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Earth Slides in Winnipeg Aqueduct Construction

Description of the Principal Methods Used by the Contractors in Dealing with the Sloughs and Slides—Bearing Tests Demonstrated Instability of the Soft Dark Clay, Analysis of Which Showed 15% of Moisture and Water of Combination

By DOUGLAS L. McLEAN

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EARTH slides in the open trench used for the construction of Winnipeg's 100-mile aqueduct were of such magnitude as to impede seriously the progress of the work. Considered by themselves, they afford an interesting study in the flow of clay under pressure and in the effect of water on the movement of large masses of earth; but viewed together with the other phases of the work, they appear as an index of the difficulties that had to be overcome in order to construct safely the aqueduct through the 10 miles of summit cut where peat bogs, 6 to 14 ft. deep, covered fine

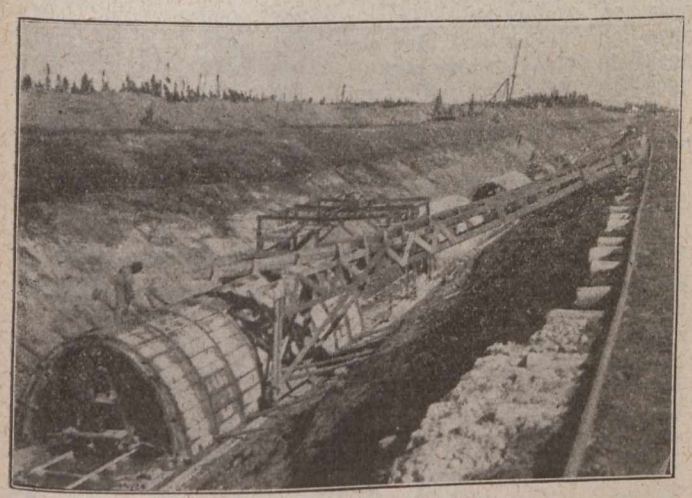


FIG. 1—INDICATING OPERATIONS IN BUILDING AQUEDUCT UNDER NORMAL CONDITIONS

sand, sandy clay and blue clay, which moved readily under comparatively light pressures.

Under normal working conditions, the water of the peat bogs was drained away along the centre line by means of a pilot ditch constructed by the contractor during the first years of his work. The Water District Railway's side-ditches to the south, and protective drainage ditches to the north, of the aqueduct line, also aided in the disposal of surplus surface waters. With the main volume of the water removed by these drains, the contractor's regular program of work was as indicated in Fig. 1.

First, the main trench, about 20 ft. deep, with 16 to 20-ft. base, was excavated with side slopes of 1:1, by means

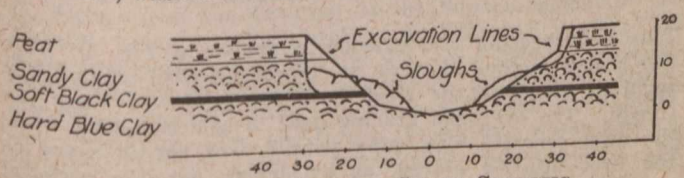


FIG. 2—DIAGRAM SHOWING SMALL SLOUGHS

of a Class No. 24 Bucyrus drag-line excavator, which placed the material removed into spoil banks 75 to 100 ft. on each side of the trench centre line.

With the spoil at such distances, there was ample room on the north for the travelling derrick, which was used to remove the final trimming taken out by hand labor just before the fresh invert concrete was placed; and room

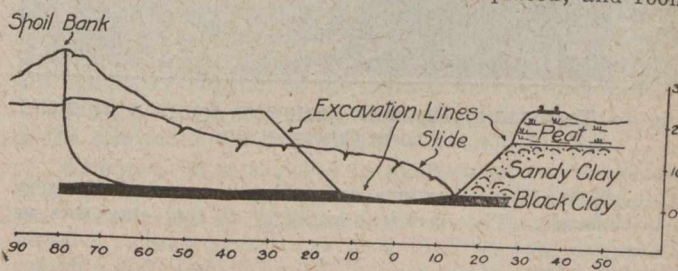


FIG. 3—DIAGRAM SHOWING SLIDE

was also left for the narrow-gauge railway which was used to transport the concrete from a central mixing plant to the forms used for moulding the aqueduct.

Pumps were spaced at intervals, depending upon the quantities of ground water that escaped into the trench, and, by aid of box-drains, kept the foundation in shape for final trimming and permitted the invert concrete to be placed in the dry. The concrete invert, or floor of the structure, was poured in 15-ft. sections, while the arch, or horse-shoe-shaped portion of the concrete pipe, was moulded in

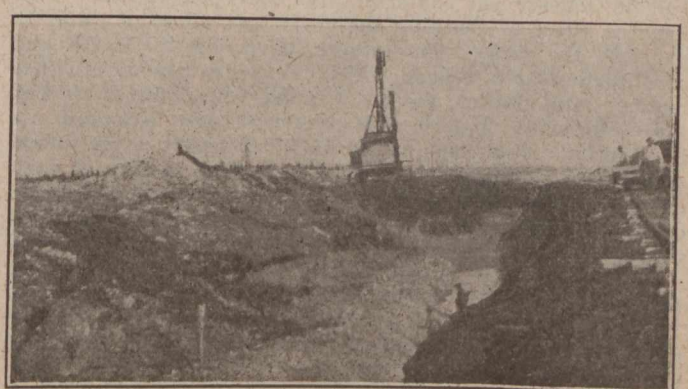


FIG. 4—SLIDE—NOTE SETTLEMENT OF SPOIL BANK

45-ft. lengths by use of steel forms. Reinforcement was placed in the invert where soft foundation was encountered. As soon as the concrete had been properly cured, the pipe was backfilled by the same drag-line that was used for the excavation.

With the spoil divided and placed well back from the trench, with excavation slopes of 1:1, and with drainage, there would appear to have been small possibility of slides; but even these precautions were not sufficient when the soft dark, waxy clay was encountered. This clay varied from a dark black to a pale gray color, depending upon the amount of drying it had received. When in its natural state it was very plastic and soft, but when air-dried it became extremely hard and showed great shrinkage. This stratum of soft clay occurred throughout long stretches of the trench and varied in thickness from 1 ft. to over 50 ft. In some places it occurred 5 or 6 ft. above invert grade, and in other places it occurred at the bottom of the excavation. In such places

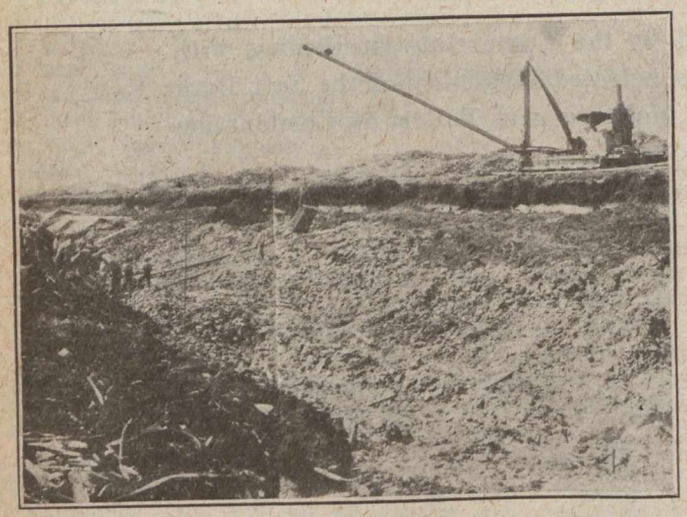


FIG. 5—TRAVELLING DERRICK REMOVING PORTION OF SLIDE ALONG CENTRE LINE

as the latter, heavy inverts and piling were used to carry the structure. The chemical analysis of this clay was as follows:—

Moisture and water of combination ..	15.10%	Chromic oxide	1.40%
Silica	34.75%	Calcium	5.30%
Iron oxide	15.20%	Magnesium	3.25%
Alumina	24.10%	Sulphates	2.90%

The accompanying table gives some bearing tests to show the difference between this soft clay and other materials encountered on the work.

Whenever this clay was encountered, movement of the trench walls took place. These movements varied from local sloughing, as shown by typical example in Fig. 2, to large slides, as shown by typical examples in Figs. 3 and 4. In the latter cases, the spoil bank appeared to settle vertically and to squeeze the material into the open trench. This had the effect of cracking the earth and allowing water to get into the mass. This water lubricated the earth and soon accumulated a head which tended to produce further motion. In addition, the water under a head forced its way into otherwise impermeable material and extended its lubrication. This combination of water pressure and lubrication kept the materials moving from time to time at various rates of speed, depending on the local conditions. As an example of the manner in which this clay transmitted vibration: The drag-line runner dropped a cubic yard of solid clay from a height of 10 ft. above the bottom of the trench, to the north of the structure, which was carried on piles (see Fig. 7). Standing on the opposite bank, 60 ft. away and 18 ft. above, one could feel the jar from the impact of the earth on the trench bottom.

The principal methods employed by the contractor to overcome these slides were:—

1. On the section of trench where the soft clay occurred near the bottom of the trench, and where the structure was carried on piles by use of special inverts, the sliding material was moved far back, an extra width of trench bottom was excavated (see Fig. 7) and the bank was sloped at a flat angle. This removal of the slide, as it were, meant the handling of large quantities of excavation, and later, of backfill.

2. Where firm material lay under the sliding materials, the method adopted was to flatten one slope and remove by the Class No. 24 drag-line such material as it could reach from the opposite side of the slide. This flat slope was allowed to drain and harden by air-drying. Then the final excavation along the centre line was made (as shown by Fig. 5) by means of a travelling derrick and hand labor. This method did not involve the handling of as much earth as did the first method, but it was only successful where the excavation was far ahead of the concrete work.

TABLE 1—BEARING TESTS ON VARIOUS MATERIALS, WINNIPEG AQUEDUCT

Area of pedestal, 36 sq. ins. Weight of pedestal, 121 lbs.

Under "Duration," read 17:16, "seventeen hours and sixteen minutes"; read 0:32, "thirty-two minutes"; etc.

Station	Foundation	Immediate (in feet) Under 3 Bags of Gravel	Immediate (in feet) Under 12 Bags of Gravel	Duration in hrs. and minutes Under 12 Bags of Gravel	Penetration in feet
4623+25	Dark gray clay* ...	.022	.082	17:16	.232
4637+80	Dark gray clay	.000	.013	1:18	.015
4677+50	*Soft dark clay .....*	*.006*	*.997*	*0:32*	*1.057†*
4679+80	*Soft dark clay .....*	*.234*	*.434*	*1:12*	*.966*
4769+25	Sandy clay	.031	.289	17:40	.457
4772+05	*Soft dark clay .....*	*.023*	*1.120‡*	.....	....
4800+00	Sandy clay	.015	.196‖	1:23	.324
4818+00	Bluish clay	.007	.059¶	1:48	.188
4831+50	*Soft dark clay .....*	*.022*	*.902*	*26:47*	*1.074*
4840+90	Blue clay with pebbles	.004	.382	18:32	0.459
4854+00	Blue clay with pebbles	.017	.077	28:35	0.100
4845+40	Blue clay with pebbles	.004	.116	4:40	0.181
5093+00	Yellow clay	.002	.011	17:35	0.036
5087+25	Heavy blue clay	.002	.009**	1:45	0.019
5078+00	Yellow and blue clay	.001	.028	8:32	0.050
5028+30	Grayish blue clay ...	.004	.032	19:53	0.052
5005+18	Blue clay with sand.	.003	.029	16:39	0.033

*Dark gray clay just under the muskeg; had a water-bearing sand stratum below the bottom of the invert.
†Resting on braces.
‡Platform and posts went down to braces before all bags were put on.
‖Water around base of post.
¶Trace of water around the post.
**Under 11 bags of gravel.

