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The Canadian Engineer

An Engineering Weekly

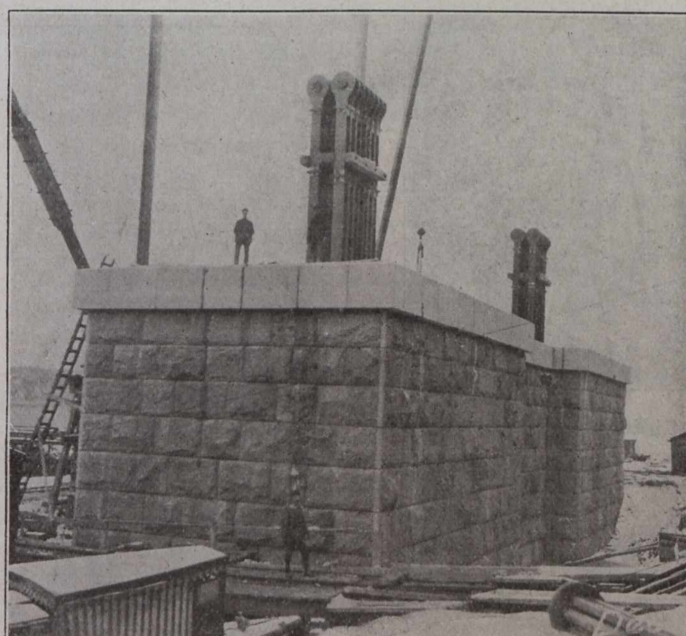
PROGRESS IN CONNECTION WITH THE CONSTRUCTION OF THE QUEBEC BRIDGE.

Very satisfactory progress has been made in connection with the construction of the huge Quebec bridge, situated some seven miles above the city of Quebec.

The contract for the substructure was let in January, 1910, and the contract for the superstructure in April, 1911. The work on both contracts has gone ahead as rapidly as possible since these dates, and at the present time there are material evidences to prove that before very long the River St. Lawrence will be successfully spanned by the largest bridge in the world.

Owing to the increase in weight and width of the superstructure, the piers of the old bridge had to be removed and new ones constructed in their place. All the more difficult work in connection with the substructure is now practically completed. The caissons for the north and south main piers have been sunk to the required depth, that for the north pier about 50 feet and that of the south about 85 feet below the bed of the river. All the rest of the work in connection with the substructure is above high-water mark or protected from the water, and presents no serious problems. The masonry involved in this contract includes alterations to the existing abutments and the entirely new construction of one intermediate pier, two anchor piers, and two main piers. The total yardage in these various pieces of masonry amounts approximately to 105,000 cubic yards. The timber used in the caissons is mostly 12-inch by 12-inch long leaf southern pine, and some 18,000,000 feet B.M. were used in the construction. The piers on the north side of the river are well advanced, and will be ready to accommodate the steelwork early in the coming season.

Since the awarding of the contract for the superstructure, the contractors, the St. Lawrance Bridge Company, of Montreal, have had a staff of between thirty and forty men engaged in their offices working on the detailed plans of the design. The design, details and problems in connection with this bridge are to a large extent without precedent, and as a result much time has been spent in investigation and studies that would not have been necessary with a smaller structure.



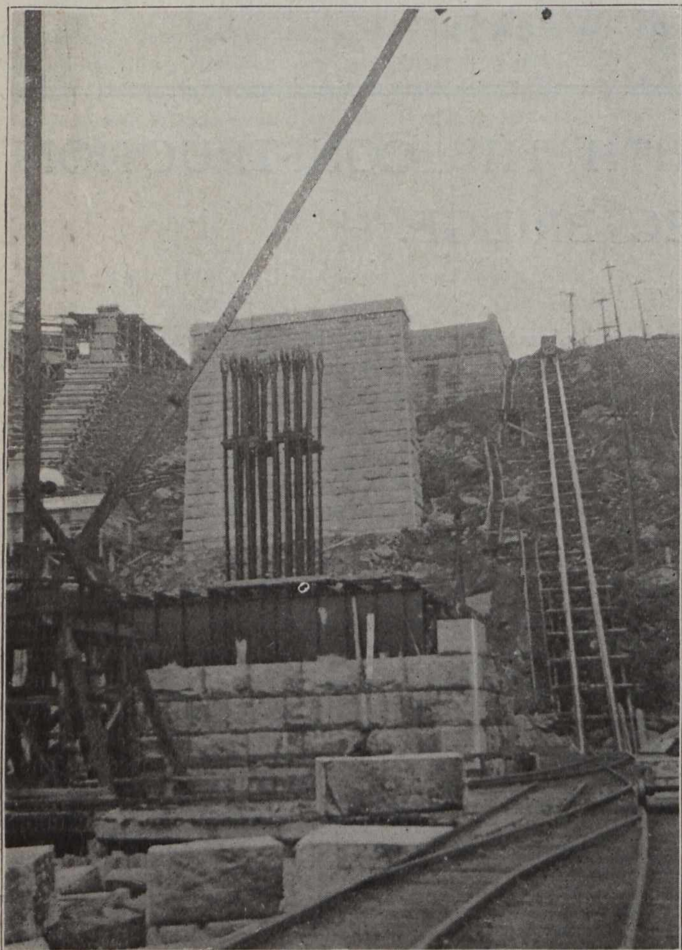
View Showing North Anchor Pier with Eyebars Extending Above.

This pier will be extended 100 ft. higher than is shown here. Some idea of the enormous size of the stones can be gained by comparing with men in the picture. Dec. 2nd, 1912.

Plan after plan has been made, studied and revised, no detail of construction or calculation being too insignificant to court the minutest investigation. The contractors work in conjunction with the designers and calculators of the board of engineers, and no detail was passed unless thoroughly approved by both. Entirely independent sets of calculations were made by the board of engineers, each calculation being checked and re-checked independently so that there could be no possibility of error creeping in. Therefore, each simple calculation was subjected to two independent investigations by the contractors and two independent investigations by the board before it was finally approved. The suspended span was first designed and shop drawings completed from which the actual dead loads were computed before starting on the cantilever arm, which is in turn being completed before the drawings of the anchor arm are made. It can therefore be seen that there can be no chance of over-run in dead weight in the completed structure, as was the case in the old bridge.

The enormous proportions of this bridge cannot be properly appreciated until actually viewed in place. Some idea, however, may be gained from the following facts:—The completed bridge will probably exceed 50,000 tons of steel, equivalent to 1,700 carloads of 30 tons each, or over 500 train loads of 30 cars each. While this is an enormous quantity of steel to go into any one structure, yet there would be no difficulty in handling it were it manufactured in the ordinary commercial sizes used in bridges and structures to which we are accustomed. The great difficulty of the mechanical side of this enterprise arises from the fact that nearly all the members of the bridge are of such enormous proportions that the ordinary shops or equipment are entirely inadequate to manufacture or handle them. Shops with columns and girders of unusual strength are required to carry the heavy cranes which handle the enormous members. Almost every piece of machinery used must be of the largest capacity, and in the majority of cases are specially designed for this job.

The main posts of this bridge are about 10 feet by 10 feet in outside area and approximately 320 feet high, or equal to the height of a thirty-story building. The shoes on the main pier upon which each of these posts rests are 21 feet by 26 feet square and 15 feet high. Many a family lives in a house



View Showing Lower Anchorage. Girders and Eyebars in Place.
(Also completed intermediate pier and abutment in the background).

considerably smaller. The main bottom chord near the pier is about 10 feet wide and 8 feet high. If it were not for the interior webs and diaphragms six men could walk abreast inside this chord without crowding or fear of hitting their heads. This chord will weigh about 8,500 lbs. per lineal foot and is erected in sections weighing from 75 to 100 tons each. The main floorbeams are approximately 90 feet long and 10 feet deep, and weigh between forty and fifty tons. In most cases they are connected to the truss by pins in order to do away with the secondry stresses in the posts. The top chords of the cantilever and anchor arms are composed of two banks of eyebars of half panel lengths, and are supported by light Warren trusses between main panel points.

The floor system is designed to carry two railway tracks and two sidewalks for pedestrians. No allowance is made for highway traffic.

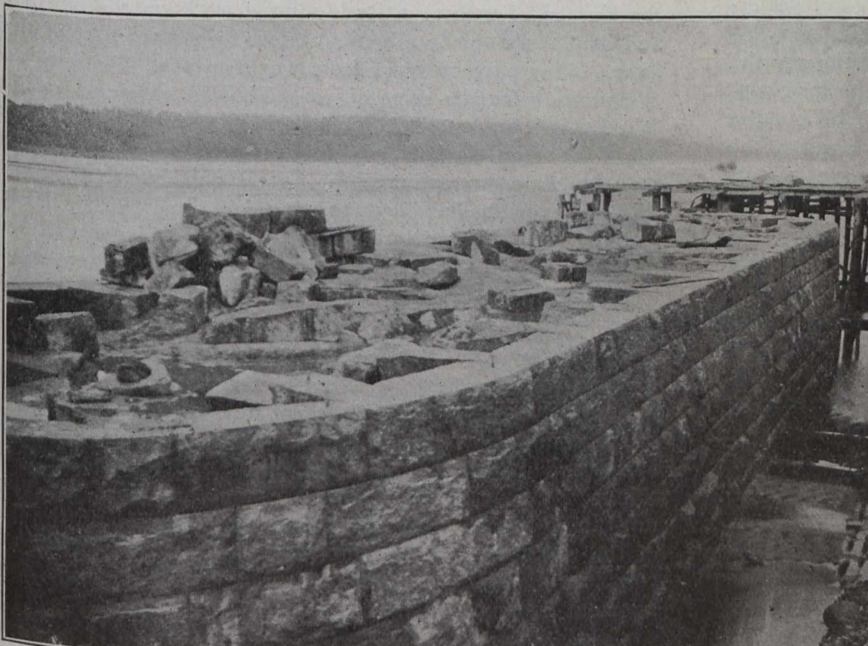
Elaborate preparations are being made by the contractors for the erection of this steel work. Erection will be carried on on both sides of the river simultaneously, which means a duplicate erection plant throughout. While this entails somewhat more expense for the contractors it will be justifiable by the saving of time. The anchor arms will be erected on heavy steel falsework which is so designed that the trusses will be carried on falsework independent from that which carries the traveler. The main traveler will be an enormous structure about 200 feet high and weighing, inclusive of hoisting machinery and tackle, about 900 tons. The traveler is constructed with an overhang from which heavy blocks are suspended and operated by means of electric hoists. Each hoist is capable of lifting 50 tons simultaneously, 60 feet beyond the point of support. The traveler is also equipped with cross gantrys and electric cranes and enormous booms which can handle material in practically every position. The blocks for the dozen or more hoists used in this traveler have all to be specially designed and constructed, many of them being over 5 feet in height and weighing over 5,000 lbs. each.

Probably one of the most interesting features of the erection will be the floating in of the 640-foot centre span. By means of this scheme of erection the difficulty of joining up at the centre is overcome and one year saved in the erection of the bridge.

While the floating in of a bridge span is a common enough occurrence to bridge erectors, yet, taking into consideration the length, weight and height of this span, and also the fact that there is a seven or eight-mile current and a 20-foot tide at this point, it can be seen that this part of the work is also without precedent. It is proposed to erect this span on steel falsework or staging on the shore or in shallow water at some point near the bridge site. This falsework is founded on concrete piers so spaced as to allow pontoons to

Starting Construction of the North Anchor Pier.
(View shows granite bed rock in place upon which steel anchorage is to be placed. Sept. 11, 1912.)

float in between them and under the falsework. When the span is completely erected and ready to be floated, the pontoons are placed in position under the falsework when the tide is low. As the tide rises the pontoons lift the bridge off the concrete piers. After the span has been towed to its proper position under the bridge it has yet to be lifted over 130 feet in the air and connected to the ends of the cantilever arms. This is done by means of hangers with slotted holes which can be quickly attached to the four corners by means of pins. After this has been done at highest tide the pontoons are floated from under and the span is lifted in place by jacks at each corner of the cantilever arms.



View Showing North Main Pier.
(Completed up to high water mark and the caisson removed. Nov. 8th, 1912)

Entirely new shops have been constructed by the St. Lawrence Bridge Company, of Rockfield, near Lachine, and manufacturing has just been started. This shop is completely equipped with the latest and most powerful electrically driven machine tools, and will have a capacity of about 2,000 tons a month.

The supervision of the entire work is under the direction of the board of engineers appointed by the government. Mr. C. N. Monsarrat is chairman and chief engineer, with whom are associated Mr. C. C. Schneider, of Philadelphia and Mr R. Modjeski, of Chicago.

THE PRINCIPLES OF SCIENTIFIC MANAGEMENT.

On the occasion of his visit to Toronto to address the Canadian Club, Frederick W. Taylor, M.E., gave an address on "The Principles of Scientific Management" to the Engineering Society of the University of Toronto, on January 21st, 1913.

In his opening remarks Dr. Taylor presented his subject as referring principally to workers of co-ordinated industry, in distinction to isolated workmen, it being applicable only to the former.

Nineteen of every twenty workmen believe that it is to their best interest to turn out as little rather than as much work as possible. It is the most serious fallacy that possesses our working class, and is attributable to two causes, for neither of which are the workmen themselves to blame.

First, if it be suggested to a group of workmen that they double their output, they reply that the procedure would throw one-half of their fellow-workers out of employment. To them it appears self-evident, and others, among whom are many of our philanthropists, uphold the belief, heralding over-production as one of the greatest social evils conducive to national idleness. It is immensely true in every trade, so its followers believe, that in going slow, their interests are advanced. Any device, therefore, tending to increased output is rebelled against by this deeply rooted nature.

No more fallacious than such belief exists, and it is borne out by history everywhere, with but one exception, that the introduction of such a device or system, into any trade, instead of forcing men out of work, has provided more work for men of that trade. The exception is in farming. Improved processes in the United States have reduced the providers of food supplies from eighty per cent. in years past to thirty-five per cent. at the present time, because the human capacity for food does not increase from generation to generation. This is the only instance where such a condition obtains.

As an illustration of the effect in other forms of labor, Dr. Taylor referred to the cotton industry, its history being comparatively older and its evolution more spectacular. The power loom was invented early in the last quarter of the eighteenth century, but the year 1840 witnessed the climax of its introduction, after a struggle many years in duration, to gain entrance into the manufacturies. In Manchester, Eng., the workmen felt that these looms would throw 3,500 of their 5,000 men out of work, and they strongly resented such outside intervention between them and their daily bread. Conditions were grave, as it was most difficult in those days to change one's trade, or even to move from one works to another. No alternative means of livelihood presented itself. The result was clear and concise. They forced the establishments, destroyed the looms, and maltreated the operators. Their rioting, however, did not affect the entrance of the loom into the industry.

Be the means what it may, bitter opposition, adverse legislation, public opinion, trade unions—all forces are powerless and futile in defeating the introduction of labor-saving development, and the effect is frequently that of accelerating its use.

The speaker stated that there is great opposition from labor leaders to scientific management, but since that opposition has become open and strong, scientific management has gone ahead more rapidly.

The result in the case of the cotton industry in the three-quarter century that has elapsed has been that the workmen have been proven wrong in their convictions. Has the increase of output thrown laborers out of work? In 1840 there were 5,000 workers. At the present time there are about 265,000 employed at the same work in Manchester. For every yard of cloth in 1840 there are now five hundred yards manufactured, though the population of England has not more than doubled within that time.

"There is a broad meaning back of it all. Wealth need only be brought into the world, for the world to use it. Although there are undeniable cases of over-production, they are abnormities, due to a general cause—the world undertaking a greater number of new enterprises than available capital warrants. It is a disease to which the public is susceptible, and the panics of 1873 and 1893 are unforgotten. On the other hand, production is necessary to wealth, which is derived from two sources, viz., out of the ground and by manufacture at the hands of man. The relation of wealth to production should be recognized, particularly by the poorer classes; their impression is erroneous that by far the major part of the bounties of this world are consumed by the wealthy classes. The reverse is the truth.

"The best index of progress in the world is the increase in output per individual, it being a measure of the increase of prosperity of the individual. The 'good old times' slogan indicates the user to be ignorant of conditions, as increase in output per man has provided such a variety of good things of life that the workmen of to-day live as the kings of yesterday. Luxuries of history are considered necessities now."

Reverting to the previously discussed condition in the farming industry, apart from those who provide the food supplies in the United States, sixty-five per cent. of the population may now engage in other industries as against the twenty per cent. years ago. This indicates increase in output per individual, which is the object of scientific management.

The second belief the workman entertains as a reason for going slow, Dr. Taylor emphasizes as being again in no way attributable to the man himself. It is illustrated by the case of a workman being paid $2.50 per day and making 10 pieces a day, entering then upon the piece-work system. The foreman pays him twenty-five cents per piece for the ten pieces which he turns out. Gradually the laborer increases his output, probably reaching twenty pieces per day, thereby doubling the contents of his pay envelope. Both laborer and foreman are well satisfied with the result.

But at the annual meeting of the board of directors, the pay-roll may properly be called for and closely examined. The foreman must explain his action in paying $5.00 per day instead of $2.50 per day. A storm of protest ensues, savoring of competitors' prices and pay-rolls, and resulting in measures to prevent the supposed ruin of the firm's labor market. The foreman is obliged to reduce the workman's salary to perhaps $2.75 per day.

"There are a great many bitter things said against the workingman, concerning his selfishness, his tyranny, etc.; some of them are true, but there is just one thing that the working man of our country is not—he is not a fool. It is only necessary to give him one lesson, or at the most two, and he becomes a 'soldier' for life. He studies just how much the management will permit him to earn, and that is the amount of his output."

The fallacy of going slow is of such vital importance that the evil of it cannot be pointed out too strongly. There is not the slightest doubt that this is the greatest evil of the age in England. She is suffering from under-production, not over-production, and no voice is raised in protest. England preceded this continent by a generation in the adoption of the policy of "soldiering," and the result has been detrimental in the reputation of the working man hailing from her shores, although he is, especially the steel worker, the most skilled workman in the world. The speaker cited cases where the laborer from across the seas absolutely refused to increase his output, curtailing it at every turn, thus necessitating drastic measures against his employment. The same thing is going on in England to-day and is the reason for unemployment and poverty. The policy of curtailing output strikes at the very root of the trouble.

"The first step of scientific management was to endeavor to prevent this diminishing output, and each succeeding step has been an earnest endeavor to remedy other existing evils in previous forms of management. Scientific management is no new or untried theory, and is no food for profound suspicion. It is a gradual evolution tested and proven step by step. It is the fruit of many men's ideas. Some years ago over fifty thousand men were working under its principles while the number has probably doubled since that computation was made.

"As in the case of all labor-saving devices, the ultimate result is that the general public gets the entire profit. The end of it all is that the whole world is going to profit from it. At first the companies that have introduced it are reaping large profits, many of them more than doubling their output. They are the pioneers, and as such are entitled to the gains."

A workman under scientific management immediately increases his wages from 33 to 100 per cent. This increase is not the greatest good to the working people, however, but the change of mental attitude toward work on the one hand and employers on the other is a more important part of their lives. They have changed from war to peace. There is now co-operation for the same object. The old suspicious watchfulness is supplanted by confidence, peace, conscientious work, and, on the whole, a feeling of satisfaction and pleasure that the employers are profiting as well as themselves. Scientific management has been introduced in almost every department of industry, and in the thirty years in which it has been thriving there has not been a strike in a place where it has been in force, although scores of strikes have occurred in other and similar works.

"It is not any efficiency device for increasing output; it is not a bonus system; it is not a cost system; it is not motion study, or time study; it is not unloading a lot of blanks at the goods entrance and saying, 'There is your system, go ahead and use it.' Most people think of it as one of these things. Scientific management cannot and does not exist until there has been a complete mental revolution on the part of the workmen and the employer, and until this great and complete mental revolution has taken place, scientific management does not exist."

