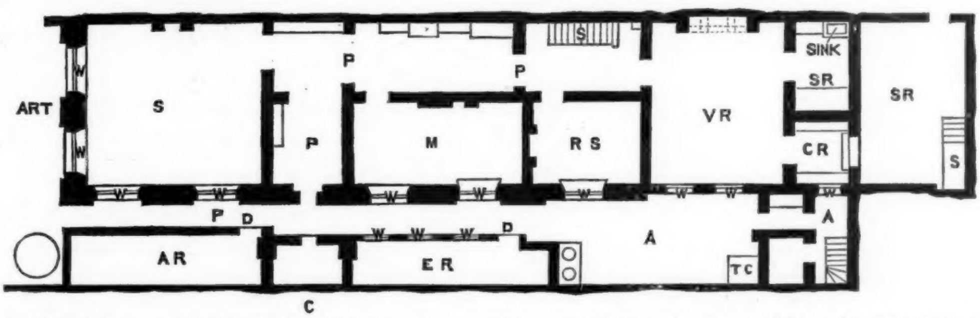
## STANDARD UNITS FOR ELECTRICAL MEASUREMENT.

(*Continued from page* 431.)

### IV.

The disposition of the various rooms and laboratories will be more readily understood from an inspection of the plan of the basement at 8, Richmond Terrace, than from any description we could give. This is shown in fig. 5, and the index accompanying the drawing gives the designations of the different departments according to the present practice of those in charge. The main entrance to the building from Whitehall is at the point marked C; a private entrance to the offices of the electrical department only is situated to the right of the transformer chamber, T C, and the stairs leading down to the area level. The ground or entresol floor is given up to clerical offices, and over the store-room, S R, and chemical room, C R, Major Cardew and Mr. Rennie are located. The remaining upper portion of the building is given up to the officials of the railway department.

As we have already mentioned, the laboratory occupies the whole of the basement, access being gained to it from the entresol floor by the stairs, S, opposite to the resistance standards room, R S. The machine room, M, is separated from the current and pressure standards room by the passage leading to the area. The verification room, V R, is one of the most recent additions to the laboratory, and has been equipped to facilitate the testing of commercial instruments, such as voltmeters for ordinary pressures, ammeters up to two hundred ampères, and recording meters of ordinary capacities. The rest of the plan is self-explanatory.




A R T, Area to Richmond Terrace; W, Windows; S, Standards room; A R, Accumulator room; P, Passages; D, Doors; C, Cellar under main entrance stairs; E R, Engine room; M, Machine room; R S, Resistance standards; S, Stairs; A, Area to Whitehall; C R, Chemical room; V R, Verification room; S R, Store rooms; T C, Transformer chamber.

Fig. 5.—Plan Board of Trade Laboratory.

#### Current and Pressure Standards.

Having now considered the standards laboratory of the Board of Trade somewhat generally, we will deal with the construction and arrangement of the standard apparatus themselves. So far the equipment has presented nothing of great peculiarity, although the plant is well disposed for the purposes of an electro-technical laboratory, and the apparatus in the machine and engine rooms is exactly that which a practical electrical engineer with a thorough physical training would be glad to have at disposal for making such tests, measurements and investigations, as have fallen to the lot of Major Cardew and Mr. Rennie and their staff. We imagine that in this respect they would be the first to acknowledge the valuable assistance and useful suggestions made by many of the best known men in the electrical engineering industry.

On this account we may rest assured that if the progress made by the State in this country in establishing a Government department, which was provided with the necessary accommodation and apparatus to carry out researches with care and in skilled hands, conditions which would render such work neither to the mind nor within the facilities of firms engaged in commercial work, and who neither could, nor should, be expected to undertake such, to them, unremunerative investigations, has been slow it is certainly sure. True, the limits of the laboratory preclude it from being classed with the Royal Imperial Technical Institute at Charlottenburg, or the Central Laboratory of the International Society of Electricians, but perhaps for this very reason it will carry out its functions all the better, being untrammelled by considerations other than those of pressing public and electrotechnical requirements.

It is, as we have already hinted, essentially the national repository of the most permanent standards from which units for electrical measurement will be at all times forthcoming. As an electrical engineer of great experience once said: "It does not matter much what these units are so long as we all use definite values and there can be no longer any doubt as to the ampère, volt, or ohm." For this reason the most active interest is displayed, not in the laboratory as a whole, but in the instrumental standards for pressure and current about which so little has been known. In discussing the laboratory it must, however, be borne in mind that it has a specific scope and that the experimental work of investigation which falls to similar institutions abroad, has not, as yet, been arranged for at 8, Richmond Terrace.

The committee which was appointed at the end of 1890 to advise the Board of Trade upon the general question of legalising electrical units, on completing their labours, endorsed with approval the leading ideas which had been adopted in providing the necessary instruments then installed in the laboratory. These were that the modes of measurement adopted should be those in which some direct action of the phenomena concerned should be the subject of estimation, and that the means for this estimation should be gravitational wherever possible. It was decided that the fundamental units to be established should be the ampère and the ohm, and that the volt should depend upon the relation between these two for continuous and steady currents. When the draft resolutions were prepared and discussed, much time and consideration was given to the difference between the definition of each unit and the form in which the standard was to be realised. Dr. Hopkinson and Lord Rayleigh pointed out that in the case of the ampère the value attached to it, and the standard of reference, should be distinct. It was inconvenient, though possible, to base the standard upon silver electrolysis.

The magnitude of the ampère was to be determined by experiments on the electrolysis of silver nitrate, assuming the value declared by Lord Rayleigh for the electro-chemical equivalent of silver, but in the opinion of the Board of Trade it was considered advisable to have certain instruments which should themselves measure, each instrument one defined multiple of the standard, and do this simply by the opposition of the constant force of gravity. Lord Kelvin thought that the ampère should be founded upon weighing the current, that the silver electrolysis method should be adopted for convenience of verification, and that by this means accuracy to the $\frac{1}{20}$th of 1 per cent. could be readily obtained. The suggestion that several standards should be provided for each class of measurement led to divergence of opinion which was reconciled by Sir Courtenay Boyle, who pointed out that the measures of length and mass were referred to standards, but that for convenience in trade and other uses, multiple measures or meters were prepared. In a similar way the Board of Trade were at liberty to use measuring instruments, giving multiples or sub-multiples of the unit current or pressure, but it was not necessary to obtain their recognition as standards.

Standard voltmeters for 500 and 5,000 volts had been asked for with the same idea in view, but the committee gradually came to an opinion that it would be a great mistake to have more than one standard, while a current of 1 ampère can be measured with greater accuracy than either higher or lower values. An ordinary weighing balance is the principle upon which electrolytic determinations are based, and it is the foundation for the majority of standards, the idea being a reproduction of the same principle. The standard for current had simply to be constructed in a form convenient for accurate use by the Board of Trade, and adapted for the measurement of one particular current.

A small sub-committee consisting of Major Cardew, Lord Rayleigh, and Mr. Glazebrook, was appointed by the General Committee to supervise the construction of a standard ampère balance. The essential parts of the standard balance, constructed by the Cambridge Instrument Company and L. Oertling, were delivered early in 1892. It consists of a dynamometer coil suspended from one arm of the Oertling balance, the current being led into the movable coil from each fixed electrode by three very fine silver wires.

The general appearance of the instrument mounted on its pier is indicated by fig. 6, while figs. 7 and 8 show the details of the fixed and movable coils and the connections leading therefrom.

The housing consists of a structure of marble, glass and mahogany. The balance portion consists of a sensitive balance suitable for the accurate determination of masses up to 5 kilogrammes, with a beam 16 inches in length between the knife edges, from which the scale pans are hung. The balance is fixed on an upper horizontal platform of marble supported by four marble pillars at a height of 2 feet 3 inches above a similar platform fixed on a heavy stone pier, rising from a massive concrete foundation. The pier is free from contact with the wooden floor of the laboratory.

On the lower platform a hollow cylinder of white statuary marble is borne by three supports. This cylinder is seen in fig. 7; it is thoroughly impregnated with paraffin wax, and carries a block of ebonite fixed on one side of the cylinder which serves as a terminal board. Two circular grooves are cut completely round the cylinder in which are wound coils of No. 18 S.W.G. copper wire, 0·12 cm. diameter, insulated with two layers of white silk. The wire was passed through a bath of shellac dissolved in alcohol as it was wound on the cylinder, and each layer was shellac varnished when wound.

In each coil there are sixteen turns per layer, and sixteen layers of wire. The fixed coils are both wound in the same direction, and the outer ends are brought on to the terminals, 1 and 3, figs. 7 and 8, under slight tension, while the inner ends are passed through the marble and secured to the terminals shown on the front of the cylinder in fig. 7. These two terminals are connected together, thus putting the two fixed coils into series permanently.

A circular coil, marked "suspended coil" in fig. 8, is suspended from one end of the balance beam by means of three gilded phosphor bronze wires, 0·086 cm. in diameter. These wires pass through an aperture in the upper marble platform, and are fastened to ivory cranks for vertical adjustment of the suspended coil. The attachment of the suspending wires to the balance is effected by ivory rings which are hooked on to a three legged fitting which is hooked to a stirrup hung on the knife edge of the beam. From the three-legged fitting mentioned is also hung a scale-pan to carry the weight forming a measure of the standard current.

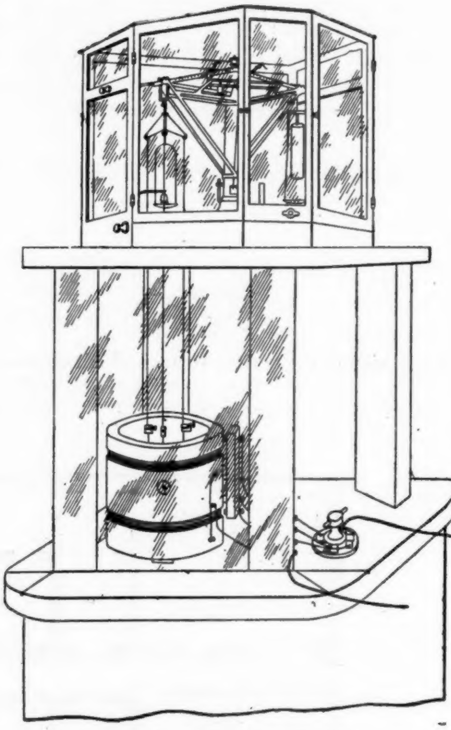


Fig 6.—Current Standard.

Vertical and horizontal alignment between the axes of the two sets of coils is provided for by sighting holes and adjustments. The sighting holes, one of which is shown in the centre of fig. 7, are three in number at equidistant angular positions in a horizontal plane passing through the suspended coil. Between the grooves on the marble cylinder the three holes have been drilled; these holes are closed on the inside by glass plates. The exact centres are indicated by the intersection of two straight lines engraved on the glass, and also by the horizontal and vertical edges of a tinfoil quadrant fastened to the glass. The upper part of ebonite pieces facing the sighting holes and carried by the suspended coil have mirrors fixed to them, the centres being marked by the intersection of cross lines and by the edges of tinfoil quadrants, similar in size to those on the glass windows of the sighting holes. The proper adjustment of the position of the suspended coil is obtained by the coincidence of the angles of the tinfoil quadrants on the mirrors and on the glass windows of the holes, when the eye is so placed that no reflected image can be observed.

The suspended coil is wound with wire of the same size and character as that used for the fixed coils, there being eighteen turns of wire in each layer and eighteen layers in all. Each complete layer was allowed 24 hours to dry after being varnished with the shellac-alcohol solution before the next layer was wound, but, as will be mentioned later, the hygroscopicity of this coil is marked in spite of such precaution. The coil is covered with a taping of silk ribbon closely laid on to overlap, and is varnished with shellac varnish in four coats, each being allowed to thoroughly dry before applying the next one.

The ends of the coil are brought out near each other on the upper surface of the coil and a considerable length of wire was left for each end, being formed into a spiral and projected horizontally to the centre of the coil, where the stiff wires terminate and flexible connections are made by three silver wires, No. 40 S.W.G., from each of the conductors, 2 and 4, fig. 8. The ebonite blocks carrying the sighting quadrants are fitted over the coil (see fig. 7), and secured by a lashing of silk thread, the suspending wires being attached to brass eyelets screwed into the ebonite. The horizontal adjustment of the axis of the pair of fixed coils is effected by the short slate supports carrying the marble cylinder. These have projections from their upper and lower surfaces, the upper being eccentric and fitting into a hole in the bottom of the marble cylinder, and the lower being concentric and fitting a radial groove in the marble slab.

The legal representation of 1 ampère is the weight which is equivalent to double the electro-dynamic action produced on the balance by a current of one ampère. This weight, which is of

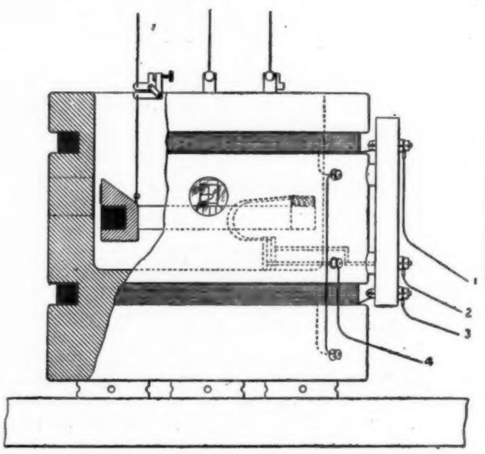



Fig. 7.—Coils of Current Standard.

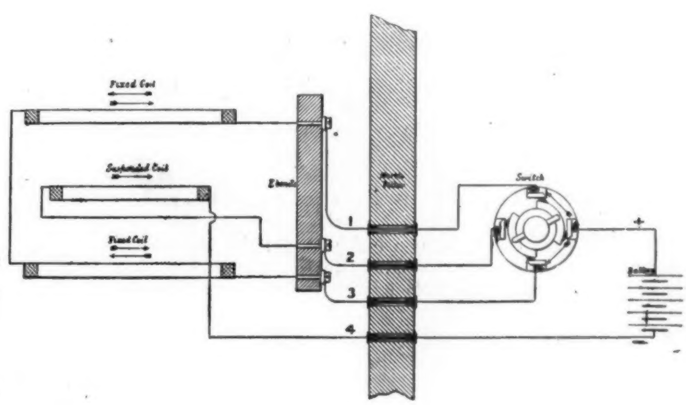



Fig. 8.—Connections of Current Coils.

iridio-platinum, can just be seen in fig. 6, operated from a system of levers, by means of which it can be lowered into the scale pan above the movable coil and released from the outside of the case. The marble cylinder is enclosed by means of three sheets of plate glass which slide in grooves cut in the marble platforms, and when in position are in contact with the sides of the three pillars adjacent to the cylinder, the plan of this enclosure being an equilateral triangle with the axis of the marble cylinder at its centre. The planes of the three glass sheets are respectively parallel to those of the glass at the back of the sighting hole viewed through them.

The balance is enclosed within a case of mahogany and glass, and arrangements are made for manipulating the rider weights of the balance and the ampère weight and its counterpoise from the outside of the case. Quite recently a second weight and lever gear have been added at the end of the balance away from the suspended coil; this is not shown in any of the views of the balance as it was not fitted when these were taken for us, but the object of the additional weight is to test the dynamic action of the balance, and to obtain the value of the rider weight by the opposition of two masses, one in either scalepan, independently of the electro-dynamic action of the coils. The whole enclosure formed by the casing of the coils and balance, is fairly dust-tight and sufficiently air-tight to prevent any disturbance of the weighing operations by currents of air. The connections to the reversing switch, fig. 8, are brought outside the enclosure by means of rods passing through the pillar adjacent to the ebonite block carrying the coil connections. The connections are shown, and the direction of the current through the various portions of the apparatus is indicated by arrows, the double set of arrows over the fixed coils showing the alteration of direction caused by reversal of the switch.

The standard, as a whole, has proved in every way a practical success, but it was apparent soon after bringing it into use that some means would be necessary to compensate for changes in the absolute weight of the suspended coil. This is one of the objects in view on account of which the extra weight was added. The weight of the suspended coil is about 2,500 grammes, and a very small percentage change of the total weight is a large percentage of the weight representing one ampère. In the earlier sets of experiments, corrections were made for this change in accordance with the curve representing the loss of weight with one ampère on continuously. This curve was found to be a straight line after the first 40 or 50 minutes from closing the circuit, and repeated trials showed the slope to be approximately the same for different experiments. One of these experiments consisted in keeping a current of about 0·9 ampère continuously on for some weeks, the result being that the coil decreased in weight by over one gramme. This merely shows that to retain a standard unit of current the instruments must be known to, and in the hands of, skilled observers, and it may be found advisable to keep such a current as that last mentioned continuously flowing through the coils. Such peculiarities on the part of the balance in no way affect the resultant accuracy which can be obtained, and merely indicate what care has been taken to push the accuracy of measurement up to the highest possible limit.

Matthiesen has defined three grades of accuracy as being attainable in electrical measurement resulting from "ordinary care, great care, and absolute care." We should certainly be inclined to credit the Board of Trade with the exercise of "absolute care" in the work of obtaining standard values, as they have "neglected almost all consideration of time and have repeated experiments at reasonable intervals in all cases in which it is possible that by lapse of time such error, as at first there is no means of detecting, may increase and so become apparent. No precautions are omitted, the best instruments have been obtained and every care taken in the manipulation."

The balance is used in the following way: The beam carrying the coil is balanced, then current is put on in such a direction as to act on the movable coil with gravity, whilst weights are placed in the opposite pan to bring the balance pointer to zero. When the current has been adjusted to what is known by subsidiary instruments to be about one ampère, the direction of the current is suddenly reversed in the fixed coils, and the standard weight is placed in the pan above the movable coil. If this operation has caused no deviation of the pointer from zero then the current flowing is one international ampère. Should any deviation be found, a second reversal, removing the standard weight and adjusting the other weights to zero, provides a means of correction.