3. Pole-sheeting of the trench was used through a section of slide when the drag-lines were busy on other slides.

FIG. 6—SHEETING THROUGH SLIDE

This pole-sheeting and bracing is shown in Fig. 6. This was a slow method of work, as special overhead bracing was required to allow the steel forms to be moved along the trench. The overhead bracing used to hold the slides while the arch concrete was being poured, was not as heavy as the first bracing placed, as by drying out the material near the pole sheeting the pressures were reduced. This

method required the moving of the smallest quantities of earth, but used the maximum amount of common labor.

While these were the three principal methods used by the contractor, various other methods of depositing spoil, draining the trench sides and sloping the side of the trench were tried. Each section of slide had peculiarities of its own and had to be dealt with as sound judgment and experience directed. In some places special heavy inverts were all that was required to hold the earth in check, while nearby the side pressure was sufficient to move piling spaced

FIG. 7—SLIDE SHOWN IN FIG. 4 REMOVED AND AQUEDUCT CONSTRUCTED

at 3-ft. intervals and cross-braced with 12-in. round timbers. Theoretically, water could be held to be the cause of all these slides, as it destroyed the cohesive qualities of the soft clay; its pressure acted as equivalent of millions of jack-screws and it further helped movement by lubrication; but in such cases as these slides, theory was of little use and reliance had to be placed on experience and sound judgment. In the employment of such, the Winnipeg Aqueduct Construction Co. were fortunate in having Wm. Smaill as field superintendent and manager, while the Greater Winnipeg Water District were equally fortunate in having W. G. Chace as chief engineer.

RECENT PUBLICATIONS

MUELLER BRASS GOODS.—Cloth-bound catalogue, 8¼ by 11 ins., 276 pages and cover, printed on coated paper, profusely illustrated; issued by the H. Mueller Manufacturing Co., Ltd., Sarnia, Ont., describing their water, plumbing and gas brass goods.

CONCRETE TANKS FOR INDUSTRIAL PURPOSES.—A 36-page illustrated pamphlet, 6 by 9 ins., published by the Portland Cement Association, illustrating and describing concrete tanks for water, mineral oils, brine, molasses, vegetable and animal oils, tanning liquids, dairy products, chemical solutions, etc.

QUEBEC STREAMS COMMISSION.—Seventh report, covering year 1918; 120 pages and paper cover; 6¾ by 9¾ ins.; illustrated; accompanied by several folded maps anl diagrams. O. Lefebvre, of Montreal, is chief engineer and secretary of the commission. Two of the three commissioners are civil engineers, namely, W. I. Bishop and Arthur Amos. The chairman of the commission, S. N. Parent, is a lawyer.

WROUGHT TUBULAR PRODUCTS.—Catalogue issued by the Page-Hersey Iron, Tube & Lead Co., Ltd., 100 Church St., Toronto; printed in two colors on coated paper; well illustrated; 76 pages and cover, 4½ by 7½ ins. It includes illustrations, weights, dimensions, diagrams and specifications for lap-welded and butt-welded pipe; pipe with flanged joints and bell and spigot; electric line tubular poles, service clamps, well tubing, etc.

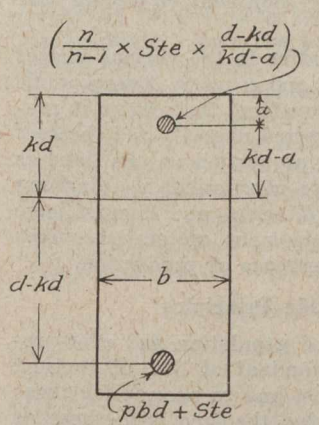
PROVINCE OF SASKATCHEWAN.—Booklet prepared by F. H. Kitto, under the direction of the Superintendent of the Natural Resources and Intelligence Branch, Ottawa; 154 pages and paper cover, 6½ by 9¾ ins. The contents include chapters on historial description, government, transportation, communication, education and religion, climate, soil, agriculture, cities and towns, forests and water powers, minerals, fish and game; illustrated by maps, charts and half-tones.

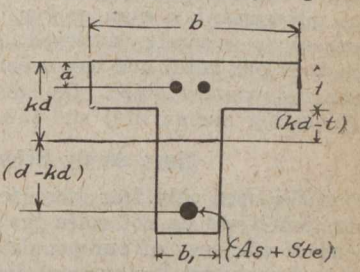
DOUBLY REINFORCED CONCRETE BEAMS

BY E. MONTGOMERY
Regina, Sask.

AT times structural requirements limit the concrete section of a beam and it becomes necessary to add compression steel to enable it to sustain a given bending moment. In such cases the amount of tensile and compressive reinforcement required can be found by the following method.

When compression steel is used, the amount of ordinary tension steel, pbd, is increased by an amount, S_{te}, the first moment of which about the neutral axis is equal to the first moment of the compression steel about that axis. The compression steel can therefore be expressed in terms of the extra tension steel, S_{te}, and *vice versa;* and since the position of the neutral axis in a reinforced concrete section depends only upon the modular ratio and unit working stresses in concrete and steel, when these and the concrete section are given, the position of the neutral axis is fully known.





With the preceding remarks in mind, the theory applied to the solution of the following problem will be clear.

Example.—It is required to reinforce a concrete section 14 by 27 ins. to sustain a bending moment of 1,081,920 inch-lbs. The depth of embedment of both tensile and compressive reinforcement is to be 3 ins.; working stresses in concrete and steel to be 640 lbs. per sq. in., and 16,000 lbs. per sq. in. respectively, and the modular ratio to be 15.

$$I = Mkd/f_c, \text{ or } nM(d-kd)/f_s.$$

Also, $I = b(kd)^3/3+npbd(d-kd)^2+nS_{te}(d-kd)(d-a)$.

For the given stresses and modular ratio, $k = 0.375$ and $p = 0.0075$. Since the effective depth of section is 24 ins., $kd = 9$ ins.; $(d-kd) = 15$ ins.; $(d-a) = 21$ ins.; $pbd = 2.52$ sq. ins.

Substituting and equating:—

$14\times9^3/3+15\times2.52\times15^2+15S_{te}\times15\times21 = 1,081,920\times9/640.$

$\therefore 4,725\ S_{te} = 3,307.5.$

$\therefore S_{te} = 0.7$ sq. in.

$pbd = 2.52$ sq. ins.

$\therefore$ Total tension steel $= 3.22$ sq. ins. and compression steel $= 15/14\times0.7\times15/6 = 1.875$ sq. ins.

In solving for T-beams of given concrete section, the only variation is in the method of computing the amount of ordinary tensile reinforcement. This is done as follows:—

Sum of compressive stresses $= A_cf_c/2 = b_1kdf_c/2+t(b-b_1)[f_c+f_c(kd-t)/kd]\times\frac{1}{2} =$

$$(f_c/2)[b_1kd+t(b-b_1)(2-t/kd)].$$

Casting out $f_c/2$, concrete compression area $= A_c = b_1kd+[t(b-b_1)(2-t/kd)]$. This equation appeared in an article by the writer on page 458 of *The Canadian Engineer* for April 15th, 1915.

Ordinary tension steel $= A_s = A_cf_c/2f_s$.

As before, $I = Mkd/f_c$, or $nM(d-kd)/f_s$.

Also, $I = b(kd)^3/3-(b-b_1)(kd-t)^3/3+nA_s(d-kd)^2+nS_{te}(d-kd)(d-a)$.

The Union of Alberta Municipalities has asked the provincial government to make an investigation of the hydro-electric possibilities of Alberta, with a view to formulating a policy for publicly owned power plants. A resolution to this effect was adopted at the Union's recent convention.

THE PLANNING OF LAND IN RELATION TO MUNICIPAL AND SOCIAL PROBLEMS*

By Thos. Adams
Town Planning Adviser to the Dominion Cabinet

In Canada and the United States the land has been planned, but not scientifically. As a rule, land has been planned on the lines that are easiest, and with little regard to economic use and natural conditions, or on the lines that suit the narrow point of view of the private speculator. We have witnessed the folly of that haphazard and wasteful method; nearly every municipality on this continent is paying the cost of bad planning.

All municipal government centres in the various phases of land development, both in town and country. Every public utility has to obtain its justification from the service it renders to land and improvements erected upon it; and the cost of government is high or low in proportion as the land is wisely or unwisely developed. We need scientific planning in both our rural and our urban districts, and it must have for its primary object the development of our resources (including human life) and the increase of production.

Must Apply Scientific Principles

We need only fear increase of population and over-production if we do not raise the standard of life, of comfort and of efficiency of our population, and to accomplish these things we must lay out and develop the land with these as the main purposes in view.

If we desire to increase wealth, we must apply scientific principles to the planning of the future growth of our cities, towns, villages, rural townships and metropolitan regions comprising portions of each,—so as to increase the productive use of land, lessen the burden of taxation caused by unproductive utilities, create better facilities for carrying on industries (including improved methods of transportation) and promote public health and more agreeable conditions of life for the citizens.

The art of city, town and rural planning is in its infancy, and the scientific data required to afford guidance to the planner is very inadequate. Whatever need there may be for planning, the greater need at the moment is the determination of the right principles on which planning should be carried out and the discovery of the rational order of things to be dealt with in the plan. In other words, city and town planning has to follow the true logical order, and be developed to a greater extent as a science before it can take its rightful place as an art. Investigation, by means of observation and experiment, to discover facts and their mutual relations, must precede all creative work in connection with any reform of our social conditions.

Character of Suitable Areas

We must have a constructive social outlook to which to work, and acquire adequate knowledge of the underlying conditions on which to build up our plans before we start to prepare them. The objective we should aim to reach is the development of a healthy and efficient social and industrial organization which will give us the maximum of production coupled with the highest degree of equality of opportunity. With regard to the methods of acquiring knowledge, we must recognize that we have to deal with a combination of physical and social conditions that overlap at every point. We have to make a survey of both these sets of conditions, and before we do so we must determine the character of the areas that are best adapted both for the preliminary study and for subsequent plans.

Our political units are divided into three main groups,—national, provincial or state, and local. These divisions are arbitrary and are not always best adapted for planning. For instance, in the Niagara region, the planning of future industrial growth is international, in Kansas it is inter-state, and in nearly every city it is inter-municipal or metropolitan.

Manufacturing industry is ceasing less and less to be influenced by city boundaries, and on the other hand the necessary relationship between manufacture and agriculture compels attention to the overlapping problems on both sides of the boundaries of every city and town and creates regional problems. Perhaps the worst housing problem in America is to be found in the "buffer" area, or "no man's land," that lies just over the boundaries of the cities. Something must be done to bring about the co-operative action of adjacent local authorities to deal with this problem.

To plan properly and control industrial and residential areas we have, therefore, to introduce a new geographical unit, namely, the regional area. The Niagara district is such an area, so also are the metropolitan areas of Greater London, Greater New York, Greater Montreal and Greater Boston. The study and comprehensive planning of these regional areas is one of the most pressing of our social needs, and should precede the planning of the local incorporated areas within them.

The division of areas might be given as: (1) National or federal; (2) provincial or state; (3) regional, i.e. any combination of incorporated local areas, or parts of such areas, forming an industrial region; (4) incorporated local (urban or rural), e.g. city, town, village or county area.

National and Provincial Plans

What has been called "nation planning" is incomprehensible in the sense in which we use the term "city planning." You cannot plan a nation, nor yet a state or province in any detail. But there are certain things both in the nation and state or province that should be dealt with from the comprehensive point of view of a central authority.

It should be a rule never to do anything by a centralized form of government that can be efficiently dealt with by a local form of government. The local government authority in a free commonwealth should have the maximum of power and responsibility consistent with efficiency. Granted that this is true, we recognize that the sphere for national or state planning must be very limited. The character and scope of the national operations will depend on the character and scope of the national jurisdiction.