Part of the cost of manufacturing is the cost of material. Another part is the cost of production of the article, and a third is the overhead expense. The difference between the sum of these three and the selling price is the surplus. All labor troubles are due to the division of this surplus. The workmen desire as much as they can get in the form of wages, etc., and the owners as much as they can get in the form of dividends. Under scientific management they have ceased combat over the division of this surplus. The result has been a surplus so large that both contenders get more than they ever received before. The workmen get at least 33 per cent. more wages, and the company gets larger profits. This is one result of the mental revolution.

Dr. Taylor pointed out forcibly the delusion almost universal among workmen that the division of the surplus in the past has been entirely wrong; that the working men are not getting their proper share of the general profits of capital and labor. Although in some cases it is true, their feelings have been rashly augmented by the labor leaders, newspapers and the public. In an article on "Division of Capital," in the Atlantic Monthly of June last, Norman Faig showed their conviction to be wrong. All that the working man can ask for is that the profits that accrue to capitalists should come to the people of the United States. They themselves could not demand all this profit. If it should be divided in the manner suggested there would be thirteen cents per day per man as dividend. It shows conclusively that the hope of the workman does not lie in the division of capital. It lies rather in an increase of output.

The speaker outlined the older type of management where, for example, 500 to 1,000 men in perhaps twenty different trades, have acquired their knowledge, not by books, but by observation and by traditional word of mouth. This is just the condition that obtained in the middle ages, and still largely obtains. Yet, in spite of lack of progress his trade is the workman's greatest asset. To achieve the best results one realizes that he must get the initiative of his workmen, but one's realization of "soldiering" forces him to the conclusion that to render this initiative the workman must receive a larger remuneration than his competitors.

The employer who has the pluck to do this, and to continue doing it, will find that his men will respond to such good treatment. This is the highest type of management under the old system, yet it cannot compete with scientific management, for under the latter there is no spontaneity on the part of the workman, but continuous effort. This, because of the new and unheardof burdens which the management assume.

The first of these principles is the gathering-in of the great mass of traditional knowledge held by the workmen; recording it, and reducing it to laws, rules and mathematical formulas. These deductions become of immense assistance in increasing the output. Rule-of-thumb knowledge is replaced by science.

Secondly, it becomes the management's duty to study carefully every man in the plant, his capacities, possibilities and limitations; and to train each to the highest class of work for which he is shown to be fitted—progressive selection and progressive study.

Thirdly, the science and the scientifically trained man are brought together. This is difficult. It can be accomplished only by binding the workman to work by science. This, however, does not cause appreciable trouble. Nine-tenths of the trouble experienced comes from forcing the management and owners to assume their burdens.

And, fourthly, a great mass of work formerly done by the workmen is now partly taken over by the management, until the whole is more equally divided. On the management's side there is generally one man for every three workmen.

These principles are deduced from years of study and work under scientific management. The system is no longer something which might be found beneficial if tried—it has been well tried—and pays.

To illustrate the application of the principles of scientific management, Dr. Taylor chose the operation of shovelling. A careful study and series of observations in a plant where four hundred to six hundred shovellers were employed resulted in a reduction in the cost of handling iron ore from eight cents per ton to less than four cents, after paying the workmen employed 60 per cent. higher wages, establishing a labor office, employing teachers to instruct the men how to scientifically handle a shovel, and timekeepers, etc., to record performances.

Investigation showed that the loads upon shovels under old methods varied from three and a half to thirty-eight pounds. Placed on a scientific basis, a load of about twenty-one pounds to the shovel, proper motions, simple and untiring, the work was now being done by 140 men. Furthermore, investigation into their private affairs showed the workmen to be living better lives, in every way, than before.

Illustrations were also given in the operation of machinery. The speaker claimed that not one in fifty of the machines in the factories of America are speeded accurately. The majority of them are 200 per cent. to 400 per cent. out, and from two and a half to nine times as much work could be done by them if they were properly adjusted. In the work of the high-class mechanic science is so great a factor that he cannot gain the proper knowledge of himself.

Dr. Taylor instanced, in closing, a case in machine manipulation where mathematicians were confronted with a problem involving twelve unknowns, and struggled with it for eighteen years. Now the problem is solved in twenty seconds on a slide rule taking care of the twelve variables.

"If you are willing to pay the price in time and hard work, things that have through the ages been termed impossibilities, can eventually be solved and put to use for the good of man."

MANITOBA'S MINERALS.

By Dr. R. C. Wallace.*

It cannot be said that a great deal of attention has been paid to the possibilities of Manitoba as a mineral producer. This is as might be expected in a province where agriculture has been and is of paramount importance. And yet the soil is not the only natural asset of any country; and a systematic investigation of the mineral resources must always play a prominent part in contributing to the development of the whole.

If we associate with the name of minerals such ores as are mined for gold or silver or copper, then it is indeed the case that minerals and good agricultural soil are not, as a rule, found together in nature. But under mineral resources must also be included materials such as clays, shales, sands and gravels, limestones, marls and coals, all of which are frequently found in districts which support a thriving agricultural population, and all of which call for development in the agricultural areas of our own province. One need only instance the case of our neighbor across the international boundary line, where a strong State Geological Survey and equally strong School of Mines, both integral parts of the University of North Dakota, are doing magnificent combined work in directing the development of the clays, cements, and coals of that state along the most rational and economical lines. A study of the features of industrial progress in a state pre-eminently agricultural, which are to be directly attributed to the researches and guidance of these organizations, would well repay the people of Manitoba.

But at a time when the province is on the eve of entering into a larger heritage, it is natural that attention should be directed rather to what we are likely to obtain than to what we already possess. Although certain areas in the vast Archaean territory of the new Manitoba have a coating of clay sufficient to provide an agricultural soil, the possibilities of revenue lie mainly in the mineral resources, the timber, the fisheries and the water power which the new territory will provide. And it is here that the onus of the work will fall. Up to the present time it has been found possible to carry out organized geological survey work only along some of the principal waterways, and private prospecting has been desultory in the extreme. In order to realize the extent of our possibilities, and the importance of systematic work in this field, it need only be pointed out that in a district—comparatively speaking at our own doors—a discovery of gold was made over two years ago which has led to the influx of a large number of prospectors into that particular area; and this in a belt which had not previously been geologically examined or even topographically mapped.

In the great Archaean Shield discoveries of ore deposits have been confined to the belts popularly known as Huronian, and consisting usually of Keewatin, Huronian, and even younger deposits, which may be generally characterized as dark or dark-green schists, conglomerates and slates, in contradistinction to the lighter color of the surrounding Laurentian granites and gneisses. Of these dark schists, there lie within the enlarged boundaries of the province several areas, no one of which has as yet been subjected to detailed investigation. Future exploration may discover still more such areas, and it is certain that the boundaries of some of those already located, as for instance the "Huronian" band in the basin of the Hole River, will be considerably extended in the future mapping of the areas concerned. Two of these "Huronian" belts—one of them rather extensive in area—will be rendered directly accessible by the Hudson Bay line. A

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third is connected by water route with Cumberland House and the Saskatchewan. Our knowledge of the existence of a fourth is primarily due to the fact that it lies along the well-used canoe route between Norway House and York Factory. Other areas lie near God's and Island Lakes; and the Black Island and Hole River belt extends eastwards beyond the limits of the province.

What these formations will produce is as yet largely a matter of conjecture. One district—that of Star Lake—near the eastern boundary of the province, and forming the western extension of the Lake of the Woods area, has now reached the producing stage, and gold mining in the province is happily an assured fact. Another, the Hole River and Rice Lake area, has been the scene of exceptional activity during the past year, and capital is now interested in developing this district, in which gold has been found over a wide area, and which, if present indications may be taken as a guide, will be producing gold within the next two years. Gold has been found in more than one of the other areas referred to, iron in several, specimens of copper ore are by no means uncommon, and discoveries such as have been made at Sudbury and Cobalt, names of worldwide importance, are by no means beyond the range of possibility. And in this connection it may be well to remember that although Cobalt is only a few miles distant from one of the earliest routes of travel in the country, its wealth lay hidden till some ten years ago; and it was due to a cutting for the Canadian Pacific Railway that the world's attention was first directed to Sudbury.

But the glamor of the Northland ought not to blind us to the necessity of utilizing the resources more easily available within the limits of the province. If Portland cement were manufactured from raw materials mined in Manitoba, a very considerable saving in freight rates might be effected. Limestones sufficiently pure for this purpose outcrop at various points on Lake Manitoba, and the necessary clay or shale is available conveniently near at hand. The calcareous Niobrara shales provide a suitable material for a natural cement, and future investigations in this direction may result in considerable increased activity. Valuable gypsum deposits are mined in the vicinity of Lake St. Martin, and in the country between Lake Manitoba and Lake Winnipeg other beds may yet be found. Borings have shown the existence of gypsum over wide areas at varying depths from the surface. A pure friable sandstone at the base of the sedimentary strata of the province will provide a good material for a future glass industry. A good phosphatic shale which is found in the western part of the province will come into requisition as a fertilizer when the soil begins to show signs of exhaustion. Our limestones are already a valuable asset, not only from the point of view of building-stone, but as lime and rubble producers. Extensive northern areas of limestone are awaiting development, and for the furtherance of the "Good Roads" movement not only the limestones, but also the available sand and gravel ridges will be utilized. Because of our great clay resources the brick and tile industry will occupy a very prominent position for many years to come; and the Geological Survey is at present investigating the possibility of utilizing the stiff till underlying the upper clays. With regard to fuel, the value of peat is being more and more emphasized in Canada and elsewhere; and Manitoba has her fair share of this commodity. Of lignites, Turtle Mountain contains on a rough estimate 160 million tons; and the formations in which lie the Lethbridge lignites extends into Western Manitoba, and deep borings may yet repay the expense they entail.

In reviewing the mining situation of Canada for 1911, the Canadian Mining Journal is compelled ot state that this province pays as yet practically no attention to exploiting her mineral resources. When, however, the greater Manitoba of the future acquires the control of her natural resources, the authorities will undoubtedly see their way to initiate a vigorous policy of development of the minerals we will then possess.

Statement of Production, 1910-11.—The following figures are given as summarizing the present situation, in so far as can be done with the latest available figures. They will also serve to contrast the present with possibilities for the future, when serious attention is given to developing our minerals.

Total production for 1911	$1,684,677
Total production for Saskatchewan	618,379
Total production for Alberta	6,404,110

Detailed Statement for 1910.

Gypsum	$195,000
Clay products and sandlime brick	735,232
Granite	3,345
Cement	21,995
Lime	100,808
Limestone	328,029

RAILWAY BUSINESS FOR NOVEMBER.

The high tide of business in the United States continues to be reflected in the railway statistics compiled by the Bureau of Railway Economics from the reports of the railways to the Interstate Commerce Commission.

The returns for last November show an increase over November of the previous year, but do not maintain the ratio of increase displayed by the month of October; while operating revenues increased $122 per mile of line for the month, operating expenses increased $74, and net revenue only $48.33. Taxes were greater than for the previous November, amounting to $46 per mile of line. Operating income averaged $12.13 per mile of line for each day in November, an amount greater by $1.63 than for November, 1911. This is the entire amount available to the railways for rentals, interest on bonds, appropriations, and dividends.

For the five months of the fiscal year the net operating revenue per mile of line of the eastern railways, compared with the corresponding months of the previous year, increased 6.3 per cent.; that of the western railways increased 15.8 per cent., while that of the railways of the south increased less than one-tenth of 1 per cent.

For the eleven months of the calendar year the net operating revenue per mile of line of the eastern railways, compared with the corresponding months of the previous year, increased 4.8 per cent.; that of the western railways increased 7.4 per cent., while that of the railways of the south shows a decrease of 4.5 per cent.

LE BULLETIN DE L'ECOLE POLYTECHNIQUE DE MONTREAL.

L'Ecole Polytechnique, of Montreal, has deided to publish a monthly bulletin, beginning with January, 1913. This bulletin is published and edited through the co-operation of a number of the professors of the School. The first issue, which has just come to hand, is a thirty-two page, 6 x 9 in. book, handsomely bound in brown board. The bulletin is intended to help in furthering the interests of the graduates of L'Ecole Polytechnique in the School, and to follow and encourage scientific and engineering movements. The editorial and business offices are located at 228 St. Denis Street, Montreal.

THE TOWN OF MAGOG, MUNICIPAL HYDRO-ELECTRIC DEVELOPMENT.

BY A. C. DOGHERTY.*

The town of Magog inaugurated in January, 1912, its new hydro-electric plant on the Magog River, which supplies energy for its waterworks, and electric lighting system, also to the cotton mills of the Dominion Textile Company. This plant replaces the town's old development which had to be abandoned owing to its delapidated condition, and to its serious waste of water due to antiquated design, and non-utilization of the whole head.

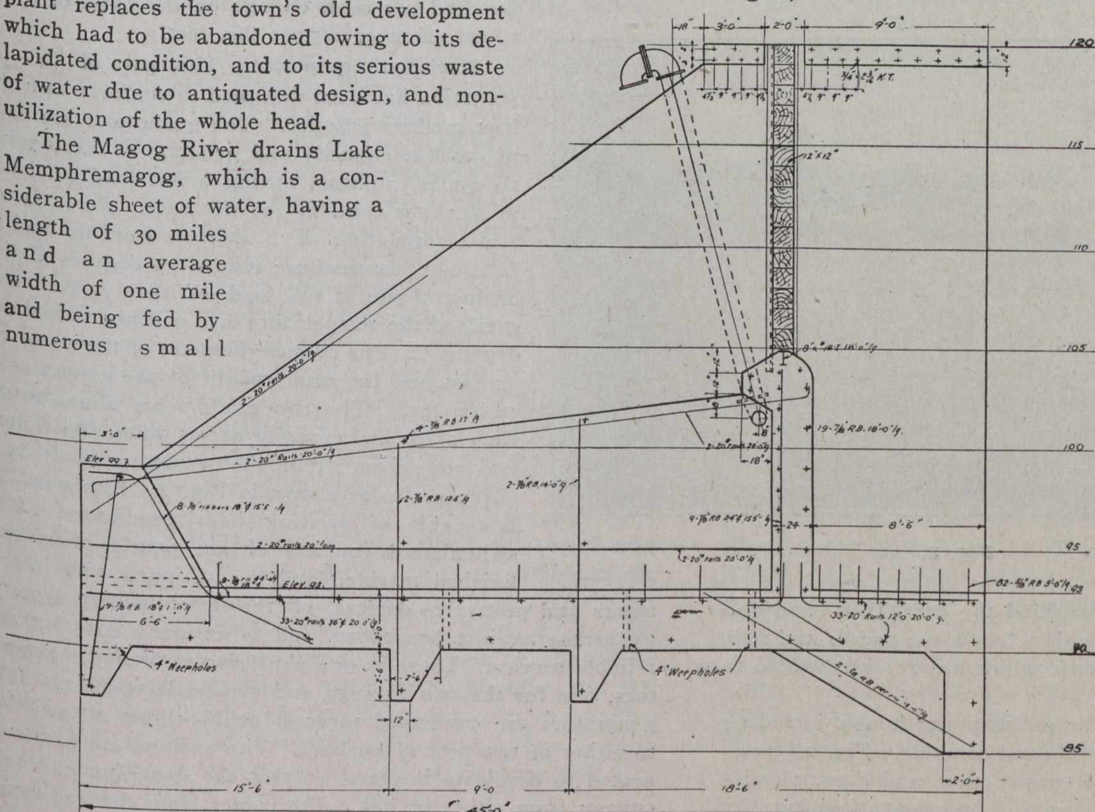

Fig. 1.—Cross-Section Through Sluiceways.

The Magog River drains Lake Memphremagog, which is a considerable sheet of water, having a length of 30 miles and an average width of one mile and being fed by numerous small streams and springs. It affords a remarkable natural storage basin for regulation of stream flow which would be advantageous to all the powers on the Magog River, and to the St. Francis River, of which the Magog is a tributary. The flow at present fluctuates considerably, though the dam of the Dominion Textile Company, which controls the outlet of the lake, helps equalization to some extent.

The Development.—The new plant is situated about two miles below the town, just below the site of the old plant, previously mentioned, and consists of a reinforced concrete power house, a reinforced concrete sluiceway, and earth embankment wing walls with concrete cores. Owing to the absence of rock, the design had to be suitable for an earth bottom, and erosion was guarded against by providing tumble-bays below the stoplog sluiceways in which the force of the falling water is absorbed by a water cushion, and by a timber crib which prevents any washing as the water leaves the tumble-bays.

The early spring of 1911 was spent in surveys and sinking test pits to obtain data for designing. The formation generally consisted of a top layer of gravel and boulders, and a heavy underlying stratum of hard clay. In March a wagon road was built into the site as well as a siding from the main line of the Canadian Pacific Railway. As the heavy blanket of snow disappeared clearing the timber and brush from the site, and flooded area was begun, and a start made on the first half of the cofferdam which was built around the site of the power house, work progressed rapidly so that by August 1st the river was turned through the turbine chambers and draft tubes, and the second part of the cofferdam, enclosing the sluiceway section, was begun. Simultaneously with the main part of the work, the concrete core walls and earth embankments were constructed, so that by October 30th the work was practically complete, except for its equipment, which was late in arriving, and it was not until January 20th, 1912, that current was turned on to the transmission line for the first time.

The Dams.—The concrete dam, 144 feet long, 35 feet high, 45 feet wide, at the base, is composed of six stoplog sluiceways and two blind sections, and is built with tumble-bays to break the force of the falling water, as shown in the section of the dam, Fig. 1. Four-inch weep holes are left in the floor of the dam for seepage and to prevent upward pressure and a twelve-inch pipe is imbedded in each pier to prevent a vacuum behind the sheet of falling water. Two recesses, 12 inches by 14 inches, lined with a 12-inch channel are left in each pier to allow the timber stoplogs to slide in. The stoplog openings in the six bays are 15 feet high by 14

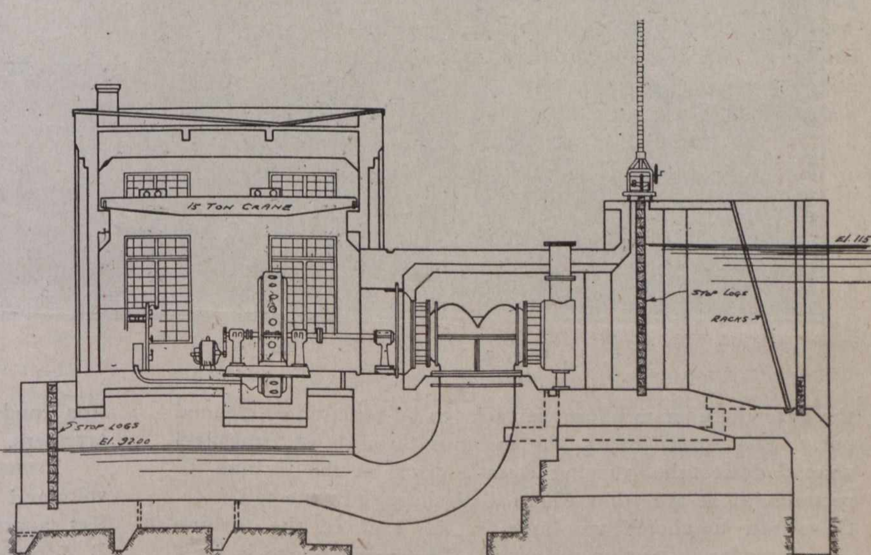

Fig 2.—Cross-Section Through Power House.

* Of T. Pringle & Son, Limited.

feet wide, and the stoplogs are removed and forced into place by a hand-operated travelling winch, which travels on rails built into the top of the dam. The winch operates all the stoplogs in both the dam and power house. A 12-inch reinforced concrete slab, nine feet wide, extends from pier to pier, to form a platform or runway.

The earth dam, which is 10 feet wide at the crest, is built with tapering concrete core wall extending into the hard pan; puddle is placed around the core, then sand and gravel, coarse gravel and boulders follow the puddle and rock fill around the toe. The slopes which are 2:1 are sodded to the water line.

Fig. 3.

