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Volume 23. Toronto Sept. 12, 1912
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The Canadian Engineer

An Engineering Weekly

THE AWAKENING OF CANADIAN IRRIGATIONISTS.

By NORMAN S. RANKIN.

NOTE.—A report of the Sixth Annual Convention of the Western Canada Irrigation Association, held at Kelowna, B.C., Aug. 13th. to 16th. Mr. Norman S. Rankin, the Secretary of the Association, who has furnished us with this account of the Convention is Publicity Manager for the Department of Natural Resources of the Canadian Pacific Railway Company.—EDITOR.

"Great oaks from little acorns grow." "Great streams begin as tiny springs," and so great companies and organizations oft-times have their birth in tiny, dark offices, with out-at-elbows desks, and an executive who is at once president, vice-president, general manager, private secretary and office boy.

Everybody interested in irrigation and agriculture in the United States has heard of the National Irrigation Congress. All know what a powerful, influential organization it is to-day, and how delegates from the four corners of the country come together, year after year, in some chosen city, to follow the deliberations and resolutions of that association.

The Delegates Being Entertained at Kelowna.

They also know that the resolutions of that great congress go up to the Senate at Washington, and there meet with careful, serious consideration.

North of the boundary line, the National Irrigation Congress, six years ago, had a little baby brother, known as the Western Canada Irrigation Association. It was then struggling its way through the ills and fevers of babyhood, but now has developed into a sturdy child, standing upright on its own legs, and looking the irrigation world in the face. Very few below the line know that this continent holds a second irrigation association, but the result of its sixth annual convention, held at the beginning of August at Kelowna, in the Okanagan Valley, British Columbia, has clearly demonstrated that the one-time infant will from now on make itself heard.

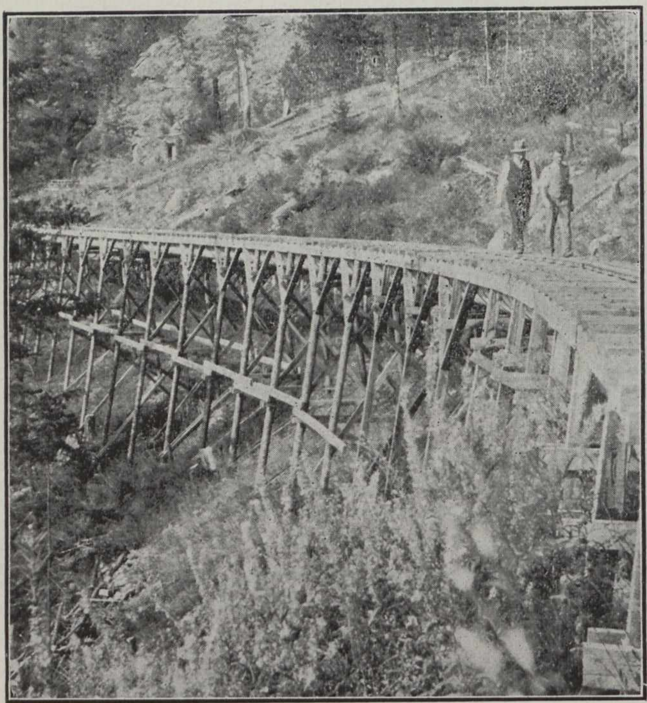
The Western Canada Irrigation Association—which has practically the same aims and objects as its big brother in the United States—has slowly but steadily extended its scope of endeavor until under its influence has fallen every up-to-date farmer and irrigator in the Western Canadian provinces of Saskatchewan, Alberta and British Columbia, and when this year its interesting and attractive official call went forth the response was hearty and encouraging.

To Kelowna then—a charming little fruit city beautifully situated on the borders of Okanagan Lake—came during August 13th, 14th, 15th and 16th, farmers, irrigationists, students, railroad and government officials and politicians.

View of Kelowna Beach and Bathing Place.

They left the main line of the Canadian Pacific Railway at Sicamous, and journeying down the fertile Okanagan Valley, reached at length the picturesque lake of that name, and boarding the huge stern-wheeler that awaited them, were borne swiftly to their destination—appropriately named, "The Orchard City." Here with open doors and flying banners, the hospitable citizens awaited them, and visitors were whirled away in automobiles to the various homes and hotels which were prepared to receive them.

That evening, at eight o'clock, in the local theatre, some five hundred interested irrigationists listened to Mayor Jones' welcoming address, while on the platform sat such distinguished men as the Hon. W. R. Ross, Minister of Lands, B.C.; J. S. Dennis, assistant to the president, Canadian Pacific Railway; the Hon. Dr. Samuel Fortier, chief irrigation investigations, U.S.A.; Sir William Willcox, an eminent irrigationist; Professor Alfred Atkinson, Department Agronomy, Agricultural College, Bozeman, Montana; John T. Burns, executive, secretary-treasurer, International Dry



Steel Flume of the Kelowna Land and Irrigation Company, British Columbia.

Farming Congress; the Hon. Price Ellison, Minister Finance and Agriculture, B.C.; Deputy Minister W. E. Scott, B.C.; Professor M. L. Dean, State Horticulturist, Missoula, Montana; A. S. Dawson, chief engineer, Department Natural Resources, C.P.R.; R. M. Winslow, provincial horticulturist, B.C.; P. L. Naismith, manager, Alberta Railway and Irrigation Co.; F. H. Peters, Commissioner of Irrigation, Dominion Govenment; R. H. Campbell, Director of Forestry, Ottawa; Professor C. I. Lewis, Corvallis, Ore.; George Harcourt, Deputy Minister of Agriculture, Alberta, and a score of others.

In the audience were delegates from as far west as Victoria, and as far east as Ottawa, gathered to discuss and resolve what was best for the farmer, and best for the country.

As an example of what irrigation meant to the Okanagan Valley and Kelowna in particular, Mayor Jones stated that during the past year nearly half a million dollars had been expended on irrigation works. One hundred and thirty thousand fruit trees had been planted on irrigated lands last season, and this year over one hundred thousand would be set out, while the tobacco industry is assuming great importance. Later, both the tobacco plantations and the local cigar factory were visited, and ample opportunity given the visitors to test the quality and flavor of the home-grown cigar.

J. S. Dennis, the father of irrigation in the west, vice-president of the association, and chairman, executive committee, in speaking of the Provincial Government and the administration of the Water Act, commented briefly regarding that admirable piece of legislation, but added that it was not sufficient to have legislation alone to obtain all the benefits desired. It was the administration of the legislation that was of supreme importance, and in order to make it successful, the government required the energetic co-operation of all users of water. All development depended on the proper administration of the Act; value lay not in the land but in the water, as the greater portion of the land in the dry belt of British Columbia would produce nothing unless irrigated. Land above the ditch was worth from $5 to $20 an acre, while that below was valued at from $100 to $400 per acre. The difference was not due to soil or climate, but to the water. It was, therefore, just as important that the law regarding title to water be as definite as that regarding the title to land, but until everyone gave loyal support to the government in the administration of this Water Act, the title to water would not be as good as to land. He spoke of the history, aims and work accomplished by the Western Canada Irrigation Association, and said that the present convention was attended by a larger number of delegates than the previous five. Perhaps this was surprising in view of the remoteness of Kelowna from the main lines of communication, but it was not when it was remembered that British Columbia was looming up as the most attractive part of the West to people south of the line and in the Old Country. From the latter country, the people came to British Columbia readily because the name itself was attractive to them, and it seemed like coming home. There was great need of taking care of these people when they arrived, and he suggested that more complete surveys of government land were needed in order to supplement the Water Act. Southern British Columbia, he believed, was now on the verge of sharing in the great movement from the south which had been greatly increasing during the past few years, and had been directed almost entirely to the western provinces. This year it would total over 150,000 people, and this "spilling over the brim" of the 100,000,000 of the population of the United States would extend to British Columbia. He said that he saw in the future all valleys from the boundary to the main line of the C.P.R. filled to their entire capacity with prosperous settlers.

Each speaker during the convention had something of interest to say to the delegates, and were followed with close attention. The Hon. Dr. Fortier delighted the audience one evening with a stereopticon lecture on "Irrigation in California," and the proceedings were occasionally broken

Orchards at Penticton, British Columbia.

with a little automobile jaunt into the country to inspect various irrigation schemes under operation or construction. Fifteen resolutions of grave import to the country were taken up, discussed and passed on to the government for consideration, while vital subjects such at "The Apple and the Baldwin Spot," "the Irrigation of Alfalfa," "Public Ownership of Irrigation Systems," "Irrigation as Applied to Forestry," and kindred subjects were discussed and resolved.

With a delightful steamboat trip down the lake to Penticton, touching at Summerland, Peachland, Naramata and other points, and a monster banquet, tendered by the citizens of the town of Penticton, at the new Incola Hotel, the convention adjourned to meet in August, 1913, in the ambitious city of Lethbridge, Southern Alberta. So keen was the interest shown in future conventions of the association that bidding for the 1914 and 1915 conventions has already commenced. In 1914 it will again meet in British Columbia, and in 1915 in Alberta, thus carrying out the accustomed procedure of the association to hold its conventions alternately in the two provinces.

The following officers were elected for the ensuing year: Hon. President, the Hon. G. A. V. Bulyea, Lieutenant-Governor, Province of Alberta; president, Hon. Duncan Marshall, Minister Agriculture, Alberta; vice-president, W. C. Ricardo, manager Coldstream ranch, Vernon, B.C.; vice-president and chairman, J. S. Dennis, assistant to president C.P.R., Calgary, Alberta.

Executive Committee.

West of Mountains.—Thomas Bulman, Kelowna, B.C.; F. K. Fulton, K.C., Kamloops, B.C.; J. A. Mackelvie, Vernon, B.C.; C. W. Dickson, Kelowna, B.C.

East of Mountains.—A. S. Dawson, Calgary, Alta.; W. H. Fairfield, Lethbridge; Wm. Pearce, Calgary, Alta.; Prof. W. J. Elliott, Strathmore, Alta.

Official word has been received from Lethbridge that "The Ambitious City" proposes to make the 1913 convention the most interesting and attractive in the history of the association.

APPRENTICES ON THE CANADIAN PACIFIC RAILWAY.

The education of the apprentices on different classes of work is demanding more and more attention from the employer of labor. The railroads have appreciated the necessity of providing such education before other branches of industry. In an article in a recent issue of "Railway and Locomotive Engineering" Mr. E. E. Bailey, the supervisor of apprentices on the western lines of the Canadian Pacific Railway, outlines this company's methods of approaching the question. Mr. Bailey says that considerable attention is paid to careful and systematic education, both practical and theoretical, in the various trades required for the production of the shops at Winnipeg. A well-organized apprentice instruction department, in charge of a supervisor of apprentices under the direction of the superintendent of shops, controls the hundred apprentices employed at Weston, both in their shop training and in their instruction classes. Those learning the machinist trade, about two-thirds of the total number, have also a shop instructor, who is employed to devote his time to showing the boys how to handle their various jobs, and who is responsible for passing them efficiently through the many branches of their trade in due order, scheduled periods for each being allotted. The remainder, including boilermakers, blacksmiths, moulders, pipefitters, tinsmiths, carpenters and patternmakers, are under direct control of their respective foremen. A careful record of their progress, behavior and aptitude is returned to the supervisor, particular attention being paid to inculcating the habit of good timekeeping; twice late per month, or a total of twelve per annum, only being allowed, together with a total loss of time each year of a hundred hours, this being allowance for vacation. Any time over this has to be made up before the boy can receive his increase of pay, which rises automatically from 13 cents the first year to 17 cents the second, 20 cents the third, 23 cents the fourth, and 26 cents the fifth, after which, on receipt of a satisfactory certificate of apprenticeship, they step at once to the schedule rates as tradesmen.

The technical or theoretical training, rightly considered as of great importance, is developed by means of classes conducted by the supervisor, fifteen boys being the average per class. In arithmetic all are taken through fractions, decimals, proportion, averages and roots and powers, and concluding with mensuration. In drawing they are instructed first in freehand, to be applied later in their training to the making of shop sketches. Then geometry, projections, intersections and developments of surfaces, and finally to the making and reading of shop or mechanical drawings, each trade being given, as far as is possible, subjects bearing on their own class of work.

Beyond this any apprentice who elects to pay a small sum per month may continue his studies in more advanced subjects, such as algebra, logarithms, trigonometry, advanced mechanical drawing, steam and kindred subjects, the company's object being as much to enable the boys to realize the advantages of extending their technical knowledge as it is to give all a good training in the rudiments.

During their first year as apprentices, when they must be sixteen years of age or over, they receive two hours' instruction per week; from then for the following two years, four hours per week is given, divided into two sessions of two hours each. At the end of the third year their theoretical training ceases, unless, as stated above, they wish to advance further, when they may continue to attend special classes until they have completed the branch of study chosen, or until they have completed their apprenticeship.

A monthly record of school and shop progress is sent to each boy's parent or guardian, and copies are kept charted up in the Instruction Room for friendly rivalry and emulation. Each December an examination on the general progress of the classes is held, scholarships being presented to the five boys with the highest marks. All apprentices are also eligible to compete for the two scholarships offered by the company covering four years' free tuition in the Faculty of Applied Science of McGill University.

It will thus be seen that generous encouragement is given to every boy entering the Winnipeg shops as an apprentice, and that no effort is spared to turn out in the finished article a thoroughly well-trained and useful member of a trade, and it must be said that the boys themselves appreciate the efforts of the company to this end, and evince a willingness to learn, and an interest in their work, to go far to justify the trouble and money expended upon their training, and finally result to their own particular advantage in the coming years.

THE NEW QUEBEC BRIDGE.

Work is progressing rapidly on the new Quebec bridge. Last year the debris of the fallen structure, a vast mass of tangled steel, partly above the water and partly submerged, was removed and new caissons were sunk, so that the work on the substructure may be considered well enough advanced to predict a completion of the new bridge in 1915. The bridge when finished will be one of the greatest of its kind in the world. Pending its completion, trains of the new Transcontinental will be transferred across the St. Lawrence by ferries.

COMPENSATING GRADES FOR CURVATURE.

The subject of compensating grades on curves in order to offset the increased train resistance due to curvature crops up periodically, and it is evident that practice in this direction is not only very diverse but is based upon a very uncertain foundation. The following article was compiled and published by the Engineering News, and presents the whole matter so fully that we reproduce it in full. It is mentioned in the early and noted "Shunk" and "Searles" field-books, the former giving a formula which is quoted below (by Mr. Beahan). In "Field Engineering" (1887), by W. H. Searles, the curve resistance (lb. per ton) on a curve of given degree is stated as $0.56 \times D$, while the grade (per cent.) on tangent having the same resistance as the given curve is stated as $0.025 \times D$. Thus the resistance and compensation were assumed to vary directly with the degree of curve, which is now almost universally recognized to give incorrect results. On the subject of compensation, Mr. Searles stated as follows:

"In locating a road, the maximum grade should be reduced on a curve by the amount of the equivalent grade of the curve [see formula above.—Editor.] so that the resistance may be no greater on the curve than elsewhere. But grades less than the maximum need not be reduced for the curves upon them, unless the sum of the grade and the grade equivalent exceeds the maximum."

The most extensive analysis (and we might say the only thorough analysis) of the subject is that given in Wellington's "Economic Theory of the Location of Railways" (1887), and we recommend a careful study of the exposition there given, with the reservation that the reader should remember that the conclusions may not apply directly under modern conditions of rolling stock and traffic. As a compilation of opinions on the subject would be incomplete without some outline of those of Mr. Wellington, we give below a few extracts together with his summary of conclusions:

Under three different conditions curvature may come (in advance of gradients) as a limiting agent to fix the weight of trains:

1. When curves are introduced on a maximum grade without reducing the rate of the latter by compensation for curvature, so as to keep the aggregate resistance constant on both curves and tangents. 2. When a line is nearly or quite level, and yet runs through a region requiring curvature which (as is very apt to happen on such lines) cannot be "compensated" because there are no grades, or no sufficiently high grades to reduce, in order to eliminate their additional resistence. 3. When on lines of the latter (or any other) class curvature of such short radius is used as to limit the length of trains more than would the same amount of curvature with longer radii. These causes are more or less interrelated.

The proper rate of compensation is not a fixed quantity, but may, under varying circumstances, vary within somewhat wide limits. The more usual rates are from 0.03 to 0.05% per degree of curvature, corresponding to 0.06 to 1.0 lb. per ton per degree. If the precise amount of curve resistance were known, and if it were always the same, of course but one rate of compensation would be proper, but as its precise rate is not known, and as there is strong reason to believe that in starting a train it may possibly amount to as much as 2 lb. per ton, a compensation sufficient to equalize curve resistance in ordinary circumstances cannot be assumed to be certainly sufficient at points where speed may be expected to be very slow, as toward the top of long grades and occasionally at other points.

Under these circumstances, prudence would indicate that wherever there is no physical limit to the possible reduction of grade on curves, it should be made ample, so that the curves should certainly offer no greater resistance than the adjacent tangents. At stations this rule would require a grade reduction of 0.1% per degree.

On the other hand, when we are merely trying to equalize the tangent and curve resistance on a long ascent, and whatever is taken off the curves must be added on to the tangents, no such practice is proper. If we come as near to an exact equality as we can, in compensating for curvature, it is of no importance whether our compensation is a little too great or a little too small. In the one case trains will stall on the tangents and in the other on the curves; that is all. Our object is simply to guard against a certainty of stalling on either. Nothing more than this is important.

Hence it may well be that on a long and crooked ascent, where the curvature greatly exceeds the tangents, yet where there are one or two considerable tangents, prudence will require the assumption of a very low rate of compensation; for otherwise a very slight loss of elevation on each curve, multiplied by many curves, will prevent our attaining the desired summit without a considerable increase of the normal tangent grade. If we have guessed right as to the real curve resistance, this may do no harm; but, on the other hand, if we have guessed wrongly, and exaggerated the probable curve resistance, we shall have unnecessarily increased our tangent grade. Hence, by assuring a low rate of curve resistance in such a case, we can hardly in any case lose anything appreciable, and may save a needless loss of grade. A compensation rate of 0.03% per degree of curvature may then be proper, below which the rate of comsation should never fall.

For the same reasons, it may well happen that at different points on the same line different rates of compensation may be proper. Where the loss of elevation by a high rate of compensation is a very serious matter, because of a great amount of curvature, it may be taken at a minimum. At other points, where there is less curvature to be compensated and a higher compensation can be had at little or no cost, it should there be used. The effect will be to make most of the maximum grade scattered over the division a little easier to handle trains on than the longest or worst grade. This may well result in handling a car or two more than would be deemed possible were the resistance as great at two or three points as it is at one.

It is always worth while to keep a little below the maximum where possible, at moderate cost. This is only another application of the same principle, but, owing to the uncertainty which hangs about the question of curve resistance, it is a wiser way of attaining the same end than to reduce the nominal tangent grade, especially in the vicinity of stations.

Conclusions.—1. With short grades or under favoring topographical conditions compensate as liberally as possible up to a maximum at special points of 0.10% per degree.

2. Where speed may sometimes be very low, and hence invariably on or very near to known stopping places, this maximum rate appears, with our present knowledge, none too much. In general, however, 0.05% per degree (= 1 lb. per ton) is an ample equivalent for curve resistance, and for fast trains alone probably 0.02 to 0.03% (= 0.4 to 0.6 lb. per ton) is sufficient to balance the resistance.

3. On sections where curves largely predominate over tangents it is particularly desirable to have ample compensation, and, if excessive, it will do least harm.

4. On sections where the amount of curvature is small it is less important to have full compensation, and if excessive it will do most harm.

5. When the rate of compensation can only be increased at the certain cost of a corresponding increase in the rate of tangent grades (making very sure that it is certain, and not an over-hasty conclusion from inexperience or lack of care), no larger rate than we feel practically certain will be required to balance the curve resistance (0.03 to 0.04) should be chosen. Otherwise, we are committing the folly of making a certain addition to the grade in one place, to avoid one in another place which is merely problematical.

6. On any minor gradients where the curvature is not sufficient to bring the virtual profile up to the maximum it is not important to compensate for curvature at all, although it is generally as well to do so, especially at points where to do so will slightly reduce the cost of construction, as is very apt to be the case on long curves. When not compensated, the curvature merely has an equivalent effect to a slight undulation of gradient, which produces no shock to the train and so is not a measurable disadvantage.

7. It is not in the least essential or important to precisely adapt the compensation to the exact length of each curve. The reduced rate may as well as not begin and end at the nearest even station, and may be made a little less on one curve and a little more on one immediately above if a horizontal slice of a foot or more may thereby be taken off a high fill on the tangent connecting them, but never so as to cause the grade to rise above the uniform grade line.

8. Curves immediately below a known stopping place for all trains need not and should not be compensated at all.

9. The rate of compensation should be uniform per degree for all degrees of curvature, or in no case made greater for the sharper curves. It may even be made less for curves of over 10 deg. If the rate be reduced one-half for the excess over 10 deg., making the compensation for a 16 deg. curve thirteen times that for a 1 deg. curve, it will certainly lead to no bad results, although a rather rough rule. This is directly contrary to the usual practice, which is to increase the rate of compensation with the sharpness of the curve, if anything; but this practice rests upon the assumption (which is the direct contrary of the truth) that the curve resistance increases with the degree of the curve. The results of experience on the New York elevated lines and numerous others with very sharp curves, both of standard and narrow gauge, is enough to disprove this, confirmed as it is very directly by the indications of theory.

