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The Canadian Engineer

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NATIONAL PARKS ROAD CONSTRUCTION

FEATURES THAT DETERMINE ALIGNMENT AND GRADES—METHODS OF DRAINAGE, GRADING AND SURFACING—TYPES OF STRUCTURES USED—WORK OF A DOMINION GOVERNMENT DEPARTMENT IN THE GOOD ROADS MOVEMENT

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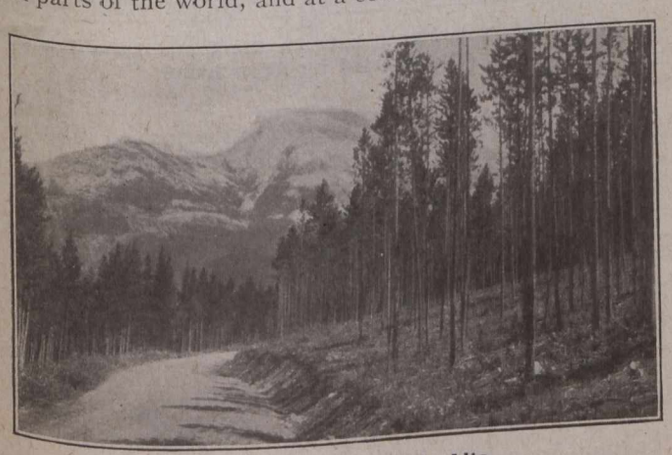
THE Canadian National Parks are chiefly situated in the Rocky Mountain and Selkirk ranges,—the combined areas of the different parks including nearly 8,000 square miles of mountainous territory.

The park area in the Selkirk range is at present limited to some 563 square miles in the vicinity of Glacier and Revelstoke, B.C., the remainder of the mountain reserve being situated along the backbone of the Rocky Mountains range and lying between the forty-ninth and fifty-third parallels.

This large territory, in addition to its value as a mountain playground for the Canadian people and as a means of conserving the forest growth and wild life of Canada, is an invaluable commercial asset of the country due to the revenue derived from its tourist traffic.

Within the park areas are some of the grandest and most picturesque portions of the two great mountain ranges of the continent, and every park is rich in points of beauty and interest that annually attract thousands of visitors.

In 1915, Rocky Mountains Park, in which the town of Banff is situated, drew over fifty thousand visitors from all parts of the world, and at a conservative estimate these

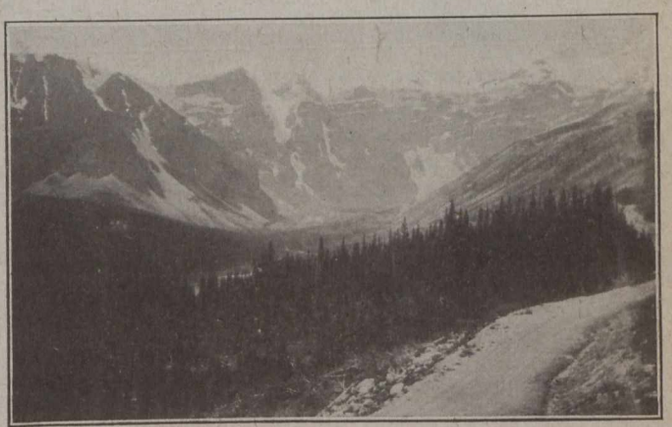


Motor Road near Banff, Alta.

people alone contributed some $5,000,000 to the wealth of the country.

In 1913, before the outbreak of the war, the revenue derived from tourist traffic ranked fourth among the revenues produced by the natural resources of Canada. In that year it was estimated that the national income from tourist traffic was over $50,000,000.

When it is recorded that Switzerland with natural scenic attractions not superior to those of the Canadian Rockies, had an annual income of over $150,000,000 from tourist traffic, the great possibilities of this source of revenue are evident. The drawing power of the Canadian National Parks will increase as they become opened up and made more accessible to the travelling public, and



Moraine Lake Road and the Valley of the Ten Peaks (near Lake Louise, Alta.)

the essential factor of this development is the construction and maintenance of good roads.

This necessary development work is being undertaken by the Dominion Parks Branch of the Department of the Interior, by which the park areas are administered. Road location and construction in the different parks were originally left to a great extent to the judgment of local park superintendents. A few years ago, however, this important work was placed on a more definite engineering basis, and the location of park highways, and the greater part of their construction, are now under the immediate direction of the highways department of the Parks Branch.

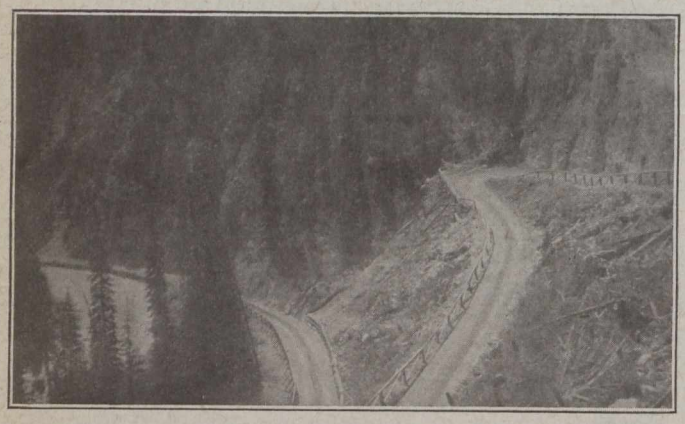
Although the development of a system of park highways is still in its early stages, there are at present some 240 miles of graded roads in the National Parks, and new roads are being located every season. Roadwork generally has been greatly reduced owing to war conditions,—construction during the past two years being practically limited to the work performed by interned alien enemies who have been utilized to build several sections of park roads.

Location.—The location of park highways is generally proceeding on previously defined lines. Park highways may be divided into two classes:

(a) Main or trunk roads, and
(b) Secondary roads.

The first class comprise roads traversing the various parks that afford the chief means of communication with the outer districts, and roads that will eventually form part of the main chain of highways connecting the parks themselves. These highways, being most important, naturally receive first consideration from a location and construction standpoint.

Secondary roads are branches from the main roads to points of interest not touched by the latter. They include loop roads and purely scenic routes. These secondary roads correspond in a physical sense to the feeders of a county road system, but their effect is more to distribute traffic than to concentrate it.

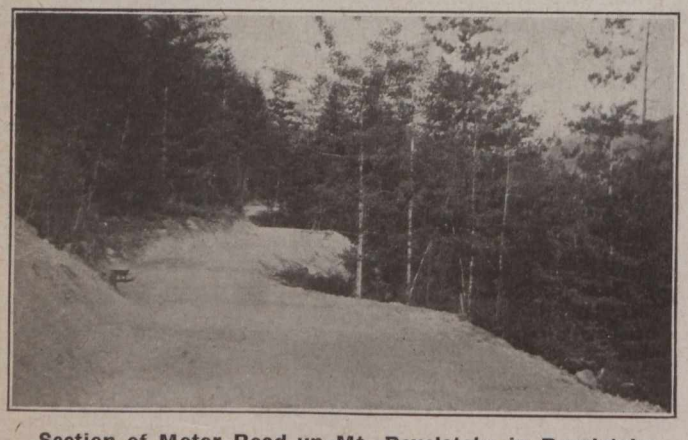


Switchbacks on the Yoho Valley Road in Yoho Park

Of the total mileage of constructed roads in the Dominion Parks at the present time, approximately 90 miles can be classed as main or trunk roads.

The conditions to be considered in the location of park roads are different to those encountered in highway work in rural districts. Park highway routes are chosen with a view to develop scenic attractions instead of farming areas. The most direct and cheapest route between given points may not be the one that will afford the best road from a park viewpoint.

National park highways have little commercial traffic resulting from industrial production. Travellers of park routes are generally on errands of recreation and enjoyment, and in a short time there will be employed but two means of locomotion,—the motor car on the highways and the saddle pony on the mountain trails. The requirements of motor traffic is therefore an all-important consideration in road location and construction work.



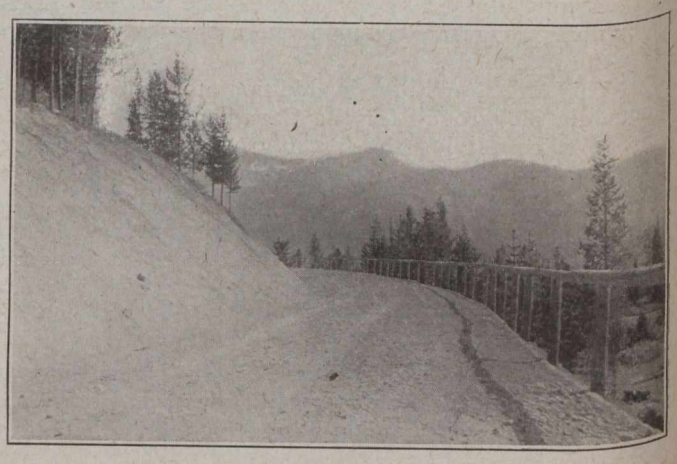
Section of Motor Road up Mt. Revelstoke in Revelstoke National Park. This road makes an ascent of 4,800 feet in 16 miles.

Actual location work in the field is controlled by three factors:—

(a) Grades and alignment.
(b) Construction cost.
(c) Scenic values.

Heavy grades and bad curves will lessen the popularity of a road good in other respects. The object of a proposed road location may not justify a high construction cost. The attractive value of a pretty waterfall may justify a greater expenditure than its value as a source of power. A well-located park road will therefore embody a careful adjustment of these three factors.

Alignment.—Owing to the rugged nature of the country included in the park areas a large portion of every road is necessarily located on mountain slopes, and the location line is generally high in curvature. Sharp curves with large intersection angles are sometimes unavoidable, and the alignment problem becomes one of determining the easiest curve with the least grading, or of adjusting the factors of safety and economy. A radius of 25 feet on centre line is the minimum employed on the location of park roads, and this small radius is never utilized unless circumstances demand the use of a switchboard on a steep sidehill slope. In all such cases provision is always made for the easement of the turn to a forty or fifty-foot radius by additional excavation when this work is justified by traffic. Apart from the case of the switchback no radius of less than 45 feet is employed on any park road, and sharp and abrupt curvature is avoided wherever possible.



Section of Motor Road between Banff and Lake Louise, Constructed by Alien Labor.

Grades.—Considering the character of the country traversed by park roads, remarkably low gradients have been obtained. Main roads are located with a maximum of 6 per cent., and the majority of the grades are considerably less than this. Steady ascents or descents are made on grades between 4 and 6 per cent., and compensation for curvature is allowed on all sharp turns or switchbacks.

Roads of a secondary type usually traverse smaller, steeper valleys and more rugged country than main roads, and often present greater difficulty in location. Higher grades are therefore employed when necessary. Barring one or two cases where there is no alternative, these do not exceed 8 per cent. Generally the ruling grades on secondary roads are between 6 and 7 per cent.

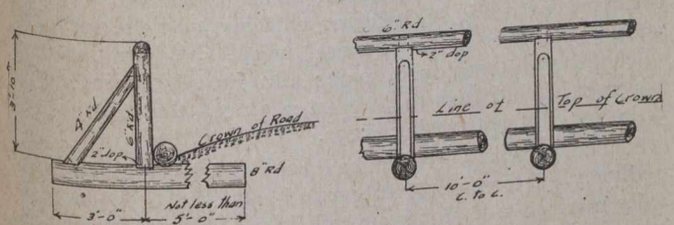
The usual procedure in the location of a new road is, first, a thorough reconnaissance of the country to be traversed for the purpose of determining the general

topography and what routes are available. Blazed lines are then run along the most promising routes,—the clinometer being used to keep within grade limits,—and the scenic possibilities and objective points are noted. A comparison of the probable costs of construction along the different lines is also made. If the information obtained is not sufficient to determine the best route, a rough line of levels is run or a rapid preliminary survey made, and sufficient data collected for the purpose.

On the line as finally located, curves are staked when the intersection angle exceeds seven degrees, and are run in by the tangent off-set method. When the numerical sum of the intersection angle and the proposed degree of curvature do not exceed 80 degrees, the length of the curve is computed by the standard railroad formula. When this sum is over 80, the formula of circular measure is employed.

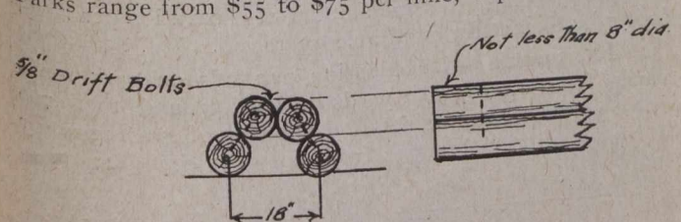
Location field work is undertaken with a party of from 6 to 10 men, depending upon the character of the country and the length of the proposed road. When the work is not conveniently near a railway line, supplies are transported by teams and wagons over existing tote roads, or pack-trains are used.

STANDARD GUARDRAIL AND WHEELGUARD



All Timber round and in the rough

The total costs of road location surveys in the National Parks range from $55 to $75 per mile, depending chiefly upon the nature of the country and the distance of the work from the source of supplies. These costs cover all lines, such as reconnaissance, preliminary or alternate lines, that may be run in connection with the location survey of the road.



4 LOG DRAIN

Construction.—In view of the present requirements of the Canadian Parks, the work of construction is being confined to the building of good earth or gravel roads.

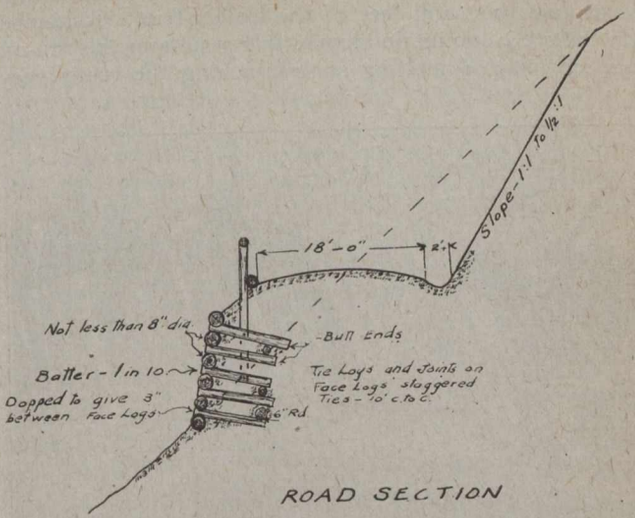
For uniformity of construction the roads in each park are built in accordance with standard plans and sections, modified if necessary to meet local conditions.

