PAGES

MISSING

The Canadian Engineer

A weekly paper for civil engineers and contractors

Standard Gauge Railway Work at the Front

Pioneer Truck "Minesweeper" Used by 277th Construction Company in Rebuilding the Main Line of the Nord Railway to Lille—In One Day Laid 2.5 Miles of Track and One Turnout Over Badly Wrecked Roadbed

"In spite of the fact that the enemy, as he withdrew, used every modern artifice for the destruction of railways, roads, bridges and water supply, the Railway Construction Troops were able to meet all demands and accomplished successfully an unparalleled programme of railway reconstruction.

"By the end of October, no less than 1,050 miles of line, much of which had been destroyed, had been brought into service for our armies. This included 485 miles of new track and some 4,000 ft. of bridging.

"The following is an instance of the speed with which the work of reconstruction was carried out: On the 17th October, Lille was evacuated by the enemy. On the 25th October, the first train of supplies for the civil population entered the city, the railway having been carried across the Lys River at Armentieres by a bridge constructed in the short space of four days."—Excerpt from Sir Douglas Haig's Victory Despatch.

IN August, 1918, the Hun was on the move toward Berlin, destroying every bridge, track and roadbed that he was forced to relinquish. The Nord Railway's main line was completely wrecked.

This railway had been of a high type of construction. The roadbed had been ballasted with crushed stone or slag—well drained and bridged. The rails were French stock, weighing from 95 to 110 pounds to the yard, laid on hard wood ties, 10 in. by 5 in. by 9 ft.

The enemy used special appliances for destroying the ties and bending the rails. Highway bridges at railway crossings were destroyed in many instances by exploding charges at abutments only (after crippling all main members beyond repair), thus causing every bridge to fall in such manner that it wedged between the abutments and effectually blocked the railway and also the highway. Bridges crossing canals and rivers were dropped in the same manner.

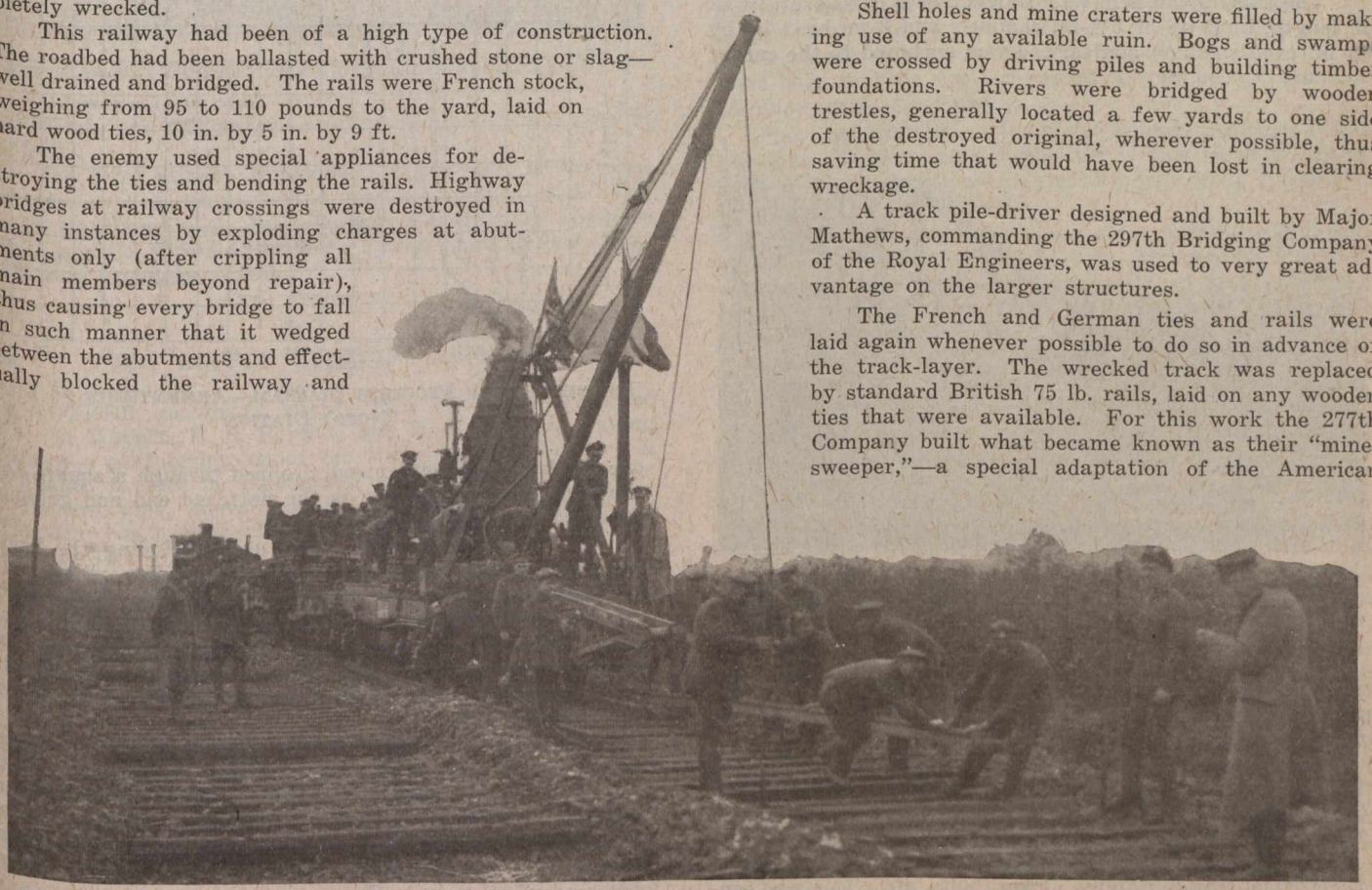
Besides this wreckage, the ever-present shell hole, mine crater, bog and flood added to the difficulties of the construction troops.

The task of rebuilding part of these wrecked railway lines, including the Nord Railway, was assigned to the 277th Railway Construction Company, which had been organized in February, 1916, at the Front, the men being selected from the various units in the trenches, and placed under the command of Captain (now Major) G. L. Ridout, M.C., R.E. From the date of organization until after the armistice, the company was continuously engaged in the construction and repair of either light or standard-gauge railways. The light railways were of the typical construction described by Lt. J. H. McKnight in the February 27th issue of *The Canadian Engineer*, and were often built over the seas of mud, shell holes and ruins so prevalent in Northern France and Belgium. The heaviest work on which the 277th was engaged, however, was the standard gauge construction during the couple months just preceding the armistice.

Shell holes and mine craters were filled by making use of any available ruin. Bogs and swamps were crossed by driving piles and building timber foundations. Rivers were bridged by wooden trestles, generally located a few yards to one side of the destroyed original, wherever possible, thus saving time that would have been lost in clearing wreckage.

A track pile-driver designed and built by Major Mathews, commanding the 297th Bridging Company of the Royal Engineers, was used to very great advantage on the larger structures.

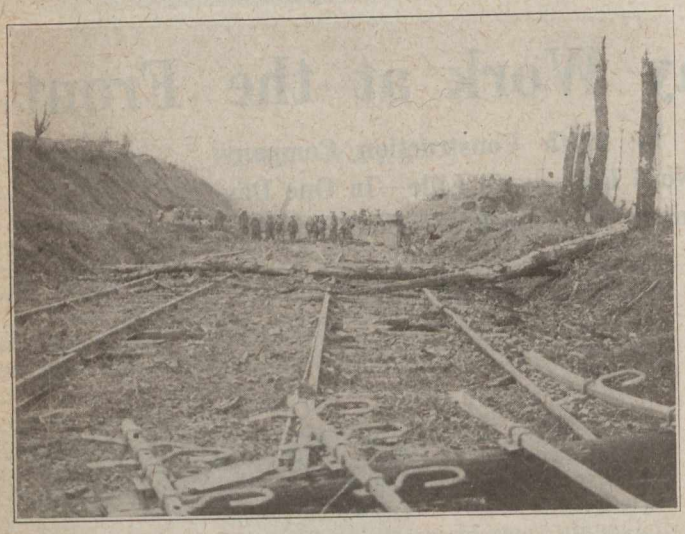
The French and German ties and rails were laid again whenever possible to do so in advance of the track-layer. The wrecked track was replaced by standard British 75 lb. rails, laid on any wooden ties that were available. For this work the 277th Company built what became known as their "minesweeper,"—a special adaptation of the American



THE 277TH COMPANY'S PIONEER TRUCK, DESIGNED AND CONSTRUCTED IN THE FIELD, LAYING RAIL BETWEEN TOURNAI AND LILLE AT THE RATE OF 2.7 MILES A DAY

track-laying machine to service conditions immediately behind the front line trenches.

The ordinary French flat car was too small for efficient track laying, having a capacity of only from 10 to 20 tons. This difficulty was overcome by securing about 20 "tank wagons," or British pressed steel flat cars, having a capacity



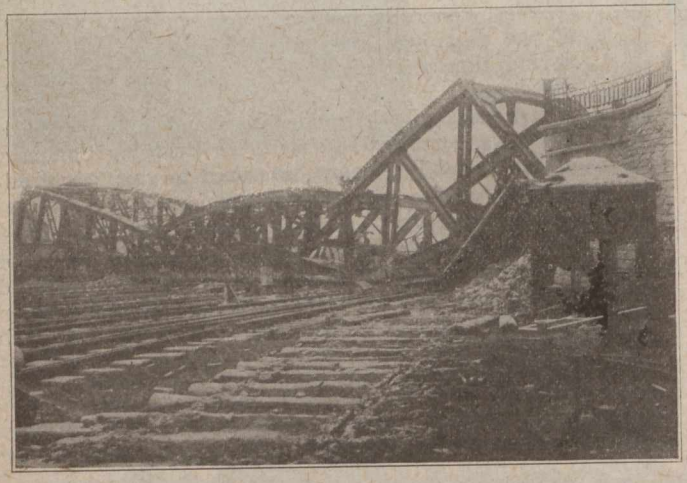
A Section of the Nord Railway Before Reconstruction

of 45 tons and specially built to transport army "tanks." One of these tank wagons was equipped as the track-layer.

Upon the car was erected a Clyde hoisting engine. Westinghouse air brakes were installed, the air being furnished by the hoisting engine.

The operator's platform was at the extreme front of the car, from which position he had an unobstructed view of the work.

The tracklaying arm was designed as a cantilever, 24 ft. in length, built up of 5½-in. channels and 3 in. by 3 in. by ½ in. (and smaller) angles, and was anchored to the car by



Tournai Railway Yards—Bridge Dropped From Abutments, Effectually Blocking the Main Line of the Nord Railway

two 1½ in. diameter circular king-pins, which allowed the cantilever arm to be dismantled easily and quickly, and swung onto a flat car by the aid of the boom.

Another function of the king-pins, equally important for this type of rapid construction, was to allow the cantilever arm to slide vertically, without damage, in case of sudden derailment of the car.

Attached to the framework of the cantilever arm was a special steel tray containing spikes, bolts, etc. This was conveniently placed to enable the men to reach for the article without walking to the front of the car.

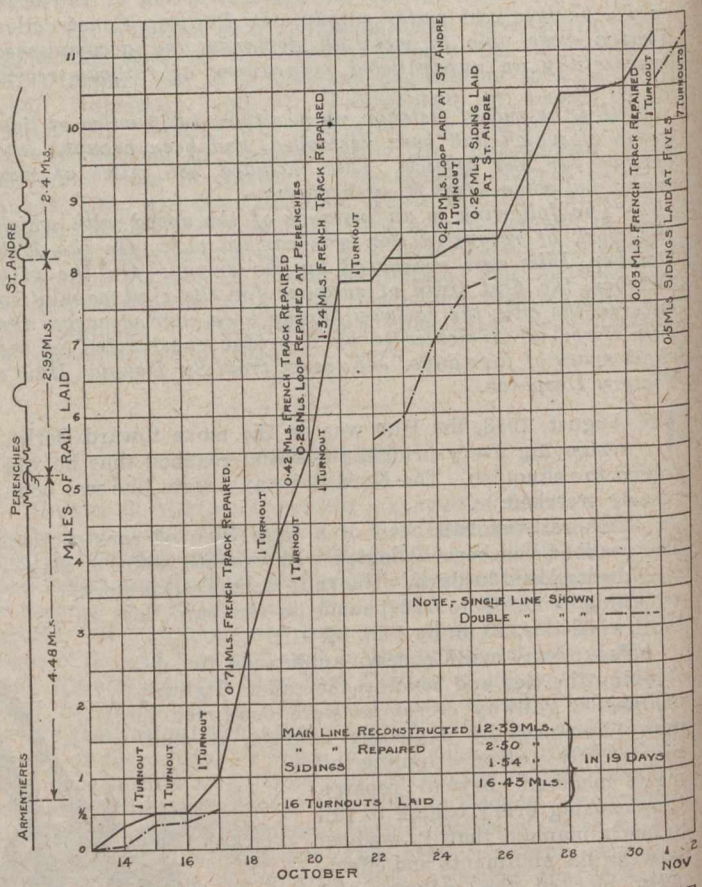
The boom used was generally a 36 ft. cedar telephone post, of standard size as used by the signal corps. These posts were conveniently located along the line and could be quickly replaced when required.

The boom was suspended from a steel "A" frame at the extreme front of the car. The height of this frame was 9 ft. above the floor of the car, to give about 12 ins. clearance for military necessities.