The period of vibration of the standard balance was found to be so long that it was useless as a means of indicating the constancy in the current flowing through the instrument. For this purpose it was arranged to use permanently with it a very sensitive one-ampère Kelvin balance as a subsidiary standard. The instrument now used for this purpose is the second of that type obtained for use in the Standards Laboratory and is extremely sensitive, as a change of one part in forty thousand in the current strength is visible. The use of the auxiliary instrument has been found advantageous, as the chief object aimed at in the construction of the standard was the securing of the greatest possible accuracy and precision of determination. The secondary ampère balance is simply a special form of Lord Kelvin's current balance instrument arranged to balance with a current of one ampère passing through the coils when a certain weight is applied at one end of the beam, but equilibrium is also maintained when this same weight is applied at the other end of the beam and no current is flowing.

The operations which have to be gone through in making a complete determination of unit current are begun by connecting the standard, the auxiliary balance and the instruments to be standardised in circuit with a sufficient number of accumulators and an adjustable resistance, a portion of which is capable of continuous variation. The first method of coupling this in circuit was to place it as a shunt to the balance and the other instruments, but we believe that a suitable series regulator having been discovered the existing practice is to adopt series regulation for adjustment. The whole circuit is arranged so that a current of approximately one ampère will flow through it on completion of the circuit. This current is allowed to pass continuously for at least one hour, being sent through the coils of the standard so as to increase the force of gravity on the suspended coil, and the counterweight on the right hand pan being adjusted from time to time.

At the end of this preliminary run the current is stopped for a short time to take a reading of the zero of the auxiliary balance and apply a correction by means of the rider weight if necessary. The current is again put on, and as rapidly as possible regulated by means of the adjustable shunt, or series regulator, to exactly one ampère, as indicated by the auxiliary balance, while the counterweight on the right hand pan of the standard is also adjusted. The switch is then turned so as to reverse the current in the fixed coils, and at the same time the weight is lowered into the left hand scale pan. The balance should then still be maintained when the current, after adjustment if requisite, is exactly one ampère by the auxiliary balance.

## THE FIRST DIRECT NEW YORK CABLE.

The *Electrical World* of New York for September 22nd, contains an article entitled "The First Direct New York Cable," which refers to the "putting" through of the Commercial Company's cable at Coney Island direct with New York.

It gives a general description of the telegraph ship, *Mackay-Bennett*, and its cable machinery, besides an account of the signalling apparatus used by the Commercial Company. The special type of cable devised to cope with icebergs is also described, being similar to an ordinary sheathed cable with the addition of steel rings inside.

The use of the James sentry for indicating any pre-determined depths when going into shallow water is here gone into and its action explained.

The article is written somewhat in the newspaper reporter style. For instance, when describing the picking up and paying out machinery aboard ss. *Mackay-Bennett*, the writer says: "They are made of massive gears operated by double cylinder engines, set at an angle of 90° to each other, making it out of the question to have both engines get on dead centre at the same time." We had always supposed this provision to be common to all double cylinder engines, and, therefore, to be in no way peculiar to cable machinery, or to that of ss. *Mackay-Bennett*.

Neither were we aware that "the bows of a cable ship is a more advantageous point from which to direct paying out operations than the stern," though, of course, a short length of cable in shallow waters is often paid out (usually in repairs) from the bows to avoid the risk of passing the cable along the side of the ship to the stern.

The use of spirits of salts for the purpose of making the solder "take" in effecting the metallic joint in the conductor, of which mention is made, is considered by some contractors to be too risky (on the score of the acid chemically acting on the copper conductor), and is not unusually substituted by rosin for submarine cable purposes.

From the sentence "It is popularly supposed that cablegrams are received by means of flashes of light," anyone might be led to imagine that the heliograph was turned to account in trans-Atlantic telegraphy!

The Wilmot automatic transmitter referred to is, of course, nothing more nor less than a Wheatstone automatic transmitter applied to submarine cables instead of to land lines.

With reference to the Thomson siphon recorder, the article says: "The improvements effected by the Commercial Company's electricians have removed all its weak points." Is not this a little strong? It used to be thought by many that these improvements were largely due to Lord Kelvin himself.

The article is apparently either written by an American or to please Americans, judging by the reference to Mr. Cyrus Field as having first accomplished Atlantic telegraphy. It would be well, for Englishmen at any rate, to bear in mind that long before Mr. Field moved in the matter a body of our countrymen were working at the scheme, and that the reason why Mr. Field's co-operation was so acceptable to them was because he (with the late Mr. F. N. Gisborne), had obtained the sole concession to lay a cable 'twixt Newfoundland and the United States.

Looking at the work also from an engineering point of view, we all know that Mr. Field in this respect played the part of a spectator pure and simple.

## CORRESPONDENCE.

### Incandescent Gas Lighting.

I hold no brief for the Incandescent Gaslight Company, nor am I in any way interested in their wares, except as a consumer, but the remarks in your last issue appearing to me rather biassed, I venture to write a few words as to my experience.

After a trial of a single burner extending over five months, I have increased my installation by purchasing four more. The burner I have been using has replaced an Argand, with results which, without scientific analysis, have been eminently satisfactory so far as the atmosphere of the room is concerned, and this in the room in which I spend the greater part of my time when my day's work is done. That the lights do give, as is claimed for them, an illumination of 50—60 candles, with a consumption of 3½ or 4 cubic feet of gas per hour, I have on very excellent unbiassed authority, viz., a personal friend, who, as a principal owner in a suburban gasworks, devoutly hoped they would not come into very general use.

In another room, one incandescent burner replaces three ordinary burners, and I have a better light than formerly. My first mantle lasted nearly five months, but was practically done about a fortnight before I replaced it.

I do not care to speak positively as to the carbon mon-oxide said to be given off, but looking at the construction of the burner and the liberal supply of air given to it, I hardly believe any carbonic oxide could escape without being burnt; at all events, there has never been any appreciable odour of this gas, even after the burner has been lighted for hours.

An enthusiastic admirer of the electric light whenever and wherever it can be obtained, I nevertheless believe in fair play to its small competitor, whose freedom from smoke makes it a great boon to those who, like myself, cannot procure the other.

**G. A. Moore.**

The Thorns, Bebington,
*October 15th*, 1894.

**The Electro-Motor and Some of its Applications.**

In last week's issue, there is described and illustrated, at some length, a method used by Messrs. Laurence, Scott and Co., of coupling the shunt circuits of electro-motors to their starting switches and resistances, in order to prevent very heavy currents being drawn by shunt motors when starting off constant potential mains.

The selfsame method has been used in several instances, with excellent results, by Messrs. Wenham & Waters, of Croydon. One large motor so constructed, and working off constant potential mains, is of 60 H.P., driving a large circular saw, and several other machines. An additional method adopted in this instance to prevent an abnormal rush of current when starting is simply a ratchet motion fitted to the lever of starting switch on the resistance frame, so that the contact brush can only be advanced one contact block at a time.

This is doubtless the best method of starting shunt motors, and there is no doubt that if it is not now, that it soon will be universally adopted.

**Arthur H. Gibson.**

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**Turning Down the Electric Light.**

I have had a great deal to do lately in correcting erroneous statements about my system of turning down incandescent lamps. Permit me to correct another. In your somewhat sarcastic article on "Daily Journals and Electrical Matters," you say: "The idea of using $1\frac{1}{2}$ ampères to make the lamp filaments merely glow savours rather of extravagance."

Now, in the first place, the lamps do a lot more than merely glow, and in the second (if you refer to the *Gazette* article, or make the experiment for yourself) you will find that I use $1\frac{1}{2}$ ampères for six, and not three, lamps. This is a matter of fact, and I will not trouble to correct any mis-statements of opinion, though many of them are as erroneous as the above-mentioned mis-statement of fact.

**Thomas Budworth Sharp.**

*October* 10*th*, 1894.

[Just so! We inadvertently said three lamps; Mr. Sharp corrects us by saying six, but unfortunately for him this makes his case far worse, for $1\frac{1}{2}$ ampères through six lamps surely gives less light per watt than if used at the same pressure upon only three. His extravagance is simply deplorable, for the energy used up to make these lamps look like red hot hairpins, is greater by nearly three times than that required for an honest 16-C.P. single lamp.—Eds. Elec. Rev.]

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**Vacuum Tubes.**

I should like to remark, with reference to your answer to Mr. Raymond, in your issue of October 12th, that, with an ordinary induction coil, I have seen tubes glow when only one terminal was connected to the machine, the other end being held in the hand. It does not, therefore, seem to be necessary to use currents of very high frequency to produce this effect.

**W. P. Steinthal.**

24, Dundonald Street, Edinburgh.

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**Localising Faults in Submarine Cables.**

Upon my return to town, I have just read Mr. Rymer Jones's article upon "Clark's Fall of Potential Tests for localising Faults in Submarine Cables," and Prof. Jamieson's comments thereon, in your issues of September 7th and 14th. Mr. Rymer Jones's clear and concise article states that a "null" method of measuring potentials is necessary on board ship, owing to the unsuitability of the ordinary "marine" for comparing "throws." Even so, however, the simpler and less complicated the method the better, and therefore the customary plan referred to by Prof. Jamieson, in which $p^1$ is at once determined by slides in terms of the standard cell employed, is preferable to that suggested by Mr. Jones (see his fig. 2), which, though neat, would seem to be unnecessarily cumbersome, more especially on board ship during the pressure of cable repairs, when simplicity and despatch are so all-important. As a matter of fact, and speaking from many years' practical experience of the potential test, I have never found any difficulty in the original plan of measuring potentials by slides. Mr. Jones, I think, somewhat overstates the demerits of the ordinary "marine." At the same time, however, his article indicates the desirability of an improved type of measuring instrument for ship use—a need which would seem to have been met by Mr. H. W. Sullivan's new suspended coil galvanometer, as just brought out by Messrs. Elliott Brothers. This instrument is alike designed for shore and ship use, and its simple arrangement for balancing the coil system against rolling and pitching motion should admit of "throws" being compared with great facility and exactitude in cases where slide resistances for the "null" method are not available.

**F. Alex. Taylor.**

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## BUSINESS NOTICES, &c.

**Universal Electrical Directory (J. A. Berly's).**—Messrs. H. Alabaster, Gatehouse & Co. have now in course of preparation the 1895 edition of this directory, which embraces all connected with the electrical trades throughout the Universe. It is indispensable to all having business transactions in the electrical world. Names and addresses for insertion, corrections, and orders for advertisements should be promptly forwarded.

**Australia.**—It is stated that the experiment of lighting trains by electricity at Adelaide has proved so successful, with regard to the cost and working, that the railway commissioners contemplate using the light for the Melbourne express.

**Barrow.**—A resolution moved at the last meeting of the City Council, asking the Selection Committee to consider the electric lighting question, was lost by a majority of six votes, on the question of expense.

**Beverley.**—The whole of the works of Mr. J. Scarr, shipbuilder, have been fitted up with electric light by Mr. S. P. Wood, of Hull.

**Birmingham.**—A Local Government Board enquiry was held on Tuesday regarding the Council's application to borrow sums of money, one of the items being £1,000 for the electric lighting of the Market Hall.

**Blackpool.**—The Town Clerk is in communication with the official at the electricity works, with a view to getting the smoke nuisance abated.

**Brazil.**—The *Financial News* correspondent at Rio de Janeiro states that there is some talk of lighting Alagoas by electricity. He also says that a complete telegraph system, placing the State of Bahia in telegraphic communication with all the other States of the Republic, will almost immediately be established in Amazonas.

**Brechin.**—As we have already stated, Messrs. D. & R. Duke made an offer to supply electricity to the extent of 1,000 C.P. for lighting St. Ninian's Square from a dynamo at their works, the cost of erecting lamps to be borne by the town. The Committee, to whom the matter was referred, have now ascertained that the cost of the cable, lamps, &c., will be between £40 and £50. The Scottish House-to-House Electric Supply Company have offered in the event of the town accepting their terms for the introduction of the electric light into the burgh, to take over the cable, lamps, &c., paying full value for them. The Board have now accepted Messrs. Duke's offer, and have voted money towards meeting the cost. The municipal buildings are to be wired. The Board are to hold a special meeting to consider the question of the Scottish House-to-House Company's application for a provisional order.

**Bristol.**—At the last meeting of the Electrical Committee, the engineer informed the committee that he had made enquiries as to the extinction of the electric light at St. Nicholas Church on September 30th, and was informed by the church authorities that they understood that the irregularity did not arise from any fault with the Corporation supply. The committee were informed that the agreement with the Redcliff Vestry had been executed, and the work of laying the mains will be commenced forthwith. It was also stated that the work at Clifton would be completed this week. It was resolved to request the Finance Committee to carry out their resolution to light the Mayor's Chapel and the Guildhall by electricity.

The Museum Subscription Library closes this week for a short time for the purpose of effecting improvements, one of these being the installation of the electric light.

The Stoke's Croft and North Street Ratepayers' Association are urging the Electric Lighting Committee to extend the mains to the Croft and Arley Chapel as soon as possible.

**Burton.**—The office of the Burton *Chronicle* has been lately fitted up for electric lighting by Messrs. Hewes & Geary. Current will be taken from the Corporation mains.

**Burton-on-Trent.**—Messrs. Hewes & Geary have secured the contract for a complete installation of electric light at the new potteries of Messrs. Cash, Massey & Co., Limited, at Woodville. An 8-unit dynamo is to be supplied.

**Cadley Hill.**—Messrs. Hall & Boardman's Cadley Hill Colliery has lately been supplied with a complete electric lighting installation, by Messrs. Hewes & Geary.

**Cardiff.**—Up to the 22nd inst. the County Borough are open to receive applications from practical men able to take full charge of the electric light machinery at the Electricity Works, Canton, Cardiff.

**Cheltenham.**—Some new engineering works being erected here for Messrs. Weyman, Hitchcock & Co., are to be lighted by electricity.

**Coventry.**—Mr. G. S. Ram has been appointed clerk of works in connection with the engineering portion of the contract for the equipment of the electric lighting station.

**Crystal Palace.**—The Crystal Palace District Electric Supply Company, Limited, were summoned on Tuesday, at the instance of the Lewisham Board of Works, for causing an effluvium to issue from their works at Springfield, Wells Road, Sydenham, contrary to the provisions of the Public Health Act, 1891. A number of witnesses were called, who stated that from time to time offensive vapours had been proceeding from a shaft at the company's works. On the other hand, it was contended that the smell did not come from the company's premises, and that if there was any smell it was from the burning of refuse. Mr. Laws, a solicitor, said that since the issue of the summons he had noticed no smell of which he could complain. The summons had been standing over since August. Mr. Young, for the Board, said that, in view of the improvement, he was willing to agree to an adjournment *sine die*, and to this Mr. Nash, for the defence, consented, on the distinct understanding that he made no admissions of any kind, and the company did not admit that there was any nuisance. Mr. Offor, the managing director of the company, said that there could not have been any improvement, because no alteration of any kind had been made. The summons was then adjourned *sine die*. Previous action taken in this matter was referred to in the ELECTRICAL REVIEW for August 24th.

**Derry.**—Several firms have offered to supply the Port and Harbour Commissioners with arc lamps, for the purpose of cattle inspection after sundown. The engineer is to report upon the matter, and ascertain when the Corporation would be able to supply the light.

**Dolgelly.**—To-day there is to be sold by auction at the Angel Hotel, Dolgelly, the whole of the electric lighting plant which has been used for the lighting of the town. The plant for sale includes a Wilson & Hartnell dynamo, switchboard, measuring instruments, switches, cable of various sizes, wire, lamp brackets, lamps, portable engine, &c. Mr. Geo. N. Dixon, of Liverpool, will conduct the sale.

**Dublin.**—The Electric Lighting Committee were waited upon the other day by a deputation from the residents in Moore Street, who want the electric light laid down there. We hear that the work is to be commenced shortly. A number of the residents have promised to use the supply in their houses.

**Glasgow.**—The present maximum charge of 15s. for each private street or court light is to be increased to 25s. per annum, and the present maximum charge of 10s. for each common stair light is to be increased to 15s. per annum.

**Hereford.**—A correspondent of the *Hereford Times* draws the ratepayers' attention to the Council's decision regarding the electric lighting of the town, and he recommends them to protest against the "useless expense."

**Herefordshire.**—Wigmore Hall is being fitted throughout with a complete electric light installation, also telephones and electric bells, by Messrs. Hewes & Geary. This firm are also supplying three motors, one to run 40 feet of shafting working three lathes, drills, and a planing machine, and others to do domestic work. The dynamo will be run by a petroleum engine charging a set of accumulators at 100 volts.

**India.**—We hear that a proposition is under consideration to light the New Government House, and other public institutions in Rangoon, by electricity, the dynamo and machinery being worked in the jail.