Clearing of the right-of-way is done to a width of 40 feet, and grubbing to 25 or 30 feet, depending upon the width required for grading. In order to prevent too rapid drying of the road surface where the ground is level and the soil very porous or sandy, clearing may be occasionally reduced to a width of 30 feet. Attractive clumps of fine trees are spared as much as possible during clearing operations.

The width to which a park road is constructed depends upon its importance and the amount of traffic it will have to carry, finished roadbeds varying in width from 15 to 18 feet. An additional width of from 4 to 10 feet is allowed at all sharp and dangerous turns. A superelevation of the outer edge of the road is also provided for at such points. The superelevation for any curve is obtained from the formula:

$$\frac{\text{width of roadbed} \times \text{degree of curvature}}{100}$$

the result being taken in inches.

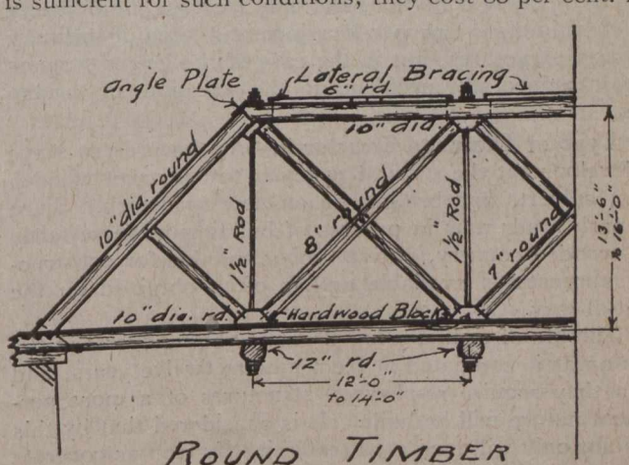


ROAD SECTION

ON STEEP SIDEHILL SHOWING CRIB AND GUARDRAIL

Drainage.—In order to ensure rapid drainage of the road surface the degree of crowning adopted is one inch per foot,—the total crown for any road being one-half its width in inches.

Ordinary surface drainage is carried across the road when necessary by means of 4-log drains placed in the subgrade. In wet ground where there is no defined water course, these drains are placed from 150 to 250 feet apart and give very satisfactory results. While their capacity is sufficient for such conditions, they cost 80 per cent. less than the ordinary wooden box culverts and are very easily constructed.



ROUND TIMBER

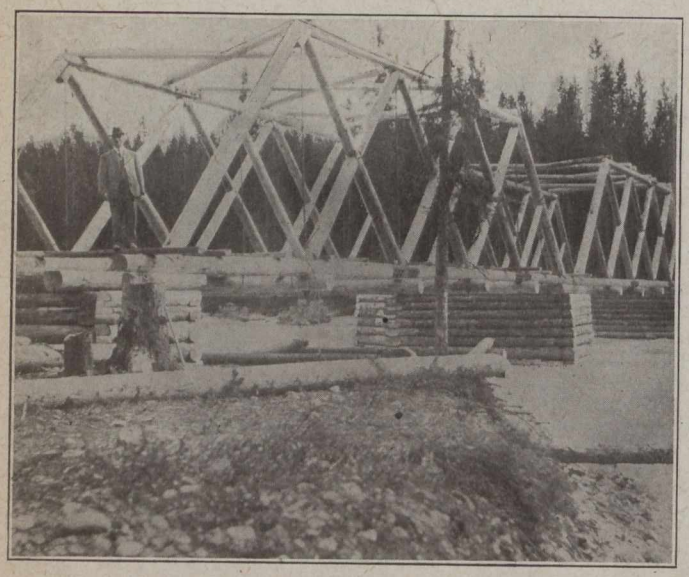
TRUSS FOR 50 to 60 ft. SPANS
Half Elev.

For defined water courses and streams, box culverts of suitable sizes are provided, and are constructed to the full width of the roadway.

Owing to the singular conditions affecting the drainage of park roads, there is often considerable difficulty in

determining the proper capacity and best positions for drainage structures.

A large percentage of the park areas lies more than a mile above sea-level, and many of the roads are within one or two thousand feet of the timber-line. Combined with the steep mountain slopes, this results in the run-off from storms and melting snow reaching the roads very



Round Timber Truss Bridge Erected over the Kicking Horse River near Field, B.C.

quickly, and the maximum discharge of any channel may be reached in a few hours. These swift mountain streams have great powers of erosion and an entire change of channel may be effected in a few minutes' time.

Many streams carrying sediment, driftwood and boulders during freshet, deposit this material on reaching the gentler slopes of the valleys, and build up beds considerably higher than the general surface of the adjacent country. These conditions not only increase the difficulty of determining the proper locations and sizes of ordinary drainage structures, but in the case of the larger streams they introduce new problems in the selection of bridge sites.

Type of Drainage Structures.—At the present stage of development the general policy is to construct wooden cribs, culverts and bridges on all new roadwork. Since the park roads now in process of building traverse fairly well-wooded country, native timber suitable for construction purposes is available and is often obtained on the right-of-way.

The life of ordinary log drains or box culverts in the park areas is estimated at from nine to twelve years, and when they require re-placing, structures of a more permanent nature will be built. It is considered that by this time not only will increased traffic justify iron or concrete drainage structures, but that the roads themselves will require some type of surface paving.

Bridges are built of sufficient width to afford a minimum clear wheelway of 14 feet 6 inches,—15 feet being the usual wheelway adopted. The life of a wooden bridge is estimated at from 16 to 25 years, and it is considered that the width allowed will accommodate traffic during the life of the bridge.

For small spans of 25 feet and under, simple wooden bridges are erected, consisting of stringers and deck supported on wooden piers or bents. For spans between 25 and 40 feet a King type of truss is used, and for spans over 40 feet and up to 80 feet, the Howe or Warren truss is employed.

With the exception of the decking, which is sawn planking, bridges are usually constructed of native timber cut near the bridge site.

A unique feature of wooden truss bridges is the use of round peeled logs for truss members. Timber for trusses is carefully chosen and matched. It should not taper too quickly and should be as straight and as free from defects as possible. When neatly framed this type of bridge is pleasing to the eye, has a better appearance than a hewn structure, and is comparatively inexpensive to erect.

These bridge trusses are designed to carry loads of from 16 to 18 tons,—thus having sufficient strength to support a steam roller or a light revolving steam shovel. In computing the unit stresses for truss members of round logs, the cross-section available is taken to be the strongest rectangular section that could be obtained from the member in question.

Grading.—Grading of the roads is accomplished by ordinary methods, scrapers or wheelers and the scraping grader being used for general work. Where interned alien labor is employed, picks and shovels with dump wagons are utilized to a greater extent than on work done by contract or day labor.

The scraping grader has been found invaluable for ordinary grading on level ground, and has been successfully used on side slopes up to 1 in 5. In order to handle more quickly and profitably the large amount of excavation necessary where side slopes are very steep, a light revolving steam shovel, mounted on traction wheels, was purchased by the Parks Branch. On sidehill construction this machine does all the rough grading, and the trimming and finishing is done by a small force of men. It is also used for ordinary grading,—in conjunction with dump wagons,—when the amount of excavation per lineal foot is sufficient for profitable operation.

The amount of excavation per mile on park roads varies from 2,000 cubic yards on level ground, to 10,000 cubic yards on steep sidehill. The cost of grading under normal conditions ranges from 20 to 35 cents for earth,

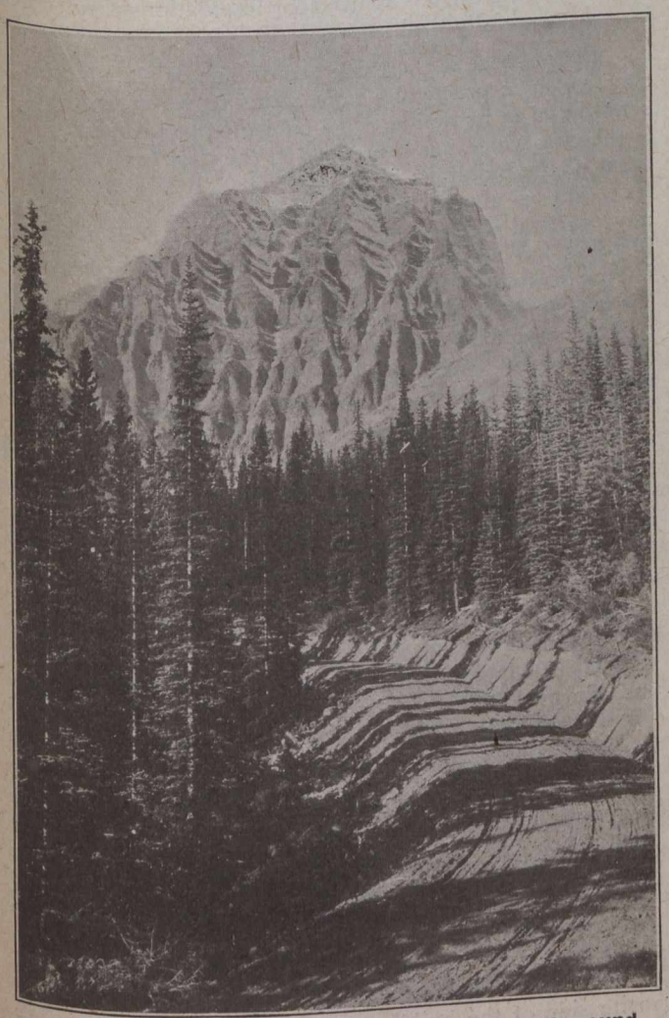
Section of Motor Road between Banff and Lake Louise, Alta. This road when completed will be 38 miles long with a maximum grade of 6 per cent. Twenty-seven miles have already been constructed.

to $1.40 and $1.70 for solid rock. Intermediate material, usually classed as loose rock, costs from 50 to 70 cents per yard.

Surfacing Material.—One of the present problems in connection with the general roadwork of the National Parks is that of a satisfactory maintenance of the earth

and gravel roads, and the constant annual increase in motor traffic will make it increasingly difficult to maintain good road surfaces. It was early realized by the Parks Branch that surfacing of a more or less permanent nature would eventually be required, and a satisfactory material has been provided for by the reservation of tar-sand areas on the Athabasca and Christina Rivers in the vicinity of Fort McMurray.

The areas reserved by the Parks Branch for this purpose consist of two claims of one square mile each,—both claims being located with the view of not only including first-class material, but of affording easy mining and good transportation facilities. A projected line of the Alberta and Great Waterways Railway passes within two



Motor Road near Lake Louise, Alta. In background, Mount Temple, 11,626 ft.

or three miles of the reservations, and it is expected that the line will be constructed early enough for transportation requirements. The claims were located for the Parks Branch by an expert of the Department of Mines in 1914.

Analysis of the bituminous deposit shows the percentage of bitumen in the aggregate to be ample for road purposes, and extracted bitumen also compares favorably in tests with standard asphalts. A sample section of bituminous sand paving was laid in Edmonton, Alberta, and showed no effects of wear after a year's use.

From the data so far obtained it is estimated that there are 3,500,000 tons of high-grade material available in the two claims, or a sufficient quantity to construct 3,800 miles of sand-bituminous paving 2 inches thick and 15 feet wide.

Conclusion.—Highway work in the National Parks has not yet reached an advanced stage, and the great part of its development still lies in the future. In addition to the roads already constructed or projected, there are hundreds of miles of future highways whose routes at present are merely marked by the rough tote road or the blazed trail.

The construction of these highways will in due course be accomplished, and the best part of the National Park areas made reasonably accessible by a network of mountain highways.

The general outline of the present roadwork in the National Parks here given, indicates the steps being taken towards this ultimate aim of park highway development, and also illustrates the part taken by a branch of the Federal Government in the "good roads movement" of Canada.

WINNIPEG SUB-SURFACE FORMATION AND SUITABLE HEAVY FOUNDATION TYPES.

By J. Q. Rankin, C.E.

IN a consideration of the type of foundations suitable for heavy buildings and structures, it is necessary that there should be some knowledge of the character of the ground over which the structure is to be placed. This knowledge can only be had authoritatively from a study of the geological history and characteristics of the district in which the proposed building or structure is to be situated.

The purpose of this paper is, however, not to deal in detail with the geology of the Winnipeg District, but I believe that a generalized summary of the nature of the rock and overlying stratifications will doubtless make clearer the points which we wish to consider in connection with the types of foundations suitable for sustaining heavy buildings and structures.

Geological Formation.—The greater part of Manitoba overlies a part of an immense area of granite and associated rocks formed in pre-Cambrian time. After a period of erosion these limestones and associated rocks, such as the basal sandstones, were laid down during the Cambrian and Ordovician periods.

The present surface of the igneous granite lies at a depth of some 600 feet below the city of Winnipeg, but outcrops east of Winnipeg near the White Mouth River. The limestones were deposited in comparatively thin layers, from a few inches up to a number of feet in thickness, and are separated from each other by bedding planes (thin layers or films of clay). They are comparatively level, having an inclination of about 3 feet in a mile toward the west. They outcrop on the present surface about 20 odd miles east of Winnipeg and also about 12 miles west of the city. Directly under Winnipeg, however, the top layer of these limestones vary from 50 to 65 feet below the surface. They are largely of fossil origin. They are also water-bearing and the present artesian water supply of this district is drawn from them. Occasional breaks are encountered in the upper layers of this rock. They have the appearance of small gullies or ravines, as though having been formed by stream action, and are filled with a very fine white sand deposit.

After these limestone stratifications had been deposited there occurred a period of comparative rest—a lost interval—and no deposits of consequence occurred

until the Cretaceous period when heavy deposits of shale were laid down east of the mountains. These deposits terminated for the most part just west of this district, and we find no shale stratifications underlying Winnipeg.

Later we have the period of the great glacial drift, at which time a blanket of ice with its accumulated rock and sediment moved down from the north, over practically the whole of this immense basin. This blanket was thousands of feet thick, and its tremendous pressure, as it moved southward, doubtless created a grinding action on the surface of the limestone, so that in some localities this rock surface has been badly broken up and displaced. I have seen cases where the rock has been shattered much the same as though it had come from a rock crusher. In other places the surface was not disturbed in the same manner, but is seamy, as though having been cracked by the heavy pressure of the overlying mass. This difference in action to the surface of the rock may be accounted for by the glacier having deposited a protective layer over those sections where we find the limestone practically undisturbed. Consequently we find deposits overlying the limestone in one place of sand, gravel and boulders; in another a composite of shattered or broken-up limestone firmly cemented together with marle, and covered with a grayish-white clay and gravel; in another place we find this deposit in the form of hardpan. This so-called hardpan is usually composed of gravel, sand, small boulders and a tough, brownish clay, and is frequently called boulder clay. I have seen small quantities of the blue clay of this district close to the rock and intermingled with gravel and hardpan. This stratification resulted mostly from glacial drift passing southward over the surface of the limestone. It varies in thickness from 6 or 7 feet to 10 or 12 feet, and is water-bearing.