The Power House.—The entire power house, including the draft tubes, is built of reinforced concrete. Fig. 2 (cross-section) gives an idea of the construction, and Figs. 3 and 5 show the exterior. The structure is seventy feet long by twenty-nine feet wide and comprises three turbine chambers and generating room. Two sets of stoplogs are provided in the gate chamber to allow the racks to be repaired or cleaned out. The water leaves the turbines through an irregular-shaped draft tube, varying from a circle at the turbine to rectangular at the point where it discharges in the tail face. Cast iron manholes are built in the roof of the turbine chambers for inspection purposes. The power house is built for three units, two of which are at present installed—the third space being left for utilization when the flow regulation scheme for Lake Memphremagog is carried out. A fifteen-ton crane travels the lengths of the generating room. An excellent finish has been obtained on the concrete work, the general effect being good, and the large number of windows provides excellent lighting.

Hydraulic Equipment.—The present installation consists of two Escher Wyss water-wheels of the twin horizontal type, each of a rated capacity of 850 horse-power, at a speed of 150 r.p.m. under an effective head of 20 feet, with a guaranteed full load efficiency at full gate opening of 81 per cent. The turbine gates are of the wicket type, controlled by Escher Wyss governors. The regulation is 3 per cent. variation in speed on 25 per cent. change of loads and 15 per cent. on a hundred per cent. change on the basis of a fly-wheel effect of 225,000 lbs. feet.

Electrical Equipment.—This part of the installation has been designed to conform with the best modern practice. The generators are each of 500 kw. capacity and generate at 2,400 volts, 60 cycles, 2-phase, having a full load efficiency of 94.7 per cent. at 100 per cent. power factor and a regulation of 8 degrees from no load to full load, temperature rise of 35 degrees C. for 24 hours' run at full load. With a 25 per cent. overload the temperature rise will not exceed 50 degrees C. The outside diameter of the stator is 14 feet and the total weight of the generator is 50,000 lbs. The two exciters are shunt-wound each of 50 kw. capacity at 125 volts, 680 r.p.m., and are driven from the generator shaft by a silent chain, as shown in Fig. 4. Either exciter is capable of exciting both generators. The switchboard consists of six panels of marine finished marble, and is equipped with instruments and protective devices of the most modern type, to guarantee against breakdown and to ensure a constant and reliable service. There is one panel for each of the generators, one for the two exciters and two feeder panels. The generators are connected through double-throw oil switches to either of two sets of busbars. The exciters are also connected to duplicate busbars, so that the generator can take current from either exciter. The cables from the generators and exciters are run through the floor in fibre conduits to the switchboard. The outgoing cables are run along the wall in iron conduit and are protected by Garton Daniels lightning arresters.

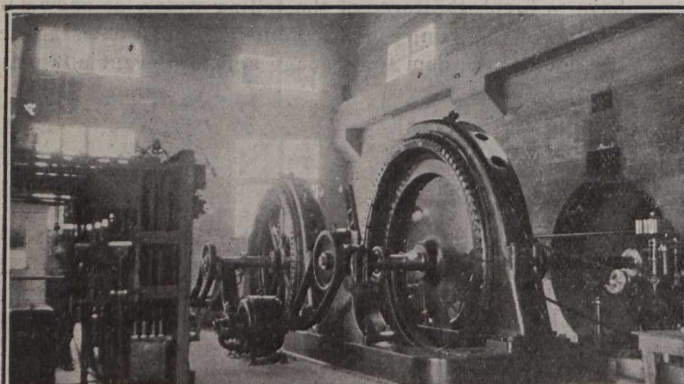

Fig. 4.

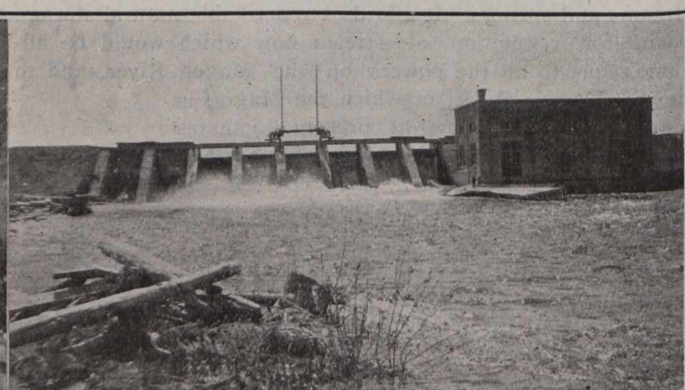

Fig. 5.

Transmission Line.—The current is transmitted at 2,400 volts and the line is carried on 35-foot cedar poles, spaced 125 feet apart. There are three two-phase circuits of No. 0000 B. & S. bare aluminum wire, on three cross-arms, the wires being spaced 21 inches apart. Two of these circuits supply the cotton mills, the other going direct to the receiving station at Magog, a distance of about two miles.

Engineering.—The plant was designed and supervised by T. Pringle & Son, Limited, consulting engineers, of Montreal, Que., and Toronto, Ont. The power house and dam were built by the Bishop Construction Company, Limited.

The complete electrical equipment was supplied and erected by the Swedish General Electric Company, the transmission line by the Electric Repair and Supply Company, of Sherbrooke, Que., the hydraulic equipment by Escher Wyss and Company, of Zurich, Switzerland, and the stoplog winch by the Victoria Foundry Company, of Ottawa, Ont.

THE BRITISH COLUMBIA ELECTRIC RAILWAY.

One of the most active properties on the Pacific Coast is the British Columbia Electric Railway Company, Limited, of Vancouver, B.C., which has a number of important improvements under way, and which are noted in a recent issue of Electric Traction. Recently it arranged with the city of Vancouver for the construction of a new terminal for its Lulu Island interurban railway. This line extends from Vancouver through Point Grey to Eburne, from which point one division runs across Lulu Island to Steveston and another extends along the North Arm of the Fraser to New Westminster. Along this route settlement has been very rapid of recent years and a large commuter traffic is now carried on over the division. The line now enters Vancouver by a bridge spanning False Creek, terminating at a station at the water level. This location is inconvenient inasmuch as the station is located on low ground and passengers transferring to city lines must either walk up a steep hill or climb a spiral stairway to the level of the Granville Street bridge, over which run all the connecting city lines except one. The new arrangement proposed by the company is the location of an interurban terminal at the south end of the Granville Street bridge. By this plant interurban passenger cars will not be obliged to cross the False Creek bridge but will be brought into the city directly on a level with the Vancouver city cars. The terminal will also be of advantage to the city system as it is located near Fourth and Granville Streets, an important city transfer point.

The terminal will consist of two wings, each about 40 by 28 feet in size, connected by a covered passageway 25 feet in width, ample to accommodate the traffic from the interurban lines to the city system. In the south wing will be located the ticket office, agents' office, etc., while in the opposite wing will be a general waiting room and separate ladies' room. The terminal being located on made ground will be of wood construction. The plans call for a handsome structure costing between $30,000 and $40,000. The trackage arrangements provide a terminus for the Lulu Island cars on the west side of the station.

The management of the company is also providing for the comfort and convenience of the motormen and conductors employed on its Vancouver lines by the construction of a five-story club building at the corner of Main and Prior Streets, Vancouver. This location is directly opposite the principal car houses of the company in the city.

The building will have a frontage of 25 feet on Main Street a depth of 60 feet on Prior Street. The Prior Street frontage to the rear of the block is owned by the company and in the plans of the building arrangement is being made for the extension of the block should the need arise.

On the first floor will be located the general waiting room for the men and offices for the station master and inspectors. On the second floor will be a large billiard room which will be furnished with billiard and pool tables. On the third floor will be located the reading room and about one-half the floor space will be used for lockers. The fourth floor will be divided entirely for lockers, this accommodation in connection with the third floor providing lockers for over 500 men. The gymnasium will be located on the fifth floor, the entire flat being left free of obstruction as far as possible. In this room will be installed a complete set of gymnasium apparatus. The upper floor of the building will be reached by an elevator as well as a winding stairway. Lavatory accommodations are provided on each floor.

The block will be of brick construction, the frontage being trimmed with terra cotta. The estimated cost is between $30,000 and $40,000.

The management of the company recently announced that a contract had been closed with the Preston Car and Coach Company, of Preston, Ontario, for 65 city passenger cars. This is the initial order of the company for 1913 delivery. The cars are to be of single-end type and 44 feet in length. The specifications are still subject to minor changes but the cars will be of the latest model throughout. Delivery will be made during the months of April and May.

The company expects soon to operate its interurban line from Victoria north through the Saanich Peninsula, 22 miles in length. For this line orders for rolling stock have been placed as follows:—Two baggage and express cars from the Niles car and Manufacturing Company and six passenger cars from the St. Louis Car Company. For freight service 15 flats and 25 box cars have been ordered from the Seattle Car Company and two 45-ton locomotives will be taken from the mainland system for use on the new interurban line.

For service on its mainland freight lines, the company has recently ordered 25 box cars from the Seattle Car Company and five 50-ton locomotives from the Westinghouse Electric and Manufacturing Company, of Pittsburg. Other rolling stock recently ordered consists of two snow-sweepers from the Ottawa Car Company and six Hark-Otis steel dump cars.

During December full delivery was made of the 24 interurban cars ordered by the company from the St. Louis Car Company last summer and this equipment is now in service. The initial shipments have also been made by the J. G. Brill Company from its Philadelphia shops on the large order for city passenger cars recently placed with that concern.

In announcing its contract with the Preston Car Company, the management of the British Columbia Electric Railway stated that it was not the intention of the company to abandon the car building work in connection with its New Westminster shops. It was stated that the schedule for new rolling stock for all lines of the system for 1913 is now being prepared and in this program ample work would be allotted the New Westminster plant. At these shops is now assembled and finished a shipment of 25 steel city passenger cars which have been constantly arriving on an order placed some time ago in the old country.

LAKE SUPERIOR CORPORATION.

The Lake Superior Corporation propose to expend a large sum of money—$12,000,000 is mentioned—to extend its plant at Sault Ste. Marie, Ontario. Mr. J. F. Taylor, vice-president and managing director of the company has been in New York in consultation with his associates, and states that the company has determined to meet the Canadian demand for steel rails. Sixty-seven acres of land have been purchased for the proposed extensions. Another blast furnace and a new steel rail mill will be erected and large additions made to the open heart hand coke plants.

Mr. Taylor states that when the new works are completed the corporation will be in a position to turn out six hundred thousand tons of steel rails per year, or a daily average of two thousand tons, and he estimates that that will be sufficient to meet the requirements of the country. The maximum output of the present steel mill is about three hundred and sixty thousand tons a year.

STORM WATER DISCHARGE.

By R. O. Wynne-Roberts* and T. Brockmann.†

The subject of storm water discharge has been dealt with in two very instructive papers, one by Mr. Lloyd Davies, the city engineer of Alexandria, Egypt, and the other an expansion of the first, by Mr. Wallington Butt. Mr. Wynne-Roberts, however, in collaboration with Mr. T. Brockmann, has made a study of the matter, and purposes to present a series of articles, of which the following is the first, to explain the several factors that affect the solution of the above problem. As the theme is being developed, Mr. Wynne-Roberts proposes to show in what manner the calculations of storm water discharges can be made more comprehensively and accurately than, he is aware, has hitherto been suggested in the English language. He, however, does not claim any originality of the method to be described later on, as it is an adoption of an idea put forward by an eminent German engineer, the late Prof. Frühling, of Dresden. —[Editor.]

The engineer who is called upon to design sewers has first of all to decide whether it is advisable to adopt the "combined" system or the "separate" system. In the former the ordinary sewage and rainwater are conveyed by one common sewer, whereas in the latter case they are conveyed by separate conduits.

Whichever system is adopted, if the sewers are constructed practically water-tight, it will not be a difficult matter to calculate the probable volume of ordinary sewage, for it must largely depend on the consumption of water for various purposes. In Europe this quantity averages about 30 gallons per head per day, but in Canada and United States, for reasons which need not be gone into here, it ranges from about 40 to over 200 gallons per head daily.

The quantity of ordinary sewage will necessarily vary during different hours of the day and in different seasons of the year. The range of fluctuation in volume of sewage to be dealt with will approximately be from about 40 per cent. below to about 60 per cent. above the mean daily flow.

When, however, the engineer has to attack the problem of providing sewers to drain away storm water, he is confronted by many perplexing considerations. The quantity to be drained away per unit of time is generally vastly greater than the volume of sewage, so much so, that the latter can oft-times be ignored when calculating the dimensions of combined sewers.

While ordinary sewage has to be disposed of in volumes ranging within more or less definite limits, the quantity of storm water varies so enormously, it is so erratic in its periodicity, and is dependent upon so many variable factors, that it is not surprising some eminent authorities who have been extensively quoted, have abandoned all attempts to establish a general formula for this purpose.

This subject has engaged the attention of many capable engineers in Europe and America, some of whom have deduced formulæ by which they considered it was possible to arrive at the probable volume of storm water to be provided for, with sufficient accuracy.

The following are some of the formulæ which have been extensively quoted:—

Bürkli-Ziegler:

$$Q = R \times C \times \sqrt[4]{\frac{S}{A}}$$

McMath:

$$Q = R \times C \times \sqrt[5]{\frac{S}{A}}$$

$$Q = R \times C \times \sqrt[5]{S \times A^4}$$

Q = Cubic feet per second per acre reaching sewers.
Q = Cubic feet per second from the whole area drained.
R = Average rain during heaviest rainfall, in cubic feet per second per acre, varying from 1.75 to 2.75.
C = Constant, 0.75 for paved streets, 0.31 for rural districts, average 0.625.
A = Area of district drained in acres.
S = General fall of area per thousand.

Hawksley and Bazaloette:

$$\text{Log } D = \frac{3 \text{ Log } A + \text{Log } N + 6.8}{10}$$

D = Diameter of circular sewer in inches, to carry off a rainfall of one inch per hour.
A = Number of acres drained.
N = Length of sewer having a fall of one foot.

Kuichling:

$$Q = A \times a \times t \times (b - c \times t)$$

Q = Discharge in cubic feet per second.
A = Area drained in acres.
a, b, c = Empirical constants which vary for different localities.
t = Time required for the concentration of storm water at the outlet.

Lloyd-Davies:

$$Q = (60.5 \times \frac{60}{Tc} \times R) \times Ap$$

Q = Cubic fet per minute.
Tc = Time of concentration, i.e., time of flow through longest line of sewers in district in minutes.
R = Rainfall in inches during Tc.
Ap = Percentage of impermeable area in acres.

If the reader cares to solve any problem concerning storm water by the foregoing formulæ, he will find that the assumptions adopted by the different authorities are far from being uniform and the results obtained will be very dissimilar.

It is interesting as a matter of history, to note how Bürkli-Ziegler's formula was established. About the year 1878 he was city engineer of Zurich and during his term of office serious floods occurred, causing destruction, which was followed by litigation for compensation.

The information as to the intensity of rainfall and the quantity discharged into the sewers, was at that time very meagre and unreliable, and this induced him to take up the matter to see if some formula could be found to suit his requirements.

He found that Hawksley had assumed a rainfall of one inch per hour, which is equivalent to 70 litres per second per hectare, and had constructed a formula which, in metric terms, had the following expression:

$$D = 0.32 \sqrt[10]{\frac{A^3}{S}}$$

D = Diameter of pipe in metres.
A = Area in hectares.
S = Slope of area in 1,000.

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†Dipl. Ing. (Berlin), Civil Engineer, Regina.

Etylwein also had brought out his forumla for ascertaining the size of pipes, which was:

$$D = 1.2 \times 10 \sqrt{\frac{A^4 \times q^4}{S^2}}$$

q = Volume of discharge per second per hectare in cubic metres.

A and S were the same as above.

By combining the two formulæ, Bürkli-Ziegler obtained the value of "q" corresponding to the rainfall assumed by Hawksley. Thus:

$$D = 0.32 \times 10 \sqrt{\frac{A^3}{S}} \text{ equal } 1.2 \times 10 \sqrt{\frac{A^4 \times q^4}{S^2}}$$

$$q = 0.037 \times \sqrt[4]{\frac{S}{A}}$$

Reducing this to litres per second per hectare he got

$$q = 37 \times \sqrt[4]{\frac{S}{A}}$$

The ratio between the discharge and the quantity of rain fallen, which was sought for by Bürkli-Ziegler, was found thus:

$$\frac{\text{Volume of discharge}}{\text{Rainfall}} = \frac{Di}{Rn} = \frac{37}{70} \times \sqrt[4]{\frac{S}{A}}, \text{ say } 0.5 \times \sqrt[4]{\frac{S}{A}}$$

$$Di = 0.5\ Rn \times \sqrt[4]{\frac{S}{A}}$$

This is the classic formula deduced by Burkli-Ziegler. Considering 0.5 as the factor of impermeability denoted by "p" it then takes the form in which it has been so extensively published in America, etc.,

$$Di = P \times Rn \times \sqrt[4]{\frac{S}{A}}$$

Of the foregoing formulæ, the last (Lloyd-Davies) is the most advanced, but is does not satisfy all the conditions, as will be shown later on. With regard to the others, it can be stated that they are inadequate and no longer up-to-date.

These formulæ (excepting Lloyd-Davies') are unsatisfactory inasmuch as it is assumed that the discharge is constant, regardless of the shape and configuration of the drainage area, and the velocity of the flow in the sewers.

Lloyd-Davies' formula is an advance on the others, for it takes into consideration the above mentioned factors, which are ignored by the others, but which, nevertheless, are important, as they actually influence the discharge of the storm water. But he and Mr. Wallington Butt, who have read interesting papers on this subject, assumed that the entire area must be contributory to the flow in the sewers, before the maximum discharge is attained. This assumption, however, must be controverted, as it does not suit all conditions.

The principal factors which influence the discharge of storm water are:

1. Rainfall intensity.
2. Impermeability of the surface of the drainage area.
3. Retardation, which depends on the shape, extent, and configuration of the drainage area and also on the velocity of flow in the sewers.

1. Rainfall Intensity.—The annual rainfall in different parts of any country varies considerably. The mean annual precipitation over a long period, in parts of Prairie Provinces, for instance, is about 18 inches, but in other parts it is much less. In the semi-arid parts of the United States it is under 10 inches, whilst in the Canadian Rockies it must be many times as much. On Table Mountain, Capetown, the average yearly rainfall over a certain area is nearly 70 inches, but in the city, which is only four miles distant, it is 30 inches. In the Berg River Hoek watershed, which is about 50 miles inland from Capetown, the mean annual precipitation is about 120 inches, whilst in the valley, less than ten miles away, it is only 36 inches.

The mean rainfall in Germany is about 26½ inches, although near Berlin it is 24 inches and near Basel 33½ inches.

The rain, moreover, does not fall in convenient, uniform showers, but often in erratic torrential downpours, with very great intensity, during more or less short periods.

In New England, a rate of 3.6 inches an hour, continuing for 5 minutes may be expected every year or so, a rate of 2 inches continuing for 20 minutes; 1½ inches for 30 minutes, and 1 inch in one hour (Folwell).

(To be continued).

LOCATING A RAILWAY LINE.

By J. A. Macdonald.*

When surveys are to be conducted in a country which is timbered and little known, it is, in the long run, a great saving of time and money if it is practicable to have the engineer who is to have charge of the survey, accompanied by a good assistant, and say, half a dozen or more men, go over the country as best he can, running rough compass lines, using a micrometer, pacing or estimating for distances, taking barometrical altitudes, and generally becoming acquainted with the nature of the country and principal difficulties he may expect to have to overcome. Having gone over the whole of the section allotted to him, and thoroughly explored the country for several miles on either side of his rough compass line, he will have naturally formed some idea of the best route to be followed and save the cost of a large party running instrumental lines that may prove, after weeks of hard labor, utterly impracticable through running into some unforeseen obstacle. The engineer in charge of work of this character should be one who has had considerable experience in a timbered country, able to find his way anywhere, and not afraid of being lost. He should be able to establish his latitude and approximate longitude by observation though, owing to the difficulty in carrying a reliable chronometer, the latter is seldom to be relied upon. On reaching his point of departure his aneroid barometers, of which he should have at least two, or better four, having all been previously compared and rated, he will assume a datum for elevation for his work, and all altitudes should be reduced to that datum. By arranging the movements of his party he can provide that one barometer will always be stationary, and if a half-hourly record of its readings is carefully kept all altitudes taken by the party in the field can be reduced to one datum, the party having kept record of the time at which the observations were made. As is well known, such barometrical altitudes cannot be explicitly relied upon, but with care and good barometers it is surprising what close approximation to the true altitudes can be obtained. My experience has been that the aneroid barometers best suited for rough work are those about two and a half inches in diameter, divided to read five feet. The range of such barometers does not generally exceed two thousand eight hundred feet, but are much less

* Late of the staff of the National Transcontinental Railway.

liable to get out of order than the larger ones, which are supposed to read verniers to one foot.