The cantilever arm was fitted with dollies which were graded to give gravity run for the travelling rails.

The usual track-laying train carried sufficient material for one mile of completed track, and was made up as follows: Track-layer, three tank wagons with steel, locomotive and sleeping cars as required.

Bridle rods, ¾-in. in diameter, flattened to ⅜-in. and turned up at either end to lap over the flange of the rail, were used as temporary fastenings to enable track laying trains to roll along without delay. These rods were held in place by



Reconstruction Progress Diagram—Armentieres to Lille (Nord) Station

one track spike at either end, dropped through a square hole provided for that purpose in the flattened end and gripping the inside of the rail flange.

All of the tools which were used, including the bridle rods, rail tongs, pickaroons, rail clips, pulley wheels and rail dollies, and also the tracklayer itself, were designed by the company's commanding officer and were built by the company. Therefore the operation of the track-laying train was continuous, except for accidents, until the supply of material was exhausted, when the empties were quickly replaced and the work continued.

Ballasting operations closely followed the track-laying train. Labor was supplied by the many infantry battalions and was always available. The spiking party followed immediately behind the train, removing the bridle rods and driving permanent track spikes. In this manner, work that was started each morning by the track-layer was completed that day ready for heavy traffic.

The progress of the work was maintained by a spirit of good natured rivalry between the various crews. At the

end of each day's work, a blue-print chart was posted on the order board, showing the daily progress, the total number of turnouts laid, the miles of French track repaired, the miles of loops or new track laid, etc.

In 44 consecutive days ending October 12th, 1918, 24.94 miles of main line, 4.9 miles of siding, 44 turnouts and 2 diamond crossings were reconstructed between Hazebrouck and Armentieres stations.

On October 20th, 1918, 2½ miles of French track and one turnout were laid between Perenchies and St. Andre.

The total for 19 consecutive days ending November 1st, 1918, was 16.43 miles of track and 16 turnouts.

The accompanying chart includes the time required for repairing or clearing the wreckage of bridges. Some of these bridges had massive, concrete-filled floors. Obstructions were cut by the oxy-acetylene torch, aided by liberal charges of guncotton.

Very few supplies could be salvaged locally for this work, as the territory had been evacuated very recently by

LIGHT RAILWAY BUILT BY THE 277TH CONSTRUCTION COMPANY

the enemy, who stripped the country of practically all useful material.

The Nord railway reconstruction was part of the programme carried out under the general direction of Lt.-Col. G. H. Harding, D.S.O., R.E., Railway Construction Engineer No. 3, and Col. David Lyall, D.S.O., R.E., Chief Railway Construction Engineer, G.H.Q.

NEW SUPPLY FIRM IN TORONTO

ANOTHER machinery supply firm has been organized in Toronto, E. S. Boynton and E. J. Williams having formed a partnership under the trade name of Boynton & Williams, to deal in machinery, mill supplies, contractors' equipment, pipe, valves and fittings, plumbers' supplies, etc. The firm has opened offices in the National Life Bldg., 25 Toronto St.

Mr. Boynton was a pilot in the Royal Naval Air Service from 1915 until September, 1918. For several months he was in a squadron which was engaged in English coast defence, flying both night and day, and was then sent to the Mediterranean where he took part in thirty-one raids over Bulgaria and Turkey, twenty-four of which were accomplished within twenty-six days. Before enlistment, Mr. Boynton was sales manager of the Gidley Boat Co., and for eight years previously had been connected with the Toronto branch of the Canadian Fairbanks-Morse Co.

Mr. Williams has been engaged in steam and hydraulic engineering, both commercially and professionally, for the past twenty years, both in England and Canada. His experience in Canada has been confined to the Gurney Foundry Co., with whom he spent seven years, and the Standard Sanitary Co., two years.

CANADA'S ROAD-BUILDING ERA*

BY A. W. CAMPBELL
Dominion Highways Commissioner

MANY changes have occurred since I first became affiliated with the Ontario Good Roads Association, 25 years ago. I was appointed to meet many municipal councils, to inspect personally their roads and to offer suggestions for improvements.

Statute labor was chiefly instrumental in building many of the roads at that time. Wonders were performed by its aid. The system was brought into disrepute by certain men who had charge, and who did not care, or who had no interest in the work. In later years, statute labor was greatly improved and partially superseded by voluntary labor on the part of farmers and municipalities.

Joint Jurisdiction in Future

I have been in 75% of the townships and in all the counties of Ontario, have attended meetings held in school houses and in any kind of houses, and have met the local men, perhaps only a few in each place but each man a hard and earnest worker for good roads. I have advised them to the best of my ability.

I cannot understand why local municipalities have had to build and maintain at their own expense, so many of the roads that the farmers use to carry their products to town and that the city people use to carry their trade and their pleasure cars into the country.

In the future there should be joint jurisdiction, joint labor and co-operation between urban and rural districts. A tax should be levied on all who benefit by the roads. Until the urban municipalities pay their share of these taxes for rural roads, the 47% of the population of this country who live in the urban centres will continue to impose on the rural district. This contribution should be in the form of provincial and Federal taxation.

I made suggestions along this line 25 years ago and was told by a farmer then, that my hair would be gray before "his" roads would be built. Well, my hair may be getting gray, but I hope to live for another 33 years and come back to your semi-centennial convention and announce that my work is completed.

Road construction methods are simple, but must be followed to the letter to get results. If this be done, the results will mean better roads, and they will repay you greater than any other public works.

Twenty-five years ago I had great ambitions regarding roads, but time and experience have brought my ideas to a more practical and a saner policy. Let us keep our feet on the ground and simply argue and reason how we are going to make better roads. For my part, I do not consider "government," "provincial" or "suburban" roads. I just consider *better roads* and think that the earth road in the back corner of some township, serving the last few farmers, is just as much worthy of its share of improvement as is the high-grade bituminous or concrete road.

Highways as Feeders

The waterways and the railways are the main arteries of any country, but without proper feeders, they would sink into oblivion. These feeders are the wagon roads—the main trunk lines—which must in turn be fed by the lesser roads.

Plan wisely, construct skilfully, maintain diligently.

Take your congested districts—the centres of your counties,—build and maintain your first roads there,—perhaps a mile each year, and radiate these roads toward the next nearest town. That town will be doing the same, and eventually you will meet with a finished and permanent road.

Ontario is the home of good roads. The Ontario Good Roads Association was the first of its kind, and the movement is now spreading all over Canada.

*Informal speech delivered March 7th at the 17th Annual Meeting of the Ontario Good Roads Association.

The roads of Canada that we may call leading roads, covering the whole territory from coast to coast, measure about 10,000 miles, but there are still 240,000 miles to be upheld by the municipalities.

Adopt a slower, keener development; get the road located properly; put in your ditches and your drains; build your foundation and let it settle properly; and don't appeal to me until you have done this, for you have no labor and we have no money to waste.

Contributions will be made in proportion to aid given by the municipalities and as it is required. Go slow and do it right. The country will be building roads for centuries to come. Do it scientificially. Construct your earth roads with as much care as you would a concrete or bituminous road. Talk good roads at every meeting you can. Keep working and talking to young and old. Educate the young to follow on with "good roads."

Government Grants Equalize Cost

The Provincial and Federal grants help to equalize the cost to all. The Dominion Government grant of 40% relieves the Provincial Government to that extent, and the Provincial grant of 70% relieves the municipality. Hence the municipality can do a great deal more work to develop the small back roads.

The Government is not looking for "control" in making the grant, excepting to see that the work is fairly done, according to, and along the lines of, a wisely defined policy.

Let the roads be opened for fast driving. Let people drive 35 to 40 miles an hour if they like,—if the road is clear. I wouldn't "fine" them, but I would jail them for accidents or really excessive or dangerous driving.

Speaking of maintenance of roads after construction, Mr. Campbell referred to New York state's method, whereby a motor or wagon patrols the road, filling up the ruts at the sides of the pavement, where the vehicles run off, thus preventing water from getting under the pavement and freezing or causing washouts.

He said that the Federal Highways Department will be a branch of the Department of Railways and Canals, and that legislation is on the order paper calling for a vote of $20,000,000 to improve and extend Canada's roads by Federal aid, but that he could not yet make any more detailed announcement.

PUBLICATIONS RECEIVED

BASCULE BRIDGES.—Very handsome catalogue issued by the Strauss Bascule Bridge Co., Inc., Chicago, Ill.; Canadian office, 14 Windsor Hotel, Montreal. 11 by 8½ ins., coated paper, two colors, 70 pages and cover, profusely illustrated. The catalogue includes a list of Canadian bascule bridges and shows a number of Canadian views. The cover is exceptionally artistic.

SAVING COAL IN STEAM POWER PLANTS.—Technical paper 217 issued by the Department of the Interior, Bureau of Mines, Washington, D.C. It is a reprint of a bulletin prepared by the United States Fuel Administration in collaboration with the Bureau of Mines. It is shown that the efficiency of boiler and furnace depends upon the refinement of the equipment and operation and may range anywhere between 35 and 84%.

ASSOCIATION OF CANADIAN BUILDING AND CONSTRUCTION INDUSTRIES.—Proceedings of conference held in Ottawa in November, 1918. 48 pages and cover, 8½ by 10¾ ins. Contains shorthand report of the meetings, addresses at luncheons and complete registration of those attending the conference. This is a report which should be in the hands of every contractor, supply dealer and manufacturer who sells to contractors. It will be of great interest to all who are associated with the building industry in Canada. It is hoped that a wide distribution of the report will be obtained. The number of copies printed is limited, and while they are gratis, they will be sent only to those who ask for copies. Address J. P. Anglin, president of the association, 165 Victoria St., Montreal, or A. H. Dancy, honorary secretary of the association, C.P.R. Bldg., Toronto.

ELEVEN RESOLUTIONS

Passed This Month at the Seventeenth Annual Meeting of the Ontario Good Roads Association

FOLLOWING are the resolutions that were passed at the 17th annual meeting of the Ontario Good Roads Association, held March 5th, 6th and 7th in Toronto:—

That in the opinion of the association, Section 495, Chapter 192, R.S.A. 1914, which prohibits the placing of road metal and all other road material on the public highways during winter months, is detrimental to the general improvement of highways, and serves no useful purpose, consequently should be repealed.

That the highways department be requested to arrange for a test case with a view to procuring an interpretation of the law and a definition of the liability of municipal corporations for the construction of approaches to private property from the highway.

That the attention of the highways department be directed to the law relating to sidewalks on county roads.

That the Minister of Highways be requested to safeguard the interests of those portions of the province without road-making material by the purchase of quarries and deposits of road making material.

That Section 324, sub-section 2, of the Municipal Act should be amended by adding, at the end of the fourth line, the words "or for the protection of."

That in the opinion of the association the Highway Improvement Act be amended to read that the province may, on request of the county, construct provincial county highways.

That this convention favors the application of federal and provincial aid for the construction and maintenance of connecting links or extensions of county roads through Indian reserves.

That in the opinion of this association the government grant towards the salary of township road superintendents should be increased from 25 per cent to at least 50 per cent.

That this convention heartily approves of the policy of government expenditure in the construction of public highways and believes that it will be a great acquisition to the wealth and convenience of the agricultural interests of Ontario.

That in maintaining highways construction or improvements by public expenditure, statute labor should be absolutely eliminated and the highways kept in repair under the supervision of a properly qualified road overseer.

That the building of roads is recognized as an economic after-war necessity, and since transportation charges on stone and gravel and other road-building material embraces a considerable portion of the total cost of road building, and since freight rates have been advanced on these approximately 65 per cent. during the past two years, the association petitions the federal government, requesting co-operation in reducing freight rates on road-building material to the pre-war basis.

SEWER PIPE PRICES MAY ADVANCE

IT is rumored among supply dealers in Toronto that the prices of vitrified clay sewer pipe, brick and tile are to be advanced to meet the increased cost of labor and fuel. Many manufacturers who had large stocks on hand before the war have been giving their customers the advantage of pre-war prices, but these stocks are now nearly exhausted, and it is said that they cannot be replaced at anywhere near the former prices.

The price of fuel plays a vital part in fixing the price of vitrified products. In fact, fuel and labor are the two principal items entering into their manufacture, and both of these have advanced very greatly during the past few years.

Engineers who are preparing estimates and contractors who are tendering on work including clay products, should make sure that they are protected for supplies before submitting figures.

STONE AND GRAVEL ROAD CONSTRUCTION*

By J. G. Wilson
County Road Superintendent, Halton County, Ontario

STONE and gravel roads are the two kinds of roads that are now largely being built, but conditions are changing very rapidly and the time is at hand when other methods of construction will have to be adopted.

We have now at least three classes of roads, viz., provincial, provincial county, and county roads, and I am sure that the Ontario government and those in charge of the Ontario Highway Department are to be congratulated on the assistance given towards the improvement of our roads. The system that has been adopted is one that should commend itself to everyone interested in the improvement of roads.

The first question which presents itself is, what roads should be built of stone or gravel?

The provincial road to connect up not only the provinces but the great nation to the south of us, and will be an advertisement of the province, also a great inducement to tourists to come in, and the great amount of traffic that will be attracted to this road will call for a more permanent type.

Next in importance is the provincial county road, which will link up the different counties and be a feeder to the provincial road. Now that the auto truck is coming into general use, this class of road will also be called upon to carry a large amount of heavy traffic, and if built of water-bound macadam, will require a bituminous wearing surface.

