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MISSING

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Hydro-Electric Development on Nipigon River

Hydro-Electric Power Commission of Ontario will Install Five Units, Totalling 60,000 H.P., at Cameron's Pool, near Port Arthur, Ont.—Concrete Dam 200 ft. Long, 43 ft. High—Scroll Cases to be Moulded in Concrete

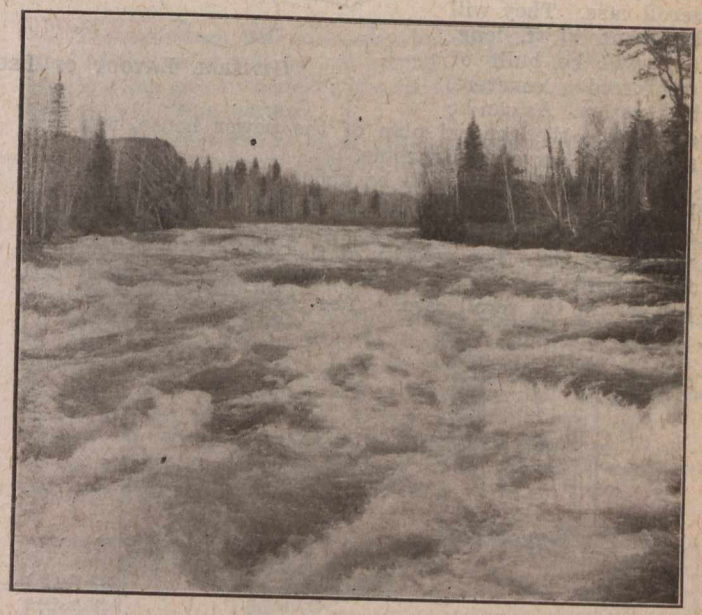
SIXTY thousand horsepower will be developed on the Nipigon River, about sixty miles northeast of Port Arthur, by the Hydro-Electric Power Commission of Ontario, and it is expected that by June of next year two 12,000 h.p. units will be in operation. Propositions from several leading water turbine builders are now being considered, and after the contract for the "wheels" is let, which may be within the next two or three weeks, definite plans will be completed and active work will be commenced at the site of the new power house.

The Nipigon River flows from Lake Nipigon to Lake Superior, a distance of about 32 miles. The normal elevation of Lake Nipigon is 852 ft., and of Lake Superior, 602 ft. There are at least four power sites on the river, all of which will ultimately be developed by the Commission. Between Lake Nipigon and Emma Lake are Virgin Falls, Rabbit Rapids and Devil Rapids, where the total head for a development through Hannah Lake would be 42 ft. South of Emma Lake are Flat Rock Rapids, White Chute and Pine Portage Rapids, with a head of 55 ft. South of Lakes

BUILDING TEMPORARY POWER-HOUSE NEAR CAMERON'S POOL TO OBTAIN POWER FOR CONSTRUCTION PURPOSES

Maria and Jessie—near Cameron's Pool—are two sites. The upper site affords 65 ft. net head and the lower, 53 ft. The upper site at Cameron's Pool is considered to be the most advantageous one on the river, and naturally will be developed first.

The drainage area of Lake Nipigon is about 9,200 square miles, and its actual area is 1,500 square miles. The discharge of the Nipigon River when measured in September, 1905, was 8,000 c.f.s.; in November, 1905, 7,014 c.f.s.; February, 1906, 5,982 c.f.s.; March, 1906, 5,878 c.f.s.; and September, 1906, 5,884 c.f.s. With a minimum flow of at least 4,550 c.f.s., 26,500 h.p. is there available as 24 hr. continuous power. The design of the proposed plant, includes a regulating dam that can raise the river level to the elevation of Lakes Maria and Jessie, which will form natural storage reservoirs. It is estimated that a peak load of 60,000 h.p. can be taken care of by the normal flow, and that is the size of the plant that will be built.



CAMERON RAPIDS—PHOTOGRAPHED MAY 16TH, 1919, FROM TEMPORARY BRIDGE

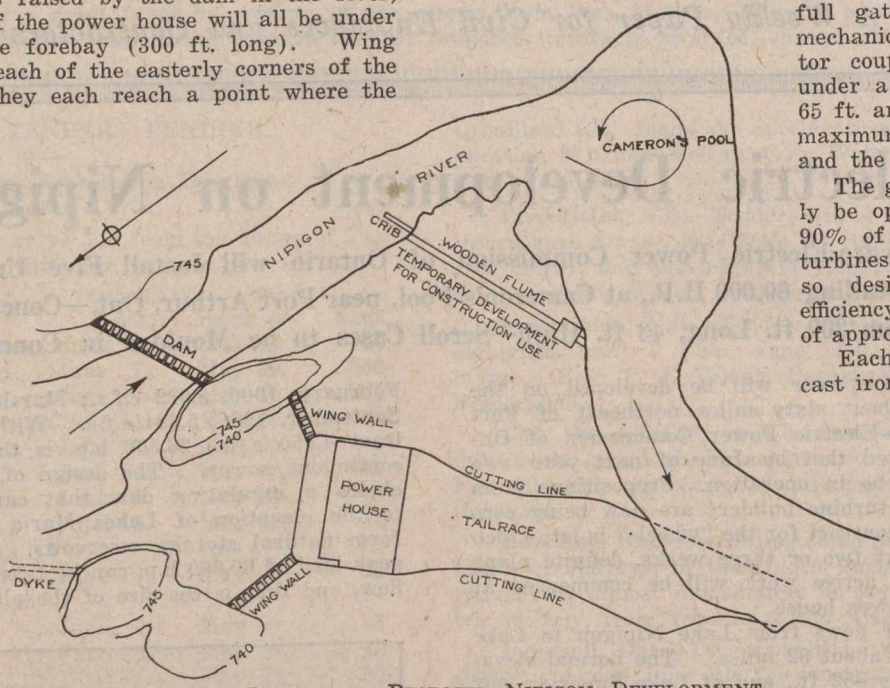
The initial installation will be two units, each 12,000 h.p., but three more will be installed at a later date. Single-runner vertical water turbines will be direct-connected to 3-phase, 60-cycle, 12,000-volt, internal revolving field generators, each 10,600 k.v.a. (80% power factor, maximum rating). The generators will be arranged for parallel operation and will supply light, heat and industrial power on the Comission's "Nipigon System." This development is further west than any other yet undertaken by the Commission.

The railway depot nearest to the power house site is Cameron's Falls, Ont., on the C.N.R. Cameron's Pool is only about one mile south of this depot. The Commission's construction department has just completed a construction railway from the site of the proposed work to the C.N.R. A construction camp and a temporary bridge across the river are now being erected. All of the construction work will be done by the Commission's construction department.

The accompanying drawings show the general layout of the development. A dam about 200 ft. long will be built across the river above Cameron's Pool. The elevation

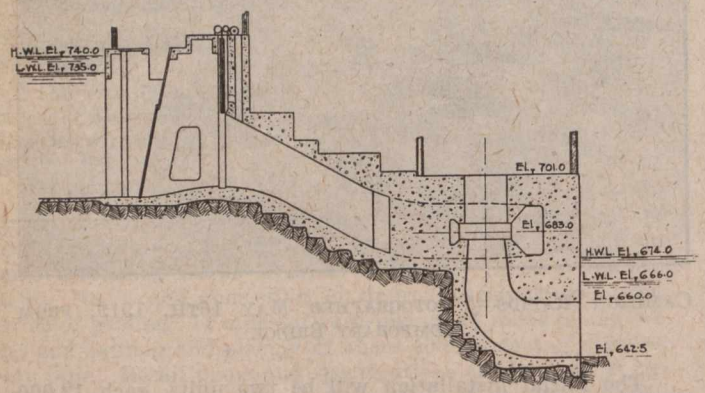
of the top of this dam will be 745 and the elevation of the river bottom is 702, so that the dam will be 43 ft. high. The river bed is rock, so no foundation troubles or construction difficulties of any kind are anticipated. The power house will be constructed in the dry, but when the water level is raised by the dam in the river, the ground to the east of the power house will all be under water and will form the forebay (300 ft. long). Wing dams will extend from each of the easterly corners of the the power house until they each reach a point where the natural elevation is 745. The natural basin that exists at this site greatly facilitates the development, as these wing walls can be constructed entirely in the dry and then, together with the power house itself, enclose an admirable forebay. Ice will be carried through the southern wing dam. No serious ice trouble is anticipated.

The penstocks will be square, tapering from 21 ft. section at the intake to approximately 18 ft. at the scroll case. They will be about 80 ft. long, and will be built of reinforced concrete, box section. As can be seen from the general plan of the power house, two penstocks will serve each turbine.



General Layout of Proposed Nipigon Development

The trash racks will be about 12 ft. behind the stop logs, and the gates about 18 ft. beyond the racks, The distance from the gates to the centre line of turbine shafts will be 80 ft. The velocity of the water will be increased from about 2 ft. per sec. at the intake to approximately 8 ft. per sec. at the scroll case. The turbine casings will be of



Section Through Power-House Showing Stop Logs, Trash Racks, Gates, Penstock, Turbine Setting and Draft Tube

the spiral, or volute, type and will be moulded in reinforced concrete. This is an innovation in design for the "Hydro" Commission, as none of its other plants have concrete scroll cases. Each draft tube will also be built in concrete, and also the power house itself and the dams, so that the construction will be reinforced concrete throughout.

For construction purposes a temporary development is being built near the pool, in order to supply light, heat and power for the job. A wooden crib will be built as shown in the general plan of the development, and a wooden flume will supply water at 22 ft. head to two turbines which will develop about 2,200 h.p. and which will drive generators and air compressors.

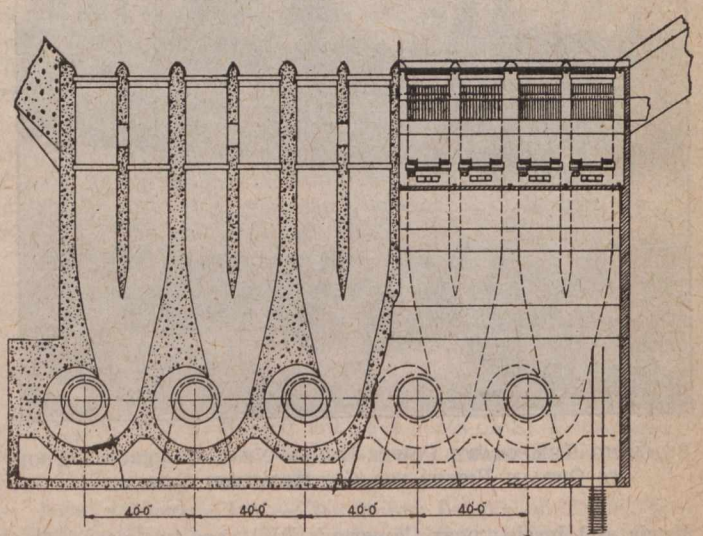
Specifications for the 12,000 h.p. water turbines were submitted several weeks ago to a number of prominent manufacturers. Among the firms from whom bids have been received are Canadian Allis-Chalmers, Ltd., Toronto; S. Morgan Smith Co., York, Pa.; Escher-Wyss Co., Switzerland; and Boving Hydraulic & Engineering Co., Lindsay, Ont.

Each turbine must have a full gate capacity of 12,000 mechanical h.p. at the generator coupling when operating under a net effective head of 65 ft. and at 120 r.p.m (The maximum gross head is 69 ft. and the minimum is 61 ft.)

The generators will normally be operated at from 60 to 90% of full rated load. The turbines, therefore, have been so designed that the best efficiency obtains with a load of approximately 10,000 h.p.

Each turbine runner will be cast iron, the vanes being cast integrally with the crowns and bands. In deciding the award of the contract for the turbines, special attention is being given to the method for providing seal and for overcoming the unbalanced thrust of the runners due to wear.

The speed ring will be made of cast iron in two sections and will consist of upper and lower flanges or crowns, connected by approximately ten stationary vanes, cast integrally with the flanges. The vanes will direct the water efficiently from casing to the guide vanes and in addition will act as stays to the upper and lower flanges, to resist the hydrostatic pressure acting upon the casing, and to support all superimposed weight. One of the vanes will provide a steel nose for the concrete at the junction between the end and inlet of the casing. The speed ring will be of such shape as to protect the concrete casing effectively from excessive wear from high velocities of the water, and also such that thin or taper sections of concrete will be avoided at the junction of the speed ring and the spiral casing.