The glacial drift was followed by another period of rest, at which time much of this glacier melted, forming a lake which covered this district to a depth of some 500 feet. It was inevitable during this period that much of the sediment and rocks which had been carried down with the glacier would settle to the bed of this lake. Also that the stream action over the higher grounds to the west would move large quantities of clay and sediment down into this basin, from the shale beds to the west. And so we find in this district a layer of clay from 30 to 40 feet in depth, which we term blue clay. It is more or less homogeneous in texture, strongly alkaline and soapy in character, and practically impervious to the flow of water. It contains near its underside a sprinkling of boulders of various sizes.

Above this blue clay is a stratification of yellow clay, about 8 to 12 feet thick, and above this in turn a surface loam, a few inches to several feet in thickness. These last two stratifications have doubtless been deposited by streams. They are also water-bearing and carry surface drainage.

To summarize, we have the following stratifications overlying the rock. Beginning at the surface and working in the direction an excavation would be made they are as follows:—

First: A layer of loam being from a few inches to several feet in thickness.

Second: A layer of yellowish clay from 8 to 12 feet in thickness.

Third: A body of blue or slatish colored clay from 30 to 40 feet in depth, with a sprinkling of boulders toward the bottom.

Fourth: A conglomerate stratification of sand, clay and gravel; boulder clay or hardpan; grayish clay and gravel, overlying shattered limestone cemented together with marle. This stratification is from 6 to 12 feet in thickness. These different materials do not necessarily occur together, although at times several of the different substances are intermingled.

Bearing Capacities and Peculiarities of the Stratifications.—Before taking up the description of the different types of foundations we will consider the bearing capacities of the different stratifications, as well as some of the peculiarities which they exhibit when subjected to heavy pressure.

The surface stratifications of loam and yellowish clay are water-bearing and are ordinarily too shallow for the foundations of large buildings. Consequently, it is needless to discuss them. If used for foundations they should be most carefully drained.

Below these is the thick bed of blue or slatish colored clay which is practically impervious to water, and yet is semi-liquid in its action when subjected to pressure. This is the clay which has been used in the past for supporting most of the buildings in this district. It is a well-known fact that in almost every instance where a building of any material weight has been founded on this clay the building has shown signs of settlement. In some cases it is more marked than in others. In several instances the settlement has been so serious as to have forced the owners into underpinning the structure from bed-rock, by means of concrete piers. In the case of the better finished buildings and dwellings the settlement has been a source of annoyance and expense to the owners, in having to renew the decorations more frequently than would otherwise be necessary. In industrial buildings settlement is usually the source of the difficulty in keeping shafting in alignment and machinery level. This condition of the clay is due to the presence of a shaly material which has largely destroyed its frictional value. I have noted some marked instances of this sort when removing old piling from excavations. Invariably the piles had a film of clay adhering to them, and the pockets left after removing the piles were as smooth as glass. The outside of the clay film adhering to the piles being just as glossy.

I will note another instance of this condition which has come under my observation. At one stage in the righting of the C.P.R. North Transcona elevator a rather peculiar lateral movement of the entire building set up. This movement was caused by a slip in the clay bank on the low side of the building. The movement was only controlled and finally stopped after elaborate and extremely heavy shoring had been placed against the opposite side of the building. An examination at different points under the mattress disclosed a bed of blue clay an inch or two thick adhering to the under-face of the concrete, the lower surface of the clay, as well as the surface of the larger bed underneath it, had the same smooth and glossy appearance referred to in the case of the old piles which had been removed.

Still another instance of the apparent lack of frictional value is frequently evident when a vertical face of the clay is exposed without being retained by sheeting. I have seen chunks a cubic yard or more in volume drop out suddenly, without the least forewarning of their coming. Here again the exposed faces of the cavity, as well as the broken faces of the fallen chunk, have this same glossy appearance.

There are cases in this district where the railroads have made heavy fills for their tracks and the weight of

the fill has caused a settlement of the underlying ground and a consequent elevation of the prairie close by. This movement has been evident mostly in the surface stratas, but the blue clay has doubtless been affected also.

The bearing capacity of the blue clay is questionable. Few experimental tests have been made from which authoritative information has resulted. Most of the present knowledge has been gained from buildings which have been damaged by settlement. This knowledge is sufficient, or should be, to prevent further repetition of founding anything but the lighter structures on this hazardous material. And even then, architects and engineers should warn their clients in advance of the probability of some future settlement or movement, either from the structure's own contained weight or from its proximity to some piece of construction that may cause settlement.

As the city grows and expands larger and deeper excavations for buildings, sewers, waterways, subways, etc., are inevitable. It is impossible to prevent some loss of ground, and even though this loss may not be and probably is not noticed at the time, the surrounding clay is sure to find the void and fill it.

The hardpan, sand, gravel and gray clay, when free from water, has usually a greater bearing capacity than the blue clay. The hardpan, particularly when dry, is very firmly compressed and cemented, and at times is almost as difficult to excavate as rock. When it is wet it is more readily opened up. The gray clay, due to the presence of sand and gravel mixed with it, is also firmer when dry than the blue clay, but if submerged it becomes a semi-liquid.

There seems to be no regularity in the arrangement of this conglomerate stratification, and it is extremely unwise to assume that the arrangement and class of material found in one boring or test pit holds good for a large adjacent area. However, the arrangement of this stratification is not so important as the question of its being submerged. In the latter event its bearing capacity is certainly less. It and the underlying rock are both water-bearing, and under normal conditions they are submerged. Directly under Winnipeg the quantity of water is very much reduced and in some places entirely absent. This can doubtless be accounted for because the city and many privately owned wells are exhausting the water from this immediate section, for there is ordinarily an abundance of water in these stratas several miles from Winnipeg.

With the completion and use of the Greater Winnipeg Aqueduct, the city and owners of privately operated wells will doubtless cease pumping to a very large extent from their present source of supply. The inevitable result will be that the subterranean water will once more rise above the stratas overlying the rock.

This brings up an interesting question. Has this stratification already become sufficiently impervious from compression that a later saturation will not materially affect its bearing capacity? This question is worth careful consideration, and wherever accessible this material presents a fruitful opportunity for investigation. Also, to what extent will the alkalinity of this subterranean water cause a deterioration of concrete submerged in it? The engineer in charge of one piece of construction in Winnipeg has been so impressed by the possibilities of disintegration in concrete, that he has had it waterproofed to prevent contact with this water. To the writer's mind this is rather a costly procedure. In view of the fact that any disintegration would probably not penetrate more than an inch or so beyond the other surface, would it not be cheaper to make the piers a couple of inches larger to start with. However, the point is worthy of consideration and investigation.

We come now to a consideration of the limestone stratification. As has been pointed out in another part of this paper, the limestone was deposited in comparatively horizontal layers, varying in thickness from a few inches to several feet, and separated from one another by thin bedding planes of clay. In many cases the top layers of the stone are quite seamy and should be removed. No rock should be left that does not give forth a solid sound from a sharp blow of a sledge. With this test fulfilled the bottom is doubtless good for far more load than will be placed upon it.

Types of Foundations.—We may group the different types of foundations under the two main headings—the floating type, and the deep type—for every foundation in this district comes under one or the other of these classifications.

Floating Types: By floating type we mean those foundations which consist of spread footings, or a mattress (continuous or semi-continuous), resting on the blue clay or surface stratas, and depending on these stratas for their support.

The spread footings are, as the term implies, spread over a larger area than the wall or column presents and are intended to distribute the loading over a larger ground area.

These footings are usually made up of masonry or concrete and some of the oldest buildings have an additional timber pad next to the clay.

A mattress is merely an extensive spread footing and is continuous if it covers the entire area occupied by the supported building, and semi-continuous if it only supports adjacent walls or columns. The mattress is strengthened by reinforcing bars or grillage beams.

A mattress is far superior to spread footings in that it will prevent serious distortion and consequent cracking of the superstructure in event of unequal settlement in the building.

Deep Types: Those foundations which depend on receiving their support directly from the rock or the strata immediately overlying it by means of piles or piers are usually termed deep foundations.

Practically all the piling used in this district up to the present is of wood, but doubtless concrete piling will supplant the timber.

Timber piling, if completely submerged by water, will last indefinitely, but where the piling is partly or wholly out of the water, or is intermittently exposed to water and air, its life is considerably shortened. Of the available timber for piling, cedar seems to be the most durable under these conditions, with a life of perhaps 20 years, whereas tamarac is good for about 8 years and fir and spruce still less. The life of a timber pile embedded in the blue clay is problematical, and presents a subject well worth careful investigation. I have removed both cedar and oak piles from this clay and found them as sound as the day they were driven. On the other hand, I have removed tamarac and spruce piles which were in a very advanced stage of decay. It is, of course, possible that these piles were in poor condition before driving. It may, however, be just as true that the clay does not contain sufficient moisture to prevent some kinds of timber from rotting.

Concrete piling, either of the precast or poured-in-place types, has been used very little in this district. While they are more expensive in the first cost than the

timber piling, they will more than make up for this in permanence. Where piling is the suitable type of foundation to adopt and there is danger from decay so common in timber, concrete piles have already, supplanted the wooden pile in many localities and will likely do the same in this district.

Wherever piling is used in or around Winnipeg it should be driven to refusal. It should never be stopped in the blue clay, depending entirely on its skin friction for its supporting power. While there is doubtless some frictional supporting power in this clay, it is safer to disregard it except as a means of lateral support, depending on the underlying stratas and the rock to carry the downward thrust.

The next type of foundations are those which are installed directly on the rock or in the rock by means of caissons or wells. This type presents the only dependable kind of foundation which can be installed, for two reasons:—

First: Because the foundation gets its support from rock, the only strata in this district which should be used for founding an important or heavy structure, and

Second: Because the method of construction affords a visible means of inspection of the class of material passed through, the bottom on which the foundation rests, and the placing of the concrete.

The pneumatic caisson is seldom used in this district, except for constructing deep bridge piers or foundations of heavy structures where it is not practical or economical to control the water volume with ordinary pumping units. Consequently this paper will not go into a detailed description of it.

The cast-iron-cylinder method of sinking wells is occasionally used in underpinning operations when working under conditions of an exceedingly heavy superimposed load, and where a very small loss of ground might prove disastrous to the building which is being underpinned or to adjoining property. The system of sinking wells by this method differs from the Chicago well method only in the manner of placing the well lining. After the excavation has been started a section of a cast-iron cylinder is set into the top of the excavation and jacked down. As the excavating proceeds, additional sections are placed, one at a time on top of the last one to be jacked down, and the jacking process repeated. The sections are provided with flanged ends (turned in) so that they can be bolted together. If necessary, the joints may be made water-tight with gaskets. By this process it is possible at all stages to keep the sides of the excavation protected against a cave-in.

Small diameter cylinders for shoring or underpinning purposes are sometimes installed by driving an open-ended pipe in the same way a pile is driven. The material is then excavated from the pipe by means of special tools and buckets made for the purpose, and the pipe filled with concrete. The two foregoing types are only used in exceptional cases where the construction conditions are peculiarly hazardous.

For ordinary conditions of underpinning existing structures or constructing foundations from the rock for new structures the Chicago well method is by far the cheapest and most satisfactory for this district. It has almost entirely supplanted rectangular wells from the standpoint of speed, economy and safety of construction.

This method obtained its name from the city where it originated and has been used very extensively.

The manner of constructing Chicago wells is briefly as follows: Excavate the well to the required diameter for a depth which will take the first set of lagging. Set the lagging and brace it firmly back against the clay with iron rings. Continue this sinking till there is depth for the second set of lagging. Place this in position so that the ends of the lagging pieces will butt up against the bottoms of the first set. Brace as before with iron rings. Continue this process until the well is finished.

The length of lagging used in each set is determined by the class and condition of material being passed through, the amount of pressure transmitted by it, and the length of time the excavation can be left unprotected against cave-ins or movement in the material. Care should be used in keeping the well plumb as the excavation proceeds. This can be done by placing the first set of lagging vertically and then plumbing each piece in the second set from the first set. Continue this rotation, plumbing each set from the one immediately above. A better method by far is to establish permanently your well centre overhead before starting the sinking. From this centre hang a plumb-bob which can be lengthened out as the sinking progresses. Always do the finished trimming by measurements taken from the central plumb string.

The trimming of the clay to receive the lagging should receive the greatest care, and none but experienced diggers should be permitted on this work, for considerable skill is required to do it properly. If the trimming is not carried far enough, difficulty will be found in placing the rings. If it is carried too far the joints between the ring flanges will have to be filled out with wedges to make the rings bear against the lagging. At the best, results from shovel trimming are uncertain, because of the voids left behind the lagging, and a loss of ground is probable from a movement in the clay to fill these voids. This difficulty may be overcome imperfectly by pouring grout behind each set of lagging as it is placed, but the remedy is slow and not entirely satisfactory. The writer devised and used on recent work a very simple little machine, operated by hand, that gives most positive results, leaving a face to the clay absolutely circular and without any unevenness.

In this connection the writer anticipates that a power-driven machine with a device for elevating the muck to the surface will before long take the place of the present method of digging by hand with shovels and elevating the muck to the surface in buckets operated by winches on the surface. About four-fifths of the sinking is through an even textured clay with no boulders or large gravel to interfere and this part of the excavation should be handled with a machine digger more economically and quickly than the present method.

The last eight to twelve feet of sinking through the conglomerate stratification overlying the rock is by no means so simple as sinking through the overlying clay. Under normal conditions this material is water-bearing, and extreme care must be used in lagging it to prevent cave-ins. Where water, however, has been drained out and the material has been permitted to consolidate and harden under pressure, much of the exposed face can be left safely without lagging. With the hardpan in this condition, sinking through it frequently is almost as expensive as going through rock. Picks make little or no impression on it. Bull points driven with sledges are effective but the progress is slow. We have had the best results from drills operated by compressed air. Wherever compressed air is available without a heavy installation charge, its use is advisable.

