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DAY LOADS FOR CENTRAL STATIONS AND HOW TO INCREASE THEM.*

BY J. A. KAMMERER.

At no period since the inception of the electric lighting industry have central station managers and operators taken such a deep interest in all the details of their plants. As an evidence of this, there is no more encouraging sign than the constant desire by operators for the most complete information concerning, and a fuller understanding of, the apparatus they are using. This interest is not exhausted by enquiring and becoming familiar with the different points in the apparatus they are using, but is extended to the underlying principles of the relation between the cost of producing electric current, and the compensation received therefrom. Study of this relation is being logically and systematically undertaken, and is more and more made a basis upon which the earning capacity of the plant is calculated. The result of this movement is making itself felt in no small measure by those pioneers in electric lighting work who are now profiting by their experience and reaping the first benefits of the departure from old lines of conducting electric lighting business. The ruinous effects of many of these old business methods are now largely recognized by central station managers, and their energies are being directed to retrieve what has been lost in the past in this respect. They are re-arranging their plants, or are completely reconstructing the same, with more efficient apparatus. One of the first questions asked by a pioneer central station manager, when he desires to purchase a new piece of apparatus is, "What is its efficiency?" not "What is the price?" He knows that the true value of everything in connection with central station work, in fact, with the entire plant, is "efficiency" or cost of operation, and "quality" or cost of repairs. His whole work must be to make the plant more efficient, and less expensive to operate and repair, and hence more remunerative in order to pay a dividend on the invested capital. This is being brought about in part by the reconstruction and rearrangement of the central stations, and is the first and essential step, but the effort does not stop at this work.

Other means of procuring remunerative return for energy expended and capital invested must be and is being sought. Increase of rates cannot be looked for, therefore additional income at present, or at even less rates, must be obtained. Such additional revenue must be obtained from increased and prolonged use of current, to obtain which, means of having current used for other purposes than illumination must be found, and consequently use in the day-time or a "day load," as it is called, must be secured. It is claimed, and it must be admitted with some truth, that because the particular business of electric lighting companies is night work, they should not look for a day load, any more than a woolen mill or any other kindred industry should look for a night load. This at first blush looks reasonable, but were the margins on the woolen mills or other commodities as small as they are in most of our cities and towns on electric lighting, the woolen mill would either have to close up, or make its plant investment work day and night to make ends meet. Then here is where the dividing line can be clearly drawn. The one industry or industries can exist because the margin of profit on their product is sufficiently large to pay a reasonable return on the capital invested by operating their plant at its maximum output only 10 or 12 hours out of 24. On the other hand a central station operating a lighting load only is handicapped because it cannot procure a maximum load for even 2 hours out of the 24. Its maximum investment is therefore only exerting its full earning power for less than 2 hours instead of 10 or 12 hours daily.

The aim then must be to place electric lighting central station business on the same footing as any other industry, by making the plant investment work a greater number of earning hours in each twenty-four. To accomplish this there must be, in addition to its regular work, a day load for the lighting plant. The operation of a day service for electric lighting prevails only in a few of our larger cities. This is usually had, however, by a separate service, necessitating the investment in and operation of two systems, one for lighting and one for power—which is too expensive for small central stations, and still leaves the question of the maximum in-

*A paper read before the Canadian Electrical Association.

vestment and maximum earning hours unsolved, as the lighting system will still have only a very small day load, as against whatever a separate power service might earn. The difficulty must therefore be met by making as small an investment as possible in what will take care of a combined light and power load. The multi-phase alternating current system, by which motor power can be provided as well as arc and incandescent lights, meets the situation in this respect. With existing single phase alternating current lighting plants, the change can be made without any considerable expense other than in the generator, as everything is already in place for the lighting, and the only expense for motor service is a small increase from time to time on capital account, as demand is made for power.

No capital invested need be idle waiting for business to turn up, as there can always be a return in sight on any investment before the extension is made. This holds good to a greater degree where a new plant is being installed, as the outlay is proportionately less, owing to the fact that arc and incandescent lights as well as power may be served from the same circuits and generator. In this manner the central station is in a position to cater for a day load. The cost of supplying a day load, in comparison with a night load only, is very much less, as the fuel necessary to start up the cooled boiler, and that for maintaining banked fires during the day, would be saved. The depreciation on apparatus would be slightly greater, but the interest on everything and the depreciation on lines, poles, etc., is the same as if it were only an all-night run, thus making the additional expenses for the day run much less than the night run alone. The central station operator is then in a position to give lighting service all day long, and add to his lighting business those consumers who have been heretofore objecting to using incandescent light, because of the necessity of maintaining coal oil or gas lamp lighting in dark places in stores, cellars, etc., during the day. Where there is an electric light day service such consumers cannot offer the excuse now made that risk from fire is as great with a few gas jets or coal oil lamps, as though they were to light throughout with an open flame light, and that the matter of the small additional cost of incandescent light is not their reason for not using it. As the central station can remuneratively furnish incandescent light throughout the 24 hours, this objection is removed, and a large amount of profitable business, which before could not be handled, can now be secured. In dry goods stores where delicate fabrics are being handled, and where an open flame light creates risk from fire, the objection that different delicate colors cannot be distinguished by artificial light is removed, as an arc lamp can be placed in these stores operating from the alternating current system, which gives a near approach to solar light, and makes it an object for the storekeeper to instal this light, as by it delicate colors are easily distinguishable.

By an all-day service there would be removed another hindrance to extended use of incandescent light. The objection is frequently and fairly offered that if incandescent light is only available during the hours of atmospheric darkness, or from dusk to daylight, it is necessary to have in reserve and ready for use at all times another source of artificial light in case of very dark days; and the conclusion is reached and acted upon, that as it is necessary to have a number of these lamps on hand, which must be kept ready for use at any moment, electric light being available during only a portion of the 24 hours, there is no reason why it should be used at all, although if available at all times it would be used because much preferred for so very many reasons. While the additional revenue secured from these lights may not be sufficient to pay the extra expense of running a day service, yet it must be borne in mind that it is not alone the day load the central station is getting, but also an additional night load consequent on customers being provided with light for the full 24 hours. This must be taken into consideration as making the night load more remunerative at a very small added cost.

These, briefly, are the points from a lighting standpoint that will commend themselves, and, no doubt, are familiar to most of the central station operators.

Aside from all this is the strictly speaking day load, which consists of the motor load, and which it is possible to secure with the multi-phase alternating current system. As a rule there is the butcher with his meat chopping machine, the baker with his dough-mixer, the newspaper with its printing press, the foundry with its line of shafting to drive, and the planing mill with its machinery to be kept going throughout the day, in every town, while other and larger industries will be attracted to a town in which a day power service may be obtained. These different industries all using power during the daytime, tend to create a steady load line, which is especially desirable, as it increases the number of hours in which the investment is exercising its earning power, and helping to increase and secure the maximum load line throughout the 24 hours.

WHY SOME LIGHTING PLANTS DO NOT PAY. *

BY F. C. ARMSTRONG.

Before proceeding to a discussion of the subject proper of this paper, it is necessary to fix a standard by which it may be determined whether a given plant is paying or not. A fair definition, taking everything into consideration, would seem to be that a plant which earns twelve per cent. per annum or over on the capital investment, which at present prices of apparatus and material would be required to provide an equipment of equivalent earning power, should be considered as a paying investment. In this definition we imply that 6 per cent. net per annum is a fair return for money invested in an enterprise of this nature; that 6 per cent. per annum is under present and prospective conditions a reasonable and sufficient allowance for depreciation; and that the capitalization upon which these charges are made should suffer the material and arbitrary reduction necessary to bring it down to the basis of present selling prices of electrical equipment. Regarding the first of these postulates a strongly affirmative view may be taken. Electric lighting has established a reason for being, beyond question, amongst modern industrial enterprises. Abundant artificial illumination for safety, need or convenience has become an indispensable requirement of our present multiplex civilization. The electric light supplies this necessity, it is safe to say, in spite of Welsbach burners or acetylene gas, more completely than any present, or as far as we can see, any possible competitor. The central station is a shining example of the sound economic principle of concentration of production and diffusion of output, which means commercially that under most circumstances it is cheaper

* A paper read before the Canadian Electrical Association.

to get your light from a central station than to instal an isolated plant. It may, therefore, fairly I think be conceded that, whatever may have been the vicissitudes of the past, the money invested in a central station to-day is entitled to take rank as a safe conservative and first-class investment from which a return of 6 per cent. per annum should be regarded with satisfaction.

The sufficiency of the allowance of 6 per cent. to cover depreciation is more open to discussion, and in it is really involved, as well, the soundness of the third assumption. In order to clear the way to a fair consideration of this matter it must be kept in mind that the depreciation of electrical apparatus in the past, and to a measurable degree in the future, is of two distinct kinds The first is in the depreciation proper, due to the wearing out of the machinery and appliances in service ; the second, and in the early days of the electrical art vastly the most important, is the arbitrary depreciation which is due not to the wearing out of the plant, but to its becoming obsolete by reason of the introduction of newer and more efficient and satisfactory types There can be no question but that the unparalleled rapidity of development of electrical science and the electrical industry which has crowded the progress of a century within one decade and a half, has borne heavily upon the earlier investors whose faith and courage made this marvellous progress possible. The apparatus produced in the tentative stages of electrical evolution was naturally crude and often unsuitable for the purpose for which it was sold, since the principles governing its operation were only dimly understood or guessed at, and that often incorrectly. Considered in the light of present standards, the units in use were, in view of subsequent requirements, absurdly small ; the commercial efficiency of generators, distribution lines and transformers when used was very low ; regulation, with all which it entails in plant efficiency, was practically non-existent. The steam plant on the market too was in a much less advanced stage of development than at present, and the relative suitability of varying types had as yet to be determined. Contrasting with this the present condition of the art, we find that in the best types but little room is left for improvement along present lines The efficiency of the best dynamos to-day is exceedingly high, 90 per cent. or better at full load being an ordinary guarantee for even the smaller sizes Regulation in the best machines, both for incandescent and arc lighting, is practically perfect. As an example of the stability to which the highest grades of apparatus have attained by a gradual course of evolution, we may instance a widely-known machine —the ironclad armature type of alternator, as constructed by a number of the principal manufacturing companies. Experience has established its perfect adaptation to the purpose for which it is primarily intended--the supply of alternating currents for incandescent lighting. Its design renders possible the highest attainable efficiency at all loads ; the regulation by the simple device of compounding provides compensation not only for armature reaction, but also for line and transformer drop, ensuring an even potential at the lamps, and permitting the use of lamps of ten, twenty, or thirty per cent higher efficiency than was possible with hand regulation. The ironclad construction of the armature secures perfect mechanical protection of the conductors buried in the slots, and these are made easily removable for repairs in case of damage. The high self-induction caused by burying the coils beneath the iron of the armature affords the best possible protection against burn-outs by lighting or short circuit. The single-phase system for which these machines are designed is admittedly the simplest and most economical for lighting distribution. Altogether, therefore, it is evident that this machine, which is selected simply as a familiar type, has proved itself in experience to be admirably adapted for the work which it is called on to perform.

Setting aside all unessential peculiarities in design, by which one or another machine or appliance may be recommended, as against that of a competing manufacturer, there can be no question that for both incandescent and arc lighting the best types to-day are practically perfected for the work which they are called on to do, and have therefore reached a reasonably permanent and stable form. This being the case, the arbitrary depreciation charges to which an investment in electric lighting plant was formerly subjected are no longer to be feared, and that the depreciation due to the natural wearing out of the machinery in service is covered by the allowance made for that purpose, no one will probably be inclined to dispute. In the matter of current prices, whilst improved methods of manufacturing and the keenness of competition may be expected to cause from time to time some further reductions, the bottom may fairly be said to have been touched in most lines of standard supplies and machinery.

Involved in the foregoing, at least by inference, is of course the conclusion that the wasted capital represented in the balance sheets of most companies by obsolete and discarded plant bought at the high prices of the early days should be wiped out ; if not by the summary process of reduction in capital stock, at any rate in so far as it affects a reasonable and just decision as to the profitable nature of the field offered by electric lighting under the conditions which obtain to-day.

Having thus defined the standard by which we may judge whether a lighting plant pays, we may now indicate briefly some of the causes of failure to realize the modest basis of earning power which we have set forth, and which is the very lowest which can be regarded as satisfactory. The matter is too large for proper treatment within the limits of a convention paper, even with its scope restricted by leaving entirely out of consideration the central stations of the larger cities. I shall therefore only attempt to suggest by touching very generally on some of the more evident cases and causes of failure, a set of conditions the real root and remedy for which will be apparent to the experience of the members of this Association.

The subject naturally divides itself into two sections, the one, failure by reason of mistakes in management and business methods ; the other, failure through mistakes in engineering and the actual operation of the plant itself. In the first, a sufficient cause for the non-success of the enterprise is often found in the personnel of the management. In this respect central stations are of five classes : the first, those which are in charge of a manager or superintendent who may be specially trained for the work, and who devotes his attention exclusively to it; in the second place, those whose management is in the hands of a man who divides his time between it and his other business interests ; the next is

the large class of small stations which manage themselves, with occasional interference on the part of the owner; in the fourth place, and I say it with due deference, we have the lighting stations which are run as appendages to a gas plant, by a gas manager, and which, treated with the care and indulgence which falls to the lot of a necessary evil, make precisely the return on the investment which might be expected. There are notable and happy exceptions, but I regret to say that the rule with this class of stations is as I have stated. Finally, we have that Ishmael amongst lighting stations, which its enemies say always, and its exponents say never, comes under the caption of this paper. I mean the municipal plant. In it we have quite often an ingenious combination of all possible methods of mismanagement. Speaking generally on this point, it will, I think, be admitted that there is to-day no industry representing an equivalent money investment, and possibility of public service, which is so generally managed by men who know little or nothing about it. But the special knowledge and training which comes with experience is in a new business not readily obtainable. The ideal manager will come with time; some of him is here to-day.

The electric light is a manufactured commodity offered for sale to the public; for it there exists in each community, a certain possible maximum sale; and with it to a greater degree than with most other manufactured products, the cost of production per unit is reduced as the output is increased. The question of rates is therefore an all-important one in deciding the earning power of an electric lighting plant. I will venture the assertion that in most flagrant cases of plants which positively refuse to show any margin on the right side between gross revenue and operating expense, the remedy lies in cutting down the rates to the point which will force a large increase in the business. A plant which supplies 200 lights at $10 each per annum has a revenue of $2,000 per annum, and may not pay; the same plant, if increased to 1,000 lights at $5 per annum, would probably be paying handsomely. It is evident also, that, like the telephone, central station electric lighting is a natural, and when conducted upon proper lines, a beneficial monopoly. The supply of current for lighting and power within a certain area can unquestionably be carried on more economically from one than from two or more competing stations. The benefits of such economical production may be shared alike by producer and consumer. When such is the case the security for the investment rests on the soundest possible basis, the rates being brought low enough to realize the fullest development of the business within the prescribed limits, the satisfaction of the public being ensured, and plainly no opening for profitable competition being left in dividing up a business which, even when extended to the utmost limits, and therefore carried on under the most favourable conditions, affords only a reasonable profit on the money invested.

In connection with rates and the field for business, the arc light contract properly comes up for consideration. Its value now-a-days to the average station is very doubtful. The development of the incandescent lighting, and more lately the power business, has established a reasonably secure and permanent market for the output of the central station, and to this fact more than any other are due the improved conditions now noticeable in the industry. It is unfortunately true that a large proportion of the existing investment is in many cases represented by dynamos, lamps, poles, lines, etc., which are valueless except for the purposes of the street lighting contract, but even under these circumstances it would in most cases pay the lighting company far better to devote their energy and plant capacity to a development of their proper and permanent business, adding whatever new capital may be necessary to properly equip them for the purpose, rather than continue their profitless and uncertain tenure of the municipal contract.

Also in connection with rates comes up naturally the question of a meter or contract basis. We are leaving out of view now, of course, the case of the large city plants. While on the face of it, it would seem reasonable that the current for electric lighting should be measured for sale like any other manufactured product, and not sold by bulk and by guess, there is at bottom a sound reason for the instinctive tendency to continue on the contract basis noticeable in many plants. The reason is, though, not always clearly understood that a mere measurement of the number of units taken to supply a customer for a given time is not a fair measure of the cost, and therefore of the selling price of the units supplied to him. This rests on the fact that all units do not cost alike. Those produced at 6 p.m. for example, the period of maximum load, cost far more than those supplied at 11, in the main and governing item of charge per unit from capital investment. Accordingly the meter measurement of quantity is not a measurement of value or cost, but only an approximation to them upon an erroneous basis. To meet this discrepancy it has been proposed to install two or more meters to measure current taken at heavy and light load periods of the plant, a larger discount being given for the latter. The basis of contract rates which is general throughout Ontario really represents this condition fairly well, the shop and business rates being relatively high, and the residence rates low considering the number of units actually supplied in each case. At the same time it must be recognized that in all cases with the larger, and quite frequently with the smaller plants, especially those supplying a day service, the meter method becomes imperative as being the only method whereby a check can be kept on the consumer for actual lighting supplied. In all cases where meters are used a meter rental should be charged, and a minimum monthly charge for each lamp installed provided for in the contract. Otherwise we frequently find a large part of the lamps connected to a central station, to provide for which a continuous charge on account of capital is going on, returning nothing whatever in the way of earnings for months at a time, and then coming in for the most favored customer treatment of the largest consumer.

Another point in connection with the relationship of the central station and the customer is the basis upon which wiring of consumers' premises is done. The vicious principle of free wiring has been practically frowned out of existence, but one equally mischievous has in some instances taken its place—that the wiring department should be conducted at a handsome profit. The correct principle is, of course, to give the customer for your current the fullest benefit of the present low prices for all interior wiring supplies in order that more and more lamps may be installed and the profits obtained in a legitimate and permanent form.

There are a number of additional matters which might be touched upon in considering this side of our subject, such as the effect of the competition of coal oil, gas and Welsbach burners; the recent Governmental regulations and certain desirable extensions of the same, and so on. Not the least important of these, in view of the certain benefits to be derived, is the building up of this Association into a strong and compact organization, able on the one hand to protect the industry in which its members are engaged from the attacks of conflicting interests or of ignorant and harmful legislation, and on the other hand by a frank interchange of experience and opinion to assist in hastening the day when Progress and Profit shall be the happy watchword in all cases describing the conditions of central station operation.

It was intended, had space permitted, to discuss the subject of this paper from the other standpoint which has been mentioned—that of engineering and operation, taking up first the question of selection of apparatus which would give the ideal plant for each set of conditions, and considering in how far deviations from such an ideal installation were responsible for failure to get best results in a given case. Such a consideration of the matter, however inadequate in itself, could not fail to bring out points in discussion which, checked by the actual experience of the managers of central stations present, would become of the utmost value.

For THE CANADIAN ENGINEER.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C. E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

CHAPTER II.

TRAIN RESISTANCES AND THEIR COST.

ART. 6.—TRAIN RESISTANCES.

It is necessary in a study of routes, especially in instituting comparisons of the advantages of alternative ones, to understand the nature, amount, and cost of the resistances which are offered to the hauling of trains, inasmuch as they have a direct effect on the working expenses of a railway.

These resistances may be any or all of the following, depending on circumstances; but the first four always exist in operating over even a level straight track.

A.—(1) Journal friction in the car trucks.
(2) Rolling friction, on the rails, of the car and engine wheels.
(3) Incidental—stopping and starting resistances.
(4) Velocity (wind and oscillating resistances.)

B. Grade resistances.

C. Curve resistances.

(*A*) *Level Tangent Resistances.*—In the earlier years of railways, due to imperfect track, workmanship, etc., the journal and rolling friction was found by Clark to be about seven pounds per ton (2,000 lbs.); since then, however, the researches of Wellington and others have shown that on a good track, at ordinary speeds of over 10 miles per hour, these resistances are:—

Loaded Cars—4 lbs. per ton in summer.
" —6 " " winter.
Empty Cars—6 " " summer.
" —8 " " winter.

A change of 60° F. in temperature, showing an increase of 50 per cent. due to poor track, ice, snow, etc., and to an inherent increase in the co-efficient. Morin's law, that friction is independent of pressure or velocity, was deduced from data of a limited range, and does not hold true for extreme cases, the empty cars showing a decidedly higher co-efficient; but when we consider the co-efficient in its relation to velocity the matter becomes more important. At the point of starting a train, the co-efficient is found to be as high as 18 to 20 pounds per ton, for loaded cars, and even higher for empties, being composed of friction + stiction; the latter disappears the instant that motion begins, and the co-efficient falls suddenly, to perhaps 10 or 12 pounds per ton, at one or two miles per hour, and goes on steadily decreasing as the speed increases; but above 10 miles per hour the change is not very appreciable. Should a train get "stalled" on a grade, or be at rest at a depot, it is plain that the *maximum* load cannot be hauled on the *maximum* grade; this matter will be taken up further on.

It will thus be seen that under ordinary cases the force necessary to propel one ton along a level, straight track at ordinary speeds, and disregarding velocity resistances, varies from 4 to 8 lbs., depending on the time of year, condition of load, track and rolling stock; in future calculations in these papers it will be taken at 6 lbs. per ton for loaded train.

The resistance offered to movement through space by the air has been extensively experimented on. The weight of evidence until recently was in favor of the belief that the resistance varied as (velocity)^2. Based on this belief, the formula deduced for total level, tangent resistance on railways, by Clark, was:—

$$\text{Lbs. per ton hauled} = R = 7 + .0052\ V^2 \quad (1)$$

(V being in miles per hour), in which the latter term represents the effect of the wind. Wellington also, as a result of the Burlington tests, made at moderate speeds, gave the following empyrical formulæ:—

Lbs. per ton (*a*) for loaded flat cars $= R = 4 + .0065\ V^2 + .57\frac{V^2}{W}$ (2)

" " (*b*) " box or psgr. cars $= R = 4 + .0075\ V^2 + .64\frac{V^2}{W}$

" " (*c*) " empty flat cars $= R = 6 + .0083\ V^2 + .57\frac{V^2}{W}$

" " (*d*) " box or psgr. cars $= R = 6 + .0106\ V^2 + .64\frac{V^2}{W}$

Where the 2nd term represents the head and side air resistances, and the 3rd term the effect of oscillations, which being chiefly in the engine, decrease, per ton, as the train gets longer, V = miles per hour W = gross weight of train in tons.

TABLE V.

POUNDS PER TON FOR TOTAL LEVEL TANGENT RESISTANCE.