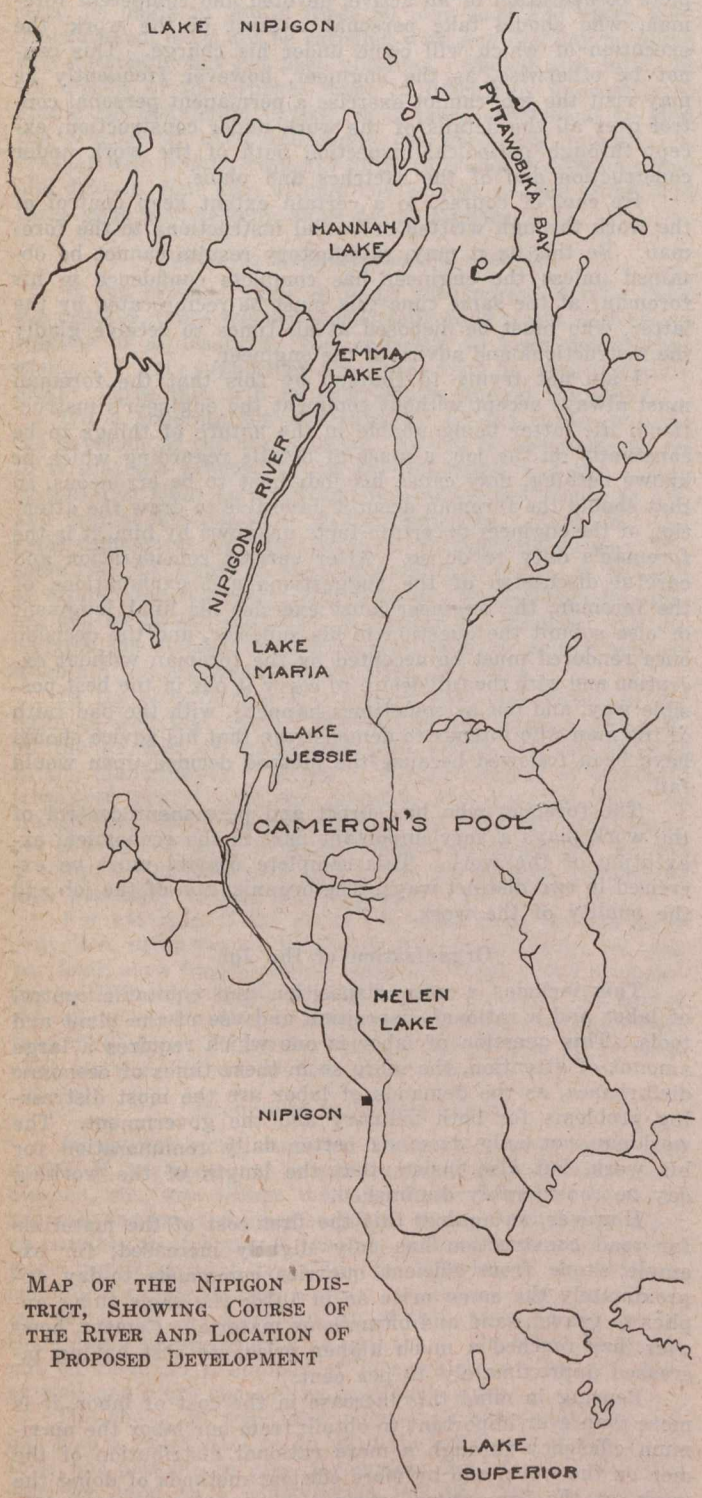


Plan of Power-House Showing Concrete Penstocks and Turbine Settings

The movable guide vanes will be of cast steel of the balanced wicket type, planed and machined all over, with the shafts highly polished. These vanes are designed to guide all water, with the least possible eddying, from the speed ring to the turbine runner. They will be pivoted and pro-

vided with cranks for outside connections to a cast steel regulating ring, and will be carefully fitted together so as to reduce to absolute minimum the leakage of water when they are in the closed position. The vanes will be pivoted so as to be approximately balanced under water pressure at one-third gate opening and will tend to close to this position from any operating position.

The upper portion of each draft tube may possibly be formed of cast iron or steel plate, and will be shaped so as



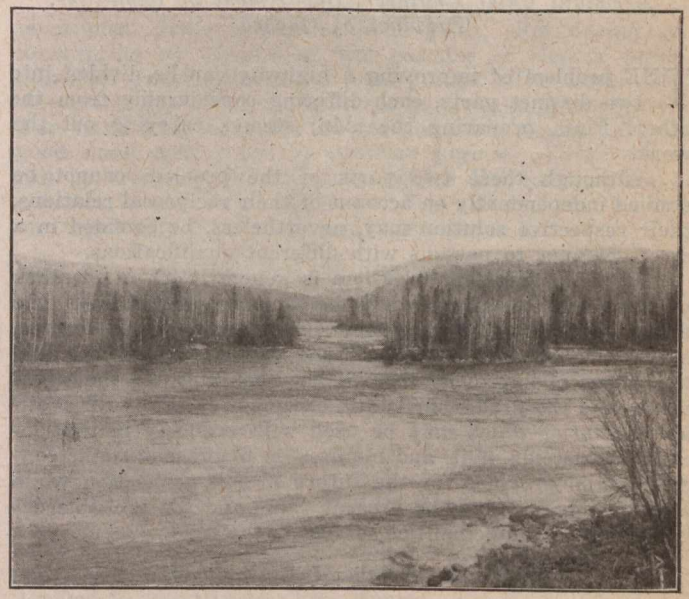
MAP OF THE NIPIGON DISTRICT, SHOWING COURSE OF THE RIVER AND LOCATION OF PROPOSED DEVELOPMENT

to direct the discharge from the runner with a minimum of disturbance due to eddying or distortion of stream lines.

The turbine shaft will be of open-hearth forged steel, with an ultimate tensile strength of 75,000 lbs. per sq. in. and an elastic limit of not less than 37,500 lbs. per sq. in.

The brakes must be capable of bringing the unit to rest from normal speed in five minutes when operated with air at 200 lbs. per sq. in. pressure.

The governors will be of the water pressure type and will be supplied with distant speed controllers, hand control gate limiting devices, over speed shut down devices, manual speed adjustments, gate opening indicators and tachometers.

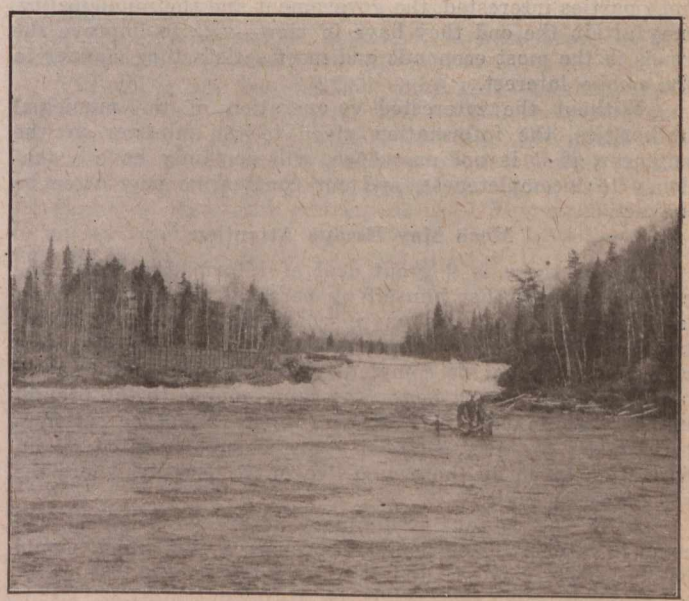


CAMERON RAPIDS AND POOL

The governors will be so adjusted that the normal closing time of the gates will be two seconds. The governors must readjust the gates whenever the speed varres more than one-half of 1% from normal.

The turbines are to be erected complete in the builder's shops before shipment. After erection in the power house, tests are to be carried on for a continuous period of at least two weeks. There also may be required a test of each turbine extending at least for a period of fifteen minutes at runaway speed; that is, under friction load only and with gates full open.

The design and construction of the Nipigon development is being handled by the regular staff of the Hydro-Electric Power Commission of Ontario, of which Sir Adam Beck is chairman and F. A. Gaby, chief engineer. H. G. Acres is hydraulic engineer; T. H. Hogg, assistant hydraulic engineer; M. V. Sauer, designing hydraulic engineer; E. T. Brandon, electrical engineer; A. H. Hull, assistant electrical engineer; A. V. Trimble, construction engineer.



LOOKING UP NIPIGON RIVER FROM EAST END OF PROPOSED REINFORCED CONCRETE DAM

PRACTICAL ADVICE TO ROAD SUPERINTENDENTS AND MUNICIPAL COUNCILS*

By Alexander Fraser
Assistant Chief Engineer, Department of Highways, Province of Quebec

THE problem of improving a highway can be divided into two distinct parts, each differing considerably from the other: First, preparing the plan; second, carrying out the work.

Although these two parts of the problem cannot be studied independently on account of their reciprocal relations, their respective solution may, nevertheless, be confided in a direct manner to persons with different qualifications.

It is the engineer to whom is generally given the task of preparing the plan. It is he who generally makes the first inspection and preliminary survey, examines the course, studies the nature of the soil and drainage conditions and the means of improving them if need be, improves the alignments and the grades, finds and examines carefully all available material which may be used with economy in that locality or outside of it, and inquires as to present traffic conditions and provides for the future in this connection while also keeping in mind the present value and the probable development of municipalities served by the road.

Municipal Officials Must Co-operate

In order that the engineer may fulfil his duty in the solution of this part of the problem, it is important that he should be assisted by the municipal authorities. It is evident that it is the latter who are more conversant with many of these questions. It is therefore necessary when the engineer makes an inspection of roads to be improved in a municipality, that intelligent men with a knowledge of all local conditions are placed at his disposal to give him the required information.

One or two men who are thoroughly conversant with the locality can supply all the information needed on the subject of drainage for the roads in question, traffic conditions, material, labor, etc. Owing to their residence in the locality, they can tell us, for instance, the parts of the road which are most affected by the spring thaws, and the parts of the road where wash-outs occur, and they also can best inform us regarding the action of the water in the water-courses over which we must build permanent bridges, and regarding the location of sand and gravel beds, field stone, quarry stone or other material which might be used economically.

Therefore, I ask municipal authorities to do all in their power to give all possible information to engineers, so that both parties interested, the government and the municipality, may attain the end they have in view—viz., to improve the roads in the most economic and most satisfactory manner in the public interest.

Without the interested co-operation of the municipal authorities, the information given to the minister by the engineer, if it is not erroneous, will certainly have a tendency to incompleteness, and our conclusions may often be inexact.

Much May Escape Attention

For if there is a great deal of information which the engineer may gather himself by personal observation, there is certainly a great deal more which may escape his attention because he does not live in the locality. The diagnosis of a doctor cannot be complete without precise information being given by his patient. The same applies to the preliminary inspection by the engineer, which cannot be satisfactory unless his own personal study is supplemented by information given by those who live in the locality where the road is to be built.

After this serious preliminary study, the engineer can come to rational conclusions and prepare a plan which should be the most economic and most satisfactory for the interested parties. He will prepare his estimates and leave the execution of the work to an experienced foreman who should act under his personal direction.

Carrying Out the Work

If the engineer, under the conditions outlined above, must bear the responsibility of the planning of the work, he should also be entrusted with the responsibility of carrying it out. For this part he must also have the sincere and complete co-operation of an active, devoted and competent foreman, who should take personal interest in the work, the execution of which will come under his charge. This cannot be otherwise, as the engineer, however frequently he may visit the job, cannot exercise a permanent personal control over all the details of the work under construction, except through periodical inspection both of the work under construction and of the sketches and plans.

He can, of course, to a certain extent keep control of the work through written or verbal instructions to the foreman. Be this as it may, satisfactory results cannot be obtained unless the engineer has complete confidence in his foreman; at the same time this must be reciprocated by the latter, who must be disposed at all times to receive gladly the instructions and advice of the engineer.

I am not trying to contend by this that the foreman must always accept without comment the engineer's instructions; the latter being unable in the nature of things to be constantly on the job, a mass of details regarding which he knows nothing, may cause his judgment to be erroneous, so that should the foreman deem it advisable to draw the attention of the engineer to certain facts unknown by him, it is the foreman's duty to do so. After serious consideration and careful discussion of the suggestions and explanations of the foreman, the engineer must exercise his final judgment or else submit the question to his superior, and the decision once rendered must be accepted by the foreman without exception and with the full desire to carry it out in the best possible way, and not as sometimes happens, with the bad faith of the man who intends to demonstrate that his advice should have been followed because the method decided upon would fail.

The foreman who has direct and permanent control of the work plays a very important part in the economical execution of the work. This complete control must be exercised in two distinct ways: The organization of the job and the quality of the work.

Organization of the Job

This includes a wise disposition and equitable control of labor and a rational disposition and use of the plant and tools. This question of labor is one which requires a large amount of attention, the more so in these times of economic disturbance, as the demands of labor are the most distressing problems for both industry and the government. The workman not only demands better daily remuneration for his work, but also insists that the length of the working day be considerably diminished.

However, as against this the first cost of the materials for road construction has only slightly increased; for example, stone from efficient quarries commands to-day approximately the same price as in 1916; the same thing applies to gravel, sand and bituminous material. Cement, however, has reached a much higher price, its cost having increased approximately 40 per cent.

Bearing in mind this increase in the cost of labor, it is more than ever important to obtain from our labor the maximum efficiency through a more rational distribution of the men on the work, and by more efficient methods of doing the work, at the same time carrying out as far as rationally possible the use of tools and machines to diminish labor costs.

To arrive at this goal it is necessary to see that each gang is composed of exactly the number of men necessary for the work planned. For example, it is obviously irrational to place six men at spreading stone when four or even two would be sufficient. It is also necessary to see that there shall not be four carts drawing stone to the crusher when three or two would be amply sufficient.

*Paper read May 21st, 1919, at the Canadian Good Roads Congress, Quebec.

The efforts of a good foreman must tend towards obtaining the maximum amount of work with the least possible labor. He should see that the crusher bin is always well filled. On a water-bound or bituminous macadam job, carried out with local stone, the capacity of the crusher will be the key note of the whole organization. This capacity will rule the number of men and the number of wagons. It is, however, obviously necessary to keep the crushers to maximum capacity at all times. If a crusher has a capacity of 80 tons of stone a day, every effort must be made to obtain these 80 tons each and every day. The foreman must not be satisfied with any one day in which this maximum has not been obtained. Should any defect in the engine or the crusher make it difficult or impossible to obtain the maximum output, it is more economical to stop the crusher at once and make the necessary repairs. A crusher with a daily capacity of 80 tons requires two wagons and drivers, four men to help the drivers to load stone, and three good men feeding stone to the crusher.