10. Since there is no reason to believe that curve resistance increases per ton with the length of the train, or even (appreciably) with the type of engine, there is no reason for varying the compensation because of the grades or length of train, except that it is usually easier to spare the elevation for a liberal rate of compensation, with low grades than with high ones. It is, therefore, proper to do so.

This author states as follows in his "Field Practice of Railway Location" (1909):

"In laying the grade line on the location profile, the rate of maximum grade per station must be reduced by such an amount as necessary to compensate for resistance due to curvature. The reduction in gradient formerly* was 0.05 ft. per station of 100 ft. for each degree of curvature. If the maximum gradient was 1%, then a 20 deg. curve would have to be level. As this rate was established by trial of locomotives it varied on different roads. Shunk's formula for equating gradient for curvature was: Degree of curvature (squared) + 10 times degree of curvature ÷ 500. This gives the reduction in grade per 100 ft. and gives an 18 deg. curve as being level when the maximum grade is 1%†. The amount of curvature, 5 deg. and flatter, that exists in America on unreduced maximum gradients is enormous. The equating of curvature remains in use as it is based on observed fact."

In his "Curves of Civil Engineering" (1903), this author gives a table of compensation for curves on maximum grades, in which the rate of compensation per degree decreases from 0.03% for a 1 deg. curve to 0.02% for 20 deg. The total compensation then ranges from 0.03% for 1 deg. to 0.1% for 3½ deg., 0.2% for 8 deg., 0.34% for 15 deg. and 0.4% for 20 deg. This idea of decrease in rate of compensation with increase in degree of curve is suggested by Wellington and also later by Raymond and Webb (as noted below), while some writers have advocated an increase in rate of compensation with the increase in degree of curve. On this subject Mr. Haynes states his views as follows:

"When laying a maximum grade or where uniform resistance is desired, the rate of grade should be made less on curves than on tangents by the amounts shown in the table [noted above.—Editor.]. In the lower portions of a maximum grade, where high velocities are admissible and can be had, compensation for curvature is unnecessary. But where the velocity may fall to 8 m.p.h., curve resistance should be compensated fully in the grade so that the resistance and velocity will be uniform. If the velocity drops so that the centrifugal force is lost, the train stalls. A maximum grade in a district is not necessarily one of maximum ratio, but one which produces a maximum tractive power, where curves and velocity are considered."

From "Railroad Location Surveys and Estimates" (1906), we take the following extracts relative to grade compensation on curves, but omitting portions which relate to the ultimate effect of such compensation upon the profile and the operating conditions:

As the resistance to the passage of trains is greater on curves than on tangents, this varying directly with the degree of curve (or, in other words, with the radius), the ruling grade used on tangents must be lessened on the curves, so that the combined resistance due to the curve and the grade on the curve will not be greater than the resistance of the grade alone on the tangents.

Owing to varying conditions of track and rolling stock, the compensation necessary cannot be determined exactly, but is ordinarily assumed to be about 0.04% per degree of curve; that is to say, with a maximum grade of 0.6% on tangents a 4 deg. curve, for instance, should not have a heavier grade than 0.6 — (4.0 × 0.04) = 0.44%. The amount of compensation for curvature is assumed usually to be the same per degree for any degree of curve; thus, if it be assumed at 0.04% per degree, a 1 deg. curve would be compensated 0.04 per station and a 6 deg. curve 0.24 per station. It is generally conceded, however, that the resistance due to curvature does not increase proportionately as the degree of curve, and the writer prefers to use a sliding scale somewhat as follows: Curves up to 2 deg., 0.6% per degree; 0.05 × to 4 deg., 0.04% to 8 deg. and 0.03% per degree to 14 deg. This is **intended only** as an approximation and suggestion.

The proper amount of compensation for curves is a matter on which opinions vary, and which varies with the state of the track, type of engines, etc. Where curves are few, and, therefore, probably of large radius, the compensa-

* The same statement is made in the 1906 edition of Mr. Beahan's book, but he does not explain what period is referred to by the term "formerly."

† See quotation further on from a modern edition of Shunk's field book.

tion can be increased to as much as 0.1% per degree, with little probability of increasing the cost of construction, and any error surely will be on the right side. On long ascents, where often every inch counts, and where often a high rate of compensation will mean a higher rate of grade on tangents, or a much longer line, compensation as low as 0.03% for all curves will probably be sufficient. It will be seen that a most important point in locating long lines on ruling grades is the avoidance of curvature as far as possible. More curvature means less rate of grade and, therefore, longer line.

Where possible, grades should always be compensated for curvature, whether they are maximum grades or not; provided, however, that such compensation of grades is less than the maximum does not unduly affect the cost. The ideal line from the operative standpoint, as regards fuel economy, and to a certain extent the wear and tear on rolling stock, is one where the differences in resistance due to varying curves and rates of grades are reduced to a minimum. In other words, where, with a constant head of steam, the throttle can be set at a certain point and the train will pull just the same all the way. [For momentum grades] curvature on the maximum grade, when this is greater than the ruling grade, must, of course, be compensated the same as elsewhere, though probably a little more liberally; and in calculating the length of the momentum grades the entire resistance of the curvature must be taken into consideration.

Compensation for curves should be from the nearest even station to the ends, and where spirals or easements are introduced this may generally be from the ends of the true curve (that is, the true curve from the offset points, including the whole central angle), except where the spirals may be very long and then an average rate for the spiral may be introduced.

The subject was under discussion some ten years ago in Engineering News, and in the issue of September 5th, 1901, Mr. Merriam stated his opinion as follows:

"The compensation for curvature should be on a sliding scale, beginning with about 0.04%, or 0.03% per degree, and decreasing as the degree of curvature increases. All the experimental data I have been able to gather confirm this conclusion, but as the condition of the rail with regard to wear enters so largely into this proposition, the results do not point to any definite formula for compensation. The general tendency of modern practice is in the direction of lower compensation all along the line, one prominent western road with easy curves uses only 0.02% per degree."

In commenting upon this, J. L. Campbell stated that he thought it rather doubtful practice to adopt lower rates of compensation on sharp curves, for, while they will give a lower resistance per degree when new rails are laid, the latter soon give increased resistance through greater wear, more nearly proportional to the degree of curve. He considered that the tendency toward lower rates on sharp curves was due more largely to the great loss of elevation entailed by a proper compensation. However, as noted elsewhere, the analysis of the subject supports the views in favor of lower rates for sharper curves. Following up this matter, we wrote Mr. Merriam recently in regard to his letter quoted above, and his reply is as follows:

"The recent discussion of this subject before the American Railway Engineering Association [noted below.—Editor.] was centred around a rate of compensation of about 0.03%. The reason for the statement I made ten years ago was this: in going over a carefully built railway while it was in perfect shape, where the track has been put up to top of rail stakes with an exactness unusual even in well built roads, and where the compensation was uniform, heavy trains which barely maintained speed on maximum grades on tangent, gained speed on curves; all curves had the same compensation, and more speed was gained on 6 deg. curves than on 2 deg. curves. I have never had the opportunity to measure the resistance due to curvature, but believe the observations above mentioned were carefully taken. They were repeated a number of times and were confirmed by the trainmen operating on the districts where the most curvature existed.

"The condition of the rail is of such importance in this connection that it will be well to state that the rail was new when the above observations were made. The rapid wear of rails would seem to be an argument against the position stated by me in 1901, but Wellington's conclusions regarding rail wear indicate a wear proportional to the degree of curvature. This being true, the increase in surface of contact would be less, after a short time, in sharp curves than in easy curves. Rail maintenance would seem to be one of the conditions required to be known before the rate of compensation can be fixed for any given line, and as this is very hard to forecast, I am using 0.03% in my own practice."

The following is from "Elements of Railroad Engineering" (1909):

"It is customary to offset curve resistance on heavy grades, and on all grades where the combination of curve resistances and grade resistance would more than equal the grade resistance of the ruling grade of the road or division, by reducing the grade. On a crooked road of light grades, curve compensation is impracticable, the curves being in effect the ruling grades. The usual allowance is 0.04 to 0.05% per degree of curvature. But it is thought that on good track 0.025% will be sufficient for 5 deg. curves. The compensation, however, should vary with the degree of curve, and the following values are suggested: 1 deg., 0.04%; 2 to 4 deg., 0.03%; 5 deg. and over, 0.025%. When there is no necessity to save in gradient, full compensation (even up to 0.05%) can do no harm. With poor track and badly curved rails, compensation should be high."

A formula given by Shunk has been mentioned already (in the quotation from W. Beahan), but we do not find this in the 1902 edition of Shunk's "Field Engineer." The subject of grade compensation for curvature is there covered by the following statement favoring a high degree of compensation:

"It is a good custom, and one which cannot prudently be neglected where long stretches of maximum gradient are encountered, to 'slacken grade' on the curves. Opinions differ as to the right allowance per degree of curvature, and no experiments seem to have been made from which to deduce an authoritative rule. Some say 0.025% per degree; others, 0.05; others, variously between the two. Probably 0.05 is the safer rate. This amounts to 2.64 ft. on a mile of continuous 1 deg. curve, and makes a 9 deg. curve about the curve of double resistance at ordinary passenger speeds."

The following extract is from "Railway Track and Track Work" (1908), and is accompanied by figures of the practice on several railways (see Table 1), showing that at that time the ordinary rate was 0.03 to 0.04%, with special rates near stopping places, and sometimes a special compensation in tunnels (to offset decreased adhesion due to damp or slippery rails):

"When curves occur on heavy grades, the grade should be so reduced that the combined train resistance due to grade and curve will not exceed that due to the maximum grade allowed on the tangent. This reduction is taken variously at 0.03 to 0.05% per degree of curve. Thus, with a maximum grade of 2% on tangent, and a rate of compensation of 0.04%, the maximum grade on a 6 deg.

curve would be 1.76%. The amount of elevation lost by compensating the grade is found by multiplying the degree of central angle of the curve by the rate of compensation; and this elevation divided by the length of grade will give the rate by which the maximum grade on tangent must be increased to avoid a final loss in elevation.

"The change in grade may commence at the nearest even station, and not necessarily at the P.C. The reduced grade extends usually beyond the curve. To avoid too great a loss in elevation or too heavy a grade on the tangent, it may be necessary to modify the rate of compensation, but this will depend largely upon traffic conditions. In general, the compensation should be introduced even upon easy grades, especially those which approach the rate of ruling grade, in order to provide for future increase in train loads or reductions in grades. For curves of 10 deg. or over, the rate of compensation may be reduced (as curve resistance does not increase with the degree of curve). There is a great diversity of practice which is based largely upon opinion and experience, and there is much need for careful experiments in order to give some definite knowledge as to the requirements under modern conditions of rolling-stock and traffic."

The following quotation is from Webb's "Railway Construction" (1909):

On minor grades the addition [of resistance due to curvature] is of little importance, but when the grade is nearly or quite the ruling grade of the road, then the additional resistance induced by a curve will make that curve a place of maximum resistance, and the real maximum will be a virtual grade somewhat higher than the nominal maximum.

The proper rate of compensation evidently is the rate of grade of which the resistance just equals the resistance due to the curve. But such resistance is variable. It is greater as the velocity is lower; it is generally about 2 lb. per ton (equal to a grade of 0.1%) per degree of curve when starting a train. On this account the compensation for a curve which occurs at a known stopping place for the heaviest trains should be 0.1% per degree of curve. The resistance is not even strictly proportioned to the degree of curvature, although it is usually considered to be so. On this account the compensation per degree of curve may be made less on a sharp curve than on an easy curve. The compensation actually required for very fast trains is less than for slow trains, say 0.02 or 0.03% per degree of curve. But since the comparatively slow and heavy freight trains are the trains which are chiefly limited by the ruling grade, the compensation would be made with respect to those trains. From 0.04 to 0.05% per degree is the rate of compensation most usually employed for average conditions.

1. On the upper side of a stopping place for the heaviest trains, compensate 0.10% per degree of curvature.

2. On the lower side of such a stopping place do not compensate at all.

3. Ordinarily compensate about 0.05% per degree of curve.

4. Reduce this rate to 0.04 or even 0.03% if the grade on tangents must be increased to reach the required summit.

5. Reduce the rate somewhat for curvature above 8 or 10 deg.

6. Curves on minor grades need not be compensated, unless the minor grade is so heavy that the added resistance of the curve would make the total resistance greater than that of the ruling grade, or unless there is some ground to believe that the ruling grade may be reduced some time below that of the minor grade under consideration.

The American Railway Engineering Association, through its standing committees, has given a considerable amount of attention to this subject. It is to be noted that the committees which have reported upon it have been of a rather exceptionally high character as to the members and their work, and for this reason their statements deserve careful consideration. Extracts from the several reports, covering practically all that is said on this particular subject, are given below:

1901—In connection with a complete change of location or a modification of the existing location, the maximum grade and curvature should be decided and the necessary compensation calculated for the curves, to make the resistance on curves equal to that on a straight line. On lines where tests have been carried out on an extensive scale, it has been found that it is good practice to use 0.03% for each degree of curvature for all curves up to and including 2 deg., and 0.04% above that to 4 deg (Committee on Grading.)

1902—From the result of the committee's inquiries it would seem that the practice in this country at present favors compensation proportioned to degree of curve, and 0.04% per degree represents average practice. The observation of the effect of compensation, however, seems on the whole not to have been critical enough to determine definitely whether or not it should be proportional to the degree of curve, and further experiment and critical observation are needed. The effect of curves, as shown on a speed recorder capable of recording slight changes in speed, is suggested as a desirable method of experimenting. (Committee on Roadway.)

1907—Curve resistance is estimated by different engineers at different values. The compilation made by the Committee on Roadway (1902), showed that 0.8 lb. per ton per degree on central angle, or 0.04% for compensation per degree, well represented average practice. (Committee on Economics of Railway Location.)

1908—An inquiry was made by the above committee as to whether any experiments had been made in recent years which confirm or modify the commonly accepted value of 0.04% per degree of curve as the rate of compensation for curvature. Although independent experimental work was referred to, many of the answers merely stated the practice regarding curve compensation. There was a remarkable amount of unanimity in saying that 0.04% was a little higher than necessary, that 0.03% was too small and that 0.035% seemed the proper figure. The variations ranged from 0.02 to 0.08%. In investigating the accuracy of allowance for compensation, the widening of gauge on curves should be tested.

1910—We are interested in curve resistance chiefly from the standpoint of its compensation. In the location of a railway, curvature evils may be eliminated partially by reducing grade on the curve by such an amount as to make the engine effort the same on curve as on tangent. Tests made on the Baltimore & Ohio R.R. (1904), show that on the portion compensated 0.03%, the resistance on curve was greater than on tangent, and on the portion compensated 0.04% the resistance on curve was less than on tangent. In replies to a circular sent out in 1907, the consensus of opinion was that 0.035% per degree gave the best results. (Committee on Economics of Railway Location.)

The committee's recommendation, as adopted by the association, reads: "In order to equalize resistance on curve and tangent, curves ordinarily should be compensated 0.035% per degree of curvature. The effect of curve resistance is dispelled more slowly at slow speed than at high speed."

In the discussion, some of the speakers proposed to substitute 0.04%. Further it was pointed out (following the Wellington line of reasoning) that the rate of compensation should never be made absolutely constant, as the effect of the compensation on construction and on the ruling grade should be taken into account. In some places a high rate of compensation can be introduced without harm; but in other cases the rate has an important influence upon the cost of construction. To adopt as standard a rate that is excessive for average conditions means waste of money and improper compensation. It was with this idea also that the meeting added the word "ordinarily" to the recommendation as originally formulated. It was suggested also in the discussion that on a line built exclusively for freight service, and having curves superelevated for low speed, 0.03% will be too much. The committee's report was accompanied by a table representing actual practice on different roads. This is given herewith, supplemented by figures from Tratman's "Railway Track and Track Work."

Railway Practice as to Grade Compensation for Curves.

N.Y., N.H. & H.	0.03 too light, 0.04 too heavy.
B. & O.	0.03 too light, 0.04 too heavy.
So. Pac. (At. Sys.)	0.03 too light, 0.04 too heavy.
*No. Pac.	0.03 too light; 0.04 fairly good results (not quite enough with curves frequently changing direction, slightly in excess for long continuous curves).
C., R. I. & P.	On 0.03 (with new rail) trains retarded at less than 10 m.p.h. and accelerated at higher velocities.
G. T. Pacific	0.04 too high for new rail.
N. Y. Central	0.03 made limiting grades on curves; 0.04 satisfactory.
*C., M. & St. P.	0.035 generally on maximum grades; sometimes 0.03.
P. & L. E.	0.035 satisfactory.
Erie	0.035 satisfactory.
N. & W.	0.035 satisfactory; trains accelerate on 0.04.
Car., C. & O.	Trains loaded for 1% grade accelerate on curves compensated 0.035.
*L. & N.	0.03 too low; 0.05 to be used.
W. & L. E.	0.03 used, but 0.04 preferred.
Can. Pac.	0.04 satisfactory up to 5°; too high for sharper curves.
Wes. Pac.	0.04 used, but probably higher than necessary.
Wash. & Ore.	Trains stalled or retarded on 0.04; 0.05 satisfactory. On 0.05 trains loaded for 10 m.p.h. on ruling grade tangents retarded; trains for 15 m.p.h. accelerated.
*Ill. Cen.	0.04. On Ind. So., 0.04 when curve was as long as maximum train, 0.03 when not more than half as long as train.
*Ph. & Read.	0.04.

* From Tratman's "Railway Track and Track Work."

A LOCK TIE BRICK COMPANY.

A new corporation, the Lock Tie Brick Company, of British Columbia, capitalized at $100,000, has been organized by Vancouver business men to take over from the Canadian Lock Tie Holdings, Limited, the rights to manufacture and sell in British Columbia Lock Tie brick. The head of the company is Mr. Louis A. Rostein, of the United Canadian Securities Agencies, and among the directors are Mr. J. B. Miller, general manager of the Clayburn Company, Limited, brick manufacturers; Mr. A. L. Russell, general manager, Evans, Coleman and Evans, Limited, and Mr. H. J. N. Hastings, of the United Canadian Agencies.

THE DISPOSAL OF SEWAGE SLUDGE.

Of the many difficult problems which the sewerage engineer is called upon to solve none gives him more anxiety than the one connected with the satisfactory disposal of sludge. In a paper read before the Royal Sanitary Institute Congress at York, England, Mr. Arthur Hindle and P. Holt Whitaker gave one solution of the sludge problem. The authors state that, in common with other engineers who are called upon to advise local authorities as to their sanitary arrangements, they have been faced with this difficulty, and at some sewage disposal works recently carried out under their guidance have installed a system of treating the sludge which has proved so efficient as to justify them in giving a brief description thereof in the hope that it may be of some interest to their professional colleagues. The system referred to was provided at the sewage disposal works which the authors designed and carried out for the Penrith Urban District Council.

Penrith is a market town in Cumberland, and has a population according to the last census of 8,993. There are no works or manufactories beyond two small breweries, so that, with this exception, the sewage is purely domestic. The original sewerage works for Penrith were carried out in the year 1850, and comprised a system of main sewers and sewage disposal works on the broad irrigation system on a large area of land known as Westmorland Holme, situate near Eamont Bridge, about one mile from the centre of the town. The new works, which are now practically completed, comprise an entirely new system of main and subsidiary sewers throughout the town, an outfall sewer about 2½ miles in length, including crossing of the River Eamont, which was done by means of a gravitating cast-iron pipe carried by a lattice girder bridge of 120 ft. span, and sewage disposal works on lands forming part of Whinfell Holme, which were acquired from Lord Hothfield, the price being fixed by arbitration. An area of 25 acres was acquired, but only about 12 acres have as yet been laid out. The subsoil is eminently suitable for filtration purposes, consisting of a deep bed of gravel, which is overlaid with about 2 ft. of fibrous soil.

The sewage treatment consists of sedimentation in tanks and filtration through land on the intermittent downward principle. There are four circular sedimentation tanks, each 40 ft. in diameter and an average of 7 ft. 6 in. deep, so arranged as to enable them to be worked on the quiescent or continuous-flow principle, either separately or in series, as circumstances dictate. Inlet and outlet channels, junction wells and controlling valves are provided. Before entering the tanks, the sewage passes through screening chambers, which are arranged in duplicate and fitted with Stott's revolving screens. Between the screening chamber and the mixing buildings there is a dividing well, whence the storm water flows to specially prepared areas. Three times the dry-weather flow passes to the works for full treatment, and three times passes to the storm-water beds. The buildings comprise mixing-house, small engine-house, with oil engine and pump, store-room, and office. Up to the present time it has not been found necessary to use any precipitants, but arrangements are made in the mixing-house therefor should their use ever be required.

After leaving the tanks the effluent passes over aeration weirs, thence into a main carrier, and is subsequently distributed by means of subsidiary carriers over the land filtration areas, which are underdrained with 3 in. agricultural tiles, the number depending upon the nature of the sub-soil in each area, and these in turn are connected to a main effluent drain, which discharges the purified effluent into the River Eamont, a well-known fishing river.

The levels of the outfall site were such as did not permit of the sludge being drawn off from the bottom of the tanks so as to gravitate to the sludge drying-beds. It was, therefore, necessary to provide some means of lifting it to the desired level, without, if possible, incurring the cost of pumping. This was accomplished by utilizing the head of the water in the tanks for the purpose of forcing the resultant sludge to the drying-beds, and to assist in this object an apparatus known as Fidler's revolving scraper was placed in each sedimentation tank.