**Ipswich.**—As we stated last week, the Hermite sanitation process is to be adopted by the Town Council. The report of the committee having the matter under consideration states that as the result of their experiments they were able to state:—1. That the fluid known as electrolysed sea water has proved itself to be a most valuable agency for the disinfection and deodorisation of sewage, and 2. That it could be produced at a smaller cost than any other disinfectant or deodoriser. It was computed that the average daily dry-weather flow of sewage for the Borough amounted to about one million and a half gallons, and it was estimated that it would be necessary, in order to deodorise this quantity of sewage, to electrolyse about 23,000 gallons of sea water to the strength of 2·25 grammes of chlorine = 35 grains per gallon. This quantity would, in fact, suffice to deal with a population and its manufactories of 57,000 inhabitants at the rate of 1 gramme of chlorine = 15·5 per head of the population per 24 hours; but the population of the borough using the sewer was only estimated to be some 45,000, showing a large excess of electrolysed sea water to the actual head of population. The committee were of opinion that the electrolysed sea water should be allowed to fall into the main sewers (at all events for some few months) at different points along the line by means of pipes which can be laid within the sewer itself. It was fully to be expected that after a short period had elapsed, say six months, the power of the present accumulations in the sewers would have become so paralysed, if not sterilised, in regard to their germs, and consequently gas-producing power, that the chlorine of the solution would travel greater distances, and in time it might be unnecessary to have more than one or two points of discharge into the sewer. It was believed that in the adoption of this process and its proper application, considerable sums would be saved which were at present expended on disinfection in other forms, and that the necessity for any further expenditure on the erection of ventilating columns or shafts would be entirely removed, and that the cost of water for flushing by lessened consumption would be very largely diminished. The committee anticipate that the final question of dealing with the solid matter at the outfall would be very considerably assisted by the adoption of this process. From experiments which had been made, it had been proved that the animal life in salt water could not be affected by the discharge into it of electrolysed sea water. The committee reported that the total cost of the plant for Hermite disinfection would be £2,000, the annual expenditure would be £443, with an annual saving under other headings of £147, making the net annual expenditure £296. Mr. Napier presented a lengthy report, giving as his conclusions:—1. That sewage is instantly deodorised when mixed with a sufficient quantity of Hermite electrolysed solution. 2. That the decomposition of the sewage is retarded by the said mixture for a length of time, depending upon the strength and quantity of solution added, and that during this time no offensive smell is given off. 3. That if this solution, giving 40 grammes of active chlorine per minute, is discharged into the main and various arterial sewers, the offensive smells at present escaping from the manholes will be prevented, and the sewage made sterile (as far as decomposition goes) for several days, sufficient for it to get well out to sea before becoming offensive. 4. That if the proposed installation produces more active chlorine than is required to oxidise the sewage, a portion of the excess chlorine will be in the form of gas, and escaping into the air, will form an aerial disinfectant, and where sewers and drains are not properly trapped, instead of offensive sewer gas going into houses, there will be this chlorous gas acting as a disinfectant. 5. That of the processes for treating sewage that I know of, all do so at the outfalls, the object being to utilise the precipitates from the sewage, or to keep, say, a river free from pollution. A process may be adopted at an outfall for precipitating objectionable matter, or for preventing pollution, but no benefit from that will be derived by the town; but with this Hermite process the solution is distributed in the arterial sewers, the disinfection takes place there, and the sewage rendered inoffensive on its passage through the town, and is kept so for a number of days, sufficient for it to get through the whole system of sewers into the Orwell. I am of opinion that if this process is adopted, and a sufficient quantity of solution manufactured, Ipswich will benefit greatly, because by having the drains and sewers disinfected, and a flow of deodorised (perhaps sterilised) sewage through the town, the health of the inhabitants will be considerably improved.

**Kensington.**—Letters received by the Vestry from the Notting Hill Electric Lighting Company and the Commercial Electricity Supply Company, *re* provisional orders, for which they intend to apply, have been referred to the Electric Lighting Committee.

**Lambeth.**—The Ratepayers' Association, as might has been expected, are strongly opposed to the electric lighting scheme. A correspondent of the *South London Press* pulls the Association's resolutions to pieces mercilessly.

**Lancaster.**—The Windermere Electric Lighting Company have notified the local authority of their intention to apply for powers to supply certain portions of the town with electricity. The subject is to be considered at the next meeting, when a resolution will be proposed refusing the application.

**Llangollen.**—A London firm of electrical engineers has asked for permission to make an experiment in lighting certain parts of the town electrically. The town clerk is in communication with the firm.

**Leeds.**—Regarding a statement which appeared in our last issue to the effect that the lighting of the Yorkshire College and Medical School was carried out by Mr. T. H. Churton, Mr. Wilson Hartnell writes us as follows:—"This is to some extent inaccurate; the lighting of the Medical School, which is some distance from the Yorkshire College, has been carried out by Mr. Churton, but the lighting of the Yorkshire College throughout has been done by me. It may interest your readers to know that the first plant was installed in 1886. Additions have been made to the college from time to time, to the designs of Mr. Waterhouse, London, and the electric light has been extended likewise. The following are a few particulars respecting the same:—The current is supplied by a Crompton dynamo, D2 type, of 380 ampères 110 volts, driven by a Premier gas engine of 55 B.H.P. There is also a small Premier engine driving a Crompton dynamo of 65 ampères. The current is led to a switchboard, which has seven double-pole two-way switches, by means of which any circuit can be instantly switched from one dynamo to the other. The circuits are as follows:—Physical Department, 49 lights of 16-C.P. and 32-C.P.; Chemical Department, 71 lights of 16-C.P. and 32-C.P.; Engineering Department, 82 lights of 16-C.P. and 32-C.P.; Arts and Dyeing Department, 91 lights of 16-C.P. and 32-C.P.; Large Hall, 33 lights of 8 C.P., and 4 100-C.P.; 87 lights of 16 C.P., and 12 200-C.P.; 20 lights of 32 C.P., and 12 50-C.P. In addition, provision is made for fitting arc lamps to many of the lecture tables throughout the buildings. There is a 6 feet ventilating fan driven by a 8-H.P. electric motor, with automatic switch, so that the current may be turned on or off in the dynamo room or elsewhere. There is also an experimental dynamo room where the countershaft is driven by an electric motor, which drives two experimental continuous dynamos and an alternating current dynamo. Additions to the lighting are still in progress, and are being carried out by me."

There are to be extensions of the tramways here, and the other day a letter appeared in the *Mercury* suggesting the running of the new lines down each side of the road instead of the centre, the overhead wire supports to carry the electric light instead of special lamp pillars being erected.

On the occasion of the recent Royal visit, the temporary electric lighting of the Grounds and Picture Gallery at Temple Newsam was placed in the hands of Messrs. Maunsell Mercier & Co., of Manchester.

The electric lighting extensions are progressing satisfactorily. The lighting of Neville Street and Swinegate, where the railway bridges cross the thoroughfare, is not giving satisfaction, and it is rumoured that these parts are to be lighted electrically.

**Liverpool.**—The Markets Committee of the City Council are dissatisfied with the present lighting of St. John's Market, and they consider that the time has arrived when the place should be electrically lighted.

**London.**—The electric light was used in the Prime Minister's official residence, in Downing Street, for the first time last week. The Cabinet Chambers, Private Secretary's apartments, and the Premier's room, as well as the large hall and waiting rooms, are also lighted electrically.

A "City Merchant," writing to the *Times*, complains of the great and protracted inconvenience caused in Cheapside by the opening of the street for the purpose of laying down new telegraph tubes by the Postal Authorities. He thinks all such work as this should be executed as far as possible by night-time, or, if the job is an extensive one, by day and night continuously, shifts of men being employed for the purpose.

In his annual report for the year 1893-94, Mr. Charles Mason, surveyor to the Vestry of St. Martin-in-the-Fields, Charing Cross, W.C., says, with regard to electric lighting, that several reports have been submitted by him upon the desirability of lighting the streets of the parish by means of electricity. The question has, however, been postponed, as it is found that the cost of lighting with electricity will exceed the amount now paid for gas.

On Monday the Whitechapel District Board decided to inform the secretary to the City of London Electric Lighting Company that the site they offered to the board for a power station will not be required, as in their present destructor premises excellent accommodation is afforded.

In granting the South London Palace of Amusements, London Road, a renewal of their license, the County Council Licensing Committee did so conditionally upon an undertaking being given to complete the electric light arrangements within two months.

**Manchester.**—The opening meeting of the Manchester Association of Engineers was held on Saturday last. In the afternoon the members, to the number of about 150, visited the electric light station in Dickinson Street. They were conducted by Mr. C. H. Wordingham, engineer.

**Monmouth.**—A special meeting of the Town Council was held on Tuesday to select sites for pumping and purifying stations in connection with the combined scheme for drainage and electric light for the borough. The various sites suggested for purchase by the corporation were inspected after the meeting.

**Montrose.**—Mr. Whiteman's motion, to which we referred last week, and by which the Council agree to support the Scottish House-to-House Electric Lighting Company's application for a provisional order, has been carried by a large majority.

**Morecambe.**—The nuisance caused by the electric lighting company not having been remedied, the Local Board have referred the matter to the medical officer of health. If his report on the subject is received before the next assembly of the board, a special meeting is to be called to consider it.

**Newcastle.**—Messrs. Siemens Bros. & Co., Limited, have issued a printed statement replying to the criticisms passed by the city engineer of Newcastle on the conduit electric system of tramways, in his report to the Town Improvement Committee in June of last year—a report, they say, which cannot fail to prejudice anyone against that particular system.

**Nottingham.**—Up to the present 54 applications have been made for current. There are 35 consumers now taking current from the mains of the corporation.

The Lighting Committee of the Town Council have decided upon lighting the great market-place by electricity. One lamp will be placed in front of the Exchange Hall, two other similar lamps across the market itself, and a fourth at the foot of the new thoroughfare leading from Long Row.

**Preston.**—Recently the Co-operative Stores in Lancaster Road were for the first time lit up by electric light from the society's own dynamo. The installation has been made by Messrs. Bennett and Druce. The society can either supply their own light or switch it on from the mains of the electric light company.

**Richmond.**—Messrs. Urquhart & Small have reported regarding the proposed extension of the electric light company's mains from Friar's Stile Road to Queen's Road. The council have decided to call upon the company to carry out the extension.

**Sevenoaks.**—The Holloway Electricity Supply Company, Limited, are applying for a provisional order for the electric lighting of this district.

**Stafford.**—The total of Messrs. Siemens Bros. & Co.'s estimate, which was accepted for the supply of conductors on the three-wire system for the Town Council, was £1,290.

**St. Pancras.**—It has been deemed desirable to acquire the freehold of the King's Road new station site, and for this purpose, as well as to meet the contracts let in connection with the destructor buildings and appliances, the central electric station buildings, electrical machinery, and mains, a sum of £65,000 is required. Application is to be made to the London County Council for a loan of £65,000.

Mr. A. E. Pycraft of the St. Pancras Vestry, has written to the *City Press* contradicting certain statements that appeared therein recently. In the article in question "it is stated that the St. Pancras Vestry undertook to supply consumers with electricity three years ago, and that up to the present time not a single private building has been supplied. This statement is absolutely contrary to the facts, for not only has the supply been available since November, 1891, but the demand has reached such an extent that a second central station is now in course of erection to supply the further demand for current. These facts are so widely known that I am surprised you were not also aware of them."

**Taunton.**—Dr. Fleming has been engaged by the Town Council as consulting engineer for the year ending September 1st, 1895, for a fee of 25 guineas, and a fee of 10 guineas and travelling expenses for each visit to Taunton.

**Tonbridge.**—The Holloway Electricity Supply Company, having given notice of their intention to seek a provisional order to supply the electric light in Tonbridge; the Local Board, being desirous of keeping the powers in their own hands, intend applying for a provisional order themselves.

**Trentham.**—An electric lighting installation is being fitted up at Trentham Hall, on the estate of the Duke of Sutherland. The waters of the Trent will be brought into use for working the dynamos.

**Wells.**—The Gas Company have written to the Council with reference to the proposal of the Council to adopt the electric light in the city, pointing out that as no complaint had been made as to the public lighting, it would be only fair, if dissatisfaction exists, to bring the matter to their notice before the Council took any action to promote the introduction of the electric light. The letter was referred to the Lighting Committee.

**Whitehaven.**—Applications are coming in well for current. Additional plant becoming necessary, tenders from Messrs. Mather & Platt and Messrs. Willans & Robinson for two engines and dynamos were recently considered by the Town and Harbour Trust. Messrs. Willans & Robinson secured the contract for the plant at £1,479.

**Windsor.**—The report of Mr. Shoolbred *re* electric lighting was presented at the council's last meeting. He estimates on the capital account an expenditure of £18,500, and on the profit and loss account an expenditure of £1,680. The estimated receipts, at 7d. per Board of Trade unit, are £2,187, showing a loss on the first two years' working of only £443. A provisional order is to be applied for, and advertisements to be published.

**Yarmouth.**—The fish wharf is to be lighted by electricity.

**York.**—The premises of the York Steam Laundry Company, Aldwark, have been fitted throughout with the electric light.

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**"Competition and its Consequences."**—In a recent issue of the *Hardware Trade Journal*, there is a capital article from the pen of "an electrician" on this subject. The present disastrous system of low cutting in prices, and the disparity between wiring tenders are severely criticised, and wiring and other contractors would do well to peruse the article.

**Elmore's.**—At the request of Mr. Wm. Elmore, the *Financial Times* has published a note of some of the steamships which have been satisfactorily fitted with Elmore copper steam pipes. "As a result of exhaustive tests," the company's works are said to "have been kept busy in the execution of important orders." We are not given to understand for how long the works were "kept busy," or whether they have now again lapsed into a quiet condition. In the light of past promises, we must accept a statement such as this regarding the Elmore works with a certain amount of reserve. Our financial contemporary also takes our view of the matter, and suggests that shareholders will not have much difficulty in calculating the dividends likely to accrue from this "busy condition" of the Leeds works.

**The Baker Street Collision.**—Major Marindin, R.E., in his report regarding the collision which occurred at Baker Street station on July 9th, considers that the accident was due chiefly to the failure of the electrical lock on the block instrument, which is quite possible under existing conditions.

**Mildé Telephones.**—Regarding the prospectus of the Mildé Telephones and Electric Supply Company, Limited, to which we referred a few weeks ago, Messrs. Ch. Mildé, Fils & Co., of Paris, have written to the *Financial News* contradicting the statement that Mr. Charles Mildé has consented to be a director of the new company, as the articles of his firm will not permit such a step under any circumstances. Messrs. Mildé, however, do not contradict the statement that the new company has been formed to purchase the sole rights for selling the Mildé telephones in the British Isles and the English colonies. It seems that Messrs. Mildé in the public interest might have explained their position in the matter more fully.

**Presentation.**—A smoking concert was given last Friday evening by the employés of the Brighton and Hove Electric Light Company, and on that occasion a presentation was made to the engineer, Mr. Willett, who is leaving the company's employ to take up the post of electrician on Captain McCalmont's new steam yacht.

**Price Lists.**—From the Shropshire Iron Company we have received one of their price lists of the various brands of iron and steel wires and ropes, also iron and steel hoops and bars; brass and copper wires are also included, and at the end of the list is a comparative table showing the weight of wire (brass, copper and iron) in 100 feet lengths.

Messrs. O. Berend & Co. have sent us copies of their "A" and "S" lists. The former gives full particulars, prices and illustrations, of the daylight electric incandescent lamps, and the latter is a trade price list of switches, cut-outs, resistances, switchboards, automatic regulators and accessories for electric lighting and power installations. A large number of illustrations are in both lists.

Mr. James Dickson, of Gray's Inn Road, W.C., has sent us priced lists descriptive of the "Tieciton" dynamo brush, which seems to be in much favour.

**Proposed New Railway in the Lake District.**—Several of the provincial papers state that there is a project on foot by which the waters of the River Kent are to be applied to the purposes of a new railway in the Lake district. It is proposed to construct an electric train line from Furness district to Bowness, with an auxiliary undertaking of eventually carrying it on to Ambleside. A meeting was held at Cartnell last week with reference to the scheme, and water rights have already been secured in order that the electric current may be generated from turbine power.

**Search-Light Advertising.**—The search-light advertising upon Lord Nelson's Monument and the buildings in the neighbourhood of Trafalgar Square, has been the subject of a great deal of correspondence in the daily papers lately, and, as is general with any newspaper controversy in which "the intelligent public" take part, a lot of nonsense has been published. Two correspondents of one of the evening papers recommend what they consider a most simple method of curing the so-called nuisance. They would oust the first established search-light advertiser by having projectors fixed in other houses round the square, these projectors shedding their light directly upon the spot where the first advertisement appears, and thus obliterating it.

**Ship Lighting.**—The *Norman*, a new vessel of the Union ss. Company's, lately launched, is fitted throughout with an electric light plant.

**The Lighting of Railway Trains.**—A correspondent of the *Glasgow Evening News* complains of the electric lighting of some of the carriages on the North British Railway. He says that the lighting is of a "feeble, blinking, underfed description," very irritating to the eyesight.

**The Proposed Electric Railway up Snowdon.**—The electric railway to Snowdon, which has so much been spoken of, is now beginning to take shape. A company was registered on September 20th, under the name of "The Hotels and Railway Company of North Wales, Limited," with a capital of £6,000 in 600 shares of £10 each, to construct a railway from Llanberis, Carnarvon, to a point near the summit of Snowdon, and to erect and carry on an hotel at or near the summit.

**The Proposed German Atlantic Cable.**—In its comments regarding the new competitive cable proposed to be laid by Germany across the Atlantic, the *Investors' Review* says:—"There are eleven of them now in operation, and there is not just at present work enough for six. This does not, it seems, deter the German Government—which is now well served by the Anglo Company, one of whose cables is kept exclusively for German use—from granting a concession, and a subsidy, for the laying of another line by way of the Azores, nor a British Company (The Telegraph Construction and Maintenance) from obtaining the contract to make the cable. Already those who had early information—a very unclean lot they are—about this coming event have made large sums of money by 'bearing' the stocks of the Anglo-American Telegraph Company on the market. This concern is so heavily over-capitalised that it forms an excellent object of attack on every scare; and weeks before its stockholders had the least inkling of what was coming, the people who unfortunately for us have the means of obtaining early news about these things, 'banged Anglo stocks' to good purpose. Were it not borne down by the deadweight of its 'water' capital, this company would give an excellent account of itself in any fight which may arise when the new cable is laid. It possesses four cables in good working order now, and will soon have a fifth. No other company has more than three, and the Direct and French companies have only one each, both old. But though this strength in resources may enable the Anglo Company to dictate terms after the war is over, the weight of its capital and the necessity it is under to rebuild its reserve, must play great havoc with its dividend, and with the prices of its stocks for a long time to come. We think the smallest sense of fair play and honour should have been enough to prevent any English company from putting its hand to the business of helping the German Government to destroy or cripple a British company which has, in spite of many drawbacks, overcome so many attacks. Were the Anglo-American Company free and managed with vigour, its best line of defence would be to attack at once. It should bring its tariff down to 3d. a word for Press, and 6d. a word for ordinary messages, and let its rivals and enemies take the consequences. If a struggle must come, and if loss must be faced, the sooner the better. Were the company further to join hands with the Commercial and Western Union companies of the States in laying two cables across the Pacific, so as to draw away the traffic of Asia and liberate merchants there from a relentless despotism, its enemies would be badly hit, and the cheap Atlantic service might pay better than the present one."