Mixer is Organization's Keystone

If the crushed stone is to be transported a mile from the crusher, there will be needed four good teams with dump wagons of at least 1½ yds. capacity, to keep the crusher going. I am supposing that the road is approximately level. Three men will be sufficient to spread the stone.

On a concrete job the capacity of the mixer will be the keystone of the organization. It will be necessary to see to it that the preparation of the sub-grade and the supply of material shall be such that the mixer will never be idle and run at all times to its full capacity. Have just the right number of men and no more to feed the mixer. The same rule will apply to the construction of a road to be built of bituminous concrete. The capacity of the plant for drying the stone and heating and mixing the bitumen will determine the number of men in each gang in such a way as to obtain the maximum output from the plant.

In the construction of a gravel road, the rules are not quite so well laid down. Everything will depend generally on the number of teams and men which can be obtained in the municipality. Given a certain number of teams to transport gravel and the distance the material must be transported, one need only put on the road the exact number of men necessary to spread the gravel which this number of wagons can transport, and in the pit just the number of men necessary to load the wagons.

For example, if the pit is 1½ miles from the job to be gravelled, using twelve two-horse wagons, carrying 1¾ yds. per load, each wagon should make six trips a day, amounting in all to sixty trips, or a total of 105 cu. yds. To spread this quantity of gravel in proper shape should not take more than five men. Any other men available can be used to clean or dig ditches, prepare subgrade, etc.

Economize in Skilled Labor

In special work, such as bridges, culverts, walls and drains, if it is necessary to use craftsmen such as carpenters, masons, etc., two things must be borne in mind: First, to use only the exact number required; next, economize as much as possible on this expert labor by letting these men do only work requiring such training and knowledge. In building concrete bridges do not let the carpenters, who are building forms, do any work outside of this. I mean, do not let them carry planks or saw or nail them. In other words, do not let them do a number of jobs which can be done just as well and more cheaply by unskilled labor.

The choice of tools and plant well adapted to the job has also a great deal to do with the efficiency of the work. It is not possible to give a complete list of work which is done by hand on a construction job, but this can be considerably reduced by a judicious use of plant and machinery. The essential part is that the machines shall be carefully chosen.

There are three classes of work in which large sums of money are uselessly spent by the lack of adoption of up-to-date methods. The first includes all excavation work. There are on the market a number of machines for all classes of excavation, both in rock and in earth. Among these are some which are designed for large work and which can be economically employed on small jobs, but there are others with a capacity of not over four to ten cubic yards per hour which can be very economically used to replace pick and shovel work.

In rock work it is often advantageous to use small mechanical drills instead of hand drills. For drying and unwatering an excavation, use gasoline or electric pumps wherever possible instead of hand pumps. The second class of work under this heading comes in the mixing of concrete. For small jobs there are on the market a number of very good small mixers run by gasoline engines. These mixers can be economically used even where the consumption of concrete is only a few yards per day and can also be used on large work as an auxiliary to the larger mixers.

Transporting and Placing Materials

The third kind of work where manual labor is usually used, is the transportation and placing of construction materials. Cars and scows are loaded and unloaded by hand; wagons are also usually loaded by hand, although nowadays most of the wagons dump automatically. For all these things there are machines to do the work that will save sums proportionate to the quantity of materials to be moved. It is true that machines cannot always be used, but my point is that they should be used whenever at all possible and even on the simplest jobs the work can be so planned as to reduce to the lowest possible amount the manual labor expended. That is rule laid down in "Modern Management Applied to Construction," by Hauer.

Road construction requires a great deal of shovel work. Much can be said on the kind of shovels which should be supplied to the men, varying with the kind of work; the horizontal and vertical distances through which the shovel must handle the materials, etc. This study would take up too much space. It is very true, however, that very few laborers understand the correct use of a shovel. It is astonishing how very few men have ever been shown the proper handling of their tools; it has been demonstrated that a man using a shovel correctly can handle easily three more shovelfulls per minute than the man using an incorrect method of handling the shovel. We know that a man loading a wheelbarrow or a cart can handle approximately fifteen shovelfulls a minute. The incorrect method of shovelling, resulting in a loss of three shovelfulls per minute, means a net loss of 20%, with just as much energy expended by the workman.

Quality of the Work

The foreman's responsibility does not cease with the organization of the job; he must see that the completed work shall be as perfect as possible to insure permanence. Aside from the plans and specifications furnished him, there is always a mass of details not shown therein but to which he must give his careful attention, because these details inevitably affect the quality of the finished work.

The plans and specifications may give the dimensions of the work, and an outline of how it shall be carried out, but they cannot possibly go into details. The plans and specifications presuppose that those whose business it will be to interpret them and to carry out the work, shall have the necessary knowledge and experience. The specifications do not generally go into explanations as to why the work must be carried out in the specified manner.

It is necessary, therefore, that the foreman shall know the reason for the specifications and for the precedure outlined therein, so that by understanding their importance, he shall willingly conform to them. Anything which the foreman does not fully understand, he must discuss with the engineer. It is his duty to find out the reason for anything he does not understand. The foreman should never forget that everything in the specifications is put there for a good and sufficient reason and usually as the result of the experience of several generations of engineers and contractors.

When a specification requires that macadam shall consist of stone as uniform as possible in size, and not of a mixture of 2-in. stone, ¾-in. stone, and stone dust, it is done for a good and sufficient reason. Stone of a uniform 2-in. size will intermesh under the roller and a certain

mechanical bond is thus obtained which will help considerably in resisting disintegration by traffic. With non-uniform material, a pavement will contain spots and pockets consisting mostly of fine material, which will easily disintegrate and leave "pot-holes" in the pavement.

The object of a specification's requiring that the stone shall be well rolled and hardened before any dust is spread on it, is for the purpose of obtaining this intermesh of the stone and to reduce voids to the minimum. One may thus obtain a uniform surface with a greater resistance against disintegration.

In concrete paving construction there is good reason for a specification's requiring that each batch of concrete be left at least one minute in the mixer. The material, stone, sand and cement are thus not only uniformly distributed, but also each stone is well covered with cement mortar and the voids between the stones will also be well filled with mortar. This is essential to perfect concrete. A specification forbidding sloppy concrete is due to the fact that a mixture that is too wet may run and thus leave porous spots in the concrete. This same reason applies to requirements that forms shall be tight.

In filling forms in the construction of bridges and culverts, the pouring must be done in successive layers of 6 ins. This procedure must be adhered to absolutely and is most economical, for if instead of 6-in. layers, 3 or 4 ft. layers be poured, we would find that in two or three years each side of the bridge or culvert would sink, and it would then be necessary to fill the depressions with stone or other material at great expense and considerable inconvenience to the traffic. Similar good reasons can be found for each particular of the specifications. They are the result of long study and experience and must be accepted and followed.

PUBLICATIONS RECEIVED

SPRING RAINS AND FLOODS.—Four-page folder printed in colors on coated paper, 8½ by 11 ins., issued by Wallace and Tiernan Co., Inc., 349 Broadway, New York City.

LIGNITE—ITS CHARACTERISTICS AND UTILIZATION.—Technical paper 178 issued by the Bureau of Mines, Department of the Interior, United States government; 20 pages, 6 by 9 ins. Price, 5c.; address superintendent of Documents, Government Printing Office, Washington, D.C.

NOVA SCOTIA WATER POWER COMMISSION.—Progress report for the year ending December 30th, 1918; 100 pages and cover, 6½ by 9¾ ins.; no illustrations. The members of the commission are Hiram Donkin, deputy commissioner of works and mines (chairman); W. G. Yorston, assistant road commissioner; F. H. Sexton, principal of the Nova Scotia Technical College; A. S. Barnstead, deputy provincial secretary (secretary).

WAR GAS INVESTIGATIONS.—Report by Van H. Manning, director of the Bureau of Mines, Department of the Interior, United States Government; 5¾ by 9 ins., 40 pages. This report covers research work in connection with war problems and describes some of the more important accomplishments, including gas masks, absorbents for carbon monoxide, smoke screens for ships, production of gases for warfare, oxygen apparatus for aviators, and gas poisoning. Price, 5c.; address Superintendent of Documents, Government Printing Office, Washington, D.C.

PRODUCTION BOOK.—Published by the American Spiral Pipe Works, Chicago, Ill. This book is a very handsome catalogue of the products of this company and consists almost entirely of large and excellently printed photographs of installations of spiral-rivetted pressure pipe, lapwelded steel pipe, forged steel pipe, flanges and corrugated furnaces for land and marine boilers. It consists of 88 pages and stiff board cover, 8 by 10½ ins., printed in three colors on suede finish coated paper. There is very little reading matter—in fact only sufficient to describe very briefly the various products of the company—and the book is almost enitrely an album of very interesting photographs. There are over 120 illustrations besides a number of reproductions of blue-prints.

MAKING HELIUM IN ALBERTA

British Government Finances Experimental Plant for Production of Non-Inflammable Gas from Calgary Company's Natural Gas

FOLLOWING is a press despatch from Calgary, Alta., dated May 31st, 1919: "Calgary has the first plant in Canada to produce the famous helium gas, the non-inflammable gas for inflating airships for the British government.

"This fact became available for publication here with the arrival in Ottawa of Professor J. C. McLennan, O.B.E., Ph.D., F.R.S., who has been acting for the British government in arranging for a supply of this gas which is so important to the future of aerial navigation.

"Professor McLennan recently paid a visit to Calgary and the press at that time was in possession of the facts concerning the big helium-producing experiment plant erected in this city, but they were not available for publication until Professor McLennan had submitted his report to the British authorities.

"Residents of Calgary will be surprised to learn that experiments in the production of helium gas, which is obtained from the natural gas supplied to the citizens of Calgary by the Calgary Gas Co., have been going forward for nearly two years. Success has at last been attained.

Half Million for Experiments

"To Hon. Clifford Sifton, one of the principal stockholders of the gas company, President Eugene Coste, of the company, and other officials largely, must be given the credit for the success of the plant, as it was through their untiring efforts that the Imperial British government was induced to set aside $500,000 for the making of experiments in the production of helium gas in Canada.

"The helium gas plant in Calgary is located on the Calgary Gas Company's property in East Calgary, the site of the old shops at Seventeenth Ave. and Eleventh St. East.

"The helium gas production experiments, now at a successful stage, have been carried on in a two-story, unostentatious looking brick building at this corner, which is full of costly and curious looking machinery.

"Adjacent to this building is a big wooden hangar, housing a large balloon which is used in the experiments. Supt. H. B. Pearson, of the gas company, who was in the secret since the experiments began, has been affording every facility to the British and Canadian government chemists and engineers, and all have guarded the experiments with the utmost secrecy. The buildings were under guard throughout the period of the experiments, as it is obvious that their result might have been of value to the enemy. The engineers were working at top speed to produce this gas in commercial quantities prior to the end of the war, and success was just in sight when the armistice was declared.

"However, the experiments have proceeded ceaselessly, and as a result of their success, it is expected that a huge helium producing plant will soon be erected in Alberta.

More Costly Than Radium

"The present experimental plant has a capacity of producing some 15,000 cubic feet of helium gas in 24 hours. Prior to the methods discovered of separating this gas from the natural gas of Alberta, largely by Prof. McLennan, helium gas was one of the most costly elements in the world, ranking ahead of gold, radium and other precious metals. Through the process perfected by Prof. McLennan, however, the helium gas can now be produced from the Alberta natural gas at the low cost of approximately 24 cents a cubic foot, according to a statement by Prof. McLennan in his report to the Imperial British government.

"Professor McLennan made the statement, on his recent visit in Calgary, that at pre-war times prices of helium, millions of dollars' worth of the precious product had been going up daily through the flues of Calgary citizens burning the natural gas.

"The helium content of the Alberta natural gas burned in this city is about 1 per cent. As the gas burned here averages 5,000,000 to 6,000,000 cubic feet in the summer time up to 35,000,000 cubic feet per day in the winter, it can be seen easily what an enormous volume of the valuable helium has hitherto been wasted. In combination with the chemical elements in the ordinary gas, the helium is consumed in the burning process, but after separation through the process perfected by Professor McLennan, it is absolutely non-inflammable.

Light as Hydrogen

"In addition to this invaluable property, helium is the next lightest gas in specific gravity to hydrogen known to science. Its lifting power is approximately the same as hydrogen. Balloons or other receptacles filled with the gas are unaffected by a direct flame, such as a bursting shell directly in the middle of the gas bag. How enormously valuable this is for war purposes is obvious at a glance. Had this gas been available for use on the western front during the last year of fighting, the lives of hundreds of airmen using the observation balloons for directing artillery fire would have been saved. Not only this, but the methods of using the balloons would have been enormously extended through their safety from inflammable bullets fired from the guns of German aviators. Also the use of the gas in the British dirigible balloons, while not increasing their lifting power or radius of operation, would have rendered them so safe as regards the use of gasoline propelling motors that great improvements could have been made in the power plant of such dirigible balloons.

"The government experimenters at the plant in East Calgary now have on hand a considerable supply of the gas cylinders used for the storage of hydrogen gas for shipment in which to put the helium gas. The gas, just as hydrogen or any other gas, can be stored in the cylinders under great pressure, but, unlike other gases, with perfect safety, and is thus available for shipment anywhere.

"It must be understood, however, that the plant in East Calgary is merely for experimental purpose, regardless of its scale and expense.

"This is because the natural gas used in this city is only a part of the whole production of the Bow Island and other fields which the Canadian Western Natural Gas, Light, Heat and Power Co. is now engaged in exploring in Southern Alberta. The location of the main helium producing plant will probably be just on the other side of the city of Lethbridge, in order that all the gas coming from the field may be put through the helium separation process, and the valuable inflammable gas obtained before the natural gas is allowed to go on to the various cities and towns for consumption.