When water is encountered in sinking, pumps must be used. The available space for hanging pumps in a

well is limited, and only certain types of pumps are adaptable for this work. For all-round results we have found the Nye and Pulsometer types most effective, because they are small, compact, easily handled and are economical in operation. If one unit is not sufficient, additional units can readily be dropped down and operated in conjunction with the first.

CEMENT JOINTS FOR CAST IRON MAINS.*

By Clark H. Shaw, Assoc.M.Am.Soc.C.E.

THIS paper presents the method of making successful cement joints in cast-iron water mains. A brief history of the use of this joint establishes the fact that this method of construction has long since passed the stage of experiment, and has been proved to be an economic factor in laying such mains.

The process of making the joints is described and illustrated, some experiments in jointing are described, cases showing the strength of cement joints under trying conditions are cited, and data relating to cost, etc., are presented.

About 1886 a cast-iron pipe line for water distribution was laid with cement joints at Redlands, Cal., and in 1891 joints of that kind were used at Los Angeles, Cal., but evidently with questionable results, as the method was not adopted. In January, 1907, Mr. Charles Thornburg,

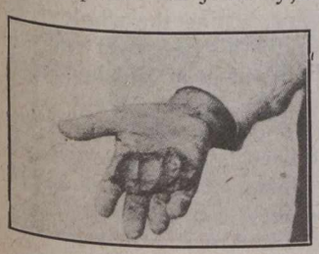


Fig. 1.

Fig. 2.

then superintendent of one of the water companies operating in Long Beach, Cal., decided to try cement joints for a 16-in. cast-iron pumping main, and instructed his foreman of construction, Mr. F. M. Shrode, to conduct some experiments.

No definite process was outlined to the foreman, but his experiments and practice in repairing steel riveted water mains under pressure, by using a dry mixture of neat cement in caulking the bands around these pipes, gave him an idea that a moist cement could be caulked into the bell solidly, and would produce the results desired. It was probably Mr. Shrode, who, by this experiment, finally perfected the joint and used it in construction of the entire line. When this line was completed and put into service, working under a static head of about 190 ft., several places showed some seepage, particularly at the lower end of the line, where the work was started, and it was decided to re-caulk these joints at the first opportunity; it was noticed, however, that the moisture was gradually drying up, and the seepage finally ceased.

Cast-iron construction was then abandoned by this company until 1911. During that year the works came into the possession of the municipality, and the writer was appointed engineer of the water department. After looking into the merits of the cement joint, as used on this 16-in. pumping main, it was adopted as the proper method of construction, and since that time it has been used throughout the entire system.

Long Beach now has 60 miles of cast-iron water mains, ranging from 4 to 24 ins. in diameter, laid with

Fig. 3.

joints of this type. All these pipes are under pressures ranging from 40 to 80 lbs. per square inch, and are giving perfect satisfaction.

Method of Making the Joint.—In making the cement joint the pipe is placed and spaced in the usual manner. A thin backing of the best dry jute is used instead of oakum, as the jute is free from oils and grease (which should be avoided). A Portland cement, conforming to the specifications advocated by the American Society for Testing Materials, is used. The dry cement is placed on a piece of canvas (usually a cement sack ripped open), and moistened just so that when thoroughly mixed by hand it will be of such a consistency that when gripped tight it will hold the form of the hand (Fig. 1), and when dropped 12 ins. it will crumble (Fig. 2). The canvas containing the cement is placed under the bell, and the cement is tamped into place by hand with a caulking iron until the bell is about half full (Fig. 6). It is then caulked with heavy blows until the cement is thoroughly packed in the back of the socket. This process is continued until the bell is packed solid out to the face (Fig. 7). A small bead of neat cement in a plastic condition is then put on, using the caulking iron as a trowel (Fig. 8). As soon as the initial set of the cement in the bead has taken place, the joint is covered with earth to protect it from the air and sun. In back-filling, the excavated material is always settled with water, which helps to cure the exposed portion of the joint.

The bead is essential, in the writer's opinion, as the cement packed in the bell is so dry that without protection

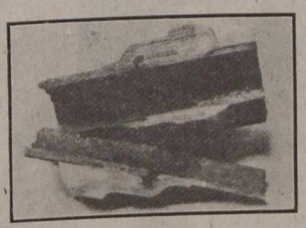


Fig. 4.

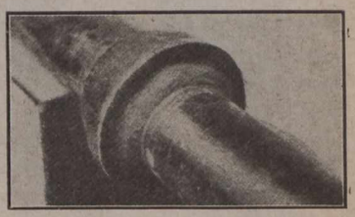


Fig. 5.

it would absorb moisture from the water used in settling the trench, and it is believed that, should the joint develop seepage when the pressure is put on in the main, the cement, being dry, would expand and aid materially in keeping the joint tight.

Experiments on cement joints constructed without the bead showed that, 24 hours after completion, they absorbed water readily. In cases where seepage has developed and has subsequently closed, it is assumed that the dry cement absorbed the moisture from the inside, expanded, and filled the seepage pores.

About 20% of the cement is wasted by falling off the canvas or being thrown out by the caulker. If any dust

*Proceedings of American Society of Civil Engineers for March, 1917.

or earth from the trench falls on the canvas or in the cement, it is immediately taken out, together with enough cement to make sure that the remainder is clean. In mixing the cement with water, care is taken that there shall be no lumps in the material, no matter how small. If any cement is left on the canvas when a joint is completed, it is used on the next joint, provided the work is continuous, otherwise new batches are made. Special blunt caulking tools are used (Fig. 3).

The joint is allowed to stand 48 hours before the pressure is turned on and the main is put into regular service. Cement joints have been used with satisfactory results, however, 12 hours after completion, but this is not considered safe practice. Pressure tests are never made by the writer prior to putting a main into service.

At San Diego, Cal., a pressure test was made by caulking a 6-in. cast-iron tee, one side of the tee being filled with a plug and each of the two ends filled with short lengths of cast-iron pipe with plugs caulked in the ends. As the pieces of pipe caulked in the tee were scrap ends cut from other pipes, they had no bead on the joint end, and, notwithstanding the fact that the joint was made with smooth pipe, it took a pressure of more than 300 lbs. per square inch to force the pipe out. The test was made about 48 hours after the joint was made.

In another test, made at Winnipeg, Man., three lengths of 6-in. pipe were laid with four cement joints, on January 13th, 1916. After 6 days, pressure was put on the pipe, in increments of 25 lbs., and the joints were found to show no leakage or moisture, up to 125 lbs. At 150 lbs. one joint showed moisture on the surface of the cement.

On January 24th another test was made, and at one joint moisture appeared at 175 lbs. On January 31st this joint showed moisture with 200 lbs., and also on March 15th, with a pressure of 255 lbs. This joint was the weakest of the four. The pressure was kept on the pipe about one-half hour in each case.

Fig. 5 is a section of a joint made with a cut piece of pipe, and shows the position of the jute and the cement when there is no caulking rim or bead on the end of the pipe (as in the San Diego test). The cement bead, as shown in Fig. 4, was made larger than usual, and covers the entire face of the bell, though normally it covers only about one-half.

The strength and rigidity of the cement joint are shown by the following instances where cast-iron mains have been subjected to severe tests: A new trenching machine was being tested by a sewer contractor in Long Beach, Cal. It is operated parallel with and 5 ft. from a 6-in. cast-iron water main, with cement joints, which had been laid in January, 1915. The trench dug by this machine was 3 ft. wide and 18 ft. deep. Some time before noon on February 1st, 1915, the side of the trench next to the water main caved in, leaving about 40 ft. of the pipe hanging and supporting about 2½ ft. of earth on top of it. This condition was not reported until the next morning, and at nine o'clock braces were put in to support the pipe. The main was under a pressure of about 65 lbs. per square inch at the time. There was not the slightest seepage from any of the joints as result of this strain.

Again, in June, 1915, 94 ft. of 4-in. cast-iron pipe with cement joints fell into a sewer trench, as the result of a cave-in under conditions similar to those just described. This pipe was under a pressure of about 55 lbs. per square inch. At one end it broke at a service connection; at the other end it broke near the spigot end of a pipe, about 8 ins. from the joint, letting the whole 94-ft. section fall into the trench. In this case every cement joint remained intact. This line had been laid in March, 1913.

Several thousand feet of 8 and 10-in. cast-iron water mains with cement joints have been laid in made ground, the fill being silt from the dredging of harbor channels;

(Concluded on page 447.)

Fig. 6.

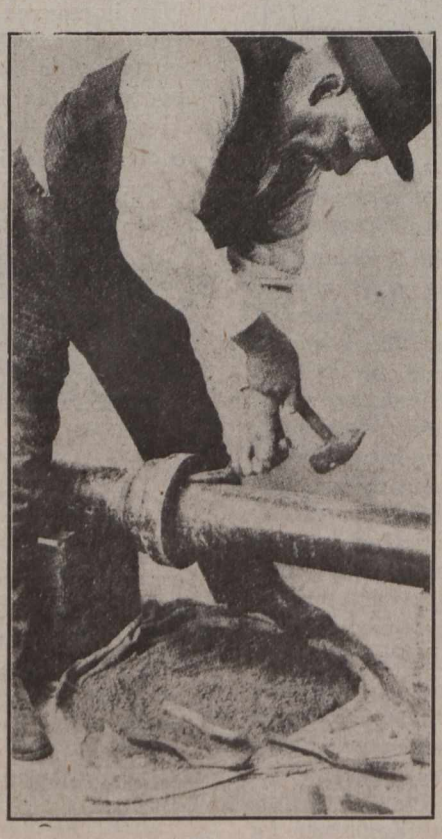


Fig. 7.

Fig. 8.

WATER SUPPLY STANDARDS.*

By William J. Orchard,
Sanitary Engineer, Wallace & Tiernan Co., Inc.

WATER supply standards may be divided into two classes, *viz.*, technical standards and non-technical standards. Technical standards may again be divided into two classes, *viz.*, official standards (formed by the promulgation of laws and regulations), and unofficial standards (which may be defined as those based on experience or current practice).

A résumé of legislation and the regulations of supervising health bodies indicates that the only definite technical standard that has officially been promulgated in the United States is that of the secretary of treasury, under date of October 21, 1914, being "A bacteriological standard of purity for drinking water supplied to the public by common carriers in interstate commerce."

From information available, it would appear that none of the state health departments have officially promulgated standards of purity, either bacteriologically or chemically. In many states, legislation exists prohibiting pollution of public water supplies, or the sources from which they are obtained. A few of the state health departments recognize the standards of the Treasury Department and aim to have all water supplies conform to these limits. Other state departments of health have official standards which are used as a means of guidance in interpretation of water analyses, most of these being bacteriological standards only.

Reports received from thirty-one state health departments indicate that thirteen states have laws protecting water supplies, but have not adopted any minimum chemical or bacteriological standards. Two states have laws protecting water supplies and have unofficially adopted United States Treasury standards. Nine states have laws protecting water supplies and have adopted tentative unofficial standards, while eight states have neither laws nor standards.

Unofficial or tentative standards that have been adopted by some of the state departments of health are of interest. A few examples are enumerated:—

Minnesota.—The Minnesota State Board of Health has not set any arbitrary standard for the purity of water. In interpretation of results, a water is not considered to be of good sanitary quality unless the bacteriological count for four days at 20° C. is less than 100 per c.c., and B. coli absent in 100 c.c. samples. This standard is subject to qualification under certain conditions. The Minnesota State Board of Health will not report on any water supply unless a thorough field investigation has been undertaken and unless samples have been collected by their own representatives. This phase of the situation is presented in a paper by H. A. Whittaker, director of the Division of Sanitation of the Minnesota State Board of Health, entitled "Fallacies in the Investigation of Water Supplies," which was presented before the engineering section of the American Public Health Association in October last.

Alabama.—The Alabama State Board of Health recognizes the standards adopted by the Treasury Department, allowing, however, a bacteriological count of 300 per c.c. after twenty-four hours' incubation at 37° C.

Virginia.—The State Board of Health of Virginia has not adopted any standards and in an interpretation of analyses is largely governed by the particular conditions surrounding the source of supply, and even though a water derived from a protected watershed on which there is no habitation, might show coli in 1 c.c. and 10 c.c. samples, unless human contamination could be shown, the water supply might be considered as good. For the information of local authorities, however, the Virginia State Board of Health indicates on its standard report forms, the significance of bacteriological counts and B. coli interpretations, differentiating between bad, suspicious, or good supplies, as follows:—

"Where colon bacilli are found in quantities of 1 c.c. of water, the sample is dangerous, and is reported bad, regardless of the number of other bacteria found in the sample.

"Where colon bacilli are found in 10 c.c. or 20 c.c. of water, and the number of other bacteria is large, the sample is regarded as dangerous, and is reported bad.

"Where colon bacilli are found in 10 c.c. or 20 c.c. of water, and the number of other bacteria is small (less than 500 per c.c.) the specimen is classed as suspicious.

"Where colon bacilli are not found in samples, and where bacteria are less than 500 per c.c., the sample is reported good."

Maryland.—The State Department of Health of Maryland has not established any standards or limits on the quality of public water supplies, but certain standards have been recommended for filtration plants. These standards are quite novel and are based on the coefficient of efficiency which is defined as "the ratio of the logarithm of raw water count at 20° C. to the logarithm of the plant effluent count." For the removal of colon, the standards are based on a so-called "standard hygienic efficiency" which is defined as "The sum of the percentages obtained by allowing a value of 20 per cent. to each successive step in the colon removal." These standards are discussed in detail in a paper by Wolman, published in the American Journal of Public Health, November, 1916.

Montana.—The Montana Department of Health has adopted tentative chemical standards for the hygienic purity of waters, applicable to restricted areas in the state, and as a rule, only supplies that show no B. coli in 10 c.c. are recommended for public consumption.

California.—The California Bureau of Sanitary Engineering considers a supply in which B. coli cannot be confirmed in 10 c.c., by the latest laboratory methods, as being safe. The occasional occurrence of B. coli in the same quantity is not considered seriously, but their presence in 10 c.c. continuously, or in less than that amount occasionally, is not considered favorably. Condemnation is usually reserved for a field inspection to determine if possible what portion of the B. coli are of human origin.

Iowa.—Iowa presents the interesting situation where chemical standards adopted for the waters of the state several years ago, have been abandoned, following the collection of information showing their inadequacy.

A résumé of reports received from over thirty state health departments shows the varied interpretations placed on bacteriological analyses, and the relative importance given to sanitary survey of watersheds in conjunction with analyses.