**The St. James's and Pall Mall Electric Light Company, Limited.**—This company announces that the electric current sold during the quarter ended September 29th amounted to £6,935, as against £4,820 for the corresponding period of 1893.

## CONTRACTS OPEN AND CLOSED.

### OPEN.

**Austria.**—Tenders are being invited by the Municipal Authorities of Scheibbs, Lower Austria, for the concession for the establishment and exploitation of a central electric lighting station in the town.

**Hapton (Lancs.).**—October 27th. For lighting with electricity the village of Hapton, and so much of the township of Hapton as the lighting inspectors may think necessary. Full particulars from Mr. Henry Cunliffe, chairman of the Lighting Inspectors, Post Office, Hapton.

**Sunderland.**—November 8th. Tenders are invited by the Corporation for wiring the Town Hall for electric lighting, including the supply and fixing of all cables, casings, lamps, and switch and fuse boards. Further details will be found among our advertisements.

**Spain.**—November 5th. The municipal authorities of Caceres are inviting tenders for the concession for the electric lighting of the town. Similar tenders have also just been invited at Sabadell.

**Warminster.** — The surveyor has been instructed to obtain tenders for the supply of a dynamo to run seven 2,000-candle-power arc lamps, also for the supply of six new lamps, a mile of cable, and the necessary lead piping. Application is to be made to the Local Government Board for power to borrow the necessary money.

**Yarmouth.**—Tenders are to be invited for the electric lighting of the Town Hall.

### CLOSED.

**London, E.C.**—The proprietors of the City Terminus Hotel, E.C., have accepted the tender of Messrs. Robey & Co., of Lincoln, for a locomotive boiler and duplicate system of main steam pipes, &c., for their electric light station, so as to meet the heavy demand which is expected to take place during this coming season.

**Cheltenham.**—The following is a list of the tenders that were sent in for the construction and erection of a 7-ton hand-power overhead travelling crane at their electric lighting station in the borough, for the Town Council:—

| | £ | s. | d. |
|---|---|---|---|
| Humpidge, Holborow & Co., Stroud | £82 | 0 | 0 |
| Chatteris Engineering Company, Cambs. | 175 | 0 | 0 |
| Such & Lander, Cheltenham | 185 | 0 | 0 |
| B. Johnson & Son, Bramley | 245 | 0 | 0 |
| Flavell & Churchill, East Greenwich | 220 | 0 | 0 |
| Carrick & Ritchie, Edinburgh | 195 | 0 | 0 |
| Marshall, Fleming & Jack, Motherwell | 179 | 0 | 0 |
| T. Smith, Rodley, near Leeds | 206 | 0 | 0 |
| J. M. Henderson, Aberdeen | 78 | 0 | 0 |
| J. M. Henderson | 68 | 0 | 0 |
| H. Morris & Bastert, London | 198 | 0 | 0 |
| J. Warner & Son, Hanley | 137 | 10 | 0 |
| Higginbotham & Mannock, Manchester | 163 | 0 | 0 |
| J. Hetherington & Son, Manchester | 245 | 0 | 0 |
| J. Ruscoe, Hyde, Manchester | 198 | 0 | 0 |
| Isles, Limited, Stanningley | 235 | 0 | 0 |
| Jessop & Sons, Leicester | 165 | 0 | 0 |
| J. Booth and Bros., Rodley, near Leeds | 160 | 0 | 0 |
| Tangyes, Limited, Birmingham | 286 | 0 | 0 |
| J. Spencer, Manchester | 160 | 0 | 0 |
| J. Spencer | 150 | 0 | 0 |
| W. Hindson & Co., Gateshead | 145 | 0 | 0 |
| W. Hindson & Co. | 130 | 0 | 0 |
| W. Hindson & Co. | 120 | 0 | 0 |
| Cowans, Sheldon & Co., Carlisle | 190 | 0 | 0 |

As already stated, the tender of Messrs. Humpidge, Holborow & Co., was accepted.

**Whitehaven.**—Messrs. Willans & Robinson's tender for two additional engines and dynamos required at the electric lighting station, at £1,479, has been accepted.

## NOTES.

**Military Electrotechnics in Russia.**—An Imperial decree has recently been published in Russia, says the *Technical World*, ordering the formation of a military electrotechnical school, for the purpose of preparing officers of the Engineers to carry out any military electrical work that may be necessary, to train the privates of the Engineers in electrical duties, and to investigate electrical discoveries and inventions likely to be of use for military purposes. The officers' course will take two years, and the maximum number of officers being instructed at the school at any one time is to be 70.

**The Turnbull Incandescent Lamp.**—We extract the following brief description of a novel form of incandescent lamp devised by a Mr. Turnbull, from the New York *Electrical Engineer*:—"Although no special advantages are here claimed, it is obvious that the principal end sought consists in producing facile means for renovating worn out lamps. The principle employed is identical with that of the Westinghouse stopper lamp, of the success of which very little has been heard. Such novelties as are introduced strike one as retrogressive rather than progressive steps. The interior reflector cannot be claimed to be superior to the radiation of light direct from the filament itself, so that the central rod becomes useless, excepting for the support of a highly inconvenient form of filament. The form shown is inconvenient for several reasons, but chiefly on account of the difficulty of accurately measuring the length of the respective carbons, and the difficulty of attaching the ends to the, presumably, metal wire collars. The thorough efficiency of the metallic grease or paint, moreover, as a substitute for conducting wires, sounds very highly problematical, whilst the means provided for securing that vital essential, a permanent vacuum, viz., by grinding the sockets with a certain tool, is sufficient to stamp the whole arrangement as impracticable. Our recommendation to Mr. Turnbull is to wait quietly for somewhat over two months, when Edison's American patent will expire, and then he will be at liberty to adopt the modern approved type of lamp."

**The Submarine Detector.**—A special interest is now attached to this instrument (devised years ago by Captain M'Evoy), inasmuch as it has recently been used with success in determining the exact position of the Russian monitor, *Rusalka*, which foundered a year ago in the Gulf of Finland. The apparatus is based on the principle of Prof. Hughes's induction balance, and it consists simply of an electrical arrangement contained in a small mahogany box, which is carried on board the searching vessel, and a sinker, which is trailed along the bottom. The sinker also contains an electrical arrangement, and is connected with that in the box by a light electrical cable of any required length. The apparatus includes a small battery and an automatic contact breaker, which opens and closes the battery circuit at short intervals. The battery circuit includes two primary coils, one in the box and the other in the sinker. Each primary coil has its secondary coil, and both the primaries and secondaries are respectively connected up by conductors, which are enclosed in the suspending cable. In the searching vessel there is a telephone, which is included in the secondary circuit. The apparatus is adjusted so that under ordinary circumstances there is silence in the telephone. When, however, the sinker approaches a mass of metal, the balance is upset, and sounds become audible in the telephone, while they are reduced in intensity as the sinker recedes from the metallic object. Three hundred feet of electrical cable were employed with the detector in searching for the *Rusalka*, and the depths searched varied from 15 to 50 fathoms. The search was continued for several weeks, and the exact position of the foundered vessel was at length placed beyond all question, as every time the searching steamer passed over a given spot the electric indicator of the detector sounded loudly, thus affording evidence that a large mass of metal was submerged below. After the vessel had been located the divers descended and examined her, the result of their examination being, so far as is at present known, that she had foundered through serious damage to her stern.

**Germany and Telegraph Cables.**—The news of the surrender of Hendrick Witbooi to Major Lieutwein (the German Imperial Commissioner for South West Africa) has taken a month to reach Berlin. This fact is stated to have accentuated the desire to have the colony connected with Germany by cable.

**A Lady Electrician.**—A writer in the *Woman's Signal*, which is edited by Lady Henry Somerset and Annie E. Holdsworth, devotes some four columns to an interview with a "lady electrician." The lady is, we learn, Dr. Margaret Sharpe, who qualified as a physician in Paris, and for once we can truly say that the answers to her interviewer given by the "lady electrician" appear to be quite free from the slightest suspicion of quackery; indeed, they seem to indicate a real practical acquaintance with genuine electro-therapeutic treatment. She speaks, and justly so, in enthusiastic terms of the Wimshurst machine, and she also refers incidentally to a gentleman who has recently fallen from his high estate, and who she sums up in the one word, quack!

**Suggested Improvement in Barometers.**—The *Daily News*, last Monday, alluded to the frequent changes taking place in the weather which are not being recorded by barometrical fluctuations. A correspondent (Mr. Franklin Fox), in the following day's issue, writes as follows on the subject:—"There is a theory which gains some currency in nautical circles that the power of the atmosphere to support the column of mercury in a glass tube (which we call a barometer) may be affected by the amount and distribution of electricity in the air. Saxby, who was a great student of weather, stated that 'electricity was the cause of all weather,' and may we not look to it as the cause of the apparent aberrations of the barometer with some slight reason for the assumption? What we want is an electrical test, a gauge of the electricity in the air, which could be attached to our barometers, and would very soon afford us a check if electricity affects the atmosphere, by which we could better understand its movements, and read our barometer, which never lies, with a more sufficient insight into its action."

**Fatal Result of Electrical Treatment in Chicago.**—We take the following remarks from the *Western Electrician*, and in reference thereto we need hardly say that we thoroughly agree with every word. It is a wonder that such deplorable results did not accrue on this side of the Atlantic before the crusade against electrical quackery was fought and won, for the treatment in some cases was conducted with the same want of experience of which our contemporary complains:—"The attention excited by the sudden death of Miss Belle White, of Chicago, while undergoing electrical 'treatment' for the removal of freckles will serve to emphasise the caution which should be exercised in the employment of electricity for any remedial or surgical purpose. It is certain that the electrical part of the process was not directly responsible for the young woman's death, which was due to a latent affection of the heart, but the lesson to be gained is that no long continued application of electricity, however slight the current, should be made upon the human body except upon the advice of an experienced practitioner of medicine. There may exist constitutional weaknesses, especially in women of nervous temperament, which should be located and guarded against before electricity is used. In the case of Miss White, who is said to have been a beautiful girl, with little need to make such a terrible sacrifice to vanity, a slight battery current was applied to the skin to be removed through moistened sponges. The skin was first thoroughly cleaned, and then rubbed with a solution of cocaine to deaden the sensibility to the shock. The theory is that the offending bit of cuticle will be burned away, and that, after a number of applications, skin free from blemishes will appear. This 'treatment' was practised upon Miss White at a 'facial massage' establishment by a woman without a medical diploma. Before leaving the office the patient dropped dead. The inquest revealed the fact that death was due to a functional disorder of the heart; but who shall say that the young woman would not now be alive were it not for the excitement due to the electrical 'treatment?' Electricity is enshrouded in the popular mind with a strange terror, and fear of it has proved fatal before this. It should not be administered save under the supervision of a qualified physician."

**A Revolutionary Arc Lamp.**—It is not too much to expect that in the next few days there will be introduced an arc lamp which, we are informed, will constitute a marked advance in lighting. We have few details concerning it, but understand that it is a 1 ampère arc lamp, and that its simplicity, both in construction and use, is remarkable. Meanwhile we wait!

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**Eastern Telegraphs.**—The *Investors' Review* for the current month raises a point regarding the relations of the Eastern Extension Telegraph Company in China with the Great Northern Telegraph Company of Copenhagen. We quote the remarks in full:—"At present we understand these two companies occupy the same offices in Shanghai and Hong Kong, so that it is impossible to keep the messages sent by the one agency from the knowledge of the other. As the lines of the Danish Company pass through Russia, where it is the easiest thing possible to tap them, this arrangement might be most injurious to British interests in the event of any difference of view arising between us and Russia with regard to the attitude to be assumed towards China and Japan. Will the board of the Eastern Telegraph Company put an end to this dangerous co-partnery? And in doing so will it likewise endeavour to liberate our trade with the Farther East from the onerous compact which maintains rates in the interests of the Danish Company? We are told that under this agreement the money is halved, while the English company does three-fourths of the work. It is to be feared that telegraphic affairs in the Far East badly want overhauling."

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**Some Experiments on Death by the Alternating Current.**—At the annual meeting of the American Electro-Therapeutic Association, Prof. E. J. Houston and Mr. A. E. Kennelly submitted a paper on this subject. The paper was a protest against the conclusions which D'Arsonval, of France, has reached regarding the possibilities of the revivification of a person who has been brought under the supposed fatal influence of the alternating current. They endorsed his suggestion that a person shocked by electricity should be treated as a person drowned, but they emphatically call in question the correctness of D'Arsonval's general conclusions in the matter. The particular case mentioned by D'Arsonval contained no marked lesions or evident destruction of tissues, the death was only apparent, and resuscitation under the circumstances, of course, possible. The fact mentioned by D'Arsonval that a pressure of 4,500 volts was on while the subject was shocked, Messrs. Houston and Kennelly think has no significance in the matter unless it is taken in connection with the current passing through the subject under that pressure. "A marked difference exists between the cases of the application of the alternating current as employed in electrocution in New York State, where the current is deliberately continued through the body for the purpose of killing, and such cases of accidental contact as that referred to by D'Arsonval. Assuming the correctness of the ammeter's reading quoted, that is, that a current of only 0·75 was passing, the resistance of the body could not have been less than 6,000 ohms, and the resistance of the body with the electrodes used in the electrocutions in New York, *i.e.*, one on the head and the other on the right calf, is sometimes as low as 200 ohms, and usually not more than 300 ohms. The current strength employed is from 5 to 8 ampères, say, from seven to ten times stronger than stated to have passed in the case mentioned." The writers then detailed a series of experiments in this line which they carried out with the help of some colleagues on a number of dogs in their Philadelphia laboratory. In the case of the dogs it was the unanimous opinion of several medical men present that the death was absolute and restoration impossible in three cases. They believe that the following conclusions may be drawn as the result of these experiments:—1. That the passage of a sufficiently powerful alternating current through the body is followed by instantaneous, painless, and absolute death. 2. That consequently where electrocution is properly carried out there is no possibility of the resuscitation of the criminal. 3. That in cases of accidental contact, where the current passing is not excessive, it is quite possible that death may be apparent only, and that the method of artificial respiration suggested by D'Arsonval should be followed.

**Fire at Henley's Telegraph Works.**—A fire occurred in one of the finishing departments of Henley's, on Wednesday last. The work of the factory, however, will not be interfered with in the slightest, the fire being confined to the one department.

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**Lectures.**—The first of a series of lectures on "Electricity" was delivered in the Town Hall, Stratford, last week, by Dr. A. H. Fison.

At Peterhead, last week, Mr. Donald Cameron, M.A., delivered a lecture on "Electric Current," in the Free Church School.

At Corsham, on 5th inst., Mr. W. Wilson, M.A., gave a lecture on "Electric Lighting," in the Town Hall.

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**Electrical Effects on the Stage.**—Electrical illumination plays a most prominent part in the "Carnival Electrique" now being performed at the Oxford. There is some good dancing by the Edene Troupe, and this leads up to a "Fin de Siècle Danse" by the Electra Trio. In the next scene, which is the principal, the stage is filled with figures in white, and whilst the chorus sings an "Ode to Light" a sudden blaze of light is turned on from glow lights fixed in wreaths carried by the dancers and in festoons hanging over them. By a mechanical arrangement, which is not apparent to the spectator, the lamps suddenly change colour with a very pretty effect.

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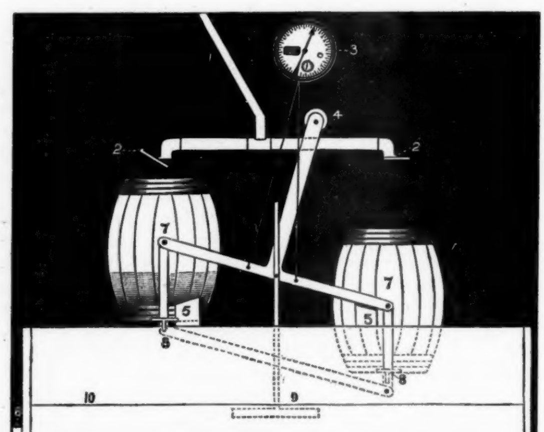
**A Water Weigher.**—In an illustrated description of the Atalanta Street Railways, the *Street Railway Gazette* gives the following details of a water weigher which has been adopted by the company:—The awful mendacity of water meters and the necessity of weighing water to determine cost of power, has driven the inventive genius of the power plant to the devising of the "water weigher" illustrated. The automatic weigher is contained in a rectangular wooden box, 2 feet by 3 feet in dimension, and 8 feet long. Inside are two barrels, one on each side of a pair of levers. When the barrels are in mid-stroke the levers are horizontal, and forged to them is an upright on which at the end is the counterbalancing weight. Across the tops of the barrels passes a




water pipe, which comes from the discharge pipe of the condenser. In the pipe are two valves, which are opened by the barrels automatically as they come to the top, and at the bottom of the barrels two similar valves discharge the water as the barrel sinks. The latter valves are the larger, in order to make it certain that all water is discharged from one barrel before the other one drops; it is not necessary to change the weight in order to adjust the barrels, but simply to alter the angle to one more acute. The boiler feed pump is connected to the bottom of the tank, and a float controls the movement of the barrels. In fact, the barrels must stand until the float sinks and pulls a latch, which allows the barrels to discharge. A street car stationary register is attached to the barrel levers and registers as the barrel sinks. It is a neat idea.