We now come to the county road, which is intended to link up the different centres in the county and to be a feeder to the provincial county road. No doubt the county roads will have to be constructed of stone or gravel, and it is very important that they should be built in the best manner possible.

Method of Construction

1.—The road should be staked out straight, in the centre of the road allowance, from 24 to 28 ft. wide, depending on the locality and the amount of traffic.

2.—The hills should be cut down to a grade of not more than 6% if possible, for after the road is constructed this is not likely to be done, and if it is, it will be at a considerable extra cost, whereas a little extra cost at the time the road is built will give more satisfaction (and the cost is soon forgotten, but a bad job is an eye-sore and an inconvenience for all time to come).

3.—It should be underdrained where necessary, and culverts placed at the natural water courses to carry the water across the road. Never carry it along the road to save putting in a culvert.

4.—The road should then be well graded and the crown for a single track road should be one inch to the foot, to allow for settling, with good open ditches with sufficient outlets. Water should never be allowed to stand in the ditches, as it will soak under and injure the road.

The preparation of the road as stated above, should be done one year before the metal is put on, to give it time to consolidate, or else the road should be thoroughly rolled. The harder one gets the foundation, the better, for it is much easier to consolidate the stone on a firm foundation.

You will never get good results when you build on a soft or yielding subgrade. Very wet weather is a bad time to build a road, as it is important that the foundation of a road should always be dry. It is also important that it be dry and hard when the road is being constructed, for when the the road is wet, the stone is pressed down into the mud and the mud is forced up through the stone, and in a very short time the road becomes rutted and soon goes to pieces.

Selection of Stone

After the road has been throughly prepared, the next thing to consider is the quality of the stone, which should be hard and tough, of course. Conditions, and the convenience of the stone to the work, will have to be considered in deciding what to use, but don't use a poor quality for the sake of saving a few cents a yard.

The next question is width and depth of metal. For a single track road, 10 ft. should be a suitable width, but it should not be less than that. Greater width would be preferable. The depth of the metal should be determined by the amount of traffic it will have to take care of, and the kind of soil on which it is built. For instance, where the foundation is of a gravel nature, making a good natural drainage, a depth of 8 ins. when consolidated might be sufficient; but where one has to build on a subgrade of heavy clay, it might be necessary to make it 12 ins. In that case the road should be excavated to a depth of 6 ins. and filled with coarse stones and thoroughly rolled when dry. For the second course of stone, from 1½ to 2 ins. would be a suitable size, and this course must also be thoroughly rolled, beginning at the edge of the stone and working toward the centre.

The screenings are then put on, and plenty of water to make a slush. The roller should still be kept going, and at the same time the road should be well brushed with stable brooms to fill the voids.

The water wagon should have wide tires, not less than 4 ins., to prevent rutting the road. In fact all wagons used on the job should have wide tires.

It is very important that the foreman in charge of the work and the man who operates the roller should be competent men, and work together with the end in view that when the road is completed it will be the best road in the county.

Gravel Roads

Gravel, while not so durable as broken stone, has some advantages on account of its being easier to construct, easier to maintain and cheaper. Of course the length of haul is a big factor in the cost of any kind of road, and where the length of haul brings the cost up to anywhere near the cost of stone, gravel should never be considered.

Gravel varies greatly in quality, but as a rule is suitable for roads where the traffic is not too heavy.

When one can get the right proportion of stone, from pebbles up to 2 ins., with just enough sand to fill the voids, it is an excellent material with which to build a road. If the road is well drained, and a sufficient depth of gravel, say from 10 to 12 ins., is put on, and the road well crowned, it will stand up under quite heavy traffic. But it is very rare that one will get a pit where the whole body of gravel is as I have described, nevertheless, in most pits there is some good gravel, and great care should be taken to see that only gravel of good quality is used.

Dirty gravel should be avoided. While gravel with an excess amount of clay will pack quickly and make a good road in dry weather, when the rains come in the spring or fall, it turns to mud and ruts badly and soon wears out.

A few stones are not objectionable if the gravel is otherwise good, as these can be raked forward and placed under the next load. Never leave them in a heap at the end of load. They prevent the gravel from settling even.

Loading at the Pit

See that an even grade of gravel is taken from the pit. One part of the pit may be very fine, another quite coarse and still another may contain too much clay. The teamsters all crowd in at the same time and load wherever it is most convenient, with the result that every load is of a different grade, and when the road is consolidated it will be very uneven, and one is able to tell, from the depressions that will be found, just where every load was dumped. A road of this kind is very objectionable.

Where the gravel has a large amount of stones or boulders, it should be run through the crusher.

Gravel should be spread on the road at least 7 ft. wide and from 10 to 12 ins. in depth. While the traffic will in time consolidate the gravel without rolling, and in a year's time there may not be much difference between it and a road that was rolled, the satisfaction of having the road in a finished state from the beginning, is well worth the cost of rolling.

*Paper read March 5th at the 17th Annual Meeting of the Ontario Good Roads Association.

ROADS RULE THE WORLD*

By C. R. Wheelock
Orangeville, Ontario

DURING the war, public works of all kinds have been at a standstill and as a result much needed works have been left over until they have piled up in heaps. This seemed at the time to be a great misfortune, but may now be turned to splendid account. Public works must be speeded up and will thus form one of the greatest factors in tiding over the reconstruction period. The federal and local governments, together with the municipal governments, by co-operating in this work, can do much in the way of providing employment. The work to be done and material supplied will give employment to all classes—laborers, skilled mechanics, farmers, professional men and manufacturers.

There is probably no public work that offers as great advantages along this line as the construction of our public roads. It will give employment to all classes in all parts of the province and allows co-operation of the governments and municipalities in the work, and besides there is no public work as necessary for our progress at the present time. That there has been an awakening to the advantages of better roads is shown by the interest now taken in all road matters. There never has been a time in the history of the country when good roads was such a live question. It is a live issue in the politics of the Dominion and province, the county and township, the city, town and village, and is heard from every platform and from the pulpit and the press.

Active Programme This Year

That there will be an active and progressive programme of road-building this year in all parts of the province seems to be admitted. Even the few who have not vision to see the advantages that will result from a good provincial system, or perhaps have not taken the trouble to investigate, have been able to read the signs of the times and, as they express it, there is to be "an orgy of road-building." If a progressive programme of road-building, every detail of which has been carefully thought out and carefully planned in the most sober and sane manner, can be called "an orgy of road-building," then we are certainly going to have "some orgy,"—an orgy that will do much in repatriating our gallant soldiers from overseas, an orgy that will do much in giving employment to the unemployed during the period of reconstruction.

The Ontario Highways Department has been engaged in devising well-considered road systems and in making surveys, plans and specifications, and those roads will be selected for improvement which are of the greatest economic importance.

Every mile of good road is a benefit to the farmer, increases his opportunity to expand his farming operations, increases the possibility of profit in farming, enables him to reach out to better markets, to distribute his products direct to the consumer in the shortest possible time, and to have the products of the factory delivered at his gate. There is not an industry in the province that does not have to pay tribute to bad roads, nor is there one that is not benefited by good roads.

Classified According to Traffic

Roads must be classified according to traffic, and must be built for the traffic they are to carry. The cost of construction and maintenance is in proportion to the traffic. And the most economical system of roads for a province, a county or a township will be the system that has its roads most intelligently classified and constructs the type of road suitable for the traffic. It is no economy to build a cheap road, suitable only for light traffic, on a road that has to carry heavy traffic; and on the other hand, it would be extravagance to build the more expensive types of roads for light traffic. Ontario's highway organization provides the following classification for her roads:—

(1)—Provincial highways, consisting of a limited number of trunk highways to provide for the heaviest class of through traffic in the province, connecting up our large cities and important terminal points.

(2)—Provincial county roads, consisting of the main through roads on county systems, connecting with adjoining county roads and forming the connecting links with all the counties and towns of the province.

(3)—County roads, consisting of main roads to local markets, that meet the needs of accumulated farm traffic.

(4)—Township roads, consisting of roads for the ordinary local traffic of a township.

(5)—Suburban roads, consisting of the roads of a county system adjacent to a city and being the leading roads radiating therefrom.

Basic Principle of Apportionment

This classification is complete, comprehensive and workable, and covers all the rural roads in the province. The government aids in different degrees the improvement of all classes of roads. The basic principle in arriving at the division of cost between municipalities benefited and the amount of the subsidy or assistance given by the government, for each class of roads, seems to have been that the cost of a road to a municipality should be in proportion to the amount of traffic for which such municipality would be fairly and justly liable.

As an example, take a road such as the Toronto and Hamilton Highway, with an average traffic of say 2,000 and a maximum of 5,000 vehicles a day, carrying inter-city and long distance, together with a comparatively small amount of local traffic. It would manifestly be unfair and unjust to leave the whole burden of this road on the rural taxpayer. The cost, therefore, is divided between the adjoining rural municipalities, the cities of Toronto and Hamilton, and the government. The government's portion, paid from the revenue derived from motor licenses, covers the proportionate share of the traffic for which the general public are liable.

It would seem that this scheme for apportioning the cost has been very carefully thought out and results in a fair and equitable distribution, and I am proud to say is along the lines that have been advanced and advocated by this association. It provides for payment by cities of a fair amount for traffic originating therein and passing over rural roads, and also provides for a fair distribution of the revenue from motor vehicle licenses, over all the roads of the province.

600 Miles of Provincial Highways

An attempt has been made to condemn the construction of trunk roads on the ground that they are built for "speedways for millionaires and pleasure-seekers." I do not think that this statement could have been made after a careful consideration of the facts. These main highways are the most important links in a provincial system of highway transportation. They relieve rural municipalities of the greater part of the upkeep of these roads which up to a few years ago fell entirely upon the rural taxpayer. Roads must be built for the traffic they are to carry, and if the heavy traffic can be concentrated on a few hundred miles of main roads, thousands of miles of ordinary country roads will be relieved of building the more expensive types which would otherwise be necessary. An ordinary gravel road would be destroyed in a few days by the traffic which the Toronto-Hamilton Highway carries.

The provincial highways designated by the government up to the present are less than 600 miles. The rural roads of old Ontario total 55,000 miles. Of this total, 9,200 miles have been assumed by county councils as county roads. A complete system of provincial county roads has not yet been designated by the highways department, but when completed will probably cover not less than 2,500 miles of the county roads.

The three elements of transportation are waterways, railways and highways, and the three must be linked up to

(Concluded on page 326)

*Presidential address delivered at the 17th Annual Meeting of the Ontario Good Roads Association.

STREET SYSTEMS; THEIR RELATION TO HIGHWAYS OUTSIDE OF URBAN DISTRICTS*

By Nelson P. Lewis
Chief Engineer, Board of Estimate and Apportionment, New York City

THE need of some kind of system in city streets is universally recognized; that is, the need of a primary system of main thoroughfares by which traffic is enabled to reach any part of the city from any other part with economy of distance and time.

The need also of suitable connections between this primary street system and the chief highways traversing the immediate surroundings of the city, or reaching near-by places of interest and recreation, while more slowly realized, is quite apparent. The interest of the city, the county and the state is still largely confined to the system of streets or roads under the jurisdiction or control of these several units, and they have not been regarded as one great system of vital interest to all the people. Few of those present, I venture to say, have not experienced the annoyance of floundering about in perplexity while trying to find the best exit from a city to the good roads known to exist in the adjoining district on the most direct improved highway to some other town, or have not felt a like uncertainty in approaching an important town.

Main Routes Should be Obvious

Were it not for the excellent work done by touring clubs and automobile associations in the erection of signs along the most frequented roads, the difficulties and delays would be far greater than they actually are. But why, we may ask, should not these direct routes for those to whom time is most important, or the attractive roads for those whose object is pleasure riding, be rendered more obvious by the width and general character of their improvement? Why should they not be as easily found as the way to the reading room of a library or the ticket offices and train platforms of a great railway station?

This lack of co-ordination is not a fault peculiar either to the city street system or the rural highway system, but is apparent in both. Rural highways connecting more or less important centres of population are generally much older than any part of city street systems except those in the oldest parts of the towns, while the outer and newer parts have been much more recently planned.

It might have been assumed that the traffic between these centres of population would continue to follow these old routes, and yet how often it is found that they are reached only through streets of minor importance, often shabby and unattractive, not infrequently by means of awkward and obscure offsets, so that the dominant feeling is one of relief in leaving them or of extreme unpleasantness upon entering them.

The same experiences are likely to await the tourist in approaching or leaving the smaller town or satellite city unless it be one of the fortunate one-street towns with one of the single broad tree-lined thoroughfares which are the just pride of New England.

Should Allow for Expansion

On the other hand, when a county or state road system is being improved, even when the roads selected for improvement lead directly to well-established city streets of adequate width, and where the further expansion of the city is quite certain to follow along this trunk highway, an increase in the width of such road as it approaches the city, the improvement of its alignment and grades, special attention to its cross-section and drainage, the planting of trees and a little more care given to the road-side, would be of incalculable benefit and involve little additional cost, while it might save much expense for future widening and much annoyance through traffic congestion.

*Read last month at the convention of the American Road Builders' Association, New York City.