Having thoroughly explored the country through which he is to operate, the engineer-in-charge selects a route for his preliminary line, and having been joined by his transitman and the rest of the party he proceeds with the running of such a line. If the country is rough and unbroken a transit should be used, but if tolerably level a picket line run by the aid of field glasses, the angles being turned with a transit or box sextant is generally the most rapid method and sufficiently accurate for preliminary purposes if the line is checked by compass bearings. The chainage should be done with a light steel chain.

Having assumed a datum for elevation, the levelling should in all cases be carefully done and checked wherever practicable, bench marks being established at least every half mile. Cross sections should be taken by the topographer as frequently as the nature of the country may require, to enable him to show contour lines for every five feet of elevation on either side of the line for considerable distances. As the through levels are not in any way affected by the cross-section work, these sections can be taken with sufficient accuracy with a good hand level, the distance right or left being measured with a chain or tape. It is a good practice to insist that the field notes of all instrument men be plotted up by the men who made them each night as the work progresses; this will save time and avoid many errors.

Having completed his preliminary line, the engineer-in-charge lays down on his plan, with the aid of contour lines, a proposed location and proceeds to stake it on the ground, the levels being checked with those of the preliminary line and bench marks established every thousand feet.

Having completed his first location and made any revisions that may have occurred to him, the engineer who has been in charge of such work should be moved on to other work and a new man put in charge of the party. This new man should, before taking charge of the party, be furnished with the plans and the profiles and given ample time to go out of the lines run by his predecessor. He may or may not be able to improve on the previous line, but in any case the judgment of two in place of one is obtained on final location.

In conclusion the commissariat for the survey party to-day is a very different matter from what it was thirty years ago. Formerly, if a party was well supplied with the necessaries of life, in the shape of bacon, beans, flour, tea, and sugar, it was all that they expected, whereas to-day, the addition of canned meats, dried fruits, vegetables and canned goods generally has added much to the variety of food supplied, but one thing that in the old days contributed more than others to the well-being and comfort of a party is still the same, namely, a good cook.

FACTOR OF SAFETY IN REINFORCED CONCRETE STRUCTURES.

In discussing the factor of safety in reinforced concrete structures, Mr. R. G. Clark, in the January issue of Ferro-Concrete, gives an interesting discussion. Mr. Clark says that the factor of safety in a reinforced concrete structure has generally been denoted by the ratio of the maximum working stress in the steel to the ultimate strength of the steel. For example, assuming that the working stress is 16,000 lb. per square inch, and the ultimate strength is 64,000 lb. per square inch, the factor of safety would be 4 by this theory.

Others, again, take the view that if the steel is stressed beyond the elastic limit the structure has, to all intents and purposes, failed, and, taking this line of reasoning, the factor of safety is expressed by the ratio of the maximum working stress to the elastic limit of the steel. Assuming the working stress at 16,000 lb. per square inch, and the elastic limit at 45,000 lb. per square inch, we then have the factor of safety reduced to about 2.75. This, however, is purely a theoretical calculation which deals with the steel only, but in any scientifically designed reinforced work we know that the concrete shares with the steel an equal responsibility concerning the stability of the structure, so that before the factor of safety can be accurately determined it is essential to see that the concrete also has an ample margin of safety.

The designer, in the matter of the quality of the steel, can safeguard himself by specifying that the British Standard Specification must be adhered to, but unfortunately no such standard is available for the concrete.

It is true that as far as the cement is concerned we have the assistance of the British Standard Specification as regards quality, but in the matter of the quantity of cement the greatest latitude is allowed when we have mixtures varying from 1:4 to 1:9 parts of cement to aggregate.

Dealing with the aggregate used for the concrete, this is more or less controlled by the materials available in any given district, and here again, to make matters worse, much difference of opinion exists as to suitable concrete materials. Very often the selection is left to the contractor, whose natural aim is to get something cheap in order to outstrip his competitors, and as the designer is generally many miles away he may not know of this arrangement, and the prejudicial effect it may have upon the factors of safety provided by his elaborate calculations.

In the past it cannot be denied that the concrete has been more or less overshadowed by the advocates of particular kinds of reinforcing steel, but the concrete in reality needs more attention than the steel, not only because of the reasons stated above, but also for the reason that the lifetime of the structure depends upon the efficient protection of the steel from corrosion. Therefore, as we assume in assessing the factor of safety of the steel that it will not deteriorate, then every care must be taken to protect it, and this can only be done by having the concrete composed of the best materials available, carefully graded and mixed with a generous quantity of the best cement.

It is by no means uncommon for competitors to state their calculated factor of safety, and it is interesting to note that for precisely the same work the factors of safety given by various firms vary from 4 to 9.

How the latter figure is arrived at is frequently a mystery, especially in cases where the firm submitting the lowest tender quote the highest safety factor.

It is obvious that something should be done to standardize the method of calculating the factor of safety, and that any method adopted should include due consideration of the strength of the concrete mixtures. It is altogether unfair to fix a limit of working stress on the concrete unless inquiry is also made into its constituent parts, as the limit may be much too low for some mixtures or too high for others.

In conclusion, it must be pointed out that the actual factor of safety is much above the calculated value if the best materials are used, but it should be remembered that the calculated factor of safety is only used for purposes of comparison. With a good concrete and steel efficiently protected the factor of safety increases as time progresses, owing to the fact that the concrete increases in strength with age, and in this respect affords a striking contrast with structural steel, timber or brickwork, which are at their best when new.

WATER RAM RESULTING FROM THE OPERATION OF A HYDRAULIC ELEVATOR.

About three years ago the Northeast Harbor Water Company experienced difficulty with fluctuations of water pressure arising from the operation of a hydraulic elevator. The company served notice upon the proprietor of the building in which the elevator was installed, to install a tank to supply water through a 4-in. service pipe for the operation of the elevator instead of drawing water for that purpose directly from the 8-in. street main. The proprietor objected to installing tanks. The company notified him that his water supply would be shut off unless he complied with their requirements. At that point the proprietor brought suit in equity to enjoin the company from shutting off his water. The result of the case, which was tried in April, 1910, may be summarized briefly as follows: The court decided that the use of water for a hydraulic elevator was a domestic use within the ordinary meaning of that term. On this ground it ruled that the company was obliged to furnish water for a hydraulic elevator, if the proprietor so desired. The court ruled, however, that the company was justified in asking the proprietor to install a tank of suitable capacity to relieve the street mains from the water ram caused by operating the elevator by direct pressure from the mains. The court decided, further, that the requirement of the company was justified since its order was given to protect its own property and to safeguard the interests of other water consumers on the same main pipe line. The injunction was not granted and the company was left free to enforce its ruling unless the proprietor substantially conformed to the requirements it laid down.

Mr. Charles W. Sherman, principal assistant engineer with Metcalf and Eddy, of Boston, was called as an expert witness by the proprietor. The results of tests made by Mr. Sherman in preparation for his testimony as well as the principal figures submitted by the water company, were given in Mr. Sherman's paper before the New England Water Works Association at the annual meeting of the association which was held in Boston on January 8, 1913. The information here given is taken from Mr. Sherman's paper.

The hotel was supplied by a 4-in. pipe, 300 or 400 ft. long, leading from an 8-in. main supply pipe at a distance of some two or three miles from the pond from which the supply is taken. The hydraulic elevator—the only one in town—is of an old type and has a total lift of about 32 feet. The travel of the plunger is about 4 feet, and its diameter is 22 inches. It was found that the elevator valve was made to open or close a series of holes, with the intention of making the opening or closing rather slow; and that it was necessary to overhaul 4½ ft. of valve rope to open or close the valve, or 9 ft. to reverse the elevator. The static pressure at the hotel was about 40 lbs. per sq. in., and a relief valve set at 45 lbs. had been installed near the elevator.

Nobody seemed to know just how long it took the elevator to make a trip, but it was conceded that it could hardly have been less than 30 seconds. Assuming this to be correct, the 22-in. plunger traveled about 4 ft., and consequently the displacement was 79 gals. in 30 seconds, or the flow was 158 gals. per minute. This flow corresponded to a velocity of less than 3 ft. per second in the 4-in. pipe, which is certainly not an excessive velocity. If this could have been checked instantaneously the resulting water ram would have been considerable, but it would obviously have required an appreciable time to overhaul 4½ ft. of valve rope to shut off the water.

The data available before the water company had presented its case were not sufficient to enable Mr. Sherman to make an estimation of the increased pressure which might have resulted from the operation of the elevator, to which he would care to testify. In order to get some information an experiment was made, through the courtesy of the superintendent of the waterworks at Ellsworth, Maine, where the court was in session. Here a place was found where there was a 4-in. pipe, some 400 ft. long, supplying a locomotive standpipe, where the normal pressure was about 68 lbs. per sq. in. This branch, like that at Northeast Harbor, was from an 8-in. main leading from the reservoir at a considerable distance. No method was discovered of drawing water, or of opening and closing the valve, at the same speed as with the elevator, so it was determined to make the test as severe as possible. The pressure gauge was attached to a house service pipe about 150 ft. from the locomotive standpipe, and the standpipe valve was opened wide, as rapidly as possible, left open until a condition of steady flow was obtained, and then closed as rapidly as possible. Mr. Sherman estimated the maximum velocity in the 4-in. pipe at not less than 10 ft. per second. The time of opening the 4-in. valve was 30 seconds, and the time of closing was 20 seconds. The pressure dropped almost immediately upon starting the valve from 68 to 28 lbs. per sq. in., or to 41 per cent. of the normal. At the instant of closing the pressure gauge registered 134 lbs. per sq. in., or 202 per cent. of the normal.

Mr. Sherman considers that this maximum pressure is not great enough to be dangerous to any well-constructed pipe system, although he believes that the sudden fluctuations would doubtless be annoying at times.

The officers of the water company presented gauge readings showing what the actual fluctuations had been in various parts of town. The significant figures, as taken down during the testimony, are as given in Table I.

Table I.—Pressures Observed at Various Places During Operation of Hydraulic Elevator.

Pounds per square inch			Per cent. of normal	
Normal.	Highest.	Lowest.	Highest.	Lowest.
56	75	40	135	71
58	60	35	104	60
55	62	32	112	58
32	40	10	126	31
32	50	10	156	31
60	80	40	133	67
58	85	35	147	60
55	75	35	136	63
54	70	25	128	46
51	70	28	137	55
30	50	10	167	33
30	50	8	167	27
28	60	10	213	35

The figures given in Table I. show that in general the operation of the elevator caused a drop in pressure ranging from 40 per cent. to between 60 per cent. and 70 per cent. when the valve was opened, and an increase in pressure, or water ram, amounting to from 30 to 50 per cent. of the normal pressure under ordinary circumstances, and sometimes running up to about 100 per cent. increase in pressure.

These results confirm in a general way the conclusions reached by Mr. Sherman from the experiment described above—that the pressure might drop about 60 per cent. below normal when the valve was opened, and rise to a maximum of about 100 per cent. above normal at the moment of closing the valve. These fluctuations are sufficient to cause annoyance, but where the normal pressures are as low as in the cases cited, should not be dangerous to the pipes.

Mr. Sherman points out that none of these results can be applied to conditions differing materially from those here described, but they may serve to give some indication of the extent of the water ram that may be experienced in a small waterworks system from the rapid closing of valves or fire hydrants.

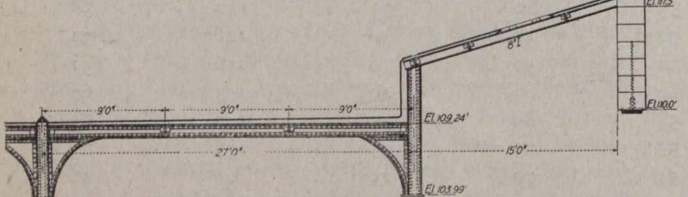
THE OTTAWA PASSENGER TERMINAL TRAIN SHED.

Three types of train shed are in general use, the long-span, high-arched roof type, the open platform canopy type and the short-span, continuous-low-roof type.

The following comments and abstract from an article in a recent issue of the Engineering Record in which the Jersey-Central freight shed and the Ottawa train shed were described. The details which deal with the Ottawa shed are here abstracted.

The long-span, high-arch roof type, while having an imposing appearance, cannot be easily ventilated, and the gases not only are an annoyance to passengers but attack the steelwork, necessitating frequent painting, which is expensive because of the height of the structure. Even then the life of the shed rarely exceeds 20 years. The soot moreover impairs the lighting and the inaccessibility of the sky-lights makes their cleaning difficult. As a consequence of the frequent cleaning of skylights and painting the maintenance costs are high. The width of the shed is limited by the moderate length of span of arch roof trusses, and with increasing business, additions to the trackage are not possible without building a new shed or housing the new tracks beneath a structure having no architectural unity with the main shed. The first cost is also high, and increases much more rapidly than in simple proportion to the width of the structure. Its erection is expensive, requiring elaborate falsework.

The canopy shed is simple and inexpensive, is adaptable to future longitudinal and transverse extension and is accessible for maintenance and repairs. It does not retain locomotive gases, and the ventilation is therefore good, and the



Part of Section Through Ottawa Train Shed and Head House.

corrosion a minimum. Besides it affords unobstructed light and lends itself to convenient and cheap methods of erection. It does not, however, offer a sufficient shelter from wind or driving rain or snow. The roofs extend beyond the platforms only a few feet, at most, and consequently the tops of the cars act as chutes to carry rain from driving storms on to the platforms.

The short-span, continuous low-roof type, represented by the Bush train shed, full details of which are given in this article in connection with a description of the shed now being built at Jersey City for the Central Railroad of New Jersey, has longitudinal rows of columns carrying short-span transverse roof girders that support a continuous roof surface sheltering the whole area of the shed. By means of a concrete duct over each track, gases, smoke and cinders are carried outside at once, and in consequence there is neither annoyance to passengers nor deleterious action on the steelwork. The ducts are so deep that wind, rain and snow cannot drive into the shed. The skylights are readily accessible, thus insuring frequent cleaning, with consequent good illumination in the shed. It should be noted that deposits of soot on the under side are entirely avoided, since the smoke does not enter the shed. Painting is likewise facilitated, and

Interier View of Ottawa Train Shed.

since, in addition, no more painting is required than for ordinary steelwork, this item of train-shed maintenance cost is reduced far below that for a high-arch shed. The freedom from gases gives these sheds practically unlimited life, provided they receive ordinary maintenance and care.

In first cost the shed is more economical both in material and in erection. The steel required per square foot of shed is not more than half that needed for a high-arch shed. Instead of using costly falsework, as is required for the high sheds, the erection is accomplished by an ordinary derrick car, and by taking one bay at a time the work can proceed without interrupting traffic. Should increased trackage be needed there is no difficulty in adding more bays of the same design, thus preserving the architectural unity.

The Ottawa train shed is of the Bush type and has recently been completed for the Grand Trunk Railway Terminal at Ottawa, Canada, Mr. H. R. Safford, chief engineer, and Mr. Wm. McNab, principal assistant engineer. It is 533½ feet long and 163½ feet wide and has seven tracks. The principal structural differences are in the use of a concrete longitudinal sidewall along one side of the shed, provided with movable windows for side ventilation and the substitution of riveted girders for I-beam longitudinal girders connecting the tops of the columns. The passenger platforms between the tracks consist of solid concrete slabs laid on the surface of the ground, and the columns are supported on piers without pile foundations.

A NEW MONTHLY MAGAZINE.

The first issue of "Steam Machinery," published by the Steam Machinery Publishing Co., of Duluth, Minn., has just come to hand. The magazine is devoted to descriptions of machinery and methods, and this first issue presents a most pleasing typographical appearance. In the editorial announcement the following statement of its purpose is given: "We believe the times are ripe for a frivolous magazine with a serious purpose. We believe this to be the sub-conscious spirit of these times. To laugh a lot; to work a lot, and to live like Billybedarned!"

The Canadian Engineer

ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

AN EXAMPLE OF COUNTY COUNCIL CONTROL.

A good example of the manner in which engineering and construction work is handled by municipal bodies is shown in the management of the good roads system in the county of Welland. At the last meeting of the County Council a by-law was passed appointing Mr. George Ross, of Welland, as engineer in charge of the work in place of Mr. J. C. Gardner, of Niagara Falls.

A year ago Mr. Gardner was appointed as engineer for the county good roads system, and three foremen, who were conspicuous more for their political activity than for their ability as construction men, were placed on the work. The work of organization and the buying of new machinery and supplies took up a good deal of time, and a great deal of time was wasted, in addition, by the council in quibblings and dickerings over what should be done. Instead of the work being placed under a small executive committee of the County Council, the whole Council acted as a committee on the work, with the result that much valuable time was lost.

Instead of this year giving Mr. Gardner full control of the situation by allowing him to appoint his own foreman and men, and profiting by the experience of last year, the Council have removed Mr. Gardner to make way for another man. Such injustice and lack of business capacity is typical of bodies of men, made up as county council is. Where political pull and local jealousies and prejudices are allowed to interfere with the carrying on of public work, inefficiency and waste is always the result.

CLASSIFICATION OF COAL LANDS.

It is a widespread popular impression that if coal is found outcropping on a tract, the land is coal land, and that if no coal is to be found outcropping the land is non-coal land. If this were true, probably more than one-half of the coal produced in the country (in some States more than 95 per cent.) would be coming from mines not on coal land.

As an illustration, 196 mines in Indiana in 1908 produced 11,997,304 tons of coal. Of these 196 mines, fifteen were working the coal from the outcrop, and produced 400,733 tons, or a little over 3 per cent. of the total. The rest was mined from land, the surface of which showed no coal. In Illinois the percentage is still less, and in both States the average production of the mines working on the outcrop is small, compared with the average of all the mines. The percentage of coal worked from the outcrop is greater in Pennsylvania, West Virginia, and the southern Appalachian States than in the two just cited, but not much, if any, greater in the Michigan field, the western interior field, or some others of the large fields of the country. It is true that in many of the fields when first exploited mines were mostly driven in on the outcrop, but for two reasons that condition has greatly changed: First, the coal close to the outcrop has been mined out; and second, after a time it has been found to be cheaper to mine the coal from shafts sunk to the bed from a point some distance back from the outcrop than to haul the coal, water, and waste up the slope of the bed as it pitches into the ground.

If, therefore, any producing coal field is examined there will usually be found a belt of outcrop in which the coal-bearing rocks rise to the surface of the ground, and outside of that belt an area, which may amount to thousands of square miles, where the coals are all below the surface, and the surface rocks may even be of entirely different age, and perhaps not coal-bearing at all.

If in any tract a bed of coal of workable thickness outcrops it evidently does not underlie all, and may underlie only a small part of the tract, and to that extent the land is not coal land, so that it sometimes happens that a bed of coal outcrops or is exposed on a given tract, and yet underlies so small a part of the tract that it would hardly be fair to consider the whole tract as coal land.

In Indiana shafts have been sunk to coal beds at a depth of 250 feet without any preliminary drilling where the coal bed did not outcrop nearer than fifteen miles, and many of the mines of Illinois are twenty-five to fifty miles from the nearest outcrop of the coal they are working.

In classifying land as to its coal character a few general principles are involved:—

1. If the land is known to be underlain only by groups of rocks known nowhere to contain coal, the land is assumed not to be underlain by coal and to be non-coal land.

2. If land is known to be underlain by one or more groups of rocks known to contain workable beds of coal, and a study of the dips shows that those groups are not too deep for the coals they contain to be worked, the land may be presumed to be coal land.