Produced by Secret Process.

"The process of separating the unburnable helium from the natural gas not only increases the efficiency of the natural gas for farming purposes, but also puts the natural gas back into the mains under a still higher pressure, as it is necessary to subject the original gas to an extremely high pressure at a certain temperature in order to separate the helium.

"The exact method of producing the helium is a jealously guarded government secret and the complicated and strange-appearing machinery conveys nothing to the mind of the uninitiated. The condensers and compressors and various sorts of other apparatus are all operated by electricity, the switch room being in a separate compartment to avoid the possibility of ignition of the original gas by an electric spark. The engineers in charge have practically eaten and slept on the job while completing their work.

"The United States government some time ago established a similar helium gas production plant in the Texas fields for the product of helium from natural gas. Up-to-date, however, the production capacity of the United States plant has been only about 47,000 cubic feet daily. The main production plant in Canada, planned to be established at some point just beyond Lethbridge, will far exceed this production when it gets into operation.

"Professor McLennan paid his first visit to Calgary some two years ago in the course of his search for a gas from which helium could be separated. On that occasion, he told various persons that he had found what he was looking for, but did not give details. It was a long, hard job to get the British government interested, but the work was finally accomplished through the British Admiralty. President Eugene Coste, who, as an expert gas engineer, is an enthusiast on the possibilities of gas, bent all his efforts to interesting the government and Hon. Clifford Sifton took the subject up personally. The upshot was the decision of the government to devote $500,000 to experiments in Canada for the production of helium gas.

"Unfortunately, however, the government proceeded first to make experiments with gas in Ontario and considerable time was lost before it was ascertained that the helium was not present in the Ontario natural gas in sufficient quanties to make it commercially available. Following the original advice of Professor McLennan, the experiments were then begun in Calgary with the Alberta natural gas, the local gas company placing its premises at the disposal of the government. The result was complete success.

May Mean Air Conquest

"While Professor McLennan himself is cautious in speaking of the possibilities of helium in the aerial navigation field, writers on the progress of aeronautics speak of it with the greatest enthusiasm. It is pointed out, for instance, that the German Zeppelin raiders were largely handicapped in their deadly purposes because of the inflammable nature of the hydrogen gas used to inflate the individual envelopes in the aluminum structure of the big airships. This was demonstrated on various occasions when British airmen exploded the big gas airships with inflammable bullets. Had the Huns possessed a non-inflammable gas with which to inflate their Zeppelin gas-bags, their raids would have had much deadlier possibilities.

"It is equally obvious that a non-inflammable gas would add greatly to the safety of airmen using dirigible balloons or heavier than air airships to cross the Atlantic ocean as is now proposed. In fact, the possibilities of the new non-inflammable gas are endless in the future conquering of the air."

A. A. E. WILL STAY OUT OF CANADA

At the fifth annual convention of the American Association of Engineers, held last month in Chicago, Fraser S. Keith, secretary of the Engineering Institute of Canada, addressed the association on "The Rehabilitation of the Institute," and the work it is now doing. After his address the following resolution was unanimously adopted:—

"Whereas the very full statement of Fraser S. Keith, secretary of the Engineering Institute of Canada, indicated that the lines of endeavor of the institute are identical with those of the American Association of Engineers, be it resolved: That no chapter of the association be established in Canada; and, be it further resolved, that the directors of the association negotiate with the institute to the end that harmonious action be had on matters of common interest."

Following are the officers elected by the association for the ensuing year: President, F. H. Newell; first vice-president, W. W. DeBerard; second vice-president, T. A. Evans; secretary, C. E. Drayer; directors, W. W. K. Sparrow, Chicago; P. E. Harroan, San Francisco; R. Burnham, Chicago; F. D. Richards, Cleveland; A. A. Matthews, Tyler, Tex.; E. F. Collins, St. Louis; director to fill vacancy, C. H. Crawford.

The new filtration plant which has been installed at Oshawa, Ont., by the John ver Mehr Engineering Co., of Toronto, is now being tested and it is expected that it will likely be in operation at an early date. This company is also installing a small plant at Rockland, Ont.

ECONOMIC STATUS OF GUARANTEES FOR PAVEMENTS ON ROADS AND STREETS*

IN view of the looseness with which the terms "guarantee" and "maintenance" are often applied to paving contracts, your committee, in discussing the subject assigned to it, wishes to make clear that it believes the two terms should be regarded as separate and distinct and that the guarantee period should not be longer than the reasonable life of the pavement without repairs except those rendered necessary by reason of defective material, workmanship, or both.

This is in accord with numerous court decisions in connection with assessment work and automatically settles the question of legality and at the same time clearly indicates the maximum period which should be called for in a guarantee. Your committee recommends that the maximum period should be fixed at five years.

Three Types of Guarantees

Three types of guarantees are in common use: (a) Bond—preferably from a surety company; (b) retention by the municipality of a certain amount of cash; (c) bond and retained percentage.

The intent of the guarantee is to guard against defects in material and workmanship and non-compliance with the specifications, but in many cases defects may develop in the pavement or roadways, which are due to other causes and conditions which may have been entirely outside of the scope of the contract.

It is apparent, therefore, that the responsibility for a satisfactory and lasting pavement is shared by both the engineer and the contractor. With the engineer rests the responsibility for providing proper drainage and adequate foundation, and the selection of a suitable type of pavement and the preparation of comprehensive plans and specifications. He must also provide such inspection as is necessary to insure strict compliance with the specifications.

With the contractor rests the responsibility of carrying out in a satisfactory and workmanlike manner the plans and specifications and instructions of the engineer.

The safeguarding of the public welfare lies, therefore, in the hands of the two parties above mentioned with the following possible exceptions:—

In a number of instances pavements have failed due to causes which may or may not have been controllable by the engineer or the contractor, as perhaps, the following: Defective street railroad construction; settlement of trenches for underground service pipes; improper system of cleaning the pavements; leaky gas or water mains.

Engineer Responsible to Community

The engineer is directly responsible to his community, and if he is negligent or incompetent should, and presumably can, be removed. Generally speaking, the question of public welfare or economics in this connection is not directly involved in the guarantee clause of a contract except in those cases where an incompetent or negligent engineer has prepared faulty specifications and as a consequence thereof has asked a contractor to guarantee a pavement which is likely to fail through causes other than defective materials and workmanship.

Assuming that the plans and specifications are entirely competent and proper, the next duty devolving upon the engineer is that of inspection, which includes testing of the materials to be used. This requires a laboratory equipped for physical and chemical testing and the services of someone who has made a specialty of testing paving materials, as such work does not come within the scope of an ordinary chemist. Most states and a number of the larger cities maintain their own laboratories and testing staffs. Smaller municipalities may, and frequently do, avail themselves of consulting and testing experts, but a certain proportion of them do not and, on the contrary, permit their pavements to be laid with only such supervision and inspection as their engineers can personally give to the work, and in many instances these engineers are not well qualified in this particular line and would gladly avail themselves of expert help were they permitted to do so.

In addition to the preliminary testing of materials, provision must be made for the inspection of the work as it progresses. Where the pavement is manufactured in a plant and then delivered to the street, inspection at both the plant and the street is essential. For example, in the case of a large asphalt plant where 200 to 300 batches of mixture are sent out daily, involving 600 to 900 separate weighings, a rigid inspection, such as would justify the total elimination of a guarantee clause, would require two inspectors. The preparation of the subgrade, the mixing and laying of the concrete base, and the laying of the wearing surface would similarly require two or three inspectors; and these must all be trained men, not haphazard appointees.

Rigid Inspection is Costly

From the standpoint of a municipal engineer this is a very serious problem. His reputation, as judged by the lasting qualities of his pavements, might often rest in the hands of inspectors whose appointments and qualifications were entirely outside his control.

In the abstract, it has been justly said that with competent inspection, guarantees could and should be entirely eliminated, but from an economic standpoint there remains the question of cost of sufficiently adequate inspection and the difficulty of securing it.

The drawbacks and defects in the guarantee system are too well-known to require elaborate discussion in this report, but it is a fact that present inspection systems have been devised and carried out with a view to providing reasonable (but not absolute) security, having in mind the certain or uncertain amount of additional protection accruing from the guarantee clause inserted in almost all paving contracts. If this is to be abolished the inspection must be made more rigid and, therefore, costly, and the lines must be drawn more tightly than heretofore, both as to materials and workmanship.

Engineering is not an exact science, so that in all cases a certain factor of safety must be employed and there is no such thing as a hair-line division between good and bad. When the results are guaranteed, even though the guarantee is far from perfect, it is human to require a somewhat lower factor of safety than would otherwise be insisted on. Where the contractor assumes no responsibility for his finished work, the inducement to slight it and thereby save money is greatly increased, and the inspecting force must be still more competent, vigilant and trustworthy than would otherwise be necessary.

Guarantee is Not Expensive

The cost of a guarantee bond to the average contractor does not exceed 1% of the total cost of the contract. On a pavement costing $3.00 per square yard, this would amount to 3 cents per square yard, which would barely cover the increased cost of inspection above described, without taking into consideration at all the increased bidding price likely to result from increased severity of inspection.

Assuming that the guarantee is only for the normal life of a pavement without repairs, there exists no legitimate reason for the contractor to increase his construction bid by more than the cost of his bond.

As between a reliable and established contractor and one who is lacking in experience, resources and equipment, it is easier and cheaper for the reliable contractor to secure his bond and this can only be regarded as a legitimate advantage to him. As a general rule, he will favor a guarantee bond.

(Concluded on page 541)

*Committee report presented at the 16th annual convention of the American Road Builders' Association, New York City, February 25th to 28th, 1919.

Committee: Chairman, Francis P. Smith, consulting paving engineer, New York City; J. F. Hill, Chicago, Ill.; C. M. Pinckney, chief engineer of highways, Borough of Manhattan, New York City; B. H. Wait, district engineer, Portland Cement Association; T. J. Wasser, county engineer of Hudson County, New Jersey.

MACADAM ROADS*

By A. P. Sandles
Secretary, National Crushed Stone Association, Columbus, Ohio

MACADAM roads are "Victory Roads." They helped to make one less kaiser in the world. In the world war they held both ends of the line—the battle line over there, the bread line over here. The meal ticket was the biggest gun in the army and navy. Food and fight were both absolutely necessary to win the war.

In 1914, the Hun horde poured into Belgium and France. Its mission was rape, raid, rob and murder. It expected but little, if any, resistance. It reckoned its victims unable to quickly assemble arms and armies to repel a foe. But,

"The Dice of God are always loaded."

When the would-be "Kaiser-Gott" sought to handcuff the earth; when the Hun dream of world dominion was at highest tide; when democracy and free government were hung in the balance; when Christian civilization was put upon the scaffold; when the priceless treasures and triumphs of all the centuries were slated for sacrifice; when mighty nations were shedding rich, red blood; when millions of women and millions of orphans were praying and mourning for loved ones; when the world's greatest tragedy was being staged; then the spirit of John Louden Macadam appeared and enlisted with the hosts of right to help them win the fight.

Sent Wilhelm Into Holland

"Macadam-Victory Roads" smote Prussianism and sent Wilhelm into Holland with a white flag and broken sword. Over these roads rolled loads of men and guns to halt the Huns at the Marne and at Verdun. These roads met the wear and tear of war. They withstood the weight and speed of heavily loaded trucks. They could be quickly repaired, and would be better than before. In this work the American engineer (Canada and United States) went to the king row and got home from third.

The Kaiser and his Huns curse Macadam and defeat. In the coming years, grandchildren will tell the tale of how the roads of France helped the Allies to hit the Hun and win the war. Posterity will owe and pay tribute to "Macadam-Victory Roads" and hail them as a blessing to mankind.

Under the folds of Britain's flag was rocked the cradle of John Louden Macadam. He was the father and the founder of macadam roads. The vast domain of the British Empire can well be proud of this illustrious citizen, who climbed to a lofty place among the sons of men. He blazed a new trail that nations and progress have followed. Wander where you will in the world, if civilization is there, macadam roads are there. Yonder, across the border, John Louden Macadam has hold of the four corners of my country, the United States, and is lifting us out of the mud and mire. "His body lies mouldering in the grave, but his soul is marching on."

From Ox-Cart to Tin-Lizzie

Mr. Macadam was road commissioner of Scotland for fifteen years,—from 1783 to 1798. Before this time he visited America. After this time he began working out his "macadam plan." Those most eminent highway engineers, Arthur H. Blanchard and Henry D. Browne, of Columbia University, New York City, say in their text book on road-making:—

"Macadam was the first man to recommend a broken stone surface of very small size stone for public roads. Other great engineers helped him to work out and demonstrate the success of his method. He proved there was great difference between a loose stone road and a perfect macadam road."

As a tribute and monument to a useful man, the world has builded more miles of macadam type roads than it has of all other types combined. The "macadam plan" was the result of years of study and experiment by a man who devoted his life to this work. His plan has worn well for a century. The novice or amateur road-builder who presumes to discredit that noted road-maker gets but little applause. Macadam type roads appear in different forms, wearing different surface-coats, to meet the need of modern travel. Mr. Macadam is the man who helped us to jump from ox-cart to tin-lizzie and from mud-boat to motor truck. He is the man who clave back the darkness and beckoned us to our place in highway transportation to-day.