In Canada the federal government has different powers and duties from those of the federal government of the United States, and what I have to say in respect of the former will not apply in detail to the latter,—although the general principles will be applicable to both.

The question may be asked whether the limited scope of planning available to our federal and state or provincial governments is not amply provided for in our political organization. The answer is in the affirmative, so far as power to deal with the matter is concerned. In the exercise of that power, however, the political measures of our central governments in relation to the development of land are not directed with proper care towards the object of the public welfare and are not preceded to a sufficient extent by scientific investigation.

Limits of Governmental Knowledge

This does not question the intentions of governments, but indicates their self-imposed limits of knowledge of the problem as a comprehensive whole.

We have good departmental heads, and experts are employed under them to investigate social problems in compartments within the powers granted by political parties. But too frequently we introduce political measures, and set up administrative machinery to deal with social problems on the basis of isolated examples instead of on the basis of scientific investigation of facts and conditions.

The function of the federal government should be to investigate the broad national aspects of the problems of land development, industrial location, health and transportation. We have our departments available to deal with these prob-

*Excerpts from paper read November 14th, 1919, before the American Society for Municipal Improvements, at New Orleans, La.

lems but more co-ordination and constructive planning is needed. The four things that come directly within the purview of the federal government are:—

(1) Preparation of topographical maps; (2) waterways, railways and main highways; (3) subdivision of areas in undeveloped territory, and land settlement in connection with such areas; (4) co-ordination of provincial schemes of land settlement, railway extension and highway improvement.

Need for Topographical Maps

We greatly need accurate topographical maps in Canada. The gain to local authorities by having such maps would be enormous. Every structure, field and fence and the physical conditions and levels of the land have been accurately mapped in Britain. The result is that local authorities are saved the expense of local surveys to ascertain existing conditions, and to enable them to carry out local improvements economically. Only national governments can adequately undertake that work. Canada and the United States are so large and scattered that the preparation of complete topographical maps could only be undertaken gradually, but it should be undertaken in respect of large extents of area—especially those that are well populated—without delay.

We have effective means of controlling the working of our waterways and railways, but no constructive policy of directing new extensions as a part of a national scheme of development. The interest of the community needs to be safeguarded to a greater extent in connection with the planning of railway enterprises.

We are giving large sums from our federal government for highway construction, but need to keep in mind that the chief interest of the federal government in good roads is in co-ordinating and assisting the provincial schemes of main highways so as to form the skeleton of a national scheme.

The federal government has a direct interest in controlling water powers and directing commerce, and, therefore, in the establishment of new centres of industry. In Canada it owns large sections of unorganized territory and is responsible for the planning of that territory for settlement. In its control of immigration it should have regard to future development according to plans as well as to existing needs.

Scope of Federal Planning

In federal planning we should deal only with the applications of definite principles to matters affecting the country as a whole, such as those I have mentioned. In state or provincial matters the federal authorities should, by consent, help to co-ordinate state functions and schemes, and always be available as a fountain-head of expert advice. To enable it to discharge that duty we need national surveys of existing conditions, such as were advocated in the United States by the Country Life Commission of the late President Roosevelt, and these surveys should include accurate topographical maps on a workable scale.

There should be set up a federal bureau of planning and development to carry out investigations and provide co-ordinating and advisory services. Only such a body could afford to subsidize investigations that go beyond what is of immediate practical utility, and only a government that will go beyond that stage will accomplish greater progress than other governments. In the domain of physical science little progress would have been made if men like Newton had restricted their work to what was of immediate practical utility; but still the "practical" man fails to see that he is deriving his success from the scientific work of those former days and only in a lesser degree from his own organizing ability.

The planning of the state or province follows the general lines of the planning of the nation. It does not get down to details, and should not interfere with local discretion. In all matters already referred to, it can supplement the work of the nation. It should have its state or provincial bureau to act in concert with the federal bureau in preparing topographical maps and surveys; planning waterway, railway and highway extensions and deviations; and planning new territory for permanent settlement. It must, however, go further, without encroaching on the rights of incorporated local authorities.

The state or province is the legislative authority in connection with matters of dispute between municipalities. In Canada the province is the court of appeal in connection with extensions of municipal boundaries. Again, when the rights of owners of property come in conflict with public or local government rights, the power of settlement rests with the state. To develop a proper town-planning policy, you must have co-operation between adjacent local authorities; means of bringing together urban and rural authorities to control properly the "buffer" areas between them; and means of maintaining a balance, in the interests of public welfare and freedom of contracts, between public and private interests in property. Here the power and value of the state or province are supreme.

Moreover, the application of a uniform code of by-laws or ordinances in regard to city and country planning is essential and can only be achieved by state legislation. Subject to state or provincial planning laws that determine the procedure and general principles to be followed in local schemes, especially in regard to the matters of over-lapping jurisdiction and rights of eminent domain, the power of the municipality should be supreme.

Regional and Town Planning

The federal bureau, as an advisory body and the directing agency in regard to topographical maps and inter-state or interprovincial means of communication, and the state or provincial planning and development boards operating under state or provincial planning laws to co-ordinate local schemes and regulate legal procedure, give us the centralized machinery we need. To be effective, each such machine would have to include a skilled director of planning and development to give his whole time to administration, and especially to give aid to the councils of the smaller local authorities.

We now come to consider the local work and machinery, and this brings us in contact with the real work of planning, which must always be dealt with by the local unit of administration. The local units will be incorporated areas except where regional schemes are necessary, and the surveying and planning of areas must be dealt with by joint boards representative of adjacent incorporated areas, in co-operation with the several local councils within the region.

As an example I might cite the regional area comprising five cities and towns known as the Border Cities and a portion of a country area in southwestern Ontario. These cities and towns are growing up side by side, serving the same industrial needs; unable to deal effectively with their public utilities except by co-operation; having a system of transportation and natural conditions that disregard incorporated boundaries; and all lacking control over the sanitary and industrial conditions overflowing their boundaries.

Essex Border Utilities Commission

The best way to illustrate the respective character of regional and town planning schemes is to describe the kind of scheme suggested by the Federal Office of Town Planning for this area. These five authorities have a Border Cities Utilities Commission which exercises some control over their public services. It is proposed that this commission should prepare a regional survey and plan for an area comprising the whole areas of the five cities and towns, and such part of the rural area outside as may be affected by their future growth. This regional survey and map would provide an exhibit of all existing conditions—physical, industrial, means of communication, buildings, local improvements, land values, etc. We thus get the essential foundation on which to plan.

The commission, having secured the survey and map, goes further and suggests the skeleton plan for dealing with the future growth of industry, transportation, residences, park areas, etc. This is only a tentative and skeleton plan of the region and is confined to main features which are common to the six authorities. It binds no one authority and conforms to no definite legal requirement.

When the regional survey and plan is completed, the next step has to be taken by each of the local councils. These

will have before them the town-planning laws of the province, setting out the procedure and confirming the necessary powers to secure proper sanitary conditions, convenience in relation to streets, and air space around buildings; and laying down the legal procedure. They will also have the regional plan, giving accurate details of existing conditions and indicating the matters that affect the neighboring authorities. On this basis, and with this information, they can proceed to prepare a detailed plan for each of their several areas, covering all matters they regard as necessary and special to themselves.

That is one variety of regional planning. There are many other varieties. There are cases like Calgary, Alta., where the city has an area of 24,000 acres for a city of 60,000 people. Here the regional plan is restricted to the incorporated city area, and within it provision is made for industrial, residential and agricultural development. Assessment is graded to suit the different purposes for which land can be used, and public utilities are confined to the parts of the area to be built upon before other parts are permitted to be developed.

The Niagara region is much greater in size and covers all the area in both Canada and the United States affected by the industrial development contingent on the power facilities obtained from Niagara Falls.

Coal mining areas are suitable for regional planning.

We thus see that the regional survey and skeleton plan must precede the city or town plan to get satisfactory schemes carried out.

This paper is of necessity a brief and general introduction to a great subject. It deals with only the outline of the principles that need attention to get more desirable forms of administration and control of land development. One or two arguments in favor of the co-operative action of municipalities under central guidance may be given in conclusion.

We are face to face with the fact that established industries all over this continent are leaving the cities and migrating to semi-rural districts, and that new plants are being erected to a greater extent in the semi-rural areas than in the crowded centres of cities. This tendency suggests two things:—

Frst, that the cities which are losing their industries and revenues should consider how to prevent future disintegration; and second, how to plan the suburban development around cities so as to prevent the recurrence of evils that have caused the dispersal of industries from the existing centres.

Industrial Centres Becoming Congested

It is largely a matter of land development, as the causes of the dispersal are associated with the dearness of land, the opportunities for expansion at reasonable cost, the facilities for transportation over the land, and the planning of residential areas suitable for housing close to the plants.

The proper control of land development is needed to prevent undue density of building in parts of our cities and undue scattering of buildings in other parts. Congestion has reached a point in most large cities where it has become impossible to carry on business with dispatch and efficiency, and where public utilities are strained beyond their capacity and causing severe losses to local authorities.

The scattering of residences and factories over our suburban areas, with the greater intervening areas of vacant lots, served by unproductive public utilities, has the same effect from a different set of causes. As cities grow, the costs of administration increase instead of decrease; transportation, while becoming more centralized, instead of being more economical, becomes more costly; and all the advantages of better sanitary conditions are lost because of lack of air space around the buildings.

The growing cost of food is not entirely due to war conditions. It is partly caused by the growing tendency to divide the city from the country and to create a cleavage between them as if their interests were not dependent on co-operation between the two. One of the biggest blunders on the American continent has been the encouragement of a system of land speculation that has sterilized the use of land in the suburbs of our cities. Tens of thousands of acres are lying idle waiting for buildings that will not come for generations, and producing no food at the door of the consumers.

These conditions need urgent attention if for no other reason than that most of our cities and towns are facing financial problems that will tax the wit of man to solve in the near future. Altering of the system of taxation will have no permanent effect if we do not control the development of land and the social forces of industry by adequate and comprehensive schemes of planning.

Summary

1. All land should be planned with the definite object of securing health, convenience and amenity in connection with industry and residence, and not for any object of speculation.

2. Scientific investigation of regions and municipal areas should precede the preparation of city and country planning schemes. We need to know more of the facts and their mutual relations before we employ the art of the regional or city planner.

3. The division of areas requiring consideration are: (1) National or federal; (2) provincial or state; (3) regional; (4) incorporated local.

4. National surveys and plans should deal with broad national and state aspects of development, such as preparation of topographical maps; planning of waterways, railways and national and state highways; and co-ordination of provincial or state schemes. The national organization should be largely advisory. The state scheme should supplement the federal schemes, and state law should set forth the procedure to be followed in connection with schemes for regional areas and incorporated local areas, and make provision for co-operation of adjacent municipalities and for dealing with conflicting public and private interests in property. A state or provincial planning and development board should be formed in each state or province.

5. Many industrial, mining and other areas are growing up without regard to incorporated boundaries and need to be surveyed and planned in regional units by co-operative action of the several authorities within them. Surveys and skeleton plans of these regions should be prepared in advance of city or town-planning schemes. A joint board, representative of the local authorities, should prepare the regional survey and skeleton plan.

6. The definite detailed plan should be prepared only by the incorporated local authorities, subject to consideration of the broad national and state aspects of the problem and to the regional aspects and conditions as revealed by the regional survey and plan. This local plan should fix the industrial and residential zones; deal with sanitary provisions, air space, convenience, local problems of transportation and amenity; and anticipate future growth for forty or fifty years. A local board, or commission, should give constant study to the planning of the incorporated area and to the execution of the plan, subject to control of the expenditure by the elected council having jurisdiction over the area.