Speed in Miles per hour.	Clark (1) $7 + .0152\ V^2$	Wellington 2(b) $4 + .0075\ V^2 + .64\frac{V^2}{W}$ (W = 450 tons.)	Wellington (3) $2 + \frac{V}{4}$	Average
10	7.52	4.89	4.5	6
20	9.08	7.56	7.0	8
30	11.68	12.03	9.5	11
40	15.32	18.27	12.0	15
50	20.00	26.30	14.5	20
60	25.72	36.12	17.0	26
70	32.48	47.71	19.5	33
80	40.28	61.08	22.0	41
90	49.12	76.27	24.5	50
100	59.00	93.20	27.0	60

Recently, however, the very high speeds obtained on various trial runs, and even scheduled trains, have thrown doubt on the idea that at high speeds, at least, the resistances could vary as the (Velocity)^2. In 1892, Mr. Wellington, after a study of Dudley's experiments on the New York Central Railway at speeds of 51 miles per hour, Sinclair's experiments on the same road at speeds of 50 to 75

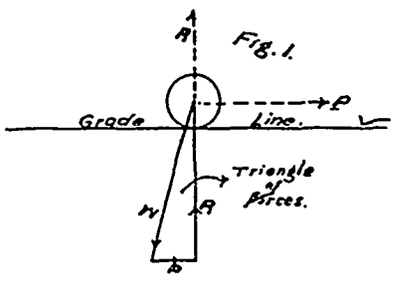
* This series of papers will be issued in book form as soon as they have appeared in THE CANADIAN ENGINEER.

miles per hour, Worsdell's experiments on the North Eastern Railway of England at speeds of 5 to 86 miles per hour, and Crosby's wind experiments, arrived at the formula: Lbs. per ton $= R = 2 + \frac{V}{4}$ .....(3) for speeds of over 40 miles per hour, but considered that at lower speeds the increased axle friction affected the results.

By which it will be seen that Clark's formula, fixed on years ago, is very close to the average, being slightly too high at low speeds. For the purposes of ordinary calculations the column of averages will be used. It is noticeable that at speeds of over 40 miles per hour, the wind resistance is a very large factor, while in freight hauling it is unimportant. And although passenger traffic is being carried on at higher speeds year by year, the addition of vestibules set out flush with the sides of the cars will very materially decrease that eddying around each car which forms a large part of the air resistance, while a pointed prow to the engine has been experimented on in France, and might be found advantageous at extreme speeds. The internal losses of a locomotive are, of course, not considered here, but the power as delivered to the rim of the driving wheels. The rolling friction of the engine wheels, being external to the engine, however, are included. The internal losses are about 10 per cent. (*i.e.*) 90 per cent. of the power developed may be applied to overcome the various train resistances.

(*B.*) Grade Resistances.

Grades are usually expressed as that per cent. which the rise or fall in a given distance is of that distance, or less frequently in feet rise or fall per mile of distance. Thus:—A grade of 1 in 100 = 1 per cent. grade = 52.8 feet per mile (in Figure 1); the forces which hold the



weight W, in equilibrium, are:—R, the reaction of the rails, and P the pull up the grade, the ratio of $\frac{P}{W}$ (or more precisely $\frac{P}{R}$ *) is seen to be the same as the rate of grade, or, up say a 1 per cent grade, the force necessary to propel a ton at a *uniform velocity*, $= \frac{1}{100} \times 2{,}000$ lbs. $= 20$ lbs., and other grades in direct proportion, in other words, grade resistance is a definite calculatable quality, and varies with the grade only.

Velocity Head on Grades.—If a train is not moving at a uniform velocity, the energy stored up in it is not constant; but varies with the speed of the train. This energy may be expressed in so many feet which the body would need to fall to acquire the velocity corresponding to a given amount of energy or velocity head $= h = \frac{v^2}{2g}$ where $v =$ velocity in feet per second, or, if we change to V miles per hour, we get $h = \frac{1}{2 \times 32} \times V^2 \times (1.5)^2 = .033V^2$ .....(4) In addition to this there is the energy stored up in the revolving wheels, which will, for ordinary cases, increase the total energy of the train in motion about 6 per cent., or change the formula to $h = .035V^2$ .....(5).

The values for h for various velocities are as follows:

TABLE VI.

V (miles per hr.)	5	10	15	20	25	30	35	40	45	50	60
h (feet)	0.8	3.5	7.8	14.0	21.9	31.5	42.9	56 0	70.9	87.5	126.0

In considering velocity head, as it affects grades, we may treat it (*a*) as it affects stopping and starting, (*b*) as it permits of fluctuating speeds and a conservation of energy.

(*a*) The amount of force necessary to expend in starting a train, over and above what is needed to keep it moving at a uniform velocity, under the same conditions, will depend on the distance through which it acts. If, for instance, it is desired to start a train from rest and acquire a velocity of 30 miles per hour in 1,500 feet, the virtual additional grade will be $\frac{31.5}{15.0} = 2.1$ per cent. grade, and the additional grade resistance will be $2.1 \times 20 = 42$ lbs. per ton *to be added* to any train resistances that would exist if the train were moving at a uniform velocity. In the same way in stopping a train the brakes absorb the stored up energy more or less rapidly depending on the length in which the stop is made (*e.g.*) a stop in 250 feet from a speed of 20 miles per hour $= \frac{14}{2.5} = 5.6$ per cent. grade to which the brake friction is equivalent $= 112$ lbs. per ton.

(*b*) Although it is usually considered that the grades of a road are certain definite inclines, this is only nominally so; actually, the "virtual" rate of grade against which the engine has to contend depends on what fluctuation of speed can be allowed between the foot and the top of the grade, and the length of the grade. The method of calculating "virtual" grades is as follows: Take an assumed speed, of say, 30 miles per hour at the foot of the grade, and a safe minimum speed to prevent stalling, of say 10 miles per hour at the head of the grade, then the difference of their velocity heads $= 31.5 - 3.5 = 28$ feet. Now this 28 feet, or whatever it may be (it may usually be limited to 25 or 30 feet), is to be deducted from the total actual grade to give the total virtual grade. It will be seen that while velocity head is a large item on short grades, it is insignificant on long ones. Thus great economy of construction can be effected often by the introduction of short, steep grades (*e.g.*) a 1 per cent. grade two miles long—actual lift $= 52.8 \times 2 = 105.6$ feet, virtual lift $= (105.6 - 28) = 77\,6$ feet (30 miles per hour speed reduced to 10 miles per hour at summit), and the virtual grade $= \frac{77.6}{105.0} = .73$ per cent.

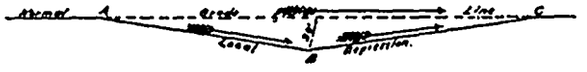
In this way on any railway profile above the actual grades should be plotted the virtual grades for different fluctuations of speed. A study of these will often enable changes in grade to be introduced, from economical motives, using short pieces of grade above the nominal maximum or dropping temporarily, in a short sag or depression, to save embankments. But the introduction of short steep grades should not be carried beyond about a 20 foot "sag" below normal; for supposing (see Fig. 2) that a train approaches A at a speed of 15 miles per hour, $= 7.8$ feet velocity head, and with uniform engine power still on, passes to B and then C, in the normal grade line, as the train passes A the tension on each draw bar will momentarily increase and the train will begin to accelerate its speed until B is reached, when the velocity will correspond to a velocity head of $7.8 \times 20 = 27.8$ feet, or will be about 28 miles per hour, from B to C; the speed will decrease and the train will arrive at C with a speed of 15 miles per hour; or, in other words, the limit of "sag" is the limit which we assign to safe freight speeds (see Chapter III. for vertical curves), and may be placed at about 20 feet, defining the point up to which local depressions, in a grade, are of no importance, and may be

* The error in taking $\frac{P}{W}$ instead of $\frac{P}{R}$ is infinitesimal, being only about $\frac{1}{100}$ lb. out of 100 lbs. on a 5 per cent. grade.

passed over with steam on, and no brakes set, or the same brakes if descending, of course, practically, no excessive dip of very high rates of grade could be used, except temporarily during construction, for sake of appearance, and because the proper use of vertical curves would eliminate them.

It is interesting to note that although the total power exerted in passing from *A* to *C* (Fig. 2) is the same as though the train had passed along the more direct grade line, the average rate of speed is increased, and the *time* of transit from *A* to *C* is *less* on the depressed grade

Fig. 2



than on the direct one. But note that a rise *above* the normal grade line is not permissible, as it would probably stall a slowly moving freight train.

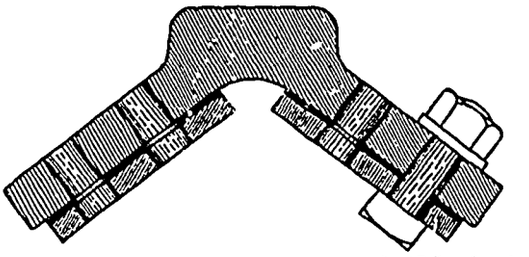
In connection with the fluctuation of speed, also, is the question of modification of grades at stopping places, where these grades are anywhere approaching the maximum, while level tangent resistance, at ordinary speeds o say 20 miles per hour, is about 8 lbs. per ton. It is as h gh as 18 to 20 lbs. per ton at zero + .. miles per hour (*i.e.*) at the instant of starting, so that any depot grade should be less than the maximum by, say, (20 − 8) = 12 lbs. per ton = $\frac{6}{10}$ grade. Also for the sake of getting up speed quickly, it should, if possible, be still further reduced, so that depot grounds are usually selected as nearly on leve ground as possible. These restrictions do not apply rigidly to light passenger or local freight trains, not loaded to the full capacity of the engine, but prevent heavily loaded freight trains from stopping at stations on grades approaching the maximum.

Another danger of yards on grades is that the wind may blow cars out on to the main line from the sidings Yards are sometimes, however, laid out with about a $\frac{6}{10}$ per cent. grade, where much sorting is done, and the cars are sorted by gravity on to different tracks.

(*To be continued.*)

THIRD RAIL TRANSMISSION.

The New York, New Haven and Hartford Railway directorate has made another advance in the application of electricity in the operation of its road, in the electrical equipment of its line running from Berlin to Hartford, Conn. This important departure differs in its electrical equipment from the line at Nantasket in that the trolley system of contact is not used. That adopted is the third rail system, the conductor or third rail being laid along the centre of the track between the running rails. The rail is rolled in 30-feet lengths, and weighs 93 lbs. to the yard. The section chosen is one which it is believed will be to a large extent self-protecting as against rain, snow and ice, as the tendency is to shed water to each side, leaving a fairly dry place immediately below the rail. This rail is mounted upon wooden block insulators impregnated with a preservative and insulating compound. These blocks are fastened to the ties by 2 inch × 2½ inch dowels, and three blocks to each 30 feet rails are ordinarily employed. The blocks are of such a length that the top of the third rail is held 1 in. above the top of the service rails, and the lowest points of the third rail are 1⅝ in. above the ties. It is necessary to have the shoe on the car carried high enough to clear the special work of the track, and the third rail low enough to avoid reaching any of the metal parts of the truck on the electric and other trains passing over the line. Careful inspection of all cars must be provided to prevent accidental short circuits due to contact of truck mechanism with the third rail.



Street Railway Journal

The third rails are mechanically and electrically connected together at their ends by heavy wrought iron fish-plates, 12 ins. × 4½ ins. × ⅜ in., between which and the rails are placed ⅛ in. sheet copper bond plates of the same area. These four plates, two of copper and two of iron, are firmly bolted to the rail by sixteen ⅞ in. bolts with lock nuts and the entire double bond has a current carrying capacity equivalent to 1,800,000 c.m., which is in excess of the capacity of the rail itself.

At switches and crossings the third rail is omitted, the circuit being continued underground by stranded bare copper cables of 500,000 circular mils and in some cases 850,000 circular mils. These cables are first drawn into creosoted wooden conduits filled with an insulating material. They are then laid in creosoted wooden troughs in turn filled with the same compound and then boxed over and buried. The broken ends of the third rail are fitted with wooden inclines or approach blocks to allow the shoe to rise upon the rail without danger of catching and breaking.

The shoe is a 12 inch by 5 inch cast-iron plate and is suspended from a wooden insulated support, fastened to the truck by links joined in such a way as to give the shoe considerable flexibility. The engineering advantages of the third rail construction are obvious. The rail can be easily and quickly laid, and so insulated from the ground that the leakage is little or nothing. This has been absolutely proven. The third rail provides a conducting capacity for the current equivalent to a very large copper cable, so that on many light traffic lines copper feeder capacity will not be required. There is little sparking between the shoe and the rail, and no appreciable wear from friction. Altogether, the advantages of the third rail construction are such that there is no doubt that, in one form or another, it will become the standard method of conveying heavy currents in railroad service.

The entire plant is very fully described in the June number of the *Street Railway Journal* by N. H. Heft, electrical engineer of the New York, New Haven & Hartford Railway.

For THE CANADIAN ENGINEER.

PAINTING METAL BRIDGES.

BY WILLIAM B. MACKENZIE, MEM. CAN. SOC. C.E., MEM. AM. SOC. C.E., ASSISTANT ENGINEER INTERCOLONIAL RAILWAY, MONCTON, CANADA.

In the early part of 1895 I began to investigate the subject of painting metal bridges. After reading what literature I could obtain, I determined to make a few experiments for myself, the results of which are here presented. I do not feel at liberty to give manufacturers' names in a communication of this kind, particularly as my tests are so few; but I have no objection to giving, in a less public

way, such facts as I have, to persons interested in the subject.

Twenty-four new wrought-iron plates, one foot square and three-eighths of an inch thick each, were painted two coats of different kinds of paint, under precisely similar conditions, the boiled linseed oil being the same in all, excepting those samples obtained ready-mixed from the manufacturers. These plates were provided with hooks on the back, and hung on the lower chord eye bars of a steel railroad bridge 1,900 feet long, across a strait or arm of the sea, in latitude 45° 56′ N., longitude 60° 59′ W. They stood vertically at a height of nine feet above the water surface and were exposed to the sun and salt air at all times, and also to salt spray in rough weather. They faced the prevailing wind from the north-east.

This strait, or arm of the sea, is situated about 35 miles from the Atlantic Ocean, lies north east and south-west, and forms a narrow passage five miles long and 1,900 feet wide, between two large inland basins. The strait is bounded by high land on both sides, the bridge crossing it in an east and west direction. The wind usually comes from the north-east, and a light breeze causes spray to be dashed against the floor. In storms, the spray is thrown over the floor and across the bridge. The rise of tide in the open sea, 35 miles distant, is five feet, but here the rise is only six inches.

Metal corrodes here very rapidly. The bridge itself was erected in 1890. One coat of iron oxide paint was applied in the shop and another coat given after erection. In 1892, it was considerably rusted, and two coats of iron oxide paint were put on the lower chords and floor system; but without proper inspection or scraping. In 1894, scales one-eighth of an inch thick were removed from the end stiffeners of the floor-beams on the north side. Pieces of this scale were trimmed to exact dimensions and the cubic contents calculated. On being weighed, the scale was found to weigh slightly more than one-half that of new steel.

A chemical analysis of iron-rust scale from the outside of the Conway Tubular Bridge, in England, is as follows:

Sesquioxide of iron	92.9	per cent.
Protoxide of iron	6.177	"
Carbonate of iron	0.617	"
Carbonate of lime	0.295	"
Silica	0.121	"
Ammonia	trace.	
	100.000	"

In August, 1895, our bridge was thoroughly scraped and painted with two coats of iron oxide paint, the analysis of which is as follows:

Color	Indian red.	
Fineness	80.00	
Body	85.00	
Strength	70.00	
Iron oxide	48.16	per cent.
Insoluble matter	51.84	"

Adulterated slightly with clay.

It is now in good condition; but will require constant attention to remedy defects in the painted surface as they appear.

It will be seen by the record of the experimental plates (see table) that the asphalt paints, the carbon paints, the coal-tar coatings, and some of the oxide of iron paints are already out of the race, and that neither the lead nor the graphite paints are holding out quite as well as might have been expected.

A chemical analysis of the water beneath the bridge was arrived at as follows:

The average density of ocean water is 1.026, and the composition is as follows:

Water	96.5	per cent.
Salts	3.5	"

The composition of the salts is as follows: —

Chloride of sodium	77.758
Chloride of magnesium	10.878
Sulphate of magnesium	4.737
Sulphate of lime	3.600
Sulphate of potash	2.465
Bromide of magnesium	0.217
Carbonate of lime	0.345
Total salts	100.000

The density of the water under the bridge was deter-

RECORD OF TWENTY-FOUR PAINTED PLATES.

EXPOSED ON A STEEL RAILROAD BRIDGE OVER AN ARM OF THE SEA, LAT. 45° 56′ N., LONG. 60° 59′ W.

Mark on Plate.	Kind of Paint.	How Mixed.	No. of Coats	When Painted.	When exposed on Bridge.	Length of time Exposed.	State when examined by W. B. McK. on Nov. 30th, 1896.
I	Oxide of iron	Boiled linseed oil	2	March, 1895	April 24, '95	1 year & 7 ms.	In good condition.
II	Red lead	Raw linseed oil	2	do	do	do	Discolored and slightly rusted.
III	Graphite paint	Boiled linseed oil (?)	2	do	do	do	Small patches of rust all over.
IV	Oxide of iron	Boiled linseed oil	2	do	do	do	Rusted all over.
V	Anti-corrosion paint	¼ raw oil, ¾ boiled linseed & turps	2	do	do	do	In good condition.
VI	Black anti-rust paint	Mixed by the manufacturer	2	do	do	do	Very much rusted.
VII	White lead	Half raw and half boiled linseed oil	2	do	do	do	Half the plate rusted and discolored.
VIII	Tar and asphalt coating applied hot		1	do	do	do	Considerably rusted.
IX	Red lead 1 lb. and lampblack 1 oz.	Raw linseed oil (no drier)	2	do	do	do	In fair condition.
X	Oxide of iron	Mixed by the manufacturer	2	do	do	do	Very much rusted.
XI	This painted plate was supplied by a painter for test. The composition of the paint is unknown to me				do	do	Considerably rusted.
XII	Black bridge paint	Mixed by the manufacturer	2		do	do	Very much rusted.
XIII	This painted plate was supplied by a painter for test. The composition of the paint is unknown to me				do	do	In good condition,
XIV	Asphalt paint	Mixed by the manufacturer	2		do	do	Rusted all over.
XV	Carbon paint	Mixed by the manufacturer	2		Oct. 31, 1895	1 year & 1 mth	Rusted in large patches.
XVI	Oxide of iron	Mixed by the manufacturer	2	July 17 1895	do	do	Fairly good condition; a few rust spots.
XVII	Oxide of iron	Mixed by the manufacturer	2	do	do	do	Covered with rust; paint all gone.
XVIII	Graphite paint	Mixed by the manufacturer	2	do	do	do	Fairly good.
XIX	Coal tar coating; plate heated and dipped in hot tar		1	do	do	do	Rust spots all over.
XX	Oxide of iron	Mixed by the manufacturer	2	do	do	do	Fairly good; a few rust spots.
XXI	2 lbs. 7ozs. yellow ochre and 1 oz lampblack	Raw linseed oil and Japan	2	do	do	do	Good; a few rust spots on back.
XXVIII	Paint for ironwork (secret process), said to be furnace slag, linseed oil and gum	Mixed by the manufacturer	2	March, 1896	April 4, 1896	8 months	Very good.
XXIX	Oxide of iron	Mixed by the manufacturer	2	April 1, 1896	April 9, 1896	do	Small rust spots scattered over.

REFERENCES:

III. The manufacturers say that the pigment is mixed in pure kettle-boiled linseed oil, and direct that in dry weather it be thinned with raw linseed oil, and in damp weather with boiled linseed oil.

XII. The manufacturers say that the pigment is mixed in linseed oil and turpentine and that it also contains asphaltum and Kauri gum.

XIV. The manufacturers say that this paint contains no coal tar, and direct that it be thinned with 62 per cent. benzine.

XVI. The manufacturers say that the mixture of this paint is a secret process and that it contains no oil. It sets too quickly and is difficult to apply for this reason.

XX. The manufacturers say that the pigment is mixed in pure clarified linseed oil.

mined roughly by weighing a certain volume and comparing it with the weight of a like volume of fresh water. This gave a density of 1.00813, which would make the composition as follows:—

Water	98.215 per cent.
Salts	1.785 "
	100.000 per cent.

The composition of the salts would be the same as that given above for ocean water.

The highest summer temperature of the air in 1895 was 82° F., and the lowest temperature in winter of 1895-6 was—2° F. The highest summer temperature of the air in 1896 was 72° F., and the lowest temperature in winter of 1896-7 was—7°. The summer temperature of the sea-water under the bridge is 60° F. to 63° F., and the winter temperature 30° F. to 35° F. Total precipitation in 1895 was probably about 70 inches. Total precipitation in 1896 was 69.86 inches. Snow lies on the ground, more or less, in depths from three inches to three feet, between the middle of December and the middle of April. The greatest velocity of the wind during north-east autumn and winter storms is about 60 miles per hour.

CORROSION.

Corrosion is most active in autumn and winter, because there is then more moisture deposited upon the metal, and the water contains a larger proportion of oxygen and carbonic acid.

At 32° F.	water will absorb	4.9%	of its own bulk	of oxygen.
At 50°F.	"	3.8%	" "	"
At 68°F.	"	3.1%	" "	"

Snow water contains more oxygen than rain or river water and will rust metal quicker. Cold water dissolves more carbon dioxide than warmer water. At 32° F. water will dissolve 1.8 volumes of carbon dioxide, and at 60° F. only one-half as much. Pure rain-water contains 2½ volumes of air in 100 volumes of water. If water is freed from oxygen by boiling, iron will not rust in it, nor will it rust in perfectly dry air. Rust consists of iron, oxygen and water and it requires a simultaneous action of oxygen and water to produce it. Damp oxygen and damp carbon dioxide in combination produce rust quickly. Neither will do so when dry either together or separately, and only to a very slight extent when damp, separately. It requires the combination of both, damp, to rust quickly.

Steel, when unprotected and exposed to the weather and sea-water, corrodes at the rate of $\frac{1}{82}$ of an inch per year	or 1 inch in 82 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{190}$ of an inch per year	or 1 inch in 190 years.
Steel, unprotected and exposed to the weather and fresh water, corrodes at the rate of $\frac{1}{170}$ of an inch per year	or 1 inch in 170 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{430}$ of an inch per year	or 1 inch in 430 years.
Steel, unprotected and submerged in sea-water, corrodes at the rate of $\frac{1}{130}$ of an inch per year,	or 1 inch in 130 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{310}$ of an inch per year	or 1 inch in 310 years.
Steel, unprotected and submerged in fresh water, corrodes at the rate of $\frac{1}{600}$ of an inch per year	or 1 inch in 600 years.
Wrought-iron, under same conditions, corrodes at the rate of $\frac{1}{700}$ of an inch per year	or 1 inch in 700 years.

Wrought-iron in an overhead bridge, subjected to coal-smoke from locomotives, corroded in 25 years from 39.5 per cent. or 1.8 per cent. per year to 100 per cent., or 4 per cent. per year, some of the members being entirely eaten away.

Unstrained members corrode more quickly than strained members. Shaded parts will corrode more slowly than parts exposed directly to the sun's rays.

Real iron-rust does not promote further rusting because of any chemical influence on the iron, but being a spongy mass, it retains in its pores 24 per cent. of water deposited as rain or dew. It does not, therefore, prevent, but rather encourages rusting, and in this way has a physically injurious effect upon iron. Corrosion accelerates with time, the second year's being 50 per cent. greater than the first.

LINSEED OIL.

In paint, oil is king; any finely ground pigment, inert toward the metal and oil, will last until the oil decays and wastes away, and against this decay and waste there is no remedy. The raw oil is obtained by both cold and hot pressure from linseed, or the seed of the flax plant, *Linum usitatissimum.* When cold-drawn, the color of the oil is golden-yellow, and when hot-pressed, brown-yellow. The specific gravity is:

At 50° F.	= 0.9385
" 53½° F.	= 0.9364
" 59° F.	= 0.[illegible]
" 68° F.	= 0.9325
" 77° F.	= 0.9300
" 266° F.	= Boiling-point.
" —16½° F.	the oil congeals to a solid yellow mass.