If the standards of the U.S. Treasury Department must apply to all water supplies used in interstate traffic, and if, as experience has clearly shown, supplies used by railroads can conform to Treasury standards, the interesting contention is presented that all public water supplies should conform at least to this standard.

*Paper read before the Chemical and Bacteriological Section of the American Water Works Association, May 10th, 1917.

If all supplies do not measure up to this standard, the regulation works an injustice on a few supplies, and does not accomplish a general improvement in the water supplies of the country, as might otherwise be the case.

If there are two towns, located one on either side of the state boundary, designated as A and B, A being a watering place for railroad equipment, and B being a way-station, according to existing legislation, the supply of A must conform to the Treasury standard, and the supply of B can be anything that the state and local officials will permit. To make the water supply of A conform to the standards, has, in all probability, placed a burden either on the water company or the taxpayers of the municipality, and has correspondingly improved the welfare of the town. Is it equitable to require A to go to this expense and not to impose a similar obligation on B? On the other hand, in justice to the consumers at B, should they not be afforded the same protection as those at A?

It is appreciated that in suggesting the feasibility of adopting tentative minimum bacteriological standards, that the principal objection to such procedure is the inability properly to consider the sanitary surroundings of the source of the water.

The abundant good that has been accomplished on a relatively few supplies, following the establishment of Treasury standards, however, would indicate that a considerably greater number of supplies could be improved, should minimum standards be promulgated for all of them.

Whether or not we are governed by arbitrary or tentative standards, more or less definitely fixed, those who in the course of their work are called upon to interpret large numbers of bacteriological analyses, unquestionably are governed by standards that they have set, upon which the interpretation is based, and this interpretation is made, first, without reference to a sanitary survey; and, secondly, in conjunction with a sanitary survey to determine, if possible, the sources of any apparent pollution. But these personally established water standards vary with the individual's interpretation of the analyses.

A water showing coli in 1/10 c.c. regularly will unquestionably be condemned, as would also, without doubt, a supply usually showing coli in 1 c.c.

A water showing coli frequently in 5 c.c., and occasionally in 1 c.c., would very likely be rejected by most sanitarians, although the frequency with which such supplies are furnished to consumers, without rigorous steps being taken to improve the quality, is surprising.

When we reach a water, however, with coli present frequently in 10 c.c. quantities, and occasionally in smaller amounts, the interpretation of the analysis lies very largely with the individual, and may be rejected or passed, in accordance with the individual's standards.

Although the difficulties of arbitrarily establishing any minimum bacteriological standard are appreciated fully, it would tend greatly to improve the quality of a great number of supplies, if minimum standards adopted after careful investigation, were to be officially promulgated by this association.

Should such standards be available for water companies, commissioners, and consumers, a definite object would be established, and the best results in any line of endeavor are secured only when a definite objective is in view.

On the other hand, should such minimum standards be established, being intelligently drawn, and formed only after due consideration of geographical conditions, they would unquestionably aid the supervising health officials in dealing with the recalcitrant water vendor, for the state sanitary engineer would have a definite objective that he could order the vendor to reach.

Although the United States Treasury standards are high, as compared to many water supplies in this country, and although a large number of waters of our bigger and better-known cities would not at all times conform to the Treasury standard, it is not high as compared to the standards existing in European countries and Great Britain.

It was expected that a considerable fund of authenticated information would be available to incorporate in this article to cover standards prevailing in these countries, and the limits of bacteriological content that are considered good practice. Presumably, this information has been lost in transit and will have to be incorporated subsequently. Many English waterworks men, however, contend that the total bacteriological content after 24 hours' incubation at 37° C. should not be more than 50 per c.c., and that colon should be absent in 100 c.c. quantities after 72 hours' incubation at 37° C., and some even go as far as to aim to have colon absent in 200 c.c. after 72 hours' incubation at 37° C.

An examination of the "Twelfth Research Report of the Metropolitan Water Board," of London, would indicate that the settled, stored and treated waters of various supplies before filtration, were comparable bacteriologically with some of our American water supplies as delivered to the consumer.

In advocating the adoption of minimum bacteriological standards of water, the object in view would be to improve the poorer supplies, and to establish a guide by which non-technical waterworks men could appraise their supplies. To establish standards not so much as an arbitrary means of appraisal as an incentive to secure better water supplies.

It is therefore suggested that consideration be given to the appointment of a sub-committee to determine the practicability of adopting standards similar to the U.S. Treasury standards for all waterworks, whether they be used for interstate traffic, or not.

Non-technical Standards.—Technical standards are easily explained in scientific terms intelligent to those familiar with their use. Non-technical standards are more difficult to explain, but may be defined as the attitude of the non-technical man toward a water used for domestic purposes. These may well be divided into two classes:—

(1) The standards of the non-technical waterworks man.

(2) The standards of the consumer.

It must be realized that there are a very vast number of waterworks men in this country, not members of this association, who do not know to any extent the necessity of a pure water supply, and to whom the colon bacillus and bacterial flora in general are unknown. Fortunately, the number of waterworks in charge of this type of man is fast diminishing.

The only reason that so many non-technical waterworks men are entirely unfamiliar with the need of safe water, and the care and vigilance that must be used to secure a safe supply, is that they do not know the fundamental reasons for a safe supply.

Two instances are worthy of mention:—

A certain surface water supply in New England upon investigation, following a typhoid epidemic, was almost definitely found to have been polluted by a typhoid carrier hunter. The State Board of Health representative, sent to install a temporary treatment plant, was ordered out

of the pumping station by the water commissioners, who waited on him in a body, to inform the Board of Health man that they were running that waterworks; that the water supply suited them; and, State Board of Health or no State Board of Health, he could not install the treatment plant, and the only thing he could do was to get out, which, having no authority under the law, he did.

The second instance is that of a waterworks superintendent of a small municipality which was required by the State Health Department to install a treatment plant. Upon the arrival of the representative of the company furnishing the purification apparatus, the superintendent roundly abused the State Board of Health officials, ridiculed the necessity of treatment, in spite of the prevailing epidemic, and informed the representative that he was not going to permit the State Board of Health to install any more contraptions that would mean more work for him; and that although he would treat the water while the State Board of Health man was around, he would pay absolutely no attention to the equipment at other times. Subsequent experience has indicated only too well that he carried out this threat.

Such attitudes on the part of non-technical waterworks men are only too familiar to those whose work has as its foundation the improvement of water supplies in general, and it can be combatted only by a most aggressive educational campaign which properly should be supervised by this association.

Contrast with this attitude that of the progressive private water company or the water department conducted by a technical man, or by individuals who realize the vital importance of their work. The large, progressive water companies or departments take every possible means at all times to improve their water supplies; to raise the standards by which they are appraised; and, by which the consumers are influenced. Such water companies, by taking the consumers frankly into their confidence, place themselves on such a firm foundation as to be able to withstand whatever adverse criticism may be directed against them.

The experience of the Indianapolis Water Company, of Indianapolis, Ind., which has taken its patrons into its confidence in regard to the treatment of its water supply and has established a reputation in Indiana of furnishing absolutely safe water under all conditions, is worthy of note. This confidence has carried the water company without criticism through two severe epidemics and has been invaluable in the matter of dollars and cents as well as good-will. A similar attitude on the part of other companies has had a comparable result.

Is it not incumbent upon this organization to endeavor to create a similar attitude on the part of every water vendor?

The water standard set by the consumer is for the most part one of appearance. If a water is not turbid or colored, he is usually satisfied. Unless his immediate family has been vitally touched by the effects of an impure water supply, he is not solicitous about the quality of the supply. This matter was discussed at length in Mr. Johnson's paper, "The Typhoid Toll," presented before the last annual convention of this association and was amplified in the printed discussion of that paper.

The consumer is, however, inextricably connected with the establishment of higher standards for a water supply. To obtain better water supplies, money is needed and a considerable quantity of it. A water company cannot improve its supply without incurring expense, which should bring return in the shape of increased rates, and increased rates can only be obtained with the partial consent at least of the consumer. Similarly, municipal supplies, if improved, increase the tax rate, and here again the consumer is the court of last resort.

The complacent and erroneous impressions that many water consumers have in reference to their supplies must be eliminated by careful, painstaking publicity and education. In discussing water supplies of various communities with non-technical men and water consumers, one is frequently advised that the water supply is the purest in the country; that it is 99 9/10 per cent. pure; or, that it is well water that never sees the light of day and is absolutely safe. The individual cannot be blamed for resting secure in these assertions, for he does not know better.

Most of those present at this meeting, in going into a strange city or town do not drink the water furnished until the nature of the supply has been ascertained. Many of us abstain from drinking water when on road trips, even in territories where other liquid refreshments are not easily obtained, simply because we appreciate the pollution that a water may carry and the danger that may lurk in a tumblerful. The average consumer, however, seldom gives this matter a thought, because his training has not taught him to do so.

Should this association be instrumental in making the water consumer stop before he draws a tumblerful of water and inquire as to the purity of that supply before he drinks the water, it would have a tremendous effect on the improvement of water supplies.

A more complete and masterful presentation of the value of pure water than that contained in Mr. Johnson's paper, "The Typhoid Toll," was probably never presented before any association. In it, Mr. Johnson, in his admirable manner, tells us that more people are killed every year by typhoid fever than by railroads. The water consumer will stop and look before he crosses a railroad track; we must make him stop and think before he drinks a glass of water. Mr. Johnson has shown us that a pure water supply is a good dollars and cents business proposition—why not treat it as such? Why not pattern our conduct as a waterworks association after that of a successful business organization? Are we not all of us, waterworks superintendents, engineers, chemists, bacteriologists, manufacturers, or what not, offering our services and our product—water—to our final customer —the consumer? Being honorable men, we want to give him the best that he will pay for, and he will only pay for the best when he is educated to its need. With the consumer educated, and demanding the best in water supplies, there will be no further danger from the non-technical, disinterested, or slovenly waterworks vendor, for he will not be permitted to do business.

Looking at this matter, then, as a business proposition, seeking to find a market for a water supply of higher standards than most of those at present furnished, should it not be approached in the same manner as any successful business campaign? Given a good product for which there is a market, the success of any business depends on bringing that product to the attention of those using it, and that can only be done by advertising and publicity.

Why not have this association act as an advertising or publicity medium to obtain higher standards on the part of the technical and non-technical waterworks man and also the consumer? Begin with the consumer—advertise to him the value of better water so that he will demand the best, and be willing to pay for it. Then he will get it.

The efforts toward improvement made by vendors of water used in interstate commerce, which could not be certified under Treasury ruling, are significant of what can be done under compulsion. How much more could be accomplished if the consumer was the compelling force all over the country?

We are all familiar with the progress made in campaigns to secure better housing, better factory conditions, better environment for employees, and protection from occupational diseases. We are also familiar with the tremendous strides in the anti-tuberculosis campaign, and the many exhibits used to educate the public along these lines. Many state health departments have travelling exhibits in charge of medical or technical men, which tour their states to give the public visible evidences of the results obtained from money they have expended.

Are we not lacking in the fulfilment of the highest objective of this association unless we endeavor by every means at our disposal to educate the general public as to the value of pure water? Are we not stultifying the influence of Mr. Johnson's paper if we confine it, for the most part, to the technical waterworks man? Should we not see to it that its contents are advertised broadcast as a good business proposition?

Let us suppose that graphic illustrations of the value of pure water were to be incorporated in every public health exhibit in the country; were to be made part of travelling exhibitions; to be incorporated by the boards of education in instructions given in school rooms, and disseminated by every educational medium—it would not be long before the demand for better water would be so insistent as to cover the entire country.

And, with the objective of creating this demand, on the part of the consumer, and thus offsetting the deleterious influence of the careless water vendor, and to support the technical waterworks man in the promulgation of higher standards of water supplies, this suggestion is offered: That this association appoint a committee to consider the feasibility of a joint board to consist of four members, one each appointed by the presidents of the American Water Works Association, the New England Water Works Association, the American Public Health Association and the Water Works Manufacturers' Association; these four men to appoint a publicity or press agent, who might well be one of the secretaries or editors of those associations, whose sole duty would be to spread the propaganda of better water supplies. There are many problems presented,—the cost of broadcast publicity at first would be prohibitive, but intensive advertising campaigns could easily be conducted in certain localities.

Sub-committees could be appointed to confer with various state departments of health, covering publicity in their territory. Other sub-committees could be appointed in some states, if necessary, to endeavor to secure legislative enactment to protect water supplies, and create an interest in the subject. Arrangements could be made with some of the larger private water companies to advertise steps they have taken to protect their supplies along the lines previously mentioned as having been undertaken by the Indianapolis Water Company. Other sub-committees could make arrangements with the boards of education, libraries and exhibits.

This is a tremendous undertaking, but unquestionably it is worth while. It is a campaign which would take years to properly cover the country, and it is not to be expected that the tangible results would be immediate. That the end to be accomplished is a good one is beyond dispute, and in aiding to spread the gospel of Pure Water this association will fulfil its highest function.

DEFICIENT RAILROAD FACILITIES.

Some striking statistics are contained in the majority report of the Railroad Inquiry Commission, signed by Sir Henry Drayton and Mr. A. M. Acworth, as to the lack of rolling stock and other facilities so far as Canadian railways, with the exception of the Canadian Pacific, are concerned. The effect of deficient railway facilities upon the country's business, it is pointed out, is very serious. It is best shown in a period of stress, whether the stress is due to traffic congestion or is the result of bad weather conditions.

"February last gives a good example," says the report. "The traffic was very heavy; embargoes were the rule and not the exception; weather conditions were worse than usual even in winter. The Grand Trunk had handled over the lines in its Ontario district in February, 1916, 318,532 cars. Last February it handled only 195,120. In its Eastern district in February, 1916, the company handled 210,914 cars; and in February of this year only 109,567 cars. This failure has occurred at a period when the demands on the country for food supplies, munitions of war and other articles used by the Allied armies, are extremely heavy. The situation is one which calls loudly and insistently for an immediate remedy.

"In fairness to the Grand Trunk, it should be pointed out that congestion inevitably causes a falling off in the volume of traffic handled. Cars which are insistently required for the necessities of life, such as coal, perishable foods, live stock—and under present circumstances munitions—have at all hazards to be got forward. This necessitates greatly increased yard-work and switching. Preferential treatment of any one class of traffic always retards the general movement, and so adds further to congestion.