The Fidler scraper arrangement is intended to facilitate the removal of sludge without interfering with the continuous working of the sedimentation tanks and to deliver the sludge at a level only a few inches below the top water level of the tank. The scraper, by means of which the sludge is directed to a sump in the bottom of the sedimentation tanks, is helical in form; it is attached to and supported from a lattice girder, and is rotated by gearing fixed at the side of the tank adjacent to a sludge discharge chamber so as to give opportunity for careful regulation of the discharge. When it is desired to remove the sludge the scraper is revolved and the sludge directed into the central sump, from the bottom of which it is forced to the sludge drying-beds. Valves are provided on the several pipes to regulate and control the flow.

The sludge drying-beds are four in number, each 25 ft. long by 10 ft. by 6 ft. deep; they are constructed of brickwork, backed on the outer side with concrete; the floors are made of concrete, laid with proper falls in the direction of the drains. Each bed is provided with doors, constructed in sections, extending the full width of the bed at the lower end, which can be raised or lowered at will as the material in the beds increases or decreases. Cross walls are formed of perforated boards laid in grooves so as to be easily adjusted.

When the sludge is about to be emptied from the sedimentation tanks, a layer of straw, litter, dried weeds or the like is first laid in each tank or compartment in such a manner that the whole surface of the bed is covered; the litter is also drawn slightly up the sides of the beds or compartments, as well as round the vertical perforated pipes or shafts. These perforated vertical pipes are about 6 in. in diameter, in lengths of about 2 ft., provided with sockets and spigots, so that they can be built up in continuous shafts from the floor to the top of the bed as it is being filled. A layer of sludge, to the depth of 4 in. to 6 in., is then run on to the litter, which acts as a filter, the litter allowing the liquid to filter through and find its way to the perforated pipes, which in turn are connected to drains laid on the floor of the beds. This operation of filling the beds alternately with litter and sludge is repeated until the bed or compartment is filled, when operations are transferred to the next bed. The liquor draining from the sludge beds is conveyed to a well, and is then pumped, by the oil engine and pump previously referred to, into the feed channel of the tanks for re-treatment. As the beds are being filled the increasing weight compresses the sludge and litter, thus forming, after proper settlement, a firm bed of manure, which is easily handled and is very portable. A layer of litter is always placed on the top of a layer of sludge to obviate any nuisance from smell, which one usually expects to arise from open sludge beds or lagoons.

The authors were assisted by the Surveyor to the Penrith Urban District Council, Mr. J. J. Knewstubb (member), who acted as resident engineer throughout the construction of the sewerage works, and who has supplied, for the purpose of this paper, the following information:—

Population dealt with in the scheme, 8,000.

Daily dry-weather flow per twenty-four hours, 290,000 gallons.

Quantity of wet sludge passed on to the beds per day, 2½ tons average.

Quantity of dried sludge taken out of the beds per day, 16 cwt. average.

Quantity of dried sludge removed from the beds and sold per annum, about 300 tons, average.

Quantity of litter used in the beds per year, 70 tons.

Length of time occupied in drying the wet sludge; this varies according to the season, but averages about six weeks.

Length of time occupied in filling one bed, about four weeks. This again varies according to the time of the year and atmospheric conditions.

Rate of consolidation varies according to depth of bed.

Length of time required for the dried sludge to attain its most beneficial condition as manure after removal from the beds, twelve months.

The sludge is sold by open tender every year, and the average price per cart load realized has been 1s. 9d. per load. The authors are informed that the manure removed from the sludge beds after treatment under this system is most beneficial for use on land growing turnips and mangolds, and also gives good results for clover and seed grass at any time and under almost any conditions. It has also been found to be an excellent material for ploughing into land of a light character.

No additional expense is placed upon the Council in dealing with the sludge, as the operation of filling the beds is performed by one of the regular men employed on the farm, and occupies but an infinitesimal portion of his time. The emptying of the beds is undertaken by, and at the expense of, the purchaser of the dried sludge, who also provides and brings to the beds part of the litter required; this, of course, being a consideration of the purchase price. So far as Penrith is concerned the sludge problem has been solved; the authors have, however, up to now hesitated to supply any description of the system, as they were desirous it should have a fair and ample trial before doing so.

This description is given purely from an engineer's point of view, apart from that of the chemist. There is, however, the practical side of the question in that the farmers of the district are competitors for the dried material. The works were completed in the latter part of 1907, were formally opened on, and have been in continuous operation since, the 19th of March, 1908.

CANADA'S COOPERAGE INDUSTRY.

Seven million two hundred and ninety-three thousand oak staves were imported into Canada during 1911, while only 2,768,000 were cut in the Dominion. These figures which show that Canada is fast losing her possibilities as a producer of tight cooperage, are contained in a bulletin issued by the forestry branch of the department of the interior.

In the manufacture of slack cooperage, used for the dry rough commodities such as lime, potatoes, apples, dry fish, flour, cereals, etc., which predominate in Canada's products, elm is the principal wood employed, forming over 50 per cent. of the total consumption. Spruce is rapidly coming into more general use as a source of stave supply, eleven million more spruce staves and nine million fewer elm staves having been used in 1911 than in 1910. When elm is exhausted birch will probably take its place, being comparatively flexible and available in great quantity.

The total value of the materials used in the slack cooperage industry in Canada for the past year was $1,465,702. In 1910 it was $1,595,119 or some $130,000 more. Imports and exports of materials and finished product were, respectively, $329,992 and $135,463, an excess of imports over exports of $194,529.

THE CYLINDER PERFORMANCE OF RECIPROCATING STEAM ENGINES.

In the report of an investigation by Mr. J. Paul Clayton, printed in the Journal of the American Society of Mechanical Engineers, April, 1912, the author states that it has been found that the indicator diagram contains in itself the evidence necessary for an almost complete analysis of cylinder performance, the results of which have not heretofore been considered possible. In obtaining these results the pressure and volume values of the indicator diagram have been plotted on logarithmic cross-section paper; and by the aid of this logarithmic diagram it has been found that the expansion and compression curves of all elastic media used in practice obey substantially the polytropic law $PV^n = C$. From this and other discovered facts the author has developed rational methods of closely approximating the clearance of a cylinder, of locating the cyclic events, of detecting moderate leakage, and of determining the actual steam consumption of the engine.

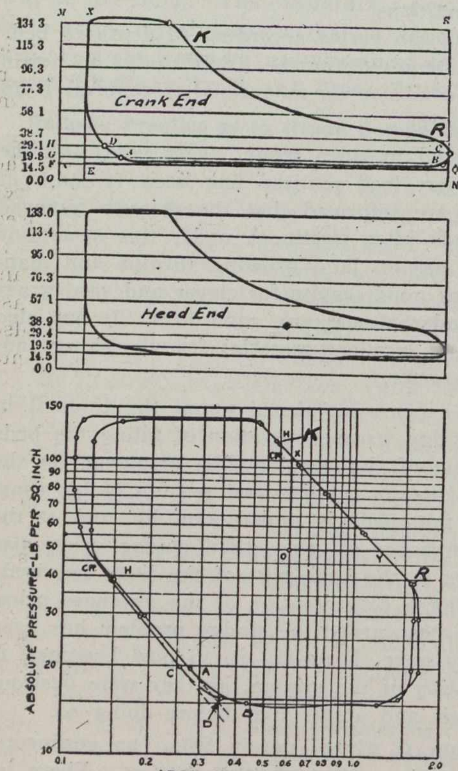


Fig. 1.—Construction of the Logarithmic Indicator Diagram.

Construction of the Logarithmic Diagram.—Fig. 1, in its upper half, shows the indicator diagrams taken from both ends of a 12 x 24-in. single-cylinder Corliss engine used in the tests; ON is the line of zero pressure, OM the line of zero volume, and FQ the atmospheric line. The clearance is 7.04% and is represented by FE. Horizontal lines are ruled over the diagram, at known pressures, as shown. Thus, absolute pressure at K = 115.3 lb., and at R = 38.7 lb.; absolute cylinder volume at K, measured from the line MO = 0.531 cu. ft., and at R = 1.572 cu. ft. These values are plotted as shown in the lower diagram, and the procedure is the same for all other points in each indicator diagram.

When the clearance volume is absolutely known, the expansion and compression law $PV^n = C$ holds true, and when plotted on logarithmic paper it becomes a straight line, for example, KR (Fig. 2). Taking the logarithms of both terms of this equation, and transposing, $\log P = -n \log V + \log C$. This equation is of the form of the straight line $y = mx + b$, where $y = \log P$, $m = -n$, $x = \log V$ and $b = \log C$. Thus $m = -n$ is the slope or inclination of the line to the axis log V. Drawing OX and OY on Fig. 2, the slope of XY will be the ratio $OX \div -OY = -n$. OY is negative, being measured to the left and giving n its negative sign.

Rational Method of Approximating Clearance.—When the true clearance volume is known, the expansion and compression lines in the logarithmic diagram are straight lines. When the value assumed for the clearance volume is greater or less than the true value, these lines are curved. Fig. 2 gives logarithmic plottings of an indicator diagram taken from a 42 x 60-in. gas engine, the clearance being assumed successively at 14, 16, 18, 20 and 22%. The approximately straight line for the value of 18% is the transition between the two families of curves bending to the left and right, as shown, and the true value of the clearance is therefore very close to 18%. All that is necessary, therefore, is to assume different values for the clearance, plot and logarithmic diagram for each value and determine the straight-line value by trial and error. This may be found to within 5 to 10% of the true value, depending as the clearance itself varies from 20% to 2%, respectively, of the piston displacement.

Locating the Stroke Position of Cyclic Events.—For ordinary purposes these can generally be located by inspection of indicator diagrams themselves; thus cut-offs may be generally located on a Corliss engine diagram to within 1/16 in. measured along its length. The actual beginning of true compression, however, can never be accurately located on the PV-diagram. True compression, unaffected by leakage, begins after the exhaust valve, in closing, has acquired enough seal to prevent leakage; its point of beginning is generally at least 5 lb. above the back pressure. The point at which leakage ceases cannot be located on the PV-diagram because the curve of true compression, and the curve during the time the valve has insufficient seal, are of the same direction of curvature, and are not reverse curves as in the general case of admission and expansion.

As expansion and compression of a constant weight of medium take place according to the law $PV^n = C$ and are indicated by straight lines in the logarithmic diagram, it becomes easy to locate thereon the events of cut-off, release, compression and lead by noting when the expansion and compression lines become straight. These events, though obscure in the PV-diagram, may be located to well within 1/16 in. in the logarithmic diagram, which is equivalent to about 1/32 in. when retransferred to the PV-diagram itself. This method largely eliminates the variable element of personal judgment. The upper part of Fig. 3 show cards taken from a 16 x 24-in. superheated steam locomotive running at short cut-off and high speed. Below these cards are plotted in the form of logarithmic diagrams, showing how the cyclic events may be readily located.

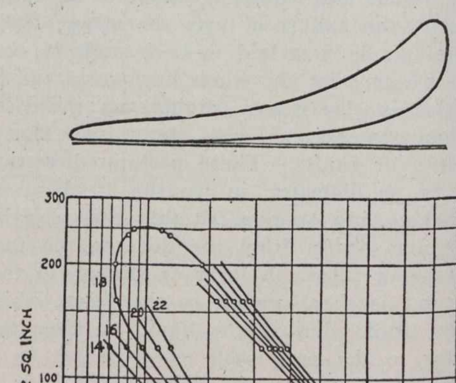


Fig. 2.—Determination of Clearance by the Logarithmic Diagram.

The Detection of Leakage.—The law $PV^n = C$ applies only in cases where the weight of the working medium remains practically constant during any expansion or compression. When this weight changes materially, either by leakage into, or out from, the cylinder, the resulting expansion or compression no longer obeys the law and it becomes a curve on the logarithmic diagram. Leakage is usually the result of wear, and occurs, as a rule, only when the pressure difference is over about 20 lb. This latter fact, founded on the analysis of numerous diagrams, makes it possible to divide the expansion and compression lines roughly into three equal parts on the logarithmic diagram (when these lines extend from the initial pressure nearly to the back pressure): (a) the upper third, influenced by leaks out from the cylinder; (b) the middle third, practically uninfluenced by leakage; and (c) the lower third, influenced by leakage into the cylinder. Thus, fairly reliable values of n, free from the effect of leakage, may be obtained from the middle third. The important result attained by this method of examination is the knowledge that leakage is taking place, so that it can be located and stopped.

The Approximate Determination of Steam Consumption from Indicator Diagrams.—The devising of an accurate method of measuring the weight of steam consumed from the diagram has hitherto been regarded as impossible, but, after many examinations into the cases of different types and sizes of engines, with non-jacketed cylinders in good order with pressures between 60 and 120 lb. absolute, and exhausting at or near atmospheric pressures, it has been found that while the initial condensation is subject to the action of ten or more variables, yet the value often resulting from a given value of Xc (or proportion of the total weight of steam mixture present as steam at cut-off, i.e., quality) is almost always substantially the same, and is expressed by the relation $Xc = 1.245n - 0.576$.

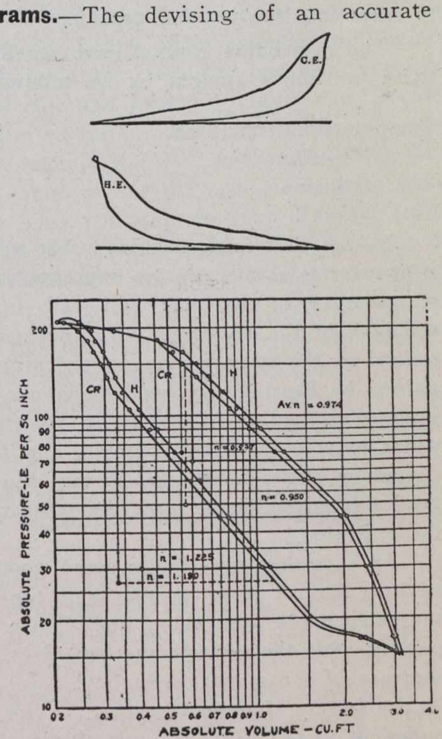


Fig. 3.—Locating the Stroke Position of Cyclic Events.

This relation is practically independent of cylinder size and of engine speed. The point of cut-off and the value of n being obtained from the logarithmic diagram, the value of Xc may be readily calculated and the actual steam consumption obtained by this method to well within 4% (on the average) of the amount consumed as measured by test.

This method is more accurate than the average test; it is the only accurate method available for testing certain classes of engines; it virtually measures an instantaneous rate instead of an average quantity over a long period, and thus enables a large number of points to be obtained for a water-rate curve; it permits of making tests at frequent intervals instead of once in the engine's life; the expense is not to be compared with that of an equally accurate test; it involves in the routine of the plant tested.

THE STRENGTH OF WOOD FOR PAVEMENTS.

The wood pavements in Paris, France, last on an average nine years, but in the most frequented roads they have to be renewed every five or six years. This rapid wear has led to the undertaking of various experiments in the Municipal Testing Laboratory in an effort to find means for increasing the strength and at the same time the durability of the materials for wood pavements. The following description of these experiments and the resulting conclusions are taken from a paper of M. P. Labordere, Engineer of Bridges and Roads, and M. F. Austett, Director of the Municipal Testing Laboratory of Paris, prepared for presentation at the Sixth Congress of the International Association for Testing Materials:

Up to the present time the only treatment to which the woods used in Paris are subjected has the aim of diminishing decay. It consists in impregnating the newly cut blocks with a heavy coal tar oil which is rich in phenols; this impregnation is as a rule simply effected by means of immersion. The Municipal Testing Laboratory, however, has for some years been occupied with securing some better impregnation by making the heavy oil enter the wood under a pressure of 5 kg. The first series of experiments which was executed in the laboratory in 1908 and 1909 brought out the conclusion that the impregnation with heavy oil under pressure improves the wood as regards the physical qualities, because it diminishes the porosity of the blocks (that is to say, the quantity of water which is capable of being absorbed by the wood after immersion), as well as their expansion under the influence of moisture, but that it remains without effect on the mechanical strength of the wood.

In order to compare the mechanical strengths of wood prepared in different manners the pressure per square centimetre which enacted in the direction of the fibres will produce crushing was adopted as a measure of this strength. The specimens used in these experiments were prisms of 75 x 75 mm. basis and 125 mm. height, and they were obtained by cutting three equal specimens out of each of the blocks, the blocks serving for the experiments being 240 x 80 x 120 mm. Care was taken to keep the different blocks employed for these experiments apart from one another, to number the blocks of each balk from one end to the other, and to mark each of the specimens cut out of each block in such a way that the specimens belonging to the same fife reckoned in the longitudinal direction of the balk could be compared. The different blocks of one and the same balk were submitted to different treatments, and the specimens cut out of these blocks were crushed in the hydraulic press.

The determination of the crushing strength does not offer any difficulties; for in the moment at which the specimen fails the pressure gage of the machine will mark a sudden fall. In order to take account of the effect of humidity which cannot be avoided on the roads, care was taken in each case to experiment on two specimens in the dry state, and on a third specimen which had been immersed in water for 30 days.

As the length of the longest balks, which the laboratory had at its disposal, 2.30 m., does not permit of cutting more than 18 blocks (or 18 comparable specimens), and as moreover the number of methods of preparing the specimen for the test was greater than 18, it was necessary to agree upon a reference basis for all these experiments. This standard was taken as the strength of an ordinary crude block and consequently in each balk two blocks at least were reserved which were left in the crude state and sawn into two specimens to be crushed in this state.

Attention having been drawn to various attempts of improving the wooden pavements by mixing the oil, with which they were to be injected, with alkaline carbonates and silicates, a study was made in the experiments of the influence upon the quality of the pine wood of a mixture of the following products:

Pine tar.

Alkaline carbonates (sodium or potassium).

Sodium silicate.

In order to study the conditions of the experiments the temperature of the bath was varied and in a more restricted manner also the proportions of the chemical products applied were varied.

The experimenters used a bath of pure pine tar heated up to 60, 80 or 110° C. They then, at analagous temperatures, made use of pine tar to which one of the following ingredients had been added:

Sodium carbonate......	2 grammes per litre of tar
	4 grammes per litre of tar
Sodium silicate	4 grammes per litre of tar

The results obtained did not show any appreciable superiority of the one or the other bath composition.

Raising the temperature of the bath, on the other hand, produced a marked increase (12 per cent.) in the strength of the specimens which had been kept dry; but it had no appreciable effect on specimens which had been preserved in water.

The objection to this process was the high price of the pine tar. Attempts were then made to replace this product by a low price hydrocarbon, and the heavy coal tar oil which is used in the works of the city of Paris for impregnating wooden pavements was employed. The impregnation was effected under the same conditions as with the pine tar at temperatures lying between 112 and 140° C. With the highest temperature applied the strengths became the same as with the bath of pine tar, at the lowest temperatures, however, the strength was equal or even inferior to that of the ordinary crude blocks. This showed the possibility of employing the heavy tar oil in the place of a vegetable tar, but only on condition that the temperature of the bath be raised up to something between 115 and 140°, and probably best to 125 or 130°.

As an improvement had been realized by the application of a complex bath (liquid No. 7, heavy oil, sodium carbonate), steps were taken to find the cause of this amelioration, and the experiments were recommenced by adding successively to the heavy oil some carbonate of soda (liquid No. 8) and some silicate of soda (liquid No. 9).

The strengths which, in the case of blocks treated with the mixture of sodium carbonate and silicate, had remained inferior or at the best equal to that of the crude blocks, underwent a sensible increase when the wood was treated alone with carbonate and, more still, when treated alone with the silicate. This result appeared at first decidedly contradictory.

The contradiction may, however, vanish when attention is paid to the temperatures of the different impregnations. The liquid No. 7, bad at a relatively low temperature of 120 or 115°, becomes excellent at 140°, the liquid No. 8, mediocre at 112°, becomes better at 120°. The liquid No. 9 finally, which is practically equivalent to the preceding in the case of balks which have been impregnated at 120°, is, on the contrary, decidedly more favorable in the case of balks impregnated at 140°.

It appears then that, in the cases studied, the nature of the chemical constituents of the baths used for impregnation has little importance, and that the temperature of the bath is the essential feature. To verify this hypothesis it was sufficient to compare the very large number of experiments conducted from the point of view of temperature. The strengths found for the blocks which had been kept in the dry were as follows:

		Mean strength.
Non-treated blocks		323 kg/cm²
Temperature of bath	80°	337 "
	90°	347 "
	100°	330 "
	110°	358 "
	120°	345 "
	140°	487 "

Fresh experiments were conducted by heating blocks in baths up to 150 and 200°, care being taken to make the bath simply of tar or heavy oil, in order to verify the correctness of the previous conclusions relative to the usefulness of the mineral constituents.

The temperature of 200° was not exceeded because at that temperature the wood begins to visibly undergo disaggregation. The escape of the constitutional water leads to the production of numerous fissures, parallel to the fibres, which would certainly not be unobjectionable, if it were only on account of the facility which the cracks provide for water to enter into the wooden paving.

The new baths studied gave sensible improvements over those previously applied, as the following figures will show:

Temperature of the bath.	Mean strength.
150°	516 kg/cm²
200°	536 kg/cm²

It was therefore concluded that up to 200°, the limit of temperatures admissible for impregnation baths, a rise in the temperature of the bath will lead to an increase in the strength of the pavement. It appears, however, that, with regard to the improvement of the strength, little would be gained by heating the wood above 130 or 140°. The inconvenient production of cracks or fissures, which allow the water to penetrate from outside, and the heavy expense incurred by heating the wood to very high temperatures would render it advisable to limit the temperature of the bath to these figures.