It is sold under different forms: Raw, refined, boiled and artist's oil. The seed should be ripe, and from two to six months old. The quality of the oil is affected by the quality of the seed, which is in turn ruled by the soil and climate in which it is grown. Boiled oil is heated to a temperature of from 266° to 600° F., and agitated mechanically for five or six hours. Water evaporates, and the scum and froth is removed from the surface with ladles; this scum is afterwards used in making putty. Equal quantities of litharge and red lead are added by slow degrees as dryers, to the extent of three per cent. of the oil, a small proportion of umber being also thrown in. The heat is continued for two or three hours, when the fire is suddenly withdrawn and the oil left covered over for ten hours longer. It is now known as "boiled oil," and is stored in settling-tanks for a few weeks, during which time the uncombined driers settle to the bottom as "foots." The heating process darkens the color and causes the oil to dry quickly, producing a hard firm surface. Pure, unadulterated linseed oil is not a common article. Driers are not infrequently added through the bunghole without boiling. Cotton-seed oil, Niger oil, hemp-seed oil, poppy-seed oil, colza oil, rape-seed oil, Lucca oil, resin oil, turpentine oil, benzine, fish oil, animal oil and water are often mixed with it, all or any of which shortens the life of the paint. There are about 17 vegetable drying oils which may be used in paint, and over 30 vegetable non-drying oils, which may be used as adulterants. The greater number of these oils are cheaper than linseed oil. In addition, there are the fish and animal oils, so that the rarity of pure linseed oil is not to be wondered at.

The purity of linseed oil may be roughly tested by shaking it well; if iridescent bubbles appear on the surface, it is adulterated with benzine or mineral oil; if sulphuric acid is present, the paint when shaken and then allowed to stand will thicken into a brown paste. Other rough tests are: Brush it upon brown paper, and expose to the sun's rays; the water, benzine, etc., will

evaporate and leave the oil. Dip a sheet of well-sized paper into the oil, and hang it up to dry; when dry the whole of the sheet should show a well-varnished coating; if only the bottom of the paper is varnished, the oil is insufficiently boiled. Brush the oil on a smooth wood surface; if it turns white, "blooms" in drying, it is adulterated with resin.

Oil, when spread out thinly, dries by absorbing oxygen from the air: the water and vapor passing out create multitudes of very minute holes in the oil cover, where water may enter; these holes are partly filled up by the second coat of paint. While the oil is absorbing oxygen, it adds 13 to 14 per cent. to its weight.

PIGMENTS.

After reading what the different manufacturers say about the price, covering capacity, and durability of their own particular paints, and the folly of using anything else, a person is inclined to believe fully in David's hasty assertion that "all men are liars."

The following comparative statement of the cost of painting a 100-foot span steel bridge, with a number of kinds of good paint, is taken from a statement published by C. E. Fowler, C.E., in the *Engineering News* of Feb. 6th, 1896. The cost of painting spans from 20 feet to 300 feet was accurately determined, and it will be seen that, after all, there is very little difference in the first cost between good qualities of the usual kinds of paint used for general railroad work; there being only $9.25 difference between oxide of iron and red lead for a span of 100 feet.

Cost of painting a 100-foot railway bridge (clean new iron) with different kinds of pigments and linseed oil:

Oxide of iron—14 gals. 1st coat, at 50c; 10 gals. 2nd coat, at 50c.
Labor, $68.00 = $80 00

Red lead—10 gals. 1st coat, at $1.25, 7 gals. 2nd coat, at $1.25.
Labor, $68.00 = $89 25

White Lead—14 gals. 1st coat, at 85c; 10 gals. 2nd coat, at 85c.
Labor, $68 00 = $88 40

Graphite—14 gals. 1st coat, at 70c.; 10 gals. 2nd coat, at 70c.
Labor, $68 00 = $84.80

Asphalt—23 gals. 1st coat, at 40c., 14 gals. 2nd coat, at 40c.
Labor, $68.00 = $82.80

Carbonizing coating—7 gals. 1st coat, $1.50; 5 gals. 2nd coat, $1 50.
Labor, $68.00 = $86.00

SCRAPING.

The labor of scraping the metal and applying the paint is from four to eight times the cost of the pigment and oil; so that there can be no economy in using cheap paint. To remove scale, loose rust, oil, dirt and cinders, use benzine, chisels and hammers, wire brushes and scrapers, as may be necessary. Unless the metal is perfectly clean and dry, no paint can be successful. Scraping should not proceed far ahead of the painting. Should salt spray touch the scraped metal, it should be scraped again before painting.

KIND OF PAINT AND ITS APPLICATION.

It is absolutely necessary that the first coat should contain a large quantity of pigment, and should dry quickly with a dense, firm surface, to receive the second coat in from 48 to 72 hours. If not dry and firm, the paint will blister, because of the separation of the first coat from the metal. To secure this, a pigment of high specific gravity must be used in boiled linseed oil, with a considerable quantity of turpentine, and we cannot do better than use a heavy, finely ground oxide of iron pigment, inert toward both metal and oil, and which has already been tested for durability, such as No. 1 of my experimental plates. Iron oxides often contain acids, lime, sulphur, clay, etc., so that there is much room for choice. Red-lead has been largely used for first-coat work, because it dries quickly, with a hard surface; but if the air, from local causes, contains obnoxious gases, such as sulphuretted hydrogen gas, produced by the passage of trains, the red-lead will be quickly destroyed. J. Newman, author of "Corrosion and Fouling," says by letter of 21st January, 1897: "Probably the *worst* paint you can use for either iron or steel is ordinary lead and oil paint." Oil alone should not be used for priming in the shop; it collects dirt and cinders; besides, the pure oil dries, but never hardens. As it contains no pigment, it is quite porous and pervious to water; the surface will consequently expand and present a shrivelled appearance and blisters will eventually appear.

For second-coat work, an elastic but firm surface is required to follow the expansion and contraction of the metal and resist the mechanical impact of strong dust or cinder-laden winds and rain, spray, hail and snow. In this coat more boiled oil, a less weighty pigment, and a less quantity of turpentine is required, so that it will dry more slowly and for a longer time resist the sun's influence, which is ever tending to harden and crack the surface and allow the entrance of water to the metal. A pigment, then, of low specific gravity must be used. Crude graphite ore powder has a specific gravity of about 0.7, and as graphite cannot be affected by chemical influences, it would seem to offer a suitable material for second-coat work. I have tested it for a period of one-and-a-half years, and so far it has done fairly well. Objections have been urged against it as follows:

1st. It is expensive to grind to a high degree of fineness, because of its oily and flaky character.

2nd. Because of its lightness, no great body of it can be got into the oil.

3rd. It settles out of the oil.

Some of these objections may be more imaginary than real.

A prominent manufacturer says that the composition of the best graphite now mined, ground and used for paint, is as follows:

ANALYSIS OF THE CRUDE ORE.

Moisture	0.15 per cent.
Graphite	33.48 "
Silica	37 54 "
Oxide of iron	14.25 "
Pyrites of iron	1.27 "
Oxide of alumina	12.35 "
Lime	0.54 "
Magnesia	0.48 "
	100.00

On referring to the statement of cost, it is seen that for a 100-foot span bridge, the cost of graphite is $4.80 greater than iron oxide.

There exists in Canada, in large quantities, a cheap natural product, the specific gravity of which, compared with No. 1 iron oxide powder, is as 0.31 to 1. This material, after an inexpensive treatment, can be mixed with the iron ore powder to reduce the weight and increase the bulk, and on adding oil, a paint will be produced affording an elastic silicious surface which will resist cracking, peeling and blistering for a much longer time than the iron oxide alone.

On a clean, dry surface, paint applied at a temperature of 70° F., will last longest. Painting should not be done in damp, wet or freezing weather, and on summer mornings time must be given for the dew to evaporate before work begins, as oil paint will not adhere to wet metal. Painting should never be done by contract, but by day work, under a competent foreman. In painting it is best to begin at the top and work down. Buy paint in

powder form when possible; next best in paste form. Light colors quickly become covered with a layer of dust, which absorbs as much heat as dark surfaces. The greater the number of pigments mixed together, the shorter the life of the paint.

LIFE OF METAL BRIDGES.

Heretofore, owing to increases in train loads, flimsy construction and neglect, the average life of iron bridges has not been over 25 years, and it is now generally believed among well-informed engineers that the average existence of such properly designed metal bridges as have lately been constructed throughout the country will not greatly exceed fifty years. Where corrosion is particularly active, as at the bridge of which I have spoken, the life of the structure must be much shorter, probably not over 35 years.

An English oxide of iron paint much used in this country contains 48 per cent. of iron oxide and 52 per cent. of insoluble material, and some American oxide of iron paints contain as little as 33 per cent. of iron oxide and 60 per cent. of silica. We have in Canada unlimited quantities of iron ore, which requires no preparation except grinding. Why should we then continue to import that with which nature has so liberally endowed us, and why should we continue to use unsuitable paints on locomotives, stationary engines, cars, roofs, bridges, freight and store-houses, when good iron oxide paints are cheaper and more lasting?

The company which will produce iron oxide paint from Canadian ore, as good as the best, push its sale, and show the people its advantages for works of this kind, will benefit both themselves and those to whom they sell. Hundreds of iron ore deposits exist in Canada, some affording 72.4 per cent. metallic iron, and several extensive graphite deposits, some of which produce 50 per cent. of pure black lead, while the natural product of low specific gravity for mixing with the iron ore powder can be supplied pure in any desired quantity.

For part of the information contained in the foregoing article, I am indebted to Prof. J. Spennrath's prize essay on "Protective Coverings for Iron," 1896; J. Newman's "Corrosion and Fouling," 1896, and to several articles in engineering periodicals by such high authorities as W. P. Wood, E. Gerber, W. G. Berg, A. H. Sabin, Samuel Wallis, J. H. Stanwood, and J. E. Greiner.

ACCUMULATORS—THEIR APPLICATION TO CENTRAL STATION LIHGTING AND POWER.*

BY W. A. JOHNSON.

To those who have given attention to the use of accumulators and have posted themselves sufficiently to have even a fair idea of their adaptability, it seems incomprehensible why the central station owners in Canada have so long delayed availing themselves of their advantages.

Considerable misconception seems to exist in reference to the cost of installing a storage battery. Like all good things having value accumulators are not given away, and the station manager who is waiting for them to get cheaper is letting one-third of the earning power of his station go to waste. Local conditions, of course, determine the capacity and consequent cost of battery, but in general terms the cost may be stated to be in most cases less than the cost of generating plant. When it is desirable to increase the capacity of a station, it means besides new dynamos, increase in engines, boilers and all steam appliances, and usually alterations in the building, and while the output of the station is increased the general efficiency remains about the same, and often times the running expenses of a moderate sized station is greater per h.p. output, owing to the increase in the working staff. On the contrary, to increase the capacity of a station with accumulators, requires, as a rule, no alteration or increase of existing steam plant, no new dynamos, and usually, owing to the small space required, plenty of room can be found in the station for the storage battery.

When such a change can be made, what are the results? The available output of plant has been largely increased; no increase in working staff is required; the operating expenses are no higher than before; the all round efficiency of the station is fully 30 per cent. more, and consequently the profits are enlarged by nearly the same proportion; the plant can thereafter give uninterrupted service 24 hours per day every day in the year, as the battery is always available when a temporary shut down of the machinery is necessary. The regulation of the voltage to the lamps is kept constant—more perfect than can be possible when no batteries are used, as the battery is a regulator to the whole system. When motors are operated this is a big advantage. No gas company would for a minute consider the operation of their plant without a storage tank; just think of the large increase in retorts and men to keep up a constant gas supply without a storage tank. Most waterworks systems require a reservoir, and yet electrical people, who are supposed to keep abreast of the times, try to get along without a storage tank to fall back upon for hours of maximum, minimum or average demand.

The central station manager will answer that he does not know the cost of maintenance, and is waiting for the other fellow to prove the case. The other fellow has proved it. In Germantown, Pa., there has been a battery having a capacity of 120 h.p. hours in use for over three years, or long enough to give a fair idea of the cost of renewals. The management of the large stations in Boston, Brooklyn, and New York, however, did not await the results in Germantown, but put in large batteries from one to two years ago, and these have since been doubled, and in one case recently enlarged for the fourth time. But interested parties can go back of the returns from the United States for further endorsation of the practicability of accumulators. In Germany, France and England they have been largely used for years past. Out of a recently published list of 30 cities in Germany, only ten are without accumulator plants. The populations of these cities range from 4,000 to 85,000. This shows that there is hardly a town or city electric plant but can use accumulators to advantage.

I mention the following among American companies who have put in large batteries, and the capacity installed as rated in h. p. hours:—

Company.	H. P. Hour Capacity
Hartford Electric Co.	3,000
Boston Edison Co., four batteries, a total of	7,400
New York Edison Co.	3,200
Brooklyn Edison Co.	1,600
Germantown Electric Light Co.	300
Electric Railway, Light & Power Co., Anaconda, Montana	500
Woonsocket Electric Machine & Power Co.	400
Eastern, Pa., Edison Co.	200

These last three plants are used both for railway and lighting work.

As good an illustration as I can give of the appli-

* A paper read before the Canadian Electrical Association.

cation of the storage battery to railroad work is to refer to the equipment of the Union Traction Company of Philadelphia, who use a battery of 400 h.p. hours for keeping up the pressure at the end of a feeder at a point about 11 miles from the power house, the new extension continuing several miles beyond. In this case the battery took the place of a new power house, or what amounted to the same thing, an increase at the old power house with enlarged feed wires. It was found that the cost of copper feed wire to operate from the main power house alone would have cost four times the total cost of a battery. Previous to the installation of the battery the pressure at the end of the feeder formerly in use frequently varied as much as 50 per cent.; the battery, however, gave practically a steady pressure at all times. Railroad men need not be told how much better for their motors and controllers the maintenance of a standard working pressure is than one which falls so low as to require an increase in the current passed through the apparatus of from 50 to 100 per cent. In the above case the load varied from one hundred to seven hundred amperes, and with the feeder of a capacity at a constant load for four hundred amperes, the demand upon the power house was at all times equivalent and independent of the changeable load on the batteries. Under such an arrangement the power house generator always operates at full load and highest efficiency, and the battery acts as a cushion to the engine when the line circuit breaker opens from any cause.

Some of the electric street railroads in Canada serve a district up to seven miles from the power house as originally laid out, and in all cases extension will be called for to reach suburban points at a greater distance and to connect through as radical lines to still more distant points. In such work the accumulator plant at the end of a feeder is destined to be an important factor in the near future, and the little trouble in operating a sub-station for this work is very satisfying to the purchaser, as the battery is automatic in charge and discharge, the only attention required being the usual occasional testing of the E.M.F. of the individual elements and the keeping of the electrolyte to the standard specified gravity (1,200).

The sub-station apparatus and connections are very simple, being only the main switch, ammeter, circuit breaker, voltmeter and recording voltmeter. The flow of the current to the line being always proportionate to the demand, one central station can therefore take care of any number of accumulator sub-stations, and the area which can profitably be covered with continuous current either for railroads, lighting or power greatly increased. The claim has been made and experience seems to prove it true, that it costs practically nothing for the energy stored in accumulators in the average lighting, power or railroad station, whether operating on a twelve or twenty-four hour basis, as if judgment is used in proportioning the size of battery to generating plant, the battery is always being charged during light load and discharged during hours of heavy load, and owing to the all-round higher efficiency, the amount of coal burned will be about the same and the current given off from the batteries will represent net profit.

While the above is a simple way of putting it, the following gives in figures the actual conditions obtained in a plant now working: Total time of operating steam plant, 9 hours; total steam plant required, dynamos working at an efficiency of 90 per cent., 93 h.p.; total steam plant required if battery is not used, 165 h.p.; saving in steam plant, 72 h.p.; total dynamo capacity required when using battery, 62,500 watts; total dynamo capacity required, without battery, 111,250 watts; saving in dynamos, 48,750 watts. In this case the battery was in service a total of 18¼ hours and during 15 hours the battery served the entire plant.

In making provision for a storage battery the room provided should, if possible, have a cement or tile floor, and should be well ventilated. Owing to the compact form of the elements, sufficient room can usually be given when arranged in tiers, one above the other. The space required for a battery capable of giving 400 h.p. for one hour per element is 14½ by 20½ inches, and as 248 cells would be used on a 500 volt system, only about 630 square feet would be necessary, this being for a battery of fairly large capacity; in fact, being equivalent to that installed by the Union Traction Company in the beforementioned instance. A suitable battery having been purchased, it requires as careful attention as is given to any other class of electrical or steam apparatus, and no more, and yet this attention is very simple; but it must be given as required, otherwise the results would be similar to that caused by neglect of a dynamo or steam boiler. There has been no instance where a properly constructed battery that has received fair treatment has failed to give good results. Attention should be paid to the proper strength and nature of the acid, the specific gravity of the acid being tested at regular periods. The individual testing of each cell by a low reading volt-meter is the keynote to successful battery operation. While in general the reading of the voltmeter connected with all the elements will give sufficient information, yet the occasional individual testing of each element prevents any single cell from being allowed to work at a disadvantage. The chloride type of negative plate has been found to be most satisfactory, and is largely in use for central stations. The positive plates generally used with chloride negatives are of the Tudor type, and are capable of giving a very high discharge, their capacity being at nominal rating from three to five ampere hours per pound of element. Such a battery is not liable to buckle or sulphate. There are numerous small water powers that have not been considered as applicable to electric lighting, owing to the small h.p. available, but if 20 h.p. can be obtained for 24 hours per day, and if a battery is used in connection therewith, 120 h.p. is available for four hours, or sufficient for the requirements of a fair-sized town. I know of one instance, in a town of from eight to ten thousand inhabitants, where a water power of 50 h.p. is available, and not used at present. This power, if stored in batteries, would give 200 h.p. for six hours, or sufficient to supply all the street, commercial and residential lighting which is now operated by steam.

At the annual meeting of the Fredericton, N.B., Gas Light Company, a dividend of 4 per cent. on the year's operations was declared, and the old board of directors, composed of Hon. F. P. Thompson, president; Hon. A. F. Randolph, W. T. Whitehead, James Dever and John A. Edwards, were re-elected.

NOVELTIES IN NAVIGATION.

During the present year, a number of experiments have been made in methods of propelling vessels, some of them novel and some not. Two of these are roller boats, one of which is the invention of a Canadian, F. A. Knapp, a lawyer, of Prescott, Ont. The principle of the roller boat is not by any means new; but there are important differences in the two under consideration from others that have gone before and proved failures. That invented by Bazin, in France, has been tried, and instead of making 30 knots an hour, as it was to do, it only made six or seven. In the first type tried in French waters the engines were not powerful enough; then new engines were put in of three times the power, but the increased weight and force submerged the rollers so that instead of making 40 turns a minute, they only made 10, and they threw up such quantities of water behind that each acted like a brake. Mr. Knapp's boat, which is now being completed at Polson's shipyard in Toronto, is quite different to Bazin's. As shown incomplete in the accompanying engraving, it is a cylinder, looking like a huge steam boiler. It is 110 feet long and 22 feet diameter, the cylinder having an inside diameter of about 12 feet. The engine and platform or cabin for passengers will be placed inside this cylinder, the engine running on a track and turning the cylinder just as a squirrel might turn the cylinder in its cage. The engine being started climbs up its track and turns the drum by its own weight, the drum moving over the water by means of paddles projecting from its outer shell about a foot. The steering gear consists of a steel blade on the lee-board principle, projecting down into the water from each end and lifted or lowered by chains. The smoke will escape by pipes from either end, the inner cylinder being of course open at the ends. Mr. Knapp believes his new boat will make a speed of a mile a minute, and so it may in rolling before a gale, but going against a gale will be quite a different matter. It seems ungracious to have to discourage a thing before its trial, but it is to be feared that Mr. Knapp has not made any mathematical calculations of the enormous force of a gale acting on the broadside of so large a drum elevated so largely out of the water, and he has evidently not considered that though his engines are to be 150 horse-power, their effective power will be limited to a proportion of their weight plus that of the framework, etc., in which they are set. There are other difficulties with regard to stowage of cargo in this outer drum which are likely to crop up on trial. Undoubtedly such a boat should make a good rate of speed in smooth water and with no adverse winds.

Another Canadian inventor, Mr. Charbonneau, is building a boat near Montreal which promises more effective work. The working model of this craft consists of two cylinders somewhat of a torpedo shape, each 8 feet long, 18 inches in diameter placed parallel, and 4 feet apart from centre to centre. Around these cylinders are spiral fins of 1½ turns to the length, one set with a right turn and one with a left. These cylinders are the support of a frame and platform on which a four h.-p. gas engine is being placed, the cylinders being geared to the driving shaft by a bicycle chain. The craft is very steady in the water, and when operated by hand-power only has made a better speed than was expected. Its test with the engine, however, is yet to be made.

ROLLER BOAT.

Herr Vass, a German, is now building a steamer to be propelled by 10 screws, the novel feature of which is that the screws will be placed at the bow and sides, as well as under and at the stern of the vessel. When we state that Herr Vass expects to cross the Atlantic in 16 hours without regard to weather, it will be seen that he is a sanguine man. Although these inventions may prove failures, partially or wholly, they will all have their value as contributing to our stock of knowledge and experience in solving the problems of fast navigation.

FOUND WANTING.

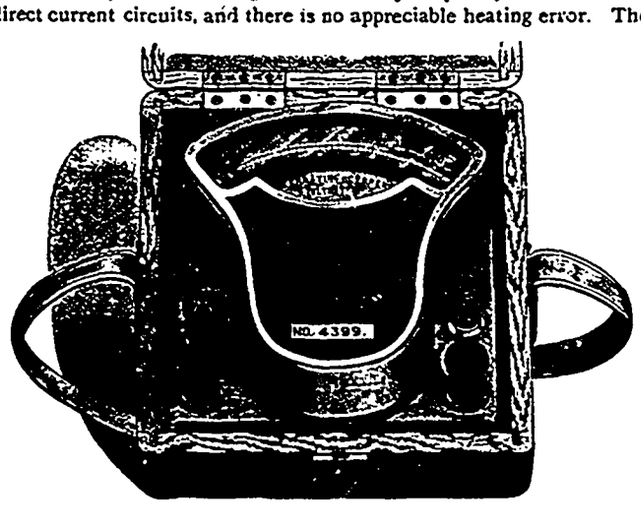
It is of course understood that many of the so-called mines, whose shares are being hawked about, have no existence save in the imagination of the alleged proprietors. That such enterprises should fail is only to be expected, and when it does occur it is a subject of congratulation to everyone interested in the development of our mineral wealth. It is far otherwise, however, when failure comes to a mining enterprise which has been conducted on thoroughly sound business principles, with the most exact scientific information, and the latest and most improved appliances. We refer with regret to the closing down of the Craig mine, Bannockburn, Hastings county, Ont., which took place on the 15th of June, the date of the expiry of the option under which it was held by the Gold Hills Exploration and Development Co. The assays, upon whose showing the working of the mine was determined, gave results indicating the value of about $35 per ton in gold. However, the ore crushed at the Kingston School of Mines, where the test was made, did not represent the average quality of the ore in the mine. The company began work January 1st, and employed about 40 men, day and night, until the 15th of June, when the operations ceased. A Tremaine two-stamp steam stamp, manufactured by the Gates Iron Works, Chicago, the first set up in Canada, was installed, with a 15 horse-power boiler and a Northey pump. Two shafts were sunk, one of 100 feet and one of 35 feet. The vein was also stripped at intervals over the whole property, and samples amounting to several tons taken from each opening. Half way down the main shaft a chute very rich in free gold, but which was very small, was struck. In all about 100 tons of ore were crushed, and the gold recovered is understood to have amounted to between $2 and $3 per ton. Horace Maybee, of the Kingston School of Mines, was in charge of the stamp mills and assaying; Gardner McKenzie, who has had a very long and successful experience in the gold mines of Nova Scotia, was superintendent, and W. Hamilton Merritt visited the mines frequently during the operations, and directed the work of development, so that there can be no question but that the property has had every opportunity to prove itself a valuable mine, and has failed to do so. The Hastings mining boom has received a serious check.