**French Cable Companies.**—The Exchange Telegraph Company's Paris correspondent, referring to the question of the fusion of the two French cable companies, states "that it is by no means certain that the scheme can be carried out as projected by the financiers, who are anxious to get rid of a heavy parcel of shares and bonds of the Société Française des Telegraphes Sous Marins, which the public has hitherto refused to take up. They had hoped to obtain a subsidy from the French Government, but independent shareholders of the P. Q. Company have strongly protested against the confiscation of their assets for the sole benefit of the clique. When the matter was mooted in council the other day, it was decided to refer it to a special telegraph committee, and it is to be hoped that this committee will look carefully into the question before giving a favourable opinion, which, in fact, they could not do if they dealt with it impartially."

**Utilisation of Water Power at Windermere.**—A project is on foot to provide an electric railway and lighting plant in the Lake district, an English company having been formed for the purpose. This company has secured the right to utilise the fall of water from the southern end of Lake Windermere, which is the best piece of water-power in England, being equal to 40,000 I.H.P. Here works will be constructed for converting this into electricity of high potential, so that the current may be distributed over a wide area. It is intended to construct an electric tramline, which we mention elsewhere, from the Furness district to Bowness, with an auxiliary undertaking of eventually carrying it through to Ambleside. A meeting was held at Cartmel last week with reference to the scheme, and water rights have already been secured in order that the electric current may be generated by turbines. Power is to be asked in the next session of Parliament to supply an area of 10 miles from the lake, including the large towns of Kendal, Ulleswater, and several other places in the vicinity.

**The Development of Electrical Manufacturing in Canada.**—The *Electrical Engineer* (New York) under this heading discusses the works and productions of the Canadian General Electric Company, of Toronto, an establishment which appears to be well founded, and in the way of carrying out a good business. Kept back as Canada has been by protective tariffs, her people are not yet awakened fully to the follies of this short-sighted policy, but when Canada really sets out to develop her resources, which she can only do by increasing her railway mileage and exchanging her products with Europe, then the future of the electrical industry should be assured, for we believe Canada is specially favoured in the matter of water-powers. As it is, the General Electric Company has already grown to a considerable size. It has become not merely a general producer of all things electrical, but owns also some of the best patent rights, such as the Edison, many of the Thomson-Houston, and others, and it has over 400 employés, with agencies at all the large centres as far west as Vancouver, and east to the Atlantic. The works of the company are now centred at Peterboro', Ont., about 70 miles from Toronto, in an area of 40 acres, alongside the line of the Canadian Pacific Railroad, which delivers material right into the works, or carries off manufactured products. The main building measures 272 feet by 110 feet, with a gallery on each side, and there are two other shops of equal length, each 50 feet wide. In the power-house is machinery supplying current for 500 incandescent lamps, and ten or a dozen arcs, and 10 motors of an aggregate 200 H.P., the shops being all electrically driven. An interesting article of manufacture is the electric percussion drill for rock work on the Sault Ste. Marie Canal, worked by a pulsatory current generator of 12 kw. capacity, at 380 strokes per minute, and capable of drilling at the rate of 100 feet per diem of 2¾ inches hole. The writer of the article, Mr. J. C. Martin, refers to the ease with which ordinary boys or women now do work that only recently needed all the skill of a trained expert. He says the first telephones took a tremendous effort; now, anyone can make a "handful of pails talk like Gabriel's trumpet." The company appear to make everything from meters, or the finest insulated wire and lamps, up to large dynamos and cars. One of their installations is the 13 miles double track electric road around Niagara; another, the Government light and power plant at the Sault Ste. Marie Canal; and the 6,000 H.P. plant of the Montreal Electric Tramway is theirs, also, as well as many other light and power plants.

**Electric Lighting at Worcester.**—After the account of the Worcester system published last week, it is not necessary to say very much about the opening ceremony which took place yesterday week. To mark in a fitting manner the importance of the event, the Mayor and Corporation invited numerous distinguished guests to take part in the various ceremonies. The proceedings were commenced by the party driving out in the early morning, 10.30 or thereabouts, to the generating station at Powick, where the turbines and engines were formally started on their career. Then a visit was paid to the waterworks, where the company saw the alternate current motors, which have been provided for pumping purposes. Upon returning to the city the company were entertained at luncheon by the Mayor and Corporation. This function took place at the Guildhall, where the event of the day took place, to wit, the grand banquet. Of this, which was magnificent in its way, we have little to say. It was a good example of an English civic banquet, an excellent dinner and dull speeches. We had a good deal of loyal and patriotic toasts from the county gentlemen present, who were masters in the art of being dull. The toast of the evening, "Success to the Electricity Works," was placed the last, and had little justice done to it. The Sub-Dean of Worcester, who proposed it confined himself mainly to the tale of a louse and a whale; and Mr. Preece, who responded, not for the whale, but for the toast, was stupidly confined to two minutes and a half. We ought to mention that an interesting exhibition of electrical appliances was opened on the same day.

**Fourth Annual Meeting of the American Electro-Therapeutic Association.**—This took place at the New York Academy of Medicine on September 25th, 26th, and 27th, and was very successful. The number of physicians attending was considerable, and included many who had come from distant States to take part in the proceedings. Glancing at the list, we noted some who hailed from Michigan, Georgia, Massachusetts, and Illinois, and two or three from Canada, besides many others from New York and the nearer States. A three days' meeting thus attended shows that electro-therapy has taken a strong hold upon the medical profession in America, and anyone listening to the proceedings could not fail to be struck with the earnestness and sincerity with which the various papers were listened to and discussed. The President, Dr. W. J. Herdman, of Ann Arbor, Mich., conducted the numerous sessions (two each day) with dignity and despatch, while the indefatigable lady secretary—Dr. Margaret A. Cleaves, of New York City—was attentive alike to the details of business routine and to the comfort of the members. Besides the presidential address and the reports of several committees, no less than 35 papers were read, and many of them discussed. Some of these papers we publish elsewhere either *in extenso* or by abstract. One interesting feature was the presence of several lady doctors, some of whom also took active part in the proceedings. In connection with the meeting was an exhibition of electro-medical apparatus. The quantity of instruments on show was not great, but the quality was very commendable. No startling novelty appeared, but many illustrations of characteristic American ingenuity were to be found. Altogether, the meeting was a most satisfactory evidence of scientific progress in electro-therapy. The admirable tone and scientific spirit of the President's address, the reception of papers by non-medical physicists, the sound and careful work indicated by many of the medical papers, the representative character of the assembly, and the earnestness which characterised the whole proceedings were, each and all, indications that a fair number of American physicians of good standing and high intellectual attainment are believers in electricity as rationally applied to medicine, and recognise that scientific truth and accuracy must form the basis of electrical as well as of other treatment. Would that British physicians would go and do likewise.

## NEW COMPANY REGISTERED.

**Charles Joyner & Co., Limited** (42,176).—This company was registered on the 12th inst. with a capital of £35,000, in £10 shares, to acquire and carry on the business of Charles Joyner & Co., of Icknield Square, Birmingham, manufacturers of fittings connected with lighting by oil, gas, or electric light, and the goodwill thereof, and to enter into an agreement for this purpose. The subscribers (with one share each) are:—J. Grubb, Icknield Square, Birmingham, manufacturer; W. Littleboy, Icknield Square, Birmingham, manufacturer; C. Butler, 75, Westfield Road, Birmingham, gentleman; G. Chambers, 10, Hockley Still, Birmingham, manager; W. H. Sturge, 17, Frederick Road, Edgbaston, electrical engineer; H. W. Fewings, Flint Green Road, Acock's Green, Birmingham, cashier; W. Sturge, 7, Frederick Road, Edgbaston, gentleman. The first directors are J. Grubb, W. Littleboy, and Cephas Butler. Qualification, £500: remuneration to be fixed in general meeting. Registered by Mackrell, Martin & Godlee, 21, Cannon Street, E.C.

## OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

**Electric Tramways Construction and Maintenance Company, Limited** (23,600).—The last return of this company shows that only seven shares, out of a capital of £250,000, in £1 shares, have been taken up, upon which nothing has been called or paid.

**Key's Electric Company, Limited** (30,994).—Mr. F. T. Eggers, the liquidator of the above concern, writes the Registrar of Joint Stock Companies to the effect that an account has been laid before the shareholders, showing the manner in which the winding up of the company has been conducted.

**London Rubber and Packing Company, Limited** (33,592).—This company's yearly return states that out of a nominal capital of £3,000, in £5 shares, 15 founders' and 245 ordinary shares have been taken up, and that £5 has been called on each of 15 founders' and 10 ordinary, and £2 10s. on each of 205 ordinary shares. The total sum received is £592 0s. 1d.; £150 has been agreed to be considered as paid, and £45 9s. 11d. is outstanding.

**Okonite Company, Limited** (31,782).—This company (which was formerly known as the International Okonite Company, Limited) has filed its yearly return, which shows that out of a nominal capital of £340,000 in £10 shares, the whole of the shares have been taken up, and the full amount called on each. A sum of £225,665 has been received, £113,320 has been agreed to be considered as paid, £1,015 is outstanding, and £5 is the amount paid on five preference shares forfeited.

**St. Nicholas Construction Company, Limited** (38,768).—This company's statutory return shows that only the seven subscribers' shares, out of a nominal capital of £400,000 in £20 shares, have been taken up. The full amount has been called, but nothing has been paid.

**Single-Wire Multiple Telephone Signal Company, Limited** (16,857).—The annual return of this company has lately been filed, and shows that out of a nominal capital of £5,000, in £10 shares, 254 shares have been taken up. The full amount has been called and paid on these shares.

**Spanish National Submarine Telegraph Company, Limited** (18,321).—The last annual return of this company shows that out of a nominal capital of £500,000, in 49,900 £10 ordinary and 1,000 £1 founders' shares, 23,719 ordinary shares have been taken up, 23,715 of which have been issued as fully paid, and the full amount has been called and paid on the remaining four shares.

**Mosley & Co., Limited** (40,422).—This company's statutory return shows that out of a nominal capital of £11,000, in £1 shares, 6,657 shares have been taken up, the full amount called, and duly paid.

**English Electric Manufacturing Company, Limited** (39,796).—The registered office of this company, according to a document filed at Somerset House, is now at 30, Stamford Street, Leicester.

**English Electric Carbon Company, Limited** (38,434).—This company's yearly return shows that, out of a nominal capital of £10,000, in £10 shares, 789 shares have been taken up. A sum of £7,840 has been received in response to calls, and £50 is outstanding.

**Johannesburg Lighting Company, Limited** (35,248).—This company's yearly return shows that out of a nominal capital of £150,000, in 50,000 preference and 100,000 ordinary shares of £1 each, 77,132 ordinary shares have been taken up, and that £1 has been called and paid on seven ordinary shares. A sum of £127,125 has been agreed to be considered as paid.

## CITY NOTES.

### The Brazilian Submarine Telegraph Company, Limited.

The report of the directors for the half-year ended June 30th, 1894, to be submitted to the 42nd ordinary general meeting on October 24th, 1894, states that the revenue for this period amounted to £94,679 16s. 4d., and the working expenses to £20,269 9s. 11d. After providing £12,880 for debenture interest and sinking funds, and £1,736 9s. 10d. for income tax, there remains a balance of £59,793 16s. 7d.; to this is added the sum of £2,207 9s. 2d. brought forward from December 31st last, making a total of £62,001 5s. 9d. A quarterly interim dividend, amounting to £19,500, has been paid, and £15,000 transferred to the reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 1s. per share, both free of income tax, which together will amount to £26,000, leaving a balance of £1,501 5s. 9d. to be carried forward. The dividend and bonus will be payable on the 25th inst. On July 31st last the sum of £18,700 was transferred to pay off 187 bonds, the balance of the 1884 issue. The receipts for the half-year include the sum of £1,500 dividend to December 31st, 1893, on the company's shares in the African Direct Telegraph Company, Limited. The directors have to report that Sir Henry D. Gooch, Bart., has resigned his seat at the board, and that it is not considered necessary to fill the seat at present. The various sections of the company's line are in good working order. Sir John Pender, G.C.M.G., M.P., and the Hon. W. St. John Brodrick, M.P., retire at this meeting, and being eligible for re-election as directors, offer themselves accordingly. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. Gane, Jackson and Jefferys, also offer themselves for re-election.

**Venezuela Telephone and Electrical Appliances Company, Limited.**—The accounts show a profit of £7,413 5s. 11d., to which is added the balance of £1,558 9s. 7d. standing to profit and loss account. After providing the interest on the first and second mortgage debentures, amounting to £4,393 8s. 6d., the directors have written off the sum of £1,711 15s. 3d. from the discount and expenses on debenture issues. This leaves a balance of £2,866 11s. 9d., out of which the directors recommend that a dividend on the company's share capital be declared for the year ended June 30th, 1894, at the rate of 4 per cent per annum. which will absorb £2,800, and that the balance of £66 11s. 9d. be carried forward. The company's property having been fully maintained, as set forth by the general manager's certificate at the end of the balance-sheet, the board does not consider it necessary at the present time to make any allowance for depreciation of plant.

**Isle of Man Electric Tramway.**—The directors of the Isle of Man Electric Tramway Company, Limited, whose line has been open only three months, have issued a circular in which they state that, having carefully considered the profits for the past season, and having consulted with the auditors, they have, after providing a large sum for the reserve and renewal fund, and making provision for further dividends at the end of the year, decided to pay an interim dividend at the rate of 6 per cent. per annum on the preference, and of 7½ per cent. on the ordinary shares for the six months ending October 31st.

**West India and Panama Telegraph Company, Limited.**—The directors of the West India and Panama Telegraph Company, Limited, have decided to recommend a dividend of 6d. per share on the ordinary shares.

**The Westminster Electric Supply Corporation.**—A meeting of shareholders has been called for the purpose of increasing the capital from £300,000 to £400,000.

## TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 14th, 1894, amounted to £921; week ending Octobe 15th, 1893, £851; increase, £70; total receipts for half-year, 1894, £12,931 corresponding period, 1893, £12,146; increase, £785.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending October 14th, 1894, amounted to £906; corresponding week last year, £582.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 12th, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £8,093.