Roads Built, Then "Murdered"

Macadam roads are the most used and most abused of any form of highway improvement. They are usually built and then murdered. Lack of maintenance is a crime and a disease. If there is any one place where the old adage, "a stitch in time saves nine," fits best, it is in the care and repair of roads. The good road secret is "macadam and maintenance." When our overseas fighting lads were marching to meet or overtake the Hun, they had both feet on "Macadam-Victory Roads." These world-war veterans will go on the witness-stand and testify that the "macadam and maintenance" road progress "over there" made the Hohenzollerns sign the armistice before breakfast and sign the peace treaty as it is written in the language of John Louden Macadam and the Republic of France.

No permanent road is made. Such theory violates natural law. Mountains slowly, but surely, wear away. Petals of the rose fade and fall. Everything, animate and inanimate, has its zenith; then comes decline and decay, which forever play a part. This natural, immutable law never has been, and never will be, repealed. It is in force on every mile of road that has been or will be made. Until the sun is cold this law will hold. In days long gone a king inscribed over his castle door this legend, "Even This Will Pass Away." In his sadness, the legend was hope and cheer. In his gladness, it was a caution and a halt on revelry. Kings and castles pass away, but the law of the legend over the door, like Tennyson's brook, goes on forever.

He who proclaims "permanent roads" should commune with nature and learn the error of his ways. The roads of Rome, the Appian Way, the roads of Cæsar in France, were builded of stone centuries ago and are wearing yet. They more nearly approach permanence than any structure ever built by man. Constantly newspapers record the fact that so-called permanent roads fail to meet the test of time, speed, modern loads and weather. No matter what the type of road, the patrol man must be on the job if the road is to be kept at 100% every day in the year.

Maintenance is the Secret

Mr. Macadam won a victory when he invented a road such that repair would strengthen its wearing capacity and add to its power of resistance. He wisely avoided a type of construction on which repair would be a weakness. He had in mind quick mending, no traffic delay and small cost. Macadam builded better than he knew. The fame and name of this uncrowned king reaches round the world. After a century of time the ways and wisdom of this great engineer still umpires more miles of road-making than all the others combined.

God made no mistake when He hauled and unloaded stone in convenient places for the use of man. Macadam knew this. He used material near at hand. Macadam is the natural cure for mud roads and bad roads. The supply of material will never be exhausted. Maintenance is the secret. One of the distinguished jurists and judges of Ohio has aptly said:—

"To neglect to build good roads is a blight on a nation, but to neglect to maintain them is inexcusable and a criminal waste of public property."

Roads must be well built. Ignorant, careless or fraudulent construction robs the public pocketbook. Brains in the engine-room of the engineer, honesty in his heart and full knowledge of road-making will make this official a public benefactor.

*Paper read May 22nd, 1919, at the Canadian Good Roads Congress, Quebec.

Hats off to him who makes the blueprint and writes the specifications which guide the workmen in building and erecting great structures! Without the engineer and architect the world would go back to chaos. The highway engineer must know his business and have the courage to umpire his game. He is a power-house. His office must be beneath his own hat.

A public policeman ought to be on the job to ensure faithful performance of contract. If this safeguard is neglected, any and every type of road will be a disappointment.

Road Officials Should Spend

A crown on a road is worth more than a crown on a kaiser. Drainage is the corner-stone of road-making. Drainage is life insurance to the roof and root of the road. Surface drainage is essential. Foundation drainage is the alphabet of every road improvement.

Maintenance is the father and mother of good roads. Mud-holes are cancers; road-ruts, a disease; dust, a pestilence. Breaks and cracks mean danger and damage. The patrol man and surface treatment are safety-first money savers. Some day we may build road vehicles so that rear wheels are wider apart than the front wheels. This will distribute the weight and wear of loads over a greater surface and lessen the chance of rut-making.

The good-road secret is "macadam and maintenance." Macadam means more miles and more service to more people for the money invested. Nations of Europe, after centuries of experiment and experience, build macadam roads. Mileage is popular. "Rightly built" and "repaired without delay" are the pass-word and countersign.

The business of road officials is to spend money, not to save money. They should make supreme effort to give the taxpayer value received for every road dollar invested. They should build roads for the benefit of road-users, and not for the purpose of making any man or set of men rich. Material men, contractors and politicians are entitled to a square deal and nothing more.

The good road sentiment is a tidal wave. It must be honestly and intelligently met and answered. If, at any time or place, there is greed, grab or graft in road-making, it should be hit, and hit hard. Road officials will do well to be wary of the fellow who wants to show them a good time. That fellow expects to grind his own axe and chop his own wood with it.

Handcuff the Excess Profits

Excess profits should be handcuffed. If any set of men attempt to manipulate underground wires to make enough profit on one job of work in one road-building season to enable them to retire and live at ease the rest of their natural life, they should be straight-jacketed and the contract held up until honesty and square dealing can be written into the records of the road improvement. Road officials should give these shysters and Shylocks a publicity shock and a chance at hard labor.

Bad roads lessen religion and increase profanity. The man who must live on a mud-road all his life won't have any fear of hell,—he will be used to it. Bad roads induce farmers to leave the farm.

Mud-roads for the many and joy-ride boulevards for the few is hardly a healthy national road policy. The hope of a good road should reach as far as the flag reaches. The hope of a good road should reach to every home that gave a son or a helping hand to win the war. The hope of a good road should reach the farm as well as town and city. There should be system. Main highways should be established. Co-operation between units or divisions of government should be the rule in road-making. This will avoid patchwork and crazy-quilt, disconnected road-building. But the meal-ticket growers should be neither neglected nor forgotten.

John Louden Macadam intended that road-building should have an economic value. Farm and food highways will give the consumer more crop for his dollar and give the producer more dollars for his crop. This double-gear gain offsets and pays off the road tax. The shortest distance between producer and consumer is a good road from farm to market. Investigation discloses the fact that the average yield of fields increases when improved highways are built into an agricultural community. The good road does social uplift work. School, church and government improve under the influence of a modern highway. Again, these blessings offset and pay off the road tax. The good road is dollars and sense. This means common sense, not copper cents.

How can everybody have the hope of a good road? How is the farmer to be served? How will rural folks be reached? France and other nations of Europe have answered these questions. Boil the story down and the answer is made in three words: Mileage, macadam, maintenance.

In Ohio, my home state, the average cost of roads per mile, 16 ft. wide, in 1918, as shown by the records in our State Highway Department, was as follows:—

Waterbound macadam, $16,000; bituminous macadam, $19,000; concrete, $31,000; reinforced concrete, $32,700; brick, stone base, $38,000; brick, concrete base, $51,000.

These were war prices. The average Ohio prices before the war, 1914, were:—

Waterbound macadam, $8,627; gravel macadam, $8,365; bituminous macadam, $11,064; concrete, $14,227; brick, $20,982.

As a rule, macadam roads are wider than other types of road. This should be kept in mind in comparing general cost prices.

Macadam at Both Ends

While the Allied armies were going to the front over macadam roads, the meat-wheat-meal-ticket was going to the front over hard-top highways over here. Mr. Macadam was a blessing at both ends of the line. We must have road mileage without bankrupting the public money-box.

War is hell painted red. When war came, railroads failed to meet the crisis. The throat of traffic choked. Terminals clogged. Freight congested. Huns laughed and rejoiced at our predicament. Again, "the Dice of God were loaded." The motor-truck appeared as a savior. Brains, mixed with lightning and gasoline, make wonder wagons. The motor-truck became an engine of war. Day and night it delivered milions of tons of freight and armies of men, on time, at the right place.

The world knows that the motor-truck was a crusader in the world war. The world knows that the motor-truck would have been helpless without the hard-top road. John Louden Macadam began one hundred years ago to build Victory Roads that were to humble the haughty Hun and make the kaiser run from Hunland to Holland. "God moves in a mysterious way His wonders to perform." Roads are the scaffolding by which nations are builded up and saved, when they have to be saved.

Macadam, mileage and maintenance make possible the following editorial comment in "Collier's Weekly":—

"Auto-passenger mile service is greater than all our railways combined, and greater than all our electric traction service. It is almost equal to steam and trolley passenger service combined, and the ton-mile service of the railway short-haul freight."

Macadam, Mileage and Maintenance

Macadam, mileage and maintenance will make the motor-truck even more useful in peace than it was in war. In one Ohio county are 900 miles of macadam roads; 95% of its people live on or within a half-mile of a hard-top road. The engineer resurfaced old roadbeds and saved taxpayers $11,000 per mile. It is economy to save old roadbeds where possible and reasonable.

In the United States farmers are leaving the farm. This was true before the days of war and abnormal wages in shop and factory. As Secretary of Agriculture in the State of Ohio, I asked 4,200 farmers, by letter, to give me their reason for this folk-flow from farm to city. The answers that outnumbered all the rest were, "Bad roads" and "mud roads." No nation can go on forever jamming its population into sky-scrapers, city flats, tenement houses and centres of population. High cost of living is no accident. Good roads

will help to keep farmers and the farm. This is safety-first. Bolshevism does not flourish on the farm. The red-rag flag gets no applause or color-bearer among country folks. The red-light danger signals flash their warning from the city, not from God's great out-of-doors.

The biggest men, the best minds and the ablest statesmen must hold the helm on the ship if great nations are to endure. Your country and mine will be most secure and content if we do those things that will keep a normal percentage of our people outside of the city. Again, macadam, mileage and maintenance are the panacea. Roads for the many, not alone for the few. Good roads are never a menace. Good roads cost less than bad roads.

"Macadam-Victory Roads"

"Macadam-Victory Roads" made thrones crumble and crowns tumble. John Louden Macadam helped to paint the picture of Hun battleships in the North Sea floating a white flag and surrendering Germany's sea power forever. Macadam helped to write the greatest chapter in human history and in human liberty. Macadam has set the makers of geography to the task of re-charting the world.

It costs more to live to-day than ever before, but it's worth more to be living now than ever before.

The peace treaty and the League of Nations will not settle all questions, but they will settle the Huns. Britain, France and the United States have not always drunk from the same canteen, but when we fought together on the fields of France and Flanders, we forged a mighty link in friendship's chain which I hope will be broken never. We dedicated and consecrated "Macadam-Victory Roads" to peace on earth and to the brotherhood of man. In lands where God and the Golden Rule hold sway, there the name of John Louden Macadam will be applauded forever.

The spring meeting of the American Society of Mechanical Engineers will be held June 16th to 19th at Hotel Statler, Detroit, Mich.

"Tension members of wood have been used for tramway stations in Vienna, and given complete satisfaction," says a recent issue of a German engineering journal. "It is, however, essential that the wood be well seasoned, impregnated to prevent warping and decay, and completely covered with concrete, as the chloride of magnesium in the cement assists preservation." An illustration is given of a staircase step where concrete is economised by enclosing a hollow wooden box in the step. The box is kept in position by stout wire. Rushes have been used in accordance with a German patent for concrete ships.

Thomas Adams, town planning adviser to the Commission of Conservation, read a paper at a recent town-planning conference at Niagara Falls, Ont., in which he said that a regional survey of the Canadian Niagara district is much needed. The problems to be solved, he said, include industrial development, economic use and regulation of land subdivisions, housing and sanitation, transportation, power distribution, water supplies, sewerage, parks and boulevards. Cheap power is having its effect in building up this district, said Mr. Adams. On the Canadian side of the river there are 145 manufacturing establishments and there are only 183 on the United States side outside of Buffalo.

The contract for the Hunter St. bridge, Peterborough, Ont., has not yet been awarded, as the members of the city council cannot agree upon the terms of the contract. A by-law had been prepared, awarding the contract to the Canadian Engineering & Contracting Co., of Hamilton, Ont., on a cost-plus basis, the company guaranteeing that the bridge would not cost more than $276,000. Subsequently, however, the city council passed a by-law raising the rate of wages and reducing the hours of labor. In view of this increased expense, the company was forced to withdraw its guarantee as to the maximum cost. The by-law authorizing the award of the contract was then defeated. The matter will be discussed further at the next council meeting.

DEVELOPMENT OF RURAL MOTOR EXPRESS*

By F. W. Fenn
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ALTHOUGH the greatest problem confronting us to-day is the high cost of living, we are fortunate in possessing two dominating factors which if applied, and applied in the right way, will tend to lower food cost to the place where it properly belongs. I refer to good roads and highway transportation.

Highway transportation is already here, but, with the exception of a small percentage, our roads are not adequate to efficient haulage. To make this form of transportation efficient and economical, we must have a solid roadbed,—heavy enough and firm enough to allow for speed and tonnage.

Consumers Need Good Roads

You cannot have these if you are operating in mud. Mud retards progress; your operating costs increase, and hence you are not able to give your patrons transportation at a figure which could be called economical, nor can you expect to receive from your operation the profit which would come to you if the operation were on a solid base.

Therefore under these conditions you would not be doing much in the way of lowering food costs to the consumer.

The consumer, as well as the producer (the farmer) should be as much interested in better roads as the operator who uses them, for economy in this line will affect all.

It has always been the practice to develop up to the existing demand. You would not build or make anything for which a demand did not exist. Taking the railroads as an example,—development of load always preceded the development of the steel highway. In the early days, wooden rails with iron bands were used because the traffic of the day did not demand more. However, as trains grew in length, cars became larger and locomotives became heavier; heavier rails were laid; ties were placed closer together; rock ballast was resorted to and stronger bridges were built. The railroad had developed up to the demands which its tonnage was making upon its roadbed.

Our tonnage for highway transportation is here, and the most flexible machine in the world for hauling that tonnage is here also when we apply the motor truck, but the highway must be built to carry it. We must not build as we built to carry horses and wagons, for if we do we are not following natural laws, but are wasting our money and our efforts.

You are no doubt aware that the rural motor express is even now ahead of highway development, for it is operating in every state and every community within our states, and its influence is being felt by the farmers in increased production and bigger profits, and by the consumer through larger supplies and ultimately lower costs.