7. Finally, the solution of our social problems and the proper development of our municipal improvements cannot be obtained by the mere art of planning, but by scientific investigation followed by plans based on sound economic principles and prepared with due regard to the ideals that should inspire every community that seeks to follow the path of real progress.

According to a report made recently to the city council of Peterboro, Ont., $116,618 has been spent to date on the Hunter street bridge, which is now being constructed.

Toronto's citizens will vote January 1st on the by-law providing for the guarantee of $4,328,665, Toronto's share of the $8,360,794 which the "Hydro" radial from Toronto to Bowmanville will cost according to the estimates made by the Hydro-Electric Power Commission of Ontario.

SANITATION AND MUNICIPAL DEATH RATES*

By George A. Soper
Major, Sanitary Corps, United States Army

By sanitation is meant that branch of systematic health work which requires plant and a force to maintain it. Examples are works for the procurement and distribution of wholesome drinking water; the collection and disposal of liquid sewage; and the gathering and final disposition of kitchen waste, ashes and other discarded material. These are obviously sanitary undertakings but the list of improvements which go to make a city sanitary does not end here. Broad, well-paved market places; suitable playgrounds; bright, well ventilated schoolhouses; in short, whatever the city has in the way of plant which goes to prevent the injuries to health which result from too densely segregated masses of people, might properly be comprised under the head of sanitation; but in everyday parlance they are not so included.

Sanitation and Disease

Yielding to works of sanitation are not only typhoid, dysentery and other diarrheal diseases, but many other forms of sickness. To introduce a public supply of pure water in place of a polluted one, or to build sewerage in a town which has had no good way of disposing of excrement, is to reduce the prevalence of nearly every disease from which men suffer and die. Nothing that can be done is so certain to lessen the death rate.

Sanitary works possess a number of advantages as compared with other measures for the prevention of disease. For one thing, they do not require as high a degree of skill in their administration as do boards of health. For another, they have an advantage over personal precautions in not being individual in application and unco-ordinated in action. Sanitary works have a wholesome application. A water supply which is pure is wholesome for every person who has occasion to use it. The street that is well paved and kept clean is of advantage to every one who travels over it by vehicle or foot. And sanitary works do not hide their merits under a bushel. Their good effects are in plain sight —a constant recommendation of the good sense of those who are responsible for the welfare of the community.

Beginning of Municipal Sanitation

From the first, sanitation has been a feature of many American cities. Sanitation, although long delayed, when it came, came like a revolution to the continental cities of Europe. The beginnings of municipal sanitation everywhere are due to European initiative. Public water supplies, as we know them to-day, and sewers to carry away the most offensive and dangerous part of a city's filth, are recent European contrivances. Street lighting, good pavements, adequate transportation, tenement house reforms, the construction of parks and playgrounds, the regulation of vehicular travel and street paving and cleaning have been developed more recently. The American city which ignores foreign practice in these directions fails to take account of experience which can save it a great deal of money.

The sanitary regeneration which European cities have experienced has had no counterpart in the United States. There has been no necessity for such revolutionary changes. American cities were small when the world began to learn that sanitation was an indispensable feature of every municipality. There was never such over-crowding, such slums to clean, such foci of filth to clear up and eliminate, as existed abroad half a century ago. In 1860 there were only 16 cities in the United States with a population of 50,000 or more, as against 148 in Europe.

Municipal Growth in America

The significant feature of municipal growth in America as compared with that in Europe has been less the reconstruction of cities already large than the construction of a great number of small cities. Hundreds of these have passed and are now passing through their periods of infancy, youth and adolescense toward a maturity which foreign cities attained long ago. Their sanitation takes place as they grow.

Water Supply Comes First

The first important sanitary improvement to be made in the growing village is the public water supply. This leads to the use of water closets and, to accommodate the drainage from these, cess-pools are built. The privies, the original provision for the disposal of excrement, are then eliminated. Street pavements are presently considered and the cleaning of the pavement and the collection of house refuse by municipal effort follow. At first garbage is collected by scavengers at the private expense of the householders; later it is done at public expense. The young city may now be said to have passed through its period of infancy and entered that of youth.

A sewerage system is built later in the city's growth. During this period the houses are gradually built closer to one another and in a more permanent form of construction until they stand in a compact mass. More attention is given now to pavements and to the cleaning of them. Parks are laid out, lighting is improved, ordinances are passed regulating many sanitary matters. The city has now reached its period of adolescence.

The period of maturity, that is, the period in which civic responsibility begins fully to express itself, comes last. The regulation of building construction, the control of traffic and the adoption of far-sighted plans to insure public health and safety are often taken up at this time. They should have been considered at a much earlier period.

Business Men the Leaders

It is instructive to observe how often it is that a community owes its sanitary improvements to its business men. It might be supposed that the principles of sanitation were more within the grasp of professional men than of those whose attention was chiefly occupied with manufacture and trade, and that doctors and lawyers and ministers would be foremost to see that the health and welfare of the public were properly looked after. This is not, however, always the fact. There is no disposition to belittle the help which professional men can give, but an experience in public work which covers many years and extends over many cities and states shows that when it comes to municipal improvements, it is the commercial element which usually exercises both the initiating and sustaining influence.

The explanation of this is simple enough. The general subject of sanitation is not so complicated as to be the exclusive province of any class or profession. Certainly the need of sanitation and the benefits of it can be understood by every intelligent person. Business men are accustomed to weigh returns against expenditures and readily appreciate that sanitation is a sound investment. Moreover, they are accustomed to action and when they get together to obtain action for the public welfare they are apt to get it.

Technical Advice is Essential

Often the important thing to know is what to do in order to improve the sanitation of a city. Why is the death rate high? What should be done to reduce it under the particular circumstances which exist? In answering these questions many technical and financial details may have to be considered. This is properly the work of experts. An unprejudiced expert should be called on to make a report based on a study of the local situation and on a knowledge of what other cities have done and are doing under similar circumstances. This report should serve as a program behind which the solid, common sense of the municipality can array itself.

When a city needs a health program, as every city does, the best way to get it is for the business men to demand it of the municipal administration through their commercial organizations. If the municipality does not possess the talent for the work, an expert should be called in from out-

*From a paper presented at the second Pan-American Commercial Conference.

side. In many cases commercial organizations have themselves employed experts to make investigations and reports to serve as a guide to the citizens in demanding what is proper.

Health Should Determine Appropriations

The question is often asked, what can a city afford to spend for sanitation? The answer is that it can afford to spend whatever is necessary in order to make it healthy. If it is already healthy, it need spend but little; if it is unhealthy, it must, of course, spend more. A city, like a man, must have health if it is fully to realize its possibilities. Epidemics paralyze business, and a high death rate is a reflection upon the good business sense of a community. In many cases, investments for sanitation should be looked upon as policies.

Every city and every village ought to have a program of development, a plan to which to build, a settled scheme of construction to which to refer details. This program should be prepared early in order to keep the growth properly proportioned and prevent the excessive development of some relatively unimportant features at the sacrifice of the essential. Paramount in such a scheme should be suitable provisions for health.

Maintenance Charges Not Excessive

Although a considerable investment of capital has to be put into sanitary works, the maintenance charges are not excessive as compared with the administrative costs of hand labor, which is often used as a substitute to accomplish the same result. It must not be expected, however, that good sanitary works can be built or that they can be effectively operated without care. Skill and attention in design and construction and operation are indispensable to the best results.

Among the 219 cities of 30,000 or more population in the United States, for every $10 put out each year for all purposes of administrative effort, $1.10 on the average is expended for health and sanitation. The amount varies among the different cities, according to the natural advantages of the site with reference to water supply, drainage, kind of population and commercial and industrial conditions, and according to th foresight and business ability with which the work is planned and carried out. The percentage of the total yearly expenditure which is devoted to health and sanitation sometimes runs as high as twice the figure stated, and occasionally falls to about one-half of it. The size of the city does not affect the percentage.

The Provincial Builders and Supply Association of Ontario will hold its next annual meeting during the first week of February. The president of the Association is Herbert Elgie, Toronto.

The 1919 membership drive, which will be held by the American Association of Engineers during the first two weeks in December, has as its slogan "10,000 members in 13 days." All of the 90 clubs and chapters of the association are making final arrangements for the drive. Never in the history of engineering organizations has anyone ever before proposed such a great increase in membership within such a brief period.

The Associated Manufacturers of Water Purifying Equipment has now become a permanent organization, and will hold a meeting this month in Omaha, Neb. Although the organization was primarily formed for the purpose of securing necessary priority orders during the war, it will now continue largely for the purpose of taking up work in standardization of equipment sizes, of guarantees to customers and of terms of sales. The officers of the association are: Chairman, F. B. Leopold, Pittsburgh Filter Mfg. Co.; vice-chairman, Arthur M. Crane, New York Continental Jewell Filtration Co.; secretary, H. G. Tate, Borromite Co. of America.

WIDENING RADIUS FOR ELECTRIC POWER*

Transmission Over Lines Exceeding Three Hundred Miles Is Now Commercially Feasible at 220,000 Volts, Making Distant Waterfalls More Valuable

RECENT achievements are increasing the distances of economical transmission of electric energy. In long-distance transmission of electricity high pressures or voltages are required—the higher the voltage, the lower the losses. For several years after long-distance transmission had been introduced, it was the practice to allow a pressure of approximately 1,000 volts per mile. It was found, however, particularly with distances of over 100 miles, that the distance allowed could be increased to as much as two miles per 1,000 volts. In other words, lines operating at about 100,000 volts pressure have been transmitting energy over distances exceeding 200 miles. More recently, lines operating at 150,000 volts have demonstrated their practicability; one of these has been in successful operation for over five years.

Now electrical engineers are of the opinion that pressures of 220,000 volts are quite feasible, and it is stated that "the handling of electrical potentials of 220,000 volts does not appear to involve any disturbing complications or uncertainties. In fact, the manufacturers do not recognize that any serious problem exists. Current design principles and materials now in ordinary use will be employed, the principal difference from present high voltage equipment being the greater amounts of insulation and the larger clearances required. The step to 220,000 volts is relatively no greater than that previously taken from 66,000 volts to 110,000 volts or from 110,000 volts to 150,000 volts. Certain of the manufacturers have already developed designs, and assert readiness to undertake the commercial production of 220,000-volt equipment on short notice."

The advantages of long-distance transmission are of particular interest to Canada, where much of our water-power is found in large units, and, to reach many consumers, it may be necessary to transmit the energy for a considerable distance. It is perhaps of greatest interest in connection with our abundant water-powers in the River St. Lawrence and in the area lying to the north of the settled regions of the prairie provinces. It brings us closer to the possibility of making these vast stores of energy available within the settled portions.

In Saskatchewan, for instance, the power sites of the Churchill river are only some 250 miles from Saskatoon and 350 miles from Regina. The transmission of energy over these distances would be quite feasible at 220,000 volts, and economically possible when the demand of the entire district reaches a high enough figure.

*From "Conservation."

Armstrong Bros. Tool Co., of Chicago, are making extensive additions to their plant, buildings and equipment. The new buildings include an addition to the drop forge department, a new building for the hardening and heat treating department, and a new reinforced concrete building for the general office, finished stock and shipping department.

Among the speakers on the program for the Great Waterways Conference, which was held last Tuesday and Wednesday, November 18th and 19th, at Windsor, Ont., were E. L. Cousins, chief engineer and general manager of the Toronto Harbor Commission; Sir Adam Beck; and W. M. German, of Welland. Mr. Cousins was scheduled to speak upon the canalization of the St. Lawrence River and what it means to Great Lakes points. The subject of Mr. German's address was "Enlargement of the Canal System Between Lake Ontario and Montreal." O. E. Fleming and Alex. Simmers were expected to lead a discussion upon the advisability of forming a Canadian Inland Waterways Association.