THE AUTOCAR INDUSTRY UP-TO-DATE.

"Save me from my friends!" the motocycle manufacturer may well exclaim—presuming that those persons claim to be his friends who are so constantly and strenuously puffing the industry and its wonderful development. A few days ago the daily papers announced with a great flourish of trumpets, that on July 16th next ensuing, the Cab Company of Paris, France, would put 500 autocars on the streets, replacing the antiquated animal-power. One of the officials of the company was quoted as saying that within a year 4,000 of such autocars would be running in Paris. A close scrutiny of the matter in quarters not accessible to the general public, reveals that the 4,000 is a myth, the 500 is also a myth, and the plain truth is that the Compagnie des Petites Voitures is "experimenting" with a view to the introduction of autocabs—if a satisfactory system can be found! "The type of vehicle has not been settled upon," but "negotiations" are in progress for the acquirement of a new accumulator "which is expected to give much better results than any now existing." The old, old story! The *Autocar*, the English organ of the movement, states in answer to "A Puzzled Investor," that the total number of autocars delivered from British factories up to date is "probably five-and-twenty, all told!" Some of the factories have been running about a year, others from six to nine months. "There are six companies," the *Autocar* says, "actually delivering commercial vehicles built in this country, viz., Messrs. Stirling, The New Beeston Cycle Co., the Coventry Motor Co., the Thornycroft Steam Wagon Co., and the Daimler Motor Co., and three others which will now commence deliveries in a week or two, these being the Great Horseless Carriage Co., the Arnold Motor Carriage Co., and the Yeovil Motor Carriage Co. Several more are also pushing forward manufacturing preparations." The amount of capital involved in these various enterprises is not stated, but it represents many millions of dollars, and the number of workmen runs into the thousands. Yet the net result to date is 25 autocars! No more striking proof could be given of the absolute accuracy of the article published in the May number of THE CANADIAN ENGINEER, which we suggest might be re-read in view of the facts stated in the above extracts.

A NEW LINE OF AMMETERS AND VOLTMETERS.

Appreciating the demand for a reliable, but low-priced line of testing voltmeters and ammeters for both direct and alternating current, the Whitney Electrical Instrument Co., of Penacook, N.H., have brought out a modified form of their well known Hoyt type. While it is not by any means their intention to discontinue the manufacture of the latter instruments, it has been found that although by far the most accurate method of taking measurements, instruments operated on the dynamometer principle are not as convenient for rapid testing as are the indicating type, hence the new instruments are in this form, and are constructed with especial reference to making them convenient when used as portable instruments. They are mounted upon handsomely finished mahogany bases and covered with neat dust-proof cases of aluminum, while a strong, well-made, hardwood case with lock and key accompanies each instrument. This case is designed so that the instrument can be used without removing from the case, although it can be readily removed when it is desired to use the instrument for laboratory work. Both the voltmeters and ammeters will read correctly on alternating current of any frequency, as well as on direct current circuits, and there is no appreciable heating error. The



ammeters are made in a variety of ranges from one ampere up to one thousand, and the voltmeters up to ten thousand volts both in single and in double scale. These instruments are tested to stand 2,000 volts between the terminals and cap, thus eliminating all danger in the case of grounds on the line Although the instruments are very compact, occupying a space only 6 x 6 inches, they have a scale length of nearly five inches, thus giving very open deflections.

MR. DOWDALL has been in town for several days taking subscriptions for THE CANADIAN ENGINEER, a monthly journal devoted to the metal trade's interests. We are pleased to know that the subscription list has been largely extended by the names of a goodly number of Orillia citizens, which was to be expected of a progressive community. THE ENGINEER certainly is an up-to-date publication and fills the bill with ability, and is thoroughly wide awake to the interests involved.—*Orillia, Ont., Packet.*

Photo by G. W. Whitaker, Niagara Falls, N.Y.

CANADIAN ELECTRICAL ASSOCIATION.

CANADIAN ELECTRICAL ASSOCIATION.

SEVENTH ANNUAL CONVENTION.

The seventh annual convention of the Canadian Electrical Association was held at the Dufferin cafe, Niagara Falls, Ont., on the 2nd, 3rd and 4th June, John Yule, president, in the chair.

Among those present were the following: K. J. Dunstan, Frederic Nichols, J. J. Wright, C. H. Mortimer, Geo. A. Wilkie, E. K. M. Wedd, Irving H. Smith, A. A. Christie, A. B. Smith, J. A. Kammerer, W. A. Johnson, A. M. Wickens, W. J. Clarke, E. D. McCormick, W. H. Bourne, Albert Esling, T. F. Dryden, James Milne, F. H. Leonard, jr., J. W. Campbell, Jos. Wright, E. B. Biggar, John C. Gardner, Ross McKenzie, Toronto, Ont.; John Yule, Guelph, Ont.; W. H Browne, John Carroll, Wm. Thompson, J. A. Baylis, Montreal, Que., C. B. Hunt, C. E. A. Carr, Capt. Williams, London, Ont.; F. Pepler, Barrie, Ont.; Stephen Noxon, G. E. Gayfer, Ingersoll, Ont.; Henry Comstock, Brockville, Ont.; George Shand, William Williams, Sarnia, Ont.; John Murphy, Ottawa, Ont.; B. F. Reesor, Lindsay, Ont.; H. O. Fisk, Peterborough, Ont.; E. E. Cary, Geo. A. Powell, St. Catharines, Ont.; James Lamont, Chatham, Ont.; Geo. Phemister, Wilfred Phillips, G. E Foster, Niagara Falls, Ont.; E. T. Freeman, Halifax, N.S.; V. B. Coleman, Port Hope, Ont.; John Farley, St. Thomas, Ont.; F. A. Bowman, New Glasgow, N.S.; J. W. Purcell, Walkerville, Ont.; W. H. Bullard, Seaforth, Ont.; C. H. Philbrook, H. E. Adams, Buffalo, N.Y.; W. J. Johnston, Wm. McCullough, New York, N.Y.; Geo. Black, W. F. McLean, F. W. Martin, Gordon J. Henderson, B. J. Throop, Thomas Wadland, Q. C. Baker, Hamilton, Ont., Thomas Duncan, Fort Wayne, Ind.; C. J. Page, Welland, Ont.; J. M. Brown, Carleton Place, Ont.; Chas. E. Taylor, Sault Ste. Marie, Ont.

The president, having welcomed the members, delivered his annual address, in which he spoke of the appropriateness of having the convention at a place like Niagara Falls, which afforded so many object lessons in electrical enterprises. In the course of his address he spoke of the question of municipal control of electric plants, as a subject of the deepest moment. The movement was gathering strength in spite of repulses, and some means would have to be devised to prevent a large part of the capital invested in the electric lighting business from being wiped out. "We hear," said he, "of Glasgow, Manchester and Birmingham, where the civic ambition largely prevails amongst men of capital, leisure and ability, who give their time and talents to promote the common good. The late Governor-General of Canada, the Earl of Derby, is now serving as mayor of a large English city; while municipal affairs in Canada are managed in odd hours snatched from business, by men who cannot afford to give the time and attention necessary to the successful management of an intricate and hazardous mercantile concern like the supply of electricity They also do not know or forget that municipal control was not introduced in England in the vicious way it is carried out in this land, by using the taxable resources of the ratepayers to ruin what was at one time, by the same people, lauded as creditable enterprise on the part of their fellow-citizens. It is not my purpose to enter into an elaborate argument why municipal control is not a success in Canada. The agitation is in the air, and how best to save our property from complete confiscation is the question of primary importance. We do not dispute the right of municipalities to control and operate all their franchises, if honestly and fairly entered into. I hope our Legislature will realize it to be their duty to provide for the compulsory purchase and transfer of properties where the local authorities decide to assume control of the lighting service, and prevent money invested by our citizens in necessary and laudable enterprises from being wantonly wasted. It is a hopeful sign that a few of our leading newspapers are now recognizing that the practice in some European countries of government control of monopolies is the true remedy for any evils that may exist. The Toronto Globe, in dealing with the telephone question, admits this principle in pointing out the mistake that would be made, and the injury to the public which would follow, should a second telephone company be permitted to enter into business in Toronto. Quite recently the same paper quoted approvingly from a paper on 'Monopolies and the People,' where the author tersely sets forth the evils of the popular attitude towards competition projects:—'Let a proposition to build a competing railroad line or a competing electric light plant be submitted to popular approval, and, under the impression that they are benefiting themselves, hard-working men will cheerfully assume heavy burdens of taxation to aid the new enterprise. So blind and unreasoning indeed is this popular abiding faith in the merits of competition, that it has been responsible for some of the greatest wastes of wealth in unproductive enterprises that have ever been known.' In Great Britain the Government forbids by legislative enactments, local authorities entering into competition with private companies, but makes it a necessary condition in their taking control of municipal franchises that all plant engaged in the business in their bounds shall be expropriated by the corporation and paid for, the value being arrived at either by mutual agreement or by arbitration. One would think from the discussions here that every municipal franchise in sight in Great Britain is operated by municipalities, but such is very far from being the case. I have not been able to procure all statistics, but will give you an example. In England, Scotland, Ireland and Wales, in the year 1895, there were 1,318 gas undertakings operated by companies, and only 165 managed by municipalities. This, in view of the fact that said muncipalities could at any time expropriate these undertakings and operate them on their own account, does not denote the marvellous success our friends would have us believe, the power to expropriate having been in existence for nearly 30 years." The president then went on to speak of the Electric Lighting Act of Great Britain, which provides for the method in which lighting companies are to be started. Companies can be organized, and on proving their good faith and ability to carry on business, notice is given to the corporation, which has then a stated time within which to take up the business on municipal account. On their failing to do so, what is called a provisional order is then issued by the Board of Trade (in England a department of the Government) to the company, permitting them to operate within their district. This provisional order is about equal to our Act of Incorporation, and gives a monopoly of the business under proper control.. Municipalities are not required to pay any price demanded by the company for lighting service. The company is compelled on a requisition from the local authorities to erect and supply street lights; the distances apart and other necessary conditions are prescribed in the General Act. Failing an agreement as to the value of the service, arbitration is resorted to for that purpose, the Board of Trade

appointing the arbitrators. In fact, arbitration is the key to the whole situation. Every precaution is taken and provision made and no wilful destruction of property is allowed. In the State of Massachusetts all gas and electric light companies are supervised by a board of control, which has now existed for 13 years. When complaints are made, or applications for reduction in price etc., the board hears evidence and gives judgment, which is usually based on common sense and equity. Every lighting company in the State is required annually to make a return, giving full particulars as to capital, income, expenses, dividends paid, etc. In 1896 there were returns from 63 companies; 33 of these paid no dividends, 6 less than 5 per cent., and 25 paid 5 per cent. and over. If this is the condition of electric lighting investments in a wealthy and populous manufacturing State like Massachusetts, he thought statistics would show Canadian companies to be worse off." He advocated an Ontario law, based partly on the British and partly on the Massachusetts laws. In closing his address the president made a feeling reference to the untimely death of their respected late second vice-president, E. Carl Breithaupt, and said, "I am sure I express the opinion of all who had the pleasure of knowing him, that he was a young man of great promise in his adopted profession, and a genial and trusty friend. His death is a decided loss to our association."

On motion of C. B. Hunt, seconded by J. J. Wright, the following were named a committee to consider and report on the recommendations contained in the president's address: Wm. Williams, S. Noxon, B. F. Reesor, J. J. Wright, J. Lamont, H. Comstock, and the mover.

The secretary-treasurer, C. H. Mortimer, then read his annual report, which showed that there had been added during the year 42 active members and two associate members, while nine active members and five associate members had resigned, and 33 active members and 14 associates had been struck off the roll for non-payment of fees. Two members, E. Carl Breithaupt and A. W. Congdon, were removed by death—a loss deeply deplored. The membership roll now comprises 154 active members and 19 associate members, a total of 173. The finances were reported in a good condition. The total receipts were $940.36, an increase of $448.03 over the previous year, while the disbursements were $352.47, an increase of $165.86 over the previous year, leaving a net gain of $282.17. The cash in hand and in bank on 31st May, 1897, was $415.82. The report was adopted.

J. J. Wright, on behalf of the Committee on Legislation, reported that during the past year there was no legislation that affected the interests of the members generally. He also reported that nothing had been done by the committee to interview the Government on the question of meters. They found that the officials of the Government were disposed to meet them in every reasonable way, and there was no urgent necessity under the circumstances to have an interview with the Government. The coming year, however, bids fair to be an important one for these committees.

The report of the Committee on Statistics was not presented, owing to the death of the chairman, E. Carl Breithaupt, who at the time of his death had a considerable amount of unassimilated material in the way of reports, which have not yet been obtained from his executors.

The president named B. F. Reesor, C. B. Hunt and A. B. Smith as a committee to nominate the standing committees.

Mr. Hunt called attention to the Government's new order-in-Council regarding the inspection of meters. By this order the charge for inspection is per lamp instead of per ampere. To those having a 106-volt or a 110-volt service the rate is very much increased. Take, for instance, a 10 ampere meter that we used to pay 75 cents for, the rating is now $1.25; on a 15 ampere meter it is increased from $1.25 to $1.75; on a 25 ampere meter it is increased from $1.75 to $2.25; on a 50 ampere meter it is increased from $2.75 to $3.50; on a 100 ampere meter it is increased from $3.50 to $5.50, and on a 150 ampere meter it is increased from $4.25 to $7.50. If you happen to have three wire meters it will be pretty nearly double that again. It was decided to bring the matter up the next day.

A paper on "Water-Driven Plants," an abstract of which will be found elsewhere, was then read by John Murphy, of Montreal.

The President said the most satisfactory regulation he found was a quick-acting engine on the same shaft with the water wheel.

H. O. Fisk—Mr. President, we regulate about the same way as you do, although we have one water power generator with an automatic regulator, which works very well; it may lose 10 or 15 volts, perhaps, with a very sudden change of load; it never exceeds that. In our incandescent lighting we regulate it by hand, and just increase the power as the load comes on, and take it off accordingly. It works very well.

B. F. Reesor—I have had no experience with regard to driving electric plant with a water wheel—we drive ours with an engine—but I have had considerable experience in water wheels, and I can quite understand where a water wheel is taxed to almost its utmost capacity it would vary very much. The same thing holds good with an engine or water wheel, but much more so with a water wheel; it will pull it down very much in putting on a considerable load. A good plan is to have any amount of power to spare.

Mr. Fisk—In regard to governors for street railway work: I suppose that is about the hardest kind of work we have to deal with. We found down in Peterboro' that it was impossible to get a wheel that would stand governing for any length of time; the pinions and everything wear right out with the constant rocking backwards and forwards. We simply had to abandon it, and I believe for that reason that the apparatus that provides a constant load for a generator would perhaps be the best in the end. We had a couple of wheels revolving on balls, and the balls actually cut right into the iron, so that the thing came right down and ground away there, and would not work. We had no end of trouble till we took our governor off, and I have since thought that perhaps the best way is to keep a constant load on the machine if it is possible. I believe there is an apparatus working up here at Niagara Falls power-house now that keeps a constant load on the generator all the time.

S. Noxon said he had experience of water power at Walkerton, in driving two or three mills. He came to the conclusion that it was impossible to regulate a water wheel running at a slow speed, under a comparatively low head. The feed of the water being so sluggish in its action, it was impossible to get any close regulation by any governor. The trouble was to get the wheel to respond quickly. It can be done under a high head, because the wheel runs altogether with the impact of the water, and as soon as the water is shut off a little the wheel responds.

A. M. Wickens, Toronto, was then called on to read his paper, entitled the "Steam End of an Electric Plant," which, with the discussion on it, will appear in next issue.

When the discussion on this paper closed the convention adjourned for a trip to Buffalo in the evening, where an inspection was made of the electrical developments there.

On assembling for the second day, the president read telegrams from O. Higman, of Ottawa, then at Vancouver, and from L. B. Macfarlane, Montreal, regretting their absence from the meeting.

On behalf of the committee to nominate the Standing Committees, Mr. Reesor reported the following nominations, which were accepted:—

Committee on Statistics—A. B. Smith, A. M. Wickens, and O. Higman.

Committee on Meter Inspection—J. J. Wright, C. Berkeley Powell, and James Milne.

Committee on Legislation—John Yule, B. F. Reesor, J. J. Wright, John Farley, W. H. Comstock, C. B. Hunt, S. J. Parker and F. Pepler.

W. H. Comstock, chairman of the committee to consider the recommendations in the president's address, reported in favor of action by the Committee on Legislation, who should be empowered to raise money for the purpose. On motion of Mr. Armstrong, seconded by Mr. Reesor, the report was adopted.

J. A. Kammerer then read his paper on "Day Loads for Central Stations and How to Increase Them." The paper appears elsewhere.

Mr. Wright said he remembered, when a boy, seeing a conjuror who poured three different kinds of wine out of one bottle. He thought it very wonderful at that time, but since then he learned that it was a fake bottle—it wasn't exactly genuine. Now he did not mean to say that a dynamo that would produce arc lighting, incandescent lighting, and power was a fake dynamo, but if the three kinds of current can be produced as easily and successfully as the gentleman he referred to

seemed to pour out his wine, we as central station men ought to know about it.

W. H. Browne, of the Royal Electric Co., Montreal, said: I presume it is tolerably well known that we have reconstructed our incandescent station and are now operating five dynamos instead of thirty. We have a direct current power service in Montreal; we have an arc lamp service and an arc lamp station. We also have what we call our incandescent station. We have diminished our arc lamp commercial circuit from 350 or 400 private commercial arc light customers to about 125. We have a direct current power service which we have not diminished in any way, but we are serving customers every day with alternating current power service, and our commercial arc service has been diminished by the replacement of alternating arc lamps, so that we have from the same dynamo, the same boiler, the same engine, and the same building, a service of incandescent light, arc lamps and power. That brings up the question that I think Mr. Kammerer's paper directly refers to—the question of a day load and how to get it. We are serving power upon a meter price system; we are asking our customers to pay us for the current they actually use, and not undertaking to serve a flat rate. We have a flat rate price, however, in the nature of a fixed or minimum charge, by which we expect to be repaid the amount of money we have invested, and we make our prices for say 10 horse-power, a certain fixed sum, small, but enough to cover our investment, and we are getting, on that line, nearly as much power service as we can take care of, and not at very low prices either. We are doing this in anticipation of a water power service, and the expectation of having low prices on that account. But at the present time we are keeping up the old motor prices as a basis, and we find the customers perfectly willing to give it. We are serving power from the same wire as the incandescent lights, and we find no difficulty; so that the conjuration of this fake bottle has disappeared.

Mr. Wright said he was aware that it could be done; the question was whether it was practically a success. In Toronto they had services on separate wires, and they would like to get them on the same machines, if they could get steady incandescent lighting while constant draughts were being made on the same dynamos for motor power.

Mr. Fisk said the few motors they were running in Peterboro' did not seem to make any difference with their lighting.

Mr. Milne thought it impossible to have perfect regulation where one had a lot of motors requiring heavy powers. Take, said he, the Edison three-wire system, where an electric elevator is turned on, taking two or three hundred amperes to start with. I defy any system to have a perfectly steady light when we have a load of that kind, and it will be all the worse when the load is less. The variation during a maximum load is very small, but where you have a very small load the variation is considerable; even in turning on a six to twelve horse-power motor you are sure to notice a wink in the light, whether that is caused by trouble in the generator or engine. Suppose it is in the engine, then the trouble is just going to happen as readily with the multiphase as with a continuous system; if the trouble is in the water wheel, it is going to make itself manifest in the light. I do not think it is very feasible to run the whole thing from the one machine, even though you had a separate circuit for the lights and a separate circuit for the power. As long as they are all driven from the one machine you are going to have the same result, because, if it is in the regulation of the engine, it is going to affect the lights. In Toronto, we are going to considerable expense in taking off all these heavy powers from our light circuit, and putting them on what we call a power circuit; at the same time we have been running on the three-wire system for several years, with a day load probably of about 1,500 of 1,600 amperes power load, yet it cannot be said to be extremely satisfactory.

Mr. Browne replied that Mr. Milne had not had direct personal contact with the use of power on a multiphase current circuit with incandescent lights, and went on to say: I presume that many of you here have had theatre circuits on your incandescent lighting system; at least they have in Toronto, where they may have four or five hundred lights in the border lights and the drop curtain lights turned on and off quickly. Four or five hundred lights represent a considerable percentage of the load on that particular circuit, and the cutting on and off of those lights affect all the other lights on the circuit. I presume that is your experience; it has been necessary in my experience in New York city to make a theatre circuit and have nothing else on, so that the lights for the theatres would be only affecting one another. You have precisely the same conditions in a motor power load, but you certainly can regulate for it; if your direct current machine does not regulate for it your multiphase machine has its own regulation. We are turning on and off 40 and 50 incandescent h.p. without affecting our incandescent lighting at all, because by regulation of the machine the variation in the line is controlled. Get enough copper in your line and you can cut on and off 40 or 50 h.p., whether it be motor power or incandescent, and the other people will not know anything about it. The experience I had in theatre circuits taught me that lesson—it is easy to take care of it, and your motor load is no different from your incandescent lighting load. We had so many theatres in New York city that it paid us to make a theatre circuit. In Montreal we have five theatres, and each one of these is on a separate circuit.

Mr. Armstrong: In considering this matter in connection with the heading of Mr. Kammerer's paper, there is another point that has not been touched upon, and which seems to me really more material to the smaller central stations who are at present operating a day load. The main difficulty experienced in working up a power business in connection with the smaller stations is that of the high price of motors, under present circumstances at any rate. There is no doubt that the alternating motor, in the smaller sizes, up to 20 h.p., with the cost of transformers added, is two, three or four times the cost of direct current motors which can be put in, and which do the work; and I think that difficulty has been found to be a very considerable one. There are in Ontario at present 15 or 20 plants using either two phase, monocyclic or three phase apparatus. In connection with these I can only call to mind at the present moment four or five motors which are in actual operation; some of these plants have been running for a year and a half and two years. One I have in mind has been running just about two years and there has been only one motor in operation since the start. If the price of motors had been brought down to about what you can buy a direct current motor at, the people would not long buy the direct current motor at the price it is. You can get around that by adding to your investment the capitalization necessary to supply the motors, but I think, considering everything, that is very doubtful commercial policy. In connection with the operating side of the matter, there are one or two points that I would like to touch upon. The difficulty which Mr. Browne spoke of in connection with his theatre circuits, realized from a change in load, would, I think, be experienced even more severely by smaller stations, becauses I agree with Messrs. Milne and Murphy that the difficulty is mainly a difficulty in the prime mover, especially in the operation of small units. It would seem to me, taking the average small plant, that the stopping or starting of a 10 or 15 h.p. motor would have a considerable effect on a 75 or 100 h.p. engine, and therefore a disastrous effect on the regulation of the lighting. There is another point, and that is, the difference between a direct current and alternating motor, due to the fact that with the alternating motor we have to contend with the idle or wattless currents. I am not aware of any alternating system in which that difficulty is entirely removed.