Of course, this requires vision, a quality all too rare, and it may even involve the diversion of traffic through by-passes about already existing centres. There are abundant instances showing what is daily lost through confusion or lack of traffic capacity at certain points along important highways. An example is afforded in Getty Square, Yonkers. Directly on the line of the Albany Post Road, a direct, wide and well improved thoroughfare leading from Broadway in New York City along the unrivalled shores of the Hudson, with scarcely a single abrupt curve to a point north of Ossining, this road here passes through the most congested centre of the city of Yonkers with several abrupt offsets, and the stranger is quite uncertain which of several corners to turn in order to keep the direct route.

The Yonkers Example

The town is so compactly built up that a by-pass around this centre would be prohibitive in cost unless it followed the steep hills back of the city, as would also the straightening and widening of the streets through this centre, while this latter would not avoid the cross-currents of traffic passing through it.

The conditions noted in Yonkers are doubtless being allowed to develop in many other places where they could now be anticipated and corrected at comparatively slight expense. On this same Albany Post Road at Poughkeepsie a situation which has become acute at an offset of, perhaps 200 ft. at Main St., is being corrected by building a roadway under a business block, affording a rectangular crossing of what is becoming a busy thoroughfare with an easy connection with the trunk highway to the north. Many other instances of such impediments to travel might be noted, with suggestions of an easy and inexpensive solution of the problem, but these will suffice.

The value of a trunk line highway is generally in proportion to its length, provided it is well improved throughout, and the value to the public of its improvement depends in no small degree upon the promptness with which the entire improvement is carried out, so that it may be made available for modern traffic for its entire distance. There are cases where an important state highway has been improved for long distances on both sides of a town and up to its corporate limits, but the town is not disposed to undertake a similar improvement of the portion of the road within its limits.

Some Communities Are Backward

The state may have the right to, and in equity it should, bear a certain portion of the expense, this portion depending upon the width at which it is to be improved through the town as compared with the width of the part outside of the town, but there may be no way of compelling the town to do its part. The result may be a delay of years in the realization of the benefit which would result from the complete improvement of the road, the annoyance and expense of reducing speed or load to adapt them to the bad condition of the road within the town or a detour around it if one is available. Such a detour, where a road is under construction or repair, is accepted philosophically as it holds out a promise of better conditions in the near future, but when due to the deliberate unwillingness of the town to put its part of the road in as good condition as the adjoining rural sections, it gives rise to some unkind thoughts and words as to the indifference and backwardness of the community which is responsible for the conditions.

And yet there is often much to be said in extension of the attitude of the town or small city which does not promptly undertake its share of the work. It may be a community where real estate values are low, where there are few, if any, industries contributing to traffic which uses the road and few who would use it for pleasure, where there are no natural attractions to induce the tourist to stop, where there is not even an inn which one would be tempted to do other than avoid.

The taxpayers of such a town think it unjust, and not unnaturally, that they should be called upon to provide a good road for what to them appears to be alien traffic, leaving nothing in its wake but a cloud of dust or a smell of

gasoline, while the mothers of the place are in dread lest their children be run down by the tourist, who too often rushes through with scant regard for the safety of pedestrians or for any law of God or man. Such conditions present a serious problem in the development of a complete state or national improved road system.

It is probable that many of the state highway laws provide for a determination of the proportions of the expense of improving such a link in its road system which should be borne by the state and the town, such proportions depending upon the additional width or the more costly type of the road through the town, but there may be no means of securing prompt action by the town authorities in providing its share of the funds.

Such laws, where they exist, are necessarily uniform and inelastic; but even this is better than would be the practice of enacting special laws to fit each case. This would result in endless log-rolling, unfair compromise and grave abuse. It is difficult, if not impossible, to standardize where conditions are quite different.

Prompt Improvement Desired

Prompt improvement of the entire trunk highway is the object to be sought. The state should be able to secure this result, but without injustice to communities where the imposition of the share of the cost determined by statute would involve serious hardship. It would seem as though the power to carry out such improvement at the time other sections of the road are improved should be vested in the state, which would become responsible for payment for the work in the first instance, and that the town should be obliged to contribute such share as may be designated by law, provided the law so specifies, with the right of appeal to some high judicial body which would have the power either to decrease or increase the proportion fixed by statute, the decision in each case to be reached after careful consideration of all the circumstances, including population, the assessed value of real estate in the town, its existing debt and tax budget in relation thereto, the amount of traffic originating in the town, the need of other improvements, the width of its streets in proportion to their traffic and probably other factors which would be essential to a fair determination of the issue.

This suggestion may be somewhat crude, but it is put forward in the belief that the conditions which it is designed to meet are a serious obstacle to the prompt realization of a complete scheme of state and national highway improvement, and also in the belief that the value of such a system is dependent in no small degree upon the promptness with which it can be wholly completed. It will probably be found that the cases where a town has obstinately and persistently refused to do its share of the improvement of a trunk highway passing through it are comparatively rare, and that they are quite generally ready to pay not only for the extra width but also for the improved type of surface deemed suitable.

The attention of the writer has been called to the case of a village in New York State, the main street of which is part of a trunk highway, where the state's share of the improvement at standard width was less than $25,000, while the contribution of the village, owing to improved type as well as to extra width, was more than $90,000. That so few serious disputes and delays have occurred is probably due in no small degree to the tact and good judgment of the state highway officials in dealing with rather delicate questions of this kind.

The Big City's Obligations

Where a state contains a large city, the population of which is a very large proportion of that of the state, and the assessed value of the real estate in which, and consequently its contribution to the expense of the state, is more than that of all the rest of the state, as is conspicuously the case in New York and Rhode Island, and where none of the state funds for road improvement are expended within the city limits, there is likely to be a certain degree of resentment on the part of the city to what it deems an injustice, especially if the city receives no part of the receipts from automobile licenses or registration fees.

While this feeling may be justified, it must be remembered that a very large proportion of the vehicles using the state highways come from the cities, while few of those in the rural districts are tempted to go to the crowded city streets for pleasure riding or are compelled to do so for business reasons. This is conspicuously true as to the heavy motor vehicles which result in the greatest wear upon road surfaces, the great majority of which are engaged in delivering goods from the large cities, where they are manufactured, to outlying towns, and which probably will soon be engaged in a vastly increased inter-city and interstate traffic.

After what may have been a digression, and returning to the actual subject of this paper, the writer believes that there has been too much of a disposition in the past to consider city, county and state highway systems as if they were three separate and distinct things, while we will not satisfactorily solve the problem confronting us until we think in larger terms and realize that they are only parts, under different jurisdictions, of a great national enterprise worthy the best efforts and enthusiastic support of every one of us.

HARBOR BOARD TO CARRY FIXED CHARGES

WOOD, GUNDY AND CO., of Toronto, have purchased $3,000,000 worth of Toronto Harbor Commission bonds. These are 35-year 4½ per cent. bonds and the price is 84.71, the same as that at which the last issue of $1,000,000 was sold in December. This means that the city is borrowing at the rate of 5.48 per cent., which is lower than the Victory Loan. This will make up the $4,000,000 required for harbor improvements. The sale of these bonds is taken as an indication that the city intends to proceed vigorously with the further work of harbor improvements along with the Dominion government.

"This four million will finance the harbor improvements through the reconstruction period," asserts the mayor, "and they can now go on with the active development. Within a year the harbor board should be able to carry its own fixed charges for sinking fund, etc., out of revenue. We are now within $150,000 of our fixed charges at present, but with the acquisition of many new industries, this deficiency will be obtained from the new leases, and the harbor board, like the Hydro, will carry its own fixed charges."

The Quebec government has granted the use of the Parliament Building to the Canadian Good Roads Association for its Sixth Annual Good Roads Congress and Exhibition, which will be held in May in Quebec City.

At a recent meeting of the House of Assembly in Nova Scotia, the Hon. H. H. Wickwire introduced a bill entitled, "An Act Respecting Loans for County Highways." Mr. Wickwire briefly pointed out that the bill aims to create a better class of roads by providing that a portion of the revenue should be treated by the county as capital for a period of seven years, the money being employed to rebuild the roads. Mr. Wickwire said that one of the chief advantages that would arise from the passage of the bill is the stimulation of contract road work.

Noulan Cauchon, consulting engineer, Ottawa, is making a report to the city of Hamilton on the location of 3 per cent. ruling grades for the development of table lands at the top of the Hamilton mountain, and incidentally for park development. Failing the elimination of the Toronto, Hamilton and Buffalo Railway right-of-way by negotiation or legislation, there will arise the contingency of grade separation at the trackage along the base of Mountain Park. The question of the city's right to 3 per cent. ruling grades may have to be established before the Board of Railway Commissioners or in the courts, unless the city desires to pay the entire cost, as the Railway Act at present permits of no apportionment of cost between the city and the railway for any ruling grades better than 5 per cent.

MAKING OUR TITANIFEROUS IRON ORE VALUABLE*

By Arthur Surveyer

Member of the Advisory Council for Scientific and Industrial Research

DURING the parleys resulting in the Treaty of Versailles, in 1783, Benjamin Franklin argued that England should not only recognize the independence of the Thirteen Colonies, but also concede to the new United States all the territory recently acquired from France, by the Treaty of Paris, in 1763. Lord Shelburne firmly refused to surrender Canada to the new-born Republic, but finally compromised by abandoning all the rich valley of the Ohio River and the country to the south of the Great Lakes. By this territorial aggrandizement, the Thirteen Colonies gained the iron ore ranges of Lake Superior, the copper mines of Michigan, the bituminous coal fields of Illinois, Ohio and Indiana, and probably also a portion of the anthracite district of Pennsylvania.

Progress and Raw Materials

The wealth of a nation is bound up in the progress of its manufacturing industries, and the progress of these depends chiefly on the production of such raw materials as coal and iron. Much has been said and written lately concerning our dependence on the United States for coal, but little concerning our imports of iron ore. Our steel industry has been highly praised for its work during the war, but few have cared to point out that it depended, for raw material, on pig-iron imported from the United States or produced in Canada from imported ores. True, the textile industries have prospered although depending on foreign fields for their staple; but the case of the basic industries of iron and steel is quite different, and they certainly should not be dependent upon foreign countries for essential supplies. The smelting of pig-iron was fostered in Canada, by aid of a system of bounties, which remained in force between the years 1883 and 1911. Steel-making was also encouraged by the same method, during the period between 1894 and 1911, and there is now a movement afoot to obtain, from the government, a subsidy of at least fifty cents per ton of Canadian ore mined and marketed.

The coal resources of Canada are in extent second only to those of the United States, but the location is such that American coal has competed successfully for the markets of central Canada. In 1917, we imported from the United States 63 per cent. of our total coal requirements, 56 per cent. of the bituminous coal consumed in Canada, and 98 per cent. of the anthracite burnt. During the same period, 96 per cent. of the iron ore charged into Canadian furnaces was mined outside of the country. The two situations are not, however, quite identical; true, 56 per cent. of the total quantity of iron ore used in Canada is imported from the United States, but 40 per cent. comes from the Wabana mines, in Newfoundland, which are owned and operated by Canadian companies. Notwithstanding the increased demand for iron and steel, created by the war, the volume of Canadian iron ore used in Canada decreased steadily from 293,305 tons in 1915 to 93,065 in 1917. The principal operating properties were the Helen and Magpie mines, in the Michipicoten district. The ores mined from this district probably represent 99 per cent. of the total Canadian production, but they have to be mixed and roasted before they can be used in the blast furnaces. In Quebec, small shipments of ilmenite were made from Terrebonne county and of titaniferous ore from Saint Urbain, on the north shore of the Saint Lawrence.

Canada's Indefinite Statement

At the international congress of geology, held at Stockholm in 1910, an attempt was made to estimate the iron ore resources of the world. The United States, Great Britain, France, Germany and most of the other countries submitted concrete figures, concerning their iron ore wealth. Canada, however, made the indefinite statement that its known resources were considerable and its potential ore supply very great. A systematic investigation of Canada's iron ore deposits has since been completed by the Mines Branch of Ottawa and by the Department of Mines of Quebec. So far, no great bodies of high-grade ores have been found, but it must be noted that the surveys carried out did not extend beyond the older and more or less settled districts of the country. Besides, the supplies of high grade ores within convenient reach of the blast furnaces of Canada and the United States are rapidly being exhausted, and the low grade ores of Canada will not have to compete with them very long. There are, in Ontario, and also in Quebec province, along the north shore of the St. Lawrence River and along the banks of the Saguenay, some important deposits of iron ore characterized by the presence of titanium in varying quantities. These ores can be classified, according to the proportion of titanium contained, as iron ores or titanium ores.

*From the "Montreal Star."

McGill Professor's Experiments

The ilmenites, or titanium ores, are used in the production of ferro-titanium, an alloy utilized as a scavenger in the manufacture of special steel. The titano-magnetites or titaniferous iron ore, containing from 8 to 20 per cent. of titanium oxyde, are very difficult to treat. The titanium oxyde is not reduced in the blast furnace, but has to be removed in the slag, thus increasing the consumption of fuel.

Some years ago, Mr. Borchers, professor of metallurgy at Aix-la-Chapelle, succeeded in reducing, in the electric furnace, both titaniferous iron ores and titanium ores. He obtained metallic iron and a slag, rich in titanium, which could be used for the manufacture of ferro-titanium. Dr. Rossi's experiments, at Buffalo, have also demonstrated that, by using a magnesian flux, it is possible to reduce economically titaniferous ore, containing as much as 18 per cent. of titanium oxyde, without an excessive consumption of fuel. This, however, requires the use of a charge containing a high percentage of iron.