As a further experiment some wooden blocks were heated in a dry air stove, at the same time that other blocks of the same balks were being heated in a heavy oil. The temperature was the same in the two cases, 200°. There was the increase of the strengths in both cases, though less marked in the former than in the latter. The result was, however, sufficient to put aside the hypothesis of an improvement of the wood simply by the action of the oil. It would therefore appear that the improvement is, to a large extent, at least due to the dehydration of the wood and to a transformation of its fibres wholly owing to the action of heat.

It would moreover appear that experiments conducted a few years ago in America (related in the work of Petsche: Wood, page 272) have established that, after heating wood up to a temperature ranging from 150 to 260° under a pressure of from 10 to 14 kg. per cm. square, a blackish antiseptic mixture is formed which remains imprisoned in the wood and which contains acetic acid, acetone and tarry matter. Should it be these substances which increase the strength of the wood? It would be premature to form more than hypothesis as regards this point.

However that may be, heating in the dry state, such as was employed in the Municipal Laboratory for certain blocks could not practically be applied, because the blocks of wood heated in the dry would lose their water more rapidly than when heated in oil and would begin to split. At 200° moreover they would undergo a very sensible superficial carbonization. It was therefore concluded that it must be the heating in the oil which is the essential thing in improving wood, and for reasons already stated the temperature of the bath should be fixed at 130 or 140°. There remained the question, for how long a period the immersion in the hot bath should be continued.

A pretty long period is forcibly necessary; for the elevation of the temperature must be progressive, lest the humidity contained in the wood should suddenly escape giving rise to fissures. In the French experiments the blocks were always put in the cold oil and the oil heated. In industrial processes this practice might be replaced by the use of several successive baths at increasing temperatures. The length of the heating period which was 10 hours in the first experiments has progressively been reduced to 8, 6 and 3 hours. It is with this last mentioned period of 3 hours that the highest strength was obtained at temperatures lying between 150 and 200°.

Experiments made with heating periods of from 2 to 3½ hours have demonstrated, that up to about 3½ hours an improvement can be noticed which is practically proportional to the length of the heating period. It was, therefore, concluded that it will be advisable to fix the heating period so far as possible at 3 or 3½ hours. The exact determination of this period depends upon the relation between expense and improvement realized, and practice alone can decide this point. The results so far alluded to all concern specimens which had been kept in the dry, although particular precautions were not taken to dry the specimens more than the surrounding air. This condition is very different from that of a wooden pavement laid on a public road, where it is always more or less soaked with water, both by rain and the frequent sprinklings.

In order to meet this later condition all the experiments mentioned above were renewed with specimens kept for 30 days in baths filled with water. Contrary to what had been established with regard to the dry specimens, the experiments yielded under these new conditions much less important results. The investigators concluded that it would therefore be advantageous to prevent the penetration of water into the wood so far as possible, in order to secure all the benefits of the hot treatment. The experiments seemed to demonstrate that to prevent the soaking of the pavement with water, impregnation by immersion and heating even up to high temperatures of 150 or 200° in heavy oil or in tar constitute altogether insufficient remedies. From experiments conducted in 1910 it was concluded that creosoting under pressure, which makes the oil penetrate more deeply into the wood, prevents the invasion of the wood by water. Experiments were therefore conducted by making this treatment at high temperature sometimes precede, and sometimes succeed the impregnation. To further vary the experimental conditions, the heating was effected sometimes in an oil bath, sometimes in a bath of dry air. The experiment seemed to nave established that creosoting under pressure combined with heating noticeably improves the strengths of blocks kept dry But as regards the blocks which had been kept immersed this treatment only resulted in imparting a strength which was about equal to that of the crude block. This was a remarkable fact; for the amount of water which is absorbed by wood is much reduced by creosoting under pressure as is well known. One may therefore declare that it is the first portions of water absorbed after desiccation which play the most injurious part. It might therefore be concluded that creosoting under pressure does not suffice to counteract the detrimental effects of soaking with water.

Efforts were made to find other means for preventing this penetration and experiments were tried with a view to surrounding each block with a superficial protective layer. This layer can easily and economically be obtained by the aid of a pitch or tar analogous to the products which are used in tarring the macadamized roads. It was found that when the wooden blocks, crude or creosoted, and consequently very permeable were simply plunged into hot pitch, there is indeed, formed about them a shiny continuous coating which suffices to keep the water out to a large extent. The increase in the weight of such blocks which have been immersed in water is indeed considerably diminished by this treatment especially when they are left in the pitch for appreciable periods (10 minutes).

When this process of coating with pitch with creosoting by immersion and particularly with creosoting under pressure was concluded altogether remarkable results were obtained. It is, however, particularly a prolonged lying of the wood in pitch which is very efficacious in preventing its invasion by water. When the immersion period lasts a sensible time, the holes, which were formed in the coating of the pitch at the moment of their being soaked by the escape of the water contained in the superficial layers of the block which were exposed to contact with the hot tar, are indeed being closed.

Attempts were made to confirm the conclusion as to the efficacy of pitch by measuring the crushing strengths of specimens which have been cut out of blocks plunged into pitch. But owing to some circumstances which have remained obscure, the results of this experiment were really contradictory. The experiments show for blocks, which were coated with pitch and then immersed in water, sometimes an increased strength and sometimes a decreased strength.

Meanwhile, however, the investigations conclude from the very small quantity of water which penetrates into blocks coated with pitch, and especially in the case of those which remain for 10 minutes in pitch at 110°, that there is some advantage in making them undergo this treatment after heating. In order to simplify the operations it might perhaps be best to heat the blocks in the pitch itself, since the nature of the heating bath does not appear to have any important influence; but it will only be after some more prolonged experiments that the practical applicability of this heating process can be decided upon.

As regards the wear of the protected coating due to the traffic, this can be obviated by proceeding periodically to a superficial tarring of the road, under the same conditions as with macadamized roads.

The experiments show that the tar can be made to enter to depths of several mm. into the wood, when sprinklers at high pressure are applied.

The conclusions arrived at by Messrs. Labordere and Anstett as the results of these experiments are as follows:

From what we have explained we consider that the crushing strengths of wooden paving blocks can considerably be improved by heating in a bath of heavy oil tar at a temperature of 130° or 140°, maintained during a period which may provisorily be fixed at 3 hours, but which further experiments may perhaps permit us to diminish. The heavy oil to be used should be chosen such as does not contain any notable quantities of products which are volatile at 140°.

In order to reduce the diminution in the strengths which is due to the inbibition of the wood paving with water, we may employ, separately or together, the two following processes:

1. Add to the oil bath a small quantity of sodium carbonate and of sodium silicate, which may approximately be fixed at 0.6% for the carbonate and at 0.1% for the silicate.

2. Immerse the blocks after heating and creosoting under pressure in a bath of liquid pitch at 110°, the immersion being kept on for about 10 minutes; then apply superficial tarring of the laid pavement as described above.

The pitch to be used should be half-dry gas pitch including about 10% of anthracene oils.

The second method appears to be of a much superior efficacy. As long as the pavement will remain in good condition the protective layer will not be attacked. The addition of alkaline salt is yet not useless; for it permits of maintaining a certain improvement even in cases where, by consequence of the wear, the blocks should no longer be protected against the infiltration of an appreciable amount of water.

COMMERCIAL UTILIZATION OF PEAT FOR POWER PURPOSES.*

By H. V. Pegg, of Belfast.

The question of the utilization of peat fuel for power purposes has received a large amount of attention from engineers for many years past. Efforts in this direction have mostly taken the shape of some form of preparation of peat fuel in order primarily to get rid of the superabundant moisture in the fuel. Very large sums of money have been spent on peat-preparing machinery with generally very inadequate results, hence it has always appeared to the author that, in order to bring the utilization of peat to a commercial level, the first consideration would be the utilization of the peat as far as possible in the condition in which it leaves the boglands without any preliminary and expensive machine treatment.

The author had the opportunity about seven years ago of experimenting with air-dried hand-cut peat fired into a special form of gas-producer. With all gas-producers using bituminous fuel the main trouble is to get rid of the tarry by-product. In this instance the gas-producer was arranged to work intermittently, there being periods of "blowing" during which the fuel in the producer was urged to incandescence, and periods of gas-making during which the tarry by-products were passed through the incandescent fuel, where they were split up into gas. The chief difficulty experienced with this plant was the high thermal value of the gas generated, about 330 B.Th.U. Owing to the high and varying percentage of hydrogen in the gas, it proved unsuitable for use in the works gas-engine; and although the plant was running more or less continuously for ten days driving the whole works, very considerable trouble was experienced, not only in the engine, but also in the plant, owing to the varying moisture content of the peat, the producer plant being decidedly sensitive in regard to this latter point. From the experience then gained it appeared evident that it would be wiser to extract the tar from the gas, rather than to try to utilize the same by converting it into gas, and further, that the producer must be comparatively non-sentitive to the amount of moisture in the peat fuel. Some two years ago the author discussed the question of the utilization of air-dried peat fuel with Mr. Hamilton Robb, of Portadown, who, having large supplies of such fuel convenient to his factory at Potadown, was strongly of opinion that it should be possible to utilize such fuel in order to generate the power required in the factory. As the result of various tests run with an experimental plant at the works of Messrs. Crossley Brothers, Openshaw, a special plant was eventually manufactured by them under their designs and patents and to the author's specification. This plant, which has been running since last September, has been so often dealt with in the daily and technical press that there is no need for the author to dwell upon the details of the plant, but he proposes to make a few remarks in regard to the difficulties experienced.

Air-dried peat is not a very convenient fuel to fire into the producer, and as it was uncertain whether it would be possible to burn the fuel direct in the form in which it came from the boglands, provision was originally made in the plant to deal with peat fuel prepared by being reduced in size to blocks of about 5 in. cube; but it was found possible to dispense with the preliminary treatment, and the construction of the plant was thereby considerably simplified.

As regards the general running of the plant, last October it was subjected to a test run of six hours' duration with a load of 250 brake horse-power, the peat consumption per brake-horse-power hour averaging 2.55 lb., the peat fuel containing 18.98 per cent. of water; this was with both producers running, although the load was considerably below the total capacity of the plant. When necessary it has been found that the above load can be safely carried with either producer working singly, and the plant has run under these conditions for several days.

It will be noted that the percentage of moisture in the fuel during the above test was unusually low. This was owing to the unusually dry summer of 1911. During November, and especially December, last the fuel fed to the plant was extremely wet, as the rainfall in those months was very heavy and the fuel supply was and is entirely exposed to the weather. The plant, however, worked just as well with sodden peat as it did with the drier peat, the only difference being the amount of fuel consumed. The amount of water in this "sodden peat" varied considerably from day to day, and the exact percentage was not arrived at; as near as could be estimated it was at least 70 per cent.

The separation of the tar from the gas was the chief difficulty to be overcome; it was found far better to rely on an ample watery-spray through which the gas passed rather than any form of a coke-scrubber, as the coke rapidly became clogged with tar. The main portion of the tar was thrown out into a tar-sump by a centrifugal tar-extractor; but unless the gases were subjected to a thorough washing and cooling by the water-spray above referred to, it was found that a certain proportion of tar got past the extractor, collected in the gas-mains, and finally found its way into the gas-engines. It was a matter of experiment as to the precise amount of water sprayed into the cooler which was necessary in order to ensure that the tar vapor should be sufficiently condensed before reaching the centrifugal extractor, so as to enable the extractor to effect the needful separation. As now arranged, the proportion of tar in the gas after passing the extractor is small, and the engine-valves do not want cleaning out more than once a week.

When first started, the plant generally, and especially the producers, required a thorough cleaning once a week; at the present date the plant can be run, if necessary, for three weeks without cleaning, though the weekly cleaning generally takes place as a matter of policy. This result has been obtained owing to the increased amount of washing-water used, which now amounts to about 7 gallons per brake horse-power per hour. The proportion of tar recovered is about 5 per cent. of the weight of fuel consumed, and during the initial stages of the running of the plant a certain amount of this tar was sold to tar-felt manufacturers at a price of 35s. per ton, but sales in this direction ceased owing to an, at present, ineradicable pyroligneous odor which persistently clings, not only to the tar itself, but to all the various oils distilled therefrom.

* Paper read before the Institution of Mechanical Engineers, at Belfast, July 31st, 1912.

Experiments have also been made with the tar in oil-burning boilers, but owing to the very high percentage of water in the tar—up to 50 per cent.—and the large quantity of solid matter also present, a very large amount of preliminary treatment is necessary. For a considerable period the tar at Portadown was used mixed with coal and burnt under a Stirling boiler; the precise heating value of the tar so consumed has not, however, been ascertained. At the present time the whole factory at Portadown is run entirely on peat-fuel, the consumption being about 44 tons per week, of which the producer plant takes about 22 tons. The nature of the peat varies considerably; with good black heavy peat the weekly consumption for all purposes drops as low as 35 tons, and with light top peat from the surface of the boglands the consumption rises to 54 tons. It is also interesting to note that the quality of the peat is reflected in the carrying capacity of the barges which bring a load of 35 tons with heavy peat and 24 tons light peat. The peat is unloaded from the barges and conveyed to the producer platform and boiler-house by a transporter. Clinker troubles are not often experienced, and only when burning the inferior grade of peat, the presence of sand in the fuel causing the trouble.

The author is indebted to Mr. W. A. Mullen, manager at the factory of Messrs. Hamilton Robb, Limited, for the following figures in regard to the cost of fuel, these figures being given on June 12 last:—

Cost of Running Factory on Coal Per Week.

	£	s.	d.
8½ tons of anthracite at 35s.	14	17	6
19 tons of steam coal at 17s.	16	3	0
	31	0	6

Cost of Running Factory on Peat Per Week.

	£	s.	d.
Say up to 50 tons of peat at 6s.	15	0	0
Weekly saving	16	0	6

Allowing for 15s. for extra labor, the net weekly saving figures out at £15 5s. 6d.

The author would here refer to the letter in Engineering of January 26 last, in which the general manager of the Power Gas Corporation, Limited, gives some very interesting particulars in regard to peat plants, more especially an ammonia-recovery plant working in the south of England. It would be of great interest if some figures as to the working costs of this plant could be laid before this meeting. It will be noted that plant is worked with ammonia recovery, which would mean a very much larger plant than that at Portadown. The amount of the nitrogen in the South of England peat is apparently high, and would appear to be considerably more than in the peat used at Portadown, analysis of which is appended hereto, together with analysis of the refuse tar and gas from the producer.

Analysis of Tar Made by Messrs. Totton and Hawthorne.

Sample of Tar No. 2.

The sample was grey when received, but very quickly turned black. On distillation it yielded:—

	Per cent.
(1) Water	37.2
(2) Light oils (distilling below 230 deg. Cent.)	5.8
(3) Middle oils (distilling at 230 to 270 deg. Cent.)	8.3
(4) Heavy oils (distilling above 270 deg.)	23.2
(5) Coke	17.8
(6) Loss	7.7
	100.0

Much frothing occurred until the water was distilled off. Towards the end the temperature went higher than a mercury thermometer will record (360 deg. Cent.). The different fractions obtained were as follows:—

1. Water, faintly acid to litmus. Phenol could not be detected.

2. Light oils (below 230 deg. Cent.) became rapidly dark red in color. Specific gravity of crude liquid 0.930.

3. Middle oils (230 deg. to 270 deg. Cent.) became dark red. Specific gravity of crude liquid, 0.944.

4. Heavy oils (above 270 deg. Cent.), on standing, crystals of paraffin wax separated out to the extent of 5.42 per cent. of the fraction (= 1.26 per cent. of the original tar). The specific gravity of the liquid portion of this fraction was 0.906.

Analysis of Sample of Peat.

(Received on September 14th from Mr. Hamilton Robb, Portadown.)

Proximate Analysis.

	Per cent.
Water	18.98
Volatile matter	55.17
Fixed carbon	24.75
Ash	1.10
	100.00

Ultimate Analysis.

	Per cent.
Carbon	44.60
Hydrogen	5.42
Nitrogen	0.97
Ash	1.10
Moisture	18.98
Oxygen (by difference)	28.93
	100.00

Analysis of Average Sample of Gas During a Ten Hours' Trial.

Moisture in Fuel, 26 Per Cent.

	Per cent.
CO_2	10.6
CO	20.1
H_2	13.0
CH_4	3.7
Total Combustible	37.7
Calorific value (calculated from analysis)	144.0 B.Th.U.

THE BEAUHARNOIS ELECTRIC COMPANY.

A new electric company has obtained letters patent from the provincial government of Quebec. It will be called the Beauharnois Electric Company, Limited. The new company will have powers in the city of Montreal, and in the counties of Laval, Jacques Cartier, Hochelaga, Laprairie, Chateauguay, Beauharnois, Two Mountains, Argenteuil, Soulanges, Vaudreuil, Terrebonne, L'Assomption, Chambly, Huntingdon, Napierville, St. Jean and Iberville. They intend to construct large power houses and electric plants at different places.

The Beauharnois Electric Company, Limited, is an independent company and they declare they will never consent to join any trust or combine of companies. The first generating station will likely be constructed at Beauharnois and th power will be taken from the rapids in that locality.

THE LATERAL PRESSURE OF LIQUID CONCRETE.

The lateral pressure of liquid concrete is a most important question for the constructing engineer. In a paper before the Institution of Civil Engineers Mr. H. St. G. Robinson has presented some notes on a series of experiments to ascertain this pressure. The first experiments were conducted about five years ago, during the construction of a heavy retaining wall, by placing boards between the uprights of the vertical forms and noting the deflections caused by the various heads of concrete.

These experiments, however, were thought to be somewhat unreliable, owing to want of refinement, and Mr. Robinson has since carried out further experiments of a similar nature, but with an apparatus constructed to secure more accurate results. This consists of a strong cast-iron chamber, fitted with a sheet-rubber working face, and is arranged so as to be readily fixed in position on the forms. The chamber is filled with water or other suitable fluid, and the pressure exerted by the concrete against the working face is recorded on two sensitive low-pressure Bourdon gauges, conveniently situated behind the chamber.

In the apparatus first used the chamber was formed of timber lined with zinc; this, however, distorted on becoming wet and was abandoned in favor of cast iron. A glass tube water-column was also fitted for recording the pressures, but it was thought that the movement of the pressure face caused by the displacement of the water was not conducive of accuracy, as it caused the concrete to arch over, a movement that does not occur when Bourdon gauges are used.

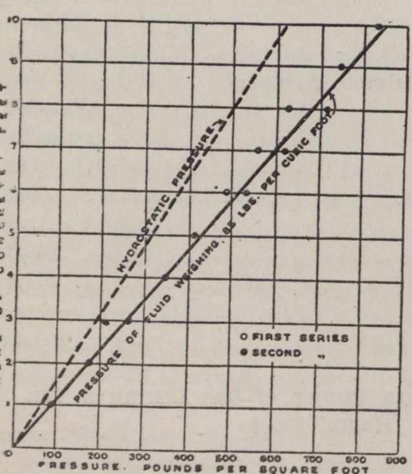


Diagram of Comparative Pressures.

A large number of experiments were made on different types of concrete structure. In heavy walls, large piers, and other members of fair size the lateral pressure exerted was found to be fairly uniform and practically constant for equal heads; but in reinforced-concrete columns of small dimensions, thin walls, and other light concrete work, the effect of friction between the more or less rough timber forms and the concrete, together with the arching action, was found to reduce the pressure considerably.

Two sets of experiments are recorded in the diagram, having been selected from a number made; they represent those in which the conditions were most favorable.

The first series of tests was made during the building of a long wall about 3 feet thick, constructed on concrete weighing 140 pounds per cubic foot and composed of slow-setting cement, sand and crushed granite in the proportions of 1:3:6, by volume. In mixing sufficient water was used to bring it to a thoroughly plastic condition, requiring little or no tamping to consolidate. The concrete was laid more rapidly than is usual in this class of work, being carried up as rapidly as the mixing and placing would permit to a height of 8 feet above the centre of the pressure face, during which time a light, iron bar provided with a turned-up end was used for churning the semi-liquid mass. Four complete sets of readings were taken, and each point on the curve represents the average value at that head.

The second series was carried out on large piers 4 feet square, the concrete in this case being a 1:2:4 mixture of cement, sand and Thames ballast, weighing 145 pounds per cubic foot. The conditions as to mixing and laying were similar to those of the first tests, and the concrete was carried up to a height of 10 feet above the centre of the pressure face. Each point of this second series represents the average of six readings.

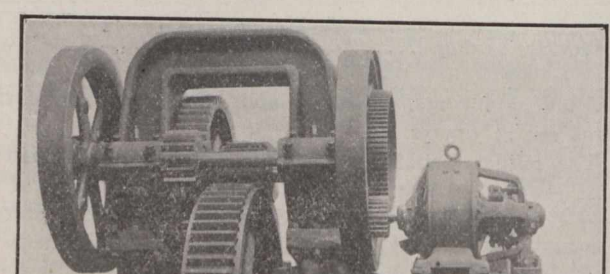
In the first series the temperature was fairly uniform throughout, while in the second considerable variation was experienced; but the effect of the differences in temperature on the lateral pressure cannot be traced, and would appear to be very small.