Born With the War

The rural motor express had its birth with the war, coming up in a time of need, when the world was calling for food, and when we were paying a price that was staggering.

Hon. John M. Baer, of North Dakota, in a speech in the United States House of Representatives, stated:—

"A new and scientific method of marketing is a problem that surpasses every other economic movement in its importance. Every plan to obtain for the farmer a greater share of what he produces, and at the same time to reduce the cost of living for the consumer, demands the immediate attention and earnest consideration of every patriotic citizen."

Mayor Shank, of Indianapolis, recently went to Grand Rapids and bought several carloads of potatoes at 50c. per

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*Paper read May 22nd, 1919, at the Canadian Good Roads Congress, Quebec.

bushel from jobbers—the farmers received 40c.—and he sold them in his city for 75c. a bushel when they were costing the consumer $2 a bushel in that city. He handled potatoes for 35c. which the profiteers got $1.50 for handling.

The report of the California Fruit Growers' Association shows that the grower received on an average, for the past four years, $1.60 per crate for oranges, while during the same period the consumer paid an average of $4.80. In New York City people paid 14c. a quart for milk for which the farmer received 5½c. In South Bend, Ill., while the farmer, 135 miles away, received 60c. a bushel for tomatoes, they were selling for $3 a bushel. A farmer gets 20c. a pound for cotton. We must pay $2.56 for that pound of cotton when woven. For a pair of shoes selling for $8, the farmer gets 75c. for the leather and the laborer gets 45c.

Federal Food Exchanges

The farmer sells his wool for 60c. a pound. We must pay $4.75 for that pound of wool when bought as yarn. In Fargo, N. Dak., when the farmer was getting 60c. for his wool, yarn was selling at $2.50,—yarn spun at very little cost. Later, when the War Industries Board fixed the price of wool at 57c., yarn sold at $4.75. The price of the raw material was fixed; the price of the finished product was not. Through these wasteful methods of handling, it costs from $2 to $5 to deliver $1 worth of food. Stated in terms of man-power, it takes from two to five men to handle a one-man-power product.

Among the many proposals that have been made to develop an efficient system of exchange between the farm and table, is the postal market or federal food exchange. At Washington, D.C., the plan is being worked out. The government is using some of the thousands of motor trucks which will soon be released from the national army. Community centres are being established, and there is the closest co-operation between the farmer and buyer. All unnecessary distributing agencies are eliminated. Instead of costing from $2 to $5 to deliver $1 in products, it costs only 10c. to 15c. It is a complete reversal of the inefficient methods of the past. This is one real remedy which rings true with definite results.

Now, I am going to tell you of the remarkable advance that has been made in a period of twelve months, as I have seen it. Operating out of Cleveland, the Highways Motor Transport Co. has been making quite a showing, and has been responsible for greater reproduction, because this line has interested the farmer to the extent that he has given more attention to greater production. Six-ton trucks and trailers are being used.

Some Motor Truck Performances

During last summer this company made quite a remarkable record in hauling hothouse vegetables from Geneva and Ashtabula to Cleveland. When fruits and vegetables began to come into the market, 20,000 crates of berries and 25,000 bushels of tomatoes were hauled to the Cleveland markets. These shipments were followed by 20,000 bushels of apples, peaches and beans. We have paid from 10c. to 15c. each for apples in New York City because we failed to realize that the finest apples in the world are grown in Connecticut and Northern New York. And so, of course, we buy apples which come 3,000 miles from Oregon and Washington. Just think what the cost of apples would be if we could bring them in from Connecticut in motor trucks,—of the great quantities which could come in, so that everyone could occasionally eat an apple without feeling guilty.

With this lower cost and greater consumption, the merchant would still make more, because of the added consumption. We are doing ourselves a great deal of harm when we permit apples to rot in New England and show a willingness to pay for a product which carries with it a long haulage cost. This same company hauled 84,000 baskets of grapes into Cleveland last summer. Trailer trains were also used, and to show the economy of this kind of an operation, 230 bushels of tomatoes were hauled on the trailer, while the truck carried 291 bushels of tomatoes, 9 bushels of cucumbers, 80 baskets of peaches and 13 cans of cottage cheese.

Another line operating over the Allegheny Mountains from Johnstown, Pa., hauled 115 bushels of potatoes to the load in three hours. The distance of this route is 35 miles.

The Omaha stock yard figures in the haulage of live stock which were published the first of the year have been very interesting. The facts revealed that a greater part of the 250,000 animals delivered from the farms within a radius of 75 miles of the stock yards came in by motor truck.

Short haul lines are not profitable to the railroads. It is on such hauls that motor trucks are demonstrating their value.

Down in Dallas, Texas, W. F. Brittson is operating a rural express train. His trucks go out hauling four trailers to Farmersville, Texas. The load consists of 70 head of sheep; 17 head of steers; net weight of load, 29,500 lbs. The distance traveled with this load is 90 miles, 22 miles of which are over black land roads.

Thinking in Road Mileage

The use of motor trucks with the farmer might be said to be developing just as rapidly as the farmer is learning to think in terms of road mileage. When he ceases to think of transportation wholly in terms of horse power and can comprehend the cost per mile per pound, regardless of the power used, then the sale of motor trucks will be tremendous.

However, trucks are being used to replace railway service, or rather to extend the farmer's marketing radius and to bring the distant city markets within hauling distance of his farm. So we may say that while the truck is being introduced largely because it offers cheaper hauling than the horses, yet a factor almost as important is its ability to do things that are entirely beyond the range of the horse. Probably the best illustration of the latter is the hauling of livestock from the farms to the large packing centres.

"Motor trucks," says E. M. Carroll, traffic manager of the St. Joseph Stock Yards Co., "are being used here to a large extent. We have had truck loads in here from as far east as Chillicothe, Mo., a distance of about 85 miles by rail. We also have received livestock by truck from across the Iowa line, a distance of from 70 to 80 miles. There are trucks making regular trips to the market from points as far as 65 to 70 miles distant. These trucks not only haul hogs, but they also bring in cattle, calves and sheep, and very frequently they bring in mixed loads, separated by partitions. Our largest day's receipts from this source were slightly more than 1,400 hogs and nearly 200 head of cattle and calves and 200 sheep. We did not count the vehicles employed to bring this stock to market, but we estimate that there were close to 250 trucks and wagons, of which 75% were trucks.

"For the 9 months ending September 30th, we received from this source 75,211 hogs; for the same period in 1917 we received 33,286; for the entire year of 1917, 56,529, while in 1916 our receipts were 52,048. For 24 days of October this year we received 11,622 cattle, 418 calves, 16,150 hogs, and 25,922 sheep; for the entire month of October, 1917, we received 801 cattle, 877 calves, 5,834 hogs and 1,607 sheep.

Facilities to be Increased

"Most of the trucks employed in bringing stock to market are engaged in this business regularly and they range from small trailers attached to the rear end of passenger vehicles to 4 and 5 ton trucks. These larger trucks have a capacity of as much as one-third of a regular railroad car of stock. Many of these trucks are able to get a return load, especially those that come from or pass through inland towns or towns not located on railroads. Some of those trucks are owned and operated by regular dealers located in the country, but the majority of them simply are engaged in transporting livestock and make a charge of so much a head, or load. We believe that this movement is permanent and are going to increase our facilities for taking care of it.

Highway haulage is making a large place for itself in the reconstructed transportation system of our country, and now Charles A. Morse, assistant director of operation in charge of engineering and maintenance, United States Railroad Administration, in a recent speech, told the New York Railroad Club that motor trucks routes are to substitute railway branch lines.

Even in old England we find that the development of the motor lorry services have been a tremendous boon to commerce and suburban sections.

The coming of highway motor transportation means that a greater day is breaking and that a greater Canada is in the making, for they reach out everywhere and anywhere under the sun and bring our commerce into real competition with the world.

Finally, however, in operating a highway transport line, you should be careful not to overtax the road. Do not overburden it with a weight which is going to smash it. It is far better to limit the size of truck and haul a trailer until such times as the highway will carry the traffic.

ECONOMIC STATUS OF GUARANTEES FOR PAVEMENTS ON ROADS AND STREETS

(Continued from page 536)

Where contractors do not have an established plant or organization in the municipality or locality where the pavement is being laid, some guarantee for the repair of such defects as may develop would seem to be a necessity. In many smaller towns a single contractor may remain for two or three years and then withdraw after the available paving area has been completely improved. It may be years before any new paving is done, and it is often very difficult to get the contractor to return and make any repairs during the guarantee period.

It is sometimes claimed by the contractor that where the specifications are closely drawn and the compliance with them is insisted upon, he should be relieved of the responsibility of guaranteeing results. Your committee believes that, after having examined the site of the improvement and studied the specifications, he is or should be fully familiar with conditions, and if after doing so he signs the contract and guarantee he has no reasonable ground for subsequently opposing the engineer in his desire to carry out the provisions of the specifications, and that such insistence on the part of the engineer does not and should not relieve the contractor of his guarantee obligations.

If he believes the specifications are faulty, he is under no compulsion to bid on the work, and if he does so, he acts with his eyes open and has no one but himself to blame. The history of court decisions would appear to show that the contractor is at least as well protected as the city when the matter comes up for legal adjudication.

Where a "Ring" Exists

We also recognize that certain large cities may have within their confines three or four large paving plants, and that conditions are such that it may be difficult for an outsider to break in. In such cases it is possible to imagine an arrangement between bidders whereby the city would pay excessively for their guarantees, but such conditions are exceptional ones and under them the same city would probably pay an excessive price for its pavements even if it eliminated the guarantee provision from its contracts. This condition could be and has been met by the establishment of large municipal plants capable of doing a considerable portion of the necessary paving.

It has also been urged that it is not logical or legitimate to ask for guarantees on pavements, because buildings are not guaranteed. The cases are not parallel. The factor of safety in a building is much greater and its life expectancy is much longer. If the average life expectancy of a building were but ten years and defects might be expected to develop within five years which might render it useless unless rebuilt, the cases might be more nearly parallel.

Having in view the facts as set forth in this report, your committee believes that, notwithstanding its admitted defects, the guarantee clause serves an effective purpose and in the light of experience is economically justified.

Uniform Guarantee not Logical

We do not believe that a uniform length of guarantee for all pavements or for the same pavement under varying traffic conditions is logical or justifiable. Certain pavements are composed of blocks which in themselves have a very long life, and but little variation is to be looked for in the blocks themselves. Defects which would develop would be almost wholly defects of workmanship and two years should be the maximum period required to make this evident, and, therefore, the guarantee should be limited to that time. Other pavements are composed of blocks which vary very greatly in hardness and resistance to wear, and for this type we would advocate a guarantee period for the full life expectancy of the pavement, without repair, as it is obviously impossible to test every block used in it. Where a pavement ultimately fails through the abrasion or disintegration of the pavement itself, and is likely to prematurely disintegrate through improper materials, or mixing, or proportions, we believe that, owing to the great difficulty of absolutely preventing these errors by inspection, the pavement should be guaranteed for its full life expectancy without repairs, and this can be reasonably varied to meet different traffic conditions.

We believe that the guarantee clause should be fairly worded so as not to impose upon the contractor responsibility for conditions arising after the completion of the pavement and over which he had no control and, as covering these points, would recommend for consideration the form adopted by the Association for Standardizing Paving Specifications at New Orleans in January, 1912. It should also clearly set forth, and be agreed to by the contractor, the life expected of the pavement without repairs.

A Hint for Canada

In the northern latitudes, if the pavement is completed and accepted between November 1st and May 15th, the guarantee period should be extended so that it will expire on the first of June first following in order to insure weather conditions being such as to permit of thorough examination and the making of all necessary repairs before the final taking over of the pavement by the city. This provision may be omitted when climatic conditions render it obviously unnecessary.

Owing to the admitted defects and shortcomings of guarantees covered by surety bonds alone and the frequent difficulty experienced by cities in having even those repairs due to poor workmanship and materials made on time, we believe that the bond should be supplemented by a cash retainer, legal interest being allowed to the contractor on the amount retained.

For new construction, involving grading, foundation and wearing surface, we would recommend that 10% of the aggregate cost of these items be retained.

For resurfacing on an old foundation we would recommend a retainer of 20%.

Payment of Retained Percentages

In the case of a two-year guarantee the whole of the retained moneys should be payable at its expiration and not before. In the case of a five-year guarantee, one-fourth of the retained moneys should be payable two years after the completion of the pavement and the balance in three equal annual installments. The date when payments of retained moneys become due shall be governed by the clause previously recommended for payments completed and accepted between November 1st and May 15th. If the contractor, having received thirty days' notice, fails to make and complete the ordered repairs at the time any annual installment (or the whole amount) of the retained moneys becomes due, he shall forfeit to the city the total amount then due, unless he shall have obtained in writing from the engineer an extension of the time, when the same provision shall apply at the expiration of the extension period.

ENLARGED ST. LAWRENCE CANAL SYSTEM

Will Yield Immediate Economic Benefits, Say Montreal Harbor Commissioners—View with Concern Completion of New York State Barge Canal

THAT the Harbor Commissioners of Montreal view with concern the completion and equipment of the New York State barge canal is shown by the annual report of the commissioners for the year 1918, which has just been published. "The New York State barge canal," says the report, "will be a considerable factor in the diversion of Canadian products through the United States ports. The whole question must be looked at and studied from a broad consideration of transport, especially of grain, from the head of the great lakes to Europe. The thought in some Canadian minds is that the new Welland Canal when completed, will throw the advantage Canada's way.