In nearly all cases where public lands have been withdrawn pending examination and classification it is known or believed that the land is underlain by groups of rocks known elsewhere to contain workable beds of coal. In probably a majority of cases it is also known, or later examination demonstrates, that coal does not outcrop on most of the land withdrawn, but underlies it, perhaps at a considerable depth.

Given, then, an area of public land withdrawn for examination and classification, under what conditions will it be classified as non-coal land?

1. Detailed examination may show that the coal-bearing group of rocks may have thinned out before reaching the area, so that although the rocks above and below this particular group are found to underlie the area, and normally this particular group should also, yet under the circumstances, if this is the only coal-bearing group in the region that might underlie the area, it is classified as non-coal land.

2. Detailed study of the dip and lay of the rocks may show that the coal-bearing group lies deeper than the limiting depth imposed by the departmental regulations governing the classification of coal land, and the area must, therefore, be classified as non-coal land.

3. Detailed study may show that the area is underlain by a coal-bearing group of rocks within minable depth, but the coal is too low in grade to be worked, or it may be found that the coal occurs only in local pockets, none of which are thought to extend under the area involved.

Where, as is the case in many parts of the western coal fields, more than one group of coal-bearing rocks exists in any area, it must be found that the facts above stated are true of each group before the area can be classified as non-coal land.

On the other hand, if, although there is no coal outcropping within many miles of a given tract of land, it appears to be true that the tract is underlain within workable depth by a group of rocks known to contain coal beds of such character, thickness, and extent as to make it highly probable that they underlie the tract within workable depth and are there of workable thickness and quality, the tract is classified as coal land.

When such a tract of coal land is valued the attempt is made to take into consideration all the data bearing on the problem, possibly data covering half the State, or more, including usually data on every coal bed in every coal-bearing group of rocks of that field, to ascertain as nearly as possible how many groups of coal-bearing rocks underlie the tract, how many beds are of workable thickness, the thickness, chemical and physical character, depth, pitch, and any other factors affecting the workability and value of the coals, and then to make all due allowance for depth, uncertainty, distance from outcrop, etc., according to fixed schedules and regulations.

It must be admitted that the data gathered for many tracts are very meagre, and a large element of uncertainty enters into the final result, but it is believed that in the vast majority of cases the allowance for uncertainty is so large that additional data, even though they show less coal than might have been expected, will, by diminishing the factor of uncertainty, tend to raise the price rather than reduce it, for, as a rule, where the uncertainty is large only the minimum price is put on the land, and unless evidence such as that obtained by deep drilling or new prospecting shall demonstrate beyond question that the supposed beds of coal are absent or too thin or too poor to work, the classification will not be changed.

The evidence obtained by the United States Geological Survey consists of observed outcrops and measured sections, properly located and described on the spot, and analyses made in the Government laboratories from coal samples collected in a definite, prescribed way, supplemented when necessary by such second-hand data as appear to be accurate and reliable, and to be in accord with the personal observations of the field men.

EDITORIAL COMMENT.

At the annual dinner of the Dominion Marine Association, held last week in Ottawa, the Minister of Railways made an announcement concerning the new Welland Canal which shows that the Government and Mr. J. L. Weller, the engineer-in-charge of the design of the new work, are thoroughly alive to the necessity of providing for the future of the shipping interests of the Great Lakes. He stated that the lock-gates on the new Canal would be thirty feet in depth, although the depth of the Canal itself would be only twenty-four and a half feet for the present. When the locks at the Sault on both sides of the river are deepened to thirty feet, as they eventually will, it will be a simple matter to provide this depth on the Welland Canal by dredging.

SAULT STE. MARIE DRYDOCK.

Substantial interests are backing the enterprise of the Sault Ste. Marie Drydock and Shipbuilding Company, Limited, particulars of which appeared in The Monetary Times last week. The shareholders in the company consist of the estate of the late Mr. W. H. Plummer, Messrs. J. O'Brien, J. J. McFadden, J. O'Boyle and D. P. O'Boyle, all of whom are well known throughout Ontario; Sir Alexandre LaCoste, Messrs. Ernest Marceau and F. H. Clergue, of Montreal; A. Simpson, of Ottawa, and other Canadian interests. Among other strong financial European interests are Mr. Robert E. Pauwells, of Brussels, Belgium; Mr. William Brice, of London, England; Dr. Charles Casoretty, of Paris, France; and Messrs. Pethick Brothers, Limited, of Plymouth and London, England.

RAILWAY HEADLIGHTS.

A review of the requirements for locomotive headlights by G. H. Stickney, is given in the January issue of the Lighting Journal, from which the following is taken:

In connection with the recent developments in drawn wire filament tungsten lamps, the writer has been led to look up the locomotive headlights as a possible application. It is the general practice to utilize for this purpose flame oil lamps equipped with parabolic reflectors so as to concentrate the light into a beam, although within the past few years, electric arcs have been substituted for the oil flames in some sections of the country.

In considering the application of tungsten filament lamps, the first question which arises is what intensity of beam is desired. Investigation shows that there is a wide variation of opinion among railroad men in regard to this point. Some insist that the headlight should be very powerful so as to illuminate a long distance ahead of the locomotive, while others object seriously to a powerful beam and demand that the headlight be made simply a marker. Analysis seems to show that the demand for the powerful headlight runs strongest on railroads which have a considerable amount of single track, while the other extreme reflects the opinion of such railroads as have two to four tracks and extensive block signal systems. And this appears to be logical. On the single track road the most dreaded accident is the head-on collision, and the powerful headlight is unquestionably an important means of last resort in preventing such accidents. On the double track roads the danger of head-on collisions is minimized, while complaint is frequently made that the headlight of an approaching locomotive momentarily blinds the engineer and may prevent his seeing properly. The further objection has been raised of the interference due to the reflection of light from signal glasses or rondels.

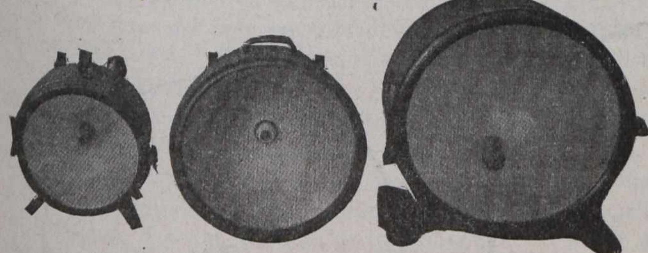


Fig. 1.—Types of Railway Headlights.

A thorough test was carried on by Profs. Harding and Topping, of Purdue University, in 1910, and their report, which may be found in the Transactions of the American Institute of Electrical Engineers, indicated in favor of a headlight of intermediate power; that is, one which would avoid the glaring and reflection effects of the powerful arc headlights and yet furnish a much stronger beam than the ordinary low intensity oil headlights.

There is, however, another phase of this question; namely, the legislative requirement. In many of the states laws have been passed regulating the headlights to be used on locomotives. Inquiry was made into the requirements of various states, and the following collation, prepared by Mr. L. C. Porter, gives a general idea of the requirements.

The States of New Jersey, New York, Connecticut, Minnesota, New Mexico, North Dakota, Virginia, Wyoming, Iowa, Massachusetts, Pennsylvania, Rhode Island, Vermont, Nevada, New Hampshire, Michigan, West Virginia, Nebraska, Missouri, and Delaware advise that they have no law covering this subject.

Colorado and Kentucky have had a bill requiring the use of "1,500 unreflected candlepower" headlights introduced, but the bill was defeated.

Illinois had a bill introduced and defeated requiring each locomotive to carry a headlight of sufficient candlepower to enable the engineer to distinguish a human form at a distance of 800 feet.

Arizona has a bill pending requiring the use of a high candlepower headlight this bill calling for "1,500 unreflected candlepower" on all locomotives except switch engines.

North Carolina requires a locomotive headlight of "1,500 unreflected candlepower" on all locomotives, with the exception of switch engines, on roads having 100 miles or more of track within the State.

Washington requires that each locomotive be equipped with an electric headlight of approved design and capacity.

Montana requires that each locomotive, with the exception of switch engines, be equipped with electric or other headlight of 1,500 candlepower when measured without a reflector.

Wisconsin requires that each locomotive be equipped with a headlight which will enable the engineer to see a man on a clear night at a distance of 800 feet.

Ohio requires that each locomotive, except switch engines, shall carry a headlight of such candlepower as to render plainly visible, at a distance of not less than 350 feet, whistling posts, land marks and other warning signs.

It is somewhat of a reflection upon the activity of illuminating engineers that in no case was the intensity of beam specified in beam candlepower or foot candles at some specified distance. It does not seem reasonable or good practice to require 1,500 unreflected candlepower, without any mention of the quality or condition of the reflector. While it might be presumed that an efficient parabolic reflector would be used, there seems to be no assurance that this would be done. The specification seems to favor one type of unit to the exclusion of others which may be more effective, as well as more economical and practical.

The requirement of sufficient intensity to pick up a man at 800 feet is the most logical and sensible of any of the specifications given. While this is somewhat indefinite and somewhat difficult of exact determination, it was probably the best requirement that could be drawn up with the information then available. As suggested, this specification could readily, by a series of tests, be interpreted in terms of foot candles at, say 200 or 400 feet, or beam candlepower measured at corresponding distances. These values are more readily reproducible than general specifications, which may depend upon local conditions, such as the color of the roadbed. color of background, color of clothes worn by the man, etc.

It is understood that this question is now under investigation by the Wisconsin Railroad Commission and others, and it is hoped that good results will soon be available.

The writer has not made any accurate measurements to determine the relation between intensity and seeing power. A western railroad, which has been conducting such experiments, reports that, with an equipment utilizing a 100 c.p. tungsten filament lamp* with the filament concentrated in a cylindrical space about ½ inch long and ⅜ inch diameter, they were able to pick up a man on the track at 1,000 feet, the locomotive being stationary, and at 800 feet with the locomotive running 30 miles per hour.

Measurements with a similar equipment gave a beam candlepower of 50,000, which is equivalent to .078 foot candles

*The lamp mentioned was made up especially for the experiment and is not standard or commercially available.

at 800 feet and .05 foot candles at 1,000 feet. The beam candlepower obtained in this case indicates the inadequacy of the specification calling for 1,500 unreflected candlepower, which does not ensure anywhere near as powerful a beam as is here produced from a lamp giving only about 100 unreflected candlepower.

A second question which arises and to which there has not, as yet, been a final answer, is the requirement of the shape and width of beam. Ordinarily a fairly narrow beam would seem to be desirable, since it not only makes it practicable to furnish a high intensity down the track, but also minimizes interference with signals or approaching trains on either side of the track. On the other hand, a wider beam would be more useful on curves.

Still a third question is that of the color of the light. Professor Harding's report intimated, to some extent that interference with colored signals was in some degree due to the color of the light, but it is in its relation to weather conditions that the color of the light would seem to be the most important consideration. The headlight question would be a comparatively simple one if fair weather only were to be considered, but the real test comes on the foggy or stormy night, when the mist or rain not only breaks up the beam, but reflects the light back into the eyes of the engineer, thus causing a haze which makes it more difficult to see distant objects, which, in themselves may be darkened and rendered less visible by being wet. That the most powerful light may be the worst under such conditions is quite conceivable; on the other hand, we know that a red or yellow light penetrates a fog more readily than the other colors, and hence not only delivers a larger proportion of the light where needed, but also decreases the likelihood of the haze or diffraction effect obstructing the vision of the engineer.

It may be well to consider briefly the theoretical and practical requirements of a headlight for railway purposes, at least from a qualitative standpoint, assuming that a reasonably powerful headlight is desirable.

As is well known, a perfect parabolic reflector, equipped with an absolute point source of light at its focal point, would reflect all the light incident upon its surface in a direction parallel to the axis, and hence form a beam which would retain its intensity for an indefinite distance, barring only atmospheric absorption. In the practical application of this principle, it is not possible to produce a true point source, so that the actual light incident upon each point of the reflector will, in all cases, come from several directions, at least within an appreciable angle, and, since the angles of reflection and incidence must be equal, it is evident that each point of the reflector will emit a cone of light, depending for its width upon the angle which the light source subtends with reference to that point of the reflector. It is also evident that, since at a distance from the reflector these cones will appear to blend, the beam of light from a parabolic reflector must be in the form of a cone and be dependent for its spread upon the relative area of the light source. It therefore appears that, where a powerful, narrow beam is desired, it is essential that the light source be made as small and brilliant as possible.

This condition is, of course, best met with the D.C. open carbon arc, which can be so arranged that a large percentage of the light from the positive crater is projected upon the reflecting surface. The carbon arc, however, is efficient and stable only in high power units. With the recent development of the drawn wire tungsten filament, it has become possible to make lamps in which the filament is concentrated into a very small space, and is strong enough to withstand reasonably hard treatment. The lamp possesses the further advantage of being free from mechanism to get out of adjustment or requiring maintenance care, does not smoke or destroy the reflecting surface, and produces a light of slightly yellowish tint, which is favorable for inclement weather conditions.

Incandescent headlights have proved very satisfactory for automobiles and are being used to some extent on interurban electric cars. It would seem that this application to railway service is principally a question of determining the requirements and adapting the automobile type of equipment to them.

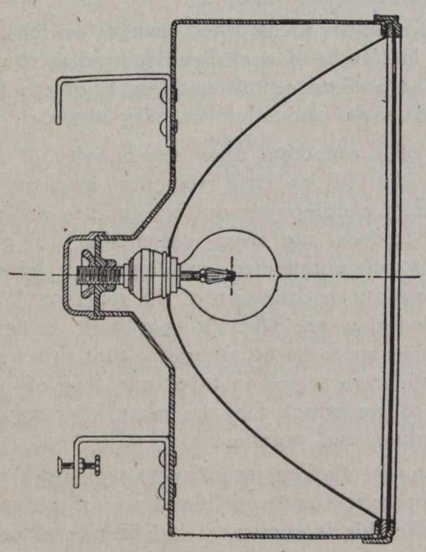


Fig. 2. Suggested Arrangement for Railway Headlight for Use With Mazda Lamp.

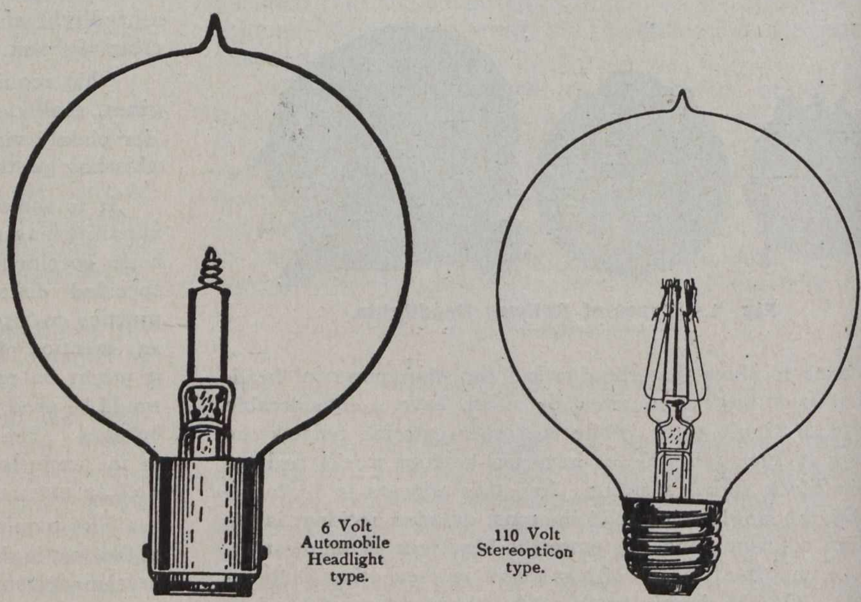


Fig. 3. Concentrated Tungsten Filament Lamps Suitable for Headlight.

Mr. F. H. Ward has resigned the position of vice-president of the Canadian Consolidated Rubber Company, but will remain a member of the executive committee and a director of the company. He will in future be associated with Mr. D. Lorne McGibbon

THE PIECEWORK OR UNIT SYSTEM OF HANDLING TIES AND TIMBERS.*

By W. W. Eldridge.†

The handling of ties and timbers on a "Piecework" or or "Unit" basis is, I believe, not universally practiced in the timber-treating industry. Some plants follow the practice to a greater or lesser extent under one system or another.

Our company has been using the piecework system of handling ties and timbers at both our plants for several years with what we consider the best of results, and my remarks will be confined to the efficient operation of a timber-preserving plant from a physical standpoint only.

A short time ago I asked my friend, Mr. Waterman, what he thought of the "piecework system," and he replied: "Piecework is the only thing for the timber-treating plant." This opinion is backed by thirty-odd years of practical experience in the handling of material, principally ties, piling and lumber, and men of all kinds, under both the "day work" and "piecework" system. I may be easier to satisfy or convince than some of you, but this recommendation is good enough for me. The proof of the pudding is in the eating, therefore, my only recommendation is that you taste it. If you like it you will eat more, if not you will leave it alone.

The question arises, "What is the object of piecework, and what are the advantages to be derived therefrom?"

The object of piecework is to get one dollar's worth of labor for one dollar, and to give one dollar for one dollar's worth of labor, or, in other words, to increase the efficiency in handling ties and timbers to the maximum so as to get the largest possible output at the least cost.

The advantages of the piecework system are numerous. In the first place, it reduces by approximately one-third the number of men required to do the work, and hence makes a corresponding decrease in the amount of supervision needed.

It enables you to get the "cream" of the laborers to do your work. There is no place for the "drone" in the piecework system, as he will be pushed aside and eventually crowded out.

It systematizes the work and assists materially in the accounting, figuring costs, etc.

It places each individual workman in business for himself, and enables him to secure pay for what he does. Being paid for what he does, it is natural for him to combine mental ability with physical strength in order to accomplish all possible.

Knowing that he is getting paid for what he does, and that in proportion as his efforts are increased his earnings are increased, he is able to make better wages than his fellow-workmen in other lines of business on a day rate system, hence he is satisfied and contented with his job at all times, and when the "shortage of labor" problem arises you will find your men still at the helm, while other industries on a day rate basis are suffering for lack of laborers, which means loss of business and decrease of efficiency and earning power. This condition brings out another important point, and that is, always treat your men in such a way and improve conditions to such an extent that the glitter of gold, so to speak, will not entice them to abandon the best of working conditions and a sure thing for an experiment. You will always find a few who are prone to become dissatisfied and wander away in search of something better, but my experience has been that within a short time they will drift back, sadder but wiser for their experience. Last, but not least, it promotes efficiency.

The installation of the "piecework system" is no small task. A great deal of tact and good judgment must be exercised, and unless it is established on good business principles it will be a failure rather than a success. There are a good many things to be taken into consideration along this line.

First, be open and above board with your men in everything you do in connection with their work, as it is of the utmost importance that the men fully understand what you expect of them, and what they can expect of you in return. You must have confidence in your men and they in you to obtain the best results to all concerned. Every detail should be fully explained to them. The existence of doubt would be disastrous, and might be likened unto the little Toredo, which enters the piling unseen and slowly but persistently destroys life and tissue until nothing but the shell is left and the piling fails. Metaphorically speaking, you should so thoroughly impregnate the minds of your men with the antiseptic "piecework" that there would be no chance for the little Toredo to gain entrance, to say nothing of existing, in your piling "the piecework system."

Second. Treat your laborers as men, and be fair and square with them at all times. Be ready and willing to counsel with them and explain any points that are not quite clear to them. My experience has been that there is a common feeling among men that in order to exist under the piecework system they must exert themselves unduly. This impression is erroneous, and you should disabuse their minds of the same. The man who starts out in the morning on a run to perform his work, regardless of method, does not accomplish the desired result, for the reason that he has set a pace that is not in keping with his physical ability, and before the day is half done he is exhausted and compelled to quit. What is the result? The man is dissatisfied because he is disappointed with the results of his efforts, and he immediately condemns the system when in fact he should condemn his own lack of good judgment. In no case should a man be permitted to set such a pace, but rather strike a good even gait that he can maintain throughout the day, and by combining method and system he will be more than satisfied with the result.

