PAGES

MISSING

The Canadian Engineer

WEEKLY

ESTABLISHED 1893.

VOL. 19. TORONTO, CANADA, NOVEMBER 3, 1910. No. 18.

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

Editor.—E. A. James, B.A.Sc.
Business Manager.—James J. Salmond.
Advertising Manager.—A. E. Jennings.

Present Terms of Subscription payable in advance:

Canada and Great Britain:		United States and other Countries:	
One Year	$3.00	One Year	$3.50
Six Months	1.75	Six Months	2.00
Three Months	1.00	Three Months	1.25

Copies Antedating This Issue by Two Months or More, 25 Cents.

ADVERTISEMENT RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone, Main 7404 and 7405, branch exchange connecting all departments.

Montreal Office: B33, Board of Trade Building. T. C. Allum, Editorial Representative, Phone M. 1001.

Winnipeg Office: Room 404, Builders' Exchange Building. Phone M. 7550. G. W. Goodall, Business and Editorial Representative.

London Office: Grand Trunk Building, Cockspur Street, Trafalgar Square, T. R. Clougher, Business and Editorial Representative. Telephone 527 Central.

Address all communications to the Company and not to individuals.

Everything affecting the editorial department should be directed to the Editor.

NOTICE TO ADVERTISERS.

Changes of advertisement copy should reach the Head Office by 10 a.m. Friday preceding the date of publication, except in cases where proofs are to be mailed to distant points, for which due time should be allowed.

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

Index to Contents:

The Index to Editorial Articles is on page 599; index to Advertisements on page 62; the Buyers' Guide is on pages 64-8; the Catalogue Index on page 60

THE CONQUEST OF THE AIR.

The balloon race from St. Louis, the attempt of Wellman to cross the Atlantic, and the Belmont Park aviation meet will mark October of 1910 as an eventful month, in which men demonstrated the possibilities of aerial flight.

Walter Wellman in his dirigible balloon failed in his attempt to cross the Atlantic, but the daring flight above the ocean served to impress bird-men with the possibilities of his plans and the probability of its early completion. The failure was an object lesson, and the knowledge gained will be used in perfecting this means of air navigation.

The St. Louis balloon race, which ended in the establishment of a new distance record, was in every way a great success. Ballooning is always a dangerous sport, and the attempt of landing in October in the great north lands in Quebec was a perilous adventure. One of the most attractive incidents of the whole meet was the true-sport-spirit of the competitors, who recognized that it was all in the game; but ballooning as a sport will not be the first pastime which developed commercial possibilities of the art.

The aviation meet at Belmont Park, Long Island, was probably the most successful of its kind, and served to call attention to the scientifically trained men who have to do with aviation, and who are planning and experimenting with appliances to give men greater control of the air, which so far he has but partially mastered. This meet appealed not only to the mechanical and commercial men and the aviator, but it must have had a wonderful influence upon the imagination of the thousands who witnessed the event, when twelve machines, monoplanes and biplanes, were soaring over the field. The most imaginative romance could not be more fascinating than the newspaper report of the close of the meet:—

> When dusk began to settle on the aviation field at Belmont Park, Long Island, this afternoon there were twelve aeroplanes in the air at once, and when night shut down two of them were still lost in the black void above. There was no moon, and it was by the most imperceptible glow of the stars that they were first sighted, singing their way back to earth. Something hovered in the air like a bat, growing momentarily larger. Presently there was another blot, a little blacker than the blackness of the background, and both Hoxsey and Johnstone alighted safely in midfield within a few moments of each other.

THE WEATHER IN RELATION TO MUNICIPAL ENGINEERING.

Some of the most difficult problems for the engineer in Canada are the result of our weather conditions. The extremes of heat and cold and dry and wet develop conditions, and make it very difficult to design plants and carry on work. Commencing with this week's issue of The Canadian Engineer we purpose giving, for forty stations throughout Canada, the elevation of those stations above the sea level, and the average temperature at these stations a year ago, with particular attention to the dates of the highest and lowest temperatures. Together with this we expect to be able to give the departure from the average. The engineer frequently wishes to know the probable temperature conditions of the next few weeks. One of the best guides in this matter is the temperature of preceding years, and in this table we expect to be able to furnish him with information that may act as a guide.

In the second issue of each month we have been giving the precipitation of a number of stations throughout Canada. It is the interest which has been taken in this table of precipitation that has led us to follow it with a second table on temperatures, and we wish to thank Dr. R. F. Stupart and his assistants in the Meteorological Observatory, Toronto, for the assistance they have given us in this matter and the cheerful manner in which they furnished us with information.

ROAD-MAKING.

In a recent issue of the "Daily Colonist," Victoria, B.C., Mr. H. P. Bell, C.E., of Victoria, made some very interesting statements on the question of road-building. There is, perhaps, no class of engineering in which the public are so interested as in the work of the highway engineer, and until the present there has been no engineering work carried on in such a haphazard way as the making of new roads. Our system of surveys, which require the running of block lines and placing the roads along these lines, irrespective of the contour of the country, inevitably leads to unsuitable gradients, except where the country is level.

For the first layout of a country the block system is the most suitable, but from a highway point of view the proper procedure would be to first locate the roads and survey the lines afterwards. It is not so important that the lots be all the same size as that the farmer and the teamster shall have the highway placed where the grades are easiest and the road high, dry and firm.

Many sections of Canada are anxious for the railways. Large bonuses have been, and are still being, paid for railway construction, but we do think with the same attention and a small amount of the same money spent on the location and re-location and construction of leading highways that the transportation problem would be much simplified.

With her scattered population and her wide territory, the highway problems of Canada assume immense proportions, but it would be a great saving if even now the Provincial Governments were to undertake the re-location and construction of many of our trunk highways.

EDITORIAL NOTE.

In an interview at Halifax, James Kent, chief manager of the C.P.R. Telegraphs, made a very interesting statement in connection with train dispatching. Mr. Kent stated that the C.P.R. would have, at the end of this year, 2,100 miles of single track train dispatching under the control of the telephone. This year alone the C.P.R. have converted some 800 miles of telegraph dispatching system into telephone dispatching system. It is claimed that the telephone dispatching gives better service, is more elastic, and just as safe as the former telegraphic methods.

TAMPING.*

By J. A. Roland, R.M., Sioux City, Iowa.

In looking back over the past fifteen or twenty years, a microscope is not necessary in order to discern great improvements in all departments of the North Western.

The standard of track and equipment has gradually moved upward, and the standard of efficiency required of employees has been "pegged ahead" from time to time, to meet new conditions as they have presented themselves.

Engines of 150 tons are replacing the old 50-ton locomotives; 100,000 pound capacity freight cars are replacing the old 30,000 or 40,000 pounds capacity cars; 100-pound rail is replacing the 50-pound and 60-pound metal, and so on down the line in all departments of the service of the road.

Track that was considered good fifteen or twenty years ago, at a speed of twenty-five to thirty-five miles per hour, with the comparatively light engines and cars, would be absolutely unsafe to-day under the engines and cars now used, and at a speed of fifty to seventy miles per hour.

It must be admitted that track is the foundation of the railroad, and without a good foundation, track cannot be maintained in the excellent condition required to-day.

With a well-built, sub-grade, a liberal coat of good ballast, ties of proper size and quality and rail of sufficient weight, it would seem that the responsibility of keeping the track in good condition rests largely with the men whose duty it is to tamp the ballast under the ties.

If there is any weakness in track repairs on the North Western to-day, that weakness lies in the tamping or lack of it.

A few years ago but little tamping was done, it being the custom to raise the track high, shovel ballast under the ties loosely—and let the trains do the tamping. This practice would invariably leave the track rough, as the settling of the track would be very uneven, and does not do at all on a modern railroad to-day.

In order to maintain track in good condition under the heavy traffic and fast speed to which it is subjected at the present time, it is absolutely necessary to place it in perfect surface, and if the raise is not in excess of one inch, to tamp every tie with a modern and approved type of tamping bar. This refers to gravel ballast.

The North Western advertises "the best of everything," which should include tamping bars, but I sometimes wonder if they are not being overlooked.

Being important tools on the section, they should be made of steel, properly formed, and the blades of different thicknesses, so as to pass under the ties and disturb the old bed as little as posssible.

Track foremen will find it a paying investment to exercise patience and persistency in teaching their men the art of tamping, as poor tamping always results in rough track, which means a reflection upon the ability and experience of the foremen and a discredit to the qualifications of the roadmaster.

*From the North Western Bulletin, Feb., 1910.

TEMPERATURE CONDITIONS THROUGHOUT CANADA FOR NOVEMBER, 1909.

In British Columbia, mean temperatures were from 2° to 10° below average; in Alberta, from 2° to 6° below; in Saskatchewan, from 1° to 5° below; in Manitoba, from 1° to 4° above average; in Ontario, from 3° to 6° above average; in Quebec, between 3° and 4° above; and in the Maritime Provinces, from 1° to 4° above average. Only three times since 1840 has the mean temperature of November, 1909, been exceeded by the mean temperatures of that month in any other year.

The highest and lowest temperatures recorded in each Province during the month of November, 1909, were:—

	Highest	Lowest
British Columbia	61° at Calgary on the 4th,	—28° at Atlin on the 30th.
Alberta	63° at Edmonton on the ,	—32° at Pakan on the 25th.
Saskatchewan	62° at Estevan on the 5th,	—35° at Meota on the 20th.
Manitoba	67° at Morden on the 4th,	—29° at Carberry on the 21st.
Ontario	74° at Huntsville on the 28th,	—11° at Stonecliffe on the 24th.
Quebec	63° at Brome on the 12th,	— 5° at Abitibi on the 24th.
New Brunswick	67° at Moncton on the 3rd,	13° at Dalhousie on the 4th and 16th
Nova Scotia	68° at Truro on the 3rd,	12° at Truro on the 20th.
Prince Edward Island	59° at Charlottetown on the 4th,	21° at Charlottetown on the 20th.

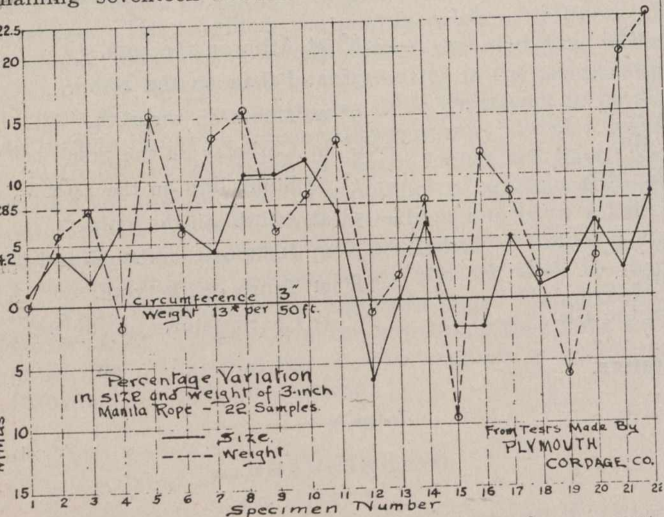
Temperature.

	Elevation above sea level, in feet.	Mean.	Difference from average.	Year's observation.	Highest.	Date.	Lowest.	Date.	Mean daily range.
Golden, B.C.	2,550	27.0	......	8	45.0	3	0.0	14	11.6
Kamloops, B.C.	1,245	35.8	+ 0.8	19	54.5	28	10.4	15	11.6
Nanaimo, B.C.	125	40.9	— 2.0	10	52.7	28	20.9	14	11.1
Calgary, Alta.	3,389	19.6	— 5.9	25	56.0	29	—12.0	20	15.8
Edmonton, Alta.	2,158	13.7	—10.5	26	56	2	—27	25	21.5
Lethbridge, Alta.	2,961	25.3	......	9	60.9	4	—15.1	20	23.7
Medicine Hat, Alta.	2,161	25.8	— 2.6	25	63	5	—15	20	18.6
Battleford, Sask.	1,620	13.9	— 5.1	18	54	2	—26	21	16.9
Indian Head, Sask.	1,924	17.9	— 3	18	57	2	—20	21	21.1
Regina, Sask.	1,885	17.9	— 1.7	24	59	3	—15	21	22.2
Saskatoon, Sask.	1,571	15.1	......	8	54	3	27.5	21	19.8
Brandon, Man.	1,176	19.9	+ 0.8	22	58.9	4	—21.2	21	24.7
Morden, Man.	978	26.4	......	6	67.0	4	—11	21	21.7
Winnipeg, Man.	760	24.8	+ 0.3	34	59.4	6	— 6.0	21	78.8
Brantford, Ont.	750	40	+ 3.8	27	68	14	14	24	18.8
Hamilton, Ont.	303	41.7	+ 4.2	34	68	11	18	25	11.3
Midland, Ont.	750	40.9	......	2	10	11	7	24	....
Port Arthur, Ont.	644	33.6	+ 6.7	29	57	7	2	23	14.4
Peterborough, Ont.	722	36.1	+ 3.4	39	68	1	6	25	18.[illegible]
Toronto, Ont.	350	40.6	+ 3.2	68	63.8	11	13.7	24	15.6
Windsor, Ont.	624	45.7	+ 6.6	35	68	15	26	24	14.3
Montreal, Que.	187	36.5	+ 3.4	35	59.5	15	10.7	24	12.3
Sherbrooke, Que.	624	34.7	......	7	61.3	13	12.1	30	16.6
Chatham, N.B.	21	36.8	+ 4.1	35	61.5	4	14	20	14.8
Fredericton, N.B.	164	36.8	+ 3.4	37	59.8	23	18	19	15.1
St. John, N.B.	70	40.4	+ 3.7	36	7.8	25	21	19	12.9
Halifax, N.S.	88	40.7	+ 1.0	35	62 6	3	20.1	20	15.2
Yarmouth, N.S.	65	41.9	+ 1.7	9	63.3	3	24.5	10	14.3
Charlottetown, P.E.I.	38	39.3	+ 2.4	34	59	4	21	20	11.6

VARIATIONS IN MANILA ROPE.

Tests of rope made by the Plymouth Cordage Company, of Plymouth, Mass., bring out some interesting facts regarding the differences in circumference and weight in a set of samples supposedly of the same size. Twenty-two specimens of "three-inch" manila produced by different makers were tested. The variations in weight and size are shown graphically in the curve below.

Of the twenty-two samples, just one was 3 ins. in circumference, three were smaller, and the remaining eighteen larger than their normal size. Assuming a weight of 13 pounds in a length of 50 feet as standard, one sample answered to these specifications, four were lighter, and the remaining seventeen heavier.



The average variation in weight was +7.85 per cent. with a maximum of +22.6 per cent. and a minimum of —9.61 per cent. The variations in size were not only less, but quite differently distributed. The average deviation was +4.2 per cent. with a maximum of +11.6 per cent. and a minimum of —6.3 per cent. As will be seen by a glance at the curve, in two cases the variation in size was plus, while the weight variation for the same sample was minus, while in one case the reverse was the case. Throughout the series there appears to be little, if any, connection between the weight and size.