TOWN PLANNING, WITH SPECIAL REFERENCE TO OTTAWA

By Noulan Cauchon
Consulting Engineer and Town Planner, Ottawa

(Continued from last week's issue)

It is the intention that both sides of the Rideau river and the Rideau canal shall be a parkway extending out beyond the limits of the city. That is coming; it is simply a question of time. The Rideau canal property is government property; it has been handed over to the Ottawa Improvement Commission with a view to their improving it so far as their funds will allow. Unfortunately the funds are largely tied up in fixed charges, so we cannot expect very much new work until the government helps us. Of course, I am looking at this thing not so much from the local point of view; if this city is to be worthy of being the capital of Canada, any accomplishments in that direction should be the result of the effort of the whole country. As a matter of fact, the only thing here that is truly "capital" is the Parliament Buildings site; on those grounds you cannot run in and do anything without the Dominion police nabbing you. Theoretically, then, the capital is confined to the Parliament grounds and the federal property along the canal.

Dominion Park near Ottawa

There is a very fine mountain range north of the city and not far from it. It was suggested some years ago by Mr. Macoun that this be made a Dominion Park, and that is a splendid suggestion; it is incorporated in the "plan." If that was made a Dominion Park like Banff, people could live there, under proper restrictions, because it is brought right to the door of the city.

I have advocated that the railroads, after they pass through the tunnel, should take the river's edge and eliminate also the barrier which in time will grow up on the present Canadian Pacific Railway tracks. Because that may be ten, fifteen or twenty years off is no reason why this trackage should be left there until it becomes just as objectionable as any other of its kind. The general principle is this: Whatever your barriers may be, you have to go across them or underneath them or over them; get as many of them together as you can, therefore, and thus simplify the problem of dealing with them.

I do not admit that a railway cannot be made a thing of beauty. A proper railway embankment, well planted and kept in good order, carrying the passengers along where they can see the scenery, is just as much a contribution to beautification as is a great boulevard. Why do we build paved roads all over the country? We have visitors who come here who are fortunate enough to be able to ride around in automobiles and see our beautiful parks. But why should we not enable the thousands who travel in trains to get the same impression of this country, of this city, or of any city in America? Why should the only impression we give the stranger who travels on trains be the one that he receives from looking at our back yards and clothes lines? I want the railway to be on a boulevard, so that the thousands of people who travel here on trains will get the same impression as the man who is fortunate enough to be able to go round and view the scenery in an automobile.

Scenery for Railway Passengers

I was in Niagara Falls, N.Y., the other day, at the invitation of the Chamber of Commerce, and I was talking with some of the members of the Michigan Central line on the Canadian side, at Falls View. I said: "By all means preserve that view for the train." They thought it rather funny, and I said, "More people will travel in trains over that line than ever travel on your roads; by all means let the railroads exhibit to the passengers as many of the beauties of Niagara Falls as possible." We make beautiful railway coaches, do we not? I am interested in this because it seems to be ingrained in the public mind that a railroad is something that is objectionable. I repeat that in principle it is one of the finest things we have; it is simply a matter of treating it properly.

The question of industrial development in Ottawa is a big one. A good many people have the idea that you cannot have industrial development and still keep the city a beautiful place to live in. I think that is another popular fallacy. You cannot have a house without a kitchen, and the kitchen is just as useful and may be just as beautiful as the parlor. But if you put the kitchen stove in the parlor and the piano in the kitchen, you have the mix-up that is characteristic of most of our cities in their civic housekeeping. It is exemplified here just as it is elsewhere. Any professor of physics will tell you that the prevailing winds on the northern half of this continent are from the west and northwest; therefore put your industrial development on the east side of your cities. I tried once or twice to reform the world, but it didn't work as fast as I thought it might. However, perhaps it is a matter of time.

Residential and Industrial City

There is nothing to prevent the development of the capital on perfect lines as a residence city and also on perfect lines as an industrial city, provided each is put in its proper place. You cannot get along without industries; they are the maintenance of life; they are the sinews of life; but they should be put in the right place.

My proposal is that all the industries should be east of the city. Of course, the question of local transportation comes in; there is the question of the canal. I got into the same trouble here a few years ago that I got into at Niagara Falls by telling the Chamber of Commerce this: "I do not know what your opinion of small canals is, but my opinion of the small canal is that anything that will not carry an eight or ten thousand ton boat is an economic absurdity."

The Buffalo papers put a two-column heading over the statement of mine that the Erie canal ought to be turned to account as an irrigation ditch. I don't know whom they were hitting at, but it is a fact that canals are an economic absurdity if they are not deep water canals and cannot carry heavy tonnage.

The Rideau canal is a beautiful streak of water through the city, but it is nothing but an open sewer, and I am in favor of removing it. I would like to see the bed of the canal used for a fast radial railroad, so that people could get from the country into the heart of the city in as few minutes as possible. The average time a man will take to go to his work is half an hour—or perhaps I should say the maximum time, for if he is faced with the alternative of living more than half an hour away from his work he will, as a matter of psychology, accept objectionable conditions in the city rather than do that. So the greater the extent to which you can get your people out of the centre of the city and into the surrounding districts within half an hour, the greater will be the area of land made available for homes.

Reducing the Home's Overhead

The great principle that we are seeking in this matter of town planning is to keep down the capitalization of the home. I believe the time will come when the providing of housing will not be, as it is now, an emergency proposition; I believe that it will be the proper function of civic government to provide houses at cost. In other words, all increment will be cut out. You can tax a man in proportion to the money that he is making, but you should not diminish the efficiency of the home. You should not much tax that which is non-productive; it seems to me that that is plain common sense. You should eliminate all taxation possible from the home.

In many cities in Canada the business area, the earning section, is very much under-assessed as compared with the homes. In fact, any laxity in assessment upon the business or earning propositions is naturally going to be doubled back upon the homes. The tax rate is limited by law, and when they get to the limit and find that they need still greater revenue, they raise the assessment. But assessment should be applicable relatively only to productive sources.

The only source of wealth is production—work; you can't take taxes out of a churn like butter; they have to be produced each year, and if you pound them out of the home you reduce the individual and national efficiency.

There is the question of the plaza, or the civic centre. Personally I favor a large, somewhat triangular centre which would couple up with the parliament grounds and give us a large open space; but the development pictured on the plan, built on great piers, would be rather costly. My proposal is that the through railroad tracks should go down on the west side of the canal to the tunnel under Wellington street south of the post office. In the Commission's plan which was submitted to the government, the tracks go through the bottom of the station, circle through the foundations of the plaza and go into the tunnel at the north side of the post office.

Going on the north side instead of the south side does not affect the post office, but going through under the station and under the plaza, means that you cannot have a clearance for your boats in the canal. A 33-ft. clearance is required, and the proposal involved in this is to start from the third lock and carry that canal through in a great canyon, rebuilding the locks a good deal south of the station. This involves a difference in cost of from two to four million dollars, that is all!—just enough to block an ordinary scheme. A few millions does not count in war time, but when you come to get it from a government or city council in time of peace, it is quite a different matter.

The tunnel proposal, I think, has been accepted by everybody. Those who think that a railroad is objectionable could wish it in no better place than underground, so they could not complain if that were done.

Criticism of Public Buildings

There is the question of the great public buildings here, the parliament buildings. The proposals so far submitted to the government for any disposition of ground along Wellington street do not seem satisfactory; it has been acknowledged that the plans which were earlier submitted were not satisfactory. One thing that I have pointed out is that the heating plant for the new parliament buildings has been placed in the centre of the area previously set aside for the new departmental buildings. Without going into the economics of putting your heating plant 3,000 ft. away from the building which is to be heated, how they are going to disguise the chimney I do not know; personally, I would blow it down without a moment's hesitation. No architect nor anybody else has a right to put his heating plant plunk in the middle of what we had hoped, and understood, to be the site in the future of a great set of departmental buildings. A chimney out of place is not a thing of beauty.

The plans of the proposed public buildings, therefore contain certain things which are not up to date. Those who have studied "sunlight engineering," as it is coming to be called, know that it is essential to health and efficiency that sunlight should penetrate at some time of the day to the base of all walls and into rooms. Here is one of the finest sites in America. Buildings are proposed here with triangular courts to the base of which the sun could not reach by any kink in the zenith. The building that the government recently put up on Queen street—I have been told that it is modelled after something up to date in Chicago or somewhere else—contains a well into which the sun cannot penetrate. This well is said to be 100 by about 50 ft. But the size is not the point; I do not care how big it is; if the sun does not go to the bottom, it is not right.

Sunlight and Office Buildings

I urged in the first place that the building be not put where it is. It was the first public building which had been put up after the submission of the plans and should be in all respects an integral part of a larger plan; and I submitted that if it was not erected on Wellington street it should at least be on Sussex street. That was my first objection; the other point of view was this: I said, "If you will not put the building anywhere else, at least open up the south side of it into a court so that the sun will penetrate into it." They did not do it; they thought it was not economical. I say that in the long run they will find that it is far from being economical to exclude the sunlight. The rays of the sun are the ultimate source of all energy on this planet. The sun is the principle of life, and if you keep it out of your buildings, I care not whether you pave them with marble or roof them with gold like the Buddhist temples, the occupants will suffer.

To the extent that sunlight is excluded, to that extent the people will be less efficient and have less vitality. There are fundamental principles of organic life; you cannot twist them or avoid them by any process of imagination or architecture or engineering or anything else. No up-to-date business enterprise would accept plans excluding sunlight from the buildings proposed to be erected. Why should we in Canada accept in public buildings a condition which is absolutely antediluvian?

Architecture of Parliament Buildings

Another point of discussion in connection with the capital is the question of architecture. Our dominating feature here is the parliament building. Originally it is in Gothic—Victorian Gothic, if you will, but whatever may be its defects that is the keynote that was given to our development. You cannot come along and make your other buildings overshadow or overpower these; if you do, you will subsequently have to replace them for something which will be in harmony—either that, or you are going to spoil your scheme.

I do not mean to say that thirteenth century Gothic should be followed in a departmental building. A Minister of the Crown, discussing the matter with me some years ago, said: "I do not like Gothic. My office is as dark as a tomb; I want some kind of architecture that will give me light." I said: "There is no architecture in the world that involves as little wall space as Gothic, if you take the right kind of Gothic." Because somebody, in the exercise of his judgment—or in his lack of judgment, I should say—chose for office buildings a style of Gothic that has the smallest possible window space, does not mean to say that Gothic is not a good style of architecture for light; it is the greatest light architecture in the world if you get the right style. It is not adaptable for office buildings as a general rule, but it is adaptable for great buildings such as are required for the Senate and the House of Commons.

My criticism of the new buildings is this: Gothic is essentially a development of functional parts joined together. That is what is lacking in our buildings here. The functional parts, like the parts of a great cathedral or an ancient castle, are not expressed. The mildest criticism of the whole thing as a matter of principle is that it is a Renaissance plan with a Gothic shirt—and pockets in the shirt. The proper expression of the spirit of Gothic lies in the expression of the functional properties of the building; you cannot cloud these and still have a good Gothic building. A very fine detail will not redeem a bad plan; that is to say, beautiful Gothic detail will not make a Renaissance building a good Gothic building.