"The Canadian Pacific is a well-organized line. Its movement also fell off in Eastern Canada. Its two districts probably most nearly comparable to the Grand Trunk's Eastern and Ontario Lines are its Ontario and Quebec Districts. In February, 1916, the Canadian Pacific handled in its Ontario district, 92,255 cars, and in 1917 only 80,414 cars. In its Quebec district it handled, in February, 1916, 130,045 cars, and in February, 1917, only 96,464 cars. The resultant percentage decreases are for the Grand Trunk in its Ontario division 39.37 per cent., and for the Canadian Pacific Railway in its Ontario district 15.58 per cent. For the Grand Trunk in its Eastern Division, and for the Canadian Pacific in its Quebec district, the percentage decreases are 48.5 per cent. and 25.82 per cent. respectively.

"At a later page of this report we refer in another connection to the fact that the Intercolonial has no terminals of its own at Montreal, but uses those of the Grand Trunk. The congestion of February was more a terminal congestion than a rail congestion, and the Intercolonial business out of Montreal was directly affected by the congestion of the Grand Trunk terminals. The Intercolonial movement in the First Division out of Montreal in February, 1916, amounted to 25,446 cars, and for the same month in 1917, to 15,628 cars, a percentage decrease of 38.58 per cent. The Intercolonial system, however, as a whole, had a movement, in February, 1917, of 51,311 cars, as compared with 66,510 cars in February, 1916, a percentage decrease of only 22.83 per cent., while the Grand Trunk for its entire system handled, in February, 1916, 652,358 cars, and in the same period in 1917, 402,133 cars, a percentage decrease of 38.35 per cent."

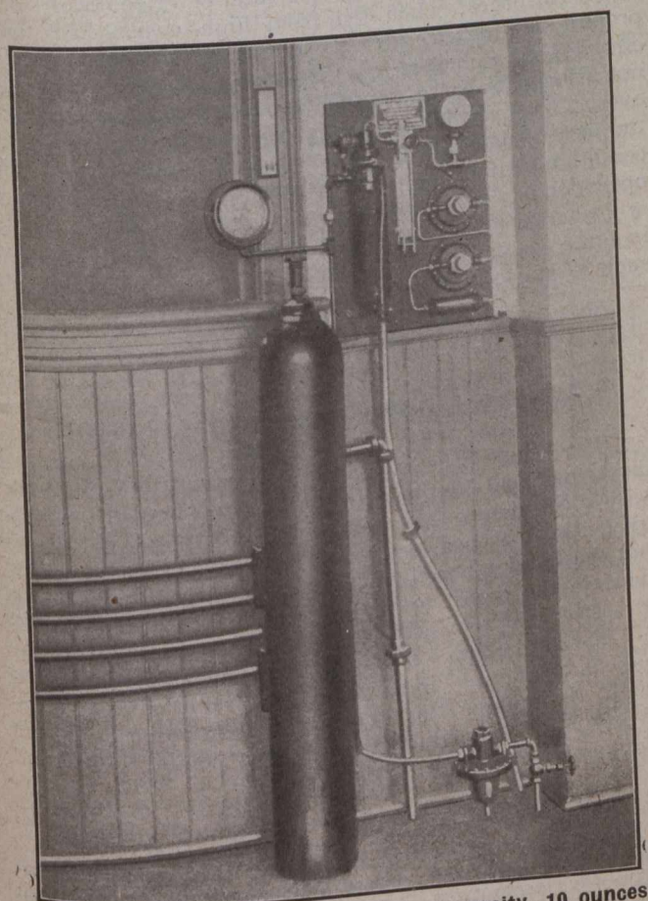
COLLINGWOOD PUMPING STATION.*

By E. J. Stapleton,
Superintendent, Collingwood Water and Light Commission.

THE waterworks of the town of Collingwood was first installed in 1889-1890. A pumping station was built on the Georgian Bay, 250 feet from the shore and a mile from the centre of the town. As formation of the earth was limestone, a trench was excavated and the water was piped in by gravity to a well 6 feet by 24 feet, which was excavated under the pump house floor, the bottom of the well being 14 feet below the lake level.

Two steam pumps "compound" of 1,500,000 gallons capacity each were purchased from the Kerr Engine Works, of Walkerville, and connected with the well by means of suction pipes. These pumps have been in commission from that time until last summer, when electrically driven turbine pumps were installed.

Collingwood has a population of 7,010. The average daily water consumption for 1916 was 770,000 gallons. When pumping by steam the coal was brought in by water and the average yearly cost of the fuel was $4,300,000. Each year's operation showed deficits that could not be avoided while water was being pumped with steam and worn out pumps.



Chlorinating Plant at Collingwood. Capacity, 10 ounces an hour.

The writer submitted a report to the Water and Light Commission early in 1915, showing that these deficits could be wiped out by the use of electric pumps. The matter of layouts and types of apparatus was later discussed with the engineers of the Hydro-Electric Power Commission and afterwards I again reported, recommending that 2 single stage De Laval pumps, each of 1,000 Imperial gallons capacity be installed, the pumps to be direct connected to induction motors of 75 h.p., 2,200 volts. The piping was arranged so that the pumps could be operated either separately or in parallel for domestic purposes, and in series for fire use.

Electrically-driven Pumps at Collingwood. Also showing Switchboard and Venturi Meter in Background.

It was also found necessary to build a new well to receive the gravitated water from the lake. The rock was excavated to a depth of 16 feet below the lake level and a well was built, the inside diameter of which was 12 feet by 25 feet deep. The well was built of Portland cement, 5 to 1. The walls of the well are 15 inches thick, reinforced. The top of the well is 8 inches thick, reinforced with a manhole opening 4 feet square. An iron ladder was also built into the walls of the well.

The frazil ice in the lake sometimes chokes the strainer at the mouth of the intake pipe, and whenever this happens the water immediately commences to fall in the well, so that for the guidance of the engineer on duty, a float was installed in the well, to which was attached a flexible wire rope, conducted over pulleys to a counterweight suspended in the pump room.

A Jefferson bell-ringing transformer was purchased and connected with the lighting system of 110 volts to an 8-inch gong. It is so arranged that, as the water falls in the well the counterweight in the pump room rises and automatically closes the switch, which rings the gong. This alarm gives the engineer plenty of time to open up an emergency shore valve on the suction pipe before there is any possibility of the pump impellers being left in operation without water.

The well complete cost $2,000. The turbine pumps and motors cost $7,138. This tender covered the cost of

*From Hydro-Electric Power Commission of Ontario Bulletin.

the pumps installed, which included in addition to the pumps, 2 Crocker-Wheeler 75 h.p., 2,200-volt induction motors, with a 25 per cent. continuous overload guarantee, also the compensators, oil switch, integrating wattmeter, the necessary piping connections and valves, including two 12-inch suction pipes and a 14-inch Venturi meter. The local commission purchased and connected up some 250 feet of 14-inch cast iron pipe, connecting the discharge from the turbine pumps with the discharge from the steam pumps and force main. It also erected a brick building with a pitch and gravel roof and did all the necessary rock excavating for the pipe trenches, building the necessary foundations.

After the installation was completed an official test was conducted on the pumps and motors. The electrical end of the test was conducted by Messrs. Fisher and Dandene, of the Hydro-Electric Power Commission, and the pump tests were in charge of Messrs. Chipman and Austin, of the Turbine Equipment Company and also the writer. The efficiency and power factor of the motors slightly exceeded the guarantee given by the Crocker-Wheeler Company. The pump readings were checked up with the readings on the Venturi meter recorder. The recorder indicates the ratio of flow from hour to hour. The results of the tests made on the pumps also slightly exceeded the guarantee given by the Turbine Equipment Company.

The total cost of the installation, including foundations, excavations and a brick building, was $13,777.91. Debentures were issued for $13,000 twenty-year term. The debentures realized $13,480.69 and 5½ per cent. interest. The yearly fixed charges on these debentures is $1,087.83. The approximate cost of electric power per year is $1,500. Coal for heating the building and carrying 40 pounds steam on one boiler as requested by the underwriters, approximated $450. In other words, the $1,500 here mentioned is only transferred from the water department to the electric department and goes back to the users of Hydro in the way of a reduction in Hydro rates; thereby effecting a cash saving in electric power over steam of $3,850 per year, and an actual net saving to the waterworks system of $2,350 per year.

The motor-driven pumps are not operated during the local peak hours, unless, as frequently happens, such additional load can be carried without affecting the maximum monthly peak on the town system. When such conditions exist, however, the pumps are operated 24 hours daily for the remainder of the month.

The intake pipe extends out into the lake 1,000 feet in a depth of 15 feet.

A chlorination plant has just been installed at the request of the local health board. The plant is the liquid process, model F, gravity type, regulating apparatus with a capacity of 10 ounces per hour, having a sight reading meter graduating from ¼ ounce to 5 ounces per hour under 25 pounds back pressure. The chlorine is purchased in 100-pound cylinders from the Electro Bleaching Gas Company, of Niagara Falls, N.Y. The object of the health board in authorizing that the water be sterilized was to guard against any possible infection which might be caused by pollution from boats and also the spring and fall freshets.

The Canadian Government Railways recently placed an order for fifty locomotives with the American Locomotive Company.

The Council of the Canadian Society of Civil Engineers has approved of the change in name of the "Regina Branch" to that of "Saskatchewan Branch."

THE ELECTRIC FURNACE.*

By Leo G. Denis, B.Sc.,
Hydro-Electric Engineer, Commission of Conservation.

The use of the electric iron and steel furnace has made exceptional progress under war conditions. When the demand for steel exceeds the supply, and junk piles are searched for available metal, the electric steel furnace experiences a boom because it is capable of making an excellent quality of steel from a comparatively poor quality of iron and steel scrap. As more and more careful conservation of natural resources becomes necessary, electrical processes steadily gain ground because of their greater economy in the use of raw materials.

At the beginning of 1916 there were 73 electric steel furnaces in the United States producing 100,000 tons per year; to-day there are over double this number with a yearly production exceeding 1,000,000 tons. These furnaces require in the neighborhood of 150,000 h.p., one of the largest single installations having a total capacity of 70 tons in units of 15 and 20 tons.

The relative growth in Canada is even greater; the electric furnace steel production has increased from 61 tons in 1915 to 43,790 tons in 1916. In Montreal alone, according to figures supplied by the Civic Investment and Industrial Co., there are in operation, or being installed, 11 electric furnaces requiring a total of 17,000 h.p. The larger furnaces, when fed from high-tension lines and properly controlled, offer no serious disturbances to their circuits, but a plant of less than 5,000 h.p. capacity should not attempt to carry single-phase furnaces of 400 k.w. or over. The possibilities as an off-peak load are good as the usual length of heat is only about three hours, which condition would adapt itself excellently to a limited service operation. The furnaces can be operated economically at from 1c. to 1½c. per k.w.h. and such rates are now in force in many Canadian centres for ordinary services such as house lighting.

*From "Conservation."

G.T.R. WILL OPPOSE NATIONALIZATION.

The Grand Trunk Railway is opposed to the nationalization scheme outlined in the Drayton-Acworth report. A. W. Smithers, chairman of the board of directors, arrived in Montreal last week. Newspaper reports state that the London board of the G.T.R. resent the references made in the report to the finances of the Grand Trunk. It is said that they will fight the nationalization of the G.T.R. and claim to have the financial resources to make any required improvements or additions to equipment. It is understood that a Canadian board in charge of policy and management will be forthcoming if the road remains an independent company.

It has been reported in Washington, D.C., that negotiations looking to the purchase of more than $100,000,000 worth of railway locomotives, cars, rails and other equipment in the United States will be one of the main purposes of the Italian war commission, which is expected to reach that country in about three weeks. A large part of the $100,000,000 already loaned by the United States to the Italian government also is likely to be spent for railroad materials, and orders probably will be placed during the Italian commission's stay here. Italian railways, which are government-owned and operated, are reported to be suffering greatly from lack of equipment since most industrial plants formerly supplying the roads now are making munitions.

NEW BUSINESS TAX ACT.

THE business profits war tax act, which came into force in 1916, will operate until 1918. Under its provisions, incorporated companies were taxed 25 per cent. on net profits exceeding 7 per cent. upon capital employed (throughout the accounting period) of $50,000, or over. The profits of a business owned other than by an incorporated company, were taxed 25 per cent. on net profits exceeding 10 per cent.

The taxation applies also to businesses with capital less than $50,000 and making munitions to the extent of 20 per cent. of their output.

The amendment to the act, introduced by Sir Thomas White in the House on May 1st, 1917, changes the fixed tax to a progressive one. A company's profits up to 7 per cent. are exempt. On profits from 8 per cent. to 15 per cent. inclusive, 7 per cent. is exempt, the balance being taxed 25 per cent. On profits exceeding 15 per cent. to 20 per cent. inclusive, 7 per cent. is exempt, 8 per cent. will be taxed 25 per cent. and the balance (not exceeding 5 per cent.) will be taxed 50 per cent. On profits exceeding 20 per cent., 7 per cent. is exempt, 8 per cent. will be taxed 25 per cent., 5 per cent. will be taxed 50 per cent., and the remainder will be taxed 75 per cent. How this progressive tax works on the profits of a company with capital of $100,000, for example, is shown in the accompanying table.

Capital employed includes (*a*) amount of capital stock of a company paid up in cash (or a fair valuation of such stock if issued against any other consideration than cash); (*b*) actual unimpaired reserves, or accumulated profits. An incorporated company's capital (plus unimpaired reserve, rest or previously accumulated profits if used as capital) existing at the beginning of the accounting period is the basis for the allowance of the 7 per cent. exemption.

The amended act provides that the increases in the tax "shall be levied against and paid by the person owning such business for each and every accounting period ending after December 31st, 1916." The tax, therefore, will cover most of the year 1916 for a large number of companies, but those whose fiscal years conform to the calendar year, will not pay the additional taxation during the latter part of 1916. The tax apparently is computed for the full year for each company from the beginning of the accounting period. Where the company's year ends January 31st, 1917, the tax commences from February 1st, 1916.

In the original act, the tax was retroactive and to be levied for three years upon the net profits shown to any accounting period (fiscal year) after December 31st, 1914. Dividends received from the stock of any incorporated company taxed under the act, were not included in the profits taxed. Reasonable deductions from gross profits for depreciation, renewals, etc., were allowed.

The periods during which the tax was payable under the old act were as follow: Any company, firm or individual which was liable on July 1st, 1916, to a tax on two or more accounting periods covering two years, the tax covering the first twelve months could be paid on November 1st, 1916, the tax covering the second twelve months on November 1st, 1917; and the third and last year's tax on November 1st, 1918. Interest at 7 per cent. is chargeable on taxes in arrears.