These tests bring out facts which may, perhaps, be familiar to the ropemaker, but to the average person they are decidedly surprising. That a total maximum variation in weight of 32.2 per cent. and in circumference of 17.9 per cent. should be found in a batch of twenty-two samples of 3-in. rope is nothing less than astonishing. It is understood similar tests have been made by the Plymouth Cordage Company. The publication of the results of these will be awaited with interest.

RAIL JOINTS.*

By R. B. Rifenberick, Consulting Engineer, Cleveland, Ohio.

The perfect rail joint is at present purely theoretical, and it will continue to be so, as long as wheel meets joint in the fight for supremacy. A perfect rail joint is a joint of few parts, in which none of the parts could ever be worked loose or worn under the loads applied on the joint. Such a joint should be easily and simply connected to the rail, and as easily disconnected when the rail has worn out. It should be capable of being applied to the second and succeeding new rails, and have such strength that it will hold the rail ends as rigid as the balance of the rail. This joint in elastic track construction must be rigid enough vertically to prevent any deflection of the joint beyond the limit of elasticity of the metal, and in a rigid or non-elastic track construction it must be rigid enough vertically to prevent any deflection, either temporary of permanent. In other words, this rail fastening must hold the rail ends so that there will be no bending upward or downward at the joint. It should require no special form of rail, requiring no increase in the cost of the rail itself. Present practice, based on past experience, is a long way from the perfect joint.

An ideal practical joint is a joint embodying such of the elements of the previously described perfect joint as are at present practical, to the extent that this joint will equal the life of the rail, and, it might be added, materially prolong the life of the rail without any further attention to the joint itself. The joint should require no maintenance during the life of the rails which it connects and supplements. With such a joint applied to the rail ends there would be no tearing up of paving or paving concrete during the life of the rail, for the purpose of making any repairs to or replacing the joint.

The third element necessary to attain a perfect joint, which is cited in the report of the committee, puts a burden on the joints that properly belongs to the rail itself. No two strips of rails rolled will, when cut up into rail lengths, and the rail cut from one strip butted to the rail cut from the other, have exactly the same cross section and be of exactly the same depth. It is this difference in the plane of the heads of the two abutting rails that causes the cupping of the receiving rail, and it is to prevent this condition arising and to remedy this defect, having once risen, that resort has been made to grinding the heads of the rail. On a new track, every joint, no matter of what form, should be ground to a perfectly plane surface before the track is given over for the operation of cars, or if this is not possible at the time, it should be done before cars have operated over the joint long enough to start the cup in the receiving rail. No bolted splice plate in use to-day will comply with this specification for an ideal practical rail joint, for as yet there has been no means of absolutely preventing the bolts from working loose under traffic. The development of the splice plate has been toward a combination of the splice plate and rail base support. The three most prominent joints of this character are mentioned in the report of the committee. Experience with these combination fastenings has shown that while they are a great improvement over the simple splice plate, they require more or less maintenance, and to make them more efficient they should be capable of being stepped, so that whenever a cup appears at the joint the fastenings can be stepped and replaced and the cup ground out of the joint. Of the joints now in service the forms that come nearest to this ideal practical joint are the cast welded, electric welded and the Clark joints. Mr. Clark has had great success with his joint, as has Mr. Kerwin with his cast-weld joint, for the welding of which he has designed and uses a water jacket to prevent the heating of the heads of the rail. In the tracks of the Detroit United Railway, some 32 kinds of joints are used on 27 different sections of rail, ranging from the 18-in. 4-hole 4-lb. strap plate to the 108-lb. 30-in. 8-hole continuous rail joint and the cast-welded joint. Most of these joints were inherited by the company from the several independent companies acquired by purchase or lease. Mr. Kerwin has been experimenting in an endeavor to attain an ideal practical joint, to maintain and add to the life of these joints and the rails to which they are connected. In conclusion, attention is called to a very exhaustive report by F. C. Schmitz to the Pennsylvania Railroad. This report appeared in a serial article in the Railroad Gazette of 1900 under the title "Some Notes on Rail Joint Fastenings." It treats at length of the same problems which are being encountered to-day.

*Abstract of paper read before the American Street & Interurban Railway Engineering Association, Atlantic City, N.J., October 10-14, 1910.

SHOULD THE QUESTION OF PUBLIC HEALTH BE SUBJECT TO THE VOTE OF THE PEOPLE?

In Canada at the present time any community may by vote choose whether a proportion of its population shall die of typhoid fever or escape.

Again and again we have examples of communities drinking absolutely polluted water, suffering from an abnormally high typhoid rate, simply because a majority of the people are ignorant, selfish, and content, and there exists no legislative machinery making hygiene compulsory.

Education is compulsory. To shoot oneself or one's neighbor is illegal and punishable. To purchase poison and administer it to one's neighbor is a crime. To poison your neighbor's water supply and kill him with typhoid, and to poison your own water supply and kill yourself with typhoid, are legal methods of committing murder or suicide. Yes, legal, if when the time comes to vote the money to prevent the murder or suicide the community decides to keep the money in their pockets.

Towns could be mentioned galore where the people know that the whole of their town site is sewage infected. They know, and it has been pointed out time after time, that the normal chlorine content of the ground water is, say, eight parts in 1,000,000; and yet analyses of the well waters show contents from 20 to 60 of chlorine, accountable by nothing else than sewage.

We have in mind such a town not sixty miles from Toronto, where typhoid is periodically breaking out; where the Provincial Board of Health have condemned the water of practically every well sample sent to them; where they have an abundance of the finest drinking water in easy and practical distance; where the minority of the inhabitants are alive to the situation; where the council have spent several hundred dollars in formulating and presenting a practical scheme; where the scheme has had the full sanction of the Provincial Board of Health; where the whole town is held up and is stagnant for want of a public water supply; where, on a vote being taken to spend a sum which would add two mills to the tax rate, the majority chose to continue to drink polluted water, remain stagnant, and take a chance with the typhoid lottery.

Nothing can be done except educate the public, wait, and re-submit another by-law in the future. Rubbish, foolishness, communal suicide, and sacrifice to a democratic fetish!

If a man chooses to purchase arsenic and poisons another, do you take time to educate him to a better view of ethics? No; you hang him.

If a community chooses to discharge its intestinal filth, laden with disease germs, into a communal stream, thus poisoning others, do you hang it? No; you commence a slow process of education. You try to make them see the error of their ways. Rubbish! They are never educated. You can no more interpenetrate their minds with the principles of cause and effect than you can make them complete bacteriologists. You can frighten them—at least nature can frighten them by killing a few score, all in a bunch, with typhoid. And so it goes jogging along. In spite of your Provincial Boards of Health, your experimentalists, your engineers, and your few enlightened citizens, it is the shadow of death that really does the trick.

So, in this so-called "reasoning age" tragedy appears to be the whole road to enlightenment. Peace is the product of war, and health the product of the fear of death.

The information flashed with limelight distinctness by Dr. Hodgetts that the typhoid death rate of Canada is 35.5 as compared with 6.2 in Scotland and 11.2 in England, calls for a thinking halt.

In England and Scotland the people are not called upon to vote on the privilege or otherwise of poisoning streams with the germs of disease. A community is served with notice to comply with the law. Non-compliance means punishment and heavy fines. At the present time there is only one Province in Canada whose laws make "stream pollution prevention" obligatory, and that is the new Province of Saskatchewan. Here no community can raise debentures for the laying or extension of a public sewer until the law regarding the prevention of water pollution by sewage is complied with. This simply carries with it the necessity of installing a sewage purification system with a sewer system where required, otherwise the community cannot get the funds to build the sewer, which would lead to contamination.

What the Health Committee of the Conservation Commission will really do we cannot pretend to say. There is talk of river sanitary surveys, of a central bacteriological station, of increased administrative machinery, of a Federal council handing out advice to Provincial Boards. What will all this do? Probably publish blue books, which only a few will glance at, cause meetings and talks between men who have measured every square inch of the subject. And, greatest thought of all, educate the public, that illusory, never myself, never yourself, that irresponsible, non-get-at-able ideal quantity which constitutes the excuse of every enervated politician who would rather think than act.

All that we have mentioned as probable work of the committee is good in itself, but it must give birth to a practical, live enactment, commencing with the words, "Thou shalt not."

Last year we experienced zephyr-like vibrations, caused by the announcement of a Dominion Act in Senate to prevent the pollution of navigable waters and waters entering the same. We followed the discussions of that august body until we got befogged in the mysteries of the British North America Act, and acute reasoning as to whether all Canada or only the Provinces were responsible for stream poisoning and its prevention, and that the Federal Government's powers only applied to pollution by sawdust and not to sewage.

But, let us get back to the subject of this article, "Should the Question of Public Health be Subject to the Vote of the Public?" We certainly conclude with a negative answer. The public may choose whether they will ride in street cars or walk, whether they light their streets with gas or electricity, whether they pave them with wood or macadam, and in all such kindred subjects of public utility. But as to continuing any method which means communal suicide and the poisoning of the stranger within its gates, the public must be denied a voice and State intervention supervene.

THE DISPOSAL OF CHEESE FACTORY WASTE.*

A considerable amount of putrescible organic matter is daily to be got rid of by cheese factories. In some cases for want of drainage facilities it is allowed to accumulate about the factory, in others it is discharged into streams to drag its filthy course sometimes a considerable distance below. This is unsanitary. In consequence of the bad odors engendered and the filthy surroundings the factory hands become careless, the milk is not handled in a cleanly manner, the milk producers get into slovenly ways and produce dirty milk. Flies are encouraged about the place (often they swarm). If the discharge is into a stream the water below is contaminated and is not good for man or beast.

In order to decide on the most representative factory in the east and in the west of easy access and to study the problems involved, factories in five districts, the Niagara, the Woodstock, the Stratford, the Colborne, and the Campbellford districts were visited to the number of twenty-five. These factories varied in size from those capable of handling 5,000 lbs. of milk a day to those with facilities to handle 30,000 lbs. a day. Thanks to the untiring energy and enthusiasm of the dairy instructors these factories were almost invariably in very fair sanitary conditions. On all hands those who know would tell you that the chief improvement had been during the last few years and yet one could frequently locate the factory by the characteristic odor of the whey tank and the accompanying dirty areas.

The quantity of water used for cleansing in the various factories was great or small, not in proportion to the quantity of milk handled but to the quantity of water available.

Most of the factories were situated well away from habitations. But many of them were a nuisance at greater or less distances on account of the pollution of the ditch or stream receiving the waste.

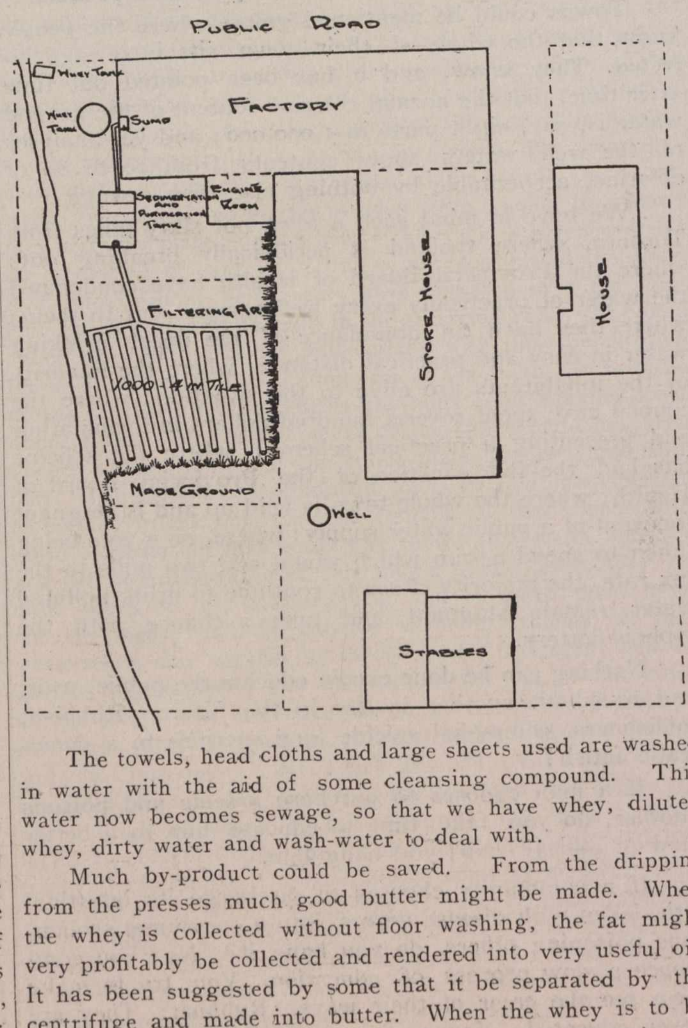
Much fat runs off with the water, and this takes a long time to purify and sticks to much on its way down, and gives rise to very foul odors. In the summer time when the streams are low, the small quantity of water used is not sufficient to dilute the waste or to flush it away.

Every cheese factory visited was provided with a steam boiler for power, for sterilizing and for hot water.

To realize the problems involved one should follow the process of manufacture. After the curd in the vats has sufficiently formed and reached the necessary acidity, the whey is strained off. In most factories this flows over the floors and back into the drains to the whey tanks, carrying with it any dirt that lies on the general floor of the factory. Many of these are of cement and well constructed, and drained to a sump, to be pumped or run directly into the whey tanks. Some are of wood and well caulked and swollen by being kept moist, and drain off well to the tank. Some are defective, and the whey runs under the floors and all about, resulting in filthy conditions. The whey tanks are often too small, the pipes leading to them are too often defective and leak, so that soaking of the ground in the neighborhood is common, and when putrefaction takes place a nuisance results. Flies are encouraged, and are a great source of danger and annoyance. In the springtime, when the farmers are busy and are short of pigs to feed and the roads are bad, the whey is not carried away for two or three days at a time; then also on Monday morning, when the Sunday as well as the Monday milk is done, overflow into the neighboring watercourses becomes necessary, with the consequent nuisance. After the curds are transferred to the sinks for turning over and draining, the vats are flushed out onto the floors, the floors are flushed off. In most places this is run off into the watercourses and constitutes the greater part of the sewage of the factory. The only legitimate reason for not putting it all into the whey tank is that the water quantity would dilute the whey too much and thus reduce its food value, but beyond its flavor there is comparatively little foodstuff in it in any case. There is an objection to carrying water by horse-power back to the farms. To object to it on account of the dirt on the floor is hardly reasonable, for the first whey rids the floor almost completely of dirt.

The curds are now rarely washed in the process of manufacture. During the various turn-overs they receive, more whey and much fat runs away. This all goes to the whey tank. During the pressing of the curds more whey but very much fat is squeezed out. In some factories this fat is made into butter and realizes a fine bit of pin-money for the cheesemaker. The rest of it reaches the whey tank. Then all the utensils are washed up usually just with hot water, and this water runs away to the tank or into the watercourse.

INNERKIP CHEESE FACTORY
WASTE TREATMENT EXPERIMENT



The towels, head cloths and large sheets used are washed in water with the aid of some cleansing compound. This water now becomes sewage, so that we have whey, diluted whey, dirty water and wash-water to deal with.