More recently, Dr. Albert Stansfield, of McGill University, using titaniferous ores in an electric furnace, made both pig-iron and a very fine tool steel. This steel, it is claimed, compares favorably with high-speed steels used in lathes and planers. The electric power required to produce a ton of pig-iron varied from 0.55 h.p. year, when a concentrate was used, to 0.64 h.p. year with the ordinary cre. At Hardanger, in Norway, an attempt was made to operate, on a commercial scale, an electric furnace of 3,500 h.p., utilizing magnetic titaniferous ores (magnetite and ilmenite) somewhat similar to the ores found in Quebec province. The operations, however, were discontinued after one year's trial, the failure being partially attributable to technical difficulties, and partially to labor troubles.

New Field for Hydro-Electricity

This question of the utilization of Canadian iron ores is very important, and should receive the attention of our governments. The smelting of iron ores in the electric furnace was first attempted, at Sault Ste. Marie, by Dr. Haanel, of the Mines Branch. These experiments were afterwards continued, both by French and Swedish metallurgists, and led to the design of the electric blast furnaces now in use in California, in Italy, in Norway and in Sweden, for the smelting of ordinary iron ores by the electro-thermic process. There are no reasons why Canada should not begin the research anew, following the method recently adopted for the study of the lignites of Alberta and Saskatchewan. The Federal Government and the two Provincial Governments interested have created the Lignite Utilization Board, with the powers of an incorporated company, and have appropriated a sum of $400,000 for the use of the board. This money is to be expended in demonstrating the commercial possibility of producing from lignite, which is an inferior fuel, carbonized briquettes of a domestic fuel with a calorific value nearly equal to that of anthracite. Quebec and Ontario are the two provinces most interested in the utilization of our titaniferous iron ores, and they should join forces with the Federal Government, in an effort to discover a commercial method of utilizing these ores and, at the same time, a new field for the use of our hydro-electricity.

CONSERVATION COMMISSION'S ACTIVITIES

The Need for Conservation, Both in Production and Consumption, Was Emphasized by the War

By M. J. Patton
Assistant Secretary, Commission of Conservation

THE wastrel is a bad citizen. That is the outstanding conservation truth the war has impressed upon the Canadian public. In pre-war days the lavish spender was called a "good fellow" and was infinitely more popular than he who made use of his brains to see what expenditures could be eliminated as unnecessary. The latter was called "close" or a "tight wad" and his economic value as a citizen was not realized. The war has changed our viewpoint entirely, and, notwithstanding nature's bountiful provision of natural wealth, it is doubtful if we can ever again revert to our old way of looking at things.

Moved by the stern necessity of war, the government has limited luxuries and unproductive expenditures on every hand. Even what we used to regard as necessaries have not seemed so essential once we began to examine them closely in the light of war's demands. In a thousand and one ways conservation has been thrust upon us and, wonderful to relate, we have discovered we can save millions of dollars' worth of materials without suffering any real hardship.

The war has made us realize that we have been consuming goods wastefully and that we can eliminate that waste without serious inconvenience; extravagance has become unpopular. That is one of the most important economic lessons the war has taught the Canadian people and far-seeing engineers would do well to take cognizance of it.

Conservation in Production

But that is only one aspect of conservation and perhaps the least important, albeit the one the man on the street usually associates with the term. It is even more important that conservation should be urged in the production of goods than in their consumption. What does conservation in production imply? First, let it be said that it does not mean withholding from use resources necessary to the comfort and well-being of the community. The conservationist has constantly to fight against this negative interpretation, that conservation is opposed to development. Nothing is further from the truth.

Conservation, it is true, is the implacable foe of waste in any form, including waste in exploitation, but it is the strongest of advocates of efficient and economical development. It is against exploiting a fishery to such an extent that the breeding stock is depleted and the fishery on the point of exhaustion; it is opposed to using only 20 ft. of the head of a waterpower where 30 ft. could be developed; it does not favor taking everything off and putting nothing back on agricultural lands, for that means soil exhaustion; and it does not favor cutting down forests without making provision for another forest crop. Conservation in production does not imply a dog-in-the-manger policy; efficient utilization is its watchword.

Now, what has been the effect of war upon this important phase of conservation? Have we been producing more wastefully or less wastefully since the battle flag was unfurled? A business man of standing recently said to me: "For the past four years the public mind has been so filled with the necessity of prosecuting the war that, in many quarters, the word 'conservation' has lost its meaning. The war has forced us to postpone our policy of conservation."

With this I take direct issue. Never before in the history of Canada has industry operated with less waste or greater efficiency. While, to some, the word conservation may have lost its meaning, the principles of conservation, call them by what name you will, have been practised as never before. Lands that have lain waste have been brought under the plough; varieties of fish we formerly knew nothing about and which the fisherman threw back into the sea, are now household words, thanks to government advertising; mines that have lain dormant have been opened up and more efficient methods of mining and smelting have been adopted; waterpowers with head only partially developed have been redeveloped to utilize every inch of fall; and inefficient, out-of-date machinery has been scrapped to give place to the more efficient. With the single possible exception of public health, there is hardly any branch of our natural resources that has not thrilled with the re-energized principles of conservation. High prices, the patriotic desire to eliminate waste and the insistent pressure of public opinion, have moved us as never before.

Let me mention a single concrete instance to illustrate the stimulating effect of war. Ever since its organization in 1910, the Commission of Conservation has been advocating the use of by-product coke ovens instead of the bee-hive type. In both of these, bituminous coal is burned to produce coke. The by-products, in the case of the by-product oven, are gas, tar and ammonia; in the case of the bee-hive, gas only. The mining engineer of the Commission, W. J. Dick, in his widely distributed report, "Conservation of Coal in Canada," expounded clearly the merits of the by-product oven, even figuring out to a cent the advantage it had over the type in common use. The Commission's monthly publication, "Conservation," kept preaching the advantages of the by-product oven, the press was supplied with articles regarding it and in other ways it was given favourable publicity, but without very encouraging results. The cost of installation was higher than for the bee-hive oven and to those interested the extra initial cost looked big in contrast with the small but regular daily savings of the by-product oven. Even where bee-hive plants were worn out, some executives were so short-sighted as to install new plants of the same type.

Then came the war and business men began to hear of T.N.T. and other explosives and chemicals in the manufacture of which the tar and ammonia by-products were essential. The prices of these began to soar and there were many heart-burnings because the merits of the by-product oven had not been more carefully considered when pre-war cost of installation had prevailed. High costs notwithstanding, they were now installed. Two of the largest users of coke in Canada have, during the war, installed large batteries of by-product ovens, costing millions of dollars, and, even considering the high cost of installation, they will make more money under peace conditions than with the wasteful bee-hive type of oven. That is one instance of how the war furthered the practice of conservation, and there are few industries of which similar tales could not be told.

Work of Commission Carried On

During the whole period of the war the patient investigative work of the Commission of Conservation has gone on, subject, of course, to limitations of man-power and financial appropriations. It may not be out of place to cite at this point an illustration to show how useful this work has been, even for war purposes.

Sitka or silver spruce was found to be the ideal wood for use in the manufacture of airplanes. Before the United States entered the war, the greater portion of this wood required by the Allies came from the Pacific Coast of that country, where large and well-known tracts of it existed. When, however, the United States entered the war, she commandeered all this timber for her own aviation service. For a time a serious scarcity of this most essential material loomed up before the Allies. It was known in a general way that British Columbia had some airplane spruce, but definite information about the exact locations, quantities, quality, availability and ownership was not available . The Imperial Munitions Board finally applied to the Commission of Conservation in the autumn of 1917 to see if it had any information about this much-needed resource. Fortunately, the Commission was just then completing a thorough survey of the forest resources of British Columbia, which had taken three years of difficult, painstaking work. Definite information regarding every tract of airplane spruce of importance in British Columbia was on file,—the locations, areas, character of the stands, the quality of the timber, its availability and ownership. This was handed over to the Imperial Munitions Board together with the loan of the services of R. D. Craig, the Assistant Forester of the Commission, employed on the in-

vestigation, and production on a large scale was begun at once. The preparedness of the Commission of Conservation undoubtedly saved months of time in beginning the production of this valuable war material and enabled our air forces to attain that superiority which so largely contributed to the successful conclusion of the war.

Other Work of the Commission

The investigation of the forest resources of British Columbia was begun and completed during the currency of the war. Although every unmarried man on the staff, and some of the married men as well, was serving overseas, the Commission of Conservation has pushed onward with its huge task of finding out what Canada's natural resources are and ascertaining the best methods of developing them to give the greatest good to the greatest number.

Some of the other undertakings may be mentioned besides the report on the Forest Resources of British Columbia. A report on the forest resources of Saskatchewan (for it is a great forest as well as prairie province) is well advanced. For the past two years the Commission has been investigating the reforestation of pulpwood lands in Eastern Canada. The experiments will extend over many years, but it has already been found that spruce and balsam take from 50 to 150 years to grow to maturity, whereas most lumbermen have been basing their operations on the supposition that a new crop could be cut about every 30 years. This investigation is of fundamental importance to the pulp and paper industry, and some of the larger companies have made substantial grants to the Commission for carrying it on.

A report showing the distribution of electrical energy throughout Canada was recently given to the public, and a most exhaustive report on the water powers of British Columbia is now on press.

Many farmers who never before kept records of their farming operations are now becoming more efficient farmers and business men by utilizing the simple yet comprehensive Farmers' Account Book designed by the Commission, whilst many, also, are learning the why and wherefore of farming operations previously understood only in part, from the pages of the Hand Book for Farmers, a booklet which has proved immensely popular in the Khaki University among the soldiers who are looking forward to going on the land when they come back to Canada. Some 15,000 copies of the Commission's reports have been sent to this university at its request, to be used as text-books and supplementary reading in the courses dealing with Canada's natural resources. Each month, also, 1,000 copies of "Conservation," the monthly paper published by the Commission, are sent to the soldier-students of this university.

Another important phase of the Commission's work has been in town planning and housing. It is not too much to say that the educational and scientific basis of the present movements in favor of town planning and housing have been laid by the skilful and persistent work of the Commission's town planning adviser, Thomas Adams.

Public Interested in Efficiency

Not only has the organized work of conservation been carried on during the war with every effort exerted to accomplish as much as possible ere the period of reconstruction arrived, but the war itself has permeated the country with the ferment of conservation. Public opinion frowns upon waste and incompetency in business, and industrial leaders are realizing that the public they serve, as well as their own shareholders, are concerned over the efficiency of the methods they employ. Monopolistic and quasi-monopolistic business will be confronted with a demand for public ownership or close public regulation in proportion as its operations are wasteful and inefficient. Public opinion believes that the public has to pay for waste and inefficiency in private as well as in public business.

The Toronto Board of Control has been requested by John Berry, of Toronto, to investigate electrolytic treatment of sewage sludge. The Works Commissioner has been asked to report on Mr. Berry's proposed experiments, which would cost $39,000.

UNITED STATES ENGINEERING COUNCIL*

Joint Activities of Engineering Societies—A Resume of Work of Engineering Council and Engineering Foundation

By Alfred D. Flinn
Secretary, Engineering Council

ENGINEERS have had a tendency to separateness and segregation due to the nature of their work and their individual characteristics. Achievements in sciences have led to specialization in engineering. Branches and minor divisions of the profession have multiplied rapidly in recent years. Interchange of information early became necessary for the solution of technical problems and the establishment of correct practices. Consequently, societies were organized at the first for technical objects. With the rapid development of sciences, beginning in the latter part of the 19th century, new societies split off from the older ones or sprang up independently, pursuing the newer lines of specialization. Whereas, only sixty years ago there were in the United States one local society, at Boston, and one national organization, the American Society of Civil Engineers, at New York, there are now approximately 400 engineering societies and branches—local, state and national. In the main they have been until recently, independent one of another. Almost exclusively their organization and activity have been determined by technical considerations. Until quite recently, but little attention has been devoted to the humanistic aspects of engineering—to fellowship, to personal welfare, to community service.

Impotent to Aid Government

Indeed, when desires for activity along these latter lines began to be expressed, not many years ago, the profession found itself almost impotent for lack of solidarity. It had been organized chiefly for the preparation, discussion and publication of technical papers for the advancement of the arts and sciences of engineering. The organization machinery could not function satisfactorily in the new activities, excepting that some of the local units had developed a happy measure of fellowship, and in a few instances had taken some part in local civic affairs.

When the great war came to the United States, the engineering profession was unable to take advantage of a great opportunity. Individually, in small groups, and when organized in the military and naval services, engineers achieved marvels. But when engineers as a great professional body sought to aid the government and the government desired its aid, the Babel voices claiming to represent the profession made satisfactory co-operation impracticable. The same lack of effectiveness has prevailed in other fields of activity in which engineers are now beginning to realize they should have taken a larger part. At various times endeavors to deal with specific problems of public service or professional welfare, have been made by means of joint committees of two or more societies, or the several larger national societies have attempted to deal with them separately.