The general conclusion to be drawn from these and other experiments is that the lateral pressure of concrete for average conditions is equivalent to that of a fluid weighing 85 pounds per cubic foot. For concrete in which little water is used in mixing the pressures are rather less, having an equivalent fluid value as low as 70 pounds per cubic foot in very dry mixtures.

PUNCH AND SHEAR PRESS.

Economy of floor space, always an important item, is particularly so in a machine shop when it is desired to install any additional tools. The accompanying illustration will indicate how this may be effected in the case of a motor-driven punch and shear press, made by the Cleveland Punch and Shear Works, Cleveland, Ohio. The arrangement of overhead gearing renders it possible to make a very compact machine and one that is economical of floor space.

The machine complete with its motor weighs approximately 50,000 pounds. It is designed for very heavy work, having sufficient capacity to shear twelve inches of 1½-inch flat bars, and to punch a five-inch hole in 1½-inch plate. The various attachments such as those for angle shearing, bar shearing, and punching are interchangeable.



Motor-Driven Punch and Shear Press.

The motor is of 25 horsepower capacity at 230 volts, and is of the well-known direct-current, commutating pole type, specially adapted for this kind of work by the Westinghouse Electric and Manufacturing Company.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

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Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
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ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404**, **7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

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The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

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Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, SEPTEMBER 12, 1912. No 11

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CANADIAN PUBLIC HEALTH ASSOCIATION CONVENTION.

The second annual congress of the Canadian Public Health Association will be held at Toronto next week on Monday, Tuesday and Wednesday.

This Dominion Public Health Association was formed about two years ago as a result of the meeting of Federal and Provincial public health officials invited to confer with the Commission of Conservation of Canada.

The formation of such a society has been well justified to date by the interest and enthusiasm shown in its work. Last year's meeting in Montreal was well attended, not only by medical health officers, but also by a great number of engineers who are interested in sanitary and public health matters. A special session of the congress last year was devoted to such subjects as water supply, sewerage, town planning, and the removal of garbage, etc. This section, therefore, dealt with the questions of public health, which are in the province of the engineering profession. One of the features of the general session was a symposium upon the question of biological sewage disposal, and the papers and discussion contributed thereon were among the most valuable features of the congress.

There is a great lack of combined and sympathetic action between the medical and engineering profession where these professions overlap, in matters appertaining to municipal and sanitary engineering. We have had occasion to note this regrettable feature before. It can only be by cordial co-operation and becoming acquainted with others' aims and ideals, that the best results will be secured.

We feel, therefore, that the Canadian Public Health Association Congress should be well supported by the engineering profession at this coming meeting. We sincerely hope that the engineers will be present in far greater numbers than last year, and will enter into the discussions with interest.

THE CALLING OF TENDERS.

In Australia there has been a good deal of discussion lately concerning certain questions of interest to Canadians. The discovery that, though the prices of British firms were considerably lower, contracts for material had been given by the Victorian Railway Department (as also indeed, by the New South Wales Railway Department) to German houses (principally Krupp's) produced some plain speaking by the Premier of Victoria, who had ascertained that, though the English firms had been given the "go by" because their goods were "not sufficiently known" to an official concerned for the public safety, their specifications comply with the requirements of the British Board of Trade, and that they have for many years supplied most of the other Australian States with the particular line of goods in question. Judging by the Premier's specific directions, **it is not likely that the lowest tenders will ever again be rejected** in Victoria without most adequate reason, and it is not improbable that similar directions will issue from the Government offices in Sydney. Since then the tenders for rails for the Transcontinental Railway have all been rejected, because of the prices asked, but the Minister concerned hoped to induce one of the firms at least to take "a reasonable view of the expenditure that should be incurred by the Commonwealth for the rails."

In future it can be reasonably expected that British contractors will receive as generous treatment from the railway officials of Australia as German contractors. Analagous cases to the above sometimes arise in Canada. We believe, however, that British firms are receiving fairer treatment than they did some time ago. There is still great room for improvement, however.

PANAMA CANAL EXCAVATION

The estimates of excavation remaining to be done after July 1st, 1912, in order to complete the Panama Canal, according to the Canal Record, show an increase of 16,903,000 cubic yards over the estimate of July 1st, 1911.

In the Atlantic Division, the increase is 295,000 cubic yards, chiefly to provide for silting in the finished channel not covered by the estimate of July 1st, 1911.

In the Central Division, an increase of 4,615,000 cubic yards is made to provide for an extension of slides and changes in the Obispo Division.

The Pacific Division has an increase of 11,993,000 cubic yards, of which 3,199,000 cubic yards are to cover excavation in the Canal prism, in the locks and dams, and silting in the finished channel, which has become necessary since the estimate of July 1st, 1911. The remainder—8,794,000 cubic yards—is for the newly begun excavation for the drydock, coaling station, and terminal at Balboa.

THE CANADIAN HIGHWAY ASSOCIATION.

The first sign-post of the Transcontinental highway was planted on May 4th, 1912, in the town of Alberni, on the west coast of Vancouver Island. The Canadian Highway Association, which is responsible for the inauguration of the idea of a highway from coast to coast, was formed at New Westminster, B.C., about eight months ago, and one of the outward symbols of the progress they have made, is this marking of the route of the Canadian highway.

The conception of a transcontinental highway is a magnificent one, and one which we hope will be carried to a successful conclusion. In his address to the Association at the recent Alberni meeting, President Kerr states:—

> "As with the building of a new railway, so with the starting of this Canadian Highway, we have decided that the first actual step should be marked with fitting ceremony, and in this we have received splendid assistance from the towns of Nanaimo, Alberni and Port Alberni, our hosts on this occasion.
>
> "From now on the route of the Canadian Highway is eastward, with Halifax as its destination. British Columbia has nobly done its share, thanks to the untiring energy of our Minister of Public Works, Mr. Taylor, and his able deputy, Mr. Foster. Over $5,000,000 is being spent on roads and bridges in this province this year, and could we but procure the active co-operation of all the other provinces in Canada our task would be simplified, and our object realized within three years.
>
> "The Province of Saskatchewan has decided to spend $2,500,000 on roads this year, and a total appropriation of $5,000,000 has been made for the roads of that province. This is to be spent within the next two or three years. In Manitoba, only $200,000 has been allotted for road-building. This sum is, in my opinion, inadequate to the needs of that province, for my recollections of Manitoba are anything but pleasant, and I know of some roads where this total amount could be expended and yet leave that particular road in an unfinished condition. Ontario is waking up to the need of good roads; this is largely owing to the activities of Provincial Commissioner of Highways MacLean, who has $6,000,000 to spend on his work this year. In Quebec, we find that old province giving $10,000,000 for road work, and I think I am safe in saying that there is more interest in good roads in that province than in any other in Canada to-day."

If this transcontinental highway serve no other purpose than to arouse enthusiasm for the good roads cause, its inception would be justified. The thought of a first-class road running through province after province from coast to coast, is one which, if carried out, cannot do else than promote the good roads movement throughout Canada.

EDITORIAL COMMENT.

It is understood that the steel work on the Quebec bridge will be begun by November next. The Quebec Bridge Commission has just completed an inspection of the progress made to date on the substructure.

* * * *

The citizens of Galt recently had a repetition of the floods which caused so much damage last spring. The recent heavy rain storms were the cause. The Provincial Government will soon be forced to move in the matter of flood regulation by the force of public opinion.

* * * *

The Provincial Government of Quebec has recently appointed a Parks Commission composed of Sir William Van Horne, W. D. Lighthall, J. C. Walsh, Senator Boyer, Dr. Lachapelle, Mayor Lavallee and A. Michaud, for the city of Montreal. To any one who is at all acquainted with Montreal, it will be appreciated that the step has been taken none too soon. The growth of the city during the last few years has been phenomenal. The narrow streets and thoroughfares, however, have caused an increasing traffic congestion which, if allowed to exist much longer, will have the effect of throttling future progress. There is ample room for work on the part of the new commission in developing a unified plan for the future growth of the city and for the relieving of the present congested condition.

* * * *

In putting a price upon any sort of work one realizes that there is a price at which under the most favorable conditions one can do the work. There are contingencies which arise in the course of a job which are not included in the ideal programme. Some of these can be removed by foresight and good management, others seem to come under the class of "unavoidable." The bidder must not only decide the cost under average conditions, but must judge whether the conditions of the proposed job are average or special. He must balance the probabilities of unforeseen circumstances and decide how narrow a margin he dares to leave between the actual possible cost of the work and a living profit. The wisest heads are not commonly those who disregard difficulties.

INVESTIGATION OF EFFECT OF FIRE IN A LARGE REINFORCED CONCRETE PAPER MILL.

At 11 p.m., May 25th, 1912, fire broke out at the pulp-board mill of the Androscoggin Pulp Company, South Windham, Maine. The Aberthaw Construction Co. built this structure in 1906, L. W. Jones, of Milton, New Hampshire, being the engineer. The building is of reinforced concrete excepting for a wooden roof carried on trusses of the same material. The window frames and sashes are also of wood.

The blaze started below the machine room floor in the main building and set fire to the wooden panelling between the piers forming the outside wall of the lower story of the building. The burning panels set fire to the wooden sash of the window of the second story and from there set fire to the roof and to a wood and plaster gallery which was located along the side of the mill.

The fire was extremely hot, there being a large quantity of dry pulp-board piled inside the building and which burned at the same time. The intenseness of heat was so great that it bent and partly melted cast iron. Streams of water were thrown at the hot surfaces with considerable force and altogether the fire offered a particularly interesting test of the effect of fire on reinforced concrete work.

On May 28th, Morton C. Tuttle, secretary of the Aberthaw Construction Co., examined the building with Seth A. Moulton, of Portland, Maine, the engineer in charge of the rebuilding, and the latter made many shrewd suggestions as to the cause of some of the results observed. A few days later the engineer and superintendent of the Aberthaw Construction Company made a careful investigation and report, which is embodied herewith.

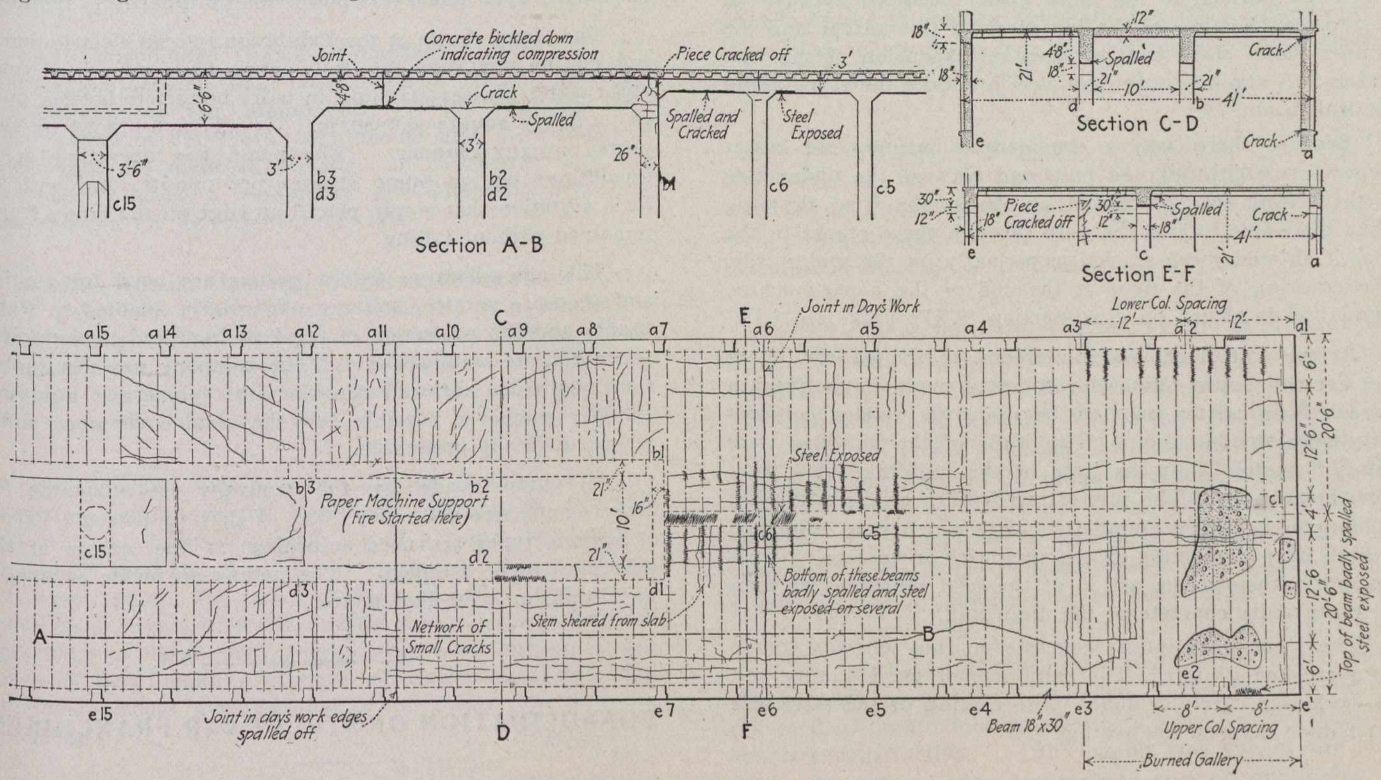


Fig. 1.—Androscoggin Pulp Co. Fire.

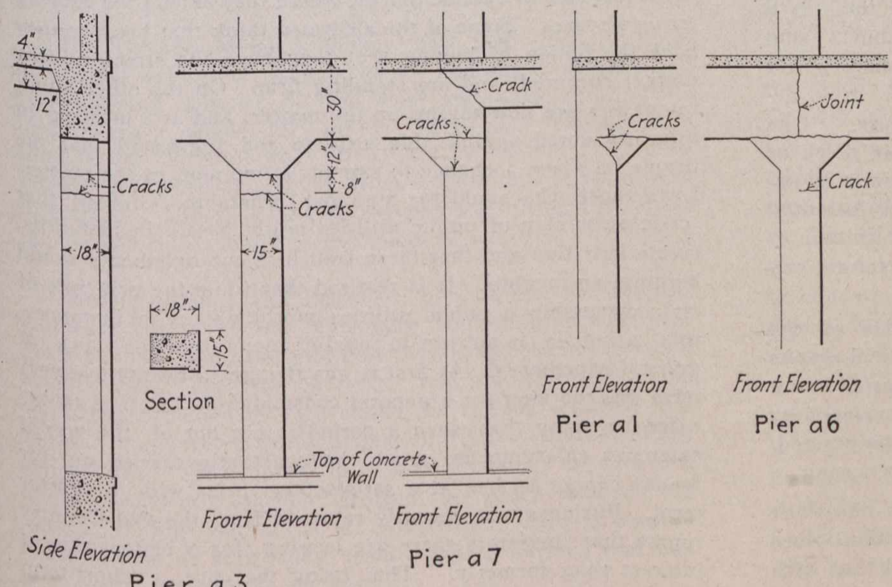


Fig. 2.

The fire started under the first floor in the middle of the building (Fig. 1). As far as could be observed, the principal effect of the heat was to expand the floor, causing a movement of the column. It was reported that on the morning of the 26th the end wall of the mill was observably out of plumb. At that time the concrete was generally so hot that one could not stand putting his hand on it outside of the building. Later on, this particular wall drew back again to the perpendicular. The crack at the pier, crack "A-7" (Fig. 2) shows the effect of this movement on the outside wall, where the size of the wall beam changes due to different spacing of the columns. The cracks above and below the bracket of the column also seemed to indicate the longitudinal movement of the floor.

The cracking of the columns at the side of the building seemed to indicate the same sort of expansion. These cracks occurred at both top and bottom of some of the columns. The top cracks are shown in Fig. 2.

It will be noticed (Fig. 1) that in the section of the floor at the wall end of the building (right end) the main cracks run longitudinally and are clearly marked, and that the cracks at right angles to the building are comparatively few.

Where the floor span decreases next to the large girders which support the paper machine the cracks begin to run at right angles, and end with diagonal cracks which die away into the part of the floor which was not heated. It is suggested that the cracks at the wall end of the building which are parallel to the main girder occurred because of the unequal heating of the big mass of this girder and the thinner floor slab, causing unequal expansion of the two masses. A similar cause may have produced the crack along the wall beam.

Because there was a considerable amount of water thrown upon light colored pulp and because the under side of the ceiling was blackened by the smoke from the fire, when the water carried the pulp through these cracks in the floor it showed these cracks very clearly on the under side. The cracking of the floor at the end of the paper-machine foundation is shown on cross-section "CD" (Fig. 1.)

At the end of the machine room, in the gallery, there was a stock house built with concrete piers, supporting a wooden floor carried on steel beams, with wooden columns carrying a wooden roof. The walls of the building were "hy-rib" metal. At the base of the building there were some brick walls. The interesting feature of the particular building was that the foundation piers which were subjected to high heat were built of concrete, rich in mortar. This concrete withstood the action of the heat much better than did the granite concrete of the main mill.

The stone used in the concrete on this job was coarse grain crushed granite. The sand was of good quality and the work was carefully done. The placing of the steel was better done than on the average job.

NON-PULSATING PUMPS.

A most interesting exhibit at the Canadian National Exhibition was that shown by the Luitwieler Pumping Engine Company, of Rochester, N.Y.; Canadian agents, The General Machinery Co., Limited, 526 Traders Bank Building, Toronto. One of the pumps exhibited by them is a triplex non-pulsating pump with 4 x 6-inch cylinders and six-inch stroke. The pump is operated by a five-horsepower motor, and pumps about 150 gallons per minute. It is designed to operate from 150 to 200 pounds pressure. One pleasing feature of the exhibit is the lack of jar noise or vibration in the running of the pump. The power is applied continually and evenly at all times by a nicely balanced arrangement of cams. By this means the water column is never allowed to slacken speed and the flow is therefore continuous.

The differentiating mechanical characteristics of the Luitwieler pumping engines are that dead centres and cranks are done away with, the rotary motion of the power being transformed into a straight line reciprocating movement by cams. A constant, unvarying load is always maintained. The resulting water delivery is even and non-fluctuating.

The two cams are key-seated oppositely upon one shaft and transmit the power to sliding yokes, the friction being relieved by rollers. These cams are so designed that each lifts the load through slightly more than a full half revolution, the overlap permitting trailing the load off gradually from one cam while the succeeding cam is at the same time gradually assuming it. The rise of the cam is even and constant between the intervals of overlap, and carries the water load forward without acceleration at even speed.

The power transformed by the cams is applied to the pistons in cylinders at any depth below the pump-head through two balanced sets of rods, hung one from each of the sliding yokes. By means of this arrangement it is always possible to keep the pumping engine at the surface no matter what the depth of the well or shaft may be. As the moving reciprocating parts throughout the entire equipment are in equilibrium at every part of the stroke, operation is effected upon much less power than ordinarily is required.

The pump shown at the Exhibition was an electric pumping engine operating at full speed while supported upon eight water glasses standing in pairs bottom to bottom upon an ordinary square saw-horse. It was not braced or supported in any manner. The pump was operating at 50 revolutions or 100 pump strokes per minute, and with so little vibration that a coin placed on edge on the pump frame remained without falling.

The non-pulsating triplex pumps are used for suction and pressure service, and are particularly adapted to water supply and fire protection of tall buildings and to municipal and corporate waterworks. The company use the duplex cam type upon all well work, with submerged pumping cylinder whenever possible, or the double chamber pump when suction is preferable.

All pumps made by the company are adaptable for direct connection with any kind of driving power. Valves of various types are used according to the nature of the substance to be pumped. The pumps are made to handle any liquid or semi-fluid matter.

CONSOLIDATION OF STREET CAR FRANCHISES.

During the past few weeks there has been quite a change in public opinion in respect to the British Columbia Electric Railway Company. For many weeks past, a Greater Vancouver committee has been at work trying to effect a consolidation of the street car franchises of the various surrounding municipalities. This city has the option of buying the system in the city proper in 1918, this will not give control of the franchises in outside places, where they extend for varying terms of years. Some of the aldermen think that because they have the option of buying that they have the street railway market cornered, and are standing firm. On the other hand, ratepayers are now taking up the matter, and at a meeting in Fairview voted against this attitude and suggested that the people be given a chance to express an opinion in the matter. Even those who stand for muicipal ownership, confess that civic ownership of public utilities might obtain in instances. create irritation and that these franchise entanglements would be quite an incubus. It is realized that while the principle of civic ownership o public utilities might obtain in instances, this principle is subject to qualifications and the laws of general expediency. At first it was thought a twenty-five year term was too long for a general consolidation, but it is recognized by many that such a period is not out of the way if extensive enlargements are to be constantly carried on, for money cannot be had at a satisfactory price with a shorter term. Business men recently returned from the Old Country report that investors there are looking for a better rate of interest than formerly. That being the case, a short-term franchise would be of little use to the British Columbia Electric, which will need much money. With the feeling now obtaining, it is not improbable that the company and the city will be able to get together and agree to some mutual proposition, especially in view of the fact that at Point Grey there is a strong desire to have the street cars running once more.

CANADIAN NATIONAL EXHIBITION.

There has not been a season in which so much competition has been shown among mechanical manufacturing firms as this present one. A walk through the Machinery Hall showed many European firms that were competeing against local firms and those from the United States, that heretofore have had the displaying space to themselves.

The Consolidated Optical Company, Limited, of Toronto, again secured their advantageous station near the main entrance of the Manufacturers' Building, and displayed a line of surveyors' instruments and meteorological devices that are made in Canada. In connection with the latter they showed a wind-gauge and automatic recorder, made-to-order for Government officials.