Much by-product could be saved. From the dripping from the presses much good butter might be made. When the whey is collected without floor washing, the fat might very profitably be collected and rendered into very useful oil. It has been suggested by some that it be separated by the centrifuge and made into butter. When the whey is to be used for food the feeders might object to this diversion of the fat.

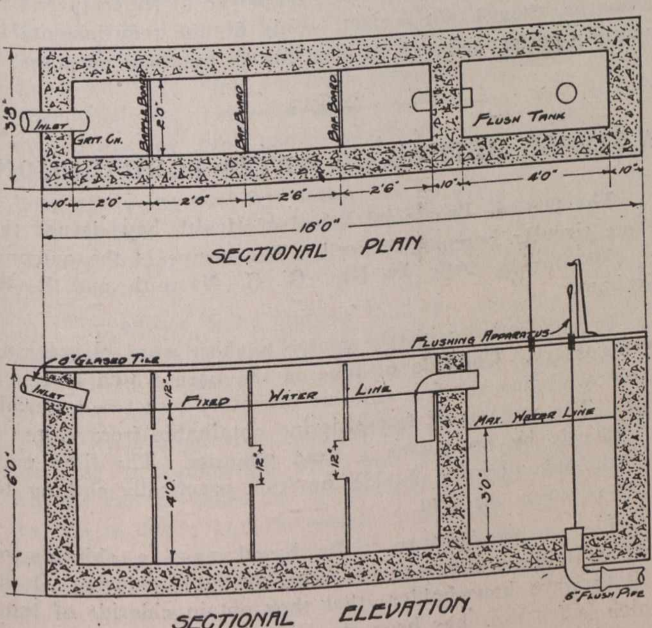
In small factories when the least amount of water possible is used, for washing, and in large factories when only the first washing is to dilute the whey **all should be run into**

*From the Annual Report of the Ontario Provincial Board of Health for the year 1909.

the whey-tank and all used as food. The dilution would be negligible. The extra amount of dirt is only the slightest since most has been washed in by the first flood of whey. In some factories the whey is carried away in barrels, in others it is carried back to the farm in the milk cans. This is the only legitimate reason for separating the washings from the whey. A far more serious objection to using the cans is the carrying of infections, of bitter yeasts, objectionable bacteria, and pathogenic ones from the mixture in the common tank to all of the farms, for it is very rare that the washing of the cans themselves is very efficient, not to speak of sterilization of them before putting the new milk in. The factory then runs the risk of turning out defective cheese, and the disease of one farm is carried to the others. All of these objections could be quite easily overcome, as has been done at the Innerkip factory, by heating the whey in the tank up to about 175° F. with exhaust steam from the engine or by steam directly from the boiler. Not much is required, and a few perforated pipes in whey tanks to let the steam into the whey is all that is needed. The advantages are these: The spread of infection is checked, the whey is brought home hot (an advantage in feeding), the hogs are saved the possibility of developing tuberculosis until such times as the formidable machinery that will be necessary to fight tuberculosis in cattle can be got going.

COLBORNE ONT

SEDIMENTATION AND PURIFICATION TANK.



In those factories using much water the case is different. If the waste is not to become a nuisance it must be treated. The proteid material in it is not difficult to handle; the sugars are not, but the fat which is in a finely divided emulsion presents a good deal of difficulty. Retention in storage for 48 or 72 hours, and the putrefaction that takes place will separate much of the fat, allowing it to rise to the surface. But this longer time even is not wholly sufficient, for putrefaction takes place slowly.

Longer retention means expensive tankage. In both of these factories we have tried a 48-hours retention, and to favor the reactions as much as possible, we have taken advantage of as many of the possible favoring conditions that we could. The tanks are divided into several communicating compartments by baffle boards, so that everything that will fall to the bottom will remain there and all that will float will be held, the outlet being so placed that it will empty from the fluid between the sediment and the scum.

Sandy land was available in both places (one made, the other natural). This was used for intermittent land treatment, but by subsurface irrigation so as to avoid the encouragement of flies, the unsightly appearance and the odors of putrefaction.

Both plants have given satisfaction. There have been no nuisances about either factory. That specific cheese factory odor has disappeared from both localities. During the last two years the flies have been a considerable nuisance in other localities. In these two factories they have practically been absent, and whereas before very legitimate complaint was made about the streams below, no nuisance exists in this regard.

The same type of plant has been installed at each of the factories selected.

These plants consist each of a concrete elongated compartmental retention reservoir or tank of a size sufficient to hold two average days' discharge. From the retention tank the now partially-treated whey passes to a discharge reservoir (or flush chamber). This "flush chamber" is of a capacity sufficient to hold one-half day's quantity of sewage. It is provided with a float indicating when this level is reached. A hand valve is provided to liberate the fluid. The next part of the plant is an "Intermittent land filtration bed." (The land in both cases is of a very porous sandy character, through which fluid drains away quickly). This is of a size corresponding to the quantity of sewage to be treated, taking such land to be able to treat such tank effluent at the rate of approximately 25,000 gallons per acre per day. The sewage is not poured onto the surface of this area, for of necessity the areas are within a hundred feet of the factories. If the discharge was made on the surface, odors and unsightliness would obtain, and besides flies would probably be attracted in large numbers. To avoid all this we have placed garden tile subsurfacelly in rows some two feet apart over the whole area. We have used four-inch tile (ordinary field tile). These approximately hold one-half gallon each. The number then required for one half day's supply is easily calculated out.

Now whatever is left of the sewage after going through this plant into the nearby stream is practically pure water.

The long retention adopted in these plants in the sedimentation tanks, was done with the idea of encouraging all the sedimentation possible and all the separation of floating material, especially fat that could be done within practicability. Whey, when undergoing putrefaction gives rise to a considerable quantity of acid, especially if it is so confined that the acid does not get away. This acid is a considerable inhibitor of ordinary putrefactive bacterial activity, so that time must be called upon to help out. But the putrefaction which takes place, the emulsion sustaining nitrogenous material is decomposed, thus liberating the fat. This then floats to the surface. With larger tank capacity and dilution much could be done to encourage this process, but then one gets into expensive tank construction, and cheese factories cannot go to the expense this would entail.

Detailed Description of the Innerkip Plant.

The daily discharge of waste at this plant averages 1,000 gallons.

The tank proper is 12 feet by 5 feet 6 inches by 5 feet in depth and calculated to hold approximately 2,000 gallons, so as to give a two days' retention.

The flush tank or chamber at the end of the former tank is of a size sufficient to hold 500 gallons. To indicate this to the factory operators a float is provided. A hand valve is

provided whereby the collected effluent may be discharged. The valve consists of a tapering heavy lead stopper fitting into a concrete ring and is operated by a handle from the top of the tank. It has worked very well. On account of its softness it fits very snugly. We did not adopt a copper automatic valve in fear of the action of the considerable quantity of lactic and other acids in the effluent.
if the ends of the tile rows are opened up. The grease in the

One thousand four-inch field tile were placed in rows two feet apart to receive the now half treated sewage, and thus distribute it evenly over the whole area so that each portion would do its share in the final disposal. It is quite admitted that the bed is overworked, but it is only for five months in the year that the plant is required to be in operation. The rest during the next six or seven months is expected to resore its efficiency, and the experience of the last two winters has sustained this expectation.

The tile is buried under 10 or 12 inches of a very sandy soil, which in this case had to be hauled from a distance to make the bed. The soil in the immediate vicinity of the factory where the sewage could be conducted by gravity was heavy clay and not suitable for this sort of work.

The plans 1 and 2 will show in detail the construction of this plant.

Detailed Description of the Plant at Colborne.

The daily discharge of sewage from this factory is from 200 to 250 gallons.

The sedimentation tank in this case is 9.5 feet by 2 feet by 4 feet in depth inside measurement, and calculated to hold approximately 450 gallons, or two days' discharge.

The flush chamber is constructed like the one at Innerkip, with a capacity of about 150 gallons. The valve and float are the same as at Innerkip.

The subsurface irrigation is carried on through 300 four-inch farm-tile, buried from 10 to 12 inches below the surface in a good, porous, natural soil.

The plans 3 and 4 will show in detail the construction of this plant.

These plants have now been in continuous operation during two seasons.

At the end of each season the first compartment in each had about one foot of scum on the top and about one foot of sludge at the bottom, the next chamber had about six inches of scum and the same of sludge, the next about two inches of scum and the same of sludge; the last chamber had only about one-half inch of scum and about the same of sludge. The effluent passing into the flush chamber was still turbid and contained some suspended matter, but was much less turbid than the fluid in the grit chamber or first compartment.

The odor was bad when the cover was lifted, but was not noticed in the factory, for the vent pipe was carried to above the roof, and escaped high enough up. The scum if rendered down ought to yield quite a quantity of good fat for, say, tannery purposes. The sludge will have to be taken out or buried or disposed overland. It is all organic matter; nevertheless it has not disappeared, as it was once claimed by septic tank promoters would happen. But one cleaning a year is not a hardship. It is localized and not all over the neighborhood.

No trouble has been experienced with the tile. However, they were not without deposit in them. They contained about one-quarter of their capacity of sludge, made up of little pieces of casein and fat chiefly. The earth about the tile was not sludge at all. The inside of the tile was greasy throughout their circumference. This sludge can be cleared out from the flush tank by using two or three quantities of clean water pipes can in great part be removed then by flushing with boiling water, thus avoiding the necessity of removing the tile, which we quite expected to have to do every two years at least. Standing over all the winter after this was done would about complete the removal of the fats from the inside.

When butter-making is being done there is no sewage being produced necessitating the use of the plant.

At Colborne the results are precisely what were found at Innerkip.

Bacterial treatment in these two cases has not been able to remove all of the organic matter, but has removed much, but with some mechanical aid has given excellent practical results.

From the above the conclusion is justified that when little water is used sewage disposal is not necessary. All of the washing and the whey, if whey tanks enough are provided, should be hauled away to supplement hog feeding. Any infection or ordinary dirt in it can be rendered harmless by a simple sterilization.

The laundry water would be dangerous on account of the alkalies used. This water could be efficiently dealt with on the ground of the neighborhood, provided it is not discharged on the same spot each time it is thrown out. It is not greater in quantity than the laundry water of an ordinary fair-sized household. If a large quantity of water is used, the whey would be too much diluted. The washings and flushings should be treated. The method employed at Innerkip and at Colborne, though not perfect, would fill the requirements in nearly a perfect manner, at least for all practical purposes.

A SIMPLE METHOD OF WATER PURIFICATION.

The Ontario Provincial Board of Health have issued the short circular here reproduced. The recipe is the outcome of experiments made by Drs. G. G. Nasmith and R. R. Graham.

In connection with the recipe a short word of warning is necessary. Chloride of lime is the base which is relied upon to produce the free chlorine necessary to act as a germicide. The amount of free chlorine obtainable from chloride of lime is by no means a fixed quantity. The lime may contain any quantity of chlorine from practically nothing to between 40-50 per cent.

The recipe appears to be based upon a chloride of lime containing about 30 per cent. available chlorine. It is well to warn householders that they obtain chloride of lime which is fresh or has been stored under due protection, and in connection with which a warranty can be given by the vender.

Chloride of lime very soon loses its efficiency as a disinfectant if exposed to the air or kept in a damp place.

Copy of Recipe.

A level teaspoonful of chloride of lime should be rubbed into a teacup of water. This solution should be diluted with three cupfuls of water, and a teaspoonful of the whole quantity should be added to each two gallon pail of drinking water. This will give .4 or .5 parts of free chlorine to a million parts of water and will in ten minutes destroy all typhoid and colon bacilli or other dysentery-producing organisms in the water. Moreover, all traces of the chlorine will rapidly disappear.

This method of purification has been tested with Toronto Bay water inoculated with millions of bacteria. Every germ has been destroyed and it has been unnecessary to boil the water.

This method should be very valuable for miners, prospectors, campers, and those living in summer resorts where the condition of the waters might not be above suspicion.

Additional copies may be had from

JOHN W. S. McCULLOUGH, M.D.,
Chief Health Officer for Ontario.

ELECTRIC STEEL REFINING.

By D. F. Campbell.

The use of electricity for the refining of steel has now taken its place amongst established metallurgical processes, and many papers have been written on the subject of electric furnaces, but the author proposes to discuss briefly the general aspects of the subject, and what he considers the probable and possible developments in the immediate future in England. The electric furnace is at present used in various works for the refining of steel from the Bessemer converter in the manufacture of rails and all classes of railway material and castings, and more commonly in connection with the basic open-hearth process for the manufacture of various products of intermediate quality, castings and tool steel of all kinds. These are the purposes for which it has been most widely adopted notably in America, Germany, and France, though it is also used for melting and refining charges of cold scrap of cheap quality for the manufacture of tool steel and small castings and its high efficiency is now generally acknowledged. The refining of steel that had been previously melted was the first use to which the electric furnace was applied commercially; but now that single furnaces have been producing over 200 tons a day for more than 16 months, it is obvious that the field for the process has widened, and already many furnaces are in construction or operation in this country.

The author is of opinion that the electric furnace is especially suitable, and will be widely adopted, for any class of work in which raw materials of a high degree of purity are now used.

A wider application for rails and sections may occur when working in connection with the Talbot furnace, for the charge can be taken to the electric furnace as soon as the carbon is down, and the necessity of removing the sulphur and getting a teeming heat is avoided, and this is done in the electric furnace both economically and completely. Thus the capacity of the Talbot furnace is substantially increased, and this covers the greater cost of electric refining.

Again, in the case of a basic open-hearth plant, using 60 per cent. of molten pig-iron and 40 per cent. of scrap, a 40-ton furnace might have 15 tons removed to the electric furnace for refining, and a similar charge put in every two hours. Thus the capacity would be increased, the quality improved, and in addition, a reduction in the cost of raw materials can also be made in some cases, as a low quality of pig-iron can be used.

Similar conditions occur when working in conjunction with an open-hearth plant for making castings, and a thoroughly dead melt and extreme fluidity can be obtained, while the commonest raw materials can be used, and refined completely. This gives economy both in the amount of grits and runners, and also in the reduction of wasters. Even in the case of foundries engaged in ordinary open-hearth casting work, in which the margin of profit is now exceedingly small, the electric furnace is considered necessary for an improvement in quality, while in a small foundry making light and intricate castings from crucible steel, an economy of several pounds per ton may be expected to result from the adoption of the electric furnace, judging from the reduction of the costs in works in Germany where crucible furnaces were replaced by this process.

There is little doubt that crucible steel, Swedish billets, and products of intermediate quality, such as are used for the Sheffield trade, and by tube-makers of Staffordshire and South Wales, can be economically replaced by steel refined by electricity, and made in Middlesbrough, Cumberland, or the larger steel-works in the Sheffield and Rotherham districts.

The use of the electric furnace is not likely to become general for rail steel manufacture at the present time, except in cases where the conditions are exceptional. In certain cases, such as South Chicago, it has been adopted for that purpose, owing to the economic conditions, notably the scarcity of good Bessemer ores and the demand for better rails. The electric furnace in such cases may save Bessemer plants from the scrap heap, or, at any rate, prolong the life of present installations, and at the same time make it possible to produce rails of a quality better than the best open-hearth steel, thus avoiding heavy capital expenditure.