"This is open to doubt, for the reason that this canal is free of charge to United States ships, though constructed at the sole expense of the Canadian people, and the United States will be enabled to bring their large lake boats through Lake Ontario to Oswego, N.Y., and thereby still further reduce the cost of transporting grain from Buffalo to New York. The ideal and proper method to pursue to get full benefit of the Welland Canal is a simultaneous development of all the canal systems to Montreal, no matter by what scheme.

"The canalization of the St. Lawrence River, with its immense power possibilities, is in the opinion of the commissioners, preferable to deepening and widening the present canal system. The completion of a scheme of such magnitude would require expense and time, but it is one that must be carried out and should be aggressively proceeded with.

"If it is not found possible to proceed with the whole scheme simultaneously, the opinion of the Harbor Commissioners is that the portion of the island transportation system which is most immediately required, and which will give the most immediate benefits, is the section of the canal system commencing at Montreal working westward. They feel that the proceeding in the first place, with the lower end of the enlarged St. Lawrence canal system, starting with the Lachine canal, will yield economic results which will give immediate benefit to Canadian transportation, without resultant benefit to foreign competitors, and the continuation of such a policy of development by proceeding westward with the Soulanges and Cornwall canals as soon as the Lachine canal is completed, would place Canada in a more outstanding position to handle its products through Canadian ports without benefit to others."

It has been decided by the village council of Mimico, Ont., to spend about $45,000 on construction of sewers and water mains. About twelve streets will benefit by this work.

In this issue is published the official advertisement for tenders for construction of sewers and water mains in Timmins, Ont. The engineers, Sutcliffe and Neelands, of New Liskeard, will receive bids until June 24th.

According to information received from C. E. Walker, township clerk at Gorrie, Ont., no action has as yet been taken by the township council with regard to awarding contract for drainage works for which tenders closed May 21st.

A. F. Stewart, chief engineer of the Canadian National Railways, has called for tenders until June 21st for rock filling, rip rapping, broken stone, ballasting, etc., on the St. Lawrence subdivision, between Cap Ronge and Portneuf. All the work is in connection with the rebuilding of the roadbed and track.

C. B. Brown, chief engineer of the eastern lines of the Canadian National Railways, has called for tenders until June 28th, for construction of railway section houses in the various subdivisions. Specifications may be seen at the offices of the resident engineers, at Edmundston, N.B., Campbellton, N.B., Quebec, P.Q., and at the office of F. P. Brady, general manager, Montreal, P.Q.

SENSE OF ART IN ENGINEERING*

IN a paper by C. W. Boynton and J. H. Libberton on "The Decorative Possibilities of Concrete," read before the Western Society of Engineers at Chicago, the authors refer to the old maxim that the designer should ornament his construction, and not construct his ornamentation. They add, however, that this rule should be subordinated to another, namely, that he should ornament his structure only if he lacks the skill to make it beautiful in itself. The structure should preferably be beautiful and not be beautified. The question of pleasing effects depends not only on the surfaces and the surface treatment, but on the combination of design with the surface texture. Notwithstanding the excellent decorative work which has been done in plain and reinforced concrete, as such, there are, nevertheless, numerous advocates of tile decoration. Instances are many where the use of brick or tile emphasises the color and enlivens the surface at very little expense. A little touch of color always relieves the monotony of a single-toned exterior.

Terra-Cotta for Ornamentation

Some American designers have produced pleasing work upon the assumption that concrete should never be used for the ornamentation upon buildings of the same material. Terra-cotta is successfully used for decorative parts, such as panels and column capitals, the high individual cost of the panels being small when compared with the total cost of the building. With colored aggregates it is generally possible to obtain many color variations. Care has, of course, to be taken that the aggregates in such cases shall be properly exposed. It matters not æsthetically whether the aggregate in the concrete has been bonded by Nature or by the hand of man with Portland cement as the binding material. This practice should not be termed an "imitation" of stone, for the ingredients are largely the same as are found in real stone. Nature's process of employing time and gravity has simply been superseded and accelerated by man's mechanical ingenuity. So far as permanence is concerned, concrete has already proved beyond a doubt its superiority to many of the natural stones.

Lattice work on the exterior, made of wooden laths, painted green and harmonizing with surrounding foliage, has been used with good results, while wood panelling will also break up large areas of concrete surface, and is entirely in keeping with the old half-timbered style of architecture, so familiar to our forefathers. Buildings of plain-faced concrete blocks have the monotony successfully broken up by the insertion of smaller squares and bands.

H Heathcote Statham, in a paper read before the Royal Institute of British Architects on "The Architectural Element in Engineering Works," said that in the nineteenth century engineers had played a more important part in the world than architects, and had had opportunities similar to those enjoyed by the architects when the mediæval cathedrals were built in the thirteenth, fourteenth and fifteenth centuries. Engineering works, properly so-called, are those in which structural and practical requirements alone are taken into account, without any special consideration of æsthetics, or any special effort at what may be called architectural effect. In a general way, it may be said that it is the effort to make them "ornamental," in the popular sense of the word, which spoils them.

Iron Needs Paint Pots

The most serious drawback to iron structures, considered in their relation to scenery, consists in the necessity for painting them. In stone we have a natural material which harmonizes with the landscape; in brick we have a material which takes on tints from weather, and, therefore, ultimately harmonizes; in the case of iron we are reduced to the paint-pot. Simplicity of design, absence of anything like pretentiousness, a simple definition of the practical lines of the structure, are the conditions under which it will have the

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*From "The Engineer," London, Eng.

best effect. Any attempt at artistic or decorative treatment of the Forth Bridge would have been preposterous, and would have defeated its own ends. But there are occasions when an engineering work may fitly be the subject of ornate treatment as a work of architecture.

Two Mistakes Frequently Met

The two mistakes we most frequently meet with in ornate modern engineering works are coarseness of design in ornament and mouldings and want of perception of scale. Scale may be regarded in two lights. It consists partly in proportioning all the parts and details of a design in such a way that they shall have a harmonious relation to one another; this is perception of scale in the abstract. Conventional scale is the recognized and habitual proportion to each other in details, such as those of the architectural orders, which have by long use come to have a certain recognized relation to one another, so that the use of one of them on an entirely different scale to what we are accustomed to confuses our sense of proportion in the structure. A detail which is good on a small scale is not always good on a larger scale, and the modern desire on the part of engineers to make ornamental structures, without having ever studied design in the artistic sense of the word, is producing structures of which we have a right to complain.

C. R. Young, of Toronto University, in a paper before the Canadian Society of Civil Engineers upon "Æsthetics of Bridge Design," said that the subject should be approached from two points of view: That of art and that of engineering science. The basic essential of an artistic engineering work is its capacity to perform the service required of it in the simplest and most efficient manner possible with the chosen materials and in the light of present knowledge. Mr. Young said that improvement in bridge design, from the æsthetic point of view, was slow in coming on account of the general lack of good taste. Where the prevailing conception of an artistic bridge is a highly ornamental one, on which tons of cast-iron finials, rosettes and stars have been lavished, little appreciation of a truly harmonious structure is to be expected. Lack of acquaintance with the principles of æsthetics leads the average engineer into adopting architectural details and features which are entirely unsuited to the work in hand. For important bridges in populous districts, or those of a monumental character, very few engineers are capable of relying exclusively upon their own æsthetic judgment.

Suggested Æsthetic Standards

For the better understanding of the question, several æsthetic standards were suggested in Mr. Young's paper, the first being that the structure must be in conformity with local physical conditions, and entirely suitable for the work which it has to perform. In wild, rocky regions, with swiftly-flowing streams, bridges should be expressive of, and in harmony with, the rough, primitive conditions existing about them. Bold, powerful structures, absolutely without ornamentation, will alone do justice to such surroundings. Where the landscape becomes thinly wooded, more regular, more graceful structures, with evidences of greater finsh, should be adopted. In the closely built-up sections of cities and towns, where clean, regular outlines, characteristic of cut stone construction, present themselves, bridges must bear evidence of greater finish than would be the case in rural or suburban districts. Cut stone or carefully finished concrete piers and abutments, with graceful superstructures exhibiting simple ornamentation, should characterize structures in such situations. The structure should also be in conformity with the prevailing style of architecture in the vicinity.

The general layout as regards symmetry is also of considerable importance. Both economic considerations and the sense of orderliness and regularity necessitate a layout symmetrical about a centre line, and involving spans of increasing length as the centre of the depression is approached, with the longest span at the centre of the bridge. This requirement is at times further facilitated by placing the summit of a gradient at the centre of the bridge. If reasons for an unsymmetrical or irregular layout are unknown to or hidden form the observer, such as the depth of the water, or the nature of the bottom, and no adequate cause appears to exist for the lack of symmetry, the structure will not be pleasing. A pier at the centre of a bridge is inconsistent with an ideal layout. The water being deepest at this point in the average case, and the maximum obstruction of the channel resulting by the introduction of a pier there, the most efficient arrangement would involve an odd number of spans rather than an even number, the central span, if possible, being longer than the adjacent spans. A bridge of two spans, or one in which the main spans are even in number, is undoubtedly inferior in appearance to a three-span structure. Where the number of spans exceeds five the eye cannot readily appreciate the departure from ideal symmetry. The same question of odd or even distribution also occurs in building and architectural work; a church with an odd number of bays, or a facade with an odd number of windows, is always more pleasing than when the distribution is even.

Familiar Materials Most Pleasing

The second axiom laid down by Mr. Young is that general approval of a design will be most probable when the material and the type of construction are well known to the people at large. The long use of stone has resulted in an accurate appreciation of its properties of resistance and the relation of strength to mass, so that incorrect or unscientific use of this material in a structure is readily detected. With new materials this detection is not generally possible.

When reinforced concrete at first came into use, the viaduct posts appeared too slender and spindling in the light of past experience in ordinary concrete and stonework. By and by, as time progressed, we did not notice this slenderness, and, in fact, we should refuse to accept thicker columns in this material. The idea that structures of steel and reinforced concrete must forever be debarred from the realm of the æsthetically meritorious is being foregone very largely as the use of the materials becomes more general. The establishment of standards depends to such a large extent upon environment and training, that we cannot say how much of our disapproval of new materials, such as steel and reinforced concrete, is due to the age-long association with stone as our chief material of construction in permanent and monumental works.

The mind regards as æsthetically defective any new departure which does not correspond to accepted and time-honoured usage. New things are seldom looked on as beautiful, and therefore, in order to build artistic bridges, dare we break away from past standards? The same things, as we have already said, occur in poetry and in music, and also in architecture. The Doric builders would have been horrified at the proportions of a Corinthian entablature, and the Norman architects would certainly have regarded the perpendicular and flamboyant details as being particularly non-æsthetic and most inartistic. Some standards of art, such as the Venus of Milo and the Warwick vase, have been accepted as standards throughout all the ages, but they are not so numerous as the standards which have been so frequently revised as time progresses. If we "design with beauty and build in truth," the period of disapproval of new ideas and novel materials is limited. As soon as the people become accustomed to new materials and forms of construction, and are satisfied that they possess ample strength and fitness to discharge the duties required of them, the structure no longer appears ugly, but soon is seen to possess beauty.

Clearly Display Constructional Principles

The third standard is that the simpler the lines of a structure, and the more clearly the constructional principles involved are displayed, the more pleasing will be the result. Any design which mystifies or leaves the public in doubt as to the adequate support of superimposed loads, is an æsthetic transgression. Instances of such transgression are afforded in many early bridges in which the suspension and cantilever or the truss and arch principles have been combined. Simplicity and directness being essentials of æsthetic excellence,

it would be expected that the simple beam or girder with constant depth, the earliest form of construction with which we are acquainted, would be the most beautiful of all forms for a bridge. On the other hand, the least pleasing of all plate girder bridges is that made up of a succession of spans of considerable length and of the same construction. The lack of contrast gives rise to pronounced monotony. By reason of greater constructional complication, the simple truss or cantilever span is in general less pleasing than a girder bridge. Articulation, which is the distinctive feature of the truss, conveys the impression of complication, and renders the layman less capable of appreciating the strength and sufficiency than in the case of a girder, arch or suspension span, each of which, in addition, has many centuries of use behind it in which the race has grown familiar with its form. The steel arch is generally regarded as more beautiful than the suspension bridge, certainly not from superior grace of line, but simply because of the age-long association with stone.

Must Retain Proper Balance

The fourth of Mr. Young's axioms is that proper balance or relation of parts to each other and to the whole must be maintained. No part of the construction should contain a suggestion of undue strength or undue weakness in comparison with any other part, but all should be equally efficient. This lack of balance is frequently seen in structures composed of widely different materials, in which, perhaps a light steel truss is supported upon heavy stone abutments. The mind of the observer is forced suddenly to change its standards for estimating the sufficiency of adjoining spans. A steel arch bridge without apparent sufficient abutments shows the same defect and excites wonder even in the lay mind as to the means by which the enormous rib thrust is resisted.

The fifth axiom is that the design which is structurally the most efficient for the amount of material employed will at the same time be the most pleasing. The author claims the correctness of the principle that the most pleasing outlines or general forms arise when the maximum economy of material is secured, and shows that nature performs her work along the lines of least resistance. In fashioning a straw, reed, or stalk, nature seeks only to obtain the greatest strength and rigidity with a minimum of weight, and by her own mathematics has arrived at the annular cross-section as the most efficient.