Messrs. William Hamilton Company, Limited, of Peterboro', Ont., had a prominent position in the Machinery Hall, and took full advantage of the same to demonstrate the qualities of the Samson Water Wheel. One large turbine was erected in their booth, and ample facilities were given to examine the mechanism.

The Canadian Boving Company, of Toronto, had an interesting exhibit in the north-east portion of the Machinery Hall. This was made up of a twelve horse-power "Bolinder" semi-Diesel crude oil engine driving a dynamo and water pump, the easy working of the latter being shown by a stream of water flowing into a large galvanized iron tank. A large sign overhanging their exhibit stated that this firm make a specialty of power apparatus, and numerous devices demonstrated below amply bore out the statement.

Messrs. John Millen & Son, Limited, occupied the south-west corner of the Machinery Hall, and had on display an interesting exhibit of chains, and a cabinet which was fitted up for the special purpose of demonstrating the mechanism of the "Coventry Noiseless Chain," for which they are the agents. They also had a number of link chain and several blocks and tackles, together with other labor-saving devices dependent upon chains for their operation.

The Canada Metal Company had their usual artistic and useful exhibit of various alloys and ingot metals, and were showing samples of lead wool and demonstrating its qualities as a calker for pipes. This wool resembles in appearances the steel wool often used by cabinet makers to remove varnishes and polish from woodwork. It is in very thin threads and well tangled together; resulting in a mass that is soft and spongy to the hand.

Messrs. Baines and Peckover, of Toronto, secured the southeast corner of the Machinery Hall and showed products coming under the title that they have selected for their exhibit, viz., "The Iron Store." Bar iron and steel, both plain and ornamental were shown in various lengths, and one wall was devoted to the display of "Atlas" metals, alloys and babbitt. The front of their booth is taken up with two or three rolls of "Lincona" belting, for which they are the agents. This belting is a composition with a canvas finish on one or both sides, resulting in a surface that has a powerful grip on the pulleys.

The General Machinery Company, local offices Traders Bank Building, Toronto, were demonstrating the merits of the Luitwieler pump in their exhibit, and for this purpose have erected a tripple stroke pump and a means of showing the force and eveness of the stream. A hydro-pneumatic water supply system is shown in the rear. This is intended to give a high-class water service to country residences and other buildings difficult of access to the mains of a municipal pumping plant. The pump was driven by an electric motor, and the latter controlled by the water level in the tank. A device was also shown whereby a gasoline engine may be started at a signal, which is automatically given, when the water in the tank falls below a pre-ascertained level. The electric device is entirely automatic but the gasoline option is a good substitute in localities where a reliable electric pressure cannot be obtained.

Messrs. Wettlaufer Brothers erected a large tent to the southwest of the Machinery Hall and gave semi-open air demonstrations of the merits of their heart-shaped concrete mixers as well as their various concrete block and brick machines, and other concrete specialties.

The building formerly occupied by educational exhibits and hand work was given up entirely to the Canadian Gas Association. In this building several interesting exhibits might be seen, among which was that of H. Mueller Mfg. Co., Canadian factory, Sarnia, Ont. (about November 1st). This firm specializes in the manufacture of gas main equipment, gas cocks, service boxes, waste cocks, etc. Their exhibit was much enjoyed by municipal officials, while the other attractions in the building, being to a large extent of a domestic nature, were visited by householders.

The Canada Cement Co., Limited, had a booth under the grandstand at which complete information could be obtained in regard to concrete roads and all other forms of concrete construction. This exhibit was one of the most unique in the grounds. It consisted of a set of illuminated transparencies of everything from a concrete fence post to a concrete viaduct. Another feature of this exhibit was the illuminated posts around the booth, being the first used on the grounds.

A feature of the fair this year was the new Government Building, erected during the past season to the west of the grounds. All the provincial governments were allotted space to demonstrate the representative merits of the districts coming under their jurisdiction. Excepting the province of Ontario, all the exhibits were of a mercantile nature and the spaces were used to exhibit wheat, minerals and natural advantages. The province of Ontario have a separate building, which is devoted exclusively to exhibits of this nature, so that their space in the Dominion Government building was used as a health exhibit and every effort was put forth to educate the visitors regarding the means of combating disease and the importance of this department of the provincial governing body.

A fair-sized pressure filter, manufactured by Messrs. Bell Bros., of Manchester, England (local representatives Bell Filtration Company, of Canada, Limited, 305 Kent Building, Toronto) was installed and a Luitwriter triplex pump connected in such a way as to illustrate a water purification system suitable for a town of one thousand persons with an estimated consumption of one hundred gallons per day each.

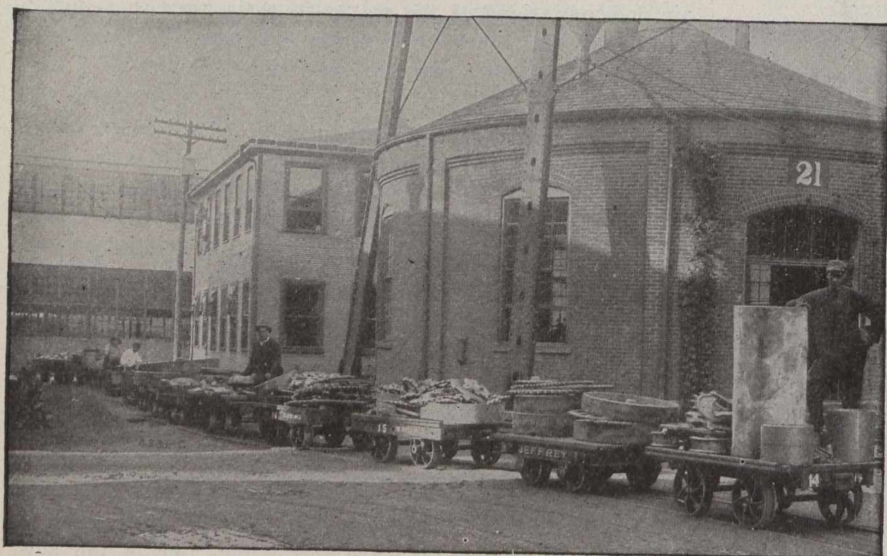
A bacteriologist was in attendance at the display of disease producing cultures which formed a splendid show. Many antitoxins were also shown, which graphically showed the progress made by science in combating diseases known to be due to the presence of micro-organisms in the body.

TRANSPORTATION OF MATERIAL IN MODERN LARGE INDUSTRIAL PLANTS.

By H. W. Arnold, Supervisor of Power and Maintenance, The Jeffrey Manufacturing Co.

During the last few years much has been written and spoken relative to efficiency in so far as the manufacturing end of the matter is concerned, but in very few instances has the transportation of material in and about manufacturing plants received the attention its importance deserves.

Necessarily, the transportation facilities of a plant include all the surface and overhead devices used in moving material from one point to another, but in this brief article it is proposed to consider only the surface movements of material.



View of Part of Industrial Track System.

In most instances large manufacturing plants present a rather difficult transportation problem. This is due to the unsymmetrical growth of plants of large proportions owing to the fact that in a great majority of cases the expansion was not anticipated or provided for in the original conception.

The Jeffrey Manufacturing Company, of Columbus, Ohio, is spread out over an area of approximately 26 acres and has 18 acres of floor space. This plant manufactures a large and varied line of electrical locomotives, electric storage battery trucks, coal mining, elevating and conveying machinery of all descriptions, structural steel work, etc., etc.

Throughout the shops of this company a high degree of efficiency has obtained for some time, but it is only several years ago that the matter of transportation of raw and finished material has received adequate consideration.

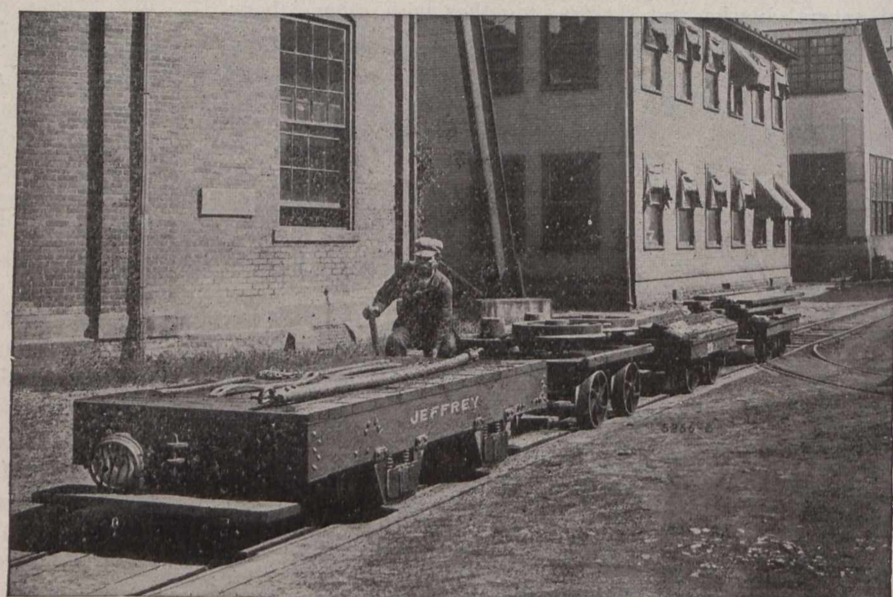
At that time our raw and finished material was being transported to and from cars in and about our various shops and departments by means of two-wheeled warehouse trucks, four-wheeled trucks and industrial cars. Also part of the territory was served by a Jeffrey storage battery truck working on a 36-inch gauge industrial track. A careful study of existing conditions made plain the fact that a very material saving could be effected by establishing a more efficient transportation system.

After considering the problem from every angle, it was decided that the Jeffrey storage battery trucks and industrial cars offered the best and most efficient means of surface transportation. Accordingly, the industrial railway was extended to take in all departments and a systematic method of car dispatching established. The accompanying plan gives an idea of how thoroughly the different buildings are served by the industrial track.

As soon as this system was established, very rigid instructions were issued that absolutely no material was to be transported by other means than the storage battery trucks and industrial cars. It was immediately found possible to dispense with the services of a two-horse team, 28 two-wheeled warehouse trucks, 13 four-wheeled trucks, 8 wheelbarrows and 18 men whose whole time had been devoted to this purpose. This effected an annual saving of more than $600 per month over the cost of the former system, taking into consideration the interest and depreciation on the investment, operating, maintenance, costs, etc. The monthly tonnage handled is close to 4,000 tons. Viewed from its present efficiency, it would seem almost an utter impossibility to go back to the previous or any other method of transporting material.

The Jeffrey storage battery truck is so simple in design and rugged in construction that it does not require the service of skilled operators, and the maintenance and operating costs are extremely low.

The industrial railway track shown in the illustrations gives a comprehensive idea of the system, and the wide range of usefulness for transporting material with the trucks. These trucks will pay for themselves in a very short period of time and especially where the industrial track system is already installed.



Operation of Industrial Track System.

THE MUNICIPAL ZONE SYSTEM.*

By B. Antrim Haldeman.

Some of the nations of Europe, out of a wealth of unfortunate experiences in the rapid growth of industrial cities and the crowding together of the people in them, have evolved what is known as the "Zone System" for controlling the use and occupation of land.

The system had its origin in the deplorable living conditions which were forced upon the working people and poorer classes of Germany during the period of industrial progress that has absorbed the energy of the German people since the Franco-Prussian war, and during which old feudal towns have been transformed into metropolitan cities and the country side into a forest of factory stacks. The administrative machinery of the towns, confronted with new and perplexing problems due to the rapid increase of population, were for many years unable to cope successfully with the new conditions by reason of the manner in which land was held, its sudden rise in value, and the lack of any authority to interfere in any effective manner with the owner's disposition and use of it.

The swift progress of industrialism throughout the German States encouraged the rapid growth of industrial towns at a time when the social conditions and the manner of living of the common people were not conducive to either the morals or health of crowded communities; the workshop and factory drew upon the farm and rural hamlet for their labor, and the working people, unable to obtain proper dwelling places, herded in caves, cellars, and unsanitary buildings, like rabbits in a warren. The rapid increase or urban population offered a fertile field for exploitation by the great landowners who erected barrack-dwellings of many stories and rooms which were an improvement over the caves and cellars and into which the working people crowded. Although these dwellings marked much improvement in living conditions they still bred many evils from the too intensive occupation and to correct these and provide greater assurance of the public health and safety a multiplicity of building regulations were enacted by the municipal authorities.

Ministerial decrees were issued tending to enlarge the authority of local councils in matters relating to the erection and occupancy of dwellings; gradually the fact dawned upon the law makers that the power and prestige of the empire among the nations of the earth depended as vitally upon the health and efficiency of its working people as upon the courage and loyalty of its fighting men. By slow degrees, slow because opposed by the great landowners who dominated many of the legislative bodies, the ministerial decrees were enacted into laws granting broad autonomy to municipalities and enabling them to strike at the root of the evil of their housing system by checking the increase of the speculative value of land, such speculative increase in some cities having risen 400% in a single year. Municipalities were also authorized to purchase ground, to erect dwellings, and to loan public funds to societies for the erection of workmen's homes; much encouragement has been given to the erection of one-family houses, and home owning has been made possible among the working people.

The story of the industrial and social evolution of Germany is an intensely absorbing one, but we consider here, and that but briefly, only the manner in which the municipal authorities exercise the powers vested in them to regulate the development of private property. This is accomplished mainly through the employment of the "zone system," under which the municipal department having charge of city planning, in establishing and extending the street system, also establishes the building lines, determines what percentage of the property may be built over and the arrangement of the buildings themselves, whether they shall be erected in solid rows, in pairs, or singly; also the distance between the buildings when built singly or in pairs, and the number of floors or stories. No appeal from the established regulations can be taken after the plans have been completed, examined, and finally approved by the several independent committees having jurisdiction. The plans frequently show three fixed lines in a block; the line to which the street is to be opened and improved, a line of restriction, a certain distance from the street line beyond which no building is allowed to extend, and an interior line fixing the boundary of the court yard or garden within which no structure is permitted.

The term "zone" as applied to the system is somewhat of a misnomer and misleading; although the general theory under which it is applied is, that the buildings should be lower and farther apart the greater their distance is from the centre of the city, the arrangement is not one of concentric girdles, as might be supposed, but a division into districts, irregular as to area and boundary and regulated in accordance with some local characteristic or special adaptability for certain classes of buildings; in fact, it sometimes occurs that a "zone" consists of a single city block, or even part of a block. True zones girdling the city would result in alternating rings of high and low buildings or a single indeterminate outer zone, regardless of topography or local conditions, and are considered unwise, if not impractical; so also are very large zones, or districts, since the application of absolute restrictions would prevent the establishment of local business and trade centres for the convenience of the people.

The system has undergone considerable modification since its introduction; keen judgment and great care are essential in determining boundaries and in imposing regulations which will permit property to be used for the purpose for which it is best adapted; although there was, and still is, considerable opposition to it in some instances, it is gradually producng the desired results, checking land speculation and inflation of values, discouraging the erection of barrack-dwellings, encouraging the erection of one-family houses, and making it possible for people of modest means to own their own houses.

Just as the industrialism and commercialism of Europe has created congestion and bad housing conditions, so are the same evils following in the wake of the tremendous activity along industrial lines in this country; the centralization of trade and the lack of adequate transportation facilities are, perhaps, the most powerful factors in producing a too intensive occupation and use of land; the desire to make property produce the largest possible income is a characteristic of landlords the world over, and tenement houses under lax regulations are splendid revenue producers.

Although the zone system as employed in Europe is the outgrowth of a long and persistently fought battle for the improvement of housing conditions, it has resulted in other economical and administrative reforms and it is along these lines that its application in the United States might also produce important results and be of great benefit. It would enable the municipal authorities to predetermine the character of improvement in any given area and, as the permanence of the improvement would be assured, very large economies in planning of streets, the construction of public works, and the conducting of general public service could be affected.

Under the zone system the permanent population of any given area may be determined with a reasonable degree of accuracy before a single building is erected upon it; with

*Abstract of a paper read before the City Planning Conference, Boston, Mass., May, 1912.

this factor known it is possible to intelligently forecast the needs of the district for every class of public works and public service and to plan accordingly, with the confidence that whatever is done will be done properly, permanently and economically.

Transportation is the great, controlling factor in the growth and development of the modern city, and the most difficult problem municipalities are called upon to solve; its difficulties would be greatly lessened if the density of population could be kept within reasonably certain limits; this is understood in the German system of town-planning and the locations of the trams, or street-railway lines, are determined as the street system is extended and are based upon the volume of traffic likely to be created by the known population and the predetermined character of the territory they will serve; the same is true of main, or trunk, lines of every kind of underground service: sewers, water pipe, electrical lines, pneumatic tubes; and subways, pipes, and tubes for every purpose of subterranean transportation. The number and capacity of public service structures, under, upon, or above the surface depends upon the density of the population and the local needs of the community; these elements being known the original construction of public works can be of the most permanent character and the liability for repairs, reconstruction, and enlargement can be reduced to a minimum.

Wide streets, planned with the almost certain knowledge the zone system would give of the traffic requirements for long years of service, would permit of a far more economical system of secondary and residential streets than we now find in most of our cities. In almost every city we find large areas laid out with streets of uniform width and uniform improvement, but they seldom carry an equal amount of traffic or are of equal public use except in congested localities; certain ones, by reason of easier grades, better connections with important points, greater business activity, or other favorable local conditions, attract the greater volume of traffic, leaving perhaps half a dozen adjacent ones unused and unlovely expanses of costly pavement.

The zone system would permit property to be restricted to the use for which it is best adapted by natural conditions. If hilly and picturesque districts were reserved for high-class residences, or for residences requiring lawns or gardens, the cost of improvement, both as to property and streets, would be greatly reduced by removing the necessity for the usual formal street system and the great amount of grading required for the building of solid rows of houses on small lots.

It also frequently occurs that a quiet and attractive neighborhood that has been occupied for many years by the better class of residences, surrounded by well kept grounds, is invaded by rows of cheap houses, the character of the neighborhood enabling the builder to realize large profits; since these profits are generally the sole object of the builder the operation seldom fits harmoniously into the surroundings and almost invariably the result is that the character of the neighborhood changes and property loses some of its desirability and value, except for the erection of more rows of houses. Operation houses are usually built for sale rather than for stability and if their erection was confined to certain districts there would be competition among builders that would result in a higher class of workmanship, more attractive arrangement and surroundings, and better value of a home.

The skyscraper, as an institution of the business life of America, is a costly luxury for which the public pays, and will continue to pay in ratio increasing with its growth, a heavy price in both cash and health; it increases enormously the dfficult problem of transportation and with its brother evils, the subway and the tenement house, for both of which it is partly responsible, it is moving steadily toward the creation of an abnormal condition of urban life. This menace of the skyscraper, the subway, and the tenement can only be removed by the enactment of regulations limiting the height of buildings, defining the areas within which those of maximum height may be erected, and prescribing the percentage of surface area they may cover and the amount of light and air space around them.

In no department of city building is there a larger opportunity for the advantageous application of the zone system than in the defining of the areas within which industrial establishments may be erected. Mills, factories, and workshops of almost any kind may now be set down in any locality which seems favorable to the promoter of the enterprise. Such establishments must invariably have facilities for transportation by rail or water, or both, especially if they are conducted upon a large scale, as most modern establishments are. Their random placing may work to the disadvantage of an entire neighborhood. There is a large economy for any concern in having transportation companies deliver and receive freights directly at its doors and the problem of supplying such service is a difficult and complicated one where industrial plants are distributed widely throughout a community.

The confinement of industrial establishments within certain prescribed areas would protect residential districts from invasion by incongruous or otherwise objectionable institutions and would immeasurably simplify the problem of industrial transportation, both local and foreign. The creation of factory zones in locations conveniently reached by rail or water would permit the development of terminals of maximum efficiency at a minimum cost; drayage between the mill and the shipping station is a large item of expense to the manufacturer, and the collection, classification, and distribution of freights from or for scattered and isolated yards are distracting problems for the traffic manager and the yard master; the short haul, the reduction or concentration of trackage, and the saving of time and energy where freights originate, or are distributed, within certain prescribed areas, all count for economy in trade and transportation. Main traffic streets for through travel could be kept clear from obstruction by railroad crossings and sidings, and to a considerable extent from costly bridges, if freight yards and freight carrying lines were kept within industrial zones.

So apparent do the advantages of the industrial zone seem, and so complex and costly are the problems of industrial transportation under present methods, that it is strange the manufacturers and transportation companies, in their efforts toward scientific and economic management, have not used their influence to establish such a system; indeed, some of the large industrial concerns have found such an arrangement so desirable that they have established their own industrial colonies in which their factories and freight service are entirely separated from the residential sections; only the most extensive ones, however, have been able to do this successfully, the smaller ones having found the problem of obtaining and keeping skilled labor a difficult one in colonies a considerable distance from large towns.

Any attempt to engraft the zone system into American schemes of municipal development would probably meet with great opposition from landowners, real estate speculators and operative builders, and from large interests not directly concerned in the development of land. The objections of the first would doubtless be based upon the abridgement of their right to do as they pleased with their own property, of the second upon the cutting off of prospective profits and of the third upon the general proposition of the invasion of vested rights. All of these arguments were advanced against the system in Germany and all had to give way at the behest of the people.