In the electric furnace almost any degree of refining can be economically effected, and the removal of sulphur, phosphorus and oxygen is especially easy. This is probably due to at least three causes: (1) The intense heating of the slag, which is the place at which refining takes place. Owing to this high temperature and the extreme fluidity of the slag, the rate of refining reaction is very great, because the velocity of reaction rises very quickly for high temperatures, and not in direct proportion to the temperature. (2) The extremely basic slag that can be kept in a very fluid state, and the calcium carbide formed by the action of the arc on the calcareous slag, are especially advantageous for desulphurization. (3) The violent motion of the steel, which results from the convection currents produced in the bath due to the two intensely hot areas caused by the arcs below the electrodes, increases the volume of steel exposed to the hot and fluid slag area, and hence the rate of refining.

The usual procedure for the use of the electric furnace in connection with the Bessemer converter is to charge the steel, holding back all slag in the ladle after putting on the bottom of the furnace lime and mill scale or iron ore. This produces an oxidizing or dephosphorizing slag, which may be carefully skimmed or poured off. On the bath of steel carbon is thrown to carburize to any required degree, and then a second highly basic and desulphurizing slag is added. The arc acting on the calcareous slag produces calcium carbide, which may combine with sulphur to form calcium sulphide. As neither gases nor air enter the furnace, and the conditions are almost completely reducing, no sulphates are formed, a dead melt is easily obtained, and when the slag is molten and the requisite heat obtained, the steel is teemed. In the open-hearth or any oxidizing furnace these reactions cannot take place so completely and efficiently.

With steel from the basic open-hearth furnace, the procedure is similar, but when the quantity of phosphorus to be removed is small, it is only necessary to use one refining slag for the elimination of sulphur and any small amount of phosphorus remaining. The usual practice is to put the carbon necessary for carburizing in the bottom of the

*Read before the Iron and Steel Institute.

furnace and then add the steel, and the basic slag materials. As soon as the teeming heat is obtained, the necessary ferro-alloys are added and the steel will be completely refined.

Another point of interest is the rarity of blow-holes in electric steel when properly made, and this leads to the question of the cause of these troubles. It is well-known that any ingot of steel when placed in a vacuum evolves nitrogen, and this is about equally true whether it be made in the crucible, the Bessemer converter, or the electric furnace. Blow-holes contain nitrogen, but this is probably not the cause. It is far more probable that they are due to the combination of oxides with the carbon in the process of cooling, and that the carbon monoxide so formed at a high temperature causes blow-holes in the cooling steel, and owing to the diminution of volume of the carbon monoxide on cooling, a partial vacuum is formed, and nitrogen is sucked into the blow-holes. In electric steel, oxides do not occur in any quantity, and consequently the prime cause of blow-holes is reduced.

Again, the quality of electrically refined steel is better than a material of similar chemical composition made in any oxidizing furnace. This is probably due to the reducing conditions under which it is finished.

It must not be forgotten in discussing these special qualities of electrically refined steel, that some inferior material has been made by incompetent melters or ineffective furnaces, and that the electric, just as much as any other furnace, required trained men, and most careful designing by metallurgists who have made a special study and had practical experience in this subject.

The question of the cost of applying this process, which must be considered before all others, is more difficult to discuss generally, owing to the great variety of conditions. The following are the chief points, all of which must be carefully considered in each particular case:—

(1) The possibility of saving in cost of raw materials since the best qualities of steel can be made from impure raw materials. For example, in the case of refining steel from open-hearth furnaces in the South Staffordshire district, the use of local pig-iron as compared with hematite iron would effect a saving of several shillings per ton owing to the high railway rates.

(2) Possibility of increasing the output of present furnaces by the addition of electric furnaces, with improvement of product. For example, in the case of Talbot and other open-hearth furnaces, where a large expense is incurred in the removal of sulphur and getting a teeming heat, the steel can be advantageously transferred to an electric furnace for desulphurization and the output materially increased. The Talbot or other tilting furnace is especially satisfactory owing to the facility with which charges can be transferred to the electric furnace, whenever required.

(3) The cost of power and possibility of using blast-furnace or coke-oven gas, exhaust steam, etc. will be the determining factor in regard to deciding whether, in the manufacture of steel, electric refining can be economically adopted. In the case of cheap power or valuable products, scrap may be economically melted and refined in the electric furnace at a current consumption of 700 to 800 kilowatt-hours per ton, or if the price of power be high, the steel may be merely desulphurized and deoxidized, after melting and dephosphorizing in a basic furnace, with a power consumption of 100 to 150 kilowatt-hours per ton.

(4) The possible reduction of capital expenditure at certain works where the present products are not sufficiently good for modern specifications. This may involve the entire re-organization of the works, but it is often cheaper and more efficient to add an electric furnace to a Bessemer plant, than to replace the latter by open-hearth furnaces.

The author does not wish to compare the different types of electric furnace in this paper, but the figures given are taken chiefly from Héroult furnaces in America, England, Germany, and France, as this type has been far more widely adopted, and is used in larger units than any other, and single furnaces are now refining 250 tons per day. This furnace is similar to a basic open-hearth furnace, and seems to present more simplicity and to embody more of the desirable features of electric furnace design than any other, which, in the author's opinion, are—

(1) The best basic open-hearth design should be followed as closely as possible. A bottom homogeneous and solid, and banks free from embedded electrodes, are important, and above all simplicity of design.

(2) All electric mechanism, in the form of generators, transformers, etc., should be entirely separate from the furnace, should work under ordinary conditions of standard electrical practice, and should be of standard design, so as to avoid all unnecessary risks and complications.

(3) A high power-factor must be maintained, thus reducing the capital cost of machinery, and increasing the general efficiency of the power-house.

(4) To avoid excessive cost of refractory materials, the roof should be protected from the direct radiation of the arcs by the electrodes themselves, and the intensely heated area of slag should be as large as possible, to increase the surface of refining action. The Héroult furnace has an advantage over the open-furnace in that the heat is applied to the centre of the bath, so that the banks are not quite so hot as the middle of the furnace and the wear of refractories is consequently less.

(5) The heat should be applied to the slag, as in the basic open-hearth furnace, and the temperature of the slag should be maintained above that of the steel, which allows of extreme basicity and fluidity being obtained and gives an intensely active refining action. The conditions in the furnace should be oxidizing, neutral or reducing, at will.

The adoption of electric refining will cause some readjustment in the steel trade. As soon as the Sheffield steel-melter has become acquainted with the process, and accustomed to the working of electric furnaces, electrically refined steel will largely replace ordinary crucible steel. This has already occurred in Germany and America, where electric furnaces are used to make all classes of special and high-speed steels, the usual practice being to refine metal from a basic open-hearth furnace. Large crucible plants and small open-hearth furnaces engaged in the manufacture of small and intricate castings such as motor-car parts, etc., may be replaced by electric furnaces, because the high degree of fluidity and dead melt obtained is especially advantageous.

In many cases manufacturers of axles, guns, and tubes will abandon the use of Swedish raw materials, and refine steel made from low-grade ores, thus reducing the value of high-grade ore deposits and the quantity imported; for, by the use of electricity, Cleveland stone will produce a steel equal to the best hematite ores. The capacity of many Talbot and basic open-hearth plants will be increased and the quality of the product improved, while much of the power that is now going to waste will be utilized for steel refining.

From the electrical engineer's point of view the electric furnace is an attractive load, as it is more or less in continuous operation. In the case of the Héroult furnace the power factor is 0.88 to 0.90, though much less with large induction furnaces. Single, two, or three-phase current of any frequency from 20 to 60 has been used without any difficulty, though it is preferable in the case of a two-phase system to transform to three-phase current, which can be done without additional difficulty or expense. The load factor will be most favorable, the usual practice when refining, for example, in a 15-ton furnace, being to use 2,000 kilowatts for 20 minutes after charging, while the steel is being heated. The current is then reduced to about 1,500 kilowatts for 45 to 75 minutes until the steel is ready for teeming. There is then an interval of ten to fifteen minutes during which the furnace is teemed, fettled, and charged, which allows the transformers or generators time to cool before the period of overload commences. Current fluctuations occur for a few minutes, while there is an evolution of gas from the steel which makes the bath boil up and touch the electrodes. This, however, is not sufficient to be objectionable, provided that the electrical machinery is properly designed for the purpose, and the extent of these variations is not so great as in the case of many rolling mills, the fluctuations in voltage being only about 3 per cent. in the South Chicago works, where a 2,000-kilowatt furnace has been working steadily since May, 1909.

The subject of electric steel refining is now receiving the attention of many steel-makers, and it is hoped that these notes may lead to a stimulating discussion, not only of the many interesting and debatable questions in relation to the operation and design of these furnaces, but also of the more important and far-reaching economic and commercial problems which this process has created.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

A very interesting and instructive address was delivered on Thursday last before the Toronto branch of the Canadian Society of Civil Engineers at the Chemistry Building, University of Toronto, on "New York Sky-scrapers, Foundations for Bridges and Buildings, and the Removal of a Seventeen-storey Building" by Mr. T. K. Thomson, C.E. The lecture was illustrated with the stereopticon, and the slides in every case gave an excellent idea of the various works.

Some good photographs of excavation work were shown first, showing the man-tubes and the excavating shaft. The force of the rush of sand in the suction through the tube was described as being exceedingly forcible in its action. Great danger exists in the amount of air pumped in. Too much pressure had been known to cause great havoc in the surrounding masonry and all connected fixtures. In excavating for a bridge in St. Louis dredging in the open had been tried out, but it was slow work. The use of plenum pneumatics and caissons filled with concrete is now prevalent. The first pneumatic tube is to be found about 1830, used by Sir Thomas Carton. The pump diving-bell originated in 1778 under Smeaton. In 1896 the Mutual Life, with foundations 32 feet under water, was placed by putting a line of caissons all around. The method used was the pile-driver. Pellets of clay were put down a 10-inch pipe and driven. Five hundred cubic yards of masonry were used. The method now in practice is to put in air-lock, excavate, and fill up with concrete. One of the dangers from the air-lock is the danger of fire, owing to the exceeding great amount of oxygen which is present in a certain space. The present way of filling caissons is to drop concrete, sometimes a distance of 60 feet. This ensures solidity and compactness. Probably the largest single caisson was one for the East River Bridge, having the dimensions of 46 by 136. In this case one air was 46 feet wide. Some interesting views were shown of caissons on floating pontoons for river or sea work. It was pointed out that considerable difficulty often attaches itself to the sinking of such caissons. First one end will be top-heavy and then the other, and almost to the last the contractor does not know exactly how it is going to turn out. Should it fail to sink properly, it would entail practically a total loss. Views were shown of various stages of caisson-sinking, and the consequent difficulty arising was pointed out. In the case of a bridge pier that was erected, 23 by 119 feet in dimensions, small and large caissons were laid. In the case of the Singer Building, Mr. Thomson pointed out that the caissons were 60 feet below the street. The question had frequently arisen, that if so great a depth was reached, and so great a weight seemingly was placed upon these supports, whether the final stress would not have a serious effect upon New York. But it was shown that inasmuch of the city's building laws would not allow more than 15 tons pressure per square foot, the impression first gained of the immense pressure was not true, and that the pressure is not so great as it might at first seem. The friction is an immense consideration of sinking a caisson through earth. The popular notion is that a caisson would sink almost of its own weight. The fallacy of this idea is shown most remarkably by the fact that blocks of iron weighing 1¾ tons each are used to overcome this friction, and many blocks are used even then.

One very remarkable incident in caisson work occurred in New York during the sinking of numerous caissons. One had been sunk, but bed-rock had not been reached. The caisson was abandoned, but finally a contractor arranged to utilize it. His procedure was to tunnel under some feet below the caisson, and when he struck bed-rock he excavated under half the caisson, and filled this excavation in from bed-rock to the caisson. He then excavated the rest and filled it in, thus bringing the caisson upon bed-rock. This is the only case in which a caisson has been tunnelled under when once down.

Mr. Thomson had on hand, besides numerous views of the actual working operations, many splendid photographs of the large sky-scrapers, especially those of the Metropolitan Tower, Singer Building and Park Row Building. One plate gave a comparison of the lofty architectures of the world, showing the sky-scraper alongside of St. Peter's, the Pyramids of Egypt and other historic structures. The marvellous period of time and small number of men needed to erect one of these present-day structures as compared to the gigantic space of time and the millions of men used in the building of some of these marvels of history fittingly showed the advance which modern machinery and modern methods are making.

Mr. Thomson cited an instance which showed the great danger from over-pressure of air or lack of strength of masonry. In forcing air in, in one instance, the pressure was so great that it forced up through 60 feet of ground and destroyed all the work. In one case six inches more masonry on top would have saved the caisson, but it was totally wrecked, as the tide came up and lifted all.

Pile-driving was also discussed quite extensively in the lecture. Mr. Thomson said that the mistakes of inspectors are responsible for a very large number of broken, wasted piles. The pile is often driven in as long as it keeps moving at all, when often they are being broken and twisted, as was well shown by illustrations of such piles. In one job fully 30 per cent. of the piles were spoiled in this manner. Where a caisson is 100 feet under water a large volume of compressed air cannot very well be put in, so piles are sometimes driven to get the bed-rock, and compressed-air drills are also used. From 160 to 600 pounds to the square foot are loaded with safety on piles. In shoring up buildings the mistake is commonly made of trusting too much to a pile than is good for a safe load.

Mr. Thomson stated that the Municipal Life Building had been one of the most extensive undertakings in caisson work. Going down about 140 feet below street level, there had been 106 caissons put in in this job. During a mishap, in which the air-pipe broke, 46 feet of water collected in the shaft in 16 minutes. Going down about 112 feet below water, concrete and cast-iron blocks were used to overcome friction. A pressure of 48 pounds to the square inch was exerted.

The seventeen-storey building Mr. Thomson referred to was moved to make room for the new Bankers' Trust Building, in process of building. The old building was 23 by 75 feet; the new will be 100 feet square. In preparing to pull down the old building a 5/8-inch steel cable was placed around the building, a 1¼-inch mesh wire netting placed on this over the street pavement, then a net of a finer mesh placed over this. To test this safety precaution a crowbar was let fall 150 feet upon it, and it held it. The old building had been built of first-class material, but in any spaces between the brick and steel a serious rusting of the steel was detected. Nine feet of steel which was below the water line, that had tar, red paint and lead on it, was in good condition. Some serious defects were found in the concrete work not being solid. The building was torn down in forty-five working days.

During the lecture, in illustrating and amplifying his remarks Mr. Thomson showed about ninety excellent views of places and active operations. There was a large and appreciative audience present, both from the Society and the School of Practical Science.

Mr. Thomson, in reply to a question, stated that 45 to 48 pounds was about the greatest pressure thought safe to have in the air chamber. At that pressure the men work in shifts of three-quarter hour's duration. There are two shifts, and seven and one-half working hours a day.

THE TRUE COST OF POWER.