When you have done all this you have gained their confidence, and when you have won their confidence you have won a battle, gentlemen, that means much to you and to your men. The spirit of indifference vanishes, and the spirit of co-operation and mutual interest is enthroned in its stead. I doubt if any of us could place a monetary value on the loss incurred by the indifference, carelessness and wastefulness which is bound to occur when all men are classed as physically and mentally equal and all paid the same stipulated scale of wages for the same class of labor. If you are a careful observer and have ever taken the time to watch a gang of men working on a day-rate basis, they having no knowledge of your presence, what did you observe? This is what you saw. A gang of men organized to do a certain piece of work without regard to the number of men, their comparative size, strength or ambition. You saw one or two, or possibly three of the men performing, at least a part of the time, all of the work that was being done, while the rest of the gang was looking on. You also saw that their efforts were absolutely devoid of system. You will naturally ask, "where is the foreman?" in most cases he is everywhere but where he should be, but in either case you will invariably find that the foreman has imbibed the same spirit exhibited by the men under him, and the only purpose he serves is to point out to the men what he wants and leaves them to work out their own salvation in any way they see fit, regardless of time, ex-

* Abstract of paper delivered before the American Wood Preservers' Association.

† General Piecework Inspector (State Department), Chicago, Burlington & Quincy Railroad.

pense or efficiency. Only the other day I was going along the street when I saw a gang of twelve men handling some stone cornice work. For ten minutes eleven of these men did nothing, while the other one was trying to saw a one-inch board in two with a hammer. The board was finally cut, and then six of them picked up a piece of stone and loaded it on the wagon, and still there were six men looking on and drawing wages for expert advice or statuary effect, I presume. I could see no other reason for keeping them there.

What do we get out of this object lesson?

Woeful lack of efficiency and improper organization.

The foreman should have been released for permitting such a condition to exist under his supervision.

We find twelve men drawing wages for a six-man job. Undoubtedly the prevailing spirit was to let the fellow who was willing do the work.

With the piecework system it is different. Every man or gang of men secure a job on their merits, the goal is pointed out to them, and immediately they enter the race with a determination to reach that goal. Some few fall by the wayside, either for lack of strength, ambition or ability, but the majority of them win the race under proper supervision, and are giving you one dollar's worth of labor for your dollar. Under the day-rate system there is no incentive for the man to do other than plod along from morn till night, day in and day out, doing as little as he can and hold his job. You might drive him, but he is continually grouchy and dissatisfied and you do not get results. How much nicer it is to have a man jump into his work with a will of his own accord, and how much greater the results to all concerned. Under the day work system his highest ambition is to see that he does no more than his fellow-workman. The piecework system sets him to thinking, and figuring out ways and means of accomplishing all he can in the best way he can to promote his and his employer's interests. He knows that he is in a sense an essential part of your organization and that his services are appreciated.

For example: We have at one of our plants a gang of nine or ten men loading trams with ties for treatment. In this gang is one man who will average sixteen trams per day, another who will average fourteen, while the poorest man in the gang averages eight to nine trams. How long would the sixteen-tram man continue to load sixteen trams if his compensation for the day's work was no more than that of the eight-tram man? Why is this man able to load sixteen trams and his co-worker only eight or nine? In this case it is partly due to his superior strength, but in a great measure it is due to his superior ability in other ways to handle ties. He has studied out all the short cuts and knows just how to pick up a tie, how to shoulder it, and how to land it on the tram where it will require the least possible shifting to properly load the tram. To what degree do men become efficient? To illustrate this I will give you the benefit of one or two of my own personal experiences. On this occasion we received an extra heavy consignment of ties in cars that were badly needed for commercial loading. The regular force was not large enough to release these cars as quickly as desired by the management, consequently they diverted two or three extra gangs to help out. The regular men were working piecework at ⅝c. to ¾c. per tie, and averaged from 25c. to 30c. per hour. The extra gang were working for $2.00 per day, and unloaded their portion at a cost of .03½c. to .04½c. per tie. Why this cost? Because the men were working for a stipulated rate of wages, and because they had absolutely no knowledge of how to handle a tie, and furthermore were physically unable to cope with the regular men, due in a great measure to their habits of living. I will leave it to you, gentlemen, to figure out which was the best paying proposition to either the company or the men.

The installation of piecework would, of a necessity, need to be worked out to fit conditions peculiar to each individual plant, hence it would be useless for me to attempt to tell you what rates should be applied, but there are several important underlying principles that should apply to all.

First. The selection of competent supervision, or foremen. A man to be a good foreman must be wide awake and energetic at all times. He should be familiar with every detail of the work assigned to him, as also the most practical way to handle ties and timbers so that he can impart it to his men. He should have a knowledge of handling men and be on the ground all the time. He should not be a slave driver, but should be firm and diplomatic in all his relations with his men. These men should understand that his word is law, but if for any reason they deem his demands unreasonable they should be at liberty to put the case up to the general foreman or other higher authority for final decision. In my opinion the superintendent or manager personally should make the final decision, if necessary to carry it that far.

Second. Care should be exercised in perfecting your organization to place your men to the best advantage, and to see that there are no more men in the gang than needed, and yet enough to handle the work without delay to other parts of the organization. You would not hitch a draft horse and a donkey to the same wagon and expect to get efficiency. This is a feature that should be considered in the personnel of your organization.

Third. Schedules should be made to cover each and every operation. These schedules may be based on any of the following units, depending entirely upon your own views and the existing conditions.

Ties—Per tie, or per team loaded.

Lumber, switch ties and crossing plank—Per 1,000 feet boardmeasure.

Piling—Per pile, or per lineal foot.

We have found the following a very good plan:—

Unloading and storing ties on ground—Per tie.

Loading trams for treatment—Per tram.

Unloading treated from trams to cars—Per tram.

Unloading treated from trams to ground—Per tram.

Piling, when handled with derrick—Per pile.

Piling, when handled by hand—Per lineal foot.

Paving blocks—Per square yard.

Lumber—Per 1,000 feet boardmeasure in all cases.

Fourth. In wording your schedules particular attention should be given to the phraseology to see that it is clear, concise and easy to understand, so there will be no chance for any dispute to creep in under the guise of a technicality, and last, but not least, cover all the work which you expect the men to perform under any schedule.

In handling ties and lumber of all kinds a distinction should be made between hard and soft wood as follows:—

Oak or hardwood.

Pine or softwood.

This for the reason that pine or fir weighs approximately three pounds per foot, while oak weighs five pounds per foot. You would not expect any man to handle 5,000 pounds for the same price as 3,000 pounds.

A competent man should be selected to make the schedules and establish the rates of pay. In order to get the best results he should have a knowledge of handling men and material. He should be competent to recommend practical changes or improvement of conditions, tools or other devices that will facilitate the handling of the ties or timbers. Oft-times a dollar judiciously spent to improve conditions means many in return. In establishing prices it is important that all the facts and figures bearing on the operation be accumulated in order that prices may be established on an intelligent basis. To accomplish this the party getting the information should be on the ground personally, watch the operation from start to finish, and make notes as to number of men, kind of material handled, how handled, time consumed by each man, degree of efficiency, or anything else that would have an important bearing on the wording of the schedule or the base rate. Prices should be based on three things: the authorized hourly rate, degree of efficiency obtained under the day rate system, and the conditions and tools furnished.

All prices should be made on a basis that is fair to the employer and the employee. Once a price is established it should never be changed unless there is a change in conditions. Suitable blanks should be provided for keeping the time and checking material in and out. These will be turned in to the timekeeper daily to figure up and enter on the pay roll.

In establishing piecework a good plan is to start in with some one gang. Advise them daily of their earnings and arrange it so that the rest of the men working on a day rate will know what this gang is earning. They will immediately begin to get interested and ask for the piecework system, and in a short time your entire force is working on the piecework basis. There will perhaps be days when, due to some peculiar unforseen condition or nature of the material, the men will fall below their former day rate, while there will be other days when they will do exceptionally well, hence only the average for the month would be a fair comparison.

Foremen should be on a monthly basis, the rates to be fixed according to your own ideas. In no case should a foreman have supervision over more than twelve men, and eight or nine men is better, in my opinion, when handling ties or lumber by hand. The duties of the foreman are to instruct his men what to do, give them the benefit of his experience in handling material, keep them supplied with work at all times, see that it is properly done, and keep track of their time and material handled, checking same personally in all cases.

When unloading ties to season, also loading trams for treatment, each man works as an individual. When handling treated ties the men generally work in pairs or gangs of three, each man getting an equal proportion of the earnings of the gang. If a man is taken out of the gang during the day and another put in his place, the foreman should take proper record so that the earnings can be properly apportioned. With us when unloading ties to season no effort is made to sort them. The sorting as to kind of wood and grade is done when loading them to trams. When unloading switch ties by hand we find four men to the gang the best, and handling switch ties, piling and lumber with a locomotive crane three men in addition to the engineer. In all cases I would advocate the same rate from start to finish of an operation, unless some unusual condition arises. The man gets the same for the last tie as for the first.

There is a maximum to all things when efficiency is considered. In storing ties to season, piling them eight to one, the maximum height of the pile should be sixteen to eighteen feet. Treated ties when piled on the ground should be in solid square piles eight to ten feet high.

It has been said that ties and timbers cannot be properly piled under the piecework system. In this connection I would invite your attention to some photo views which I have taken at our Galesburg plant showing what we accomplish under this system. These photos are representative views of our entire yard, not a pile here and there. I would call your particular attention to the symmetrical piles, both from a side and end view, as also the alignment of the piles. Look them over and decide for yourself whether or not ties and timbers can be properly piled under this system.

Someone has said that the efficiency of a timber-treating plant should be based on the number of retort hours worked out of the total possible retort hours. In obtaining efficiency in plant operation the fact must not be lost sight of that good and effective treatment is the first or primary object, and at the same time your supervision, your organization, and your system of physical handling must be the best possible. This is what we claim to have under the "piecework system." During the year 1912 at our Galesburg plant we obtained on the above basis 98¾ per cent. efficiency, or, in other words, each of the three retorts were in actual operation 98¾ per cent. of the time. This means that out of a total of 7,488 possible retort hours for each retort they were operated 7,394.4 hours, holidays excluded.

Efficiency is a watchword, and the day is now at hand when the railroads, the corporations and the business man in all lines expects and demands efficiency. This demand is growing every day, each year we are expected to do better than we did the previous year until we have reached the limit, and unless you and I, or whoever is held responsible, get in "the efficiency band wagon," we are going to wake up some day and find someone else occupying our seat.

PRESERVATION OF LUMBER FOR CAR CONSTRUCTION.*

By J. H. Waterman.†

I have been requested by your committee on programme to write a paper on the above subject. I have compiled a few facts for you, but before I give you the facts I want to say that my observation leads me to make the statement that treating lumber with creosote for car construction will be necessarily limited, on account of the fact that it is impossible to paint timber, or rather impractical, after it has been creosoted. Most roads in this country have a standard color for their cars, and they would not want to change that color to black in order to please the wood preservers of this country. If any road should desire to change their stock cars to a standard black, then the creosoted timber would be the ideal, for they would be permanently painted, providing the timber was framed before it was treated, and as they are used for taking stock to the market, which means the grave for the stock, why not advocate painting all the stock cars in this country black. It would be a good color, if it did remind you of a funeral train as it went by.

So far we have treated only car sills and car decking.

Fir Car Sills.—To date we have treated a total of twenty-three runs.

We succeeded in getting an average absorption of 11.41 lbs. per cubic foot.

Board feet treated, 326,204.
Average steam pressure, 15 pounds.
Average time steam, 2 hours 23 minutes.
Average initial vacuum, 23 inches.
Average initial vacuum held, 1 hour 37 minutes.
Average solution pressure, 175 pounds.
Average solution pressure held, 17 hours 26 minutes.
Average final vacuum, 20 inches.
Average time final vacuum, 1 hour.

Fir Car Decking.—To date we have treated a total of thirty-nine runs.

* Abstract of paper delivered before the American Wood Preservers' Association.

† Supt. Timber Preservation, C., B. & Q. R.R. Co.

We succeeded in getting an average absorption of 14.33 lbs. per cubic foot.

Board feet treated, 1,013,472.
Average steam, 15 pounds.
Average time steam, 57 minutes.
Average initial vacuum, 24 inches.
Average initial vacuum held, 1 hour 6 minutes.
Average solution pressure, 175 pounds.
Average solution pressure held, 13 hours 10 minutes.
Average final vacuum, 21 inches.
Average time final vacuum, 1 hour.

The Fir Car Sills.—In the sap wood we got a thorough penetration; in the hardwood not to exceed one inch all around.

In the car decking, when it was dry, it was thoroughly penetrated with creosote. I presume you all understand that car decking is 1¾ inches thick.

Our people feel that it is not only practical, but that it pays, to treat the car sills and car decking for stock cars. You all realize that it would be impractical to treat car decking for box cars on account of the odor. They could not be used for flour and many other lines of merchandise, which would absorb at least the odor from the wood if treated with creosote. We never can look for a very broad field to operate in so far as treating car lumber goes. However, I believe it is practical to treat car decking for stock cars and flat cars. For stock cars it also acts as a disinfectant, and from that point it would be not only practical but, I believe, effective, and the roads that are using lumber for car sills, there is no question but what it would lengthen the life very materially. How much I am not able to say, for we have only practiced treating car sills and car decking for about one year.

All of our new stock cars now that we build with wooden sills we treat the sills and all of them we treat the decking.

I would recommend that the president appoint a standing committee to go into carefully, not only the treating of car sills, but the treating of any and all timber which would be practical, and by that means the field for treating timber will be broadened and strengthened, and the committee should have power to make recommendations, and we, as the American Wood Preservers' Association, should stamp our approval or disapproval on what they recommend. And, gentlemen, I believe it would have weight in the commercial world, and what are we here for if we do not further our own interests and conserve the forests of our country by getting the longest possible life out of all wood that is used.

THE REQUIREMENTS FOR SUCCESSFUL TIMBER TREATMENT.*

By Hermann von Schrenk.

Treated timber has been used in the United States for a sufficient number of years so that we are beginning to obtain some results. As is the case in every other industry, some failures are becoming evident in various parts of the country. During the last year I have spent a good deal of time investigating the reasons for failures of pieces of so-called treated timber. I say so-called treated timber advisedly. In discussing the causes for failure of the cases referred to with a number of persons interested in wood preserving, it was suggested that I say a few words about the general subject of successful timber treatment to the members of this association. I do this with the feeling that there is probably no subject in which we are more vitally interested than to see to it that the results of our labors give satisfactory returns to everybody concerned.

Timber treatment has grown so rapidly in the United States that the amount of material actually treated every year is ten times what it was seven or eight years ago, and the number of men engaged in the industry has correspondingly increased. As the use of treated wood has increased, inevitably some conditions have arisen which I believe it is well for us to consider. In the early days of timber treatment there was a good deal of experimenting as to methods, and, for that matter, there is still some experimenting, but, as the result of some twenty years' experience, some facts are sufficiently well known at the present time to all of us, and these facts have become more or less axiomatic. Briefly stated, in order to get good results from treated timber the following points must be observed:

1. Only perfectly sound timber should be treated.
2. In order to obtain the best results, properly seasoned material should be used.
3. A good preservative is essential to long life.
4. Proper injection as to quantity and penetration is essential.
5. Proper subsequent handling of the timber is essential.

In my investigations I have found that the premature failures of so-called treated timber were almost without exception due to the non-observance of one or more of the above principles. I am perfectly sure that in the early days a good deal of timber was treated which was sap rotten. It was not realized ten years ago, as it is to-day, that timber may be very badly decayed in the interior and yet show absolutely no evidence on the outside. With the best intentions, therefore, many sticks of wood were doubtless treated which we would unhesitatingly throw out to-day. Many of the failures were, however, due to the fact that timber was treated because of certain contract requirements and in spite of a better knowledge of the person responsible for the actual treatment. The lessons to be drawn from failures are very obvious, and I believe we should take cognizance of them, particularly in view of more thorough knowledge of all the factors surrounding the operations which make for successful treatment.

While there is no doubt very general agreement among the men engaged in the timber-preserving industry as to the fundamental conditions enumerated above, we all know that frequently, under stress of business circumstances, they are not always adhered to. The consumer frequently makes demands which cannot be fulfilled, and if they are they are bound to result in speedy and ultimate failure.

The inspection of material before treatment should be made with greater care. I believe that every treating company should be empowered to refuse to treat material which they know to be defective. In other words, I do not think that anyone is warranted, under any circumstances, to treat material which he knows to be unfit because of various defects. A defective stick was never improved by any kind of treatment.

The same holds true for improperly seasoned material. The excuse is frequently given, in demanding treatment of absolutely green material, that emergencies have arisen which necessitate such treatment, or some similar explanation is given. Unfortunately, with the increased use of timber in its various forms, the tendency to require and do such rush work seems to me to be increasing. It is frequently inconvenient to wait six or eight months, or more, to properly season material; besides, it costs considerable for interest charges.

That which has been said for the inspection of the material before treatment holds equally for the preservative used and the manner of treatment. How much service do you suppose will be obtained by treating green red oak ties with two gallons of creosote oil by the full-cell process? We all

* Abstract of paper delivered before the American Wood Preservers' Association.

know that the penetration of timber so treated is insignificant and that internal sap rot is bound to occur in comparatively short periods of time.

I may be treading on delicate ground when I refer to the relation which should exist between a treating company and its customer. I have no hesitation, however, in saying that I believe it to be the duty of the man who knows how timber should be treated (because that is his business) to protest vigorously against any requirements which necessitate his treating a customer's material in a manner which he knows to be wrong. I wish to protest against the tendency which requires the actual treating operation to be conducted in accordance with any demands which may be made by the customer, because not only does this give disappointing results so far as any particular piece of work is concerned, but also because it reacts on the company doing the work and on the industry as a whole. The people as a whole are apt to forget that when the piece of so-called treated material fails, that that particular piece of material was treated under unusual conditions, no matter how much these conditions may have been justified at the time. I wish to protest against the "necessity" tendency to do rush work. We might as well face the problem now and say that successful treatment of timber can only be accomplished by observing certain laws, and that when one or more of these laws are broken, the consequences will be swift and certain. If I had the opportunity I could demonstrate the truth of this statement to anyone interested, and all I would have to do would be to show him some choice samples of so-called treated timber, which I have in my possession, which failed after three or four years' service, and explain why it failed, and then point to work well done, with twenty to thirty years' service behind it.

I have referred in this brief manner to what appears to me a very important situation affecting the timber-preserving industry at this time, and as one interested in the timber-preserving industry, and anxious to see timber last, I speak also as one anxious to see those engaged in this industry put into a position to carry out its basic principles. I know that there are difficulties which both the consumer and the timber-preserving company have to meet, and, as in all other affairs, that there are emergencies which will warrant doing exceptional things. I know also, however, that frequently requirements are made in the best of faith which it is hard to object to. I believe it would be perfectly proper for this association, standing as it does, for all that is best in the wood-preserving industry, to give expression to some of the sentiments herein expressed. I would favor the passage of some resolution emphasizing the necessity for a careful observance of the principles referred to. I am sure that a strong statement coming from this representative organization would be of the greatest service in giving a proper appreciation of what the wood-preserving industry as a whole stands for.

NEW STEAMER ORDERED.

The Collingwood Shipbuilding Company has been awarded a contract for a combined passenger and freight steamer by the Pelee and Lake Erie Navigation Company, which operates between Pelee Island and the mainland ports including Rondeau. The new steamer will be constructed of steel and will be 145 feet long with 24 feet beam and a depth of 18 feet 3 inches. It will be a day boat and will be fitted up specially for the route on which she will ply. The motive power will consist of triple expansion engines, 12½, 21, 34 inches with a stroke of 21 inches. This will be supplied with steam by one Scotch boiler 12 feet 6 inches in diameter and 10 feet 6 inches in length. The steamer will develop a speed of thirteen miles per hour. The contract calls for delivery in July next.

TORONTO RAILWAY COMPANY.