Plan Commission Appointed

A few days ago I saw a copy of an order-in-council which has remedied, in principle at least, a great defect which has existed in respect to the submission of plans for the improvement of Ottawa. Plans are made; sometimes they are accepted and sometimes they are not; but even if they are accepted they are put in a pigeon-hole and left there; and when a man wants to build something which is in contravention of that plan, there is nobody to hit him promptly on the head with a club. That is exactly what happened in the case of the office building that I have referred to; there was nobody whose particular business it was to keep alive the spirit of the plans which had been submitted. This order-in-council names three gentlemen as a commission to look after that very thing: David Ewart, consulting architect to the government; R. C. Wright, chief architect, Public Works Department; and Thomas Adams, town planning adviser to the Commission of Conservation and to the Dominion Cabinet.

I hope, therefore, that we shall make progress towards the preservation and employment of what is good in the

plan; we have now a body to which we can go and make suggestions, and I am sure that they will get a sympathetic hearing. I hope it will be their practice, as it has been the practice in connection with town planning schemes in England, to have public hearings in regard to these matters. You cannot put anything through there without the public having their way. Of course, the representations that are made are not always heeded, but opportunity is given for the ventilation of all grievances, and, after all, that is the safety valve of our democratic system of government.

THE CONTRACTOR'S SALARY AS "OVERHEAD"*

By J. F. Lidral
Of Arvesen & Lidral, General Contractors, Seattle, Wash.

THERE are many among you who have been brought up on construction work since boyhood. There are others among you who have perhaps gone to school to equip yourselves more scientifically for your life's work. In either case you have devoted long years of experience and hard work to place yourselves in a position to be able to accomplish something which the ordinary individual cannot do. You have all the marks of a profession if you will demand from the world that you be considered as professional men.

When a calling is placed in the rank of a profession, the world recognizes that the individual engaged therein has been qualified by virtue of long study and experience and classes him as an expert who is capable of understanding and undertaking difficult problems. With this recognition comes also the inclination to be willing to compensate him in direct proportion and to the extent that he is able to save time and money for the man who engages him.

You have endeavored to build up your organization and working force. You have saved your money and paid your bills in an attempt to build up your credit standing. Why? So that you are able to perform work better and quicker and buy material cheaper than the outsider or the ordinary layman.

Now, laying aside for the moment the fact that you risk your money and reputation in your business, how much in the nature of a salary are you worth to your firm? Are you working simply for the love of work or are you worth a salary of $100, $200 or $1,000? You hire a foreman and you pay him perhaps $10 a day or approximately $250 a month. This foreman is working for you because he lacks something you possess. Either he does not possess the necessary knowledge to run his own business or his credit is gone or he possesses too much knowledge, knowing that he would be minus his $250 if he figured his worth as do some contractors. The foreman works his eight hours per day and his troubles end.

Forty Hours? Probably Eighty!

There are very few of you who limit your week's work to a minimum of 40 hours for your profession. It is more likely that you are on the job at 7.30 and spend the time until 4.30 racing like mad to keep it going. Then you go to the office until 6, trying to catch up with what you missed during the day. In the evening you have an engagement, here, for example, if you wish, or some party wishes a little free information about a building they never intend to erect, or your car needs adjusting after a hard day's abuse hauling nails and wheelbarrows, or you may go back to the office to work on the books and worry about how you are coming out on that job you took too low. Even Saturdays and Sundays are not exempt for most of you, and I'll wager that the majority of you neglect your families almost entirely. It is safe to assume that you put in more than double the time your foreman does. Is it not logical that each and every one of you is worth at least $500 to your firm? This item is just as much an overhead as is your office rent, interest on the money invested and other items. In other words, to the overhead of every firm should be added a salary for each individual engaged therein.

Some of you may not agree with me perhaps and will make the declaration that a man's compensation should come out of the profit. The definition of business is an undertaking to which risk is attached and which is attempted in order to result in a profit. Your overhead does not and cannot include a probable loss on any job. You lose money as all of you have done at different times. Your profit then is solely the necessary compensation over and above everything else to warrant your assuming the risk involved. In other words it is a bonus over and above your overhead and labor which is rightfully yours for the assumption of the undertaking.

It may be well at this point to make comment on some of the work going on this year. There is at present a noticeable shortage of carpenters and bricklayers. All are employed, indicating that there is considerable work under way. Go along any street of this city and you will see evidence of considerable building activity. How many of you contractors have a job at present that you are satisfied is bringing you all the returns to which you are entitled? There seems to be plenty, and still most of you are marking time waiting for more work to turn up at better prices.

Entitled to Fair Profit

We will take a concrete example: The one-story mill type garages, so many of which are under construction at the present time, with brick walls, concrete floor, tar and gravel roof on trusses and cold water paint on the interior. This is the simplest sort of a job to figure and yet our figures vary 100 per cent. Why? There are no slave-drivers among us nowadays. The workmen will give just about the same amount of work to all of us. Your credit, let us assume, is equally good or at most we cannot underbuy each other more than 10 per cent. There are two reasons. First, you are afraid that the other fellow is going to grab it and you cannot get over the idea that you may make a little spending money if all goes well and you are lucky. Second, you have been influenced by owners and real estate operators who convince you that such buildings have always been and are now being built for 6½ cents a cubic foot. It can't be done. You can't put in brickwork for much less than $40 and 8-in. concrete, including form work, much under $18, so what is the use and why worry about the cheap owners and architects who persuade some uninformed mortal to pack their troubles? I plead with you that in these days of plenty for all of us, you figure to come out on top, allowing for your overhead, a salary for yourself and a fair profit.

In closing, I would like to ask each one of you this question: What do you consider you are worth to the business and professional world, standing apart as one who is an expert? Not until you take enough personal pride in yourself and place a fair price on your labor will the world wake up to the fact that you deserve recognition as an expert and are entitled to a fair compensation for the time, money, experience and energy which you have devoted to your life's work.

*Excerpts from an address before the Seattle Master Builders' Association.

There are only four other communities in the world that have gone a greater distance to secure their water supply than has Winnipeg, Man.

The annual meeting of the Union of Manitoba Municipalities is being held this week in Winnipeg. One of the principal speakers will be J. G. Sullivan, on drainage.

Prominent citizens connected with the Board of Trade of Peterboro, Ont., are advocating the formation of a City Development Commission in order to prepare a plan for that city. Thomas Adams has promised his assistance if the commission be formed. James White, deputy head of the Commission of Conservation, who was in Peterboro recently, is reported as having said that Mr. Adams has been offered $100 a day to go to the United States and plan cities there, and that he feared that the commission would lose Mr. Adams' services.

THE LOGICAL CONTRACTOR*

By William S. Wollner

A CONTRACTOR was asked recently to bid upon a piece of work consisting principally of the erection of a timber truss lift bridge with the necessary foundations and approaches, the total cost of the job being estimated in the vicinity of a quarter of a million dollars. The job seemed a desirable one to the contractor and he carefully prepared his bid which he submitted to his bankers to learn if they would finance the work if he should be the successful bidder. The bankers referred him to their consulting engineer who requested him to leave his figures for a few days so that they might be checked. When the contractor returned for the engineer's decision he was told that while his bid had been carefully and accurately figured it would be useless for him to submit it as there was no chance of his being awarded the work.

The contractor was disappointed and proceeded to display his disappointment in an angry arraignment of the engineer, who also lost control of his temper and instead of explaining the reason for his statement remarked that he could even tell the name of the contractor to whom the work would be awarded. Upon the accuracy of his statement being questioned he named "Smith, Jones & Company" as the firm to whom the work would be awarded and showed the contractor the door. When the bids were opened it was found that Smith, Jones & Company were the lowest bidders for the job, their figure for doing the work being many thousands of dollars less than that of the contractor first mentioned. This man called upon the engineer, apologized for his display of anger, and remarked that if the engineer had told him that he was upon the "inside" he would not have questioned his judgment upon his previous visit. The engineer protested that he was not on the "inside" and proceeded to explain the course of reasoning that had led him to believe that Smith, Jones & Company would be the successful bidders. His explanation ran something like this:—

"In checking over the figures from which your bid was made I found that they took in every contingency that might arise; that you have very properly figured upon the safe side wherever there was a question as to what might be encountered in the course of the work. In your foundation excavation, for example, you figured the cost upon the expectation of encountering rock where there might only be mud and shale, it being of course impossible to determine this under-water condition accurately until the work was under way. Likewise, you figured upon using the extreme length of piling and upon paying the highest scale of wages.

"Another thing that I noticed was that a large proportion of your bid represented the cost of getting your outfit onto and off of the job. You have all the machinery necessary to do the work but it is located far from it and it was necessary for you to figure the freight upon it as well as the cost of getting the equipment to the site of the job and back to the railroad.

Competitors Had Strategical Advantage

"From your point of view you had figured the cost of the job properly. That is, you figured how much it would cost you to actually do the work under the worst conditions that might prevail, with a moderate margin for profit. Having assured myself of the accuracy of your figures from this viewpoint I proceeded to the next question—What would it cost someone else to do the work? In surveying the field I learned that Smith, Jones & Company were the *logical contractors* to do this work. They had done considerable work of a similar nature in the same vicinity and had in fact constructed a bridge for a railroad within a few hundred feet of the proposed structure a few years before. They did not have to back up their guess of what material would be encountered by figuring upon encountering the most difficult to handle; they knew what they would find and where they would find it. Likewise, they knew almost to a foot the length of piling that would be needed.

"Then as to wages; Smith and Jones have been working in this same territory for some years and have built up an efficient organization in which they pay the prevailing scale but from which they get a much larger return in work than you or any other contractor not similarly situated could hope to get. Further, not only do they not have to pay freight on their equipment, but as it is located further up the stream that this structure is to bridge, they have merely to float it down to the site of the work at practically no expense for transportation or loading. As they have work to do in the same vicinity when the job is finished, the cost of removing their outfit will be comparatively small.

"Thus they had the advantage over you or any other contractor who might figure on doing this particular piece of work, and I was practically certain that they would be the successful bidders. Furthermore, as the *logical contractors* for this job it was right that the work should be theirs."

As engineers sometimes become contractors and are often called upon to pass upon the bids of contractors, either as the employee of the contractor or as the engineer of the project, it is important that they understand this theory of the logical contractor. As a contractor or a contractor's engineer he should consider his position with reference to other bidders, and determine whether he is the logical contractor, and if not, whether he is willing to cut down his bid to meet the advantage that the logical contractor possesses. As a project engineer he must be certain to see that the logical contractor is not only given the opportunity to bid but that he is urged to do so in order that the project may have the advantage of the lower bid made possible by his strategic position.

Securing Advantageous Highway Bid

An illustration of how an engineer may reduce the cost of having work done by inducing contractors who are in a position to carry it on at a minimum cost bid for it was given in the recent letting of a county highway job. A road was to be built connecting "A" with "B," the construction cost, according to the engineer's estimate, being divided about evenly between grading and paving. The job was just about big enough to attract bidders from a reasonable distance but not big enough to absorb the cost of transporting a complete grading and paving outfit to and from the work without unduly adding to the expense of building the road. There were only two contractors in the vicinity of the work; one at "A," where he was grading the site for an industry, and the other at "B," where he was placing a concrete and asphalt surface on an old road for the State Highway Commission. Each of these contractors had a complete equipment for the work he was doing but was unprepared to do anything but that. The county ordinance under which the road work was to be done called for bids covering the entire job and it was therefore impossible for either contractor to bid for the portion of the work he was prepared to do.

Realizing that these men were the logical ones to do the work, the county engineer invited them to meet him in his office and pointed out to them the opportunity for combining their outfits and bidding jointly for the work. He pointed out to them that they had an advantage over other bidders in that their equipment was practically upon the job and that their forces were already organized to do the work. Being convinced, they followed his suggestion and filed a joint bid for the job which proved to be considerably less than any other offer and which saved the county a part of the cost of building the road.