That the real cost of purchased power includes not only the price paid for the purchased power but also the fixed charges and running costs of whatever make-up power plant is maintained by a factory, is a fact that seems to elude the grasp of many business men when they face the problem of power supply. When nothing but outside power is used, there is, of course, little difficulty in the reckoning; but in many instances factories of various sorts have expanded in such a way that the purchased power is sometimes insufficient or unreliable, and constant operation of the factory means the installing of a full-power independent plant. When it becomes necessary to install a full-power plant for make-up use it is nearly always cheaper to depend altogether on the independent plant and give up the purchased power.

This fact is shown with particular clearness in a recent report by F. W. Dean, mill engineer and architect, of Boston, on a plant which was buying electric power which was often insufficient during the hours of the heavy lighting load, and sometimes failed entirely. An 80 k.w. generator, run from the company's own steam plant, had been used for make-up power, but a prospective need for the output of a 300 k.w. generator, or fully double what had been purchased, brought up the issue of installing a full-power independent plant. Mr. Dean showed that under the conditions the company could make a large saving by making all its power in its own plant.

The purchased power cost $24 per horse-power per year, the charge being based on the maximum reading of the ammeter each day. The average actually used was 123 horse-power, while the maximum reading was 138 horse-power. The former is 89 per cent. of the latter, and the real cost of power to the company was, therefore, $24, divided by 0.89, equals $27. The real cost of power to the company if it installed a full-power plant for merely make-up use would be this $27 plus the fixed charges on its own engine plant, together with some other charges, such as a portion of the coal used, part of the labor costs, etc., of the steam plant that was required apart from power needs.

Mr. Dean made detailed estimates for three different types of independent full-power plant, providing for the needs that were reasonably within sight in view of the rapid expansion of the company's output. A 1,000 horse-power Corliss steam plant, with generators, house and all auxiliaries, including flue and chimney, gave a cost per i.h.p. per year of $19.19, which, by separating the portion of the charges due to non-power use of steam, came down to about $18 per i.h.p. per year. A producer gas plant, with engines and two 300 k.w. generators, gave a cost of $17.18 per i.h.p. per year. Steam turbines were not figured to such detail in operating costs, but the estimates, providing for two 300 k.w. steam turbines and a complete plant, including generators, showed an installation cost of over ten dollars less per i.h.p. than either gas or reciprocating engines. The cost of operation would be less than that of a reciprocating plant and not higher than that for gas engines; the turbines were, therefore, recommended. It is plain that in any one of these three ways the company could provide itself with full power at much lower cost than by purchasing power at the rate named, even without installing a make-up plant; and that if the needed make-up plant was to be of full capacity the cost under those conditions would be nearly double the cost of independent full power.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS WILL MEET AT WINNIPEG, MAN., JANUARY 24th, 25th, 26th and 27th, 1911.

ROADS AND PAVEMENTS

ROADS AND TRAILS.

Many had lost sight of the most important point, namely, the impossibility of locating good roads so long as the Ontario law obliged the placing of the road allowance upon the survey section lines instead of upon the grade contours as nature made them. In the old countries there are no section lines, and new roads are located by an engineer in strict accordance with the topographical features of the country, upon the best economical grades and curved lines that the country permits of.

Take as an illustration a country well known to the writer, where long sections of road have been built, including such work as grading round a rough, rock-bound coast, including short tunnels, sea coast protection, metal bridges, sunk cylinders, masonry, arch bridges and culverts, etc.

In the county surveyor's office one engineer took charge of the roads, laid them all out, designed their structures, etc.

When a new road was to be located and built, this man made a preliminary survey, whereby he obtained a plan and profile. To locate this road, the same engineer would employ about half a dozen men (in tolerably clear country) and buy a bundle of plasterer's laths. He would be seen to go ahead with his preliminary plan and profile in hand accompanied by a man with the laths, and to be occupied in placing these in a grade contour line so far as possible, forming the centre line of the road. Behind him would come two men, chaining and staking 100-link lengths of a statute chain (66 feet), and behind them again would be two men levelling. Last of all would come one man picking up laths and taking them forward to the man in front, who was along with the engineer marking the course of the centre line. After this was finished, the centre line would be traversed (in a country of which no maps were procurable) and all the stakes offset from the traverse line to form permanent record and plan. This last was the practice used by the writer in South America for the very hilly road between Valparaiso and Casa Blanca, to remove the public road from the watershed of the Valparaiso waterworks. This practice differs only from our ordinary railway survey in the fact that it requires a better trained eye than that which is required for railway work, which consists of an elaborate system of contours that consume more time and cost more money. These laths being of equal lengths, their tops indicate more or less the uniformity of the grade the engineer is marking by eyesight, from point to point, and his preliminary plan and profile does for him the rest. In a short editorial the Toronto "Globe" approved of the letter referred to for its practicability, and recommended it to those interested in the Good Roads movement.

For quite a different reason it may be said that the practice here described applies in great measure to the trails and roads of the Upper Country in British Columbia, than upon some of which it would be impossible to conceive how money could have been more improvidently spent, due to the fact that these trails and roads were not generally subjected, first, to a method practical, yet scientific, rapid, yet definite, but more often laid out by some road boss or local expert, who never knew that falling from a summit one should not rise, and rising to a summit one should not fall, and that for packing purposes with animals one should avoid creek crossings with soft bottoms, where animals are sure to mire before repairs can be made. There are trails inside the bend of the Fraser River where a man going in to mine some years ago lost his whole pack-train, loaded only 250 pounds each, and where an engineer exploring a railway line durst not pack his animals over 150 pounds each.

There is a main road leading to the 150-Mile House that had upon it some years ago a hill that reduced the traffic capacity by 50 per cent. of the load that could otherwise be carried, and thus without necessity for such a sacrifice. These defects remind one of the Irishman's opinion when the election candidate was discussing absentee landloards, he said: "Begorra, yer honor, the courthouse is full of them." To have built all these trails and roads upon the best lines in the first instance might have been difficult, although not so costly as their future conversion into anything like efficient work.

There are some examples of trails cut in the Upper Country that were faily good, most of them by the Dominion Government about thirty-six years ago, more or less, being old survey pack trails of the Dominion Government survey of the C.P.R. before the days of the company. The old telegraph trail, which bore marks of care in its exploration by duly qualified engineers, was undoubtedly an intelligent and well-placed work, as also the trail from Kamloops up to Tete Jaune cache. With the lapse of time facilities improve, and, as we have arrived at the time when the general public all over the continent has become interested in good roads, there should no longer be Government trails nor roads constructed except upon some scientific basis, such as that above described, thus finally forming out of that which was first a trail the route of a good road.

The system here advocated can be used for either clear or bush-covered country. If the latter, the leveller is in front with the engineer, and the transit or zenith instrument behind. The sequence of operations would be: (1) Cut first the trial line and survey pack trail. (2) Cut second the centre line of a good road or trail as described. The final result will be a well-placed and efficient public work upon which the best roads can be packed or hauled that the configuration of the country will admit of. The final result of work done at random, without any basis of definite technique, will never be other than guesswork, including costly rectifications. It is just as important in the public interest that a trail, to be finally converted into a good road, should be properly located in the first instance as it is that a railway line should be treated in a similar way. There are many other points in the same connection that will suggest themselves to those accustomed to road-building, but enough said now to illustrate the importance of the omission above referred to. Treating of trails, it may be pertinent to note that one of the most useful still left to open up the country east of and parallel with the coast range is spoken of in the local press as possible.

This is the trail that should have been cut any time in the last thirty-five years; in fact, as soon as possible after the Waddington Road, via the Homathco River, was abandoned.

The building of this trail would probably have resulted in the settlement of the whole flank of the coast range from the head of the Homathco River up to the Blackwater. This, instead of obliging the people now, there within fifty miles of the coast to go round 300 to 400 miles in order to reach the salt water. There is a large extent of country there, nearly all of it inside the northern limits of the bunch grass country, abutting upon the eastern toe of the coast range, much of it irrigable and capable of affording the finest water-powers in British Columbia. The only thing that need surprise one is that the settlers throughout the Chilicotin country did not leave it fifteen or more years ago, due to the hopeless want of foresight of the powers that were. Since then the Klena Klene River has been explored, from which the head waters of the Homathco are accessible, and quite likely the Loughborough Inlet could be joined up with the Klena Klene or by another route, which would pass through the heart of the lumber country as at present situated. With reference to the present settlers, it might reasonably be urged that those interests which have suffered the longest with the last reason should receive consideration amongst the first.

OIL ON CITY STREETS.

George Clark, A.M. Can. Soc. C.E.*

The experiments with oil on the city streets were carried on with two objects in view. The experiments were to determine the efficiency of oil as a dust-laying device, and as a means of binding together the particles forming the surface of the street, to make a temporary pavement, and so improve traffic. The oil was claimed to contain 35 per cent. asphalt, and suitable for the attainment of this two-fold purpose.

The oil was applied on two pieces of street, and the cost per square yard was 22.67 cents. It seems to me that the following reasons are sufficient to warrant a discontinuance of the application of oil on the streets:—

1. A great many complaints have been made by residents, and not without reason, I think, of damage done by oil to carpets and clothing, and if all the streets were oiled the grievance would be very much aggravated.

2. In case of high wind storms it is not so much the dust on the business streets that create a nuisance as that which blows in from outside areas.

3. The oil does not bind the surface of the road to make it waterproof, and consequently the streets are not improved for traffic.

4. Assuming that oil as applied lays the dust for three months for each application, the cost per square yard per day would be 25 cents, whereas the application of water at 10 cents per 1,000 gallons cost .053 cents per square yard per day.

I would, therefore, recommend that four additional water carts be purchased, to be ready for operation in the spring.

The results of the experiments were that the fine dust had been laid effectively for a time, and that the larger particles of sand and clay, saturated with oil, instead of knitting, have become granular, and will not bind together.

Another experiment was made on Avenue E, from Seventeenth Street north. Believing that in the first experiment the fineness of the particles and the shallowness of the loose material were not conducive to the best results being attained, it was decided in the second experiment to remove the top surface. This was done, and the soil was then worked up until there were six inches of loose material, which consisted of about equal proportions of clay and sand.

A third experiment was made by taking a quantity of sand and adding to it sufficient clay to fill the voids as determined by the water test. A quantity of oil was then heated to a temperature of 150 degrees Fahrenheit, and sufficient of it added to the sand and clay to make a paste. This was placed in a three-inch layer of the street and thoroughly tamped. The results so far seem to be the same as those obtained from the use of the unheated oil.

Cost of Experiment No. 1.

Cost of preparing the street—One team and man, 21 hours at 50 cents	$ 10 50
One man, 22 hours at 25 cents	5 50
Oil applied, 1,020 gallons at 14.5 per gallon	147 90
Cost of applying oil—Two men and team, 16 hours at 75 cents	12 00
Proportion of cost of attachment	60 20
Seven yards of gravel at $2	14 00
Road roller, 5 hours at $1 per hour	5 00
Gasoline engineer, 5 hours at 30 cents per hour	1 50
Five gallons of gasoline at 22.5 cents	1 15
Foreman, 5 days at $3 per day	15 00
	$ 272 75

Area treated, 977 square yards.

Cost per square yard, 20.75 cents.

Cost of Experiment No. 2.

Cost of preparing street—One team and man, 87 hours at 50 cents	$ 43 50
One man, 90 hours	22 50
Oil applied, 4,900 gallons at 14.5 cents	710 50
Cost of applying oil—Two men and one team, 60 hours at 75 cents	45 00
Proportion of cost of attachment	210 75
Road roller, 22 hours at $1	22 00
Gasoline engineer, 22 hours at 30 cents	6 60
Twenty-two gallons of gasoline at 22.5 cents	4 95
Foreman, 5 days at $3	15 00
	$1,080 80

Area treated, 4,993 square yards.

Cost per square yard, 21.65 cents.

Total area treated in two experiments, 5,970 square yards.

Total cost, $1,353.55, or an average of 22.67 cents per square yard.

*City Engineer, Saskatoon, Sask.

STREAM MEASUREMENTS FOR THE DOMINION GOVERNMENT IN ALBERTA, SASK.*

One of the most important resources of a country is its water supply. In the arid and semi-arid regions, the limit of agricultural developments is determined to a considerable extent by the amount of water available for irrigation, while in all parts of the country the increase in the population of cities and towns makes necessary additional water supply for domestic and industrial uses, in procuring which both the quantity and quality that may be obtained must be considered. The notable advances made in electric transmission of power have led to the utilization of water powers for the operation of manufacturing establishments, railroads, and municipal lighting plants, many of which are at some distance from the places at which the power is developed.

The success of future irrigation development in Alberta and Saskatchewan depends to a large extent upon a correct estimate of the water supply available and the permanency of that supply. Frequently applications to purchase lands under the Irrigation regulations cannot be dealt with for a considerable time and sometimes not at all, owing to insufficient information as to the water supply. In dealing with projects which must depend entirely on high water and flood stages it is very important that both the quantity of water at those stages and the probable duration of those stages, should be known. Applications to divert water from streams upon which the Department has made no investiga-

*Abbreviated from a report presented by Mr. Sauder to Mr. R. H. Campbell, Superintendent of Forestry and Irrigation.

tions, are often received and cannot be dealt with until an estimate of the water supply can be made. This often discourages investors, who naturally feel that they must depend on the Government for the information as to water supply and do not care to invest money in a project depending almost entirely on a resource of which so little is known. Reliable information can only be obtained by years of systematic observations, and private enterprise cannot be expected to do this.

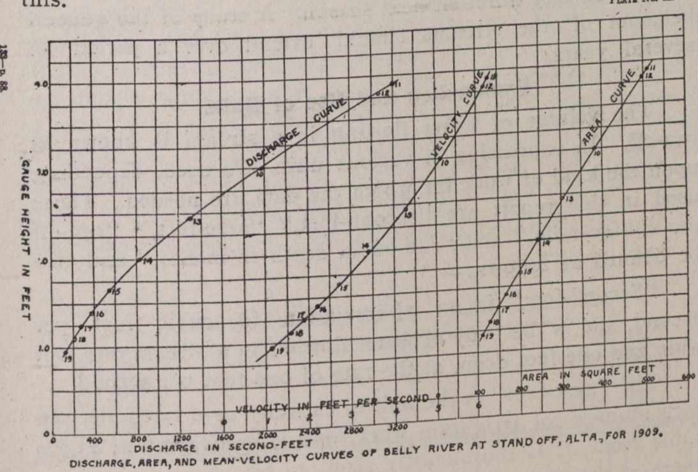


Fig. 1.

The flow of a stream varies greatly from year to year, and yet the engineer is often expected to make estimates and prepare plans from observations extending over a short period. Systematic observations should be carried on over a period of several years to determine the general behavior of a stream. Many failures of large power, irrigation and other projects have been due to the fact that the plans were made without sufficient information regarding the water supply.