The amended act applies to all incorporated companies or private firms to which the original act applied.

HOW THE NEW BUSINESS WAR TAX WORKS ON PROFITS OF A COMPANY WITH CAPITAL OF $100,000

	A company, with capital of $100,000, earning	Will be free of taxation up to 7%	The company will pay on the balance of its profits:								Thus, of total profits of	The company will retain of profits	*or*	Government will retain as tax of profits	*or*	
			25% of	*or*	50% of	*or*	75% of	*or*								
	%	$	$	$	$	$	$	$			$	%	$	%	$	
1	10	7,000	3,000	750	—	—	—	—			10,000	9¼	9,250	¾	750	1
2	15	7,000	8,000	2,000	—	—	—	—			15,000	13	13,000	2	2,000	2
3	20	7,000	8,000	2,000	5,000	2,500	—	—			20,000	15⅔	15,500	4½	4,500	3
4	25	7,000	8,000	2,000	5,000	2,500	5,000	3,750			25,000	16¾	16,750	8¼	8,250	4
5	30	7,000	8,000	2,000	5,000	2,500	10,000	7,500			30,000	18	18,000	12	12,000	5
6	50	7,000	8,000	2,000	5,000	2,500	30,000	22,500			50,000	23	23,000	27	27,000	6
7	100	7,000	8,000	2,000	5,000	2,500	80,000	60,000			100,000	35½	35,500	64½	64,500	7
8	200	7,000	8,000	2,000	5,000	2,500	180,000	135,000			200,000	60½	60,500	139½	139,500	8

REPORT SAYS GOVERNMENT SHOULD CONTROL NEW RAILROAD EXPENDITURES.

THE majority report of the Railway Inquiry Commission expresses the opinion that instructions should be given by the government forthwith, without waiting for further action on this report, to the Canadian Northern and Grand Trunk Pacific companies to discontinue all expenditure on works in hand, unless and until express permission is received for their continuance.

This part of the report continues as follows: "It is to be anticipated that difficulties, more or less great, will need to be overcome before a final settlement can be reached with the Grand Trunk and Canadian Northern Railway Companies. We realize that, if the matter were dealt with in the ordinary manner, it might be a matter of months, if not years, before a final settlement was reached. The pressing public interest demands that the matter be not so treated.

"We will enumerate certain other matters that will not brook delay. In the West the Canadian Northern is not giving, and is not able to give, adequate service to the grain-growers in some important districts which are dependent on its lines. The situation in the Goose Lake district is highly unsatisfactory. The branch is in bad shape and is not fit to do the business offering. There is absolutely no room for doubt as to the lack of freight cars and the resulting inconveniences, and even in many cases distress. In the East the position of the Grand Trunk is most unsatisfactory. Beyond question the system immediately requires at least 200 more locomotives and at least 10,000 freight cars. If coal famines are to be avoided, and the proper winter movement kept up, the line from Burlington Junction to Fort Erie urgently requires double tracking. The question of electrification ought to be taken into consideration forthwith.

"If things go on as at present, the traffic conditions of this year will in all probability return in an aggravated form next winter. The old equipment will be a little older, the roadbed will be in a little worse condition. And the situation in Eastern Canada has been so bad this winter, that there has been much difficulty, specially at Grand Trunk points, in maintaining a supply of grain and flour from the West. It is imperative that strong and efficient action be immediately taken.

"Recognizing the probability of delays, caused by the efforts of the companies to secure better terms from the government, we think that, in order to protect the business interests of the country, the government should immediately put itself in a position to obtain orders appointing receivers for the Grand Trunk and Grand Trunk Pacific systems. We recommend that, at the present sitting of the House, an act be passed constituting the Board of Trustees, so that, in case receiverships are necessary, the trustees may, on the application of the government, under its existing rights as a creditor, be appointed receivers. They would then be in a position to take, through the courts, the necessary steps to vest the properties in the Dominion Railway Company so as to constitute the new system that we have recommended. Should the companies show themselves ready and anxious to come to a prompt agreement, actual application to the courts would of course not be made.

"We feel that the appointment of receivers is not in the interest of the country's credit. It certainly is not in the interest of the companies, as the evidence of this report shows that the property of the Grand Trunk Company, if it were put into a receiver's hands, would leave little or nothing for the shareholders. The result of court proceedings would probably be to divest the shareholders of all interest, and to place the government in the position to take, to the fullest extent, the advantages of their legal position as holders of defaulting securities. But, though we hope receiverships will not be necessary, we think the government must face the possibility.

"In the case of the Canadian Northern Railway Company no proceedings in court are requisite. Under the provisions of section 24 of the Canadian Northern Railway Guarantee Act, 1914 (4-5 Geo. V., chap. 20), the Governor-General-in-Council has power, when authorized by Parliament, to declare by Order, if default is made by the company in payment of interest on the $45,000,000 guaranteed securities (the interest on which is at present being found by the government) that the equity of redemption of the company is absolutely barred and foreclosed; and thereupon the whole property becomes vested in His Majesty.

"If receiverships become necessary, the advantage of appointing the trustees as receivers is obvious. The trustees, with the government behind them, and with the approval of the court, would be in a position to operate the roads as a combined system, to purchase much needed rolling stock, and to make essential improvements, in a way that no ordinary court receiver could do. Receiverships in the ordinary sense would only result in greater traffic congestion than ever, and in losses . . . at large."

SEWAGE TREATMENT ESSENTIAL.*

By Leo G. Denis, B.Sc.,
Hydro-Electric Engineer, Commission of Conservation.

Progress in water purification constitutes one of the brightest pages in the history of sanitary engineering in America during the past 25 years, but much remains to be done both as regards its general adoption and its application where local conditions call for special treatment. Apparently, progress in water filtration has been somewhat retarded through efforts to make chlorination serve as a substitute under conditions where it is not entirely adequate. Chlorination has done much to improve public water supplies. But it is not a cure-all, and its limitations are far more clearly appreciated with the practical proofs now existing than when academically recited six or eight years ago.

Under certain conditions chlorination secures public water supplies of good quality without filtration. The great difficulty lies in gauging the proper amount to be introduced. For many water supplies subject to chlorination without filtration, real difficulties are encountered in so adjusting the dose of chlorine as to guard against objectionable taste and odors on the one hand, and inadequate destruction of objectionable bacteria on the other.

Present-day consideration of sewage disposal as related to water supplies assumes that the primary source of supply is not grossly polluted and that any sewage affecting its purity has been treated in order that its filtration for domestic use may not be rendered ineffective through the overloading of the filters. The methods adopted must involve the recognized principle that any water filtration process must begin by the treatment of the sewage before it is allowed to contaminate the source of water supply.

*From "Conservation."

CEMENT JOINTS FOR CAST IRON MAINS.

(Continued from page 438.)

also several thousand feet of 8-in. cast-iron pipe have been laid in fine beach sand; all are giving perfect satisfaction. An 8-in. cast-iron main with cement joints was laid in filled ground (the soil being clay) with only 6 ins. of covering above the pipe when the line was put in service; the fill was then completed to 18 ins. above the top of the pipe, and was rolled with a 14-ton steam road roller, without causing the slightest seepage in any of the joints. The rolling was done preparatory to paving the street in which the pipe was laid. This was a very severe test of the merits of the cement joint. At the time this rolling was done, had any seepage developed, it would have been readily detected, as the whole line was within 3 ft. of the edge of the fill. The fill was completed to a width of 80 ft., 3 months later, leaving the pipe 12 ft. from the centre of the street.

In several instances a cast-iron main laid with cement joints has settled 3 ins., or probably more, in loose or filled ground, without developing any leakage. In fact, there is only one case that the writer can recall where the cement joint was not satisfactory. This was in a 6-in. cast-iron main on a dock, about 3 ft. from a railroad track. Many joints in this pipe have developed seepage, and some have small pin leaks, but the leakage is not considered serious enough to warrant closing down the line for re-construction. This failure may be due to faulty construction, as the pipe was laid when the making of cement joints was in its infancy. However, the main is situated so that it cannot be entirely covered.

Removing Cement-Jointed Pipes.—Fig. 5 shows a completed joint. The cement joint can be taken apart in a very simple and economical way. The pipe is uncovered about one-half, or a little below the centre. At the joint where the original bell-hole was dug, the trench is usually made wider on the sides (but not deeper under the pipe), in order to permit the caulker to work at the joint. The upper half of the joint is cleaned out with a cape-chisel; then, with tripod and blocks, the free end of the pipe is raised until the lower half of the joint breaks free from the bell. The pipe seldom has to be pulled out of the bell, as it nearly always works itself out as the free end is lowered. If portions of the cement stick to the spigot end of the pipe, or fail to be entirely crushed in the bell, it is a very simple matter to clean out the bell with a cape-chisel, or knock the cement from the spigot with a hammer.

On occasions, after a joint has been cemented tight in the line, it is necessary to cut it out entirely (such as for laying a valve on its side; turning a tee or Y in another direction; adjusting a tee to conform to or meet a grade; avoiding a sewer connection or any other unforeseen obstacle). Table 1 has been compiled from records of the actual time spent in doing such work.

Table 1.—Time Required for One Man to Dig Out a Complete Cement Joint, Without Removing the Fitting or Gates from the Line.

Size.	Time.
4 inches	18 minutes
6 "	22 "
8 "	26 "
10 "	30 "
12 "	38 "
14 "	48 "
16 "	60 "

Table 2.—Data Relative to Cement Joints.

Size of pipe, in inches.	Rings of jute per joint.	Jute per joint, in pounds (approximate).	No. of joints per 94-lb. sack of cement.*	No. of joints per 8-hour day (one caulker).
4	2	0.14	24	50
6	2	0.19	18	42
8	2	0.24	14	34
10	3	0.43	11	28
12	3	0.51	8	24
14	3	0.58	7	20
16	3	0.66	6	17
18	3	0.73	5	14
20	3	0.80	4	11
24	3	0.95	3	7

*Including the 20 per cent. of cement wasted or left over.

The writer has never cut out a joint on a main of greater diameter than 16 ins. It is fair to assume that to cut out the upper half of a joint, for the purpose of removing a pipe, would take only one-half the time indicated in Table 1.

At Long Beach unit costs have been kept on all construction, covering nearly the entire 60 miles of cast-iron water mains. Table 2 has been carefully compiled from these unit costs, and presents data concerning cement joints.

GOOD RESULTS OF ONTARIO GOVERNMENT RY.

The total mileage of the Temiskaming and Northern Ontario Railway in operation at the end of 1916 was 454 miles, according to the fifteenth annual report of the road. The total operating revenue was $2,138,121, as compared with $1,550,403 in the previous year, and the operating expenses were $1,594,177 in 1916, as against $1,356,049 in 1915. The net operating revenue, therefore, was $543,944 in 1916, as against $194,353 in 1915. Total earnings were: $528,705 in 1916, $210,538 in 1915. The payroll totalled $1,127,885, as compared with $953,209 in 1915, and $216,119 in 1905, the year in which the road commenced operation.

Other figures are: Revenue per mile of road, 1916, $6,508; 1915, $4,719. Expenditure, per mile, 1916, $4,852; 1915, $4,128—a betterment in net revenue in 1916 of $1,064 per mile operated over that of 1915. During 1916 the commission spent $463,604 on equipment and improvements, as against $112,000 in 1915.

SASKATCHEWAN BRANCH, CAN. SOC. C.E.

At a meeting of the Saskatchewan Branch of the Canadian Society of Civil Engineers held at the Assiniboia Club, Regina, on May 10th, the following officers were elected for the year: Chairman, L. A. Thornton, Regina; vice-chairman, G. D. Mackie, Moose Jaw; secretary, J. N. de Stein, Regina; executive, H. S. Carpenter, E. G. W. Montgomery, Regina; A. H. Dion, Moose Jaw; C. J. Yorath and Prof. A. R. Greig, Saskatoon.

It was decided to hold a public meeting at Regina on May 25th, when railway problems will be discussed, and a similar gathering will be held in Moose Jaw some time in August.

The Dominion Government has spent $17,790,587.74 on the construction of the Hudson Bay Railway and the Port Nelson terminals.

W. J. FRANCIS ADDRESSES SASKATCHEWAN BRANCH OF CAN. SOC. C.E.

Regina, Sask., May 19th.—Walter J. Francis, of Montreal, who is a councillor of the Canadian Society of Civil Engineers, addressed the members of the Saskatchewan Branch of the Society last week at the Assiniboia Club. Mr. Francis told about the newer spirit now dominating the engineers of Canada, who feel that they should take a more vital interest in public life of the Dominion.

He called attention to the fact that there is not an engineer member of the Senate or House of Commons at Ottawa, and yet engineers are extremely important members of the community, whose work is necessary to the building up of the land.

The speaker then dwelt on the activities of the Society, and said that it is now preparing a memorial which was to be presented to Sir Robert Borden upon his return from Europe, calling attention to the fact that large engineering and other public works are being executed in Canada by alien engineers and contractors, and also giving instances of large public undertakings by Canadian engineers. Alien engineers, according to Mr. Francis, are being employed on the St. Lawrence River work and by the Dominion Railway Board of Engineers, and even one of the largest corporations in Saskatchewan is at present employing an alien engineer in the supervision of its largest structure.

The speaker also mentioned the Lindsay Arsenal contract, which was let by the Dominion Government to an American firm.

"We shall mention in the memorial that in future the government will be held strictly responsible for any similar cases. We shall seek full recognition for Canadian engineers from the federal and provincial governments," declared Mr. Francis.

Attention was also called by the speaker to the memorandum which was recently presented to the government in reference to the proposed plans for the industrial development of Canada. A suggested plan had been drawn up by four members of the Society and Sir Chas. Ross. One of the practical results of this was the appointment of the honorary advisory council on industrial and scientific research, which had received a government grant of $200,000.

AM. SOC. C.E. CANCELS ANNUAL CONVENTION.

The American Society of Civil Engineers has issued a circular to its members cancelling the annual convention which was to be held June 12th to 15th, 1917, at St. Paul and Minneapolis, Minn. The circular states that on May 7th the War Department authorized the formation of nine volunteer engineer regiments for immediate service in France, and this action caused the executive of the society to realize that many members would not be able to attend the convention, so it was unanimously decided that the wise course to pursue was to abandon the 1917 convention. The next annual convention of the society will be held at St. Paul and Minneapolis provided that it is the desire of the membership in that locality, and thereafter the rotation of place for holding the convention in the various districts of the society will be maintained as previously. It is said that quite a number of other United States engineering organizations which hold annual conventions have taken similar action.