Of course this engineer opened the way for charges of favoritism toward these particular contractors, but the fact that he was serving the best interests of his principal was sufficient reason for the course he took. It is the manner in which he handles matters of this kind that makes an engineer valuable or otherwise to his employer and indicates whether he belongs with the common run of untrained and inexperienced men or is entitled to his professional status as an engineer. The dollars and cents side of an engineer's duties may not be the most pleasant feature of his employment, but the working out of the business problems of his projects is an important part of the reason for his employment and will well repay close study and attention.

*From "The Monad."

Letters to the Editor

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES

Sir,—I am very much pleased to find that you thought my discussion on water-hammer of sufficient interest to publish it in full in your esteemed paper, issue of September 25th. May I ask you to record the following correction in your next issue, in order to avoid possible misunderstandings:—

Seventh line from top, first column, page 329, "to the area of the gate opening at the time, $t = 0$" should be changed to "to the (assumed) constant area of the penstock, i.e.,

$\psi(t) = (1-t/T)[c_o/(2gy_o)^{1/2}]$."

This mistake was discovered too late to be corrected in the original of my discussion.

EUGENE HALMOS

New York City, November 8th, 1919.

ENGINEERING OPPORTUNITIES IN CHINA

Sir,—"For ways that are dark and tricks that are vain, the heathen Chinee is peculiar." When Bret Harte thus summarized his conception of Chinese character, his estimate and ultimatum were accepted by some millions of "whites" as a final proposition. It ends in a cul-de-sac so far as the average man is concerned, and he is content to mentally add "finis" to things Chinese and direct his attention to other matters and other peoples.

In this attitude he is probably justified if his time is limited or his sphere of activities confined to American or Western European fields. The engineer, however, is not, or should not be, included among those who dismiss the Asiatic with a well-turned phrase and a shrug of indifference. He can learn many things to his advantage from the "yellow race" if he is so inclined and will forget (for the time at least) that he is a superior being, and that he has some centuries of human progress and development behind him which the other has not.

It is generally conceded that China, of the individual "promising fields," offers the largest and broadest scope for development, both commercially and industrially. If this be conceded, it naturally follows that the commercial and industrial activites must be supplemented and, in some cases preceded, by engineering activities involving exploration, study, experience and works. The field is undoubtedly there. The need for the engineer who can visualize and initiate development works is great, but it is imperative that the engineer who intends to share in the development, approach his task with the proper perspective.

Blueprints Are Useless There

China is not virgin territory in the sense that was, or is, Canada, the western states, the African colonies and the South American republics. It is older than the pyramids in race, customs, habits and pursuits. The traditional conservatism of the Englishman is vacillating radicalism when compared to that exhibited by the Chinaman in authority until it is indisputably proven to the Chinaman that it is to his advantage to throw over the old for the new.

Do not try to sell an article or a project to a Chinaman from a blueprint! Show him a photograph; or better still, demonstrate on a small scale, and, if you have adapted your proposition to what he requires or would like, and not to what you think he should have, you have a shrewd but open-minded prospect. Here is a wonderfully inviting field for the young engineer of some experience and undoubted ability who finds his progress blocked or his field overcrowded at home by older men already established.

The mercantile and contracting-engineer concerns of Canada who are looking afield for new business and customers, are awakening to the possibilities in the Far East, but they seem to be overlooking one important element to success. They must have technically-trained men on the ground, as a very few American and British firms have. It is not sufficient to sell a Chinaman or the Chinese government a dredge (for example), send a man over to set it up for operation, and consider the transaction closed. In case of a breakdown or a necessary adjustment for different raw material, an engineer should be easily and quickly available to render the necessary service and advice.

Big Plant Stands Idle

A Chinese company manufacturing hosiery and other knitted wear, was prevailed upon to install two American knitting machines of excellent design and output capacity. A qualified mechanic installed them and remained long enough to see that they were operating. Two weeks after his departure the machines stopped. They were still lying idle two years later when one of the owners, happening to meet a mechanical engineer in Hong Kong, took him home to see the factory. Noticing the discarded machines, the engineer asked permission to set them up again. Three days later they were running to capacity and have continued to do so.

A progressive Chinaman decided to substitute steam for man and animal power in his plant. An over-zealous salesman sold him a boiler and engine generating and delivering five times the amount of power the plant required. It was always too costly, but the war came and coal rose in price and was difficult to get in sufficient quantity. The plant is again run by the original power. The solution of this man's problem lies, not in specifying a smaller power plant, but in utilizing a waterfall quite close to the property to generate both light and power. It is probably not yet too late, but Mr. Canton has a mortal fear of being bitten twice in the same place.

Typical cases could be multiplied, but the sight of a $500,000 dredging plant lying idle in one of the fairly important harbors on the coastline, while some two or three hundred primitive, native dredgers are carrying out a fine piece of harbor deepening and reclamation work nearby, is sufficient demonstration of the fact that governments, as well as individuals, have suffered from a lack of advice from technically trained and experienced engineers.

Pioneer and educational work in developing a market for exports and for securing contracts involves considerable expense at best, but the manufacturer or contractor who supplements his sales efforts by an investment in technical service is building up capital in prestige and good-will. Cognizance is taken of this latter fact at home; why lose sight of it when entering a new field?

Group Export Associations Needed

An adaptation of the "grouping" or "circular" export associations being formed by various American firms, is worthy of serious consideration by members of the Canadian Manufacturers' Association and similar bodies. These groups are composed of a varying number of non-competing houses which combine to form a subsidiary export or trading company. An office is opened in Shanghai or some other of the treaty ports or commercial centres, and the expense is shared by the members according to agreement.

This scheme would seem to be meeting with a satisfactory amount of success, but too much effort has been given to the sales end and too little to the educational, constructional and technical features of the campaigns. Each of these groups should, advisedly, have in its employ a general contractor member, and at least one technically-trained engineer, resident at the foreign office and possessed of initiating ability that will not allow of his becoming a mere travelling mechanic or instrument man.

The number of modern manufacturing plants in existence in China is ridiculously small when the consumer market and the raw materials available are taken into consideration. The number of wealthy Chinamen who are good prospective large-scale manufacturers is much greater than

is generally supposed on this side of the Pacific. An attractive field for development is suggested by these conditions and admit of almost unlimited expansion if attacked in an aggressive and comprehensive manner.

This view, that the Chinaman should be encouraged to manufacture his own raw materials into consumable products, may be a new one, and it probably will not meet with favor on the part of our importers of these raw materials. It is, however, self-evident that if we supply machinery, building materials and equipment for fabricating the finished products, we benefit in the first instance and the Chinese workman earns money to buy more of our distinctively Canadian exportable commodities. The introductory work suggested is not as difficult as it appears in prospect.

Win Feng, compradore for a Canadian trading company, is in a friendly and intimate business standing with a number of prominent Chinese merchants; among these is Sin Foo, an exporter of hides and skins. It is suggested that it would be more profitable for Mr. Foo to erect a tannery and export leather. The trading company stands ready to supply technical service, plans for the building and plant and, if necessary, will arrange for the supply of a skilled foreman. Mr. Foo, and possibly some of his friends, decide to become manufacturers. Contracts and orders for machinery follow.

The engineer who is included in any organization in the Orient will find that he is continually picking up valuable suggestions in the native processes which will assist his principals in designing buildings and machines peculiarly adapted to local conditions and requirements. In this connection it is suggested that a civil and a mechanical or electrical engineer should be attached to each of the Dominion Trade Commissioners' offices in the Far East.

P. E. DONCASTER,
Public Works Department.
New Westminster, B.C., October 18th, 1919.

MINERAL RESOURCES OF CANADA, WITH SPECIAL REFERENCE TO LIGNITES AND THEIR TREATMENT

Sir,—It is no secret to the well-informed, the observer the reader and the traveller that there are enormous mineral deposits in Canada. These deposits are of the richest kind, and of almost every description. It only requires inventiveness, specialized application and practical knowledge and experience, combined with moderate capital, to produce from these raw materials an abundance of the most essential and now greatly needed commodities to replace the depleted stocks destroyed in the great struggle and to meet the increased demands of the future.

The world is gradually approaching an oil age, an age rapidly approaching, due to the progress made in the development of the internal combustion engine. Ships of every description will be adopting this method of propulsion before many years are passed; the heavy oil engine of the Diesel type will be in common use for marine work. The submersible ship of the future will largely depend upon oil for driving; the motor car, the aeroplane and a thousand other applications of the internal combustion engine are becoming more common daily. Oil will vie with "white coal," of which Canada has such an abundance. The demand for fuel spirit, fuel oil and motor spirit is increasing rapidly, and it will go on increasing.

For years to come the world must practise the strictest economy; everything must yield to the utmost. The great wastes of the past must be abolished, and it is only by conservation and economical utilization of the natural resources that we can recover our stability. Canada is in the finest position to perform a great part in this reconstruction. Its resources are such that it could provide for the needs of a great percentage of the human race. Its mineral wealth is as yet barely glimpsed. One has only to leave the beaten trail for a few miles to see the vast riches of the earth cropping out in every direction. Coal, lignite, oil-bearing shales and oil-bearing sand are the commonest but not the least valuable of our mineral deposits.

Observe the east and the west of the country, where there are limitless measures of the finest bituminous coal, only waiting human genius to wrest vast quantities of oil, spirit, chemicals and fertilizer from these stores of raw material. At present much of man's labor is wasted, especially in the coal fields of the west, where no care is taken to conserve the by-products which represent the most valuable portion of the coal mined. These valuable products are "going up in smoke." Beehive ovens are employed to produce coke for the smelters, ignoring other products.

Consider what underlies the prairie provinces: Billions of tons of the finest lignite. The people of that region need not import fuel if the material which lies beneath their feet is properly treated, and as it can be commercially treated. They need not want for cheap power to develop their industries. They need not regret that they have not the vast water powers of other provinces. Nature has provided for them by giving them these vast stores of buried sunshine, fuel, power, light, heat and many useful by-products besides, such as oil, spirit, gas, fertilizer and chemical bases. All that lignite requires is treatment.

Dormant Wealth East and West

Imagine the dormant wealth lying under the surface of the ground in the maritime provinces—billions of tons of rich oil-bearing shale which, under treatment, would yield per ton of shale an average of 50 gallons of crude oil, 60 lbs. of sulphate of ammonia, and other by-products.

Few people realize the great deposits of oil sand and bitumen lying hidden away in the northwest, but they exist, and only need exploiting. The object of generalizing is to remind the reader that we have these advantages, and that Canada must bestir itself and make development rapidly. Unfortunately the reticence which permeates all governments, is preventing progress. Good men are employed but are bound round with red tape. Capital is offered for development, but is rejected on the grounds that private enterprise and development might result in unhealthy monopoly of common property. Whether the enterprise is private or governmental, it must be made, and made soon. Private development is better than governmental, and it can be controlled by sound legislation. Progress and development of a country means progress and betterment of the people of that country. Let us progress!

The great war has brought out latent powers, sharpened wits, and forced development in many directions. It has brought forward more economical methods and processes for the treatment of raw materials. This is very noticeable in processes dealing with fuels, oils and by-products. J. A. Yeadon, of England, a mining engineer, has for many years been working on a system to carbonize coal and to obtain the by-products from it cheaply and to improve the quality and quantity of same. He has for a number of years experimented with automatic retorts to carbonize coal, oil shale, lignite and other analogous materials at low temperatures. With the assistance of other experts, and chemical engineers, he perfected his system, or process, in the early days of the war.

For years attempts have been made to solve this problem, but with indifferent success, but up to the time of Mr. Yeadon's perfecting his process, no one had been able to make the low temperature carbonization process a commercial success. The retort designed by Mr. Yeadon has solved the difficulty.