A type of structure which illustrates the principle that economy of material and æsthetic quality go hand in hand is the simple truss span with the curved top chord, which by this means shows both a saving of material and an improvement in appearance. Quite as significant is the fact that the saving is greatest and the appearance best when the curvature of the chords is the most regular. The coincidence of æsthetic correctness with scientific efficiency is also illustrated in the relative slope of the diagonals of trusses with curved top chords. A wide variation in the slope of these members is æsthetically objectionable from the lack of satisfaction with the general outlines, and probably from a breach of orderliness. This dislike of large variation in the slope of diagonals has a scientific basis, for there is an economic inclination of such diagonals—about 45 deg.—and this inclination of the members is the one most pleasing to the eye.

Shams are Æsthetic Failures

Again, the most pleasing axial curve for an arch ring is the one which corresponds most nearly with the dead-load line of pressures. The use of curves which are noticeably flat on the haunches is particularly objectionable for arches of low rise, the reason being that apparently full advantage has not been taken of the possible rise. The form of arch ring which involves the greatest security for the piers in case of the development of an unbalanced thrust is also at the same time the most pleasing to the eye.

The sixth axiom is that there should be no attempt to conceal the true nature of the material of the bridge or the structural principles involved. Not alone in the realm of ethics is deliberate deception and falsehood to be condemned, but also quite promptly in art. Any structure in which the real nature of the material or the structural principle employed is purposely disguised is a sham, and, therefore, a failure æsthetically.

Ornamentation Only an Aid

The effort to make monolithic concrete look like masonry by the use of joint lines is unsatisfactory to the eye, because the lines of the structure at once give the lie to the surface treatment from the fact that the arch is much flatter than it would be if constructed in masonry. The same reasoning holds good if rock-faced or cut stone masonry has been employed only to produce a pleasing surface finish. It may, however, be said that when the lines of the structure would be the same as if a masonry construction had been adopted, and that the apparent masonry is, to all intents and purposes, strong enough to take the loads, there is no more æsthetical objection than there is to the use of marble or mosaic facing to a concrete backing. The eye at once realizes that a facing only is intended, and that there has been no attempt at gross premeditated deception.

The seventh standard enunciated by Mr. Young is that the chief beauty of a structure arises from its general form. The truth of this axiom may be proved from many examples of structures which obviously possess beautiful lines, but which are quite devoid of ornament; and from many other examples which have been much ornamented, but which possess no charm, showing the total inability of decoration to compensate for lack of beauty in form.

This last standard has its corollary in the eighth axiom, that ornamentation should be employed only as an aid to the display of general lines and proportions. The author states that ornamentation may be legitimately and properly used to accentuate or contrast the structural functions and characteristics of the parts, to emphasize the magnitude or strength of the structure, or to afford relief to long unbroken straight lines or large blank spaces. It should never be applied thoughtlessly to the first clear space which occurs to the designer as in need of beautification, but only where it can serve as handmaiden to the chief element of beauty, the general form. Careful use should be made of the column, which should always have the function of supporting loads. The insertion of large columns over the piers of a bridge without any apparent load upon them is not permissible.

Massive Load-Bearing Parts

Decoration should always be applied to the lighter and frailer portions of a structure rather than to massive load bearing parts. We do not usually find great strength and great delicacy as co-existent attributes of the same object. The application of ornament to the chords or end posts of a truss is, therefore, incompatible with the character of these members. In masonry, the necessity for the radial arrangement of the voussoirs involves the desired accentuation of the ring, but no such condition exists in concrete construction. If the ring is accentuated, the true structural dimensions should be preserved, since noticeable deviations from such true dimensions are highly objectionable. Often faulty panelling will suggest a constant thickness of arch ring where such is not existent. The springings should be clearly defined, the abutting of the ring accentuated, and the arch ring should not appear to have no support and so to be liable to slip vertically down between the abutments.

Emphasis of the lateral stability of piers and abutments adds to our appreciation of their functions. Counterforts running from the tops of the piers to the top of the coping give the effect of security against side-wise displacement of the structure, and, at the same time, break the monotony of a plain spandrel wall above the piers. A batter of the face of the abutments is essential to obviate the appearance of a liabilty to move forwards. Skilful contrasts of color may be employed, but only to accentuate the main structural lines and to assist the eye to trace the functions of the various parts. Emphasis of strength, either directly,

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PRINCIPAL CONTENTS

POWER CONTROLLER PRESENTS REPORT

SIR Henry Drayton, who was until recently power controller for the Dominion, has presented his report to the government. He states that there are two questions which demand serious consideration: First, the policy that ought to be adopted as to the export of electricity; and secondly, the use of water at Niagara Falls for power purposes and the treaty limitations which confine Canadian diversion from above the falls to 36,000 c.f.s.

Notwithstanding the great increase of available power which the Queenston plant will afford, the ever increasing demand for electricity in Ontario, he says, requires the consideration of the question of increased utilization of the water of the Niagara River.

"The situation is common on both sides of the river," he states. "Shortages have existed in both territories. The situation is perhaps accentuated on the American side, as a great amount of electricity is now being produced by steam in the very efficient plant of the Buffalo General Electric. The ever increasing cost of coal and its transportation, however, will inevitably tell in favor of modern hydraulic plants. As I see it, the question of a larger use of the waters of the river is one in which both countries are equally concerned, and the use of an increased quantity of the water for the purposes of electrical development is in the interest of both."

CALENDAR REVISION

CANADIANS should support the movement which is already under way to simplify the calendar. The changes proposed would eliminate the difficulties now due to the fact that the month is not composed of an even number of weeks, which complicates any comparison of figures compiled on a weekly basis with others compiled on a monthly basis.

It is suggested that a thirteenth month should be added and the number of weeks in each month should be made exactly four. This would make 364 days, and New Years day could be regarded as separate from any month; every fourth year there could be an additional "New Year's Day." Every month would then be of exactly the same length, and comparisons of such figures as railway earnings, bank clearings, pay rolls, etc., would be a simple matter. An association by the name of the American Equal Month Calendar Association has been formed in Minneapolis, Minn., for the purpose of furthering this plan. They propose that the additional month should be the third in the new calendar, and should be called "Liberty."

TOWN PLAN FOR MONTREAL SUBURB

THAT part of Chambly County immediately opposite and tributary to the city of Montreal is served by the South Shore Board of Trade. The bulk of its members is drawn from the towns of St. Lambert, Greenfield Park, Montreal South and Longueuil. During its short life it has proved itself a useful agency for good, and has recently undertaken the ambitious project of securing the adoption of a comprehensive town planning scheme for that part of suburban Montreal.

A committee of its own members, headed by Wayland Williams, spent a considerable portion of last year in considering how best to accomplish this object. As a result of its labors, this committee has now been succeeded by one composed of two aldermen from each of the four towns, one from the parish of St. Antoine de Longueuil and five members at large, with Mr. Williams as chairman. The other members are D. F. Kyle, Alex. Thurber, Omer Lecuyer, Edmond Hardy, J. E. Campbell, E. P. Gordon, S. J. Milligan, E. Backhoven, J. W. Oakley, E. Drinkwater, Jas. Ewing, W. J. Carmichael and A. Vincent. R. DeL. French, consulting engineer to the Lignite Utilization Board of Canada, has been acting as secretary.

This committee has adopted the title of the "South Shore Joint Town Planning Board," and has held a number of meetings. All the town councils concerned have been interviewed, their support solicited, and a considerable amount of work has already been accomplished.

Ewing, Lovelace & Tremblay, consulting engineers, Montreal, are preparing a plan of the area to be included in the town-planning scheme, which will show all the physical features, both natural and artificial, including the public and semi-public buildings. With this plan, which is expected to be ready about October 1st, as a basis, the board intends to lay out a scheme of highways; industrial, business and residential areas; parks; sites for future public buildings; railway and harbor facilities; etc. This will be the "town plan" and it will be submitted to the citizens for their criticism and discussion.

When an acceptable town plan has been finally developed, the board hopes to have an act ready for presentation to the provincial assembly, providing for an authority to which will be entrusted the duty of putting the plan into effect. Little can be done along these lines, however, in advance of the appeal to and approval by public opinion.

The projects of the board have been very favorably received thus far by the municipal authorities, who have agreed to meet the cost of the plan as the first step in the scheme.

The South Shore, like most of Montreal's suburbs, is a jumble of subdivisions, promoted by various real estate operators. As a result, the street system, for example, is far from well arranged, and other features are in much the same state. With the rapid return of Canada to normal conditions, and the extensive development schemes of the Harbor Commissioners of Montreal, the Canadian National Railways and numerous industrial concerns, the present seems a most opportune time to consider the planning of

this territory in such a way that the most good will accrue to the greatest number of its citizens.

Town-planning means to many merely the beautification of the community. It is really much more than this, and concerns itself with all that which affects the physical well-being of the people. Towns have grown too long in a haphazard and expensive manner. The South Shore Joint Town Planning Board intends that the South Shore shall hereafter develop along rational and economical lines. More power to its arm!

PERSONALS

MORRIS KNOWLES, president of Morris Knowles, Ltd., consulting engineers, Pittsburgh, Pa., and Windsor, Ont., who are engaged in extensive water works and sewerage schemes for the Border Cities (Windsor, Walkerville, Sandwich, Ojibway, etc.), was born October 13th, 1869, at Lawrence, Mass., and graduated in 1891 at the Massachusetts Institute of Technology. For two years after graduation, Mr. Knowles was with the East Jersey Water Co., and then entered the employ of the Massachusetts State Board of Health. He was connected with the design and construction of the Boston metropolitan water works. From 1897 to 1899, Mr. Knowles made investigations for an improved and enlarged water supply for the Pittsburgh Filtration Commission, and for the following two years made similar investigations in connection with the Philadelphia and New York water supplies. In 1901 he was engaged to design and construct a slow sand filtration system for the city of Pittsburgh. In 1903 Mr. Knowles entered private practice. Among the more important works in which he has been engaged as consulting engineer, are the design and construction of a waterworks system for the Tennessee Coal, Iron & Railroad Co., at Birmingham, Ala.; the investigation of living and sanitary conditions for the Alabama Coal Operators' Association; and the design of water and sewerage systems for the United States Steel Corporation, in connection with the new towns at Duluth, Minn., and Ojibway, Ont. Since 1908 he has been member of the engineering committee of the Pittsburgh Flood Commission, and from 1909 to 1912 he was a member of the Pittsburgh Civic Commission. Since 1917 he has been the director of the department of sanitary engineering of the University of Pittsburgh. During the war he was chief engineer of the housing department, Emergency Fleet Corporation, U.S. Shipping Board. He is also a member of the valuation board of the Pittsburgh railway system, and is president of the Knowles-Main Appraisal Bureau. Mr. Knowles is a member of the Engineering Institute of Canada, American Institute of Consulting Engineers, American Society of Civil Engineers, American Society of Mechanical Engineers, American Water Works Association, Boston Society of Civil Engineers, and various other engineering and housing associations.

ADOLPH AEBERLI resigned recently from the technical staff of Canadian Allis-Chalmers, Ltd., to accept a position in the hydraulic department of the Hydro-Electric Power Commission of Ontario. Mr. Aeberli will have charge of tests on and repairs to hydraulic equipment.

CAPT. F. A. DALLYN, sanitary engineer of the Board of Health of the Province of Ontario, who has been in Siberia for several months past, in charge of sanitation and housing for the Canadian expeditionary force, has entirely recovered from the attack of typhus fever which he recently experienced, and writes that he expects to sail for Canada in about two months.

HON. GEO. LANGLEY, minister of municipal affairs for Saskatchewan, has been asked to accept an honorary membership in the Town Planning Institute of Canada. Mr. Langley has signified his intention of accepting the honor. The distinction has been conferred upon the minister as a mark of approval of the action of his government in passing the Town Planning Act and because of the interest which he takes in housing and town planning. He recently appointed a director of town planning for the province and a town planning engineer to carry out the provisions of the new act.

LT.-COL. GEORGE A. JOHNSON, who is well-known in Canadian engineering circles, and MAJ. WEBSTER L. BENHAM have formed a partnership for a general consulting engineering practice under the firm name of Johnson & Benham, with offices in New York City and Kansas City, Mo. Col. Johnson is still second in command of the Maintenance and Repair Branch of the Construction Division of the United States Army, but expects to be discharged within a few months. Maj. Benham was discharged from the service last month. He was assistant to the chief of the Construction Division.

SENSE OF ART IN ENGINEERING

(Continued from page 544)

or by withholding any decorative feature, are important æsthetic details. Heavy feaures and even clusters of lamps should be placed rather over the piers than over the crown of the arch.

The ninth axiom is that public appreciation of the work will be largely affected by the character of the surface finish. Many concrete bridges of excellent design have a most unattractive appearance by reason of a rough, discolored, or patched surface finish, and it seems necessary that the surface should either be scrubbed or etched with acid, bush hammered or ground down and washed with a thin mortar.

The tenth, and last axiom, is that neatness of the surroundings and approaches are indispensable to a pleasing appearance.

Water was turned into the new penstocks of the Ontario Power Co. at Niagara Falls, Ont., last Saturday, for the first time, and a test on the new units is now being conducted. They will take on load at an early date.

Gen. J. W. Stewart, who came into very great prominence in France, through his capable direction of standard-gauge and light railway work is again actively engaged in civil work. J. W. Stewart & Co., of Vancouver, have started upon the construction of the Kamloops-to-Kelowna line of the Canadian National Railways. This is a 133 mile branch with some heavy rock work. General Stewart has also undertaken some smaller contracts in the prairie provinces.

Several of the younger members of the Toronto branch of the Engineering Institute of Canada have requested further discussion on the draft bill of proposed legislation. It is the opinion of these members that the proposed draft has objectionable features; that it does not give the desired protection either to the public or to the great majority of salaried engineers, which, they say, primarily should be the main object of the bill. A special general meeting of the branch has been called to discuss these features, and will be held this evening in the lecture room of the Engineers' Club, Toronto.