TO DISCUSS REPORT ON MONTREAL AQUEDUCT

A meeting of the ratepaying engineers of Montreal who have been opposing the Montreal Aqueduct scheme, as at present constituted, has been called to discuss the report made to the city by Messrs. Vautelet, St. Laurent and McRae. Controller Villeneuve is also preparing a report on the same subject. A newspaper interview quotes the controller as saying that so far as he can see the report concurs with the opinion of the ratepaying engineers that the present aqueduct scheme is impracticable. He remarked, however, that only three questions had been definitely answered by the Vautelet-St. Laurent-McRae commission out of the seven which had been submitted to them, the others being "indirectly hidden" in the body of the report.

WALL ST. COMMENT ON RAILROAD REPORT.

The Wall Street Journal says editorially:—"Further consideration of the majority report of the Royal Commission appointed to inquire into the railways and transportation of Canada does not make it convincing. It is clear enough that the commissioners acted in good faith and were free from that taint of politics which is often the bane of public affairs in Canada. President Smith of the New York Central makes a suggestion that may well come from one of the most brilliant operating railroad men in the country, who knows how the Canadian railroads should be run to work out their own salvation, and does not particularly know or care where the money to do it comes from. The lack of indicated capital supply is the weakest feature of his minority report.

"But the majority report, while sincerely disclaiming any attempt at government ownership, goes much further than government ownership. The idea is to take 25,000 miles of railroad out of politics and to do so by creating a self-perpetuating committee to handle the most staggering railroad proposition even this continent has ever seen.

"Canada went crazy over railroad development and is now reaping the consequences. The attempt to save something out of the mess is praiseworthy, but the suggestion of Sir Henry Drayton and Mr. Acworth that a non-political commission could manage the proposition is visionary. Either the commission suggested would become more autocratic than government ownership itself in its worst form, or it would become the tool of the political party in power, because the patronage of 25,000 miles of railroad could not fail to tempt the politician, and there is nothing in the history of Canada to show that the politician would fail to succumb to the temptation.

"Mr. Smith's plan involves financing to an extent which he probably does not entirely appreciate, but at least it is sound railroad ownership on a common-sense basis, where the stockholder could take his risks and lose his money or make his profits as fate might determine. The Drayton-Acworth plan disclaims government ownership, which it can well afford to do. It proposes to send good money after bad, and to deprive holders of stock with no earning capacity of the only thing that remains to them—their equity in the railroad future."

EIGHTY MILLIONS FOR AIR DEFENCES.

"Before summer, Canada will have a $5,000,000 aviation camp located at Camp Borden," says "Flying," in its April issue. "It will be the largest permanent establishment of its kind on this continent. Fifteen concrete sheds 120 by 66 ft., lighted and heated by electricity, are now being finished, and when the barracks are done, the camp will accommodate about 2,000 men. This camp represents the first step taken by the Canadian Government in establishing its permanent air defences, for which $80,000,000 are to be spent. Hitherto the greater number of aviators have been trained at Valcartier, but this camp will soon be given up for this kind of work, on account of the short season there, with its great amount of snow.

"There will be 160 experienced military aviators constantly on duty at Camp Borden, either trained by the experts of the Curtiss Company, or selected from 600 Canadian airmen now in service on the battle fronts of Europe. These 600 men form an available reserve of pilots, who have heard the shrapnel swish by them in actual battle, and know every detail of organization, as well as the work to be done in the air. Plans include training 5,000 aviators, but it is not expected that the training of more than 2,000 will be finished this year. As soon as pilots are graduated from the school they will be assigned to permanent camps, which will be scattered all over Canada."

HERRON BROS. GET JUDGMENT.

Justice Masten last week at Toronto gave judgment in favor of the plaintiffs in the suit of Herron Bros. vs. Canadian-Stewart Co. to recover 90 per cent. of the price of piles said to be delivered to the defendants. The latter argued that a large portion of the piles had been rejected by the engineers of the Harbor Board.

Editorial

MR. CHAMBERLIN'S STATEMENT.

Mr. E. J. Chamberlin, president of the G.T.R., has issued a statement to the public taking exception to a number of figures quoted in the majority report of the Railway Commission. At the time the report was issued Mr. Chamberlin wrote to his shareholders saying, "At a later date a full statement with regard to the company's position will be made," so it is to be presumed that the statement now given out, which occupies about three and a half newspaper columns, is the full statement to which Mr. Chamberlin previously referred and represents the full comment that the railway has to make upon the commission's report.

If this is so, it is particularly noticeable that no reference whatever is made to Grand Trunk Pacific finances and but very little to the capital expenditures said to be required by the Grand Trunk Railway.

Mr. Chamberlin's statement is devoted entirely to showing how the G.T.R. compares with other Canadian and United States railways from the standpoint of equipment and business done, and to pointing out that the twenty-one million dollars which the commission refers to as being required for maintenance, are not all deferred maintenance charges but partially deferred capital charges. Mr. Chamberlin's figures regarding the equipment of the road, business done and revenues received are no doubt correct, but there will be considerable wonder by the public as to why a road which has been doing so well should be in any way backward in its expenditures on either maintenance or capital account. Mr. Chamberlin shows operating revenues of $10,983 per mile, compared with $9,593 for the C.P.R. He shows 5,675 freight train miles per mile of line, compared with 3,511 for the C.P.R.; and also 2,322 passenger train miles per mile of line, compared with 1,399 for the C.P.R. If judgment is to be based on these figures alone, the Grand Trunk could well be expected to be richer than the Canadian Pacific.

Mr. Chamberlin says that only $13,104,998 is really the total of the deferred maintenance expenditures, and that the remaining $8,076,347 of the $21,181,345 quoted by the commission as being deferred maintenance charges, should really be considered as deferred capital expenditures. Of the $13,104,998 which he himself calls deferred maintenance expenditures, $11,761,598 are for maintenance of way renewals, and even of this sum Mr. Chamberlin says that $1,846,900 are truly capital expenditures, being for tie plates, rail anchors and farm tile in cuts.

It is to be hoped sincerely that the railway commissioners are wrong and that Mr. Chamberlin is right in these matters. Everyone in Canada will rejoice if these facts are correct. The fewer deferred renewals the G.T.R. has, the better for the country. If the G.T.R. can take care of its renewals, and has sufficient command of capital to make the necessary improvements, and meet all its obligations, the government should allow it to be continued as a private road. But Mr. Chamberlin does not show how he intends to catch up even on the $13,104,998 of deferred maintenance charges; and he passes very lightly over the main item of the thirty-million-dollar capital expenditure said to be required (namely, twenty-six million dollars for rolling stock, shops and machinery); and he ignores entirely the obligations of the G.T.R. to the people in respect to the G.T.P. The only phases of the report to which Mr. Chamberlin really offers an apparently adequate reply are two charges, (*a*) that the Grand Trunk's freight-carrying efficiency has greatly decreased, and, (*b*) that the Intercolonial has not been properly served at the Montreal terminal.

Mr. Chamberlin was examined under oath by the commissioners at Montreal on February 24th, 1917. The report of the commissioners includes extracts from the shorthand report of that examination. Mr. Chamberlin then said in part:—

"We can no more carry out that contract with the government than anything in the world. * * * The fact is that the Grand Trunk is not able to contribute anything toward paying its own security holders and making the improvements the people of Canada demand and the business of Canada require. * * * We would not likely have paid any dividends last year if we had paid out all on the Grand Trunk that we ought to have paid for betterments. We have not put in any rails for two years past, of any account. * * * I bought about 10,000 cars the first year I was here. They were all charged to capital account. We should have had a reserve fund for taking care of them. We now have to go and do the same thing over again. * * * If we had twenty-five million dollars now, it would put us in fine shape. * * * That is one reason I am fighting so hard for that twenty-five million dollars. I want to spend it here on the Grand Trunk. * * * I do not mean to say that the rails are dangerous. But we must put in a certain percentage every year. If we go for a couple of years, the first thing we know we will have a lot of rotten rails."

It is not easy to reconcile this evidence with Mr. Chamberlin's public statement. Nevertheless, the fullest consideration should be given to Mr. Chamberlin's statement by the government and by the railway commission; and as this is a subject upon which the public should be fully informed, so that public opinion may be correctly shaped, the Railway Inquiry Commissioners might very properly issue a later statement that would make any amendments to their previous report such as might appear advisable in the light of the facts brought out by Mr. Chamberlin's latest statement.

And the Canadian Northern System is yet to be heard from. If the heads of that railroad have any exceptions to make to the commission's report, it would be well for them to take the public into their confidence and to issue a frank statement of their position just as has been done by Mr. Chamberlin.

FOREIGN TRADE.

The growth of our foreign trade during the past few years has led many to believe that this business will be retained after the war. Most of the foreign trade we are getting now however, is being given to us.

After the war, with every nation keen to obtain new business, we will have to go into foreign markets and get

it in the face of keen competition. Canadian manufacturers have refused substantial peace orders, being too busy on war orders. Those manufacturers whose machinery is turning out war products probably recognize the necessity of finding employment for many of their machinists upon an output for normal markets. They will meet new competition in the lines they manufactured prior to the war, competition which has crept in while they were refusing orders.

Foreign trade, presenting certain difficulties which were duly solved, will present new difficulties, less easy of solution, in the light of competition. Favorable factors, which we cannot foresee now, may help the Canadian manufacturer after the war, but the man who is planning for that period will benefit his workmen, his country and himself.

PERSONAL.

F. F. BACKUS has been promoted to the position of general manager of the Toronto, Hamilton and Buffalo Railway. His former position, that of assistant to the president, has been abolished.

Lieut. THOMAS RUSSEL BUCHANAN, B.A.Sc., University of Toronto, 1913, has been wounded in action. He is a graduate of the mining section and went to the front with the Engineers in 1916. He was born in Thessalon, Ont., 26 years ago.

M. J. BUTLER, LL.B., C.M.G., of Montreal, past president of the Canadian Society of Civil Engineers, and D. H. McDOUGALL, M.Can.Soc.C.E., general manager, Dominion Steel Corporation, Sydney, N.S., received the honorary degree of LL.D. at the commencement exercises of St. Francois Xavier University, Antigonish, N.S., held on May 15th.

Lieut. GORDON PARSONS DAVIDSON, of Toronto, a graduate of the School of Practical Science, 1915, has been missing since May 3, and is believed to have fallen in action. Lieut. Davidson enlisted in a Toronto battery in October, 1915. Within a short time he had risen to the rank of sergeant, and in February, 1916, was selected as one of the University graduates for the draft which went overseas to receive commissions in the Imperial forces. After taking his course at Shorncliffe and Oxford, he was attached to the Royal Scots Fusiliers. Lieut. Davidson is 24 years of age and at the time of enlistment he was in the employ of A. H. Winter Joyner, Limited, Toronto.

Lieut. W. H. R. GOULD, Uxbridge, Ont., an honor graduate, in electrical engineering, of Toronto University, left for England on April 25, to join the Royal Naval Air Service. He received his lieutenant's certificate at Niagara Camp in the summer of 1915 with the C.O.T.C. Since graduation he has been superintendent of the Uxbridge electric light plant.

N. E. GUTELIUS, who has been resident engineer of the Brownville Division of the C.P.R. for the past two years, has been transferred to a similar position at Sudbury, Ont. His successor at Brownville is A. O. WOLFF, formerly resident engineer of the C.P.R. at Chapleau, Ont.

W. M. HUNTER, of Toronto, has been recommended by the Board of Control of London, Ont., for the position of superintendent of the asphalt department of that city.

W. D. JACOWAY has been appointed superintendent of the open-hearth and electric furnace departments at the new plant of Armstrong, Whitworth of Canada, Limited, at Longueuil, near Montreal. For some time Mr. Jacoway was connected with the open-hearth department of the Dominion Iron & Steel Co., Sydney, N.S., and later was with the Bethlehem Steel Co. at South Bethlehem.

Gunner ROGER ALLAN MACDONALD, B.A.Sc., University of Toronto, of Stratford, Ont., has been wounded and is reported seriously ill, suffering from a gunshot wound in the head. Gunner Macdonald enlisted over a year ago with the 54th Battery in Toronto and had been serving with the 6th Battery at the front for several months.

Dr. GEORGE G. NASMITH, C.M.G., Director of Laboratories, Health Department, Toronto, was admitted to the degree of Doctor of Science at the annual convocation of the University of Toronto, held on May 18th. The degree had been deferred since last year owing to the absence of Dr. Nasmith at the front.

Capt. GEORGE LAWTON RIDOUT, only son of Mr. Geo. Ridout, Toronto, was mentioned for gallantry in General Haig's despatch. He went overseas in the first contingent as a lieutenant in the Canadian Engineers, but was later transferred to the Royal Engineers, and promoted to a captain's rank. He is 29 years of age and before enlisting was engaged in engineering work. He was graduated from the Royal Military College, Kingston, in 1907.

Capt. C. JAMES SWIFT, of Kingston, Ont., who for five years was resident engineer of the Transcontinental Railway, and at the time of enlistment was an engineer on the Welland Canal, has been reported seriously wounded. He went overseas in May, 1915. He was graduated from the Royal Military College, Kingston, in 1908, and is a junior member of the Canadian Society of Civil Engineers.

Flight Lieut. M. B. WATSON, of Toronto, a graduate of the School of Applied Science, who enlisted at the beginning of the war with the Canadian Engineers, and who transferred to the Royal Engineers and subsequently to the Royal Flying Corps, has returned home for the purpose of helping with the training in Canada.

OBITUARY.

Major HOWARD CHURCH SYMMES, a graduate in science, McGill University, 1897, was killed in action while serving with the South African Infantry. After going through the South African campaign with the artillery from Guelph, Ont., he was employed as an electrical engineer in the Bureau of Mines at Johannesburg. He was a son of the late Mr. T. Symmes, of Aylmer, P.Q.

ALMOND PENFIELD TURNER, formerly president of the Canadian Copper Company, a subsidiary of the International Nickel Company, passed away at his home in Oakville on May 18th at the age of 52. The late Mr. Turner spent most of his life in Cleveland, but was in Copper Cliff, Ont., for ten years, joining the company in a junior position and rising to the presidency. He retired five years ago on account of ill-health.

A. R. WILLIAMS, president of the A. R. Williams Machinery Company, Limited, Toronto, passed away at his home on May 18th following a stroke of paralysis. Mr. Williams, who was in his 79th year, was born in Troy, Pennsylvania.