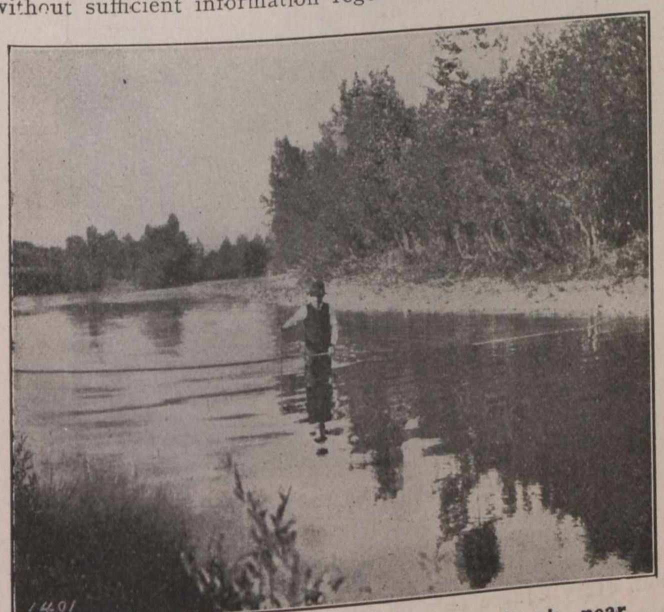


Fig. 2.—Measurement by wading, Fish Creek, near Priddis, Alta.

On the information furnished by the Government on the water supply, will depend to a very great extent, the development of water power in Canada. It only takes a short time to locate a good power site and determine the amount of power which can be developed when the water supply is known. Very often the hydraulic engineer has to spend a year or more in making observations of the discharge of a stream before he can make an estimate of the water power, and in many cases it has been found that the possible water power development has been much over-estimated and in other cases much under-estimated.

Many problems in connection with municipal water supply, stock watering, mining, sewage disposal, navigation, etc., are readily solved when definite information on the water supply is available. In the United States, where stream measurements have been carried on systematically for several years, interested parties need only apply to the Government to obtain full information on the flow of almost any river.

The records of stream flow published by the Irrigation Surveys give a fair approximation of the discharge of the principal streams in Southern Alberta and Saskatchewan at the different stages, but do not give the duration of the periods of high and flood discharge. As the water supply in some of the larger streams is apparently almost all recorded, the necessity of carrying on a systematic observance of daily discharge is evident.

The chief features of the hydrographic work are the collection of data relating to the flow of the surface waters and the conditions affecting this flow. Information is also collected concerning the river profiles, duration and magnitude of floods, water power, etc., which may be of use in hydrographic studies.

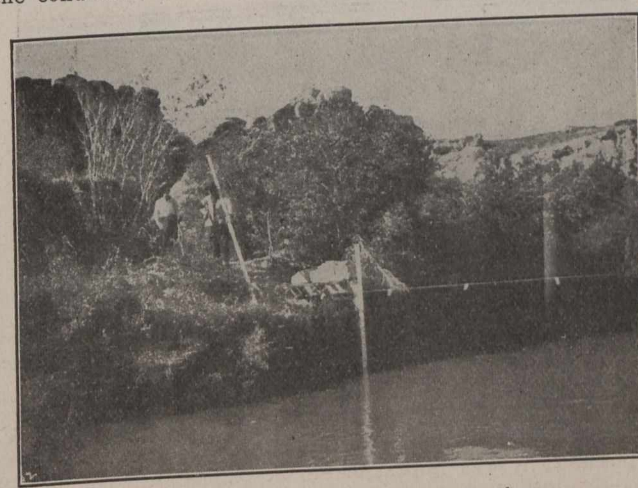


Fig. 3.—Gauge Rod at Writing-on-Stone.

Organization and Scope of Work.

These investigations became a distinct feature of this Department in the spring of 1909, when a separate survey was organized, with headquarters at Calgary. The first specific appropriation for hydraulic work was made by Parliament during the session of 1908, an appropriation of $10,000 being made for gauging streams and determining the water supply in Southern Alberta and Saskatchewan. As this vote was not available until the season was too far advanced to organize and equip parties for field work in 1908, only a part of it was used in purchasing instruments and equipment for the parties which were sent out early in 1909. A further appropriation of $10,000 was made to carry on the work for 1909.

In organizing the Hydrographic Surveys it was realized that with the funds available, it would be impossible to make complete investigations of the whole of the water supply in the irrigation tract, but an effort was made to include all the more important streams. Gauging stations had already been established by the Irrigation Surveys on a number of the more important streams, and it was important that the observations at these should be continued without interruption. There were, however, many streams of considerable importance upon which there were no gauging stations. It, therefore, became the policy of the survey to continue the investigations at the stations already established and to establish other stations as soon as possible.

It was decided at first to place three parties in the field and the irrigation tract was divided into three districts. In each district there was one hydrographer and an assistant.

Each party was equipped with a team and light wagon and the necessary gauging and surveying instruments. It was aimed to supply each hydrographer with sufficient equipment for the proper execution of his work, but at the same time to keep the outfit as light as possible, so that the least possible time would be spent in travelling. For this reason no camp equipment was furnished except in the case of the Maple Creek District, where in some localities, accommodation could not be secured.

Fig. 4.—Gauge Rod on the North Branch Branch at Mackie's Ranche.

While every effort was made to establish regular gauging stations on all the more important streams at as early a date as possible, it was impossible to accomplish this on many streams until the season was somewhat advanced. In the early part of the season, owing to numerous fluctuations in the flow, frequent discharge measurements had to be made at the gauging stations already established. After July the flow in the streams was lower and more regular and the hydrographers spent much more time in locating and establishing new gauging stations. In some cases, considerable time had to be spent in reconnaissance to locate the most suitable site for the gauging station.

With the data collected during the past season, some very valuable records of discharge and run-off have been compiled, and in a number of cases these records cover almost the whole of the open season. In some cases, for higher stages, there were scarcely sufficient data for complete records, but with few exceptions the computations are considered to be a very close estimate of the actual flow.

As the survey did not have a rating station, the manufacturers of the meters were asked to have them specially rated before being shipped. This they claimed had been done, but for some reason the rating tables were never furnished, although repeated efforts were made to secure them. The season was far advanced before it was definitely known that they would not be furnished and it was impossible to establish a rating station at that late date, so the general rating table for each particular type of meter had to be used. All meters should be tested from time to time, but, except as the result of accidents, it is very improbable that they will differ by any appreciable amount from the standard rating table while new and in good condition. A close watch of each meter and comparisons with other meters did not reveal any defects in any of the new meters.

While the records in this report show the regimen and behavior of the different streams during the past season and in several cases during part of the season of 1908, it must not be considered that sufficient information has been obtained and that the work at these stations may be discontinued. The precipitation and hence the flow of the streams or the run-off may be very different next season. A study of the general behavior of the streams should extend over a period of several years.

Explanation and Use of Data.

The volume of water flowing in a stream is known as run-off. In expressing it various units are used, depending upon the kind of work for which the data are needed. Those used in this report are "second-feet," "acre-feet," "run-off per square mile," and "run-off in depth in inches," and may be defined as follows:—

"Second-foot" is an abbreviation for cubic foot per second, and is the body of water flowing in a stream one foot wide and one foot deep, at the rate of one foot per second.

The "acre-foot" is the unit of capacity used in connection with storage for irrigation work, and is equivalent to 43,560 cubic feet. It is the quantity required to cover an acre to a depth of one foot.

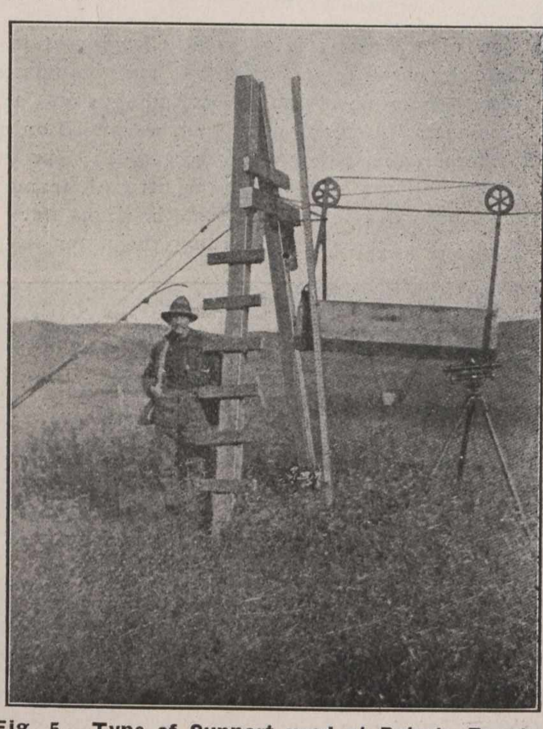


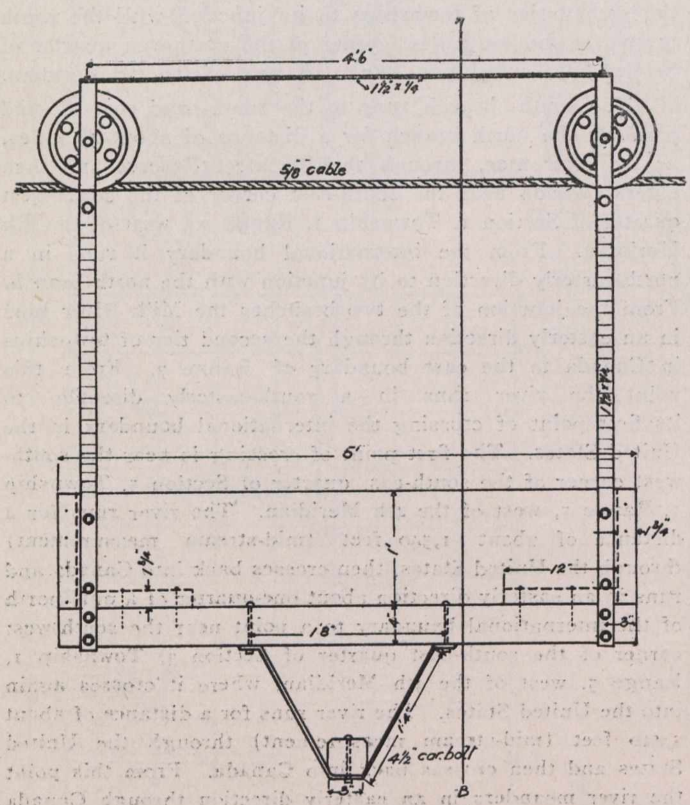
Fig. 5.—Type of Support used at Peter's Ranche.

The expression "second-feet per square mile" means the average number of cubic feet of water flowing each second from every square mile of drainage area on the assumption that the run-off is uniformly distributed.

"Depth in inches" means the depth of water in inches that would have covered the drainage area, uniformly distributed, if all the water could have accumulated on the surface. This quantity is used for comparing run-off with rainfall, which quantity is usually given in depth in inches.

It should be noticed that "acre-feet and depth in inches" represent the actual quantities of water which are produced during the periods in question while "second-feet" on the contrary, is merely a rate of flow per second.

With but one exception, i.e., the station on Bridge or Thirty-two Mile Creek, all gauging stations established in the Maple Creek District, which was under H. R. Carscallen, during the past season, were wading stations and the method of procedure was practically the same in all cases. A hole about two feet deep was dug in the bed of the stream at one of its banks. Then a post at least six inches through and from twelve to fourteen feet in length was placed in the hole; the gauge height, a plain staff graduated to feet and hundredths, was spiked securely to the post and the hole filled in with gravel and large stones. Two large stakes, about four inches through, were driven into the ground from ten to twelve feet apart. Stout timber braces were then secured to the stakes and to the post in the form of a V. In some cases anchors were nailed to the bottom of the posts, while in others two stout stakes were driven slantingly into the bank and spiked to the post near its base. Large stones, earth



SIDE ELEVATION

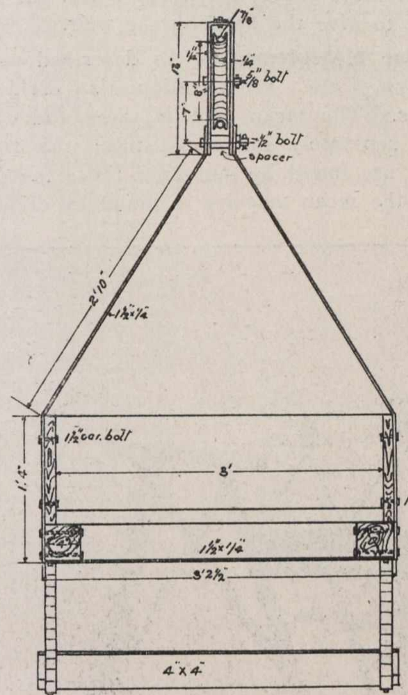
and gravel were packed between these stakes. Then the gauge height was referred to bench marks, a cross-section of the station was developed and the initial and final points permanently marked.

The station established on Bridge Creek was a bridge station, the gauge height in this case being attached vertically to a centre pile of the bridge.

Method of Discharge Measurements.

The large electric meter is suitable only for large streams flowing at a fairly high rate of speed, owing to the amount of water which it displaces and also to the velocity required to overcome the friction. The majority of the streams in this district have very small discharges during the greater part of the season, and for this reason the large meter was of service only while the streams were in flood. At low stages it was necessary to use either the acoustic meter or a weir. The acoustic meter is suitable for shallow streams having fairly high velocities. Many of the streams when at low stages have velocities too small to be accurately recorded by the acoustic meter and results obtained in these cases were unsatisfactory. The weir used was a 15" x 4", capable of measuring discharges of approximately one sec.-ft. and under and was found very useful and accurate.

The method of procedure in making discharge measurements is briefly described below under two headings—current meter measurements and weir measurements.



SECTION THROUGH A-B

Current Meter Measurements.—The cross-section is divided into a number of equal parts varying in length from one-half to five feet, depending on the size of the stream. At each point of division the depth and mean velocity of the water are recorded. In all cases of meter measurements the one-point method of obtaining mean velocity was employed.

Fig. 8.—Cable Car and Gauge on Elbow River at Calgary.

This method, which is the result of many experiments carried on by the United States Geological Survey, assumes that the thread of mean velocity in any vertical is at six-tenths the depth of the stream.

Weir Measurements.—In making a weir measurement a suitable place for the immersion of the weir is selected. The weir is then placed in the stream at right angles to the direction of flow and as nearly level as possible. It is packed firmly with sods in order that no leakage may occur and that the full discharge of the stream flows over its crest. When the stream has adjusted itself to the change in slope due to the presence of the weir, the head of water is taken by means of an engineer's level. The rod is held on the crest of the weir and also at water level beyond the velocity of approach (approximately six feet above, for a 15" weir), the readings being subtracted to give the head on the weir.

Current Meter Measurements.—As described under the previous heading, the cross-section is divided into elementary strips. The mean velocity, area and discharge are determined separately for each strip; the total discharge and area are found by summing those for the various strips; and the mean velocity is found by dividing the

Fig. 9.—Left frame at Pendant d'Oreill. Height, 17 feet.

total discharge by the total area.

Weir Measurements.—A rectangular, sharp-crested weir, having complete end contractions, was used in all cases of weir measurement. The Francis formula, $Q = 3.33 (L-.2H)H^{3}/_{2}$, was used in the computation. This formula neglects the velocity of approach the percentage of error resulting being so small that it is practically negligible.