# SHARE LIST OF ELECTRICAL COMPANIES.

## TELEGRAPH AND TELEPHONE COMPANIES.

| Present issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1891. | 1892. | 1893. | Closing Quotation. October 10th. | Closing Quotation October 17th. | Business done during week ended October 17th, 1894. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 173,400*l* | African Direct Teleg., Ltd., 4 % Deb. ... ... ... | 100 | ... | ... | ... | 102 —105 | 102 —105 | ... | ... |
| 1,012,880*l* | Anglo-American Teleg., Ltd. ... ... ... ... ... | Stock | £2 12s. | £2 15s. | £2 11s. | 39 — 42 | 38 — 41 xd | 39½ | 38 |
| 2,993,560*l* | Do. do. 6 % Pref. ... ... ... ... ... | Stock | £5 5s. | £5 10s | £5 2s. | 75½— 76½ | 75 — 76 xd | 75½ | 74½ |
| 2,993,560*l* | Do. do. Defd. ... ... ... ... ... ... | Stock | ... | ... | ... | 6¾— 7¼ | 6¾— 7¼ | ... | ... |
| 130,000 | Brazilian Submarine Teleg., Ltd. ... ... ... ... | 10 | 8 % § | 6½% § | 6½% § | 12¾— 13¼ | 12¾— 13¼ | 13 | 12¾ |
| 75,000*l* | Do. do. 5 %, repayable June 1906 ... ... | 100 | ... | ... | ... | 110 —114 | 110 —114 | ... | ... |
| 44,000 | Chili Teleph., Ltd., Nos. 1 to 40,000 ... ... ... ... | 5 | ... § | 10%‖ § | ... § | 2 — 3 | 2 — 3 | 2 5/16 | 2⅛ |
| 10,000,000$ | Commercial Cable Co. ... ... ... ... ... ... | $100 | 7 % | 7 % | 7 % | 135 —145 | 135 —145 | ... | ... |
| 224,850 | Consolidated Telep. Const. and Main., Ltd. ... ... | 10/- | 3½% § | 2 % § | 2 % § | ⅛ — ¼ | ⅛— ¼ | ... | ... |
| 16,000 | Cuba Teleg., Ltd. ... ... ... ... ... ... ... | 10 | 8 % | 8 % | 8 % | 12½— 13½ | 12½— 13½ | ... | ... |
| 6,000 | Do. 10 % Pref. ... ... ... ... ... ... | 10 | 10 % | 10 % | 10 % | 19 — 20 | 19 — 20 | 19⅞ | ... |
| 12,931 | Direct Spanish Teleg., Ltd., £4 paid ... ... ... | 5 | 4½% | 4 % | 4 % | 4¼— 4¾ | 4¼— 4¾ | ... | ... |
| 6,000 | Do. do. 10 % Pref. ... ... ... ... | 5 | 10 % | 10 % | 10 % | 9¼— 9¾ | 9¼— 9¾ | ... | ... |
| 30,000*l* | Do. do. 4½ % Debs of £50, Nos. 1 to 1,600 | ... | ... | ... | ... | 105 —108% | 105 —108% | ... | ... |
| 60,710 | Direct United States Cable, Ltd., 1877 ... ... ... | 20 | 3½% § | 3½% § | 2⅝% § | 8¾— 9¼ | 8½— 9 xd | 9 | 8 13/16 |
| 400,000 | Eastern Teleg., Ltd., Nos. 1 to 400,000 .. ... ... | 10 | 6½% § | 6½% § | 6½% § | 15¾— 16 | 15¾— 16 xd | 16 | 15¾ |
| 70,000 | Do. 6 % Pref. ... ... ... ... ... ... | 10 | 6 % § | 6 % § | 6 % § | 16¾— 17¼ | 16¾— 17¼xd | 16 13/16 | 16¾ |
| 102,100*l* | Do. 5 % Debs., repay. August, 1899 ... ... | 100 | ... | ... | ... | 106 —110 | 106 —110 | ... | ... |
| 1,297,837*l* | Do. 4 % Mort. Deb. ... ... ... ... ... | Stock | ... | ... | ... | 118 —121 | 118 —121 | 120 | ... |
| 250,000 | Eastern Extension, Australasia and China Teleg., Ltd. ... | 10 | 7 % | 7 % | 7 % | 16 — 16¼ | 16 — 16¼xd | 16 3/16 | 16 |
| 54,100*l* | Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326 | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 194,300*l* | Do. do. Bearer, 1,050—3,975 and 4,327—6,400 | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 320,000*l* | Do. 4 % Deb. Stock ... ... ... ... ... ... | Stock | ... | ... | ... | 116 —120 | 116 —120 | ... | ... |
| 95,100*l* | Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343 | 100 | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 129,100*l* | Do. do. do. to bearer, 2,344 to 5,500 | ... | ... | ... | ... | 103 —106 | 103 —106 | ... | ... |
| 300,000*l* | Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909 | 100 | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 200,000*l* | Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000 | 25 | ... | ... | ... | 109 —112% | 109 —112% | ... | ... |
| 180,227 | Globe Telegraph and Trust, Ltd. ... ... ... ... | 10 | 5¼% § | 4⅞% § | 4⅝% § | 8⅞— 9⅛ | 8¾— 9 xd | 9 | 8 13/16 |
| 180,042 | Do. do. 6 % Pref. ... ... ... ... | 10 | 6 % § | 6 % § | 6 % § | 15¾— 16¼ | 15½— 16 xd | 16 | 15¾ |
| 150,000 | Great Northern Teleg. Company of Copenhagen ... ... | 10 | 8⅜% § | 8⅜% § | 8⅜% | 20½— 21½ | 20½— 21½ | 20⅞ | ... |
| 190,000*l* | Do. do. do. 5 % Debs. | 100 | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 17,000 | Indo-European Teleg., Ltd. ... ... ... ... ... ... | 25 | 10 % | 10 % | 10 % | 46 — 48 | 46 — 48 | 47½ | 47 |
| 37,548 | London Platino-Brazilian Teleg., Ltd. ... ... ... | 10 | ... | ... | ... | 5 — 7 | 5 — 7 | ... | ... |
| 100,000*l* | Do. do. 6 % Debs. ... ... | 100 | ... | ... | ... | 107 —110 | 107 —110 | ... | ... |
| 15,000 | Monte Video Teleph. Co., Ord., 1 to 15,000 ... ... | 5 | ... | ... | ... | ¼— ¾ | ¼— ¾ | ... | ... |
| 28,000 | Do. do. 6 % Pref., 1 to 28,000 ... ... | 5 | ... | ... | ... | 1 — 1½ | 1 — 1½ | ... | ... |
| 484,597 | National Teleph., Ltd., 1 to 438,984 ... ... ... ... | 5 | 6 % § | 5 % § | 5 % § | 4⅞— 5⅛ | 4⅞— 5⅛ | 5⅛ | 4 15/16 |
| 15,000 | Do. 6 % Cum. 1st Pref. ... ... ... | 10 | ... | ... | ... | 15 — 15½ | 15 — 15½ | 15 1/16 | ... |
| 15,000 | Do. 6 % Cum. 2nd Pref. ... ... | 10 | ... | ... | ... | 14 — 15 | 14 — 15 | 14¾ | 14½ |
| 119,234 | Do. 5 % Non-cum. 3rd Pref., 1 to 90,950 | 5 | ... | ... | ... | 5½— 5¾ | 5½— 5¾ | 5¾ | 5 11/16 |
| 1,000,000*l* | Do. 4½ % Deb. Stock Prov. Certs. ... | ... | ... | ... | ... | 109 —112 | 110 —113 | ... | ... |
| 48,800 | New Teleph., Ltd., 25,901 to 74,700; £4 paid ... ... | 10 | ... | ... | ... | ... ... | ... ... | ... | ... |
| 171,504 | Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid | 1 | ... | ... | ... | 7/16— 9/16 | 7/16 — 9/16 | ... | ... |
| 100,000*l* | Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000 | 100 | ... | ... | ... | 104 —107 | 104 —107 | ... | ... |
| 11,839 | Reuter's Ltd. ... ... ... ... ... ... ... ... | 8 | 5 % | 5 % | 0 % | 3 — 5 | 3 — 5 | ... | ... |
| 3,381 | Submarine Cables Trust ... ... ... ... ... | Cert. | ... | ... | ... | 106 —111 | 105 —110 | ... | ... |
| 58,000 | United River Plate Teleph., Ltd. ... ... ... ... | 5 | ... | ... | ... | 2 — 3 | 2 — 3 | ... | ... |
| 146,733*l* | Do. do. 5 % Debs. ... ... ... ... | Stock | ... | ... | ... | 88 — 94 | 88 — 94 | ... | ... |
| 15,609 | West African Teleg., Ltd., 7,501 to 23,109 ... ... ... | 10 | 4 % | .. | 0 % | 3 — 5 | 3 — 5 | ... | ... |
| 249,900*l* | Do. do. do. 5 % Debs. ... ... ... | 100 | ... | ... | ... | 100 —103 | 100 —103 | 102½ | ... |
| 30,000 | West Coast of America Teleg., Ltd. ... ... ... ... | 10 | ... | ... | ... | 2 — 3 | 2 — 3 | ... | ... |
| 150,000*l* | Do. do. do. 8 % Debs., repay. 1902 | 100 | ... | ... | ... | 101 —106 | 101 —106 | ... | ... |
| 64,242 | Western and Brazilian Teleg., Ltd. ... ... ... ... | 15 | 4 % | 2½% | 2½% | 8¾— 9¼ | 8½— 9 | 8¾ | ... |
| 33,129 | Do. do. do. 5 % Cum. Pref. ... | 7½ | ... | ... | ... | 6½— 7 | 6½— 7 | 6¾ | 6 9/16 |
| 33,129 | Do. do. do. 5 % Def. ... ... | 7½ | 3 % | ... | ... | 2¾— 3¼ | 2¾— 3¼ | ... | ... |
| 171,900*l* | Do. do. do. 6 % Debs. "A," 1910 ... | 100 | ... | ... | ... | 106 —109 | 106 —109 | ... | ... |
| 214,800*l* | Do. 6 % Mort. Debs., series "B," red. Feb. 1910 | 100 | ... | ... | ... | 106 —109 | 106 —109 | ... | ... |
| 88,321 | West India and Panama Teleg., Ltd. ... ... ... | 10 | ¼% | ¼% | ⅜% | 1⅜— 1⅝ | 1⅜— 1⅝ | 1⅜ | ... |
| 34,563 | Do. do. do. 6 % 1st Pref. ... | 10 | ... | ... | ... | 10¾— 11¼ | 10¾— 11¼ | 11¼ | 10⅞ |
| 4,669 | Do. do. do. 6 % 2nd Pref. ... | 10 | ... | ... | .. | 9 — 10 | 9 — 10 | 9⅞ | 9¾ |
| 80,000*l* | Do. do. 5 % Debs. (1917) No. 1 to 1,000 | 100 | ... | ... | ... | 108 —111 | 108 —111 | ... | ... |
| $1,211,000 | Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ... | $1000 | ... | ... | ... | 115 —120 | 115 —120 | ... | ... |
| 166,900*l* | Do. do. 6 % Ster. Bonds. ... ... | 100 | ... | ... | ... | 102 —104 | 102 —104 | ... | ... |

## ELECTRICITY SUPPLY COMPANIES.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 30,000 | Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000 | 5 | ... | 5 % | 4½% | 4½— 5½ | 4 — 5 | 4⅞ | ... |
| 40,000 | City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000 | 10 | ... | ... | ... | 13 — 14 | 13½— 14½ | 13¾ | ... |
| 40,000 | Do. do. 6 % Cum. Pref., 1 to 40,000 | 10 | ... | 6 % | 6 % | 14½— 15 | 14¾— 15¼ | 15⅛ | 15 |
| 100,000 | Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid | ... | ... | ... | ... | 131 —133 | 131 —133 | 132¾ | 132 |
| 50,000 | †Liverpool Electric Supply, all paid ... ... ... ... | 5 | 4½% | 5 % | 5 % | 6¾— 7 | 6¾— 7 | ... | ... |
| 49,900 | *Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ... | 10 | 1 % | 2 % | 2½% | 9½— 10 | 9½— 10 | 9¾ | 9⅝ |
| 100,000*l* | Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40 | ... | ... | ... | ... | ... — ... | ... — ... | ... | ... |
| 6,452 | Notting Hill Electric Lightg. Co., Ltd. ... ... ... | 10 | ... | ... | ... | 5½— 6½ | 5½— 6½ | 6¼ | ... |
| 19,980 | St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780 | 5 | 8½% | 7½% | 4½% | 7¼— 7¾ | 7¼— 7¾ | 7 9/16 | 7½ |
| 20,000 | Do. do. 7 % Pref., 20,081 to 40,080 | 5 | 7 % | 7 % | 7 % | 8½— 9 | 8½— 9 | 8⅝ | 8¾ |
| 59,900 | *Westminster Electric Supply Corp., Ord., 101 to 60,000 ... | 5 | ... | 3½% | 4 % | 6¾— 7¼ | 6½— 7 | 7 3/16 | 6⅝ |

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

## SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

### ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

| Present Issue. | NAME. | Stock or Share. ‡ | Dividends for the last three years. 1891. | 1892. | 1893. | Closing Quotation, Oct. 10th. | Closing Quotation, Oct. 17th. | Business done during week ended Oct. 17th, 1894. Highest. | Lowest |
|---|---|---|---|---|---|---|---|---|---|
| 90,000 | Brush Elecl. Enging. Co., Ord., 1 to 90,000... ... ... | 3 | ... | 6 % § | 6 % § | 2¾— 3 | 2⅝— 2⅞xd | $2\frac{15}{16}$ | 2¾ |
| 90,000 | Do. do. Non-cum. 6 % Pref., 1 to 90,000 | 2 | ... | 6 % § | 6 % § | 2½— 2¾ | 2½— 2¾xd | 2½ | ... |
| 125,000*l* | Do. do. 4½ % Deb. ... ... ... | Stock | ... | ... | ... | 110 —113 | 111 —114 | 112¾ | 112 |
| 630,000*l* | City and South London Railway ... ... ... ... | Stock | ... | ⅝% | ⅝% | 36 — 38 | 36 — 38 | 37¼ | ... |
| 28,180 | Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180 | 5 | 7 % § | 7 % § | 7 % § | 2 — 2½ | 2 — 2½ | ... | ... |
| 50,000*l* | { Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each } | ... | ... | ... | ... | 94 — 99 | 94 — 99 | ... | ... |
| 120,000 | Electric Construction, Ltd., 1 to 120,000 ... ... ... | 2 | ... | ... | ... | ⅜— ⅝ | ¼— ½ | ¼ | ⅜ |
| 12,845 | Do. do. 7 % Cum. Pref., 1 to 12,845 ... | 2 | ... | ... | ... | 1¾— 2¼ | 1½— 2 | 2¼ | $1\frac{13}{16}$ |
| 100,000 | Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ... | 2 | *nil* | *nil* | *nil* | $\frac{3}{16}$— $\frac{5}{16}$ | $\frac{3}{16}$— $\frac{5}{16}$ | ... | ... |
| 91,195 | Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000 ... ... | 2 | *nil* ¶ | *nil* | *nil* | 1⅜— 1⅝ | 1⅜— 1⅝ | 1⅜ | ... |
| 67,385 | Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ... | 2 | *nil* | *nil* | *nil* | 1⅛— 1⅜ | 1⅛— 1⅜ | ... | ... |
| 20,000 | Fowler-Waring Cables, Nos. 301 to 20,300 ... ... ... | 5 | *nil* § | *nil* § | *nil* § | ½— 1½ | ½— 1½ | ... | ... |
| 9,600*l* | Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ... | 10 | 7 % | ... | ... | 6½— 7½ | 6½— 7½ | ... | ... |
| 6,837 | Henley's (W. T.) Telegraph Works, Ltd., Ord. ... ... | 10 | 5 % | 5 % | 5 % | 8 — 9 | 8 — 9 | ... | ... |
| 50,000 | India-Rubber, Gutta Percha and Teleg. Works, Ltd. ... | 10 | 12½% | 12½% | 12½% | 24 — 25 | 24½— 25½ | 25 | 24¾ |
| 200,000 | Do. do. do. 4½ % Deb., 1896 | 100 | ... | ... | ... | 102 —104 | 102 —104 | ... | ... |
| 37,500 | †Liverpool Overhead Railway, Ord. ... ... ... ... | 10 | ... | ... | 1 % | 7⅞— 8⅛ | $7\frac{15}{16}$— $8\frac{1}{16}$ | ... | ... |
| 6,295 | † Do. do. Pref., £8 paid ... ... | 10 | ... | ... | ... | 13 — 13¼ | 13 — 13¼ | ... | ... |
| | Swan United Electric Light, Ltd. ... ... ... ... | ... | 11 % § | 10 % § | 7½%§ | ... — ... | ... — ... | ... | ... |
| 37,350 | Telegraph Constn. and Maintce., Ltd. ... ... ... | 12 | 20 % | 15 % | 20 % | 41 — 43 | 41 — 43 | 42⅝ | 42 |
| 150,000*l* | Do. do. do. 5 % Bonds, red. 1894 | 100 | ... | ... | ... | 105 —108 | 106 —109 | 107¼ | 107 |
| 54,000 | Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ... | 10 | ... | ... | ... | 2 — 2¼ | 2 — 2¼ | 2¼ | $2\frac{3}{16}$ |

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50 % for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0 % §; 1891—7 % §; 1890—8 % §.

### LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5¼—5¾.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
House-to-House Company (£5 paid), 1—1½.
Do. do. 7 % Preference, of £5, 5¼—5½.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4¾—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6¼—6¾.
Liverpool Electric Supply, £5 (fully paid), 6⅜—6⅞.
London Electric Supply Corporation, £5 Ordinary, ⅞—1¼.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4¾.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

## REVIEWS.

*Dynamo Attendants and their Dynamos.* By Alfred H. Gibbings, A.I.E.E. London: Sydney Rentell, Ludgate Hill.

This little work, a reprint of a series of articles on *Electricity*, gives a good deal of information which should prove very useful for workmen who may be called upon to handle dynamos.

The "dynamo attendant" forms a large part of the title but is very scantily treated in the work, the first two paragraphs only being devoted to the discussion of this highly interesting character. To him, however, this book should prove a big shilling's worth, and may materially assist him in the noble effort to deserve his wages, for the information is correct and plainly conveyed.

*Construction des Lignes Electriques Aeriennes.* By A. Boussac, Inspecteur-General des Postes et Telegraphes. Cours complété by E. Massin, Ingenieur des Telegraphes. Paris: Gauthier-Villars et Fils, 55, Quai des Grands-Augustins.

This work is actually a reprint of a course of 25 lectures delivered by M. A. Boussac at the Ecole de Telegraphie; 19 only had been put into form by the lecturer for publication when his death took place. M. Massin has now put the whole into form and has supplemented the same by filling in the incompleted lectures. While acknowledging the ability of the work and the utility of much of the matter, we have here again one more instance of the filling out by pages which can only be characterised as "much ado about nothing." The everlasting formulæ on the catenary and other curves, are repeated, developed, and described, *ad nauseam*, and will in all probability remain, as usual, quite unnoticed, they being, as every telegraph engineer knows, perfectly useless for any practical purpose. There are mathematical formulæ in plenty which are of real value and to which no reasonable exception can be taken, but authors who are mathematicians cannot, or will not, resist the temptation to cram in and develop in their works much which is wholly unnecessary, or rather, we should say, give a most undue importance to what might be recorded but which should certainly not be put forward as essential matter.

To the English reader there is not much which will prove of value, though it is of interest to know "how they do these things" elsewhere than in our own country. Apart from the utility of the book we have little but praise to give; M. Massin has done his task well, and in arrangement and completeness the lectures leave little to be desired.

*The Glasgow and West of Scotland Technical College Calendar for the Session* 1894-95.

This volume contains the usual information common to callendars of the class. The electrical engineering section of the college continues to flourish under Prof. Jamieson, assisted by Messrs. Livingstone and Fulton.

*A Text-Book of Dynamics: A Text-Book of Statics.* By W. Briggs and C. N. Bryan. London: University Correspondence College Press, 13, Bookseller's Row, Strand, W.C.

The frequent issue of books of this class is a distinct indication that the period of the terribly cramped style in which text-books of 20 or 30 years ago were written, is well nigh come to an end. It is quite refreshing to read Messrs. Brigg's and Bryan's productions side by side with the antiquated volumes of our youth, solid as the matter was which the latter contained. The authors have, as far as possible, avoided the use of mathematical formulæ in the solution of problems, and have, instead, deduced results by direct application of principles themselves; this is an excellent line to follow and, in our opinion, is the very best method of rendering important principles clear to the student. The use of numerous examples fully worked out is also an excellent feature and one which we have always laid great stress upon. Not a little credit is due to the letterpress which, in arrangement and clearness, leaves little to be desired

## THE AMERICAN ELECTRO-THERAPEUTIC ASSOCIATION.

### THE HYDRO-ELECTRIC THERAPEUTICS OF THE CONSTANT CURRENT.

By Dr. Hedley.

This paper chiefly concerns itself with the electric water bath. Those localised applications by douche, by water introduced into cavities, or by local immersions, are, it is understood, to be dealt with in other communications. To designate, respectively, that form of bath in which the water constitutes only one pole of the circuit, or that form in which both poles are in the water, the terms "monopolar" and "dipolar" are adhered to. It seems scarcely necessary, however, to admit the word "multipolar" of recent introduction. To regard the multiplication of electrodes as a divided anode, or a divided cathode, is probably simpler, and certainly more correct. The question of exact dosage in the dipolar bath is one of pure physics. In other words, the following is the problem that presents itself:—With a given current running through a given bath, what proportion of such current will find its way through the body of a patient immersed therein? This question, however, does not enter into the scope of the present paper. It is one of extreme difficulty, and well worthy the attention of those distinguished physicists who are about to discuss it. One of the chief difficulties lies in ascertaining body resistance under the conditions of immersion. It is obvious that the body then becomes part of a compound conductor, and that it will take its share of current according to definite physical laws. As to what that share is various estimates have been hazarded. These have varied between 5 per cent. of total current flowing and 20 per cent., and within an even wider range. But so far as the present writer is aware, neither by direct measurement of body resistance, nor by more indirect methods, has this question ever received a satisfactory answer. Under these circumstances, therefore, dosage can only be expressed in terms of a certain current running through a certain bath containing a human body under certain conditions of immersion. It also becomes evident that if results are to be compared, and any approach to exactness arrived at, in no form of electrisation is "standard" apparatus of greater consequence than in the case of the electric bath. The dimensions and construction of the bath tub which the writer has found useful in practice is given in an appendix to this paper. With so large a number of electrodes the current is easily manipulated by means of a suitable switchboard. This subdivision of the two poles presents advantages both in the way of diffusion and localisation.