The gratification of a shareholder who was present at the annual meeting of the Toronto Railway Company this week, at the excellent financial statement presented by the directorate, was apparently disturbed by prospects of civic competition. Mr. Fleming, the general manager, however, quieted those fears, merely pointing out the heavy loss at which the short existing civic lines were being run. Every street railway is trailed by an army of critics. Mr. Fleming told his shareholders, and incidentally the army, that the Toronto system is one of the best on the continent, and we think that fair-minded critics will agree with the statement.

The gross earnings last year amounted to $5,448,050. Deducting therefrom charges of $2,866,550 for operating, maintenance, etc., the net earnings were $2,581,500. Several substantial payments were made from that sum, the heaviest being to the city and amounting to $942,048, while $879,595 represented dividends to the shareholders. Bond interest, etc., absorbed $190,992. The payments to the city were greater by $119,815 or 14.6 per cent. than in the previous year.

The progress of the company in recent years is shown in the following table:—

	1902.	1908.	1912.
Gross income	$1,834,908	$3,610,272	$5,448,050
Operating, maintenance.	1,015,361	1,889,046	2,866,550
Net earnings	819,547	1,721,226	2,581,500
Passengers carried	44,437,678	89,139,571	135,786,573
Per cent. of charges to passenger earnings .	55.3%	52.9%	58.4%

The Toronto and York Radial Railway Company report that their earnings continue to show satisfactory increases, the gross earnings amounting to $492,922, compared with $449,059 for the previous year—an increase of 9.76 per cent.

OTTAWA ELECTRIC RAILWAY.

The shareholders of the Ottawa Electric Railway Company have every reason to be pleased with results of operations for the year ended December 31st, 1912. The gross earnings were $934,397, an increase of $93,717 over the previous year. The net earnings were $400,059. Out of that sum, four quarterly dividends of 3 per cent. and a bonus of 3 per cent. were paid, being a distribution to shareholders of $255,947. The gratification of the shareholders was further strengthened by the prediction of Mr. T. Ahearn, the president, that the prospects for the coming year are of the brightest character.

The growth of the company in the past few years is clearly shown in the following table:—

	1893.	1903.	1912.
Gross receipts	$110,071	$348,888	$934,397
Total expenses	70,221	254,346	578,540
Net income	39,850	94,541	355,856
Passengers carried	2,394,504	7,911,718	21,815,798
Per cent. of operating expenses to receipts		61 4-5%	57 1-5%

After the payment of dividends and bonus last year, the substantial sum of $69,000 was placed at the credit of contingent account to be applied to the reduction of track renewal, car equipment and other accounts. Interest on bonds and loans absorbed $21,303; mileage payments, $13,435, and taxes, $9,463. There remained a sum of $30,908 for transference to credit of profit and loss account. The balance at credit of that account is now $138,264 and at the credit of rest account $200,000. Several important improvements were made to the company's system last year, by which the earning capacity and facilities for handling the increasing traffic will be greatly augmented.

NOTES ON STAKING OUT TRACK CONNECTIONS.

The solution of maintenance engineering problems in railway work is well treated in an article published in the January 24, 1913, issue of the Railway Age Gazette. This article is written by W. H. Wilms, and is here given in full.

The ordinary field book is of slight value to the engineer engaged in maintenance work in the solution of track problems. None of the problems presented in such books have been solved with a view to practical application. Following the methods outlined in these books, it is not uncommon, for instance, to see new sidings staked with the initial curve tangent to the centre of the track from which the turnout leads, although a little study will show that the curve is not necessarily tangent to the frog, and unless it is tangent, an elbow must be thrown in the curve, or a piece of tangent introduced, depending on whether the curve beyond the frog is of less or greater degree than the curve back of the frog. In either case, the siding presents a bad appearance and in case of an extremely sharp curve and close quarters, the engineer would probably find the siding could not be operated until relocated. The only field book that has attempted to treat track problems with a view to practical application by means of a so-called "reference curve" makes such problems really more complicated than they are. In the following notes only such problems as commonly occur in practice are given, leaving it to the ingenuity of the engineer to modify these methods to meet his particular requirements in more complicated cases. While no claim to originality is made in the solution of these problems, it is believed a number of them will be new to not a few engineers.

Switch Leads.—From both the operating and maintenance standpoints the installation of turnouts leading from curves is to be avoided whenever practicable. When the installation of a turnout on the outside of a curve is unavoidable, the switch leads should be made straight wherever it is possible

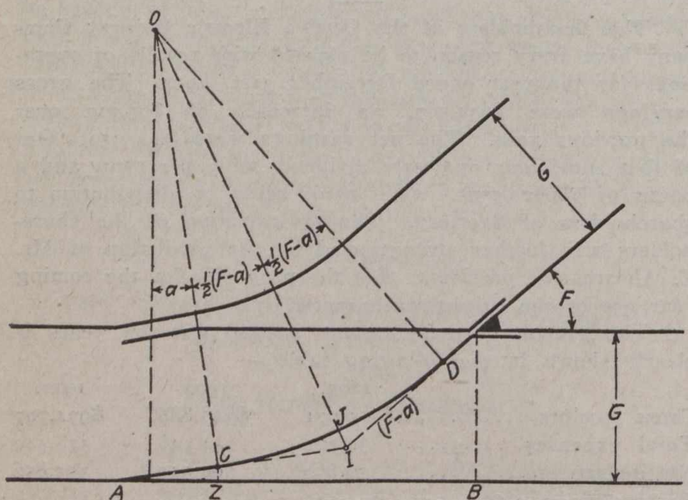


Fig. 1.

to do so, as the benefits in safer operation and decreased maintenance of the switch by using straight leads are very pronounced. Often a slight change of alinement or the substitution of a different size frog will readily effect this.

Of equal importance is the reduction to a minimum of the curvature in the leads of a turnout on the inside of a curve. This also can often be effected by slight changes in alinement and the substitution of a higher frog number.

Also, for similar reasons, the alinement of the turnout track immediately beyond the frog is of importance. Where a curve is necessary it should, if possible, be of the same degree as the curvature in the lead; otherwise there results the objectionable feature of a change in curvature in a very bad place, which not only looks bad but is apt to be a constant source of trouble in operation and maintenance. This is especially true where the curvature is sharp and connections close.

In order to obtain a solution to such problems as the above where the alinement of the switch lead is taken into consideration, it is quite necessary to know the actual length and degree of curve of the leads of the road's standard turnouts from straight track. Knowing the length of switch rail,

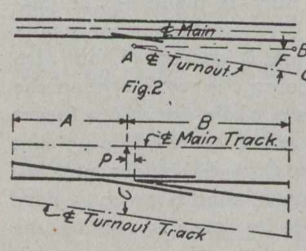


Fig.2

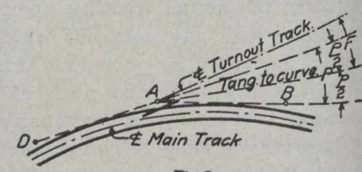


Fig.3.

No.	Angle	A	B	C	D	p	Lead

Fig. 4.

spread at heel of switch and length of frog from theoretical point to toe, the length and curvature of the lead are readily obtained from the following formulas:

(From Manual of Am. Ry. Eng. Assoc.).

F = Frog angle
W = Length of wing rail of frog
S = Length of switch rail
H = Heel distance of frog
G = Gauge of track
R = Radius of centre line of lead curve
a = Switch angle

$$\text{Lead dis. AB (Fig. 1)} = (S - W)\frac{\sin \frac{1}{2}(F - a)}{\sin \frac{1}{2}(F + a)} + G \times \cot \tfrac{1}{2}(F + a)$$

$$\text{Radius of lead curve} = \frac{G - H - W \times \sin F}{\cos a - \cos F} - \frac{G}{2}$$

Having once computed this data from the road's standard frog numbers, the engineer should place it in his field book for future reference.

Significance of Stakes.—Due to the fact that many track foremen and supervisors have to work to stakes set by many different engineers, some of whom make it a practice to set stakes indicating the location of a frog on the rail line at the theoretical point and others who set such stakes on the centre line of track opposite the actual point, costly mistakes sometimes result. To avoid such trouble, it is a good plan to have some definite system of marking and setting stakes, and after the tracks have been staked out to go over the layout with the track foreman and explain to him the significance of the stakes, so that when track laying begins there will be no chance for mistake or confusion. In most cases it is unnecessary to take into consideration the difference between the theoretical and actual points in the location of a frog. There are a few cases, however, where a failure to observe this difference would result seriously. For example, in the location of the frogs of a No. 10 crossover between parallel straight tracks, 13 ft. centre to centre, where the track is straight between frogs, the distance from theoretical to actual point of a No. 10 frog with a ½-in. point is 5 in. Now, if stakes are set for theoretical points and the foreman sets the actual point of frogs to these stakes—a thing he is very likely to do unless the significance of the stakes has been explained to him—there will result a total error in the position of the two frogs of 10 in., resulting in a gauge of only 4 ft. 7½ in. in the straight track between the frogs. This is no hypothetical case, but along with other mistakes of its kind is almost of constant occurrence with young and inexperienced engineers. To avoid such trouble, stakes marking position of frog should be set for actual point and plainly marked to that effect. When the location of a frog in the existing track

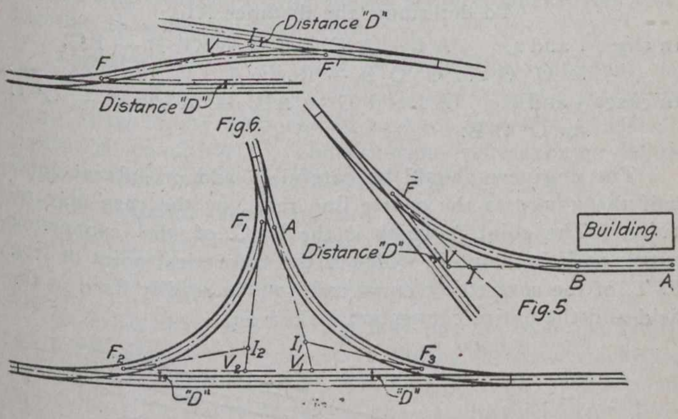


Fig. 7.

is not definitely fixed by conditions, the point of the frog should be so located as to bring the heel or the toe at a rail joint. If this is done, only one rail cutting is necessary and no short rails are required.

Graphical Solution of Track Problems.—A great many track problems can be readily solved by graphical methods. With careful and accurate drafting on a large scale—say 10 or 20 ft. to the inch—many complicated problems are readily solved with all the accuracy usually required in track work. In a great many problems a solution can be easily and quickly effected by making a few trials in the field. In such cases it has been the writer's practice to carry with him in the field a few curve templets, scale, triangle and drawing paper, and by locating the critical or determining points and plotting them to scale, he has generally been able to decrease the number of trials necessary for a solution to one or two.

In staking out tracks to and around existing structures the young and inexperienced engineer may not appreciate the importance of proper clearance and many a track has been staked and afterwards built 6 in. to a foot or more too close to an existing structure.

General Methods.—The ordinary method of locating turnouts where the position of the frog in the main or body track is not a critical feature is as follows: Set up the instrument at A (Fig. 2), this point being in the centre line of the turnout track opposite the point of the frog. Foresight is taken on point B gauge distance from the centre line of main or body track, with the vernier set at minus the frog angle so that when the reading is turned to zero the line of sight is in the centre line A-C of the turnout track. If, now, the turnout track is to proceed on a curved alinement, deflections may be turned either right or left and the curve located. A stake set back a distance from A equal to the length of the lead locates the switch point and the track foreman lines the curve between the heel of the switch and the toe of the frog, either by eye or by using a series of ordinates from the main track rail. If the main or body track is curved (Fig. 3), a backsight D and a foresight B are set, making the distance A-D equal the distance A-B. The angle between the line A-B and the line D-A extended is bisected to obtain a line parallel to the tangent to the main track rail at the point of frog and the frog angle F is then turned off from this tangent line. The work of locating the turnout track is thus done with one set up of the instrument, entirely independent of any theoretical assumption regarding the curve in the lead.

To make the curve (if any) in the turnout track tangent at the heel of the frog instead of at the point, which many would consider better practice, it is only necessary to have a table as in Fig. 4, and using the offset D, proceed as before.

In locating close connections between tracks and sharply curved branch tracks running into or along buildings where the exact position of the frog is a critical feature of the work, this position may usually be obtained as follows: Let A-B (Fig. 5) be the centre line of a branch track whose position for the distance A-B is determined by the building. Extend line A-B towards the main track to point V at distance D from the centre line of the main track. Measure the angle V and the distance VB. Let I be the point of intersection of the line AV with the line FI, angle IFV being the frog angle. Now the criterion for the minimum degree of curvature in the curve FB is that the point of intersection I shall be equally distant from the points F and B. This makes the curve FB a simple circular curve. To solve the problem, let FI = IB = T and let measured distance BV = M.

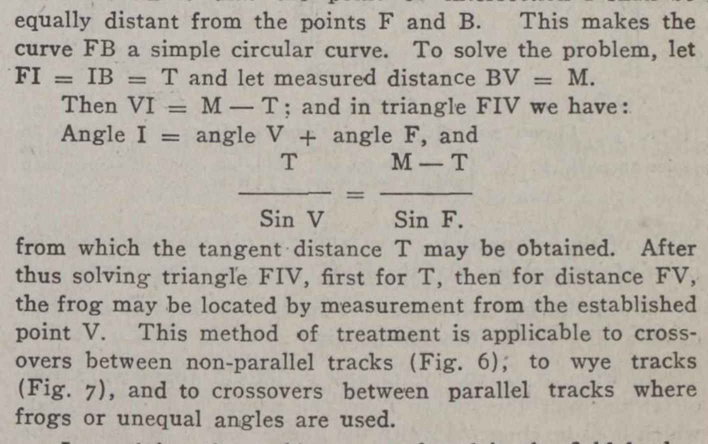
Then VI = M — T; and in triangle FIV we have:

Angle I = angle V + angle F, and

$$\frac{T}{\text{Sin V}} = \frac{M - T}{\text{Sin F.}}$$

from which the tangent distance T may be obtained. After thus solving triangle FIV, first for T, then for distance FV, the frog may be located by measurement from the established point V. This method of treatment is applicable to crossovers between non-parallel tracks (Fig. 6), to wye tracks (Fig. 7), and to crossovers between parallel tracks where frogs or unequal angles are used.

In applying the problems, as found in the field books, where a turnout from a curved track is to form a connection with an established tangent, the engineer is restricted to the use of but one curve, the degree of which is that of the theoretical curve of the turnout, which equals the degree of curve of turnout from a straight track, plus or minus the degree of the curve of the track from which the turnout springs. The use of this one curve will rarely prove desirable on account of its being either too sharp or too flat.



[Case 1. Curves in Opposite Directions. Δ less than 90°.]

[Case 2a. Curves in Opposite Directions. Δ greater than 90°, R¹ greater than R cos Δ.]

[Case 2b. Curves in Opposite Directions. Δ greater than 90°, R¹ less than R cos Δ.]

Four general cases of the problem present themselves, as shown in the illustrations, Figs. 8, 9, 10, 11, 12, 13. The necessary field work in each case consists in measuring the angle between the centre line of tangent and the tangent to the centre line of the curve at the point of intersection; or better yet, the angle between a line offset one-half the gauge from the centre line of the tangent and the rail which will pass through the frog, as the latter will simplify the problem, and the radius of the rail is determined simultaneously by measuring the middle ordinates for one or more chords.

Having the angle of intersection, as described above, the radius of the curved track, and the angle of the frog to be used, and having selected a radius for the connecting curve, the essentials of the location are the distance between the point of intersection and the point of the frog, the central

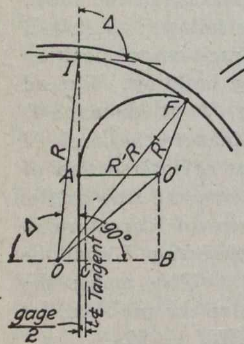


Fig.11.

[Case 3. Curves in Same Direction. Δ greater than 90°.]

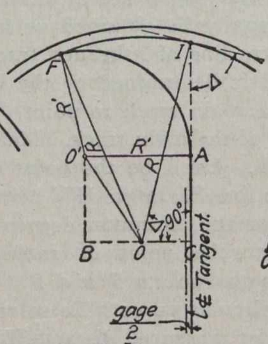


Fig.12.

[Case 4a. Curves in Same Direction. Δ less than 90°. R^1 greater than R cos Δ.]

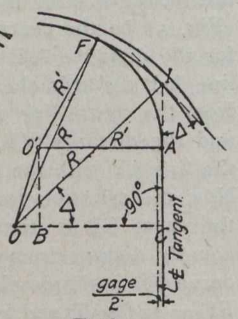


Fig.13.

[Case 4b. Curves in Same Direction. Δ less than 90°. R^1 less than R cos Δ.]

angle of the connecting curve and the distance between the point of intersection and the B. C. of connecting curve.

The following solutions offer ready and accurate methods of obtaining the above-named points:

In Figs. 8, 9, 10, 11, 12 and 13 let CA represent a line offset one-half the gauge from the centre line of tangent, which is to be connected with the gauge line of the rail of the curved track by means of a frog having an angle of F and a curve whose radius is R. O and O^1 are the centres, I the point of intersection where the angle Δ has been measured, and the other notations are as shown in the diagrams. The rail opposite the frog and the switch rails are not shown as they have no bearing on the problem. Required to determine the angle I O F. Then measure on the curve:

Arc F I = R $\times$ angle I O F in minutes $\times$ a constant (= 0.00029089).

Or chord F I = 2R $\times$ sin ½ I O F.

Fig.15.

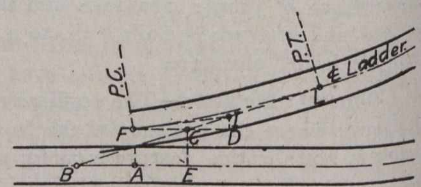


Fig.16

The distance OO^1 is determined by solving the triangle OFO^1 of which the angle F and its including sides R and R^1 are known. This also determines the angles FO^1O and FOO^1.

In cases 1 and 3, Figs. 8 and 11, O B = B C + O C = R^1 + R cos Δ

In cases 2a and 4a, Figs. 9 and 12, O B = B C — O C = R^1 — R cos Δ

In cases 2b and 4b, Figs. 10 and 13, O B = O C — B C = R cos Δ — R^1.

It should then be noted that when O B is computed to be greater than O O^1, impossible conditions have been imposed; the radius of the connecting curve has been taken too large.

Having determined the angle O^1 O B from the right triangle O B O^1, in which O B and O O^1 are known, the angle I O F is found as follows:

In cases 1 and 2a, I O F = Δ — (F O O^1 + O^1 O B).
In cases 3 and 4a, I O F = 180° — (Δ + F O O^1 + O^1 O B).
In case 4b, I O F = O^1 O B — (F O O^1 + Δ).
In case 2b, I O F = Δ — (180° — O^1 O B + F O O^1).
In cases 1 and 2a, A O^1 F = O^1 O B — F O^1 O.
In cases 3 and 4a A O^1 F = F O^1 O — O^1 O B.
In case 4b, A O^1 F = F O^1 O — (180° — O^1 O B).
In case 2b, A O^1 F = 180° — (O^1 O B + F O^1 O).

To determine the distance AI:

In cases 1 and 2, A I = A C — I C = O^1 B — I C, = O^1 O sin O^1 O B — R sin Δ.

In cases 3 and 4 A I = I C — A C = R sin Δ — O^1 O sin O^1 O B.

The engineer should be careful to add or subtract one-half the gauge to the centre line radii, as the case may require. The point A which is the B. C. of the connecting curve, and the point F, which is the theoretical point of frog P. T. of the connecting curve can now be readily fixed in the field and the entire connection staked out.

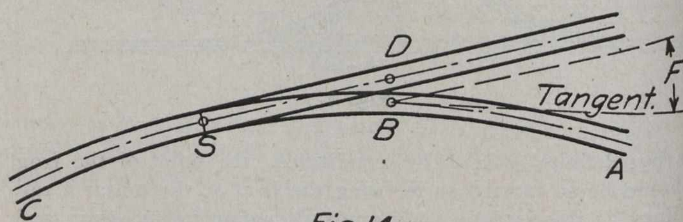


Fig.14.