The office work of plotting cross-section and discharge rating curves for the streams of the Maple Creek district shows that in the majority of cases the beds of the streams shift more or less during flood stages. Hence, whenever a change occurs, a new rating curve must be plotted and sufficient measurements must be made in the field while conditions remain unchanged in order that a rating curve may be plotted which will cover the range of daily gauge heights obtained during this time. Another condition affecting the accuracy of records is that, with few exceptions, the gauge heights are read to the nearest tenth or half-tenth of a foot This is due to the difficulty in explaining the decimal marking of the gauges. For this reason approximate results only are obtainable in the case of very small streams.

As soon as funds were available, Mr. F. H. Peters, C.E., was deputed to enquire into the water rights on St. Mary and Milk Rivers.

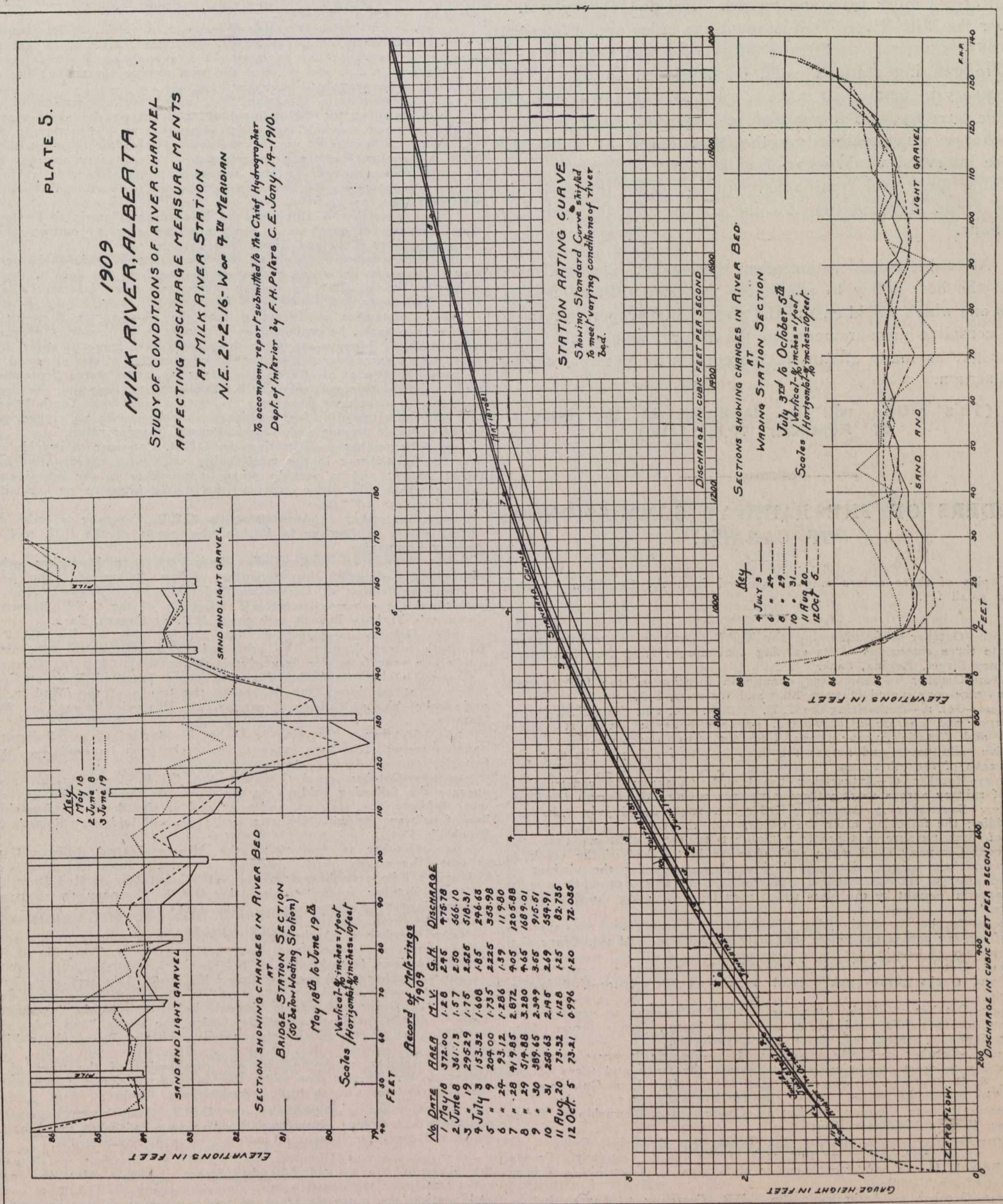
The Milk River rises on the eastern slope of the foothills in the Blackfeet Indian Reserve in the United States. Its headwaters run down in two main streams which are known, after entering Canada, as the north and south branches. The north branch runs in a north-easterly direction through the Blackfeet Reserve for a distance of about 15 miles, and then enters Canada near the south-east corner of the south-west quarter of Section 3, Township 1, Range 23, west of 4th Meridian. From the international boundary the stream continues in a north-easterly direction for about nine miles when it bends to the east and runs in an easterly direction through the second tier of townships to its junction with the south branch at the south-west corner of the north-east quarter of Section 20, Township 2, Range 18, west of the 4th Meridian.

The south branch runs to the south and east of, and parallels the north branch for a distance of about 48 miles, as the crow flies, through the Blackfeet Reserve and then enters Canada near the south-east corner of the south-west quarter of Section 1, Township 1, Range 20, west of the 4th Meridian. From the international boundary it runs in a north-easterly direction to its junction with the north branch. From the junction of the two branches the Milk River runs in an easterly direction through the second tier of townships in Canada to the east boundary of Range 7. From this point the river runs in a south-easterly direction to its first point of crossing the international boundary in the United States. The first point of crossing is near the south-west corner of the south-east quarter of Section 5, Township 1, Range 5, west of the 4th Meridian. The river runs for a distance of about 1,540 feet (mid-stream measurement) through the United States, then crosses back into Canada and runs in an easterly direction about one-quarter of a mile north of the international boundary to a point near the south-west corner of the south-east quarter of Section 3, Township 1, Range 5, west of the 4th Meridian, where it crosses again into the United States. The river runs for a distance of about 2,440 feet (mid-stream measurement) through the United States and then crosses back into Canada. From this point the river meanders in an easterly direction through Canada to a point on the international boundary about 900 feet west of the east boundary of Section 1, Township 1, Range 5, west of the 4th Meridian, where it finally crosses into the United States. This point is known as the "Eastern Crossing." The length of the course of Milk River in Canada from the western crossing of the north branch to the eastern crossing is 179 miles. The length of the course of the south branch in Canada is 20 miles.

Throughout its course in Canada from the western crossing of the north branch to the eastern crossing the Milk River runs through a well defined valley bordered on each side by a range of hills. The whole of its water-shed in Canada is bald prairie land. The river receives a number of small tributary creeks along its course, all of which discharge a considerable volume of water during the spring freshets; they all dry up by July 1st, (about) and have no considerable discharge again until late in the fall when some of them have a small flow for perhaps a month before the freeze up. The same remarks apply to the south branch in its course through Canada.

The general conditions of flow in the river are such as are typical of all rivers which have a watershed devoid of tree growth; that is, it is subject to extreme floods during the freshet period and to correspondingly low flow during the summer months. From its headwaters to the eastern crossing the total area of the watershed of Milk River is 2,448 square

The instrumental equipment of the party included:—Draughting instruments, one pocket sextant, one Y level (Gurley's 14″ with compass), one large Price electric meter, one small Price electric meter, one stop watch—cutting to 1-5 second, one Price acoustic meter.



miles. Of this total amount 1,645 square miles are in Canada and 803 square miles in the United States.

The party consisted of one engineer in charge, one assistant, one teamster and a cook. The party was equipped with a camping outfit which included one heavy team and Bain wagon, one driving team and democrat and a saddle pony. The party worked from Milk River station as a base.

Instructions Regarding Work Required.

The instructions given to the engineer in charge were to the effect that the work required of the party was to make complete stream measurements covering the whole of the Milk River in Canada for the whole season, and also to prepare permanent stations along the river so that records could be made in succeeding seasons covering all stages of flow. In addition to this it was desirable that a reconnaissance be made of the tributaries of Milk River as far east as Battle Creek.

The conditions to be confronted were these: The whole territory to be covered meant a distance to be travelled by trail of 214 miles from end to end. The distance by trail to cover the Milk River alone is about 150 miles and throughout all of this territory no definite information was available as to where gauging stations could be developed so that it was necessary to first of all make a reconnaissance trip over the whole territory, and it was also realized that to get complete discharge measurements on the Milk River, at sufficiently close intervals, would mean that the party would have to do nothing but travel continuously up and down the river and this would leave no time for the construction of permanent stations.

After due consideration of all these points it was decided that the best policy to adopt, for the best ultimate results, was one which would ensure the river being properly prepared for complete measurements in the future, and at the same time get as many stream measurements as possible during the season.

(This article will be concluded in the issue of November 10th, 1910.)

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

12020—October 20—Authorizing the C.P.R. Company to construct and operate three extensions of its existing spur across Rose Street, north of Dewdney Street, Regina, Sask.

12021—October 19—Approving change in location of the C.P.R. main line as now constructed between Elko and Wardner, B.C.

12022—Oct. 12—Authorizing the T. H. & B. R. Co., and the G.T.R. Co., to construct and operate a stub-track, or spur between Wentworth Street South and Victoria Avenue South, Hamilton, from the main lines of respective railways to and across the lines of and forming a junction with the tracks of the other.

12023—October 18—Authorizing the C.N.R. Company to construct its line of railway across seventy-three highways west of the Fourth Meridian.

12024—September 27—Amending Order No. 11278, dated July 19th, 1910, by adding the following after the words, "On the said plan 'A,'" at the end of first paragraph thereof: "Subject to the conditions that the Applicant Company shall make such changes in the bed of the creek as will permit the same uninterrupted flow of water under the viaduct as existed prior to its construction, and shall, at all times, promptly remove any material caught by the piers which may be obstructing the flow of the stream."

12025—October 19—Authorizing the C.N.O.R. Company to construct its line of railway across the public road between Lots 194 and 196, Concession 1, Township of Chatham, County Argenteuil.

12026—October 19—Authorizing the C.N.O.R. Company to construct its lines and tracks across public road known as Mary Street, Belleville, Ontario.

12027—October 18—Authorizing the C.N.O.R. Company to construct its railway across public road known as Maria Street, James Street, John Street, Pinnacle Street, and Water Street, Belleville.

12028-9—October 20—Authorizing the Hydro-Electric Power Commission of Ontario to erect transmission wires across the track and wires of the T. H. & B. Railway Company at Pearl Street, Hamilton, Ont., and to erect its telephone wires across the tracks and wires of the Pere Marquette Railway Company at Lot 19, Concession 2, Township of Westminster, County Middlesex, Ont.

12030—October 18—Authorizing the Lethbridge Collieries, Limited, to lay a six-inch steel pipe under the track of the C.P.R. Company's Crow's Nest Branch, in the south-west quarter of Section 21, Township 9, Range 22, west of 4th Meridian.

12031—October 14—Authorizing the C.P.R. Company to carry what is known as Mimimo Cut-off, Township of Etobicoke, across Scarlett Road, Chadwick Avenue, Church Street, Dundas Street, Montgomery Street, and two road allowances in Concession 5, also to raise grade of Dundas Street and of the tracks of the Toronto Suburban Electric Railway at Dundas Street.

12032-3—October 19—Authorizing the C.N.O.R. Company to construct its railway across the public roads known as Front Street, and Church Street, city of Belleville.

12034-5—October 18—Authorizing the Kingston & Pembroke Railway Company to construct bridges Nos. 87.2 and 79.2 on its line of railway.

12036—October 13—Authorizing the C.N.O.R. Company to construct the proposed extension of its siding across Muskoka Road, Washago.

12037—October 13—Refusing application of Edward Bayly, Toronto, on behalf of Miss Ethel A. Bayly, re rate charged by the Bell Telephone Company for a telephone installed in their house at 28 Ross Street, Toronto.

12038—September 24—Refusing application of J. T. Hall, Yorkton, Sask., for a farm crossing over the G.T.P. Railway.

12039—September 23—Dismissing application of the Grain Growers' Association of Kenville, Man., complaint that the rate charged by the C.N.R. Company on shipments of grain on its Thunder Hill Branch are excessive and discriminatory.

12040—September 6—Directing Vancouver, Victoria, & Eastern Railway to widen the dump on Oscar Street, Abbotsford, B.C., to 20 feet top and guarded by railings; and to construct a subway on Montrose Avenue, 20 feet clear in width, and to open the said avenue for traffic; the work to be finished on or before September 1st, 1911.

12041—September 1—Directing that, upon the corporation of city of Victoria providing for the removal of all trees on the south-west corner of the proposed crossing and undertaking that no obstruction to the view be allowed to be erected on the north-west side of the crossing, the Esquimalt & Nanaimo Railway Company make the necessary changes in order to carry Wilson Street, Victoria, across its right-of-way, so as in all respects to comply with the Standard Regulations of the Board affecting highway crossings, as amended May 4th, 1910.

12042—September 6—Directing the Vancouver, Victoria & Eastern Railway Company to construct a wooden bridge over its cutting where the same intersects Woodland Drive, Vancouver.

12043—September 6—Directing the Vancouver, Victoria & Eastern Railway Company to construct, within six months from the date of this Order, a wooden bridge over its cutting where the same intersects Lakewood Drive, Vancouver, B.C.

12044—September 21—Directing that the crossing at Eleventh Street, Moose Jaw, Sask., be protected by a subway to be constructed by the city not later than January 1st, 1912; the city to have leave to apply, if necessary, for an extension of time for the construction of the proposed work.

12045—September 22—Rescinding Order No. 11654, dated September 13th, 1910, which authorized the C.P.R. Company to construct an industrial spur from a point near Roseberry Street to a point near Tenth Street, also four sub-spurs from the last-mentioned spur in Blocks 70, 71 and 72, lying between Pacific Avenue and Rosser Avenue, Brandon, Man.

12046—September 22—Directing the C.N.R. Company to provide culverts over its right-of-way in the municipality of Montcalm, Man., at four different points; and to provide proper approaches to the crossing of the railway where the same crosses the public highway on or adjoining River Lots 251 and 253.

12047—September 22—Authorizing the C.P.R. Company to cross with its second track, at Portage la Prairie, the tracks of the C.N. and G.T.P. Railway Companies.

12048—September 23—Rescinding Order No. 8914, December 15th, 1909, which was made upon the application of Wm. Bailey, of Zelma, Sask.

12049—September 22—Rescinding Order No. 11156, July 11th, 1910, which authorized the construction of the connection of the G.T.P. Branch Lines Company's Yorkton Branch with the C.N.R. at Canora, Sask.

12050—October 13—Directing that the crossing by the C.P.R. over Elizabeth Street, Toronto, be protected by a subway to be constructed within one year from the date of this Order.