Until after investigations more extended than any that have yet been carried out, it will be difficult to assign to the constant current bath its exact place in therapeutics. So far as the present writer is concerned, it is still on its trial. He does not hold a brief in its favour. Indeed, so far from being its apologist, he has to confess that he now finds himself using it much less frequently than the bath with sinusoidal and other alternating currents. But, at the same time, he feels bound to ask himself how far his practice is based on careful enquiry, and how far it is a mere experiment, how far carried away by the enthusiasm others, how far borne along on one of these irresistible fashion-waves that every now and then in medicine, as in other things, sweep everything before them. It may at least be well to suspend judgment until some of the excitement has passed over, which, for the moment at least, seems to have placed alternating currents everywhere in the ascendant.

Before proceeding to details, it is well in the first instance to clear the ground by distinguishing between the electric and the purely thermal effects of a bath. The warm bath (*i.e.*, the bath at 95° to 104° F.) slightly increases the activity of the circulation and somewhat retards tissue metamorphosis. It is a valuable soothing agent, but in other respects its effects on the system are almost inappreciable (Shelley). It appears, therefore, that we have not much to expect from the warm bath *per se*. As a means, however, of applying electricity to the body, it is invaluable.

With the dipolar form of bath, and a bath tub of the construction and dimensions indicated,* the writer finds that he uses a current strength of 50 to 200 m.a. With the cervical, dorsal, and terminal electrodes in action, the first bath commences at the lower figure (the current being *gradually* turned on through a cell collector or rheostat) for the first five minutes. A somewhat greater strength is gradually attained during the rest of the time, which altogether extends to 8 or 10 minutes for the first bath. Both duration, direction, and strength, will, of course, vary according to the therapeutic results aimed at, the strength and electrical capacity of the patient, the number of electrodes in action, and other circumstances. The case is then watched for a day or two, and another bath given with an increasing current. In another day or two a third bath is administered. Tolerance having thus been attained and no contra-indication having manifested itself, a series of half-a-dozen baths are taken in successive days. Then follow two or three on alternate days, an average "course" thus extending over about three weeks, and consisting of 12 baths. The position of the patient in the bath will vary according to circumstances—completely immersed if desirable to act on the whole length of the spine, or sitting upright on the gluteal electrode in the direct line of current between the two laterals in cases where it may be intended to influence the hips or the organs of the abdomen and pelvis; the arms being allowed to lie across the line of current flow, or carried to the front of the patient so as to avoid it. Temperature will vary according to circumstances, but 94° to 100° F. is a sufficiently wide range in this climate. It is often considered useful to allow a Faradic current of moderate strength to run for a few minutes before the patient emerges from the bath, or whilst he stands up in the water a cold affusion in some form or a mild Faradic douche is applied, according to individual toleration. The patient who finds it necessary to undergo a course of electric baths has not generally any considerable resisting power to cold; he is, moreover, often nervous or hyper-sensitive. Therefore, if stimulation either by cold affusion or by the electrised douche be attempted, it is obvious that the operator must have his apparatus "well in hand." It is scarcely too much to say that the success of the electric douche depends upon the easy graduation and the perfect controlability both of its electric and of its hydriatic strength. A quarter of an hour's rest is taken, and weather and strength permitting, the patient walks at least part of the distance home. In administering a bath to insane, paralysed, anæsthetic, and other helpless people, special precautions must be taken, especially if the patient be heavy as well as helpless. In certain cases, paralysed in the lower extremities only, I have availed myself of the suspension tripod ordinarily used for locomotor ataxy. With this placed across one upper corner of a low bed, and with an improvised seat or "chair" made of straps or stout webbing, a patient can easily be swung into a bath placed alongside the bed. If wholly helpless the apparatus figured and described by Mr. Stephen for the cold bath treatment of typhoid may be used. Of this also I attach a very rough reproduction. In all such cases the greatest care must be exercised, not only in placing the patent in the bath, but in looking for wounds, ulcerated surfaces, skin abrasions, &c., and protecting them from the action of the current.

Before being placed in the bath the condition of the patient's "sensibilities" (tactile, pain, temperature, muscular sense) must be carefully enquired into. It is within the writer's knowledge that in the case of tabetics, who were also anæsthetic, serious ill effects have followed the administration of electric baths by incompetent persons, whose only limit to dosage is what the patient will bear.

The question of polarity will have to be decided on general principles, or rather by a process of cautious experimentation. The late Dr. Stevenson states that the direction of current flow should generally be from the feet to the head. No reason seems to be assigned for this rule, and it is not altogether easy to feel satisfied of its usefulness, but always necessary to bear it in mind as being the opinion of an admitted authority, and the outcome of large experience. Rules for administration intensity—direction and duration of current flow—the necessity for a *gradual* making and breaking of circuit (unless when the special effects of sudden rupture or reversal are desired), all these things are as in ordinary electrical applications, and need not be entered upon before a society like this. It will be noticed that the douche apparatus is *single*, not double. The latter has recently been recommended, and the details of application, as given in recent essay,* are as follows:—There are two douches, or jets, one attached to each pole of the battery. Whilst one is directed upon the body of the patient, the other is directed downwards on the cemented floor of the cabinet until a sheet of water is formed, surrounding the patient's feet, thus constituting the second or indifferent electrode. This surely seems a very unnecessary application of douche to the floor, and it is difficult to see why the second electrode be not in metallic communication with the source of supply. There are, of course, circumstances when two jets might be useful to secure a strict localisation; but anyone who has tried to manipulate two jets held at a definite distance apart, and both at equal distances from the body, and at the same time to watch the galvanometer, will not be slow to express a preference for a purely polar application and an "indifferent" electrode. Those who are familiar with what has been already written on this subject will not materially add to their knowledge by a perusal of this essay, unless, indeed, it be by the following electrical discovery. Its writer finds to his surprise that not only water, but the *moisture* of *air*, will conduct his currents; and the reason why he thinks so is this: He finds that the wire connecting one pole of the induction apparatus to douche No. 1 having been detached from the latter, rolled up, and hung about 3 metres from the patient (its other extremity being still connected with the coil), and the second wire still attached to the second pole of the induction apparatus, as well as to the metallic part of the second douche, and the cabinet full of a thick cloud of watery vapour, behold a current was established. The patient said he felt it, and the fact, it is stated, was further verified by a galvanometer and constant current. "Evidently, therefore, the circuit was completed by the watery vapour surrounding the body of the patient."

Before publishing this conclusion it might have been well if the writer, leaving behind him his douches and cabinets and moisture-laden air—but taking with him a large coil and, say, two bichromate cells to drive it, had proceeded to a dry room, and there carried out the following experiment:—Attaching a conducting wire by one of its ends to the secondary of the coil, the other end of this wire being free, and the other pole of the coil being "idle;" let the coil be put into action. If now the free end of the wire be touched by the finger, a current is felt to pass each time contact is made. The patient, slightly insulated, might then take into his hand an ordinary electrode, attached by its rheophore to one (secondary) pole of the coil. If now the operator lightly touch the patient's forehead, a distinct electrical sensation is felt, or the patient being as in the last experiment, the "idle" pole of the coil might be connected with a gas or water pipe. Then if the arm be touched by a second person standing

* In Appendix.

* "Sur une nouvelle méthode d'application des courants electriques a l'aide de l'eau et de la vapeur d'eau—par le doct. P. Guyénot.

"to earth," a distinct effect, just short of muscular contraction, will be produced. These are not mere experiments modified in a variety of ways; they are most useful in practice. But the present point is this, that in all these cases there is a circuit completed, one pole is "idle," and where the moisture-laden air? A few experiments with this "idle pole" work might have suggested to him that when he hangs up his wire or his carbon plate attached to one pole of coil, he is perhaps in reality only making a good earth for his idle pole, *viâ* ceiling, wall, and floor, and that the earth rather than the watery vapour is the medium of conduction. But there is the control experiment to deal with. It is stated that when a galvanic battery was substituted for the coil, a galvanometer in circuit showed a deflection. (Nothing is stated as to the character of this deflection. Was it a steady and persistent rise, denoting leakage, or was it a "kick," denoting some possible capacity effect, or was it neither, or only an error of observation?) Be the explanation what it may, the following simple experiment will exclude the one (watery vapour conduction) offered in the essay referred to. Let the experimenter provide himself with a tea-kettle, boiling, and with a good jet of steam issuing from the spout. Then taking a metal tube, say 2 inches long by 2 inches diameter, connect it with one pole of a constant current circuit, having a pressure of 115 volts, placing in circuit a galvanometer and a resistance of, say, 600 ohms. Hang this tube at the end of the kettle spout, so that the steam issuing from the spout becomes condensed in the metal tube, and assumes the condition of a dense cloud of watery vapour. To the other pole of the source of supply attach by its rheophore an ordinary metal disc electrode, having a wooden handle. Now holding this handle, let the watery vapour driven through the tube play upon the metal disc held at, say, ¼ inch, or as near as possible to the tube.

The ordinary galvanometer will not betray the completion of a circuit by the very faintest "kick." How then can it be hoped to convey a therapeutic current by such means? Now all this is very elementary, and I owe an apology for bringing it before this society. But the case quoted is no solitary instance of that loose and inaccurate work which has again and again brought medical electricity into disrepute. Better than to theorise is simply to try.

Speaking broadly, the painless and evenly distributed current of the electric bath makes it one of the best methods of general electrisation, with, at the same time, a considerable power of concentration on special parts, according to the indications of the case. In all states of general debility and impaired nutrition (Erb), in weakness or exhaustion of the spinal nervous system, "nervous dyspepsia," palpitation, hysteria (Erb), neurasthenia, "nervous break-down," and many of those diseases referable to some derangement of the nervous system without appreciable lesion, commonly called neuroses; it may be resorted to with excellent and unique results. Neuralgias, sciatica (whether perineuritic or purely neuralgic), paralyses both of central and peripheral origin, chorea, primary lateral sclerosis, muscular rheumatism, gout, rheumatoid arthritis, and occasionally chronic articular rheumatism, are all recorded to have been cured or alleviated by its use. It is claimed that it has been used with good effect in some irritative conditions of the spinal cord, in alcoholic or mercurial tremours, plumbism, and even paralysis agitans (Lehr, Erb), and peripheral neuritis, from whatever cause, though not, perhaps, in every stage.

Of the cases which the present writer has found himself able to treat by the constant current bath with a fair measure of success, perhaps the largest is that of rheumatoid arthritis. He comparatively seldom is fortunate enough to encounter this class of case in an early stage, when it can be dealt with as a trophoneurosis; but even when of old standing with articular mischief well established, locomotion may be improved and pain relieved more frequently at least by this, than by any other remedial measure with which the writer is acquainted, with the exception, perhaps, of baths with the current from alternating light circuits, having a pressure of 100 volts and about 8,000 alternations.

His experiences of this treatment in other diseases may be summarised thus:—Muscular rheumatism, frequent and rapid cures; not superior, however, to other electrical methods. Chronic articular rheumatism, results, on the whole, disappointing. Gout often improved after a course of baths in suitable cases, but being generally combined with other remedies, and always with dieting, the exact relationship of cause and effect becomes comparatively obscure. Sciatica good results, not superior to alternating current baths, but perhaps superior in the majority of cases to other electrical methods. Urethral synovitis only yields to these baths when the disease has continued for some time, and is probably waning in the ordinary course of events. Locomotor ataxy, occasional alleviation in symptoms, but not always easy to separate results from those periods of arrest which usually characterise the disease. Not all cases suitable. Chorea, ordinary cases sometimes get rapidly well under a course of these baths, as after Faradic baths, or any other form of treatment, or after no treatment at all. But that comparatively small class of cases occuring before 20, which not only do not cure themselves, but often resist even rest and arsenic, and known as "relapsing" chorea, have been treated with only temporary benefit, lasting, perhaps, for only a few hours after each immersion, seldom with a permanent success. In amenorrhaea, a current localised between the lateral and gluteal electrodes has, in several instances, been found quickly successful. Amongst the rarer cases, one of melancholia and one of hysterical paralysis have been improved. In the insomnia of neurasthenia, this form of bath has been found useful as a beginning of treatment. A case of "ataxic paraplegia" has been notably benefitted, and in Parkinson's disease the tremour temporarily alleviated. In the four last-mentioned cases, however, alternating currents were also used.

The following result of treatment by electric baths has been kindly sent me by Dr. Lewis Jones from recent records of the Electrical Department of St. Bartholomew's Hospital:—

A.—Galvanic Bath Anode to Foot.

Sciatica {
1. Louisa F., 41; 12 baths; 200 m.a.; sciatica; cured; general health improved much.
2. Louisa F., 41; 8 baths; cure.
3. Henry G., 64; relieved after 4 baths; returned five months later; 8 baths, but no relief.
4. Henry G., 64; cure after 4 weeks; 8 baths.
}
5. M.; gonorrheal rheumatism; 9 baths: no definite improvement.
6. F.; rheumatoid arthritis; 12 baths; slight improvement.

B.—Faradic Bath.

Sciatica {
7. H. B., male, 43; 7 baths; induction coil; cure.
8. Male, 47; 7 baths; induction coil; cure. A long previous treatment with anode to thigh (without baths) ineffectual.
9. F., 50; rapid cure; number of baths not given.
10. Thos. H., 25; galvanic baths first, then anode to thigh; then Faradic bath last; most useful; relieved.
}

C.—Alternating Mains.

Sciatica {
11. R. E., 60, male; 15 baths; sinusoidal; cure.
12. F., 30, female; 4 baths; sinusoidal; cure.
13. F., 30, female; same patient, with general rheumatic pains; two years previously had galvanic baths (12), and was cured.
14. W. H., 23, male; 5 baths; much relieved; left London; wrote a week later that improvement continued.
}
15. G. T., 25, female; severe neuralgia (cervico brachial); 10 baths; sinusoidal; cure; old standing case.
16. F.; rheumatoid arthritis; 20 baths; no improvement.
17. F.; rheumatoid arthritis; 20 baths; doubtful.

Those rarer uses of the constant current bath, consisting of the introduction of medicinal substances, or the elimination of metallic impurities ("medication and de-medication") must be considered. The latter is demonstrable and certain. Apart from other evidence, a case has occurred within the writer's knowledge where an appreciable quantity of lead, which could have come from no other source than the tissues of the body, was found in the deposit on the copper plate. To carry out the process in a case of plumbism, a little sulphuric acid is added to the water of the bath, into which a large copper plate connected with the negative pole of the battery is introduced.* The patient then grasps the anode (outside the water) and the current is gradually turned on. The lead from the patient's tissues becomes deposited on the copper plate, according to the law well known to electroplaters. For metals other than lead, nitric acid takes the place of the sulphuric. The question of making use of the constant current bath as a means of introducing medicinal substances into the body deserves a close and patient investigation. Now that the process of cataphoresis has passed the experimental stage, this method is not without a promise of tangible results. Its practicability will depend upon the density of current necessary to secure with a given substance cataphoric transference through the skin. If in order to obtain a large surface for the anodal diffusion the bath be made monopolar and the water anode, the density of current per square centimetre of body surface must be exceedingly small. If the external electrode be anode, it is difficult to see any advantage of the bath over ordinary methods of cataphoric medication. Speaking in the absence of experiment, which alone can decide such questions, it would seem that the dipolar bath, in which large currents are practicable, will be found the only efficient form of bath for this purpose. For use with mineral waters—and equally, of course, for medicated water—Gartner has, it appears, introduced a division or diaphragm into baths. The present writer has not seen this arrangement, but presuming that the body passes through the diaphragm, and even without supposing the possibility of securing an actually electro-tight junction between the two, the arrangement seems practicable. (It may be suggested that (supposing an electro-tight junction), the same expedient might also, perhaps, be available to determine body resistances under conditions of immersion). The questions, then, for the experimentalist seem these: What is the current density required to pass a certain substance in a solution of a certain strength through the skin? Is such a density theoretically secured on the surface of the body by the current proposed to be used? Can the medicinal substance be found in the secretions or excretions of the body after having been subjected to the conditions named?

The treatment of skin disease by electrical methods is one of great and growing importance. The material in possession of the present writer does not enable him to deal with it in any satisfactory way, so far as the constant current bath is concerned.

Judging, however, by the few cases in which he has seen it used (urticaria and eczema), and by the effects of other forms of electrical treatment with which all are familiar, this form of bath would seem to deserve a careful and extended trial. No doubt there are those present who have valuable experience on this point. For purposes of the present paper, and his own information, the writer has consulted special works on cutaneous disease, but without adding materially to his information. Amongst these works, however, there lies before him a brochure on "The Bath in Diseases of the Skin," wherein (at p. 81) he finds a passage so interesting and instructive, that he ventures to extract it:—"It will naturally be expected that I should say something of the galvanic bath. . . . . I frequently employ them through the medium of a foot bath, one foot being placed

* Unless the bath itself be of copper.

on each handle, and the force being given by the 100-cell Becker-Muirhead used at the hospital, or a good-sized wheel magnet." After indicating this latter novel source of galvanic supply, the author proceeds:—"But to suppose that a galvanic bath possesses any power besides that inherent in galvanism. . . . . I certainly say that if such be the case it has entirely escaped my powers of observation." So say we all, and it would be pleasant to leave the question at a point where none can differ; but the following passage seems too instructive to omit.* In matters of charlatanism an amount of credulity is constantly met with, even among the educated classes of this country, which would be considered abject superstition in a Hottentot.