In reply to Mr. Pepler, Mr. Armstrong said the same difficulty would occur in the case of a railway operated during the day.

Mr. Browne observed that the real difficulty in these cases was that the prime mover, whether a water wheel or an engine, was not large enough for the work.

Mr. Armstrong: It is perfectly correct that for the conditions of railway service we can offer generators which will give a regulation adapted to that service, so that even if the whole load is thrown off instantaneously, it will not effect the service. There is this difference in a railway service, that it has a variation of 10, 15, and 20 per cent. or more in line potential, and the voltage of a railway circuit will run from 550 to 500 volts, and the line voltage will vary even more. But Mr. Browne will admit it is quite out of the question to have any such variation in a lighting circuit, and that was the point I was endeavoring to bring out in my reply to Mr. Pepler's question. The variation in the prime mover, due to the change of speed primarily, is too great to keep the dynamo potential steady enough to permit of a satisfactory lighting service.

Coming to the other side of Mr. Browne's remarks, while there is no doubt weight in what he says, that the difficulty in small plants occasioned by putting a motor on or off is due to the disproportion between the size, say of a 20 or 30 h.p. motor and a 75 or 100 h.p. generator, still I do not think he would propose as a remedy that you should all put in 300 or 400 h.p.

Mr. Reesor said that in a small town a company could not afford to throw away their transformers and get nothing for them, but in a big city the loss would be equalized.

Mr. Kammerer pointed out that his paper distinctly referred to transformer losses, and said that this was being regulated by the reconstruction or rearrangement of the separate stations.

Mr. Farley said it would seem that we had not arrived at that stage where electricians could all agree that all these serivces could be provided for over the same lines by the same dynamo, but for a small company it was very important that it should be done.

Mr. Armstrong: I think there is no person who will question the perfect feasibility and desirability of operating a lighting station (especially a small one), and supplying three or four kinds of service from one generator, one circuit, and one set of appliances all through. There are so many desirable things about such a circuit that it is not necessary to enlarge upon them at all. But the question simply resolves itself into one, that in commercial practice it is not found to be, so far as my experience goes, the easiest to work out under ordinary circumstances.

In answer to a question, Mr. Browne said that in calculating the cost of such a plant, we have two fixed items—the interest upon the capital invested and the labor necessary to produce; so it may be ascertained by any one how much it will cost him to serve light or power. The additional cost will be the amount of coal, oil and waste that he will use up every hour that he is operating his station. When you come to put a day load on there, you do not increase the capital invested if you use the same boilers, the same engines, the same dynamos and the same wire. The capital invested remains the same. You do not increase your labor item, but you may increase your coal burning under your boiler to produce power. Therefore it is easily calculable what your day service is going to cost you and what you can get for it. And the benefit of that day service is that you reduce the proportion of your capital investment and your labor account pro rata through the hours of service that you get power for; that is why power service or day service will pay the station, because you are getting something in return for capital invested and for the labor that you necessarily employ. Leakage from the old style of transformers would be disastrous in this method, but transformers can now be supplied to reduce the leakage from 150 h.p. to 10 h.p. on a 7,000-light plant.

After some discussion on the next place of meeting, it was unanimously decided to hold the convention of 1898 at Montreal.

Wm. Thompson, Montreal, then read his paper on the "Determination of the Heating Power and Steam-Producing Value of Coals from a Preliminary Examination," which, with the discussion on it, will be found in our next number.

At the noon recess, on the invitation of Wilfred Phillips, the manager of the Niagara Falls Park and River railway, the members visited the company's fine power-house, near the Falls.

On resuming, the first business brought up was the election of officers.

J. Carroll stated that L. B. Macfarlane had requested that his name should not be brought up for re-election to office for the coming year, as it would be impossible for him to serve the association as he would like.

After some discussion the following officers were elected: President, John Yule, Guleph (re-elected by acclamation); 1st vice-president, C. B. Hunt, London (acclamation); 2nd vice-president, J. A. Kammerer, Toronto (acclamation); secretary-treasurer, C. H. Mortimer, Toronto (acclamation). Executive Council—F. C. Armstrong, Toronto; J. J. Wright, Toronto; John Carroll, Montreal; A. B. Smith, Toronto: O. Higman, Ottawa; F. A. Bowman, New Glasgow, N.S.; W. H. Browne, Montreal; Wm. Thompson, Montreal; Wilfred Phillips, Niagara Falls; and A. A. Dion, Ottawa.

The usual bonus of $75 was voted to Mr. Mortimer for his services as secretary.

F C. Armstrong then read his paper on "Why Some Lighting Plants do not Pay," the text of which will be found in another part of this issue. Mr. Armstrong explained that owing to the press of other work, he could not cover the whole field he had mapped out, and was obliged to cut it in two.

Mr. Browne complimented Mr. Armstrong on his paper, which was well thought out and well constructed; but for the purpose of starting a discussion he would take issue with Mr. Armstrong on the question of rates. He found with flat rates that the maximum output is taxed to its utmost, with less result in the income than by the meter system; in other words, by the meter system you are able to get a larger or higher amount in revenue than you can by flat rates. The idea is this: your customer has a certain number of lamps on his premises; your meter ratings every month will tell you the number of hours of consumption; that will tell you whether that man's consumption has been one hour per lamp per day or more. Divide the number of lamps into the number of hours and the number of days, and for the first hour of service charge him your price, and for all the hours beyond that, whatever they may be, a lower price.

Mr. Armstrong: The method Mr. Browne speaks of is, I believe, quite general in England; it is practically giving a discount to the consumer, proportionate to his use of the current during a certain period. It seems to meet the difficulty from one point of view, but my idea in pointing this out was to get the views of the owners of the smaller stations present who have had actual experience. One difficulty I have found in operating the smaller classes of stations in towns of 5,000 or less, is the failure to get sufficient annual revenue at all, on any basis of rates, that will admit of the use of light on the lamp hour basis.

S. Noxon was glad to see Mr. Armstrong had cracked a nut and exposed the kernel on a question of great importance to central station managers. His own company was supplying electricity upon the flat rate basis, and although they had pondered over this matter the objections which seemed to present themselves to us were such that we could not see our way to changing our system. And in this he differed from Mr. Browne in his experience. It was easier to get a customer to pay a uniform rate per month on a flat rate than to get him to pay a large rate per month during the heavy lighting season, and a smaller rate during the summer months, for the reason that the customer's attention is attracted very much more forcibly by the maximum amount he pays.

W. Thompson: I have at present both meter rates and flat rates, and I must say that the flat rates are an abomination to me. When we started in business we undertook to serve current by the flat rate, and in thinking it out it meant a great deal. The ordinary house, with us, gets about from 15 to 20 lights; and the houses being in a residential suburb, are very much scattered. We had to provide alternating transformers and secondary mains. Where we put 20 lights in a house on the flat rate system we had to provide 20-light transformers and also a corresponding capacity on secondary mains. We very soon found that the capital outlay for putting in the extra transformers and secondary mains was going to swell up so much every year, and there was only one way to get over the difficulty, and that was to put in meters. We undertook to do that. The consequence is that on a 500-light machine I am able to put a thousand lights, and during four years I have never seen that machine loaded above 70 or 80 per cent. of its capacity. I venture to say, by cutting off the balance of my flat rate contracts and putting them all on the meter system, I could double that machine and still it would do its work. Not only that, but in one case I have two 50-light transformers working together and there are 200 lights working off that, and in the four years I have not even had the fuse broken. Supposing I had to provide current on the flat rate, with copper enough to carry over that amount of current, 200 amperes, and with transformer capacity enough, why, the flat rates at 30 cents a month wouldn't pay the interest on the capital alone.

Mr. Armstrong pointed out that Mr. Thompson was near Montreal, where city conditions existed. If one could get paid for everything that passed through the meter it would be satisfactory, but measuring the ampere hours does not represent the value of what is passing through your meter.

Mr. Pepler: I may say we had a flat rate, and our great trouble was that with the load we had to carry we had no way of checking the consumption. There is no question, it is easier to deal with customers on the flat rate than on the meter

plan. We are now on the meter system, but it is not altogether satisfactory, and not popular. When you are in the hands of a municipality you have got to consider that question. We are now considering this scheme (partly by way of meeting the demand there certainly is for a flat rate—people say they want to know what they are about; that is the position they take—and partly by way of increasing the number of our small consumers); we are proposing to have a sort of combined plant; to continue the meter plant for large consumers and offer a flat rate to very small consumers, say, five or ten lights, at a certain fixed sum per year. We are also considering the advisability, in fact, we have concluded to do it, not exactly as Mr. Browne suggested, but to make a reduction to large consumers on the meter plan; a discount to consumers of $75, and a still larger discount to consumers over $100.

Mr. Browne thought the difficulty of dealing with customers greatly exaggerated. When the question of complaints from customers came up, he said to his clerks: We will insist upon our station men operating the plant within a reasonable range of pressure, so that we will be able to know that a given number of lamp hours, when burning, should represent a given number of hours of registration; and when we have done that we will say to our customers: If you find any fault with your bill consult your meter. I adopted the plan of making a test for a given number of hours with all the lamps burning, and reading and comparing the number of hours by the registration of the meter. That plan has always succeeded; the man never complained the second time; he was able to go and read his meter, and check it up every day. Not only that, but the managers of large places who are dependent upon their employees for the turning on and off of their light, are able to use the meter to check the consumption by employees. In one case the manager of a large institution had every meter tabulated and had printed forms showing the number of lights connected, and what they were, and the registration of them presented to him every morning, so that he was able to know exactly whether there was any use or abuse of the lighting. The great trouble we find in the business is that our commodity is too expensive. It is a luxury, and our efforts should be to offer it to the public so that they must buy it of necessity, not as a luxury. The flat rate system insists upon a high price as the first requisite, whether the man wants to use the light or not, and he objects. Charging by the flat rate is not honest; it is not fair to the consumer in the summer time, who does not need to burn it, and yet has to pay for it; it is not fair to the consumer in the winter time to pay $10 when he has only used $3 worth. We should cultivate an increased use, not by making a discount on it for the sake of the dollars in it, not because a man's bill is $75 or $100 a month; that is a matter of no consequence; the man that pays you $75 may not be as good a customer as the man who pays you $5. The man who uses your current up a great many hours of the day is the man you want to make the price for, so that he will be obliged in self-defence to buy it. I recommend to the consideration of all here the idea of getting the electric light down to a lower price. I believe that will be the way in which central stations will pay.

Mr. Reesor: I am thoroughly in sympathy with using meters; we are working into the meter system. I quite agree with Mr. Browne that we should make our rates low; people will use more. Just before I left home I closed a contract with a large firm in this way: We put in a certain number of lights in his mill and charge him a minimum rate per year; he thinks he will run all night at times—24 hours a day. They start at six in the morning and run until six at night. Then in the fall of the year they have to light up when it gets dark after six, and then in the morning when they start up they have to light up, putting out the lights at daylight. If they run all night they will use a great deal more current, and the contract is that we charge him a minimum rate per year; if he does not use an ordinary amount of current he must pay so much; if he uses a certain quantity we give him a discount off. We give a discount, in any case, if the account is paid before the 10th of the month. If he uses a larger quantity he gets a larger discount, and we make the rate low. We do the same thing with other customers.

F. A. Bowman: I have been using meters now for about five years; we have flat rates as well, but our object is, as fast as possible, to work our customers on to the meter rates. We take no customer using over four lights on anything but the meter system. My experience is that it reduces the consumption of light. You can over-wire very much more largely when you have a number of meters in than you can under any other conditions. When we make flat rates we base them on what we consider would be a fair average consumption through the year. I know you have to keep constant watch or else you will find them leaving the lights on; you will find some customers leaving lights on every night and all night. I think I saw it stated in an English paper that when lighting residences on the meter system you can depend on the consumption, that is to say, the number of kilowatts going out at any time, as being about 35 per cent. of what you are wired up to. When we give flat rates most of us figure on 16 c.p. lamps, whereas on the meter basis we can figure on 5 c.p. and 10 c.p. I might say in this connection that I have rather a unique scheme; I have a small town where I am lighting the streets on the meter system; in other words, we put in an independent circuit, on a three-wire circuit, centred at the Town hall, and they have a meter and switch of their own and simply turn the lights on and off whenever they like. We have no contract with them. As a result, I think they are satisfied. The arrangement has been running about a year and a half now, and they gave me an order to put in very considerable extensions to the system.

H. O. Fisk: In regard to the flat rate system, we ran against a snag that I have not heard mentioned; we started with a contract for 16 c.p. lamps at a certain rate, then 10 c.p. at a certain rate, and we found after a while there were a great many 10 c.p. used. They said they were as good as 16 c.p. lamps. This thing went on for a year or so, the load got tremendously heavy, and the income didn't come up, so we sent an unknown man to investigate. He went around and looked at all the lights, and the result was that about ninety-eight per cent. of our 10 c.p. lamps were 16 c.p. The company then decided they would have no more flat rates for anything except 16 c.p. lamps. With reference to the meter rate, we made a discount about a year ago of 33 1-3 per cent. of what we were charging, for all bills paid before the 10th of the month. The result was that by the 10th, or at the latest the 11th of the month, all our bills with the exception of perhaps one, would be paid in cash in the office, and that one you could look out for, because if he didn't wish to take advantage of the 33 1-3 per cent. you could watch him. I might say also that in a year we almost doubled our number of units in that way.

In the course of further discussion, Mr. Browne said: In my personal experience, I had a plant in which we had no residential lighting of any kind; it was entirely commercial business, hotels, saloons, theatres, stores and so on, and the maximum burning at midwinter, in holiday times, did not exceed 60 per cent. of the lights wired on the meter. My experience in residential lighting is, although Mr. Bowman says it is 35 per cent. in England, that it does not equal 30 per cent.; in other words, you will have 1,000 lights wired up and 300 is the maximum burning. Therefore, you are able to serve all of your customers with your 300 light machine, and you are able to get your revenue from the full capacity of that machine.

Mr. Noxon: We have lately put in a thousand light capacity, and I want to know if it is the opinion of those who have had experience that we are safe in wiring up to the extent of 3,000 lights on this machine?

Mr. Browne: If you use the meter basis. If you have residential lighting and commercial lighting together you can easily wire 5,000 lights on a thousand light capacity. In Montreal to-day we have wired up on our circuits 65,000 lights; we are serving those lights with five 300 kilowatt machines, that is, 1,500 kilowatt capacity, and we always have one to spare.

Mr. Armstrong: Those who are in favor of the meter system hold that they are right, and the other gentlemen express themselves with equal confidence. It simply establishes the fact that it is all a matter of conditions. What I contend is, that for plants in towns of from one to three, four or five thousand people—the contract basis has proved itself in actual operation to be very satisfactory. I have in my mind the case of the town of Penetanguishene, where the plant installed was put in some four years ago; it was put in on the basis of the idea which Mr. Browne has just expressed, and which at that time as very clear in my own mind, that the way to make money out of the electric light business was to sell the light cheaply. In establishing the rates a good deal of care was taken to make

the sliding scale equivalent to a meter basis. The result is that that has paid the stockholders very handsomely. The system has been extended as far as the size of the town will permit, and they have some 1,700 or 1,800 lights. A fact that has been established is, that on the basis of charging for lamp renewals you can very largely realize the conditions of the meter plan. With respect to overloading machines they have, up to the present, without any difficulty, been able to operate that number of lights from one 60 kilowatt alternator.

J. M. Browne: I run a small plant in Carleton Place. When we started out we had the idea of putting all the residences and as many of the stores as possible on the meter basis. They did not run very long until they began to kick and said their returns were too light. I came to the conclusion then, that in order to work up a business, it would be better for me to adopt a flat rate right through. We did so and gave a very reasonable rate, and we have, of course, installed more lamps, but I can clearly see that in the near future my plant will be loaded up and I will have to go back to the meter basis or else put in more apparatus. For commercial lighting you should have an assured return to pay for the capital involved, to carry that amount of lighting. For residences I believe it should be run on the meter basis, and on the meter basis only, to be satisfactory to central station men. At the present time we are running them half on the meter and half on the flat rate, and I know for a fact that those who are on the flat rate are using three or four times the amount of light that the other people are, and I am getting very little more money from them.

C. E. A. Carr, of London, then read his paper on "Electric Railways: How to Make Them a Commercial Success."

Mr. Browne: Mr. Carr, from a railway standpoint, has amplified what I think is a necessity with all businesses, namely, good employees and loyal employees, who make themselves interested.

The President then called upon W. A. Johnson, of Toronto, to read his paper on "Accumulators—Their Application to Central Station Lighting and Power." Mr. Johnson's paper is printed in this issue.

J. Farley said that while all the papers had been exceedingly interesting, there was none probably that has a more practical bearing on the future than Mr. Johnson's.

Mr. Browne asked as to the cost of maintenance of the storage battery.

Mr. Johnson: During the three years in which time the modern type of battery has been in use in central stations on this continent, there is good evidence that repairs will not exceed from three to five per cent. of the cost. The manufacturers give a perpetual guarantee that the cost will not exceed 10 per cent. in any case. It has been found in all the more recent stations installed that the companies purchasing have availed themselves of the privilege of doing their own repairs, and if there is any difference between that and 10 per cent. they save it. But there is a definite guarantee of 10 per cent. given in all cases where they expect the plant will receive reasonable usage. I have no further figures than these. I may say, however, that in several plants in Canada these figures have been found to hold good.

Mr. Browne: If it does not exceed 10 per cent. it goes without saying that we must use the storage battery. I have had in mind for some considerable time the utilization of the storage battery in connection with our station. I know the experience with it in New York is that it is satisfactory. The only element which is uncertain is as to the fixed amount of repair in operation.

Mr. Armstrong: The field for the storage battery is unfortunately confined to direct current work. How would you get over that difficulty?

Mr. Browne: By operating a direct current machine and charging my battery, and in return operating a motor to drive an alternator. I am calculating on having an efficiency of 50 per cent. from the plant. I believe I can afford to do it.

Mr. Johnson: There are a number of cases where alternating current dynamos are operated by water power some distance from towns or cities where the current might be delivered through the city and rectifiers used to charge the batteries or rotary transformers, and the capacity of the generating plant and the transmission line be kept down. The distribution could be handled as easily, perhaps, with the same generators as through the usual alternating circuits; that would apply especially to a water power that was not large.

The paper by D. H. Keeley, on "Economy in Circuits," was taken as read, and is crowded out of this issue.

Votes of thanks were passed to the authors of the various papers, to Mr. Phillips, of the Niagara Falls Power and River railway, for the efforts he made for the success of the convention; to the various companies that had contributed to the entertainment of the convention, and to the press.

The annual dinner took place on Thursday evening, June 3rd, and Friday was devoted to sight-seeing. Reference to these features will be found under another heading.

JOHN YULE, PRESIDENT CANADIAN ELECTRICAL ASSOCIATION.

A biographical sketch of Mr. Yule appeared in THE CANADIAN ENGINEER last year.

CHAS. BREWER HUNT, FIRST VICE-PRESIDENT.

CHAS. BREWER HUNT, manager London Electric Company, 1st vice-president of the Canadian Electrical Association, 1897, was born at Windsor, Ont., November, 1849. His first venture in the electric business was in 1878, when he built a private telephone line in London, with two calls upon it, extending from his office, corner of Richmond and King streets, to Hunt City Mills This was the first telephone line doing practical work in London, and was the beginning of a telephone exchange, which was established by Mr. Hunt and several other gentlemen a few months later, and which was sold out at a good profit to the present Bell Telephone Company a year or so afterwards. Shortly after this, Mr. Hunt became interested in a small arc lighting plant, which was started in London by the Royal Electric Company. This being the first electric plant established in that neighborhood, was an object of great interest to all who chanced to see it. Mr. Hunt himself being infatuated with the mysterious working of the electric arc dynamos, decided, in company with his brother, to buy out the Royal Electric Company's interest. This was the starting of the present large and flourishing business carried on by the London Electric Company, of which the subject of this notice is now the manager. Mr. Hunt retains the fullest confidence of all the directors, many of whom

are residents of Toronto. He is also largely interested in the London Street Railway, which was recently converted from a horse to an electric road, and is, undoubtedly, one of the finest equipped electric railways in Ontario. Mr. Hunt takes an active interest in all matters connected with the Canadian Electrical Association, and any member visiting London will, we feel sure, be welcomed by him at the London Electric Company Power House.

J. A. KAMMERER, SECOND VICE-PRESIDENT.

J. A. Kammerer was born at Niagara Falls, N.Y., about 40 years ago. From 1871 until 1891 he was connected with the telegraph and telephone service throughout the United States. He took up electric lighting in 1888. He came to Canada in 1891 and entered the service of the Royal Electric Co., Montreal, in April of that year, as sales agent, and spent a year in Manitoba and the North-West Territories He then came to Toronto, in the interest of the company, and took charge of the Ontario district for about a year, when he was appointed general agent for the company.

COMMENTS ON THE CONVENTION, AND NOTES ON NIAGARA.

The seventh convention of the Canadian Electrical Association was, all things considered, the best yet held, a feature specially notable about it being the large attendance of central station men, and the interest they took in the proceedings.

The re-election of Mr. Yule, though not anticipated in the ordinary course of official changes, is a popular appointment, as he has worked hard and intelligently, and has neglected nothing that he has conceived to be in the interests of the association. Messrs. Hunt and Kammerer, as vice-presidents, will both make excellent officers, for both have good business abilities, as well as a knowledge of the needs of the association.

The members were loud in their praises of the services of Wilfred Phillips, the genial manager of the Niagara Falls Park and River Railway, to whose kindness and forethought the association were so much indebted for the pleasures which have made this convention one to be remembered. Mr. Phillips' services to the association, though so important, were rendered with the modesty that is so natural to him, and the vote of thanks to him, passed at the convention, was no mere formality. Certainly the trip over the Niagara Falls Park and River Railway was one that will not be forgotten by the visitors.