To Promote Solidarity

Desiring to promote the solidarity of the profession, a group of engineers, through the generosity of Andrew Carnegie, were able to establish the Engineering Societies Building in New York in the first decade of the twentieth century. For the purpose of holding and administering this property the American Societies of Mining, Mechanical and Electrical Engineers formed the United Engineering Society. After twelve years, the Civil Engineers accepted a repeated invitation to be one of the Founder Societies. United Engineering Society, therefore, now has four members. To accommodate the civil engineers, three additional stories were added to the building and completed in 1917. Engineering Societies Building is now a sixteen-story structure, and with its land represents an investment of approximately $2,000,000, one-half of which has been contri-

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*Notes on talk before Engineers' Club of Philadelphia, March 14th, 1919.

buted by the societies. It houses seventeen engineering organizations with a total membership of almost 60,000.

Engineering Societies Library was created by bringing together into the new building, in rooms specially designed for a large library, the separate collections of books belonging to the three Founder Societies. To this collection, the American Society of Civil Engineers later added its large library, after eliminating duplicates. Growing continually, Engineering Societies Library now contains nearly 160,000 books and pamphlets. It is the largest engineering library on the western hemisphere and one of the most important in the world.. It is managed by a board of twenty-one members, five from each of the four Founder Societies and the director of the library. This library is more than a collection of books. It is a technical information bureau serving hundreds of persons at a distance, as well as those who can visit its rooms. Through its service bureau searches are made in response to mail or wire inquiries, and bibliographies, photostat and other copies, translations and abstracts are supplied at the cost for doing the work. Orders are received from even the remotest countries. Last year they totalled more than 1,700, and this year's total bids fair to be much greater. An index of current technical literature is being prepared monthly by the library in co-operation with the Founder Societies and printed in their publications and those of some other societies, in whole or part. Projects for further extension of the library's usefulness are in hand and will go forward as resources permit.

Engineering Foundation

"For the furtherance of research in science and engineering, or for the advancement in any other manner of the profession of engineering and the good of mankind," in 1915, Ambrose Swasey gave $200,000 as a nucleus of an endowment fund for the Engineering Foundation. This he supplemented in 1918 with another $100,000, and further gifts to the endowment from other sources are now assured. Early in 1916, President Wilson requested the National Academy of Sciences to establish the National Research Council for the promotion of science and industry and preparedness for national defense. This research council when first organized was without funds and headquarters. Engineering Foundation provided both for the first year and has since continued to co-operate with the work of the Council, which during the war has been of great importance. Engineering Foundation has also financed several small investigations in connection with the war and with the peace activity of engineering. Its business is administered by a board of sixteen, made up of three members each from the four Founder Societies, three members at large, and the president of the United Engineering Society ex officio.

As the great societies were thus being drawn together by being housed in the same building, by becoming interested in Engineering Foundation, by merging their libraries, and by establishing the John Fritz Medal, the need became more and more evident for an organization which could deal with "matters of common concern to engineers as well as those of public welfare in which the profession is interested, in order that united action might be made possible." Appreciation of this necessity resulted in 1917 in the modification by the Founder Societies, of the by-laws of United Engineering Society to provide for a new department to be known as Engineering Council. On this Council each Founder Society has five representatives, and United Engineering Society is represented by four of its trustees, one from each Founder Society, and the American Society for Testing Materials has one representative. Other national engineering or technical societies may be admitted to membership. Early this year the American Society for Testing Materials became the fifth member of Engineering Council.

Engineering Council's Activities

Engineering Council held its organization meeting June 27, 1917. Until November, 1918, a large proportion of its efforts were naturally devoted to activities directly or indirectly connected with the war. Nevertheless, much progress was made meanwhile in defining the normal field of activity of Council, developing its organization and determining its methods of operation.

Its War Committee of Technical Societies embraced representatives of eleven technical organizations and was closely associated with the naval consulting board and the inventions section of the Army General Staff. Of both these governmental bodies the chairman of the committee was a member. This committee assisted in reviewing 135,000 suggestions for military and naval devices and in stimulating the solution of war problems.

American Engineering Service devoted its energies chiefly to aiding some thirty major and subordinate governmental departments in securing personnel. In response to approximately 200 requisitions and other requests, the names of about 4,000 engineers, carefully selected, were furnished the government from lists of many thousands which had been compiled with the assistance of a number of engineering societies. Incidentally, many engineers and opportunities for engagements in civilian work were brought together.

The Fuel Conservation Committee co-operated with the Fuel Administration and the Bureau of Mines in economizing the use of fuel during the war, and in continuing its work for the benefit of industry and the public at large in peace times.

Committee Studies Compensation Problem

Through its Public Affairs Committee, its Executive Committee and some special committees, Council gave consideration to other war activities. It also took up with the Railway Wage Commission a plea for better compensation to engineers in the railway service and has pursued this matter to the present time. A special committee is now being organized to study carefully and take action upon the whole matter of classification and compensation of engineers, especially those in governmental and railroad employment.

Immediately after the signing of the armistice, Engineering Council supplanted its American Engineering Service by the Engineering Societies Employment Bureau. The secretaries of the four Founder Societies were made a board of directors and the manager and staff of American Engineering Service were engaged as the nucleus for the new work. This work has been enlarged steadily and since the first of December, approximately 1,500 engineers, many of them returning from war service at home and abroad, have been registered. Positions have been found for about 300, and as the work develops and the industries of the country are being readjusted, a larger proportion will be placed. No charge is made for this service, and it is open not only to members of the societies, but to non-members introduced by members. The service is appreciated, especially because of the discrimination and intelligence with which it is managed. Requests for men for many important engagements are coming to this office as well as those for minor positions.

Council some months ago created a Patents Committee, which has co-operated with a similar committee of the National Research Council upon working out and recommending important changes in the organization and practice of the Patent Office. These may be stated as follows:—

1. Establishment of a single Court of Patent Appeals;
2. Separation of Patent Office from Department of Interior;
3. Increase in force and salaries of Patent Office;
4. Modification of that section of the law granting compensation for infringement of patents.

Water Conservation, Licensing, Etc.

A Water Conservation Committee has been created to deal broadly with questions concerning utilization and control of water in all parts of the country for municipal supply, power development, navigation, irrigation, sewage disposal, flood control and other purposes; to promote such consideration of water resources by Congress and legislatures as will result in conservation rather than unintelligent appropriation to a narrow use at the expense of some more important use, also to encourage wise development.

A Committee on Licensing of Engineers was created at the beginning of the year after long efforts to secure a proper membership. The committee has thirteen members in as many different states: its chairman being in Chicago. The country has been divided into districts, one assigned

to each member of the committee, for the collection of information relating to present and proposed laws concerning the licensing of engineers and architects. This matter is receiving active attention by large numbers of engineers as well as the legislatures of several states.

January 1st the Public Service Commission for the First District of New York was forced by the adoption of a segregated budget by the Board of Estimate and Apportionment of New York City, to discharge without notice, 339 engineers and assistants engaged upon subway construction. January 14th, at the request of the acting chairman of the Commission and of several engineering societies and individuals, Engineering Council held a hearing. The findings were printed and sent to the city authorities and engineers interested to the Governor, to 100 civic organizations and the daily papers and engineering periodicals. Partly as a result of these actions of Council, most of the engineers were reinstated February 1st, and some of them were paid for the month of January.

Affiliation With Canadian Institute

To maintain some communication, although informal, with groups of engineers throughout the country, Engineering Council has approximately thirty local correspondents in as many centres of engineering population. Canadian engineers have repeatedly expressed desire for friendly relationships with Engineering Council, and at its meeting February 20th, Council appointed members of joint committees on International Affiliation of Engineers, to which it is expected the Engineering Institute of Canada, also, will appoint a few members.

Council is financed by its member societies. Each year each Founder Society has appropriated $4,000, for the purpose of Engineering Council; that is $800 per representative. The American Society for Testing Materials is contributing at the same rate. Council's activities are now limited chiefly by the financial resources at its command. New methods of financing are necessary in order that the services which engineers of their joint organizations seem to be desiring may be carried on and may be supported by general contributions. Of this more may be heard in due course through the societies. Time limitation prevents mention of many activities of Council, but there is one, which promises to be its most important, which deserves attention.

Office at Nation's Capital

From the beginning of its existence Engineering Council recognized the desirability of establishing at the national capital an office to represent the engineering profession. Ways and means for accomplishing this purpose did not appear until the end of 1918, when a National Service Committee of nine members was created. The members are distributed among several societies and located in many parts of the country, but the chairman is the Washington representative of Engineering Council and in charge of an office recently opened in the McLachlen Building at 10th and G Streets.

The National Service Committee is to deal with matters of national legislation and work of the Federal departments referred to it by Engineering Council. It will also maintain an information bureau for engineers to answer inquiries regarding the reports and activities of the departments and matters before Congress. Its most important item hitherto, has been the discussion of a National Department of Public Works before Senate committees at their requests. Preparations are being made for pursuing this subject before the 66th Congress after consideration by a conference of representatives of engineering societies, preliminaries for which are now in hand.

Thus it appears that out of the somewhat chaotic condition which had come about in engineering organization in the pursuit of the constantly differentiating specialties of technical practice, there are growing up strong organizations for joint activities in those interests of the profession which demand federation and general support. Although from necessity the headquarters are located in New York, the activities are reaching throughout the country and seeking to be of use to engineers everywhere.

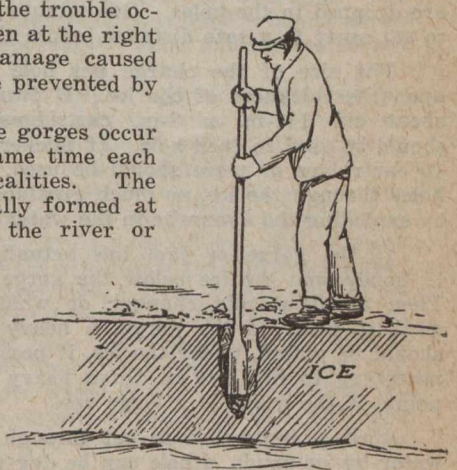
THE MENACE OF THE ICE GORGE

By S. R. Russell
Technical Division, E. I. du Pont de Nemours & Co.

DAMAGE to the extent of millions of dollars is caused every year on this continent by ice gorges. Bridges, docks and other structures along the shore are carried away or destroyed by the sheer force of the ice. Probably the greatest damage, however, results from the flooding of the surrounding country by the water which is dammed up by the ice jamming against bridge piers or other artificial obstructions. Sometimes at narrow parts of the stream where the current is sluggish, the water freezes right to the bottom. When the thaw comes the ice at this point does not thaw quickly enough, so that when the upper ice gives way it rushes down and piles up at the solid seetion, thus forming a barrier or dam.

No matter how the trouble occurs, if action is taken at the right time most of the damage caused by ice gorges can be prevented by the use of dynamite.

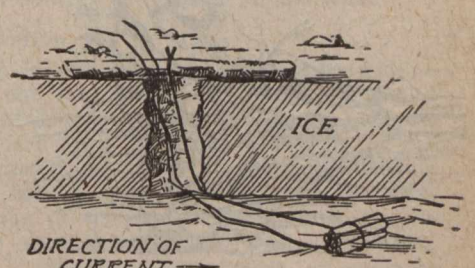
Floods due to ice gorges occur usually about the same time each year in various localities. The gorge also is generally formed at the same place in the river or stream. For this reason, therefore, preparations can be made and work started in ample time before the break actually occurs. When the "back of the cold spell is broken" some time elapses before the ice begins to melt.



Spudding Hole in Ice

It is well to begin at the downstream end, considerably below the probable location of the gorge, and work upstream some distance above it, depending on the width and size of the stream. The ice should be practically honeycombed or cracked up below and above the danger point, so that when the "rush" comes it will give or move easily without jamming or causing damage.

A force of men should be put to work digging holes from 6 to 12 inches in diameter clear through the ice with ice spuds or picks, beginning at the downstream end and several hundred feet below the probable location of the gorge. These holes should be about 30 feet apart across the stream, and from 60 to 75 feet between rows. It is advisable to shoot one row at a time at first, then the execution of the charge can be noted and determined whether or not it is advisable to decrease the charge, or space the holes further apart. For the initial charges from five to ten 1¼-in. x 8-in. cartridges of dynamite, 40% strength, should be tied into a bundle with a stout cord, and each bundle primed with an electric blasting cap. One bundle of dynamite should be dropped in each hole so that it will be suspended in the water under the ice—even two or three feet under the ice is best. A stick of wood laid across the hole on the ice surface to which the other end of the string is attached will prevent the dynamite from being carried away and lost.



Charge Tied to Stick Laid Across Hole in Ice

The electric blasting cap wires should be connected in series and fired by means of an electric blasting machine.

The leading wires running from the holes to the machine should be strung toward the upstream end, and should be sufficiently long so that the operator is at a safe distance from flying ice.

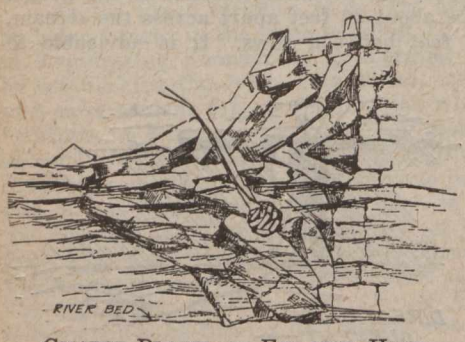
If it is inconvenient to use electric firing, the charges can be exploded by means of fuse and blasting caps; but care should be taken to protect each cap from water by smearing heavy grease or soap at the point where the cap is inserted in the dynamite. Also, a good grade of waterproof fuse should be used. Of course, in the latter method only one hole at a time can be fired, while with the electric method as many as desired can be set off simultaneously with much greater efficiency, assurance and safety. Good safety fuse burns at the rate of about 30 seconds per foot. Do not have a fuse too long, as this means that the fuse and cap are exposed to water a longer time. The bundles can be all made up and tied to the cross sticks and about 2 or 3 feet of fuse used in each. Fuses can be lighted before bundles are dropped in the holes. One minute is ample time for all to get away to a safe distance before the charge explodes.