While the writer realizes that it is better practice to place the frog end of the connecting curve at the heel of the frog, to impose that condition in the above problem would complicate it beyond measure. In inserting 10 or 15-ft. frogs in a curved track, the trackmen cannot help slightly changing the original alinement of the track at that point, and energy spent in making a closer solution than that outlined above will surely be wasted.

Method of Obtaining Straight Leads.—Theoretically, a turnout leading off the outside of a curve, the degree of which is equal to that for the turnout from straight track will have a straight lead. Practically, however, the lead will not be straight, but curved to a greater or less extent. This is due to the fact that switch rails and frogs are straight and not curved as is generally assumed. When it is possible to do so, it is desirable from both the operating and maintenance standpoints to obtain absolutely straight leads. To obtain straight leads in turnouts leading off the outside of a curve where the main curve is also being staked at the same time, the following method will prove effective. (See Fig. 14).

After staking out the main curve ABC to B, the point decided upon for the location of the frog, set up the instrument at D, this point being in the centre of the turnout track opposite the point of frog. The frog angle is now turned off from a line through D parallel to the tangent to the curve at B, and the point S is located a distance equal to the length of the switch lead from point D. The instrument is now set up at S, and the main curve is continued from the line DS, or switch lead, after which the alinement of the turnout beyond the frog can be proceeded with.

Where conditions permit, it is desirable to have the alinement of crossovers between frog points straight. In the case of crossovers between parallel curved tracks, it is not generally possible to meet this requirement using standard frog numbers, a special frog being necessary in such cases. The writer has known of a number of instances where this requirement of straight track between the frogs of a crossover was of sufficient importance to justify the ordering of the special frog necessary, frog points being comparatively close together in most crossover work.

Ladder Tracks.—In order to obtain the maximum car capacity of the body tracks connected to a ladder track, the angle of the ladder track should be made the greatest possible under the conditions. The criterion for maximum ladder angle is given by the formula (see Fig. 15):

$$\text{Sine of maximum ladder angle} = \frac{\text{Distance between switch points K}}{\text{Distance centre to centre of body tracks.}}$$

In order that road engines may operate over the ladder track it is desirable that the curve beyond the main track frog be made as light as possible. In a number of extensive ladder layouts the writer has used two and three degree curves in such places with very good effect. The method of staking out such ladder tracks is as follows:

After locating the position of the main track frog the point of intersection of the centre line of the ladder track with the centre line of the main track, B, is found by measuring off the distance AB. The instrument is set up at B, the ladder angle turned off and the frog points along the ladder located by measuring the computed distances from B. At the same time the points of intersection of the centre line of various body tracks with the centre line of the ladder track are located by measuring the distance DC, FE, etc., from the frog points. The curve beyond the main track frog is now located. The instrument is then set up at the points C, E, etc., and the body tracks staked out by foresight established at the opposite ends of these tracks by measuring over the respective track centres of each track from the main track. The curves connecting the various body tracks to the ladder track being very short, it is sufficient to locate only their middle and end points.

To compute the distance AB (Fig. 16), let

T = Tangent distance of curve FL
ICD = Ladder track angle

Then

$$\begin{aligned} DI &= T \sin F \\ FD &= T \cos F \\ CD &= DI \cot ICD \\ FC &= FD - CD \\ AB &= BE - AE \\ &= \text{gauge} \times \cot ICD - FC. \end{aligned}$$

While the writer believes that the above method of laying out ladder tracks represents the best practice, there are a number of engineers who prefer to make the ladder angle equal to the angle of the frog to be used in the ladder track, thus making the ladder track frogs line up straight with the body tracks. The central angle of the curve beyond the main track frog is then simply the difference between the angles of the main and ladder track frogs. However, the writer sees no justification in sacrificing valuable ground space and consequent car capacity for the little, if any, advantage that is gained by eliminating the slight curve beyond the ladder track frogs. Those who favor this method claim that by the elimination of this curve in the body tracks, switching operations are rendered more safe by reason of the better views afforded trainmen. However, the writer believes this apparent advantage is more imaginary than real.

CONTROL AND REGULATION OF NIAGARA RIVER.

Hearings were held on January 22 and 23 before the United States House Committee on Foreign Affairs on the new bill controlling the diversion of water on the American side of the Niagara River and the importation of electricity from Canada. The Burton Act expires by limitation on March 4, and a fight is in progress to take from the federal government the control of the diversion of water in navigable rivers and, in the Niagara Falls case, vesting it in the State of New York. The Secretary of War has appointed a board to report upon the problem of diversion of water from Niagara Falls, consisting of Lieutenant-Colonel Mason M. Patrick, Colonel Francis J. Kernan and Major Charles Keller, all of the Corps of Engineers, U.S.A.

The treaty between Great Britain and the United States authorizes the United States to permit the diversion of not more than 20,000 cubic feet of water per second, while the Canadian government is empowered to authorize the diversion of not more than 36,000 cubic feet per second. At present the diversion on the American side of the Niagara River aggregates 15,600 cubic feet per second. The bill now before Congress does not permit the diversion of any more than that amount, and whereas the Burton Act permitted the importation of a maximum of 35,000 h.p. from Canada, the present bill limits the amount to 200,000 h.p. It also makes it obligatory for the generating companies to utilize the water at its maximum efficiency and stipulates that the companies receiving permits for the transmission or delivery of electrical energy shall be regulated to rates, etc., by the Public Service Commission of the State, or where such a commission is lacking by the governor of the State.

At the hearing on January 22 the State of New York through its attorney-general claimed, after the government has decided how much water may be diverted from the Niagara River, that it is entitled to control the diversion of the water and to decide the parties to whom it shall go. It was contended that while the federal government has a right to determine the quantity of water that may be diverted from a boundary stream in the exercise of its constitutional rights to control navigation, that power is exercised pursuant to that constitutional right only for the purpose of regulating and controlling navigation and for no other.

The president of the New York State Conservation Commission expressed opposition to any legislation which will permit the existing generating companies to get any additional water from Niagara Falls. He said that the present policy of the State is to utilize all the undeveloped water-powers for the benefit of the people generally. The generation of electricity which is to be transmitted to the various municipalities and through them to the ultimate consumer at practically the cost of its development. He also maintained that true conservation presupposes the utilization of all the water permitted by the treaty at its maximum efficiency.

It was brought out at the hearing that the taxes of the Niagara Falls Power Company to the State and municipalities aggregate \$3 per horse-power, while the Canadian government charges practically \$1 per horse-power. The Cataract Power and Conduit Company, which distributes Niagara energy in Buffalo, pays the Niagara Falls Power Company \$16 per horse-power-year and sells it at practically \$25 per horse-power-year; the difference being used to pay all the charges of transformation and transmission to Buffalo and its distribution in that city. The Hydro-Electric Power Commission of Ontario pays \$9.40 per horse-power-year for energy to the Ontario Power Company delivered at the terminals of the transforming apparatus, or practically at the power house.

It was also pointed out that the Ontario Power Company generates 17 h.p. for every cubic foot of water per second that is used, whereas the Niagara Falls Power Company is able to generate only about 11⅓ h.p. for every second-foot of water used.

NEW BUILDINGS OF THE CANADA FORGE COMPANY.

The Canada Forge Company, Limited, Welland, Ont., are rushing to completion a temporary building to replace the one recently burned, and will positively have a part of their forge department in operation within a week, which is record time. This quick work will enable them to satisfactorily care for the delivery requirements of their many customers.

This building will be covered within ninety days by a modern fireproof steel construction forge shop of the most advanced type, contract for which has been placed with the Standard Steel Construction Company, and especially designed for the manufacture of forgings up to 40,000 pounds in weight each.

The general dimensions of this building will be 100 feet by 200 feet, with centre bay equipped with 20-ton electric crane 60-foot span, with two bays each to be served with five-ton electric crane, 20-foot span.

At the end of this building and continuing a distance of 100 feet, there will be constructed a 60-foot span electric crane runway 20-ton capacity for handling raw materials and shipping.

This will not only insure the company against further interruptions in their production, on account of fire, but will greatly increase the scope of their work; and equipped as it will be with steam hammers, hydraulic forging presses, annealing and heat treating furnaces, it will be one of the finest forge shops on this continent.

WANT SHIPBUILDING ENCOURAGED.

A deputation, representing shipbuilding interests from coast to coast, has waited on Premier Borden. They state that the Canadian shipbuilding industry, in which twenty million dollars are now invested, will go out of business unless protected against British and United States competition, and encouraged by way of a government subsidy or bonus on a tonnage basis.

The government were asked to take prompt action to prevent the practical disappearance of the industry in Canada, and the deputation maintained that under existing conditions of competition with Great Britain a government encouragement to the extent of about 20 per cent. of the cost of building iron and steel vessels in Canada should be given either by way of subsidy or by way of tariff protection.

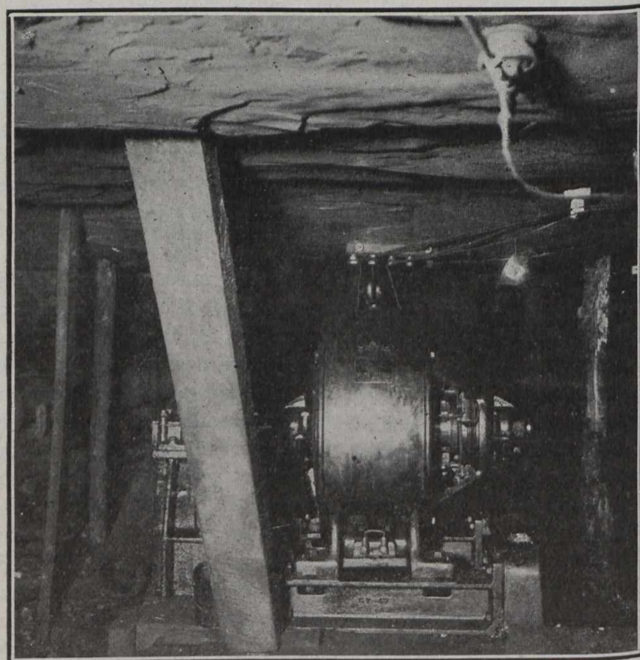
Premier Borden promised careful consideration of the written brief submitted by the deputation, coupled with a suggestion that the government might well adopt a policy of having all government vessels built in Canada, even if the cost was a little more than if the orders were placed in Great Britain.

The English shipbuilding firm of Swan, Hunter and Wigham Richardson are considering entering the Canadian shipbuilding trade, according to the statement of Mr. Clarence I. DeSota, Canadian director of the firm.

SELF-STARTING DIRECT-CURRENT MOTORS FOR DRIVING MINE PUMPS AND FANS.

The electric motor has proved so thoroughly satisfactory for driving mine pumps and fans that it seems almost impossible to improve it. It can be placed wherever a pump or fan can be located; a couple of wires supply it with the power it needs; and when running it requires no attention whatever beyond occasional inspection and oiling. In fact, motors have proved themselves so useful and economical that they are rapidly displacing all other forms of power for fan and pump service wherever electricity is available.

An improvement has, however, been recently developed which greatly increases the value of motors for mine work. This improvement consists in making the direct current motors self-starting.



Heretofore, while it has been possible under some conditions to start them from the power house, most motors driving nine pumps and fans had to be started by hand. Hence, if the power went off temporarily for any reason, the motors stopped, necessitating an attendant to go to each station to start them again.

With the new self-starting D.C. motors, this inconvenience is done away with. When the power fails, the motors stop, it is true, but as soon as the power comes on again, the motors start automatically and settle down to work as though nothing had happened. Moreover, starting boxes are rendered unnecessary, and the wiring is of the simplest possible character. An occasional visit of inspection is now all the motors require. Otherwise they can be left entirely to themselves.

These motors have been thoroughly tried out in practical service and their uses are commending them highly, as is shown by the number of repeat orders the manufacturers are obtaining.

The electrical characteristics of the self-starting motor differ but little from those of the usual type, the only alteration being in the use of a heavier compounding winding which reduces the flow of current when starting. Mechanically, there is no change.

Self-starting motors are made by the Westinghouse Electric and Manufacturing Company, East Pittsburg, Pa., in ratings up to 20 horse-power for the voltage usually employed in mine work. They can be supplied for all kinds of pump and fan service.

COAST TO COAST.

Ottawa, Ont.—Western votes in the main estimates include an appropriation of $10,000 for a new dredging plant for Manitoba, Saskatchewan and Alberta, and $50,000 for improvements to Rainy River.

Boston, Mass.—President Chamberlin, of the Grand Trunk Railway, has raised $6,000,000 to help in the fight of extending the Grand Trunk lines through New England to Boston. The interests opposing this move are large and powerful and will put up a strenuous opposition to the Grand Trunk.

Windsor, Ont.—The Remington Arms Union Metallic Cartridge Company, of New York, have purchased a site for a large plant here and will enter the Canadian field on an extensive scale. No high explosives of any kind will be used and no powder manufactured in Windsor, and ample precautions to guard against possible explosions have been arranged for.

Winnipeg, Man.—Petitions are being circulated to have the duty of 52½ cents per barrel on American cement reduced to 26 cents, so that American cement can be shipped to Canada at a fair profit. This is due to the fact that nearly all the municipalities in the Dominion are looking forward to a banner road-building and construction year, of which cement forms the chief material and Western Canada fears another cement famine unless American cement can be shipped here, but which the present duty prohibits.

Chicago, Ill.—That the Canadian Pacific Railway will have one of its largest terminals in Chicago is indicated by recent purchases of real estate. The Central Terminal Railway, a local corporate name of the Canadian Pacific, has bought three full blocks on the west side. The company has now bought thirteen additional parcels of land near Fifteenth and South Union Streets. The entire property will be used for freight terminals, according to present plans. In addition to down-town land, the company is purchasing property at Harvard Street and West Forty-eighth Avenue for auxiliary yards. To date, the company has bought 252 parcels of land in Chicago at a cost of $2,480,681.

DOMINION SAWMILLS COMPANY REORGANIZED

The receivers, managers and the liquidator of the Dominion Sawmills and Lumber Company, Limited, announce that the following have been appointed as the board of Forest Mills of British Columbia, Limited, successors to the business heretofore carried on by the former corporation:—Messrs. J. M. Savage, of Victoria, chairman; R. S. Lennie, barrister; W. J. Blake Wilson, T. Frank Patterson, all of Vancouver, and W. A. Anstie, of Calgary.

Mr. Anstie will occupy the position of executive agent of the board with headquarters in Vancouver. The receivers express their appreciation of the support accorded them during the period of their management of the business which has now terminated.

The Forest Mills of British Columbia, Limited, owns extensive timber tracts in the interior in proximity to its five sawmills located at Three Valley, Taft, Comaplix, Cascade and Nelson respectively, as well as an organization for selling the output in the local and prairie markets.

The bonds of the Dominion Sawmills, Limited, were practically all sold in Great Britain, and the failure of the company did not help the cause of British capital in Canada.

DOMINION TAR AND CHEMICAL COMPANY.

The timber preserving plant at Sydney of the Dominion Tar and Chemical Company, Limited, is far from being unable to accept orders, but is ready and anxious to treat all classes of timber, railroad ties, bridge timbers, piling, sheathing, etc.

It is not the only plant of its kind in Canada, as the Dominion Tar and Chemical Company, Limited, has a larger plant at Transcona, near Winnipeg, where they have three large treating cylinders operating, creosoting ties and other timbers chiefly for use of the Canadian Pacific Railway. The treating plant at Sydney is an adjunct to a large tar distilling plant of the company which produces in large quantities the creosote oils used in the preservative treatment of timber.

The company has another large tar distillery at Sault Ste. Marie, Ont., engaged in the same operations, except that there is no timber treating plant at that point.

PERSONAL.

JAS. McKEOWN has been appointed superintendent of highways in Welland County, Ont.

E. J. PHILLIPS has been appointed manager of the Berlin, Ont., light and water department to succeed C. T. Wilkinson.

JOHN McKAY, engineer of the trunk sewer, Regina, Sask., has been appointed superintendent of the Regina waterworks.

GEO. ROSS, Associate Member of the Canadian Society of Civil Engineers, has been placed in charge of roadways in Welland County, Ontario.

J. R. WEMLINGER has been re-elected for the second time secretary of the American Society of Engineering Contractors, with headquarters at 11 Broadway, New York.

FRANK H. MARTIN, superintendent of the Toronto Power Company's hydro-electric plant at Niagara Falls, has returned after a six weeks' trip to Bermuda on account of his health.

A. W. ELLSON FAWKES, chief assistant engineer in charge of the mechanical water filtration scheme at Minneapolis, has been appointed waterworks engineer for the city of Calgary.

W. ARMSTRONG, of the Canadian P. J. Mitchell Company, Montreal, will sail for England in about two weeks on business concerning the lines manufactured by Richard Garrett & Sons and Lassen & Hjort.

ALLAN McQUEEN, B.A.Sc., an honor graduate of the School of Practical Science, Toronto University, 1912, has been appointed assistant power engineer of the city light and power system, of Winnipeg, Man.

GEORGE W. FULLER, of New York City, has been retained as consulting engineer to prepare plans and specifications for the 12,000,000-gallon, slow sand filtration plant to be built at Evanston, Ill. Mr. Langdon Pearse will be associated with him on the work.

CANADIAN MINING INSTITUTE.

The annual meeting of the Canadian Mining Institute will be held at the Chateau Laurier, Ottawa, on March 5th, 6th and 7th. The meeting will be opened by H.R.H. the Duke of Connaught. The papers read and discussions will deal with mining industries in the vicinity of Ottawa, including mica and graphite; ore dressing subjects, especially the treatment of the gold ores of the Porcupine district, and the silver ores of the Cobalt district; mining and metallurgy of iron.

ENGINEERS' CLUB OF TORONTO.

The annual meeting of the Engineers' Club was held on the 6th inst., and the annual report for 1912, which showed a very successful year, was discussed. Five new directors were chosen for the coming year: Messrs. Willis Chapman, Hustace G. Bird, E. T. J. Brandon, W. T. Ferrier, and Jas. Milne. The officers for the coming year will be chosen by the directors at the next meeting.

CANADIAN FORESTRY ASSOCIATION.

The annual business meeting of the Canadian Forestry Association was held at Ottawa, February 5th. The election of officers resulted in the choice of Hon. W. A. Charlton, vice-president, as the new president, and W. Power as vice-president. On the board of directors Messrs. J. B. White, E. J. Jarvis, R. D. Pretty, H. R. MacMillan, of British Columbia, and G. Colquhoun were added to the list. The secretary, Mr. James Lawler, was re-elected.

COMING MEETINGS.

ILLINOIS WATER SUPPLY ASSOCIATION.—The Fifth Annual Meeting of the Association will be held at the University of Illinois, Campaign-Urbana, Ill., March 11th and 12th, 1913. Secretary, Edward Bartow.

THE CLAY PRODUCTS EXPOSITION.—To be held in the Coliseum, Chicago, Feb. 26th to Mar. 8th.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Annual Meeting will be held March, 3, 4 and 5, 1913, in the Green Room, Congress Hotel and Annex, Chicago, Ill. Secretary, Will P. Blair.

CANADIAN MINING INSTITUTE.—Annual Meeting will be held at Chateau Laurier, Ottawa, March 5th, 6th and 7th. H. Mortimer Lamb, Windsor Hotel, Montreal, Secretary.

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.

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, Phelps Johnson; 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, R. F. Uniacke, 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, E. A. James; Secretary-Treasurer, A. Garrow. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, G. E. G. Conway; Secretary-Treasurer, F. Pardo Wilson, Address: 422 Pacific Building, Vancouver, B.C.

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, F. P. Layton, Mayor of Camrose; Secretary-Treasurer G. J. Kinnaird, Edmonton, Alta.

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

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. W. Lines, Edmonton; Hon. Secretary, W. D. Cromarty, Edmonton, 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.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, 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, Patrick Dubee, Montreal; 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 ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

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, C. P. Meredith, Ottawa; 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, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

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, H. C. Russell, Winnipeg, Man.; 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, W. G. Mitchell; 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.