There is not a foot of the route traversed by the Niagara Falls Park and River Railway from Queenston to Chippewa that does not present some scene that has a charm to the traveller. The wonders and beauties of Niagara are not to be realized in a day, and the scenery along this favorite route cannot be fully appreciated in one trip. Indeed one of the oldest residents at the Falls observed to the writer that he never goes up and down this wonderful river without making some new scenic discovery that charms and surprises him. In this respect the Canadian side of the river is remarkable; and while about two-thirds of the water of the whole river pours down on the Canadian side, it is also true that two-thirds of the great natural features about the Falls are to be found on Canadian territory. While this is true, it must be admitted that because of superior energy, combined with other causes, the Americans have made far greater commercial use of their opportunities than we have. The engravings we give in connection with these sketches illustrate this remark. We have all the grand natural scenery, they have the big hotels and the business that flows from them; we have most of the water power, they monopolize nearly all that has been developed. The Niagara Falls Park and River Railway are the only users of power from the Niagara on the Canadian side, and they, unfortunately, are not permitted under their charter to sell power or use it for other than their own railway requirements. Readers of THE CANADIAN ENGINEER are aware that the vast water-power on the Canadian side has been tied up by an unfortunate bargain with the company known as the Canadian Niagara Falls Power Co., composed in reality of members of the Cataract Construction Co. who own the big electric power works on the American side. It will be remembered that this company recently applied for an extension of time in which to complete their power works on the Canadian side, and if this time had been granted it would have tied up the Canadian power development for another period, and fastened a most undesirable monopoly on the Province of Ontario—for it is a question whether any independent company would have the right to take water from around the Canadian Falls if the conditions made with the so-called Canadian company had been fulfilled. Indeed, as matters stand, the claims of another company who propose to draw water from the Welland (Chippewa) River by a canal and discharge it under the Park grounds just below the falls, have not yet been determined. Quite recently this question was brought before the Ontario Court of Appeal for an opinion as to the status of the parties, but the promoters of the Welland River scheme, known locally as the "Canal scheme," withdrew the reference to the court, apparently preferring to start in and take their chances of a favorable interpretation afterwards. Having already made preliminary surveys, they last month started a few men on digging a ditch above the falls, and a representative of this paper was informed that an announcement of their plans would be made in a short time. This scheme is not to be confounded with that of the Cataract Power Co. promoted by John Patterson, of Hamilton, who proposed to convey water to a point near De Cew's Falls and carry electric power thence to Hamilton. Meantime the American syndicate, who counted easily on the Ontario Government granting the delay asked for, but who have been informed that the works must be completed as first agreed by November 1st, 1898, have been digesting plans by which they can save their charter and the $25,000 rent they have been paying to the Queen Victoria N.F. Park Commission since 1892. Engineers have staked out the site, borings have been made through rock that is to be pierced by the big shafts, and it is said that the new machinery for carrying out the work will be on the ground from the United States next month. So, between the two or three schemes pending, we may at last look for the building of the great industrial enterprises that should have been commenced long ago on the Canadian side of the world's greatest water power.

Meantime the only existing power we can boast of is that owned by the N. F. P. & R. Railway, views of whose power house are given herewith. It has a capacity for 3,000 h.p., of which 2,000 h p. have been put in. The present power is provided by two wheels of 1,000 h.p each, built by Wm. Kennedy & Sons, of Owen Sound. There are three Canadian electric generators of 200 K.W. each, the company still using also its steam power generators at Queenston to surmount the steep hill there. The electrical installation was made under the superintendence of Mr. Phillips, who was then the electrician of the road, and everything works with admirable smoothness. The construction of the road, which is 13½ miles long, reflects great credit on W. T. Jennings, C.E., Toronto, who supervised the work. It is well ballasted, with heavy ties and heavy steel rails, and guard rails are placed wherever the track curves near the river bank. The cars are exceptionally strong, with solid steel 33-inch wheels, and heavy steel axles. Some cars are built with three tiers of seats running longitudinally, so that all passengers can view the scenes below without rising from their seats.

The business of the Canadian convention closed by a banquet at the Dufferin Cafe. The dinner was excellent and was well served, and the arrangement of the whole programme reflected much credit on the committee, which was composed of E. E. Cary, chairman; F. C. Armstrong, C. B. Hunt, W. Phillips and A. B. Smith. After the Queen had been loyally toasted, "Our Guests" was proposed and replied to by James Wilson, of the Niagara Falls Park Commission; Mr. Lincoln, of the Cataract Construction Co., and James Innes, ex-M.P. of Guelph. Mr. Wilson referred to the attractions of Niagara and pointed to the great electrical works on the American side as a foretaste of what might soon be expected on the Canadian side. Mr. Innes in his speech paid a compliment to the ability and energy of the chairman (Mr. Yule). He remembered, as a press man, coming down to see the first coal oil lamp, which seemed a remarkable advance in the progress of house illumination, but no one seemed to conceive then of the wonders of electric lighting. "The Electrical Industries" was replied to by W. H. Browne, of Montreal, who looked forward to the time when this association would no longer be limited to questions of electric light, but when heat, power and chemical work would come in for an equal share of

attention—for there was a tendency to transform electricity into all forms of power. He was associated with what was probably the first electric railway in the world—in Virginia in 1887—when there seemed but little probability of the present attainments in electric railway operations; but now that the experiments of the N. Y. and New England railway with the third-rail system had proved so successful, it was quite possible that within another five years the steam locomotive would be practically superseded by the electric one. Even now the G.T.R. contemplate the operation of all their lines around Montreal by electricity. The ease of transportation is bringing the country into the city and giving the city access to the country, and the next step is the carrying on of farm work by electricity, and then we shall have the horseless era. The time was not far off when cooking and the commoner forms of labor will be done by electricity, so that lighting will be the least important branch of the electrical field. There was a great opportunity for the young to study this great power field. H. P. Dwight, of the G.N.W. Telegraph Company, also replied, giving interesting reminiscences of the early days of the telegraph. After letters of regret were read from absent friends, the toast of the "Ladies" was responded to by F. C. Armstrong, in a humorous speech, and the "Press," the last toast, was replied to by W. J. Johnston, of the *Electrical World*, New York Mr Johnston told how his paper was first started 23 years ago under the name of the *Operator*, and came into existence to represent the interests of telegraph operators. The paper followed the advances and changes of electrical work, until now few would trace the relationship of the present volumes to those of its humble beginning

The miniature incandescent lamp formed into a scarf pin, distributed by the Canadian General Electric Company, was the best appreciated souvenir of the convention, and the demand was much greater than the supply. At the National Electric Light Association's gathering on the New York side there were souvenirs in abundance, from lead pencils and paper weights to sections of cable and chunks of carborundum, but wherever THE CANADIAN ENGINEER man went with his miniature lamp displayed on his badge he was asked, "Who's giving out that lamp?"

Speaking of carborundum and the American convention, the special industries gathered round the water power district of the American Falls are an interesting sight, and an object lesson to Canadians, who are allowing time and opportunity to slip by in the development of like Canadian industries. Some of these American factories are kept strictly closed to visitors who have not some special "pull" with the owners, but others are freely open. There are the big aluminum works of the Pittsburg Reduction Co., the Carborundum Works, the Calcium Carbide Works, the works where the electrical production of soda and other chemicals is carried on, the Mathieson Alkali Works, and there are paper mills, pulp mills, lumber mills, foundries, all of which have combined to double the population since 1890. The latest of the large special industries to be established here is the American branch of the Oldbury Chemical Company, near Birmingham, England, who are large manufacturers of electro-chemical products and who have two and a half acres of ground for their new plant now being erected. In this connection it must not be supposed that the Cataract Construction Company are the only developers of power here, for the company known as the Niagara Falls Hydraulic Power and Manufacturing Co., supply eight concerns with water-power, ten concerns with electric power, and two with mechanical power furnished from their shafts. This company was in existence years before the Cataract Construction Co., and have a canal of their own through which water is led from above the falls sufficient to generate 150,000 horse-power, of which about 40,000 horse-power is now developed and used. A view of the river bank displaying some of the cataracts from their discharge pipes and tunnels is shown in this issue. The hydraulic engineer of this company is W. C. Johnson, of Niagara Falls, N.Y., who has made a special study of hydraulics and who has solved many difficult problems in the erection of various works here. Through the courtesy of Mr. Johnson, our representative was shown through the various factories where these problems have been worked out.

On Friday morning, before the members started out on their sight-seeing jaunt, they were greeted with a summary report of the convention, which Mr. Mortimer, with commendable enterprise, had compiled, one page being devoted to humorous skits, which were taken in good part by those who were "skitted."

To the Toronto members one of the pleasantest features of the convention was the trip across the lake and back by the Niagara Navigation Co.'s fine steamers. It seems like getting into a new country to face the cool and appetizing breezes of that grand old lake, and everybody enjoyed the trip as if it had been their first.

Then there is the Niagara Falls Power Company, associated with the Cataract Construction Company, having a tunnel of 100,000 h.p. capacity, and a second tunnel which will yield 150,000 h.p. So that the American power works, when developed, can supply 400,000 h.p. It may here be noted that the three tunnels contemplated by the Canadian Niagara Falls Power Company would yield a total of 350 000 h.p. The N. F. Power Company have so far laid out about $7,000,000 in plant and property on the American side, but have bought no land on the Canadian side, except for the immediate works of the Can. N. F. Power Co The N. F. Power Company now supply hydraulic power to one company to the extent of 7,200 h.p., and electric power to 21 companies to the extent of 14,695 h.p., besides the 5,000 electrical h.p. they send to Buffalo, making a total of 26,895 h.p. which they now furnish. Besides their large interests in Niagara Falls city, they own the suburban village of Echota, which they are building up, and the houses in which are all rented at a reasonable price, which always includes water supply and electric light. The power furnished from their three big dynamos of 5,000 h.p. each (described in a former number) has of course all been taken up, and the company are pushing ahead with excavations for seven or eight new wheel pits, so that it will probably not be long before the whole 50,000 h.p., for which this power house is planned, will be taken up.

Among the most interesting of the special industries of this place is the works of the Carborundum Co. What is carborundum? It is made by four s's—sand, sugar, salt and sawdust. These simple materials are mixed and fused in an electric furnace at a low heat, and the result is carbide of silicon, or carborundum, which is a mass of crystals as hard as diamonds. They are in effect artificial diamonds, and their commercial use is as an abrasive. The crystals after being reduced to all grades of fineness are mixed with porcelain or other material, and made into cylinders, discs, straps, boards and blocks for use in grinding and polishing, from delicate dental and jewlery work to the coarsest machine and tool work. For these purposes it is fast superseding emery and corundum, for though dearer to begin with, it is vastly superior in life and efficiency. The company started recently with capacity to produce 300 lbs. per day, but so great has been the demand that they are now turning out 10,000 lbs. per day, and the 1,000 horse-power which they are now using requires to be doubled to 2,000 h.p. More than this, the company are now preparing to equip a branch plant in Canada, of which THE CANADIAN ENGINEER will give particulars later on Reserving a detailed description of its manufacture till then, we may observe that carborundum is both infusible and insoluble—neither oils, water nor acids affect it. Even hydrofluoric acid, which dissolves all the silicates—does not eat it. The colors of the crystals as they come from the furnace vary from pale greens to cobalt blues and violets, and their sheen is beautiful beyond description.

The Pittsburg Reduction Co. started the manufacture of aluminum at Niagara Falls in 1895 with 1,500 h.p., now they have two establishments here, using over 6,000 h.p. The direct electric current is essential to the making of aluminum, so that this is likely to be the headquarters of this industry. Indeed, it is understood that this company, while controlling the entire output of the United States, are now securing control of the European market, and would so rule the world's product of this metal, as the Standard Oil Co. does that of petroleum and its products. While the output of aluminum is steadily increasing, the reader should be informed that a great many of the uses for which it has been so highly lauded have been proved to be impracticable. Some enthusiasts imagined that aluminum was to supersede every other metal under the sun, and when its failure was demonstrated to the cost of experimenters in many lines, it has got a "black eye" in other quarters where it did not deserve it. The fact is that aluminum has a low melting point, and for uses where the metal is subjected to intense or prolonged heat, it is a failure. It is successfully used to make many articles of household use such as cooking utensils and articles in which lightness is an object, and a factory exists near the Reduction Company's works that is turning out large quantities of such articles. Among the items which the Reduction Company put in their price-list are ingot, in pure aluminum and in alloys, but it is noted that the metal is not suited for alloying with brass or zinc, though a special casting is made as a substitute for brass. These ingots range from 31 to 42 cents per lb., and aluminum castings at 45 cents per lb. upwards, according to circumstances. Rolled rods, wire plates and sheets are made at corresponding prices. Under certain conditions aluminum wire is being successfully used instead of copper wire for the transmission of electricity.

After an interesting trip over the "Gorge Route" electric railway, on the American side, the Canadian convention came to a delightful close by a run into the foot of the cataract on the steamer "Maid of the Mist," by courtesy of the genial Capt. Carter, whose own trusty hand was at the helm.

The American convention (National Electric Light Association), from June 8th to 10th, was characterized by the usual vim and bustle of our cousins across the border. The International Hotel was a humming throng each day, and numerous exhibits, which could not be placed in one room, were scattered among the private apartments of the hotel. It is to be hoped that the day will come when the Canadian electrical interests will also be able to make a good exhibition as a feature of the convention. To us the American convention had a special interest, derived from the fact that a Canadian, who had sat on the council for five years, during which he had been elected successively to the second and first vice-presidencies, was now in the sixth year sitting as president over the most influenti l electrical institution in the Union. And a very able and diplomatic president he made, as was generously conceded by the technical press. The selection of him was an honor to Canada, and not to Mr. Nicholls only.

In his presidential term, Mr Nicholls introduced the idea of in terim presidential messages, which may well be adopted by presidents of other bodies. Whenever any question of importance cropped up he did not wait till the annual meeting, but sent out a message to the association giving information, or soliciting or giving opinions on the subject Where members of an association are scattered over a wide geographical area, and special meetings are inconvenient and expensive, the plan is a good one.

The photo from which the engraving at the head of our convention report is made, was taken by G. W. Whitaker, the skillful photographer at the Hotel Lafayette, which was the headquarters of the Canadian convention.

One of the instructive sights to the visitor interested in engineering is the new steel arch bridge over the Niagara, replacing the old suspension bridge at Clifton, about which we hope to give something in next issue The new bridge is built below and around the suspension bridge so that when the cables of the old were removed it rested on the new structure, which will be finished without interrupting the railway traffic a single hour The work will perhaps be finished by the time these pages are in the hands of the reader. The wires which form the big cables of the old bridge were perfectly sound, and it is understood they have been bought up by a Montreal firm to be manufactured into wire nails.

Speaking of bridges, it is understood that the new upper suspension bridge near the falls will be at once replaced by a new steel arch bridge, if the tenders now under consideration for the project are not too high If built, the arch will describe a parabolic curve, and will be the largest span in existence, being 840 feet, or 200 feet larger than that of the one at Clifton. A condition of the contract is that the bridge should be completed by the end of March, 1898. The plans provide for a double track electric road, as well as for a carriage way and road for foot passengers. One proposition is to take the materials of the present suspension bridge and build a suspension bridge on the site of the old one just above Queenston, the stringers and pieces of which now dangle weirdly in mid-air. This would connect the Gorge route with the Canadian Niagara Falls Park and River Railway at both ends, and by interchange traffic form a belt line which would be very convenient for the tourist, and could be made as profitable for the two companies

THE REVOLVING FIELD TYPE OF ALTERNATING CURRENT GENERATOR.

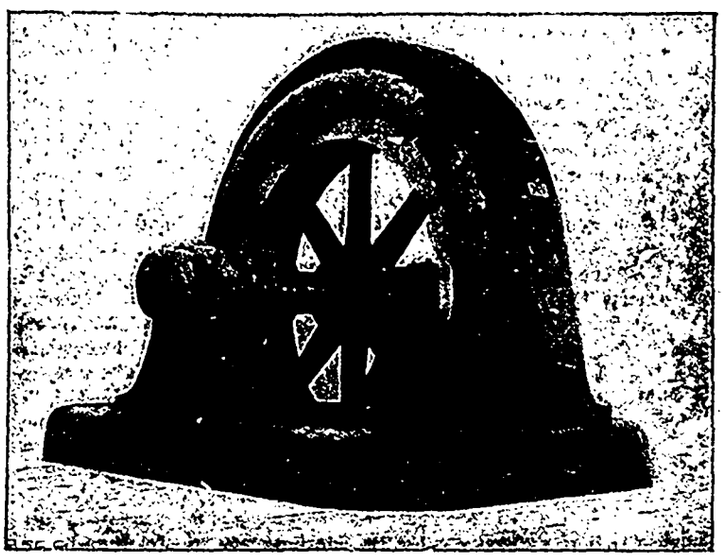
The development of the revolving field type of alternating-current generator and the standardization of a complete line, both for the monocyclic and three-phase systems, has of late occupied the attention of the engineering department of the General Electric Company with successful results. The alternators are designed for the standard frequency of 60 cycles and for pressures ranging between 500 and 5,000 volts.

The machines are built on the same lines as the Canadian General Electric type of induction motor. The stationary armature is built up of laminations stamped from specially selected and tested steel plates. Ample spaces are left for ventilation, and the coils are covered and protected by shields. The base of the armature is of smooth cast-iron and the pedestals supporting the bearings are provided with spherical seats, which support the boxes and allow of perfect alignment.

The removable bearings are, of course, self-oiling, with the oilways so cut as to give an even flow of oil from the resting places of the rings in the shaft to the end of the bearings where the oil returns to the reservoir.

The revolving field is extremely simple of construction. It is merely an iron spider mounted on a shaft carrying a soft-steel ring, serving as a yoke for the pole pieces, which are made up of laminated iron with polar projections. The field coils are removable, and in the larger sizes are wound with flat copper strips placed edgewise to allow of free egress from the coils of any heat. The armature can be moved along the base to facilitate access to fields and armature winding.

With a high efficiency, these alternators combine good inherent regulation, and can be, if desired, compounded for accurate automatic regulation. Such compounding in certain cases is not necessary to convenient operation, and may be omitted. When compounded a commutator is mounted on the shaft and rectifies current supplied from a series transformer in the main circuit. These compounding devices are not, however, included in the generator, properly so called. They come



THE REVOLVING FIELD ALTERNATING CURRENT GENERATOR.

under the head of extras. The temperature of the armature and the field windings does not rise above 45 degrees centigrade above that of the surrounding atmosphere.

The new type of generator is not, of course, intended to displace the revolving armature type. The revolving field type has its own special field of usefulness. It is free from high-potential collector rings and commutators, the only collector rings being the two used to bring the exciting current to the revolving fields. The high-potential part of the alternator—the armature—being a stationary structure, can, it is claimed, be wound and insulated for much higher pressures than is desirable for revolving armatures; and the current can be fed directly into the line without the intermediary of step-up transformers. All the high-potential terminals are effectually insulated.

The revolving field alternators can be wound for the two-phase system when desired, and when so wound are so arranged that armature coils can be cut in or out to give independent regulation of the two phases.

During the past year the Canadian General Electric Company has sold a number of machines of this type, some for belt drive, but principally for direct connection to water wheels and steam engines. The illustration shows a 750-kilowatt, 40-pole, three-phase machine, running at 175 revolutions and delivering current at 4,400 volts. It is one of 12 which will be used on the Lachine Rapids installation.

Two more generators of the same size and type are being constructed for the 30-mile transmission plant of the West Kootenay Power and Light Company. For very low potential work this type is especially well adapted, two machines of 150 kilowatts capacity each having been in use for several months in the works of the Willson Carbide Company at Merritton, Ontario.

FREDERIC NICHOLLS, PRESIDENT OF THE NATIONAL ELECTRIC LIGHT ASSOCIATION.

We noted in our issue of one year ago the election of Frederic Nicholls, second vice-president and general manager of the Canadian General Electric Co., to the presidency of the National Electric Light Association of the United States, which is numerically and otherwise the most powerful organization in the world devoted to the furtherance of electrical interests. It was to be expected by those who are acquainted with the personal force and executive ability which Mr. Nicholls brings to bear on the many business enterprises with which he is identified, that the affairs of the National Electric Light Association would under his *regime* be conducted with characteristic energy. The main difficulty with all associations of this kind is to maintain the serious interest of the members in those matters of current importance to deal with which as an organized body is their apparent reason for existence. In practice innocuous desuetude during three hundred and sixty-two days in the year, and a junket for the remaining three, is only too apt to be the actual *modus operandi*. The National Electric Light Association has admittedly suffered from this tendency in the past, but the improvement visible for the past few years has culminated under the presidency of Mr. Nicholls in a year of serious effort to deal with matters of vital moment to the electrical industry, and more particularly in the proceedings of the convention just closed at Niagara Falls, admitted on all sides to be the most successful in the history of the association.

The papers read before the convention were in most cases statements by recognized authorities upon topics of special interest. Amongst such may be mentioned the paper by Professor Elihu Thomson, on "Arc Lighting"; that by Arthur Wright, of Brighton, Eng., on "Profitable Extensions of Electricity Supply Stations"; that by Mr. Scott, on "Rotary Converters," and the lecture by L. B Stillwell, on the "Application of Niagara Power." The attendance at the convention was the largest on record, reaching a total of over one thousand, and the proceedings throughout were of a most animated and interesting nature.

The American electrical press, in speaking of the convention, does so in terms which are highly complimentary to Mr. Nicholls as president of the association. We quote from the *Electrical Engineer*, of New York, as follows

"In every respect the convention of the National Electric Light Association, at Niagara Falls last week, must be regarded as a great and brilliant success, far beyond that which was expected by those who had worked hardest to secure a happy result. The attendance was large; the papers were excellent and timely, the devotion to work was exemplary, harmony prevailed, the weather rang the changes so that the Falls could be seen in every aspect, and a good choice was made of officers to carry out the programme of usefulness to which the association has for some years past so consistently pledged itself. President Nicholls retired from office in a literal blaze of glory."

The *Engineer* further says: "To President Nicholls the association is under the deepest obligations for his devotion to duty and his skillful guidance of its affairs, and his term of office will always stand out in bright relief, no matter how much good work precedes it, nor how earnestly his successors strive to leave a brilliant record also."

Electricity, of New York, speaks thus: "President Nicholls made a model and dignified presiding officer. He far eclipsed his previous efforts, and it will be a high compliment indeed to any of his successors if it can be said of him that he equalled Mr. Nicholls as a presiding officer."

The *Western Electrician* of Chicago, in an article on President Nicholls' administration, believes that "it has been a great many years since the National Electric Light Association has had such an energetic president as the occupant of the office at this time, and it is but fitting in the closing days of his administration to call attention to the excellent character of the work he has done and the value of the service he has contributed to the association."

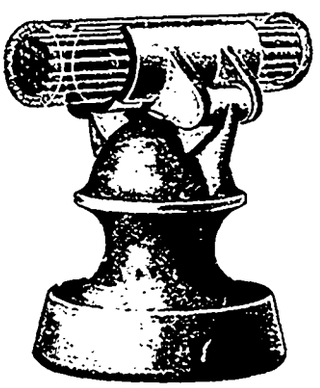
The *Electrical World* refers to the general character of the convention as follows: "While the social features and minor gaieties which characterize all conventions were not forgotten in this instance, the gathering was generally commented upon as the most business-like meeting that has yet been held by the association. The discussions of some of the papers were more than ordinarily valuable in bringing out the views of men whose opinions are entitled to respect, while the papers themselves were of a class calculated to instruct as well as to edify those who heard them. It is a pleasant task to be thus able to sum up the twentieth convention as the best in the history of the association, and still more pleasant to be able to prophesy that from all indications the twenty-first convention will be still more valuable and attractive to those who may have the pleasure and privilege to attend it."

The *Electrical Review*, of New York, has the following to say: "The success of the association during the past year under the wise and enterprising management of its retiring president, Frederic Nicholls, has been marked, highly satisfactory to all concerned. The administration has been at all times vigorous and well directed."

Altogether Mr. Nicholls in person, and the electrical public in Canada generally, have reason to feel most gratified at the manifest approval with which our American friends have greeted the occupancy on part of a representative Canadian of the president's chair of their most important electrical organization.

TOGGLE-CLAMP FEED WIRE INSULATOR.