The size of the charge per hole will depend entirely upon the thickness of the ice. If two or three feet thick, about six 1¼-in. x 8-in. cartridges, or three pounds, should be used in each hole. If thicker than this, from 8 to 10 cartridges or more should be used. Be sure to get the holes through the ice, as much greater efficiency is obtained by exploding the dynamite in the water than in the ice itself.

If the gorge or jam has actually formed it is well to honeycomb the ice below the gorge, as above described. Then at about mid channel, or what appears to be the weakest point of the gorge, a heavy charge of dynamite should be placed, under the ice, if possible; often it may be necessary to fire two or three heavy charges at different points if the gorge is a large one.

If it is impossible to get through the thick ice to the water by ice spuds, a hole can be dug partially through and a small charge of say 8 to 10 cartridges fired in it. This charge will enlarge the hole and probably break through and permit placing the heavier charge in the water under the ice. If the first light charge does not break through or make a large enough cavity, try a second or a third charge if necessary.

The size of the heavy charge will depend, of course, on the thickness and extent of the ice mass, and may vary from 50 to 100 pounds up to a ton or more. Size of charge must be regulated also according to the location and proximity of structures that might possibly be damaged by the explosion. It would be inadvisable to blast too heavily if too near a bridge pier, a cable line, dock or a factory building on shore. If, however, nothing like these interfere it is well to use larger sized charges. The tendency of most people in using dynamite for blasting ice is not to use enough. The reason is that the work is usually performed by those who have very little knowledge and a very exaggerated idea of the force of high explosives.



CHARGE PLACED TO ENLARGE HOLE

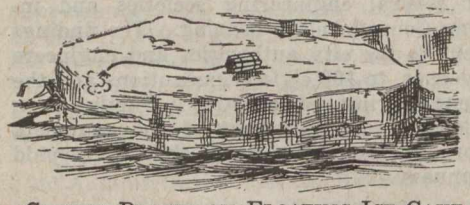
In breaking the great ice gorge at Niagara several years ago, 2,100 pounds of 60% dynamite were used at one time, distributed in three charges, before the ice gave away.

We know of a rather amusing case where just the opposite prevailed:

An ice gorge had actually formed in the river near a certain city, and the chief of the local fire department decided to try blasting. The chief of police had ordered all windows of houses and factories opened within several hundred feet of the river bank, and the factories vacated. No one was permitted to get anywhere near the work. They then proceeded with great fear and trembling to explode one cartridge—8 ounces—on a mass of ice that would actually require at least 100 pounds!

It is well, therefore, in blasting ice to err on the side of over-charging, as this sort of blasting can usually be carried on without fear of injury to adjoining or nearby property.

When heavy charges are necessary, dynamite can be placed in position in its original cases, containing 50 pounds each.


CHARGE PLACED ON FLOATING ICE CAKE

If the ice is floating, a gorge can often be prevented from forming at some lower point in the stream by shattering and breaking up the large floating cakes before they reach the narrow part or obstruction.

Breaking these large floating cakes is best accomplished by throwing charges of dynamite onto the cakes from the shore; or, if possible, from the downstream side of bridges considerably above the danger point. Each charge should be primed with a blasting cap and fuse, and a charge may vary from two cartridges to eight or ten cartridges of 40% tied securely into a bundle with a cord. The bundle can be wrapped in old newspaper or gunny sacking, which makes it less liable to roll or slide off the ice. In blasting ice in this way it is necessary to light the fuse while the dynamite is in the hands of the blaster, and particular attention should be given to having the fuse plenty long enough, and the charge must be thrown just as soon as the fuse is lighted.

It is most essential to make sure that the dynamite is thoroughly thawed before using, as chilled or frozen dynamite will not give satisfactory results. For that reason, low freezing dynamites like 40% to 60% dynamite is recommended for this class of work.

Do not leave dynamite exposed too long to cold water. Get all holes dug and bundles made up before loading, and place and fire the charges as quickly as possible.—From the Dupont Magazine.

NEW CONSULTING FIRM IN TORONTO

ANOTHER firm was added last month to the list of consulting engineers in Toronto, when E. J. Philip & Sons established an office in the Hamilton Trust Bldg., Queen St. West. Mr. Philip has just returned from Porto Rico where he spent two years with the Roberts Filter Mfg. Co., Inc., of Darby, Philadelphia, Pa., on American government business in connection with emergency water supplies. Previous to his connection with the Roberts Filter Co., Mr. Philip was manager at Brockville, Ont., of the gas, electric light and waterworks departments, and had previously held a similar position at Kitchener, Ont., where for seven and a half years he had been manager of the gas, electric light and street railway services. Prior to moving to Kitchener, he spent seven years as mechanical and electrical engineer with the T. Eaton Co., Ltd., Toronto. Engaged in private practice with Mr. Philip will be his two sons, one of whom has been in France for the past four years with the 11th Battery.

At the Irrigation Convention, held last week at Lethbridge, Alta., an irrigation plan involving the expenditure of $2,500,000, was discussed. This work would irrigate about 100,000 acres. The water would be obtained from the Old Man River, west of Macleod. Other irrigation projects discussed would require an expenditure of from $5,000,000 to $15,000,000.

SHALL ENGINEERS BE PAID OVERTIME?*

By Halbert P. Gillette
Editor, Engineering and Contracting, Chicago

THE eight-hour day is practically the standard for employees on public works in America. Labor unions have succeeded in making it almost universal in factories and mines. Nominally, at least, it is now the standard for railway trainmen and enginemen.

Wherever labor unions have secured the eight-hour day, they have also secured provision for payment for overtime work. The question that we are putting to ourselves as technical engineers is whether a labor unionist should receive overtime payment from the same employer who denies overtime payment to those who do not belong to a union? If so, why?

The daily output of men whose main work is with their hands, rather than their minds, bears a somewhat definite relation to the number of hours worked. The daily output of men whose main work is either of a supervisory or of designing nature, bears less relation to the time spent upon it than to the intensity and character of the mental effort. One good idea, the result perhaps of only a few hours' thinking, may eventually effect an economy of thousands, or even millions, of dollars. Hence it is that a designer or a manager who has large problems to solve does not rate the value of his output by the time expended.

The Tendency to Overwork

Time, of course, is a factor in every effort, whether mental or physical; but a high grade brain may accomplish more for society in an hour than a low grade brain can accomplish in a life time. It is clear, therefore, that the designer as well as the supervisor of important work ought never to hold himself or be held to a time unit as a basis for payment for services rendered. In fact the tendency of most brain workers of great ability is to overwork themselves. The very joy of accomplishment leads them into unwise expenditure of nervous energy. Such men need a restraining bit rather than a spur.

Between the extremes of purely muscular and purely mental work, there is a great intermediate class of work that calls for both muscular and mental activity, such, for example, as ordinary drafting or operating an instrument like a transit. The men who do this intermediate class of work frequently aspire to advance to a higher grade wherein nearly all their work will be mental and of a designing or supervisory character. Yet so long as they hold positions of a semi-mental, semi-muscular nature, is it just to require them to be oblivious to the length of the working day in the hope that eventually they will be rewarded by advancement to the supervisory class? I doubt it.

It seems to me that there has been altogether too much feeding of young engineers on hopes of future incomes from higher positions. There has been too much appeal to their professional aspirations while asking them to accept less than skilled mechanics' pay.

A man able to run a steam shovel, a locomotive or a lathe efficiency—a skilled mechanic—is really in about the same class as a good leveler or a transitman, so far as purely manipulative skill is concerned, but in a lower class so far as mental training is concerned. Hence for wage purposes, it would surely be reasonable for instrument men in surveying parties to receive at least as favorable wage considerations as skilled mechanics receive. I am, therefore, inclined to believe that technical engineers in subordinate positions should be paid overtime wherever practicable.

Subordinate and Supervisory Positions

This brings us to the matter of drawing a line between "subordinate" and "supervisory" positions. A little thought will show that there is no purely logical dividing line, and that a somewhat arbitrary division must be made. A transitman, for example, supervises the axmen, chainmen, "stake artist" and flagman of his party; yet much of his work consists of the mechanical manipulation of his instrument, and the almost mechanical processes of taking notes and making calculations. On the other hand, a structural designer performs much of his most effective work when he is supervising no one, that is when his brain is working alone on the solution of the larger elements of some economic problem of design. Evidently, then, the mere act of supervising men cannot be made to serve as a standard by which to classify employees for overtime payment purposes.

Classification by Wage Scale

As a rough-and-ready, practical way of meeting the difficulty the following is suggested: Take the wage or salary of the highest paid union labor employee as a standard by which to differentiate between "subordinate" and "supervisory" engineers. Thus, if locomotive enginemen working full time on an eight-hour day basis earn $200 a month, and are paid overtime, then all technical engineers who receive $200 or less per month would be paid for overtime. All technical engineers receiving more than $200 a month would then be placed in the "supervisory" class and receive no pay for overtime.

There are objections to any scheme that may be suggested for overtime payment for engineers and there are practical difficulties in the execution of any plan, but neither objections nor difficulties are insurmountable.

It may be argued that overtime payments are readily applicable to office draftsmen, but not to field surveyors. I fail, however, to see sound reason for letting little difficulties in time-keeping or work scheduling prevent the application of an overtime payment plan. When I hark back to my days as a railway surveyor, I hear no discordant note in the suggestion that it would have been comparatively easy to have reported all the overtime of my party every day; and I am quite sure that there would have been no jarring, untuneful sounds from the throats of my party had each man received reward for the 2 to 4 hours of his daily overtime work.

Engineers in the higher positions are apt to be unduly influenced against paying any of their subordinates overtime. To begin with, having reached supervisory positions, they like to make a good showing of low costs. I know of one celebrated engineer who estimated that he could keep the cost of engineering on a big project within 3 per cent. He was so anxious to "make good" on his estimate that he lost his sense of fairness toward his subordinates. He held their salaries down to the lowest possible notch. When there was complaint, he told them he could easily fill their places, and that the training they were receiving under him was alone worth more than their salaries—the old, old story. Had there been a vigorous organization of engineers bent upon securing fair salaries, and had the organization threatened to make public to all engineers the attitude of this chief engineer, I doubt whether he would have been so keen to keep engineering costs down to 3 per cent. of the total.

Ambition Apt to Wane

Although it is not directly germane, it has a bearing on this subject to point out that while the percentage cost of engineering can be kept down by paying inadequate salaries, in the long run this is a very expensive procedure. The total cost of any engineering project depends very largely upon the design, and this, in turn, depends upon the skill, experience and ambition of the designers—not one, but all the designers. When salaries are held down, ambition to excel is apt to wane. When ambition wanes, an engineer either does not do full justice to his task or he seeks a new position where opportunity looks brighter.

American railways have suffered untold losses through failure to pay adequate salaries to employees in the engineering departments. They have driven many of the most able and ambitious engineers into other fields. They have weakened the ambition of many of those who have remained.

I am reminded of the colored soldier in France who was lazily breaking stone for a macadam road. The blows from his knapping hammer were infrequent enough at best, but he paused to rest upon the slightest excuse. A white officer, noticing his exasperating slowness, went up to him and said:—

*Address delivered March 17th, 1919, at the Railroad Conference of the American Association of Engineers.

"Say, haven't you any ambition? You aren't down South on a plantation working for a slave driver. You're a soldier working for Uncle Sam. Come now, show some ambition."

"Ambition? What good's ambition? I gets my li'le thirty per ef I got ambition, and I gets it ef I ain't."

Engineers may never fall into the utterly ambitionless class because of low salaries, but there is no gainsaying that inadequate remuneration eventually takes some of the "pep" out of nearly any man.

Contrasted with skilled mechanics, most draftsmen and instrument men are badly underpaid. Not only are their daily rates disproportionately low, but they rarely receive pay for overtime work. Aside from being unjust, this I feel is an economic mistake.

ROAD MAINTENANCE*

By F. A. Senecal
County Road Superintendent, Prescott and Russell Counties, Ontario

DURING the last year there has been so much said and written in regard to highway legislation, road construction and the classification of roads that perhaps the largest problem, as it stands to-day in Ontario in regard to the general improvement of the roads, seems to be forgotten.

The obvious reason for this resides in the fact that a great change in public opinion has taken place in many localities. The people to-day seem to favor a speedy construction of high-class roads where, only a few years ago, they would have been impossible. Scores of good roads enthusiasts are developed every day, and all have ideas of their own—more or less practical. One thing, however, to be commended is the generosity of some of them. They are ever ready to give their services free of charge—especially advice —as to what must be done for the improvement of the roads.

The Lawyer's Advice

Some time ago, at a large meeting in Ottawa, the problem of road maintenance appears to have been solved in a rather startling manner. A so-called road expert—who, by the way, is a well-known lawyer—was giving a powerful address on road construction. After drawing a rather dark picture of the roads in Ontario and deploring the inferiority of the construction of some roads he had travelled over, and which, he said, were intended to be permanent when built a few years ago, he told his audience how easily he would overcome this very problem of road maintenance. He made this remarkable statement:—

"When building your roads, build your maintenance 'in' your roads," inferring, I presume, that a road, when properly constructed, would require no maintenance whatever. This statement, strange as it may appear to be, seemed to meet with the approval of his audience.