The opinion may seem a strong one, "but . . . . what are the proper words to use respecting the confidently expressed statements by patients that they know that the disease has been drawn out by the electricity, and that they have seen it deposited at the bottom of the bath in the shape of shreds." To those who know anything of the matter, an interesting question here suggests itself. Was this a case of metallic poisoning? Is it possible that a patient in describing the disease as "drawn out by the electricity" might have been making a practically accurate statement of what sometimes is known to occur? Is it within the bounds of possibility that this was an instance of the elimination of metallic impurities from the body by the agency of the constant current bath, a case of "demedication?" Perhaps, after all, a patient without the learned author's medical (and electrical) knowledge in speaking of such a deposit, had scarcely done anything so outrageous as to deserve to be called a Hottentot. We must, however, tear ourselves away from this fascinating and instructive volume; this paper has already grown to undue length, and its writer owes, and offers, an apology.

Brighton, *September*, 1894.

## APPENDIX.

(Not forming part of the foregoing paper, but explanatory of it, and inserted here to secure a certain measure of completeness without the necessity of repetition).†

Against the hydro-electric methods, more, perhaps, than against any other form of electrical treatment, has been levelled the charge of empiricism; and, perhaps, not without reason. Never having been adequately investigated, their real power is but little known, and their real province but little understood. Could anything, for example, be looser and more haphazard than the way in which that commonest and best of hydro-electric methods, the electric bath, is commonly prescribed and administered? For carrying out treatment by these methods, the electrical equipment must be not less complete than that for other purposes.

The requirements will be:—

1. A constant current supply in the shape of a battery with a low resistance which will work up to a powerful current strength through the estimated R. If we take our supply from an electric light circuit, of course it will have to be safe-guarded by shunts and appropriate resistances in addition to a reliable "cut-out."
2. A means of opening and closing the circuit, and regulating strength by easy gradation, so as to avoid pain or shock, *i.e.* "a current collector," or rheostat, or, in dynamo circuits, an adjustable rheostat or a sliding shunt.
3. A milliampère meter, *i.e.*, a galvanometer graduated in milliampères, and registering up to, say, 500 m.a.
4. A powerful induction coil for Faradic bath, or supply from an alternating dynamo.
5. Some means of suddenly reversing the current ("current reverser" or "pole changer") as well as an arrangement for throwing the two currents together for combined use ("current combiner," or "De Watteville key.")
6. As an adjunct, but not an actual necessity, may be mentioned a voltmeter, useful for occasionally determining the electromotive force of the battery, or any particular cell, and for other purposes. Some galvanometers are also voltmeters.

The ordinary electric bath is best made of oak or porcelain, perhaps porcelain for choice, if expense need not be considered. Insulation must be carefully attended to, both of conducting wires and waste-pipe, the latter being insulated from earth by a short length of rubber tubing let in near the bath.

The bath is an ovoid oak tub, 4 feet 10 inches long, and 2 feet 6 inches at greatest width, which is about 2 inches nearer head than foot. Height at head 1 foot 11 inches, height at foot 1 foot 5 inches. There are five fixed electrodes of bright metal, covered only by light removable open wooden framework, size as follows:—

"Cervical," 28 × 29 cm.
"Lumbar," 24 × 17 cm.
"Lateral" (2), 26·5 × 18 cm.
"Gluteal" (circular), 30 cm. (diameter).
"Terminal" (foot), 22 × 38 cm.

In addition to these there is an electrode for monopolar purposes, consisting of a removable metal rod, 1 inch in diameter, covered with wash-leather. This is fixed across the widest part of the bath, and can be conveniently grasped by the hands. These electrodes are connected, by carefully insulated wires, with seven terminals, and these in turn lead to a switchboard, so arranged that by the insertion of plugs, any electrode can be brought into action, either as anode or cathode. The connection with the battery, coil, or other source of supply is by means of well insulated connections leading to two ordinary "binding posts" on the plug switchboard.

It is best in the interests of cleanliness, if for no other reason, that the electrodes be of bare bright metal, as the cleansing and changing of covers is often very imperfectly attended to, and is a matter of serious consequence sometimes, as several unfortunate instances show.

The size of the electrodes will depend upon the theoretical considerations already advanced, looked at in the light of experimental results which are detailed elsewhere. But, speaking generally, the sizes and positions of those electrodes already mentioned are suitable. The only further addition (and a very useful one) is the so-called "paddle" electrode. By means of a long insulated handle this electrode can be applied to the vicinity of any part of the body upon which it may be desirable to concentrate the current.

For the comfort of the patient it is sometimes considered advisable to use some support for the shoulders. Individual views and ingenuity will here be the guide. One way of effecting the purpose is to use straps, one under the back of the neck, the other supporting the body under the arms. Another method is to have an open framework, made of wood and webbing, somewhat like the invalid appliance known as a "bed-rest." Or in the case of a very infirm for spinal affections, the wooden back-rest may be modified by having it made solid, excepting a longitudinal opening through its whole length opposite the vertebral column, the upper electrode being of such size, shape, and distance from the part, as to allow the lines of current flow to concentrate themselves on this opening. My experience, however, is that with the bath shaped as described—the fixed metal electrodes in the positions named, and controlled by a switchboard—the current can be so handled as to concentrate it, or diffuse it, or send it longitudinally, or transversely, or obliquely through the water, as may be desired.

The question of density, which is so important a factor in "dosage," and which in ordinary electrical applications depends upon the size of the electrodes, becomes a very complicated one in the dipolar bath. Here it is evident that not only the size of the electrodes is to be considered, but also the amount of diffusion the current undergoes in passing through the water from the electrode of the body; and this will depend partly on the size of the electrode, partly on the distance, and partly on the conductivity of the water. In other words, we have not only to consider the size and position of the electrodes electrising the water, but we have to look upon the whole extent of water in contact with the body as a huge electrode carrying a widely diffused current with a density diminished in proportion to its diffusion.

The device of placing a partition or diaphragm across the bath through which the immersed body passes seems well worthy of a trial. It must in an important degree influence current diffusion, and if further experience and investigation prove its usefulness, it ought to become a constant feature of the "Standard" electric water bath.

The appendix relating to the douche is the reproduction of an article by Dr. Hedley in the *Journal of British and Foreign Health Resorts*, April, 1893.

* "The Bath in Diseases of the Skin," by J. L. Milton, senior surgeon to St. John's Hospital for Diseases of the Skin, Lecturer on Diseases of the Skin, member of the Harveian Society, corresponding member of the New York Dermatological Society, &c.

† "The Hydro-Electric Methods in Medicine." W. S. Hedley, M.D., July 1st, 1892.

## NEW PATENTS—1894.

18,542. "Improvements in facsimile telegraphs." H. W. C. Cox and R. J. Crowley. Dated October 1st.

18,559. "An improvement in electric conductors." A. W. Gamage. Dated October 1st.

18,661. "An improved frame or holder for detachable electric fuses." The Acme and Immisch Electric Works, Limited, and E. F. Moy. Dated October 2nd.

18,662. "An improvement in switches for electric circuits." The Acme and Immisch Electric Works, Limited, and E. F. Moy. Dated October 2nd.

18,673. "Improvements in electric mechanism for winding and synchronising clocks." H. F. Mouquin. Dated October 2nd. (*Complete.*)

18,696. "Improvements in instantaneous, quick-break double-pole switches." F. H. Starling. Dated October 3rd.

18,743. "An improvement in collectors for overhead electric conductors." A. H. Bagnold. Dated October 3rd.

18,753. "Improvements relating to the transmission of telegraphic signals and to apparatus therefor." J. M. McMahan. Dated October 3rd.

18,754. "Improvements relating to the transmission of telegraphic signals and to apparatus therefor." J. M. McMahan. Dated October 3rd.

18,755. "Improvements in and relating to apparatus for intermittently closing and interrupting electric circuits." J. M. McMahan. Dated October 3rd.

18,757. "An improved insulation for either high or low tension cables, and joints in same particularly." W. Parrott, A. Essinger, and T. Harden. Dated October 3rd.

18,767. "Improvements in automatic switches for transformers or other electrical appliances." D. Bates, T. Harden, and O. L. Peard. Dated October 3rd.

18,809. "Improvements in or connected with secondary or electric storage batteries." F. King. Dated October 4th.

18,814. "Improvements in electric batteries." B. A. Balasny. Dated October 4th.

18,825. "Improvements in rope or cable grips." J. Whitall. Dated October 4th. (*Complete.*)

18,854. "New or improved instrument for use in ascertaining the description of leads or conductors required to suit conditions of electrical systems." C. W. G. Little. Dated October 4th.

18,860. "Improvements in the automatic connection of conductors conveying alternating currents of electricity." G. K. Chambers. Dated October 5th.

18,910. "Improvements in and relating to vessels for electrolytical purposes." P. Jensen. (Communicated by H. Cappelen and D. Cappelen, Norway.) Dated October 5th. (*Complete.*)

18,925. "Improved means of attaching electric lamp holders to oil lamps." F. C. B. Robinson. Dated October 5th.

18,933. "Improvements in apparatus for making and breaking electric circuits." H. T. Harrison. Dated October 5th.

18,996. "Improvements in or relating to brush and commutator mechanism for dynamos." A. Ramsay. Dated October 6th.

18,999. "Improvements in electric fuses for mines and like purposes." W. P. Thompson. (Communicated by La Société M. Gaupillat and Co., France.) Dated October 6th.

19,008. "Improvements in signalling to and from railway trains and apparatus for that purpose." S. A. Varley and R. Burn. Dated October 6th.

## ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

13,133. "An improved automatic electro-magnetic switch." J. H. McLean. Dated July 5th. Consists of an electric switch actuated by a lever which latter is connected to an iron armature of an electro-magnet. 2 claims.

14,056. "Improvements in electrolytes for primary batteries." W. H. Longsdorf. Dated July 20th. Claims:—1. As a new article of manufacture, a depolariser in a dry and preferably powdered state for use in primary batteries, the same consisting of nitric acid, sulphuric acid, and bichromate of soda, in the proportions specified. 2. The improved method of manufacturing a depolariser in a dry state for use in primary batteries, substantially as described, the same consisting in adding the proper proportion of sulphuric acid to the proper proportion of nitric acid, heating the mixture to the temperature specified, dissolving in the heated mixture the proper proportion of dry bichromate of soda, allowing the compound to cool, and thereafter reducing the same to powder. 3. For use in primary batteries, an excitant in a dry and preferably powdered state, the same consisting of chloride of sodium and bisulphate of mercury combined, in the proportions specified.

15,907. "Improved insulator for telegraph and telephone wires." H. Koster. Dated August 23rd. Relates to an improved insulator whereby telegraph and telephone wires are fixed firmly thereto without the use of any binding wire as is necessary with the insulators at present employed, and, further, the insulators are more securely fixed to the arms that carry them. 4 claims.

16,575. "Improvements in the vaporiser and ignition tubes of oil engines." J. A. Drake. Dated September 4th. Relates firstly to the back cover of the combustion chamber of the cylinder being cast hollow, and also with a tube cast vertically through this said hollow and used as a chimney for an ordinary paraffin lamp, and having cast on the outside of the said tube or chimney and inside of the said hollow cover a spiral gutter into which the oil drops and runs into the said spiral gutter, and during its passage round the outside of the said tube or chimney becomes vaporised from the heat of the said paraffin or other lamp. Secondly: The ignition tube fixed to hang downwards may be placed inside of the aforesaid tube or chimney and heated by the said paraffin or other lamp, or the said ignition tube can be fixed to hang downwards separately on another part of the combustion chamber or cylinder. This said ignition tube is placed inside the said tube or chimney to receive the heat from the same lamp used for heating the said vaporiser, or the same ignition tube may be fitted to any part of the combustion chamber that will be found convenient, and secured to hang downwards so that it may enter the top of the chimney of a paraffin or other lamp and passing downwards to any distance suitable to the requirements of the lamp. 4 claims.

16,581. "Improved insulating material for electrical purposes, and method of producing same." A. Gentzsch. Dated September 7th. The fossil resins, particularly ozokerite, asphalt, and amber, are subjected, according to this invention, to a process of distillation, a boiler, or preferably a still being employed for that purpose. When it is observed that gases, vapour, or oil cease to escape, the heating is discontinued and the mass allowed to cool. 2 claims.

16,597. "Improved inspissated oil for electrical insulating purposes, and method of producing same." A. Gentzsch. Dated September 4th. The oil or fat is placed in a suitable boiler and heated to a temperature of about 200° centigrade. When that temperature is reached, water is allowed to drip from a suitable height into the boiling mass, which is meanwhile stirred or agitated from time to time. 2 claims.

17,197. "Improvements in dynamo-electric machinery." R. E. B. Crompton and S. L. Brunton. Dated September 13th. The object of the invention is to construct a stronger armature, and one in which each separate armature coil can be removed, replaced, or tightened up at pleasure. 4 claims.

17,310. "Improvements in contact apparatus for receiving currents from overhead conductors on electric railways." Siemens Brothers & Co., Ltd. (Communicated from abroad by Messrs. Siemens & Halske, of Berlin.) Dated September 14th. Consists in arranging two contact devices on the current receiver in such manner that they can each make contact with a conductor independently of the other one, even with the greatest possible variations in the relative positions of the conductors. 2 claims.

17,341. "Improvements in alternate current dynamos." G. Kapp. Dated September 15th. In a dynamo constructed according to the improvements, the armature is constructed with an annular core composed of thin wrought-iron plates insulated from each other, the inner surface of the core being smooth, or nearly smooth, and concentric with the field magnet system which revolves within it. The armature winding is embedded in suitable grooves formed near the inner surface of the annular core, which is not continuous, but divided circumferentially into as many truncated wedge-shaped sections as there are poles in the field, each of the sections being separate and distinct, and the radial divisions between them being made as small as practicable, so that the condition of a magnetically continuous core is approached as nearly as possible. 3 claims.

17,348. "Improvements in electrical transformer street surface boxes." H. W. Bowden and W. Boby. Dated September 15th. Relates to an improved form of street surface box for use in connection with electric lighting cables and transformers, and an improved method of connecting the cables to such box. 11 claims.

17,493. "Improvements relating to thermo-electric batteries, and to apparatus for use in the manufacture of the same." J. B. C. Dion. Dated September 16th. Claims: 1. A system of thermo-electric battery consisting of a series of elements composed of antimony, zinc, and a small quantity of tungsten, and arsenical cobalt, obtained by casting the metal in fusion into moulds arranged as specified, these elements being connected with each other by metallic strips and placed in superposed crowns or in spirals round a furnace, the temperature of which is kept constant in an automatic manner. 2. In the system of thermo-electric battery claimed above, the device enabling a constant temperature to be automatically maintained, constituted by a thermometer arranged in such a manner that the mercury arriving at a certain height closes a circuit, the current then passes through an electromagnet, the latter attracts the extremity of a lever which actuates an obturator regulating the arrival of air in the furnace. 3. The process of manufacture of the elements constituting the thermo-electric battery system claimed above.

17,645. "Improvements relating to the distribution and regulation of electric current." H. H. Grenfell and O. March. Dated September 19th. The inventors provide one resistance, part of which is in the circuit of one lamp, the remaining part being in circuit with another lamp. The main wire from the source of electricity is joined to the said resistance at a point intermediate of its ends by an adjustable contact, which can be moved along the resistance so that the relative proportions of the resistances of the two branches can be varied. 2 claims.

17,866. "An improved manufacture of electric accumulators." L. W. Schoffer, and G. E. W. Schoffer. Dated September 22nd. Claim:—The manufacture of electric accumulators in which the active covering material of the positive electrode consists of a mixture of metallic lead finely pulverised with an electrically indifferent substance in the form of powder, which is either (1) separated by the acid in proportion as the conversion of the lead into peroxide progresses and thus gives room for the increase of volume, such as zinc dust, starch, and the like, or (2) is, or becomes, sufficiently yielding to permit of the expansion of the particles of lead in their conversion into peroxide of lead and to receive the pressure produced, such as pumice stone, blast furnace slag, glass, cork, wood and the like, in the form of powder.

17,972. "Improvements in make-and-break contacts for electric bells, fire and burglar alarms, and other purposes." A. Mills. Dated September 25th. Consists mainly of four parts, namely, a rocker, a movable weight, a fixed support for the movable weight, and a stop or stops. 4 claims.

17,981. "A magneto-electrical igniting apparatus." J. Drach. Dated September 25th. Relates to magneto-electrical apparatus so arranged that by the rapid movement of a solenoid so as to bring its poles away from poles of a permanent magnet, or to poles opposite to those with which they were previously in contact, an electric current is induced in the coil of the solenoid, which, by means of a contact breaker in the circuit of the coil, produces a spark for effecting ignition of any inflammable or explosive material. 1 claim.

18,911. "Improvements in electrical contact apparatus worked by passage of railway trains." E. Tyer. Dated October 9th. Relates to apparatus such that the movement resulting from the deflection of a rail as a train passes over it causes an electrical contact to be made, for the purpose of signalling or controlling signals. 1 claim.

18,912. "Electrical apparatus for signalling on railways." E. Tyer. Dated October 9th. Claim:—In electrical apparatus for signalling on railways, the combination with the signalling handle and plunger of three screens, and a safety switch arranged and operating, substantially as and for the purposes set forth.

19,102. "Improvements in and applicable to suspension tracks for overhead cable or railway systems." W. J. Brewer. Dated October 11th. The cable tracks may be combined with a rigid or girder track for a portion of their length, or may be so combined at their stations or termini, or the end stations instead of being termini can be curved to form a continuous track at the same time that improved grip or carrier means are employed. In combination with such improved tracks or railway systems, the inventor employs turntables at certain points where tracks are required to converge or diverge, or that the vehicles are to be shunted into sidings or branches. 6 claims.