The usual method of attaching feed wires for electric railroads and electric light wires to their insulators consists in the use of a binding wire, a loose screw cap or hammering over the fingers which are furnished on either side of a groove in the top of the insulator. The use of a tire wire necessarily requires time and the risk of abrading or cutting through the insulating covering of the wire. A screw cap is liable to fall from the hands of the lineman or to cause other trouble on account of its size and nature. The hammering over on the wire of the metal retaining fingers is not to be considered good practice for the reason that the fingers are usually so stiff and brittle that in case the wire has afterwards to be removed the fingers are with difficulty opened or break off in the effort. The "toggle-clamp" feed wire insulator has been designed to provide an instantaneous fastening for the wire, with none of the disadvantages just mentioned, and every advantage in the way of instant removal without injury to the wire. The construction consists of two hinged parts as shown in the cut, so arranged that the



weight of the cable causes the two jaws to come closer together with a powerful toggle action. To insert the cable the jaws are opened by an upward movement and the cable is dropped into place. No other fastening is necessary. The cable is removed by simply lifting it out of the jaws, thus saving a great deal of time in installing, or shifting a line. The moulded insulation is protected with a malleable cast iron casing completely covering the exterior surface of the insulator. The toggle-clamp cable insulator is manufactured by the H. W. Johns Mfg. Co., 100 William st., New York.

METAL IMPORTS FROM GREAT BRITAIN.

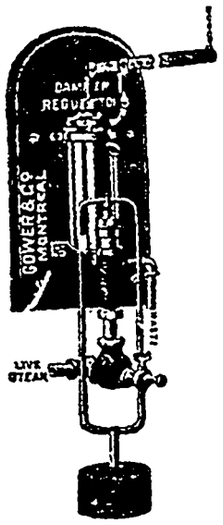
The following are the sterling values of the metal imports from Great Britain for May, and the five months ending May, 1896 and 1897:

	Month of May.		Five months ending May.	
	1896	1897.	1896.	1897.
Hardware and cutlery	£6,097	£7,730	£27,493	£25,647
Pig iron	3,179	563	7,780	1,018
Bar, etc.	2,141	316	6,299	4,205
Railroad	9,675	6,935	22,038	20,286
Hoops, sheets, etc	5,481	5,436	11,696	16,445
Galvanized sheets	3,006	3,975	15,672	15,998
Tin plates	13,753	8,652	56,119	80,972
Cast, wrought, etc., iron	6,776	3,882	21,568	14,965
Old (for re-manufacture)	2,680		3,061	572
Steel	10,590	3,493	36,727	18,480
Lead	1,182	1,672	5,443	4,454
Tin, unwrought	1,559	1,609	7,074	8,925
Cement	3,393	1,825	10,365	4,778

THE International Luxfer Prism Company, Chicago, Ill., has been incorporated under the laws of the State of Illinois, with a capital of $1,000,000, commencing with $500, to manufacture and deal in iron, building materials, etc. John M. Ewin, Wm. A. Illsley, and W. M. Sturgis, Chicago, Ill.; Thos. W. Horn, Toronto, Ont.; W. H. Winslow, River Forest, Ill., are the incorporators.

AUTOMATIC DAMPER REGULATORS.

Hitherto the high price of these and the cost of delivery and high customs duty have all tended to prevent the spread of this useful appliance in Canada that it deserves. Gower & Co., Montreal, are now, however, introducing on to this market a damper regulator for steam boilers at the reasonable price of $60, which is somewhat about half the price of those that have been put before the steam users up to the present. The advantages of a damper regulator are manifold. It adds to the life of the boiler, keeping the expansion and contraction more uniform. It keeps a steadier stroke on the engine. It can be absolutely relied on as a safety valve. It saves coal and can always be depended upon at night or by day, and eases the mind of the fireman, who, in many cases, has his coal pile many yards away from his boilers. Messrs Gower & Co.'s regulator is warranted to operate the dampers of any size on a variation of but one pound pressure. So that if the damper is of ample size the boiler pressure will never vary more than one pound. It is actuated entirely by steam and has but



one connection to the boiler and no water connection. There are no complicated parts, the only movable parts being two pistons; one small, controlling steam to the larger one. The regulator can be taken apart and cleaned by any fireman or engineer. Messrs. Gower & Co. are well known as the Canadian engineers and representatives of the celebrated Green's Fuel Economizer, and we feel sure that the firm make sure of the excellence of any machinery they put on to the market.

WATER DRIVEN PLANTS.*

BY JOHN MURPHY.

As close regulation is the most important point in the operation of any electrical plant, I will endeavor to show how this can be accomplished best in a water-driven plant, and, as so much depends on the manner of installation, I will dwell for a moment on the importance and method of properly equipping the water wheel gate. I take it for granted that the water wheel itself was placed in position by a competent engineer, due provision made to cope with low water, anchor ice, and the many other troubles inherent in the use of water power. This having been done the gate and all its connections, from the water wheel to the hand wheel in the dynamo room, should be so constructed as to move quickly, positively and easily, so that the instant the regulator is actuated by a variation in speed the water wheel will receive its greater or lesser supply of water and thus be enabled to maintain a constant speed. An arc plant with its automatic current controllers, driven by a water wheel equipped as indicated above, will run for an indefinite period with little or no attention, but incandescent lighting and power machinery require somewhat more supervision. I hold it is a mistake to attempt to supply power from a lighting circuit except in very small units. One of the greatest recommendations for the glow-lamp as an illuminant is its steadiness, but this quality is almost unknown when motors which are frequently started and stopped are run on the same circuit. The separately driven exciter is a great boon to water power users whose loads are subject to great variations. Its many advantages are so apparent that it seems unnecessary for me to do more than merely mention it in passing. Another arrangement, the utility of which speaks for itself, is the automatic field controller, which strengthens or weakens the generator field circuit according as the potential on the line falls or rises.

An incandescent lighting plant requires a certain amount of hand regulation, although the apparatus just referred to is useful, within certain limits. All hand regulation necessary on a lighting circuit should be done, figuratively speaking, as far away from the lamp as possible; in other words, it is the field circuit of the exciter that should be varied when it is necessary to change the potential on the line. The exciter field rheostat should be of large range and divided into a great many sections, so that the movement of the rheostat-arm from one point to another would cause such a slight change in field current as to make a scarcely perceptible difference in the brilliancy of the lamps. Where large generators are used and many circuits are run, the use of the individual circuit regulators becomes imperative.

I wish to call your attention to two pieces of mechanism. The first device is an automatic speed indicator and alarm, which points out the speed at which the machinery is running, and also rings a bell at every change of speed. The other is to close the water wheel gate the instant the speed rises above a predetermined point. It consists chiefly in a pair of friction pulleys mounted on a frame. One of the friction pulleys is continuously driven from the machinery to be controlled, and the other is connected to the gate-closing apparatus. These friction pulleys are normally placed apart and are brought into contact by a weight or spring, which is released by a lever attached to a pair of governor balls. The instant the speed rises a certain percentage above the normal, the governor balls move the lever, and the weight or spring being released, the frictions are pulled together and the gate is immediately closed.

It would hardly seem correct to leave the subject of the operation of water power plants without at least mentioning that bane of water power users—anchor ice. If wheels are favorably situated, that is, if they are supplied from a large pond in which there is little or no current, and if there is an overflow or by-wash into which most of the floating ice can be diverted, by extreme watchfulness a complete shut-down can be prevented. But, if the wheels have no still pond from which to draw their water supply, it is prudent to resort to the auxiliary steam plant as soon as there is the least suspicion of anchor ice.

* Abstract of a paper read before the Canadian Electrical Association.

JUBILEE FOUNTAIN FOR MONTREAL.

It was a happy inspiration which moved Mr. Macaulay, of the Sun Life Assurance Co., to present a drinking fountain to the City of Montreal, as a memorial of the Queen's Jubilee. The accompanying illustration is a sketch reproduced from the *Witness*, of the proposed

SUN LIFE ASSURANCE CO.'S FOUNTAIN.

fountain, which will be a granite block surmounted by the figure of a sleeping lion, and having the inscription, "A tribute to Her Majesty, Queen Victoria," with the dates 1837-1897.

DYNAMOMETER.

Editor CANADIAN ENGINEER.

SIR,—Kindly inform me if there is a car coupler that will test the draft of a locomotive, giving the draft in pounds. Where can it be got?

J. W. VAN NORMAN.

Peterboro, Ont., June 5th, 1897.

The apparatus you refer to is usually known as a Dynamometer and there are a number of them on the market. If you were to enquire of any of the leading makers of testing machines, as the Riehle Bros. Testing Machine Co., Philadelphia, Pa., they would be glad to afford you all the information possible on the subject.

THE KINGSTON, ONT., SCHOOL OF MINING.

Editor CANADIAN ENGINEER:

SIR,—Kindly correct a mistake in your report, in a recent issue of your paper, of the number of students attending the School of Mining, Kingston. The number 502 as given in THE ENGINEER includes the 300 students who attended the ten outside classes. Thus, the total number of students attending classes in the School of Mining is 202. Long before it reaches 502 we shall need larger buildings.

I remain, yours, etc.,

W. L. GOODWIN.

FIRES OF THE MONTH.

June 1st.—W. S Stewart's planing mill, etc., Lucknow, Ont., also electric light plant. Loss, $15,000 — June 1st.—Carriage factory belonging to S. Siggins, Woodstock, Ont. Loss, $5,000.——June 3rd.—Firstbrook's box factory, Toronto; damages amounting to $200.——June 8th.—Cossit's foundry, Brockville, Ont., fire started in painting department. Fully covered by insurance.——June 12th.—Davidson & Campbell's planing mill, Niagara, Ont. Loss, $15,000.——June 15th.—Part of the east end abbattoir, Montreal. Loss, $35,000.——June 16th.—Canning factory at Tiverton, N.S. Loss, $3,000. —— July 4th.—Fenderson & Co.'s saw mills, Sayabec, Que. Loss, $30,000; insurance, $8,000.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Kingston branch No. 10, C.A.S.E., has elected and installed the following officers for the current year. President, Fred. Simmons, vice president, Charles Asselstine; secretary, John L. Orr; treasurer, Charles Selby; conductor, Wm. H. Woodrow; door-keeper, Robert Bajus; trustees, Past President Sandford Donnelly and Jas Blomley

At the June meeting of Toronto No. 1, C.A.S.E., held in Engineers' Hall, the following officers were elected President, Geo C Mooring; vice president, Thos. Eversfield, rec. sec., John W. Marr, 28 Grant street, Toronto; financial sec., John G. Bain; treasurer, Samuel Thompson (acc.), conductor, George W. Thompson, door-keeper, T. Cadwell.

Arrangements are progressing for the forthcoming convention of the Canadian Association of Stationary Engineers at Brockville. By the constitution the convention should be held on the 17th and 18th August, but the date may be changed a day or two later, owing to arrangements that are being made for a special illumination of the islands. The exact date will be announced in our next number.

Albert E. Edkins, the popular inspector for the Boiler Inspection and Insurance Co., is slowly recovering from his recent serious illness, though not yet able to resume active duties. His many friends in the C.A.S.E. will be glad to see him among them again.

The Steam Boilers Act, which was a bill before the Dominion Parliament to provide for the examination of stationary engineers and the inspection of steam boilers, promoted by the members of Canadian nd Ontario Associations of Stationary Engineers, has been laid over till next session.

The following officers have been elected for Montreal No. 1, C.A.S.E.: President, Wm. Smyth; 1st vice-president, J. M. Boden; 2nd vice-president, P. McNaughton, secretary, Jas. O'Rourke, treasurer, J. L. Jones conductor, J. Glennan, doorkeeper, J. Wilson, trustees, John J. York and Geo. Hunt

An association called the Railway Men's Air Brake Club has been ormed among the G.T.R. employees at Sarnia, the principal object of which is the study of the air brake. J. B. Wilson is president and Ed. Everett, secretary, and the association now numbers about 75 members, though it has only been in existence about five months A similar organization called the G.T. Air Brake Mutual Association has been formed in London, Ont., with Thos. McHattie as president and Geo. Black, secretary.

ELECTRIC RAILWAYS—HOW TO MAKE THEM A COMMERCIAL SUCCESS. *

BY C. B. A. CARR.

For an electric road in a town or city street, or wherever pavements of a permanent character are used, the girder rail seems to be the only one suitable. The depth of the rail should be not less than 7 in., and should weigh from 70 to 90 pounds to the yard. What the exact weight of the rail should be would depend upon the frequency of the service required, and the weight of the rolling stock to be used. In a macadam or unpaved roadway, a T rail of 65 pounds to the yard is all that is necessary. While it may be better, under certain conditions, to have rails laid in concrete with a permanent pavement, my experience has been that cars rattle and jar a great deal more than when running over a road-bed of less rigidity. In all paved streets, rails should be firmly spiked on oak ties 5 in. x 7 in. x 7 feet, spaced 2 feet apart. The grade should first be properly levelled, and the whole surface covered with good coarse gravel 6 in. in depth. Fish plates or angle bars 3 feet long, with not less than 6 bolts at each rail joint, should be properly fitted and bolted. Soft copper bonds of sufficient size to carry the maximum return current from any distant part of the line to the power house, should be properly attached at each joint.

The trolley should be carried with a straight line hanger thoroughly insulated and attached to a flexible bracket or span wire.

The rolling stock should be the best obtainable, and for city traffic, mounted on single truck with wheel base not more than 7' 6".

The power house should be built near a railroad track, so that coal can be cheaply delivered, and it is very desirable that the site selected should be near a good water supply, so that condensing engines may be used. If these conditions can be had near the centre of distribution, a very great saving can be effected in the cost of copper feeders.

In Canada, where soft coal is used for fuel, the high freight and duty rates make it essential to have boilers of the highest efficiency, without much regard to their first cost. For this same reason, the boiler room should be fitted with fuel saving appliances, such as an economizer, heater, stoker, automatic damper, regulators, etc.

A certain degree of revenue is the reward of all street railways, but it is not enough that we carry our regular customers. These come to us anyway, and it is to these that we look for a guarantee of our operating expense. The profit or success of the railway lies in the margin of how many we can induce to become patrons, and thereby increase the regular revenue. One good way is to issue annually a handsomely illustrated booklet, which contains cuts of all the interesting points touched by the cars, briefly telling how to get there. A specially illuminated car for trolley parties is a profitable source of revenue. Many electric railway companies establish parks at the end of one or more of their lines, and provide amusements in the way of band concerts, etc. This brings considerable increased revenue, at a time of the day when cars would otherwise be running light. Some companies claim to have profited by this departure, while others have an adverse experience.

The selection of employees has more to do with the success of an electric railway than anything else. The idea that anyone can run a street car, has, in many cases, resulted in the employment of incompetent, careless and ignorant men, who, through these qualities, have brought the railway into public disfavor. Conductors, motormen, inspectors and shopmen have the power to earn or lose money; make the railway popular or odious with the public, keep claims for damages at a minimum or make them a burden, and very often their selection does not receive the care that is exercised in the purchase of ordinary supplies.

A NEW horseless fire engine has been put into commission at Boston. It weighs 17,000 pounds, and will be handled by three men So far it has not been tried at a fire, but the captain who has charge of it is confident of its successful working.

* Abstract of a paper read before the Canadian Electrical Association.

Industrial Notes.

A SAW MILL is to be erected in Wardner, near Vancouver, B.C.

C. R. CLOUGH & Co., Lennoxville, Que., are about to build a grist mill.

SMITH & MCLEOD have built a new sash and door factory at Vernon, B C.

GEO. W. UPHAM, Woodstock, N.B., is building a new saw mill at Fredericton, N.B.

J. W. COOK, photographer, Caledonia, Ont., has invented another unrefillable bottle.

THE McClary Mfg. Co., London, Ont., will, it is said, establish a branch in Montreal.

THE Globe Furniture Co., Walkerville, Ont., is exporting its products to South Africa.

THE Gas and Water Company, Sherbrooke, Que., has empowered its directors to sell out to the city.

THE Queen City Oil Co. has made Brockville, Ont., one of its chief distributing points in Ontario.

R. SMITH & Co., Orillia, Ont., are putting a fifty-horse power engine and boiler in their stave mill.

A COUNTY bridge is to be built over the Nottawasaga river, on the town line between Sunnidale and Essa.

THE Toronto Aqueduct Power Company's bill has been killed for the session by the Railway Committee.

THE Macgregor-Gourlay Co., Galt, Ont., has had a Grand Trunk Railway siding put into their premises.

THE Malleable Iron Works, Toronto Junction, have closed down for an indefinite period, for stock taking.

THE Carleton Place, Ont., sawmills have closed down finally, as the supply of lumber has been exhausted.

WORK is proceeding on two bridges on the Trent and Table Rivers, on the Nanaimo-Comox road, B.C.

THE Hamilton Blast Furnace Co., Ltd., Hamilton, Ont., recently sold 800 tons of pig iron to a Montreal firm.

A. L. CASSON, of the Northwest Fixture Company, Seattle, Wash., proposes to build water works at Slocan, B.C.

LUKE MADIGAN, contractor, of Forest, Ont., has secured the contract for the $100,000 breakwater at Goderich, Ont.

THE Dominion Government has purchased a Sawyer-Massey road machine for use at the Ottawa experimental farm.

THE Nova Scotia Lumber Company has decided to rebuild its mill at Sherbrooke, N.S., recently destroyed by fire.

THE Lake of the Woods Milling Company will this year build elevators with a capacity of 200,000 bushels, in Manitoba.

NELSON, B.C., has bought the plant of the Consumers' Water Works Co. for $5,000 Possession to date from May 1st.

CHARLES C. HEARLE, Montreal, and John H. Bell, of New York, have formed a partnership for manufacturing boiler cleaners in Montreal.

GEO. MONTGOMERY is building at Dalhousie, N.B., a mill equipped with rotary, four shingle machines, planer and matcher and other machinery.

TALLMAN & SON, proprietors of the Beamsville Pressed Brick Co., have assigned to W. G. E. Boyd, Hamilton, Ont., for the benefit of creditors.

F. F. BUSTEED has prepared estimates for water works and electric light plant for the town of Fort William, calling for an expenditure of $48,000.

THE Renfrew town council has retained Willis Chipman, C.E., Toronto, as engineer for putting in a system of water-works and sewerage.

A. ROBB & SONS have purchased the Mumford Machine Works, at Hantsport, N S., and will remove the machinery, etc., to Amherst, Nova Scotia.

IT is reported that the Gould Coupler Company, Buffalo, N Y., will erect a plant at Brantford, Ont., to manufacture its devices for the Canadian trade.

A DAM on Ponhook Lake, above Windsor, N.S., broke recently and swept down a quantity of timber, damaging dams and bridges to the amount of $100,000.

GANONG BROS., manufacturing confectioners, St. Stephen, N.B., have ordered a 100-horse-power Monarch Economic boiler from the Robb Engineering Company, Amherst, N.S.

A TWENTY-FIVE years contract for the water supply of St. Lambert's, Que., has been given to T. J. Drummond, of the Montreal Pipe Foundry Works, to be completed by Nov 1st.

J. LIVINGSTONE, Montreal, recently recovered $574 from the Bank du Peuple, being a balance of $1,500 which he charged for managing the business of Wm. Clendinneng & Son for three months.

ABOUT three hundred men are employed on the new works of the Bushnell Oil Co., at Sarnia, Ont. At the present rate of progress, the company will equip the plant in remarkably short time.

N. N. BENTLEY, Five Islands, N.S., has purchased Hill & French's lumber property at Ship Harbor. The Ship Harbor mills, which were burnt down a year ago, will not be rebuilt.

THE Nelson *Miner* says that a powder mill is to be established at Kaslo, B.C., as T. J Watter and Raymond Meyer have decided to erect a plant that will have a capacity of 50,000 pounds a month.

C. & E. MILLER, exporters of West Australian hardwoods, have offered to supply blocks for paving 10 chains of street, in Toronto, free of charge, in order to demonstrate the suitability of this material for street paving.

THE National Convention of Master Plumbers of Canada was held in Toronto, July 1st, 2nd and 3rd. Pressure on our columns prevents more extended reference this month, but we hope to give our readers an account of the meeting in our next issue.

THE Universal Patent Developing Company, Limited, applies for a Dominion charter to deal in patent rights. Capital, $20,000. The incorporators are: L. H. Henault, A. S. Delisle, M. E. Lymburner, G. N. Ducharme, Ste. Cunegonde; J. Adam, Montreal.

LUNENBURG Foundry Company, Limited, applies for a Nova Scotia charter to manufacture stoves and machinery. Capital, $20,000. The incorporators are J. D. Sperry, Petite Riviere; Joseph Creighton, G. E. Sollows, W. L. Romkey and A. K. MacLean, Lunenburg, N.S.

THE Hamilton Bridge Co. has been awarded the contract for constructing bridges required in connection with the widening of the Queen street subway, Toronto, at $10,464 for a bridge to carry Grand Trunk Railway tracks, and $6,990 for carrying the Canadian Pacific tracks.

R. H. SMITH & Co., saw manufacturers, St. Catharines, Ont., are building an addition to their works in the shape of a malleable iron foundry for the manufacture of iron bedsteads. This will be the second firm making iron bedsteads in St. Catharines. The new foundry is to be in operation this month.

THE city council of St. Hyacinthe, Que., has appropriated $40,000 for the improvement of the waterworks. A new pumping station is to be built nearly a mile above the present one and beyond the city limits, and a high-duty pump, with a capacity of 2,000,000 gals. per day, will be put in. A filtering system will be adopted.

THE Government has decided to allow only 900 cu. feet of water per second to be drawn from the old Welland Canal, nearly half will be used by the company which is to supply power in Hamilton, Ont. The carbide factory and other manufacturers at Thorold, Merritton and St. Catharines have applied for the whole of the rest of the available supply.

THE arbitrators in the matter of the expropriation of the plant of the waterworks company by the town of Cornwall, have made a unanimous award placing the value of the plant and system at $78,620, which, with the ten per cent. allowed by law, brings the expropriating price up to $86,491.73. The cost of the arbitration will be about eight thousand dollars.

THE Dominion Elevator Company asks for incorporation with headquarters at Winnipeg. The capital stock of the company will be $200,000. Applicants are as follows: R. P. Roblin, G. Leary, J. Harris, D. J. Harris, D G. McBean, R. Muir, F. Phillips, W. W. McMillan, A. McBean, S. A. McGaw, Winnipeg, grain merchants, and H. S. Patterson, Portage la Prairie.

SALARIES in the Toronto City Engineer's Department have been reduced from $24,000 to $20,000. The salary list of the department in 1890, exclusive of the surveying and plumbing departments, totalled $41,932.22, which included $4,338.76 for the waterworks branch, work which is now all done in the department. Since then the reductions have gradually reached the figures named.

ALEXANDER FORD, an employee of the Bertram Engine Works, Toronto, had a narrow escape from death recently. An immense plate of steel was being hoisted by a derrick, when the chain broke,

and the sheet of metal fell straight downwards, cutting the flesh from the upper muscles at the front of Ford's legs and severely crushing his toes. Had he been an inch farther forward when the mishap occurred his skull would have been crushed in.