12051—October 13—Authorizing the Essex Terminal Railway Company to cross, at rail level, with its tracks the tracks of the Windsor, Essex, and Lake Shore Railway Company, at Howard Avenue, in Windsor, Ontario.

12052—October 7—Granting leave to the Bay of Quinte Railway Company to move, at its own expense, its tracks from its yards at Napanee, Ontario.

12053-54—October 21—Authorizing the C.P.R. Company to use and operate the following bridges on the Prescott Branch of its line of railway: Bridges Nos. 1.9, 43.3, and 51.3; and on the Brockville Branch of its line of railway: Bridges Nos. 18.2, and 18.39, and bridge on Smart's Siding, Brockville Loop.

21055—October 21—Authorizing the Alberta Central Railway Company to cross, by means of an overhead bridge, the lines and tracks of the Calgary & Edmonton Branch of the C.P.R. Company at Red Deer, Alta.

12056—October 20—Authorizing the G.T.R. Company to construct an additional or passing track upon and across Division and Prince Edward Streets, Brighton, Ontario.

12057—October 20—Authorizing the C.N.O.R. Company to construct its railway across Kingston Road, Lot 33, Concession 1, Township of Sidney, County Hastings, Ontario.

12058—October 20—Amending Order No. 11288, July 25th, 1910, by striking out the words, "and one mile east," in the fourth line of the operative part of the Order and adding thereto, before the words "approved and sanctioned," in the last line of the Order, the words "two miles east of Red Deer, as shown on the plan on file with the Board under File No. 14097.1."

12059—October 21—Authorizing the corporation of the town of Buckingham to lay a sewer pipe under the track of the C.P.R. Company where the same crosses Church Street, Buckingham, Quebec.

12060—October 21—Authorizing the G.T.R. Company to construct and operate a branch line of railway or siding to premises of the Canada Refining and Smelting Company Limited, Township South Orillia.

12061—October 12—Directing that the G.T.R. Company install gates at the Sherman Avenue and Lottridge Street crossings, Hamilton, appointing a watchman to operate same; also authorizing the G.T.R. to construct and operate the northerly track of the two additional tracks, authorized by Order No. 3370, to be constructed at these crossings.

12062—September 15—Directing the C.P.R. Company to construct an overhead bridge about 1,200 feet west of the present crossing at mileage 2.6, west of city limits of city of Lethbridge; and to construct at mileage 10.6, an overhead bridge.

12063—October 21—Authorizing the corporation of town of Brantford, Ontario, to lay a storm and sanitary sewer under the track of the T. H. & B. Railway Company on South Market Street, Brantford.

12064—October 21—Authorizing the corporation of the town of Meaford, Ontario, to lay a water main under the G.T.R. where the same intersects St. Vincent Street, Meaford, Ont.

RAILWAY EARNINGS; STOCK QUOTATIONS.

The following table gives the latest traffic earnings it is possible to obtain at the time of going to press:

Road	Wk ended	1910	Previous week	1909
C. P. R.	Oct. 21	$2,302,000	$2,334,000	$2,147,000
G. T. R.	Oct. 21	963,374	952,653	904,674
C. N. R.	Oct. 21	403,900	341,800	328,100
T. & N. O.	Oct. 21	23,772	21,972	32,854
Hal. Elec.	Oct. 21	3,643	3,848	3,409

Figures showing the earnings of Canadian roads since July 1st, this year and last, are appended:

Road.	Mileage.	July 1st to	1910.	1909.
C. P. R.	10,326	Oct. 21	$33,580,000	$21,760,000
G. T. R.	3,536	Oct. 21	13,940,549	13,013,007
C. N. R.	3,180	Oct. 21	4,669,600	3,654,300
T. & N. O.	264	Oct. 21	380,333	488,239
Hal. Elec.	13.3	Oct. 21	73,584	69,910

Stock quotations on Toronto, Montreal and London exchanges, and other information relative to the companies listed in the above tables, are appended. The par value of all shares is $100.

Co.	Capital. 000's Omitted.	Price Oct. 28 1909.	Price Oct. 20 1910.	Price Oct. 27 1910.	Sales last week.
C. P. R.	$150,000	184½-183¾	199½-198½	199-198	617
Mont. St.	18,000	207½-202	230½-230	230-229	62
Hal. Elec.	1,400	-116½	130-129¾	130-129	17
Toronto St. ..	8,000	123-122½	124½-	123½-	104
G. T. R.	226,000	1st pfd. 108;	2nd pfd. 55;	com. 25⅞	

C.P.R. TRAFFIC RETURNS FOR SEPTEMBER SHOWS INCREASE OF $479,711 OVER SAME PERIOD LAST YEAR.

Gross earnings, $9,315,214; working expenses, $5,403,-614; net profits, $3,911,600. In September, 1909, net profits were $3,431,889, and for the three months ended September 30th, 1910, the figures are as follows: Gross earnings, $27,-439,760; working expenses, $16,351,868; net profits, $11,-087,892. For the three months ended September 30th, 1909 there was a net profit of $8,875,818. The increase in net profits over the same period last year is therefore for September $479,711, and for the three months ended September 30th, there was an increase of $2,212,074.

CANADIAN NORTHERN.

September Net $381,200 Compared With $311,500 Same Month 1909.

The report of the Canadian Northern Railroad Company, for the month of September and three months ended September 30th, 1910, compares as follows:—

	1910	1909	1908	1907
Miles operat.	3,297	3,158	2,874	....
Sept. gross	$1,297,900	$1,076,800	$901,700	$758,300
Expenses	898,700	765,300	650,600	549,200
Sept. net.	381,200	311,500	251,100	209,100
3 mos. gross	3,598,000	2,727,400	2,377,600	2,618,200
Expenses	2,605,600	1,981,900	1,737,500	1,830,700
3 mos. net.	992,400	745,500	640,100	787,500

NATIONAL TRANSCONTINENTAL RAILWAY SHOWS BIG INCREASE IN THE FOLLOWING REPORT OF EARNINGS FOR THE PAST YEAR:

Spent on the National.

The capital expenditure during the past fiscal year on National Transcontinental Railway construction was $19,-968,126, bringing the total expenditure on March 31st last up to $71,918,843, representing 1,106 miles of the line graded 813 miles of track laid, and a little over 60 per cent. of the whole work from Winnipeg to Moncton completed.

I.C.R. Revenue.

The revenue of the Intercolonial increased by $741,165, working expenses were reduced by $682,951, the net profit was $623,164, and there was a net betterment of not less than $1,424,116, as compared with the previous year.

Railway subsidies earned during the year amounted to $2,048,097.

The grand total of Federal expenditure on the railways and canals of Canada on March 31st last was $556,326,737, of which $126,328,956 was spent on canals. The total canal traffic amounted to 33,720,748 tons, an increase of 16,217,928, or nearly 100 per cent. as compared with 1908.

Government Roads' Earnings.

The gross earnings of the Government roads for the twelve months ended March 31st last amounted to $9,647,963, the working expenses amounted to $9,095,903, showing a profit of $552,059. The Intercolonial Railway working expenses amounted to $8,645,070; its earnings amounted to $9,268,234, a profit of $623,164.

The Windsor branch maintenance expenditure amounted to $23,549, the earnings amounted to $60,653, leaving a profit of $37,104. The Prince Edward Island Railway working expenses amounted to $427,282; its earnings amounted to $319,-074, the deficit being $108,208.

Passengers Carried.

The number of passengers carried on the Intercolonial last year was 3,122,324, an increase of 215,087, compared with the previous year. Revenue-producing freight totalling 3,927,240 tons was carried, an increase of 353,268 tons.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

(Continued from page 598).

12065—October 22—Amending Order No. 11822, dated September 17th, 1910, which authorized the construction of a subway crossing under the tracks of the C.P.R. Company at Ross Street, (now Fourth Street West), Calgary, by adding the following clause, namely;—"5. That 20 per cent. of the cost of constructing said gates be paid out of the Railway Grade Crossing Fund."

12066—October 22—Authorizing the G.T.P.R. Company to construct its railway across the road allowance between Section 7, Township 44, Range 6, west of 4th Meridian, and Section 12, Township 44, Range 6, west of 4th Meridian; to close said road allowance between the south boundary of the right-of-way of the G.T.R. Company, and the north boundary of Sections 7 and 12; and to divert the highway to a crossing 415 feet east of the road allowance.

TORONTO, CANADA, NOV. 3, 1910.

CONTENTS OF THIS ISSUE.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS PENDING.

In addition to those in this issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Annapolis Royal, N.S., piers	Nov. 8.	Oct. 20.	537
Black Point, N.S., breakwater	Nov. 7.	Oct. 20.	537
Calgary, Alta., steel bridges	Nov. 7.	Oct. 6.	54
Calgary, Alta., railway material	Nov. 7.	Oct. 6.	56
Dresden, Ont., post-office	Nov. 9.	Oct. 27.	569
Duncan's Cove, N.S., breakwater	Nov. 7.	Oct. 13.	508
Gravenhurst, Ont., wharf	Nov. 8.	Oct. 20.	537
Lethbridge, Alta., electric light	Nov. 5.	Oct. 27.	569
Ottawa, Ont., freight sheds	Nov. 8.	Oct. 20.	537
Paris, Ont., armoury	Nov. 10.	Oct. 27.	569
Providence Bay, Ont., wharf	Nov. 7.	Oct. 13.	508
Quebec, Que., office building	Nov. 4.	Oct. 27.	569
St. Louis du Mile End., Que., post-office	Nov. 24.	Oct. 20.	537
South Ingonish, N.S., wharf	Nov. 8.	Oct. 20.	537
Temiskaming, Ont., excavation	Nov. 15.	Oct. 27.	569
Toronto, Ont., street lighting		Oct. 20.	54
Toronto, Ont., Tungsten lamps		Oct. 20.	54
Three Fathom Harbor, N.S., beach protection	Nov. 7.	Oct. 13.	508
Victoria, B.C., lighthouse and steamer	Oct. 31.	Oct. 6.	476
Walhachin, B.C., steel bridge	Nov. 28.	Oct. 27.	569

TENDERS.

Lorneville, N.B.—Tenders will be received until November 23rd for the construction of an extension to the breakwater. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Burke's Head, N.S.—Tenders will be received until November 22nd for the construction of a breakwater. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Westport, N.S.—Tenders will be received until November 8th for the construction of a pile-work wharf. R. C. Desrochers, secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until November 15th for the construction of an ice-house at each of the following places: Springfield, Man.; Redditt, Man., and Graham, Ont. P. E. Regan, secretary, Commission of Transcontinental Railway.

Toronto, Ont.—Tenders will be received until November 8th for cast iron lanterns and pillars. G. R. Geary (Mayor), chairman, Board of Control.

Oak Lake, Man.—Tenders will be received until November 10th for the erection of a platform truss bridge, 42 ft. over all, with an approach at each end of 30 ft. 6 in., over the Pipestone Creek, on Section 31-8-25. Also for the erection of a 50-ft. span of a Howe Truss Bridge, renewing part of a bridge now spanning the Assiniboine River on Section 36-9-24 W. R. H. Hocken secretary-treasurer.

Winnipeg, Man.—Tenders will be received until November 14th for supply for a quantity of cast iron water pipe, valves, and hydrants for the Domestic Waterworks System. M. Peterson, Secretary, Board of Control.

Winnipeg, Man.—The city council have decided to call for the construction of public baths. M. Peterson, secretary, Board of Control.

Winnipeg, Man.—Tenders will be received until November 7th for wire and cable, also pole and line supplies. M. Peterson, secretary, Board of Control.

Calgary, Alta.—Tenders will be received until November 10th for the erection of timber trestle at mileage, 53.7, Crow's Nest subdivision. Maximum height, 115 feet. Length, 750 feet. Plans and forms of tender on file at following offices: Assistant chief engineer, Winnipeg; division engineers, Moose Jaw and Calgary; resident engineer, Cranbrook. H. B. Walkem, acting division engineer, Calgary.

Maple Creek, Alta.—Tenders will be received until November 10th for the erection and installation of an electrical light and power plant and flour mill. D. Paterson, secretary-treasurer.

Point Grey, Vancouver, B.C.—Within a fortnight tenders will be called for the construction of a six-compartment reservoir with a capacity of 18,000,000 gallons.

Victoria, B.C.—Tenders will be received until November 7th for the work of making the reservoir watertight. W. W. Northcott, purchasing agent.

Walhachin, B.C.—Tenders will be received until November 28th for the manufacture of superstructure over the Thompson River. F. C. Gamble, Public Works Engineer, Victoria.

CONTRACTS AWARDED.

Hamilton, Ont.—Contract for the building of a revetment wall at the beach was awarded to Joseph Battle at $23,000, being the lowest tender. Length of wall, approximately 1,600 feet.

Kingston, Ont.—The Canadian Locomotive Works has just received a contract from the C.P.R. for ten ten-wheeler engines. This is a big contract, and in itself would be sufficient to keep the works going during the winter; more work is in sight however.

Newmarket, Ont.—The Office Specialty Manufacturing Company, Limited, have let the contract of their new factory buildings to John L. Young of Stratford, at an estimated cost of $75,000. This will give an additional floor space of 6,300 feet to the present plant. O. E. Tench, architect, Newmarket.

Port Arthur, Ont.—Contractor Sherwood has received from the C.P.R. the contract for the straightening out of the track near North Bay.

Port Arthur, Ont.—The Thunder Bay Harbor Improvement Company have received the contract for erection of C.N.R. storage sheds. This building will have a floor space of 32,400 square feet.

Toronto, Ont.—The Foundation Co., Ltd., No. 76 Bank of Ottawa Building, Montreal, have been awarded the contract for constructing 10 sets of concrete piers for carrying the hydro-electric steel towers and cables. These piers are to be in the lake at Parkdale, and in general follow the line of the shore.

Toronto, Ont.—At a cost of approximately $50,000, the Purdy, Mansell Company have received the contract for installing the ventilating apparatus in the Parliament buildings.

Winnipeg, Man.—The Board of Control recommended the purchasing of 1,000,000 feet of lumber from T. D. Robertson.

Winnipeg, Man.—A contract has just been let to Norcross Bros., Ltd., of Boston, who are building the new Bank of Montreal here, for the erection of a large brick and stone warehouse in the rear of the present Hudson Bay stores. The new building will be 200 by fifty feet, and five storeys.

Camrose, Alta.—W. E. Allen, of the Grand Trunk Pacific Lines Company, has the contract for the erection of their station and freight sheds, at an estimated cost of $5,000.

Diamond City, Alta.—James Patterson was the successful tenderer for the erection of the new school, at $14,758.00.

Stettler, Alta.—W. L. McKenzie & Company, of Lethbridge, received the contract for school building.

Yale Road, B.C.—Thos. Turnbull was given the contract for the erection of Public school at $3,500.

Okanagan Landing, B.C.—Contract for erection of Public school was awarded to W. G. Simpson, of Vernon, at $1,750.

Glenbank, B.C.—Jas. Dancey & Company, Nelson, was awarded the contract for the erection of a Public school at $3,977.