The plea for the protection of the vested right has not the force it had a few years ago. The great unrest we find throughout the country to-day may readily be traced to the exploitation of nearly every line of activity under the so-called vested rights; the days of the perpetual franchises and special privileges are passing away, and, while every reasonable safeguard must be maintained around the rights of property and invested capital, their leveling down to the service of people who have given property its value and capital its reward is proceeding steadily.

A long process of reasoning might be necessary to convince people that our municipal officers may be trusted with such large powers as are involved in the practical application of the zoning system, for there is a too well-founded suspicion that public service does not always mean serving the public. But the administrative machinery of our cities is passing from the control of political and corporate interests to the control of enlightened public sentiment; the people have been thinking and inquiring into public affairs, and they are learning that the city, with all its vast resources and wealth, is theirs, created by their energy and labor; they are learning what a tremendous organism the modern city is, and, in the pride of their own work, are beginning to assert their right to rule it. Municipal government in the United States is undergoing an evolution that points toward material improvement and the time may not be far distant when our cities will be governed as wisely and honestly as those of Germany, where the power of the local officials is so great, and so unrestrained by constitutional or statute laws. that only capable and trustworthy men dare be placed in the public service, and where election to a public office is a real honor.

PUBLIC UTILITIES AND REGULATION

From its very nature the operation of a public utility, both from the standpoint of the public and of the utility corporation, must be a monopoly. Operation by two or more companies means additional poles, wires, tracks, or pipe mains in the streets and while competition may for a brief time mean lower rates, such lower rates mean a poorer service until finally one, or all, of the corporations are forced to the wall, or the weaker company is merged in the stronger with inconvenience to the community and loss to the investor.

These opinions were expressed by ex-Mayor MacIlreith, of Halifax, at the recent convention of municipalities.

"But to most people," he continued, "the words corporation and monopoly signify the necessity of girding on armor for immediate warfare in order to obtain even a semblance of public rights. Therefore, at the outset, it behooves the public utility corporation to show to the community within whose bounds it operates, by actions, not promises, that a good service at reasonable cost is furnished and that sufficient capital is provided from time to time, to expand or extend the service as the fair claims of the community for such expansion or extension arise. By acting thus, the natural prejudices of the public against the corporation ought to be very largely removed and fair treatment should be accorded the corporation by the community evidenced by a willingness to pay a fair and reasonable price for the service accorded.

"If these ideal relations could be established, there would be no need for regulations, but perhaps, while not possible of absolute establishment, they can be approached unto, and the necessity of recourse to the regulating body rendered unnecessary in most cases.

"The right of the state to set up bodies to regulate public utility companies is undoubted, and the duties and powers of such bodies are, of course, contained in the acts of the legislature creating such utility boards. After such a board has been created, the fear of the public of the monopoly largely vanishes. Under all utility commission acts, it is the duty of the board to see that the corporation renders good service at a fair cost, allowing the legitimate investor a fair return for the money he has invested.

"In our province the Act creating the public utilities board is chapter 1, of the Acts of 1909. At the last session of the legislature an Act (chapter 64), amending the above Act, was passed to come into force when proclaimed by the Governor-in-Council. As these Acts are available to all it becomes practically unnecessary for me to do more than mention a few main points.

"In the first place every public utility is required to furnish reasonably adequate service and facilities, and the charge made for such service shall be reasonable and just, and every unjust or unreasonable charge for such service is prohibited and declared unlawful.

"Secondly all rates must be filled with the board and there must be no discrimination. And thirdly, the board is empowered to value the property of public utilities and regulate the issue of stock.

"The method and procedure for the hearing of complaints is made as simple as possible. In order that personal or imaginary grievances may not be made the pretext for hearings the Act provides that the complaint must be made by a municipal corporation or by any five persons, firms or corporations. Our Act, like other utility Acts, is designed to safeguard the rights of the public and at the same time to only require the utility corporation to do what is fair and reasonable and in filing rates and charges to have in view a fair return to the investor.

"While as a rule the public sees only its own side it must be remembered that there are two sides to every question, and it is for the regulating body to weigh these carefully and dispassionately, and while having in view the reasonable demands of the community, they must treat the corporation with fairness."

LOCATING UNDERGROUND PIPES.

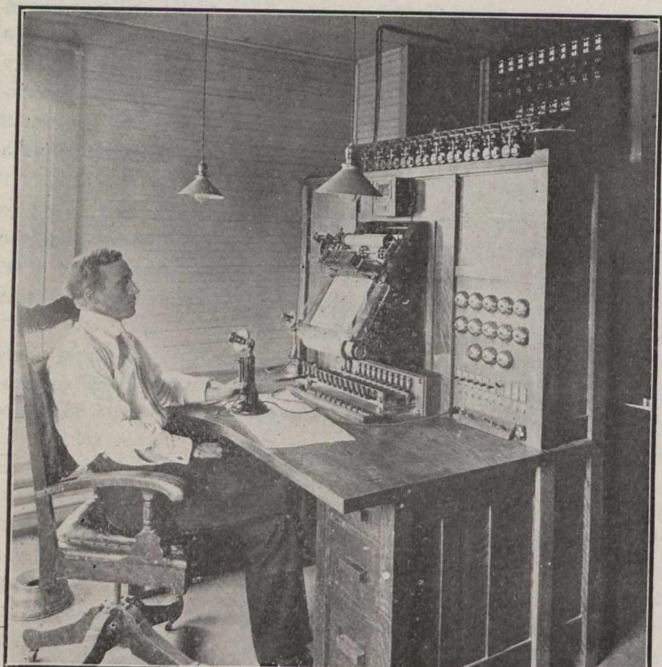
In waterworks systems there are often pipes, the exact position of which is not recorded, and when repairs or new connections are to be made with such pipes, a great deal of time and money may be saved by the use of a device which will indicate their positions, says Engineering News for August 15, 1912. Some electric devices have proved successful in this field, one of them being based on the principle of causing a slight flow of electric current in the pipe, which thus becomes a conductor. When an electric coil is brought within the field of this conductor, a current will be induced in the coil and cause a sound in a telephone receiver connected to the coil. The sound increases or decreases as the coil is carried nearer to, or farther from the underground conductor, but ceases when nearest to it; that is, directly over it. By locating a number of points directly over the pipe, its situation is accurately determined.

In using the instrument, wires from a portable battery are attached to suitable connections and the operator, carrying the instrument in his hand and the receiver at his ear, walks across the supposed line of the pipe, the exact position being indicated by the absence of sound. To locate a service pipe the battery wires would be connected to the house cock and hydrant, creating a current along the service line. This device is manufactured by the Modern Iron Works, of Quincy, Ill., and is used by a number of water companies.

THE SIMMEN SYSTEM OF RAILWAY SIGNALLING AND DISPATCHING.

By Mr. Paul J. Simmen.

The executives of both steam and interurban electric railroads in Canada and the United States are earnestly seeking greater safety, greater facility in operation, greater track capacity and better discipline for handling their traffic at a cost bearing some reasonable relation to their earning capacity.



Dispatcher Reading Movements of Cars from Sheets.

The present systems of train control divide themselves broadly into two divisions, namely, dispatching and signalling.

The dispatching section requires elaborate rules, time-table rights and dispatchers. These dispatchers must, through some form of telegraph or telephone system, including operators at numerous stations along the line, convey orders to the conductor and engineer; reports of the actual train movements being wired to the dispatchers by the operators or train crews.

The efforts of the signalling section have been to prevent collisions between trains endeavoring to follow the running orders based on the time table rights, train rules and dispatchers' order. This second section involves all sorts of devices from target boards to elaborate automatic or controlled manual semaphores, often with electric locking devices, and, in some instances, automatic stops.

Practically no improvements have been brought about in the dispatching section for a generation, and the various associations of railroad officials, Government and State Boards, have repeatedly condemned these methods as being totally inadequate to meet the requirements of present day traffic. The large number of accidents annually recorded on roads throughout the country forms conclusive evidence of this fact.

In the signal division fine results have been obtained, but these results have been accompanied not only with a large first cost, but more important still, with a large yearly maintenance expense. Automatic or manually controlled block signals are essentially only auxiliary to the dispatching section, and where used, the combined operating expense of both the dispatching and signal section is materially larger.

The Simmen system is especially designed to meet a long-felt want. It is absolutely safe; it reduces delays in train movements; it increases the track capacity and it affords a simple and ready means of increasing the efficiency of train crews, at a cost much below that of any other known system.

The Simmen system is radically different, both in intention and mechanism, from anything else now offered to railways. It breaks new ground by combining into one all the essentials of the dispatching and signalling sections. It is not an effort at detail improvement, but an entirely new and effective system for the management of railway traffic, which is safe, accurate and inexpensive. The claims made for the system and its many desirable features have been fully justified by the results obtained from actual installations and tests of the system under service conditions.

The actions of the persons upon whom the safety of the traffic depends. namely, the dispatchers, train crews and telegraph operators, are all protected against error. The responsibility first of all rests upon the individual himself, but any error which he would unwittingly make is throughout the system prevented or corrected by electrical or mechanical means. The dispatcher is protected against error by an interlocked switchboard. The engineer or motorman is given a more effective signal than heretofore, appealing both to the sense of vision and hearing, but should he fail to obey the signal to stop, the air brakes are automatically applied. The telegraph operator, whom statistics prove to be the weakest link in the present chain of train operation, is dispensed with altogether by the Simmen system, thus removing a frequent cause of error, and making a large saving in operating expense possible.

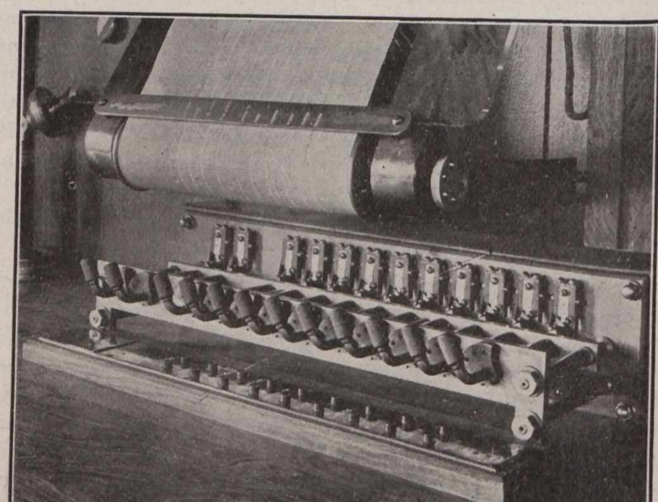


Fig. 1.—Dispatcher's Switchboard. (Switches all Set for Westbound Movement.)

The system is not an experiment. It has been in use for nearly three years on the Toronto and York Radial Railway with marked success. A test installation of 18 miles was made on the Indianapolis & Cincinnati Traction

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[In the issue of *The Canadian Engineer* of June 11, 1909, there appeared a description of the Simmen Automatic Railway Signal Device, which had, at that time, just been installed on the Mimico division of the Toronto and York Radial Railway. We herewith present a more complete description of the system, prepared by the inventor.—Ed.]

Company's line, in the State of Indiana, and has been in use successfully for three months, operating successfully at speeds of 85 miles an hour. As a result of this test the Railroad Commission of Indiana has approved the system and has ordered its use on the entire Shelbyville division of this company, a distance of 45 miles. The Indianapolis & Cincinnati Traction Company were so well pleased with the test that they placed their order for the equipping of their entire mileage of 100 miles with Northey-Plummer, Limited, of Toronto and Indianapolis, Indiana, who control the patents of the Simmen System. The system is approved for test by the Block Signal and Train Control Board, and is endorsed by many signal engineers of the country. Electrically speaking, it is throughout, in accordance with the requirements of the Electric Railway Association.

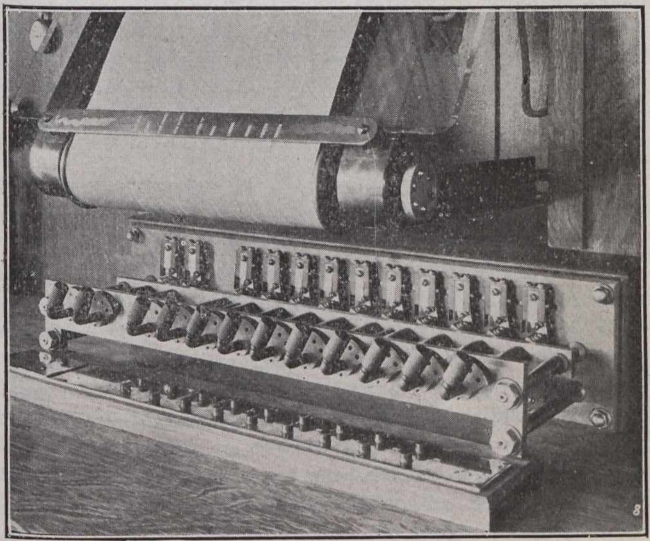

Fig. 2.—Dispatcher's Switchboard. (Switches all Set for Eastbound Movement.)

An attractive feature of it is its elasticity and its fundamental simplicity. It provides for an automatic record of train movements in the dispatcher's office in graphic form, interlocked switches by which dispatcher can signal danger or clear indications to engineer or motorman direct in his cab, and direct telephone communication, between engineer and dispatcher. Additional protection which may be desirable and justifiable for heavy or high-speed traffic, such as automatic block, track circuits and automatic stop, can be added from time to time and made to fit in and work as auxiliary to this system without prohibitive complication.

The following are some of the advantages of the system:

Safety.—The dispatcher and engineer are protected against error by automatic devices. The entire system is so designed that any failure whatever in the equipment will result in danger indications. The telegraph operator being eliminated, his errors disappear also. Every movement into a new block must receive a positive clear signal, which an engineer must await, irrespective of the running orders or time table rights.

Facility.—The system facilitates quicker train movements to an extent equal to placing (eight-hour shift) telegraph operators at every passing siding on a single track road, or block station on a double track road. The time requisite to deliver instructions to the train crew through a third party (the telegraph operator) is saved, as all dispatchers' instructions go direct to engineer. The dispatcher can change a meeting or passing point instantly, without the least risk, simply by changing the switches in his office. Therefore, in case of delay to one train opposing trains will not waste time waiting for a meet. Extra trains and other unexpected train movement are directed with as great facility as the movements of regular trains.

Track Capacity.—Fifty per cent. more trains can be handled over a single track road, therefore the double tracking of a line may be postponed for many years. On double track roads westbound movements on the eastbound track or vice versa, are quickly arranged for.

Efficiency.—Ninety per cent. of all apparatus used is stock apparatus, simple in construction and thoroughly tested for signal and other purposes. A high degree of efficiency is therefore assured. The principal apparatus is in the dispatcher's office and under the dispatcher's immediate and direct care. The simple signal apparatus is entirely located on the locomotive or car and is subject to inspection by efficient mechanics at least once a day. Line wire and third rails are the only part of the system installed along the roadway, and are subject to few failures since they contain no moving parts. Lightning troubles cause no delay because all fuses and arresters are placed in the dispatcher's office and can promptly be replaced when burnt out. Trains are directed both by signal and telephone, therefore a complete tie-up is not possible unless both signal and telephone apparatus are out of order at the same time.

Discipline.—The automatic record in the dispatcher's office serves two purposes. It gives the dispatcher the fullest possible knowledge as to the whereabouts of all trains, etc., and enables him to direct very perfectly all train movements; and in addition to this it serves as a permanent record of many important acts of the train crews, such as a train running behind or ahead of schedule; the speed maintained through any block; length of delays; the efficiency of dispatcher in directing train movements, etc. This information is all recorded in graphic form and a few minutes perusal by the superintendent of each day's record will enable him promptly and justly to correct any weakness in his organization.

Economy.—The first cost is far less than the automatic block system and is in direct proportion to the amount of traffic. Maintenance expense is low because no specially trained men are needed to look after the apparatus along the track. Dispatchers maintain the office equipment, and roundhouse or barn men the signal equipment. Roads now using the manual block system will save a large amount in operating expense by the elimination of block operators, and will find that expenses, arising from overtime to crews of delayed trains, are much reduced.

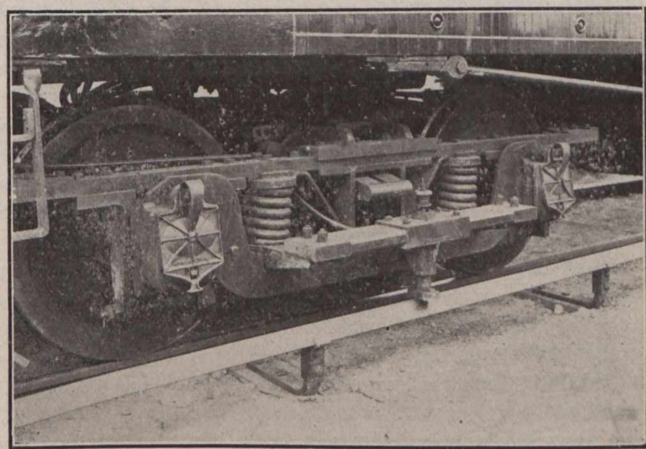

Fig. 3.—Showing Contact Shoe on Third Rail. (Cap Removed to Show Contact Detail.)

Description of the Simmen System.

The elements which enter into the system may be divided as follows:—

(1) A record sheet of train movements in graphic form.

(2) An automatic means for the recording of train movements upon the sheet.

(3) A means by which the dispatcher can display "danger" and "clear" signals on moving trains (or any other type of signals).

(4) A direct telephone connection between the engineer, on his engine, and the dispatcher.

(5) A new, simple, inexpensive and effective cab signal.

(6) An inexpensive automatic stop, based on a new principle, by which the stops and proper speeds are enforced over every foot of the road.

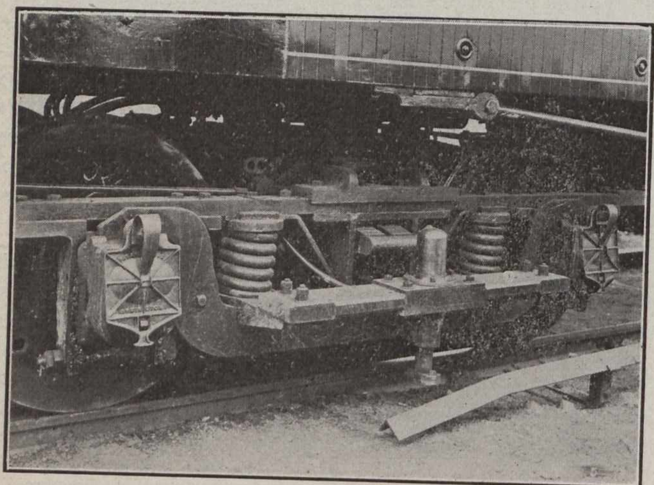

Fig. 4.—Shoe About to Make Contact on Third Rail.

Dispatcher's Record Sheet.—The record sheet is divided into time lines in one direction (10 a.m., 10.20 a.m., etc.) and block lines in the other, (e.g., Sunnyside, Humber, Mimico, Long Branch, etc.). (Figs. 1 and 2). On a single track road, blocks usually run from passing siding to passing siding and are spaced on the sheet proportionately to their length.

Each day a new record sheet is placed upon the dispatcher's recording table. The recording table is provided with clock-work for continuously moving the sheet, and with electrically operated perforating needles. Two such perforating needles are provided for each block, one recording eastbound movements and the other westbound. The record sheet, when placed, is regularly and continuously moved by clockwork, so that the correct time line, as marked upon the sheet, is always directly under the perforating needles.

It should be pointed out here that it is quite feasible to have proper schedule lines printed upon the actual dispatcher's charts if this should be considered to be of any practical advantage to the dispatcher. The size of the record depends upon the amount of traffic and upon the length of the road.

A time scale of three inches to the hour will give good results for traffic where trains are running on a thirty-minute schedule, but for heavier traffic a scale of six inches to the hour will usually be found better. For an average single track division of 100 miles, the record chart need not be over 14 inches in breadth.

Space is provided on the margin of the sheet for such notes as the dispatcher may desire to make. In addition to the record the system provides for automatically recording a number of other facts, such as the kind of signal displayed to a train, etc.

An Automatic Means for the Recording of Train Movements Upon the Dispatcher's Sheet.—At every siding along the road there will usually be four "third" rails placed at suitable locations. These third rails are insulated from the track and their length depends upon the speeds attained upon the particular road. For fast traffic they are from 70 to 80 feet long. Two of these rails are for the direction of westbound movements and two for eastbound. One "eastbound" rail is placed near the beginning of a block, and is known as the "home rail." The other is placed at a point one to two thousand feet back from the beginning of a new block and is known as the "distant rail." Similarly with the "westbound" rails.

A locomotive or motor car is provided with a shoe which makes an electrical contact with the third rails when sliding over them. (Figs. 3 and 4). When a shoe is in contact with a third rail, the (normally) open circuit between the third rail and track, is closed, the closed circuit then running from third rail through the contact shoe, and apparatus on cab, to a ground return on the truck and track rails.

The third rails (home rails) at siding are connected by wire to dispatcher's office and there are connected to one side of the dispatcher's switch.