THE Halifax, N.S., *Chronicle* says that a new industry is soon to be started in Halifax county. Nearly two months ago an English syndicate sent an agent to Nova Scotia for the purpose of searching for a suitable material for the manufacture of terra cotta, and as the result of his research it is understood he has been instructed to purchase some property in Halifax county, build a factory and manufacture terra cotta. The output of the factory will be sold both in the United States and Canada

THE statement presented at the meeting of the creditors of Paxton, Tate & Co., Port Perry, Ont., who have assigned to H. Barber, Toronto, showed liabilities of $47,018.69, and assets of $44,117.69, leaving a nominal deficiency of $2,901. There are over 100 creditors, in Toronto, Montreal, Hamilton, Galt and Port Perry principally. Most of the Port Perry creditors are for small amounts The largest creditors are William McGill, of Port Perry, $17,200, Hon. John Dryden, Brooklin, $10,750; the Ontario Bank, $6,900, and the Western Bank, $3,735.03 The banks are secured. The direct liabilities are $37,746.04, the preferred $1,105.59, and the secured $8,169 06. In the statement of liabilities the principal creditors are as follows:—Polson Iron Works, Toronto, $492; Plews & Scott, Toronto, $225; James Holman, Toronto, $102; Hamilton Blast Furnace Co., Hamilton, $264.85; H. E. Plant, Montreal, $500; Frothingham & Workman, Montreal, $251.08; James Hutton & Co., $181 65, Mrs. E Paxton, Whitby, $1,600; Dickson & Co., Peterboro', $218.64. Ottawa Saw Works, Ottawa, $141.45; Isaac Clemence, Seagrave, $100. The statement of assets is:—Stock, unencumbered, $1,150.75, encumbered, $34,101 96. Realty, land connected with and surrounding foundry, comprising about eight acres, $700; dwelling-house, occupied by George McLean, $400; foundry buildings and outsheds, $5 500, all valued at $6,600; dwelling-house and one acre, occupied by G. H. Dryden, $3,500, less mortgage of $1,545; bills receivable, $67.50; accounts, book debts, $242.48; total assets, $44,117 69 In the preferred claims the principal amounts are for taxes, 1896, $150.27; George McLean, $175; James Reid, $150; L. N. Walling, $130 26, these latter for wages. The secured liabilities are:—The Ontario Bank, $6,900, secured by first mortgage on land connected with foundry, together with all buildings, machinery tools and material on and about the premises, also dwelling-house occupied by George McLean; the Western Bank, $3,735.03, secured by customers' paper valued at about $4,500, and also a life policy in the Mutual Reserve for $10,000; Mrs. Mary Hodgson, $1,019.06, secured by chattel mortgage on house furniture and second mortgage on foundry, machinery, tools, etc; Goldie & McCulloch, $250, secured by lien on engine On the indirect liabilities Hon. John Dryden, of Brooklin, is a creditor for endorsement on paper held by the Ontario Bank as additional security for $6,900.

Electric Flashes.

THE Montreal Park and Island Railway is now running cars to the Lachine wharf.

THE Watford, Ont., electric light company has recently installed a new plant.

WELLAND, ONT., is putting in an electrical fire alarm system A. Anderson, Toronto, has the contract.

H. SURTEES, son of the Ottawa city engineer, has been engaged as chief electrician of the Quebec Electric Street Railway.

THE Cornwall, Ont., Electric Street Railway has not been running a year, and already shows a profit of about five per cent.

PLANS are under consideration to extend the proposed Hamilton, Chedoke and Ancaster Electric Railway to Brantford, Ont.

STEPHEN SMITH, Toronto, has lost the use of his leg owing to the decay of the flesh, which had been exposed to X-ray photography.

THE Montreal Belt Line Railway Company intends to extend its line through Bout de l'Isle to Berthier. J. P. Mullarkey is managing director.

THE town council of Owen Sound has passed a resolution favoring the establishment of a municipal lighting plant, at a cost of about $27,000.

THE Carleton Place, Ont., council has concluded a bargain with the Bell Telephone Company to establish a general fire alarm system for the town

THE Peterboro Electric Light and Power Co. is building a new central station this summer at which there will be about 1,000 horse-power (water) at their disposal.

THE Dundas, Ont., Light and Power Company has offered to furnish the town of Dundas with 25 street lights of 1,600 candle power for 300 nights a year, at $61.25 each.

THE St. Thomas street railway is to be converted into an electric system, says the Aylmer *Sun*. Col. Stacey, owner of the present road and J. H. Still, are interested in the undertaking.

THE Cornwall Electric Railway is now in good running, with six or eight motor cars The company is now considering the question of extending its system to some neighboring villages.

THE Minister of Public Works, Hon. J. I. Tarte, has prepared plans for extending the electric plant in the Parliament Buildings at Ottawa to supply light and also power for pumping.

THE Chambly electric power works are making rapid progress. Some 500 men are employed in this enterprise, and Peter Lyall, the contractor, hopes to have the dam finished this fall.

SADLER & HAWORTH, belting manufacturers, Montreal and Toronto, have just furnished the Hull and Aylmer Electric Railroad with two double leather main driving belts one hundred and thirty feet long and thirty-six inches wide.

THE Robb Engineering Co. are building two 300 horse-power tandem compound engines, one for the Halifax Electric Tramway Co., and the other for the St. John Railway Co. This makes five of these engines sold to the Halifax company.

GANANOQUE, ONT, has sixteen arc and eight incandescent lights, costing $1,216 a year, or $70 for each arc and $12 for each incandescent Under a new five years' contract there will be twenty-one arcs for $1,200, and nine incandescents for $80; total, $1,280.

THE Stevens Manufacturing Co., London, Ont., have recently gone into the manufacture of dynamos, motors, transformers, switches, etc. They are the sole manufacturers in Canada under the Easton patents, and are already doing a large trade throughout Ontario.

IT is estimated that 4,000 16-candle power lamps will be required to light the new Toronto municipal buildings. The city engineer, Mr. Keating, makes an estimate of $45,000 to instal the necessary plant at the waterworks pumping station, and $5,000 a year for maintenance.

ARRANGEMENTS are being made by which Her Majesty Queen Victoria will start the electric works of the Lachine Hydraulic and Land Company at Lachine Rapids, Que. This will be done by means of the Atlantic cable, Her Majesty simply touching the electric button at Windsor Castle.

J. A. BAILEY and A. Lane, of Sandusky, O., were in Hamilton, Ont., recently, in the interests of the Partridge Carbon Company which is looking for a location for a Canadian branch of its factory. The company's specialty is an electric light carbon, which they claim is superior to those now in use.

THE Lachine Rapids Hydraulic & Land Company are now in shape for supplying power and light to Montreal, having practically inaugurated their service on Jubilee Day. They are supplying power, at $40 to $70 per h.p. per year, and incandescent lighting at from one-half cent per hour up, by meter.

IN the item in last issue referring to the installation of an electric light at Perrin's biscuit factory, London, Ont., it was stated that the whole installation was made by the Rogers Electric Co. We are informed that the plant was supplied by the Electrical Construction Co., of London, the wiring only being done by the Rogers Electric Company.

THE Montreal Street Railway Company will, it is said, adopt a new style of trolley pole. The present ones, composed of round wrought-iron piping, are to be gradually removed and replaced by small towers of angle steel riveted together. It is expected that being openwork they will more easily resist the storms of the winter, as the wind can blow through their interstices.

THE news that the Queen has approved the formation of a new volunteer corps in England, to be called "The Electrical Engineers, Royal Engineers (Volunteers)," will be pleasing to all of our readers. The idea of forming such a body of electrical engineers originated from Dr. John Hopkinson during the early months of 1896, when the Venezuelan dispute was before the country.

THE directors of the British Columbia Electric Railways, Ltd., which has taken over the business and systems of the electric railways of Victoria city, Vancouver and Westminster, are: F. S. Barnard, Horne Payne, R. M. H. Payne, A. C. Mitchell-Innes, R. N. Laurie, G. P. Norton, and R. S. Sperling. Qualification, £500; remuneration, £1,000 per annum and a share in profits.

THE Montreal Street Railway Co. has erected two miniature Eiffel towers of angle steel a hundred and sixty-five feet high They are nineteen feet square at the base, and fifteen inches square at the top. They rest on a foundation of concrete twelve feet deep. These towers will support a cable across the Lachine Canal into Point St. Charles, to supply power to the company's line.

FIVE companies tendered for the construction of the Chatham, Ont., civic electric lighting plant. They were the Stephenson Company, of London; John Abell, Toronto; the Thompson Electric Company, Hamilton; the Royal Electric Company, Montreal, and the Harris Electric Company, Detroit, U.S.A. A number of them tender only for the electrical apparatus, wiring, etc., while others make their tender cover everything required

AT a recent special meeting of the town council of Niagara Falls, Ont, a by-law was introduced giving the electric-car company holding the present charter for the horse-car line a 20-year charter, with the privilege of running over the same route, with a few extensions, providing the company put in motive power other than horses or steam. The company must act within thirty days of the passing of the by-law and complete the line within sixty days.

NEARLY 400 people registered their attendance at the convention of the National Electric Light Association at Niagara Falls, N. Y. June 8th—10th. Details in next issue. Among whom were noted the following: F. C. Armstrong, Toronto; T. A. Badger, jr., Quebec; E. B Biggar (CANADIAN ENGINEER); F. A. Bowman, New Glasgow, N.S.; John Carroll, Montreal; Prof. C. A. Carus-Wilson, Montreal; E. E. Cary, St. Catharines; E. T. Freeman, Halifax, N.S.; W. A. Johnson, Toronto; J. A. Kammerer, Toronto; R. S. Kelsch, Montreal; John Langton, Toronto; Frank LeBlond, Niagara Falls, Ont.; E. D. McCormack, Toronto; Charles Morton, Montreal; John Murphy Ottawa; Frederic Nicholls, Geo. A. Powell, St. Catharines, Ont.; J. F. Rothsay, Niagara Falls, Ont.; A. E. Smaill, Montreal; W. McLea Walbank, Montreal; Geo. W. Watts, Toronto.

THE West Kootenay Power and Light Company, Limited, which was recently organized for the purpose of developing the magnificent water power available at the Falls of the Kootenay, ten miles from Nelson, B C, has just closed a contract for the hydraulic and electrical machinery, to develop 2,000 horse-power, immediately, the ultimate scope of the undertaking being the utilization of the full power of the river at this point, estimated at from 8,000 to 10,000 horse-power. At the head of the company is Sir Charles Ross, Bart., who is largely interested in mining properties, and with him are associated C. R. Hosmer, Frank Paul, and other influential and well-known capitalists. The services of Robert Jamieson, formerly engineer in charge of the Lillooet, Fraser River and Cariboo Gold Fields Co., Limited, have been secured to supervise the entire undertaking, and his wide experience in mining engineering work of all kinds, will insure the most efficient working out of all the detail appliances necessary to apply the electric power in the most satisfactory manner for mining work. Some interesting details as to the electrical features of the scheme have been made known. The apparatus will be of the three-phase type manufactured by the General Electric Company, Limited, and the generators of the revolving field type, similar to those now being installed in the large power plant of the Lachine Rapids Hydraulic and Land Company at Montreal. The initial generating plant will consist of two machines, having a capacity of 1,000 horse-power each, from which the current will pass through step-up transformers, raising it to 20,000 volts, the highest pressure as yet used on any electrical transmission line. At this high pressure, the energy will be carried to a sub-station at Rossland, a distance of thirty miles, where it will be reduced to a pressure of 2,000 volts for transmission to the motors used in connection with the different mining enterprises. The electric power will be used for operating tramways, hoists, pumps, ventilators, stamp mills, drills, etc., and will be sold at a price which, in comparison with the present high cost of power generated from coal, means a greatly reduced expenditure in this direction by the different mining companies The machinery is now in course of construction, and the plant is to be in full operation early in the Fall.

A SAFETY VALVE PROBLEM.

Editor CANADIAN ENGINEER.

SIR,—Kindly answer this safety-valve question in the July issue of your valuable paper: What is the weight required on the end of the lever, not considering the weight of the valve stem or lever, when the length of the lever is 36 inches, the diameter of valve is 3 inches, the fulcrum is 3 inches, and the steam pressure 125 pounds?

THREE ENGINEERS.

Under the conditions stated, viz., lever, 36 ins; diameter of valve, 3 inches; fulcrum, 3 inches; pressure, 125 lbs., the weight required on the lever is 76.542 lbs.—[EDITOR.

AT a public meeting held recently in Rat Portage, Ont., it was resolved that water works were at once necessary for the health of the town. T. R. Deacon is town engineer.

Railway Matters.

RICHARD WOOD has been appointed receiver of the St. Catharines and Niagara Central Railway.

THE C P.R. has arranged for the construction of 1,000 new freight cars at their various shops.

PEMBROKE, ONT., has passed a by-law to grant a bonus of $20,000 to the Pembroke Southern Railway.

QUITE a number of Canadian Pacific workmen have been sent from Toronto Junction to Perth, Ont., to assist in the construction of 200 new freight cars.

THE C.P.R. have received a number of new refrigerator cars from their Perth workshops. Five of them have been sent to Weehawken, N.J., to load butter for Australia.

THE Richelieu & Ontario Navigation Co. has issued a very neat pamphlet showing to its friends the beauties and attractions of the Ontario waterways. Some interesting chapters are devoted to the lovely spots between Montreal, Toronto and Hamilton.

IT is reported that General Manager C. M Hays, of the Grand Trunk Railway, has issued an order to the effect that section foremen must dispense with the services of relatives working under them, and that relatives must not in future be employed by them.

A. FACKNEY has contracted for the erection of car-houses, etc., for the Quebec District Railway Company on St. John, d'Aiguillon, Racine and Richelieu streets, Quebec, the building to be 176 by 116 feet, two stories, in brick and stone with mansard roof, at a cost of $25,000.

ON June 1st the Dominion Government officials stopped the running of trains on the Baie des Chaleurs Railway, which has been operated as a branch of the Intercolonial since January last, and the road was handed over to the representatives of the Atlantic & Lake Superior Railway Company.

THE Railway Y.M.C.A., which was opened a short time ago in roomy quarters, Front street and Spadina avenue, Toronto, by General Manager C. M. Hays and a number of distinguished men and philanthropists, is doing a splendid work. There is quite a good library in the association rooms.

D. F. BURK, Port Arthur, Ont., has secured an injunction restraining the provisional directorate of the Ontario Rainy River Railway receiving a first payment of $7,000 in the sale of the Ontario Rainy River Railway. The purchasers are Wm. Mackenzie, president of the Toronto Street Railway Company, and his brother, R. Mackenzie.

THE C.P.R. has let the contract for the construction of the Slocan valley branch of the Columbia and Kootenay system. McVey & Poupore will do the grading from Slocan Crossing to within sixteen miles of Slocan. The rest of the work will be done by McLean Brothers, of Nelson. About 1,000 men will be employed this summer establishing the necessary grade, constructing bridges and putting down the rails.

W. J HANLY, Toronto, will have charge of construction on the Crow's Nest Pass Railway when it is begun. Mr. Hanly has done a good deal of work for the Canadian Pacific, and was, in fact, the first superintendent of the Canadian Pacific before the formation of the present company, and built the Pembroke branch, and also the Kingston and Pembroke. On the main line, Mr. Hanly built the section between Rat Portage and Selkirk, Man., a distance of 150 miles, and likewise from Port Moody to Griffin Lake, 350 miles.

JOSEPH HOBSON, chief engineer of the Grand Trunk Railway System, having been assigned the entire charge of the construction of the new Victoria bridge, it has been decided that, to enable him to devote his personal attention to this and other important new works of the company, taking effect July 1st, the immediate supervision of the maintenance of track, buildings, water stations and wooden bridges will be placed under the jurisdiction of the superintendents of the respective divisions, who will report to and receive their instructions from the general superintendent, F. H McGuigan. The chief engineer will continue in charge of the St. Clair tunnel, all iron bridges, masonry and signals and interlocking. He will also have the direction and supervision of all contract work, the preparation of plans, specifications and estimates for new work, and the custody of original maps and profiles of the roads comprising the system.

Mining Matters.

M. BEATTY & SONS, manufacturers of contractors' plant and mining machinery, Welland, Ont., have appointed E. Leonard & Sons their agents in Montreal.

THE following are the duties upon ore brought down by the Dominion Government. (a) On nickel contained in matte or in the ore, or in any crude or partially manufactured state, and upon copper contained in any matte or ore, which also contains nickel, when exported from Canada, upon such nickel an export duty not exceeding 10c per pound, and upon such copper an export duty not exceeding two cents per pound (b) On ores which contain copper or any metal other than nickel or lead, when exported from Canada, an export duty not exceeding 15 per cent. on the value of the said ores. (c) On lead ores, and on lead and silver ores, when exported from Canada to a country which imposes an import duty on lead in bar or in the form of pig lead in excess of the import duty on lead contained in lead ores, or in lead and silver ores, an export duty on the lead containing the ores so exported from Canada to an amount per pound equivalent to such excess.

A DISCOVERY of black granite is said to have been made at Welsford, N B The property has been acquired by a Bridgewater, Nova Scotia, firm, and they will commence the erection of polishing works.

THE successful operation of the new calcining and refining furnaces at the Nelson, B C, copper mines, has been a matter of general congratulation, and the fineness of the copper produced has been steadily improved. The grade now produced is 98 and 99 per cent copper, silver and gold, and as much as fifteen tons have been taken from the refining furnace from a single charge.

THIS season there will be four members of the Canadian Geological Survey at work in Nova Scotia. Dr. Ells, Mr. Fletcher and Dr. Ami will visit the coal measures and complete surveys that have been going on for some time. Mr. Fairbault will resume his study of the gold-bearing rocks along the Atlantic coasts of that province.

THE Hawk Bay mine in western Ontario is now equipped with a fine plant, the machinery consisting of two 35 h p boilers, a three drill air compressor, three Rand drills, a 17 x 10 double cylinder hoisting engine, and a single cylinder hoisting engine

A NEW dredge is to be put in place at Big Bar, on the Fraser River, where, H O Bowe says, a bucketful of gravel yielded $2 in gold.

WM OGILVIE, D L S, gives some startling information about the richness of the gold bearing gravel in the Klondike region on the Yukon. Placer mining is being carried on in Bonanza Creek, an affluent of the Klondike, and the workings must be exceptionally rich, for three men worked out $75 in four hours, and a $12 nugget has also been found, showing that there is coarse gold and plenty of it. It is claimed that from $100 to $500 a day can be made off the ground that has been prospected. One man washed out a single pan of dirt on one of the claims and found $14 25 in it. The average on that claim, it is reported, is $5 to $7 per pan, with 5 feet of pay dirt and the width yet undetermined, but it is known to be at least 30 feet, so that, figuring at nine to ten pans to the cubic foot, on a length of 500 feet, the result would be nearly $4,000,000, at $5 per pan. Another claim has been prospected to such an extent that it is known there is about 5 feet of pay dirt, averaging $2 per pan, and of a width of not less than 30 feet.

Marine News.

THE Dominion Atlantic Railway Co. is building a wharf at Yarmouth, N.S.

AN attempt was made to burn the steamer "Lakeside," at St. Catharines, Ont., recently.

THE Ontario Government has granted two leases for the ferry business between Kingston and the islands.

THE Rondeau and Cleveland Steamship Company, Limited, has applied for incorporation. Chief place of business, Chatham, Ont.; capital, $20,000.

THE Richelieu and Ontario Navigation Co.'s steamer "Corsican," which was practically rebuilt last winter, is now one of the finest boats on the lake and river route.

THE contract of Wm. Davis & Sons at Cardinal, on the St. Lawrence Canal, will involve the making of a cut half a mile long, 60 feet deep and about 300 feet wide.

THE contract for building the wharf at Pugwash, N.S., for which $10,000 were placed in the estimates in the last session of Parliament, has been awarded to McDonald & Moffat, North Sydney, C.B.

THE Canadian Pacific Railway Company will add to its fleet on the Columbia by building an express boat for carrying passengers, mail and express. The keel of the new boat was recently laid at Nakusp. When completed, it is expected that the boat will be the fastest craft in any of the inland waters of the North-West, and it is expected to make the time from Trail to Arrowhead in 24 hours, equal to 19 miles an hour. The boat will be christened "The Flyer."

AFTER being bitterly fought, step by step, through the courts for nearly a score of years, a decision has been handed down in the United States Supreme Court, in the case of the owners of the barges "Eldorado," "George W. Wesley" and "Bay City," against the owners of the steamer "J. B. Donaldson. The court held that when a steamer is compelled to desert her tow in a storm for self preservation she cannot be held liable for any general average loss sustained by the tow.

Personal.

J. F. MILLAR, of Morrisburg, Ont., recently visited Japan as agent for the Leonard & Ellis Oil Company.

JOSEPH MCNEIL, an employee of the Nova Scotia Steel Co. at Ferrona, N.S., was killed recently by falling from a moving train.

C. H. RUST, assistant city engineer, Toronto, has been appointed a member of the council of the Canadian Society of Civil Engineers.

THE fly wheel of the engine in the St. John, N.B., street railway power-house burst recently, seriously injuring Chas. Sullivan, who was in charge.

ELISHA STEWART, O L S, Collingwood, Ont., has been appointed by the Ontario Government as chief of the Bureau of Mines Department, to be established at Rat Portage, Ont.

WM DAVIDSON, Sherbrooke, Que, who recently graduated with high honors from Columbia College, New York, has been sent to Japan by the Rand Drill Company to erect a large mining plant.

SYDNEY M JOHNSON, B.A., Sc., P.L.S., and J. E. McAllister, B.A., Sc., have opened an office in Trail, B.C., where as Johnson & McAllister they do business as surveyors, assayers and mining engineers.

ALEXANDER R. GOLDIE, of Goldie & McCulloch, Galt, Ont., was recently married to Miss Nora Gibson, daughter of the late James Gibson, at the residence of the bride's mother, "Spring Valley Farm," Berlin, Ont.

D. J. WATERous, of the Waterous Engine Works Company, Brantford, Ont, was polishing the chain of his bicycle recently on an emery wheel. While working, the chain in some manner was caught and jerked violently, and winding round his arm tore the coat sleeve off and inflicted painful bruises and cuts all the way up his arm.

R. O. KING, B.A Sc., Toronto, who graduated from McGill University with the British Association Gold Medal in 1895, and whose portrait appeared in THE CANADIAN ENGINEER at the time, has just been appointed to the William Whitney Fellowship, at Harvard University, where Mr. King has been taking a course in the graduate school. Mr. King was born at Port Hope, Ont., 23 years ago, and received his earliest education at Georgetown, Ont.

WHILST superintending the construction of machinery at Montmorency Falls, not long ago, Omer Carrier, of the firm of Carrier, Laine & Co., Levis, Que., accidentally touched a live wire. He was knocked down, but rising again he said to those around him, "Oh, it is nothing." He sank to the ground again, and all efforts to revive him were fruitless. Mr. Carrier, who was 27 years of age, and leaves a widow and two children, is much regretted by a large circle of friends

J. R. ROY, C.E., formerly of Montreal, who is in the Public Works Department of Canada, has recently been appointed to fill the important position of resident engineer in the Province of British Columbia, where he will have the full charge of all the work of the department in that province. The chief provincial office of the department has recently been moved from Victoria to New Westminster, from whence Mr. Roy will leave early in July for a tour of inspection of the other offices of the department in the province. A very important part of Mr. Roy's work has been the establishing, at different points along the Fraser River, of gauges to record its rise and fall. The state of the river will be telegraphed to points which have before now suffered by inundations, and farmers will in future have due warning.

THE 29th annual convention of the American Society of Civil Engineers opened in Quebec, July 1st.