Unfortunately for us who are gathered here to-day, and who are so deeply concerned with this very problem, this "genius" did not give us his formula; he did not tell us how this could be accomplished, i.e., what kind of construction would he recommend that would be so permanent that it would do away with the problem of maintenance altogether.

No public office would be too high for the man who could devise a system or material of road construction that would not require any maintenance after its construction. His name would go down in history as a public benefactor. This lawyer's advice on road maintenance may sound very plausible, but we must admit that this problem cannot be disposed of in this manner.

True it is that a competent engineer, when supplied with all the information in regard to the nature of the traffic over a certain road, can lay out plans and specifications of a road that would meet those conditions and determine the approximate cost of the materials most suitable for that particular case, but never can a road be so constructed that it will stand under heavy traffic without a proper system of maintenance.

Sometimes we are pointed to the famous roads in Europe, such as the Appian Way, built by the Romans about 315 B.C., and also to the roads of France and England, also built after the Roman invasion, as models of efficiency and permanence, but these so-called road experts do not seem to realize that there has been a change in the conditions in the world since the invasion of Britain by the Romans.

Marvellously as some of these roads in Europe have stood the wear and tear of centuries, none of them have escaped from the natural consequences of the improved means of transportation over those roads. In fact, all the roads that are left have been resurfaced, and some of them many times,, and this invariably according to the nature of the traffic passing over those roads.

In this country the conditions are so different that we cannot always be guided by the experience of older countries. Our sparsely-settled population, climatic conditions and other matters make the problem of road-building and maintenance altogether different to that of the older countries.

New Conditions Almost Daily

With the advent of the motor traffic over the roads, new conditions are being created every day. Roads built only a few years ago to carry a certain class of traffic are now inadequate to carry the increased traffic and show evidence of deterioration on account of the new conditions. I, for my part, would not always charge that to deficiencies in construction.

It is not my intention to take up the question of road maintenance as it presents itself in connection with the various types of road construction. This would take more than the scope of one short paper on this subject would allow. My intention is merely to open up the subject in order that several amongst you may give us the benefit of their experience, especially as to the proper method of dealing with a most important problem, because it affects nearly 90 per cent. of the roads in Ontario.

When we stop to consider that about 90 per cent. of the farm products have to pass over those roads before reaching the more permanent roads or the railway stations, we may well ask ourselves if we are really giving to this question all the consideration it deserves.

To my mind, an ideal organization of road maintenance should be prompt, systematic and continuous.

It should be prompt, because when once the need of repairs becomes apparent it serves no good purpose to delay them. The longer the delay, the more difficult they become, and may soon develop into a source of liability for damages. Moreover, the action of the water remaining in the subgrade soon affects its firmness and would ultimately destroy the roadbed entirely.

Repairs should be systematic because the best results in roadwork are obtained only when a well-planned system of maintenance is scrupulously adhered to and followed to the letter.

Finally, repairs should be continuous, because no organization can be called complete unless the various sections are united together under the patrol system, which is generally followed on the county roads to-day.

There are a few other points which, I believe, should always be borne in mind by the superintendent when laying out his plans for heavy maintenance work on the roads. These are the proper location of the graded roadway, and also the question of providing sufficient drainage for the roadbed. No labor can be employed more profitably than that of locating the road properly, and, having done so, to place the underdrains wherever required, thus ensuring a perfectly dry roadbed before beginning the work of constructing with stone.

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*Paper read March 6th at the 17th annual meeting of the Ontario Good Roads Association.

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PRINCIPAL CONTENTS

PROFESSIONAL EMPLOYMENT BUREAU

As advocated editorially by *The Canadian Engineer* in the issue of December 18th, 1918, the Dominion government has decided to establish a professional employment service for members of the Canadian Expeditionary Force. An office has been established at 287 Queen Street West, Toronto, in charge of Major R. D. Galbraith. Offices are also being located in Ottawa and Montreal.

Employers wishing to obtain the services of returned soldiers who had technical training and experience before enlistment, are invited to write to Major Galbraith and inform him of their requirements.

Officers and men of the Canadian or Imperial army or navy who are seeking employment, are urged to fyle their names, and full particulars of their qualifications and experience, with Major Galbraith.

This is a splendid scheme and one which should have been adopted several months ago by the government. The work should not be conducted in any haphazard manner. The offices should be manned by a staff large enough and sufficiently competent to really be of some service to the engineers and other professional men who are seeking employment.

As we have said in previous editorials, the task of dealing with thoroughly trained men who in many instances can and should demand high salaries, requires a special organization, with sufficient funds to retain psychologists, engineering and other technical advisers, and keen business organizers.

Experience in the United States shows that the engineering field presents the largest problem for that branch of the United States Employment Service which is called the Professional Division. Nearly one-half of all the applicants so far have been men who have qualified for some kind of work in the engineering profession.

While the main object of the establishment of this new service is to aid the returned men, and while it is only proper that those men should be given every preference by the bureaus, it is to be hoped that the service can be extended before long so as to be available to all professional men, and especially to those who engaged in munitions and other similar war work.

ONTARIO GOOD ROADS ASSOCIATION

Following is the annual report of the executive committee of the Ontario Good Roads Association, presented at the recent meeting in Toronto:—

Immediately following the close of last year's convention, the new executive met for the customary formal business.

The annual mid-season meeting of the executive committee was convened at Kingston on July 8th, 1918. President C. R. Wheelock was in the chair and there was a full attendance, including A. Rankin, M.P.P., Frontenac, and W. D. Black, M.P.P., Addington. Secretary G. S. Henry, M.P.P. for East York, was warmly congratulated on his well-deserved preferment as Minister of Agriculture.

Considerable routine business was disposed of. The importance of regulating traffic on improved highways was discussed. The use of the motor truck shows that roads adjoining and between populous centres in Canada and the United States are not being constructed or maintained so as to stand up under this class of traffic.

Road construction, owing to war conditions, was being held up in most counties, and it was thought that a full report on the question should be available for consideration at the next session of the legislature. On the following day the committee were entertained at luncheon by the Council and Board of Trade and were shown the beauties of Kingston. An extended trip through the counties of Frontenac and Leeds gave them an opportunity of becoming acquainted with county road development and the difficulties that have to be solved in that district.

At Gananoque the members of the committee met J. R. Dargavel, M.P.P. for Leeds, and were placed in charge of the local Board of Trade, which has been most active in promoting the location of the provincial highway along the St. Lawrence.

A public meeting was held in the evening in the beautiful grounds surrounding the town hall. This was addressed by members of the committee and the Deputy Minister of Highways, W. A. McLean, who took advantage of the occasion to make the first public announcement that the provincial highway would follow the old-established line of travel through Gananoque to Kingston. This was received with great enthusiasm, and is one of the results achieved by the board in its campaign for improved highways.

On the following day the committee, as the guests of the Council and Board of Trade of the town, were taken for a trip through the beautiful Thousand Islands to Clayton, N.Y., where motors were in waiting for a trip over some of the highly improved state roads, to give them an idea of what may be expected when the provincial highway is completed.

At Watertown, N.Y., the delegation was met by the mayor and president of the Chamber of Commerce. After luncheon, patriotic greetings were exchanged and a visit made to the beautiful park donated to the city some years ago. One of the sights was a munition factory occupying fifteen acres, employing 8,000 men, all under military guard.

The return trip was via the Thousand Island House at Alexandria Bay, over magnificent asphaltic macadam roads. Maintenance material was deposited on the roadsides and the one-horse-and-man-patrol repair outfits were passed at intervals. The state roads were uniformly good and dustless.

PERSONALS

DONALD HUGH MCDOUGALL, president of the Nova Scotia Steel and Coal Co., Ltd., has been elected president of the Canadian Mining Institute for the ensuing year. Mr. McDougall was born in 1879 in Cape Breton. He was educated at the Government Mining School, Glace Bay, N.S., through the International Correspondence Schools, at Dalhousie College (mining course) and at summer schools. In 1900 he joined the staff of the Dominion Iron and Steel Co. as an apprentice mechanic and became in turn assistant mine and railway surveyor, mine surveyor, civil engineer and engineer in charge of construction. In 1902 he joined the New York Central and Hudson River Railway as assistant resident engineer. In 1904 he was appointed manager of the Wabana Mines, Newfoundland, and three years later became superintendent of mines and quarries for the Dominion Iron and Steel Co. In 1910 he was appointed assistant general manager of the Dominion Coal Co. and in 1912 general manager. In 1916 Mr. McDougall became general manager of the Dominion Steel Corporation, resigning last fall to become president and general manager of the Nova Scotia Steel and Coal Co. He is a member of the Mining Institute of Scotland, the Royal Astronomical Society of Canada, the American Iron and Steel Institute and the Engineering Institute of Canada.

CHARLES W. DILL, of Winnipeg, has been appointed Superintendent of Highways, Province of Manitoba. Mr. Dill will have charge of all work in the field.

D. T. BLACK, city engineer of Welland, Ont., has been appointed town engineer of Owen Sound, Ont., and has placed his resignation in the hands of the Welland Council.

MAJOR W. D. ADAMS, formerly assistant engineer of railways, city of Toronto, has returned from overseas. Major Adams enlisted with the 14th Battalion, first contingent, and won the Military Cross.

W. G. MAWHINNEY, of Tuelon, Man., has been appointed engineer of St. Clements municipality, with office at Selkirk, Man. Mr. Mawhinney, who recently returned from overseas, is a graduate in civil engineering of the University of Manitoba.

JAMES P. GORDON has been appointed town engineer of Trenton, Ont. For the past four months Mr. Gordon has been on the engineering staff of the International Nickel Co., but for twelve years previously had been on the staff of Chipman & Power, consulting engineers, Toronto. He graduated in 1904 at S. P. S., University of Toronto.

CHARLES H. WALLACE, sales manager of the Hamilton & Toronto Sewer Pipe Co., has resigned to become manager of the newly-incorporated Clay Products Agency, Ltd., Toronto. Mr. Wallace has been sales manager of the Hamilton & Toronto Sewer Pipe Co. for the past eleven years, and previously spent seven years with the Toronto Pottery Co. The agency will represent manufacturers in the sale of all kinds of vitrified clay products, including sewer pipe and blocks, fire brick and clay, paving and sewer brick, land tile, building blocks and conduits.

ROAD MAINTENANCE

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The tools generally employed to maintain the roads are graders and drags. With proper handling, these tools render excellent services, but sometimes they are useless in the hands of an incompetent man. I have heard the statement made that road drags are useless to maintain earth roads. Upon investigation, I found that they had been experimented with under most unfavorable conditions.

In my experience, the proper time to use a drag on the road depends on two factors: The nature of the soil, and the traffic over the road.

An earth road mixed with gravel should be dragged when very wet, as also when the traffic is light on any road. But, when the traffic is considerable, it is useless to drag it until the earth has sufficient body to prevent cutting by the wheels of vehicles. This matter, however, can be easily adjusted by a few trials with the drag under various conditions of the road.

There is also another matter in connection with road maintenance that seems to be overlooked because it does not affect all the counties of Ontario to the same extent. I refer to the maintenance of winter, or snow, roads. In the northern part, as also in eastern Ontario, snowplows and rollers are used in many localities. Both have their merits, but, considering the uncertainty of the snowfall in some parts of Ontario, I believe that the ordinary land roller answers the purpose quite well. It is better to begin when there are 8 or 10 ins. of snow over the road and to roll the road after each snowstorm.

If this is delayed until there is a foot or two of snow over the road, it is practically useless to roll the road. The action of the roller in packing down the snow provides a smooth road, free from "pitch holes," which are sometimes prevalent during winter.

In conclusion, I must say that success or failure in road maintenance depends largely on the spirit of hearty co-operation of all the men connected with the work. Nothing should be neglected that will tend towards this end. The superintendent should endeavor to create some emulation among his foremen with the view of obtaining the best results for the money expended under each of them.

ROADS RULE THE WORLD

(Continued from page 314)

form a perfect transportation system for this province. Without waterways, we would lack sufficient transportation; without railways, we would lack to a greater degree sufficient transportation; and without highways, our whole transportation system would be useless,—we would be uncivilized. Byrne, in his "Highway Construction," says, "Countries inhabited by the least civilized people, whose wants can be supplied in the immediate vicinity of their dwellings, are almost destitute of roads; hence it has come to be said that roads are the physical symbol by which to measure the progress of any age or people. If the community is stagnant, the condition of the roads will indicate the fact; if they have no roads they are savages."

Smiles, in "Lives of the Engineers," says, "The road is so necessary an instrument of social well-being, that in every new colony it is one of the first things thought of. . . . . The new country, as well as the old, can only be effectually opened up by roads, and until these roads are made it is virtually closed." And to quote further, "Roads rule the world—not kings nor courts, not ships nor soldiers. The road is the only royal line in the democracy, the only legislature that never changes, the only court that never sleeps, the only army that never quits, the first aid to the redemption of any nation, the exodus from stagnation in any society, the call from savagery in any tribe, the herald of prosperity. The road is umpire in every war, and when the new map is made, it simply pushes on its great campaign of help, hope, brotherhood, efficiency and peace."