From the other side of the dispatcher's switch a wire connects through the winding of the main relay to the pole of the storage battery, the other pole of the storage battery being connected to ground at track rails. The instant a contact shoe on a train makes contact with a third rail a circuit is established as follows. From storage battery in the dispatcher's office, through wire, main relay, dispatcher's switch, wire, third rail, contact shoe, signal relay on cab, ground on truck, and track rail, back to dispatcher's battery. The closing of this main circuit energizes the main

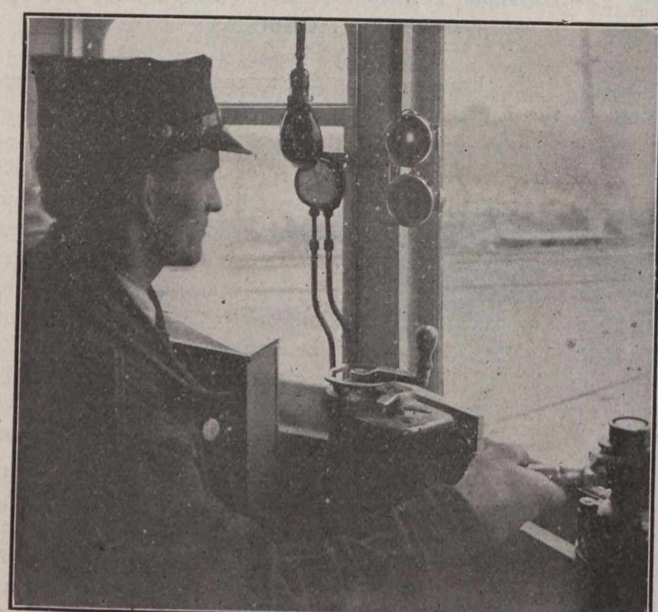

Fig. 5.—Motorman in Cab. (Shows Position of Red and Green Lights.)

relay which in turn closes a local circuit through the perforating magnet as follows:—

From storage battery through wire, perforating magnet, armature of main relay, to negative side of storage battery. The perforating magnet, being energized, acts on its armature, which forces the perforating needle upwards, thus perforating the dispatcher's record sheet and recording upon it the time and place of a train passing siding. The perforating circuits provide only for a single punch upon the recording sheet when a train is passing a third rail. To give continuous perforation as long as a train is in the block, a polarized relay is used.

Signalling Means.—A new type of cab signal has been developed which, by means of inexpensive intermittent third rails, gives as complete signal information as can be accomplished by a continuous third (signal) rail. The underlying principle of the cab signal is that if a third rail is electrically energized, a train in passing will receive a clear signal; if the third rail is de-energized a danger signal is displayed. Furthermore, a clear signal received in entering a new block will continue to show clear throughout the block, and a danger signal once displayed will continue at danger until it is automatically cleared when a train is passing an energized third rail. Either a clear or a danger signal is always in evidence every foot of the way. The cab signal circuit is shown in Fig. 6, and Fig. 5 shows motorman in cab with position of red and green lights. The third rail has inclined approaches at each end. When the contact shoe approaches the third rail the shoe is raised and the arm of the contact shoe separates from the front stop.

If so desired a bell can be inserted into the danger circuit so that both visible and audible danger signals will be given. This bell gives one tap each time a third rail is passed, thus calling the attention of the engineer to a possible change of signals, as well as being a positive signal that the cab equipment is in perfect operating condition.

When a third rail is energized a clear signal is displayed; when de-energized, a danger signal is displayed. Since the dispatcher's switch controlling the signals at siding is closed, it is evident that the third rails at siding are energized, and therefore set for a clear signal. To display a danger or stop signal at siding the dispatcher simply opens switch, thus depriving the third rails of electrical energy from the storage battery.

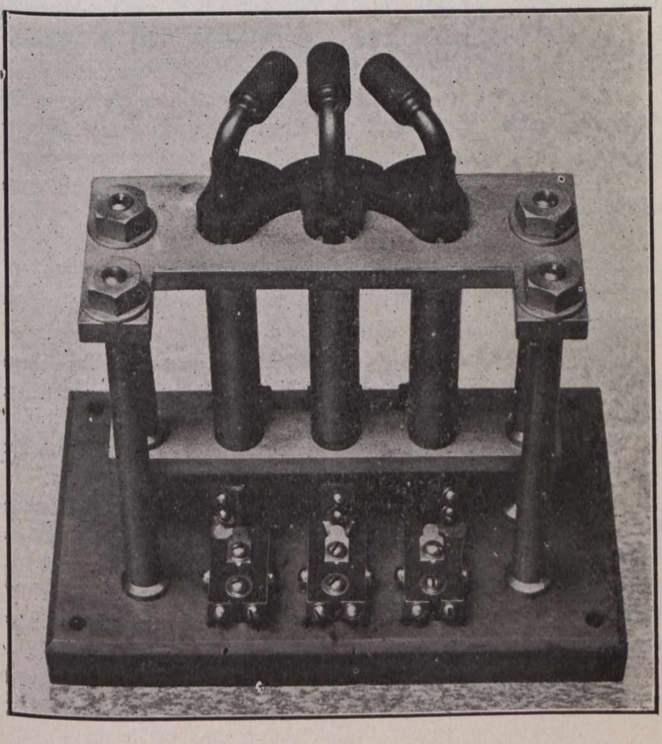

Fig. 7.—Unit of Three Switches.

Interlocking arrangements on the dispatcher's switchboard prevent the dispatcher from giving a clear signal to an eastbound train entering a block until the signal for the westbound train at the opposite end of the block is set to danger.

Only the broad essentials of the circuits and their functions have been described. Various modifications and combinations with the present signalling methods are possible, by which any special traffic requirements can be met. Telephone communications are established over the same circuit as is used for signalling, the telephone apparatus being placed in shunt with the same and provided with condensers. Fig. 7 is a photograph of a unit of three switches.

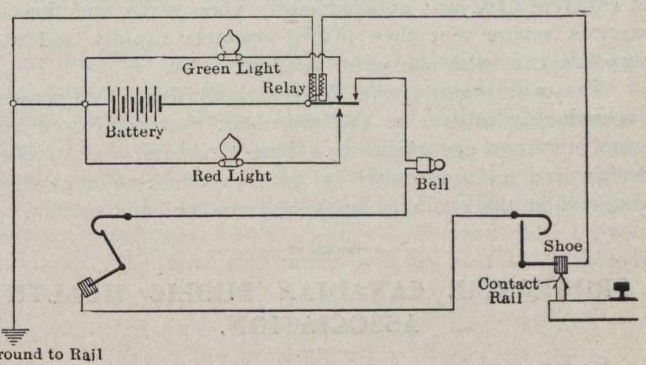

Fig. 6.—Diagram of Car Circuit.

The Simmen automatic stop provides for the automatic application of air brakes under the following conditions:—

(a) Where danger signals have been given but not obeyed.

(b) Where proper speeds at curves, grades, yard limits, or grade crossings are not observed.

(c) Where reduced speed for permissive or backward movements are not observed.

NEW WAREHOUSES OF THE NEW ENGLAND WASTE COMPANY.

The warehouse and waste plant of the New England Waste Co., at Revere, Mass., is an unusually attractive reinforced concrete building. The architects and engineers, Lockwood, Greene & Co., of Boston, specified the use of brick curtain walls, which make an effective and pleasing contrast with the concrete. The building is located adjacent to the tracks of the Boston & Maine Railroad, rendering excellent facilities for shipping.

This structure is 180 by 56 feet, four stories high with basement, and has a projecting tower on the front enclosing stairs, laboratories, and boiler for heating. As is usual with concrete, maximum window area has been obtained. The building is equipped with automatic whip hoist trolley conveyors and baling presses.

The floors of this building were designed to carry a live load of 150 lbs. per square foot. The column spacing is 20 by 18 feet, and the height of stories is 14 feet. It is interesting to note in this connection that although the floors were designed for 150 lbs. live load they were only slightly damaged by the accidental falling of a 4,000 lb. weight. On the second floor was located a baling press with plunger running through the third floor and counterbalanced by a 4,000 lb. weight made up of pieces of cast iron. The weight was suspended from the fourth floor by a through bolt with hook and pulley attached. The rope parted and the 4,000 lb. weight fell to the floor through a distance of 8½ feet. The only damage done to the concrete was a flaking of a space of about 20 inches in diameter on the under side of the floor.

The building was erected by the New England Concrete Construction Co., of Boston, and the methods employed by them in handling the materials and concrete are of unusual interest. The aggregates for the concrete were handled mechanically from the time they left the railroad cars until they were dumped into the mixer. The concrete, after being hoisted to a sufficient elevation, was distributed through spouts to the various forms.

The practice of placing concrete by spouts instead of by carts or wheelbarrows, while not unusual is still not common. Where the job is large enough it is a most economical way to handle concrete. On the work in question the amount of concrete used was approximately 3,000 yards and the contractors report that they placed concrete rapidly and at a very low cost with the plant adopted.

This warehouse of the New England Waste Co. presents a convincing answer to the argument that reinforced concrete buildings are unsightly. This structure is of excellent design and its appearance is more excellent than could be obtained in the ordinary brick and timber construction.

PROGRAMME CANADIAN PUBLIC HEALTH ASSOCIATION.

The Canadian Public Health Association convention will be held in Toronto September 16th, 17th and 18th, 1912, at the University of Toronto. The following is the programme:

Monday, September 16th.

Physics Building, Toronto University.

10 a.m. to 11 a.m.—General opening business meeting, room 43.

General session, room 43: 11 a.m. to 11.30 a.m.—"How Shall Canada Save Her People from the Physical and Mental Degeneracy Due to Industrialism as Seen in the Great Cities of Older Civilization?" Dr. P. H. Bryce, seperintendent of immigration, Ottawa.

11.30 a.m. to 12.30 p.m.—Symposium. "Tuberculosis," Dr. J. H. Elliot, Toronto.

Discussion—Dr. G. D. Porter, Toronto; Dr. Harold Parsons, Toronto; Dr. W. B. Kendall, Muskoka Sanatorium; Dr. C. D. Parfitt, Gravenhurst; Miss Dyke, Toronto; and others.

12.30 p.m. to 1 p.m.—"Prevention of Tuberculosis in the Country," Dr. H. G. Roberts, Guelph, Ont.

2.30 to 3 p.m.—"Hospitals, Their Relation to the Community and Public Health," Dr. Bruce Smith, inspector of prisons and public charities for Ontario.

3 p.m. to 3.30 p.m.—"Dust in the House and in the Street," Dr. Adam Wright, chairman Ontario Board of Health.

3.30 p.m. to 4 p.m.—"The Ontario Public Health Act," Dr. John W. S. McCullough, chief health officer for Ontario.

4 p.m. to 4.30 p.m.—"Purification of Water by Slow Sand Filtration," T. Aird Murray, C.E., Toronto.

7.30 p.m.—Moving health pictures, Ontario Provincial Board of Health.

8 p.m.—Address by Dr. Evans.

9.30 p.m.—Smoking concert, York Club.

Tuesday, September 17th.

Sectional Meetings, 9.30 a.m. to 1 p.m.

Section I.—"Military Hygiene," at room 30. Convenor, J. T. Fotheringham, Lieut.-Col. P.M.O., A.M.S., D.G.M.S., Canada.

9.30 a.m. to 10.15 a.m.—"Sanitation of a Beseiged City or Town," G. Carleton Jones, Col., A.M.S., D.G.M.S., Canada.

10.15 to 11 a.m.—"The Sanitation of the Bivouac," D. B. Bentley, Lieut.-Col. A.M.C., district officer of health, Ontario.

11 a.m. to 11.45 a.m.—"Some Observations on Sanitation for the Soldier," T. B. Richardson, major A.M.C.

11.45 a.m. to 12.30 p.m.—"The Militia as a Factor in Public Health," Lorne Drum, major, A.M.S.

12.30 p.m. to 1 p.m.—Election of convener and committee of section.

Section II.—"Milk Inspection," at room 42. Convenor, Andrew R. B. Richmond, V.S., B.V.Sc.

9.30 a.m. to 10.15 a.m.—"Municipal Milk Inspection in Toronto," G. G. Nasmith, director of laboratories, city of Toronto.

10.15 a.m. to 11.00 a.m.—"Municipal Food Inspection," Robert Awde, chief food inspector, Toronto.

11 a.m. to 11.45 a.m.—"Dominion Meat Inspection," L. W. Wilson, in charge of Dominion meat inspection staff, Toronto.

11.45 a.m. to 12.30 p.m.—"Municipal Inspection," Andrew R. B. Richmond, chief of staff of veterinary inspectors, Toronto.

12.30 p.m. to 1.30 p.m.—Election of convenor and Committee of section.

Section III.—Engineers and Architects, room 62. Convener, T. Aird Murray, M.Can.Soc.C.E.

9.30 a.m. to 10 a.m.—"Toronto Filtration Plant," Jos. Race, bacteriologist, city of Ottawa.

10 a.m. to 10.30 a.m.—"A Complete Sewage Disposal Plant for a Public Institution," T. Lowes, C.E., Toronto.

10.30 a.m. to 11.00 a.m.—"How to Obtain Efficiency from Pressure Filters," H. W. Cowan, C.E., Toronto.

11.00 a.m. to 11.30 a.m.—"Housing and Ventilation," N. Couchon, C.E., Ottawa.

11.30 a.m. to 12.00 a.m.—"Storm and Surface Water Drainage in Relation to Sewage Disposal," R. R. Knight, C.E., Toronto.

12.00 a.m. to 12.30 p.m.—"The Relations Between the Medical Health Officer and the Engineer," Thos. H. Hogg, C.E., B.A.Sc., Toronto.

12.30 p.m. to 1.00 p.m.—Election of convener and committee of section.

Section IV.—Medical Officers of Health, at room No. 41. Convener, James Roberts, M.D., medical officer of health, Hamilton.

9.30 a.m. to 10.15 a.m.—"A Modern Hospital for Cummunicable Diseases," Dr. Chas. J. C. O. Hastings, medical officer of health, Toronto.

10.15 a.m. to 11 a.m.—"The International Hygiene Exhibition, Dresden," Dr. J. F. Honsberger, Berlin, Ont.

11 a.m. to 11.45 a.m.—"Municipal Control of Milk Supplies," Dr. Whitelaw, medical officer of health, Edmonton, Alta.

11.45 a.m. to 12.30 p.m.—"The Importance of Trained Sanitary Inspectors," Dr. A. J. Douglas, medical officer of Health, Winnipeg, Man.

12.30 p.m. to 1.00 p.m.—Election of convener and section committee.

Section V.—Medical Inspection, at room 18. Convener, Dr. W. E. Struthers, medical inspector of schools, Toronto.

9.30 a.m. to 10 a.m.—"Tuberculosis in Children," Dr. J. H. Elliott, Toronto.

10 a.m. to 10.30 a.m.—"Nursing Side of Medical Inspection of Schools," Miss L. L. Rogers, T.N., Toronto.

10.30 a.m. to 11.00 a.m.—Lantern slides on the work of medical inspection of schools in Toronto, W. E. Struthers, B.A.M.D., Toronto.

11 a.m. to 11.30 a.m.—"The Dental Aspect of Medical Inspection of Schools," W. H. Doherty, D.D.S.

11.30 a.m. to 12 a.m.—Paper and lantern slides: "The Open Air Schools of England," A. J. Green, headmaster of Birley House Open Air School, London, Eng.

12 a.m. to 12.30 p.m.—Election of convener and section committee.

Section VI.—Social Workers. Convener, Helen MacMurchy, Toronto. (See printed list).

Section VII.—Laboratory Workers, at room 39. Convener, J. A. Amyot, M.D., Toronto.

9.30 a.m. to 10.15 a.m.—Paper, Dr. H. W. Hill, director, Institute of Pubic Health, London, Ont.

10.15 a.m. to 11 a.m.—"Vitality of Bacilli in Water Supplies," Jos. Race, bacteriologist, Ottawa.

11 a.m. to 11.45 a.m.—Paper, Dr. Revell, Provincial Board of Health, Edmonton, Alta.

11.45 a.m. to 12.30 p.m.—Paper, G. G. Nasmith, city of Toronto.

12.30 p.m. to 1 p.m.—Election of convener of section committee.

Second General Session, Room 43, 2.30 p.m. to 4.30 p.m.

2.30 p.m. to 3.00 p.m.—"Diet in Relation to Disease," Dr. H. B. Anderson, Toronto. Professor V. E. Henderson, Toronto, and Professor Fotheringham will open discussion.

3.30 p.m.—President's address, Chas. A. Hodgetts, M.D., Ottawa, Ont.

3.30 p.m. to 4.00 p.m.—Paper, Dr. W. T. Sherreff, medical officer of health, Ottawa.

4.00 p.m. to 4.30 p.m.—"A Threatened Outbreak of Typhoid Fever in Fort William and Means Taken to Avert it," Dr. R. E. Woodhouse, district officer of health.

Garden party—Sir Edmund B. Osler, 4.30 p.m. to 7.00 p.m.

Annual dinner—McConkey's, 8 p.m. Tickets at registration office, $2.

Wednesday, September 18th.

Third General Session, Room 43.

9.30 a.m. to 10.00 a.m.—Paper, Dr. H. W. Hill, director Institute of Public Health, London, Ont.

10.00 a.m. to 10.30 a.m.—"The Feeble Minded," Mr. J. P. Downey, superintendent, Asylum for Insane, Orillia.

10.30 to 11.00 a.m.—"Medical Inspection of Public Schools," Dr. A. P. Reid, provincial health officer of Nova Scotia.

11.00 a.m. to 11.30 a.m.—Symposium. "Communicable Diseases."

11.30 a.m. to 12 a.m.—Paper, Dr. H. G. Murray, Owen Sound.

12 a.m. to 12.30 p.m.—"The Value of a Public Health Laboratory to a Municipality," G. G. Nasmith, city bacteriologist, Toronto.

12.30 p.m. to 1.00 p.m.—"Of What Value are Sanatoria as a Public Health Measure?" Dr. W. B. Kendall.

1.00 p.m. to 2.00 p.m.—Adjournment.

General Session (Continued)—2.00 p.m. to 2.30 p.m.—"The Effects of Immigration on the National Health," Will. W. Lee, secretary of immigration branch of Y.M.C.A., Quebec.

2.30 a.m. to 3.00 p.m.—"The Open Window," J. Flemming Goodchild.

3.00 p.m. to 3.30 p.m.—"A Federal Public Health Department," Dr. J. L. Chabot, M.P., Ottawa.

Business meeting, 3.30 p.m.

A musicale Wednesday evening, courtesy of Col. and Mrs. A. E. Gooderham.

Arrangements will be made by courtesy of R. Harris, commissioner of works, for the members to visit the Toronto city filtration plant and sewage dispasal works.

UNION OF CANADIAN MUNICIPALITIES.

At the final session of this organization held in Windsor, Ont., August 29th, the following were elected officers for the coming season:—Mayor Hopewell, of Ottawa, president; Mayor Lavallee, of Montreal, first vice-president; Mayor Waugh, of Winnipeg, 2nd vice-president, and Mayor Beckwith, of Victoria, 3rd vice-president; W. D. Lightall, of Montreal, honorary secretary-treasurer, and G. S. Wilson, assistant secretary. The next convention will be held in Saskatoon, Sask.

RAILWAY COLLISION IN ENGLAND.

A rear collision at the Vauxhall Station of the London & Southwestern Railway, in London, England, on August 29th, resulted in the death of two and the injury of forty persons. A crowded commuters' train from Aldershot was standing in the station, when a light passenger train, consisting of a locomotive and two coaches, crashed into the rear end of it. A defective switch is blamed for the accident.

PERSONAL.

MR. J. G. MILL, until recently employed in the main drainage department of the City Engineer's office of Toronto, has been appointed resident engineer on the sewage disposal works of North Toronto.

MR. R. O. WYNNE-ROBERTS, consulting engineer, of Regina, called at the office of *The Canadian Engineer* in Toronto this week. Mr. Wynne-Roberts is on a tour of inspection of gas-works in Eastern Canada and the United States.

MR. R. H. MURRAY, A.M.I.C.E., who has been resident engineer for Mr. T. Aird Murray on the installation of sewers and sewage disposal plant for North Toronto, has been appointed resident sanitary engineer for the Province of Saskatchewan, with headquarters at Regina.

MR. R. F. PACK has been appointed general manager of the Minneapolis General Electric Company. Mr. Pack has been for several years general manager of the Toronto Electric Light Company, and has just recently resigned to accept the new position. He was elected president of the Canadian Electrical Association at the last annual meeting held in Ottawa.

MR. C. W. WARD, of Messrs. Reavell & Co., Limited, of Ipswich, Eng., returned to London this week after having been in Canada in connection with air compressors supplied to the Water Commissioners of London, Ont. The machines had been rejected by the commission because of low volumetric efficiency. Messrs. Reavell & Co., Limited, being of the opinion that a mistake had been made in testing the plant, sent Mr. Ward out to locate the trouble. The results of further tests demonstrated the efficiency of the plant, and it has been accepted without any alteration being made.

MR. JOSEPH RACE, F.I.C., has been appointed director of Laboratories for Ottawa at a salary of $2,400 per annum. Mr. Race, who has been analyst at the Toronto Filtration Plant, is well known to readers of *The Canadian Engineer*, as he has been a frequent contributor on sanitary subjects.

COMING MEETINGS.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept 9th, 1912, during the Exhibition. Sec'y-Treasurer. John Keillor, Hamilton, Ont.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912. Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. The Secretary, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary. Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton; Secretary-Treasurer, Mr. K W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson. Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President. Chase. Hopewell. Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—President, Reeve Forke Pipestone, Man.: Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor. Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto. President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO ASSOCIATION OF ARCHITECTS.—President, A. F. Wickson; Toronto. Secretary. H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5. Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, J. P. McRae; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W H Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.