Retort for Carbonizing Lignites

This revolving horizontal retort is of special design and construction, with a view to dividing up the charge into fine streams and thus effecting perfect carbonization at a uniform rate, at the same time automatically working the charge through the retort in a continous stream. The speed of carbonization is under perfect control, so that the material need only make one passage through the retort from the point where raw material enters to the point where the carbonized material is extracted. During the progress of the material through the retort, the by-products are extracted in gaseous form. This gas passes up to the hydraulic main, the hydro-carbons are extracted, and from thence it can be used for various purposes. The residuum or car-

bonized material, if coal or lignite, can be turned into fuel for domestic purposes, steam raising, power gas plants, or smelting of ores in blast furnaces, depending on the preparation, which is varied to suit requirements.

The process of coal carbonization can be divided into two distinct systems:—

(a) High temperature carbonization, the chief function of which is to extract the maximum amount of gas for illumination purposes, heating, cooking, etc.

(b) Low temperature carbonization, which is specially adapted to the production of the maximum of by-products, comprising crude oil, sulphate of ammonia, chemical bases and carbon residue.

In speaking of coal, it is meant that shale, cannel, lignite and other analogous materials are included, such as can be treated in a heated retort or other closed vessel for the purpose of producing gas and by-products.

New Low Temperature System

In the high temperature system, notwithstanding the high heat applied, the coal must remain in the retort for a long period—6 to 8 hours—before it is considered to be sufficiently carbonized. Thus it naturally follows that the lower the heat of the retort the longer will be the time required for carbonization, and the smaller the quantity carbonized in a given time in a retort of given dimensions.

These difficulties are further increased in proportion as the smaller sizes of coal are fed into the retort, as these lie "dead." In low temperature carbonization various schemes have been adopted to assist this slow process of carbonization, such as internal shafts, travelling chains, stirrer arms, and other appliances to work inside the retort for the purpose of agitating and stirring up the charge and conveying it through the retort, with a view to getting a more rapid and thorough carbonization. So far these efforts have met with but very indifferent success and have proved of no commercial value.

The invention described in this letter was designed to meet and remedy the aforementioned defects by combining the principle of low temperature carbonization with two other important processes, neither of which had hitherto been worked in conjunction with same.

In the first process the coal is pulverized to a granulated condition, thus allowing the use of the smallest and consequently the cheapest grade, also allowing every particle of coal to come into quick contact with the surface or reflected heat inside the retort, and by this means securing rapid and almost instantaneous carbonization, This necessarily finely granulated condition of the charge is further ensured by drying and partially heating the coal before entering the retort.

In the second process this rapid carbonization is secured by the use of a tapered revolving retort into which the coal is continuously fed at the one end and the carbonized material continuously discharged at the other, both operations done mechanically and automatically."

Automatic Feed and Discharge

The retort is corrugated longitudinally, the corrugations serving a dual purpose: (a) To strengthen the retort body; (b) to increase the internal heating surface; and (c) to agitate the layer of finely granulated coal in its passage through the retort. There are no moving parts inside the retort to give trouble. The charge is fed into the retort by a self-sealed revolving screw feed and is discharged by a similar appliance at the opposite end. The feed and discharge are continuous and automatically controlled without any ingress of air or egress of gas.

The discharged carbon is in an ideal state for being agglomerated with a small proportion of bituminous matter or lime, and converted into block fuel, especially valuable for domestic purposes or for manufacturing uses. The fuel is practically smokeless.

The retort can be heated by part of the gas produced in it.

Labor is reduced to a minimum, and no skilled attention is necessary to operate the retort bench. The capacity of the retort is very great and much exceeds any other form of carbonizer, gas works retort or coke oven. The product is more uniform in quality, whether gas, oil or carbon is the objective.

A great feature in favor of this type of retort over the coke oven is the ease with which the plant can be increased without disturbing the existing plant, its great capacity for producing a large amount of the highest quality of blast furnace fuel at a low cost, and the continuous process of manufacture.

As a smelting fuel, the carbon is superior to coke. The granulated carbon is turned into blocks of 20 lbs. weight very cheaply, and in this form it is strong and capable of carrying a very heavy "burden." It takes up a position in the furnace which tends to produce perfect combustion, admitting of the blasts having a free course, and thus producing a more uniform heat throughout the furnace, and reducing the amount of fuel per ton of ore smelted.

This fuel is almost pure carbon; it has no equal for open fires or closed furnaces. It is practically smokeless, whether made from bituminous coal or lignite, and the calorific value is greater, weight for weight, than the raw material.

In the manufacture of smelting fuel, the agglomerate may be hydrated lime, whilst in the manufacture of domestic fuel, very little agglomerate is required if the retort works in direct conjunction with the press. If agglomerant has to be used, it may be the pitch produced from the carbonization, or tar, sulphite pitch or the residuum from oil refineries, or a mixture of the two latter. It depends entirely on local conditions and circumstances.

Says Private Capital Is Available

The carbon makes an excellent fuel for producer gas plants, and in this connection a good yield of sulphate of ammonia is obtained. The volume of good, clean gas of first-class quality is very great. The retort can be adapted to producing gas for domestic use and its adoption places within the reach of every small town a public supply of gas for heating and lighting purposes.

Canada has the raw material; it wants only brains and money to exploit them. There is no dearth of brains, experience and practical knowledge, and the capital is forthcoming providing that the owners have the co-operation and protection of the government. In other words, let the provincial governments grant concessions for the development of these resources by private capital and by men who know how to do it; it is not amateurs' work. Resources, men and money are available and waiting to develop Canada.

WILLIAM ARMSTRONG.

Montreal, November 4th, 1919.

The Ontario Section of the American Society of Mechanical Engineers held its first meeting of this season last Friday evening. The season's work was discussed, and it was decided to hold one meeting per month, the meetings to be alternately a technical session and a dinner with an address. Members of the society came from as far as Chatham, London and Belleville to attend last Friday's dinner, and it was felt that this indicated that considerable interest would be taken in the work this season. After the dinner, which was held at the Engineers' Club, Toronto, Brig.-Gen. C. H. Mitchell delivered an address upon some phases of mechanical engineering which had come under his observation in France and Italy during the war. He particularly covered transportation and the mobile shops in the advanced areas in France. He made some interesting observations regarding Italian hydro-electric power developments as he found them at the end of the war in comparison with their condition and size in 1906. He also gave a vivid description of the Italian engineering feats in the construction of the "teleferrica," or wire cableways, which transported munitions and men in hanging carriers over mountainous peaks and across great chasms even when subject to heavy shell fire.

PROBLEMS AFFECTING DESIGN AND CONSTRUCTION OF HIGHWAYS*

By W. G. Thompson
State Highway Engineer of New Jersey

IT has been said by a well-known railroad executive that the railroad of the future may find it more economical to tear up short-line tracks and develop motor truck transportation in their place. Although the supplying of tonnage is the freight traffic manager's problem, it is also a problem which should engage the serious attention of the engineering department, from the viewpoint that every means should be employed to reduce the cost of supplying tonnage to the main lines, just as careful attention is given in location and construction, to reducing grades and curvature to the minimum. It is claimed that, considered as a unit, few branch lines pay expenses, but as gatherers of freight and passengers to increase density of main-line traffic, they are sources of profit. As, however, traffic gathered by them is turned over to the main lines with a deficit attached, which has to be overcome during the main-line movement before any profit is made, it might be a decided advantage if this traffic could be delivered to the trunk line by means of the motor truck or tractor, without this bill of expense attached.

May Eliminate One Handling

Since it is a fact that it is now necessary to truck products of all kinds, and especially farm products, to the short branch line, and load them into cars, a serious investigation of the matter may disclose that one handling might be obviated and considerable expense saved if the tracks were removed from many branch lines and the grade used for an improved motor road, which could be entered from every intersecting highway. Such an arrangement would mean increased facilities at main-line points for freight handling, but with the present rapid improvement of country and interurban highways, it would relieve the railroads of the burden of maintaining freight stations, water systems, coaling stations, track and other structures, and the inevitable overhead expense during seasons when traffic is light.

It is inconceivable that trunk highways paralleling trunk lines of railroads will ever seriously affect the tonnage carried by the railroads, but it is quite conceivable that with the extensive building of hard, smooth, all-year highways, the tonnage of branch line roads will be very seriously affected, and in my opinion this problem should from now on engage the attention and induce careful investigation by the engineering departments of railroads, whose managers are looking to the future and the economical handling and transportation of freight.

There are, at present, approximately 6,000,000 passenger motor cars in the United States. Conservative estimates place the passenger mileage of automobiles in the United States at 45,000,000,000 per annum. Commercial motor cars increased from 60,000 in 1912 to approximately 600,000 in 1918. The mileage for all kinds of commercial motor cars is now estimated at 5,000,000,000 ton-miles per year. It is estimated there will be in use at the end of the next 10 years 20,000,000 passenger and 5,000,000 commercial motor cars. Surely the above figures should cause railroad officials more than casual concern and lead to consideration of the matter of short-line hauls from the highway viewpoint.

Same Principles of Design

Highway engineering to-day differs little from railway engineering. The same fundamental principles are involved in the original design of both—viz.: Alignment, grades, curves, drainage of subgrade, bridges, superelevation of curves, etc. There must also be traffic regulations and signals, danger signs, distance and direction markers, etc. Particular attention is being given to grades and curves, especially on the New Jersey state highway system, where, except in very hilly country, 5 per cent. grades and 6 deg. curves are the maximum.

The advent of the swiftly moving motor vehicle soon demonstrated that the earth and macadam pavements were unsuitable and uneconomical for that class of traffic, therefore the most durable types such as concrete, stone block, asphalt and brick pavements are now being laid. Light foundations and inadequate drainage are the most fruitful causes of pavement failure, as they are in track construction. Systems should be provided for thorough drainage of the sub-foundation, such as lateral drains under the pavement, leading to longitudinal drains; the construction of storm sewers on a grade in long, level sections; and the construction of side ditches and gutters. In the preparation of sub-foundation, all areas of permanent saturation are removed and replaced with coarse sand or broken stone placed directly beneath the pavement. Experience is developing the fact that concrete provides the most durable and lasting foundation under heavy traffic. It is being used in rapidly increasing amount as a pavement and as a foundation for other types of pavement.

Widths, Thicknesses, Curves, etc.

On country and interurban highways, graded widths from gutter to gutter are not less than 30 ft. and the hard pavement not less than 18 ft., widening to 24 to 30 ft. where several roads converge, or when approaching large cities. All curves exceeding 3 degs. are superelevated, as in railroad practice, in accordance with a formula devised for the purpose and based on a speed of 30 miles per hour, though some of our banked curves have been driven at 60 miles per hour, presumably because the driver liked the sensation of rounding a curve at high speed without the effort of resisting the overturning force.

Laws of most eastern states permit gross loads of from 24,000 to 30,000 lbs. on trucks, therefore bridges are being designed for 20-ton loads, assuming 75% of the load as being on the rear axle.

Rapid increase in use of motor vehicles makes pertinent the question as to whether we are building pavements sufficiently wide and foundations sufficiently heavy. The first is a matter of local finances; the second is one which can be determined only by experience and observation, extended over a period of years. On our most heavily traveled route, that between Newark and Trenton, we are laying a concrete pavement 8 ins. thick at the sides and 10½ ins. at the centre. On all other routes the pavement is being laid 6 ins. at the sides and 8¾ ins. at the centre. It is believed these will suffice for 15 or 20 years.

Public Service Conditions Changing

A comprehensive system of marking the highways with danger, distance and direction markers is being installed to enable the motorist to travel from place to place with convenience and safety, if he will but observe the traffic regulations and ordinary courtesy to others.

Highway and highway transportation engineering offer a broad, promising field to young engineers in the future. There are objections to employment in public service, the principal one being uncertain tenure of office, due to changing political administrations, but it is within the power of the engineers of this continent, by united and persistent effort, by educational propaganda, the exercise of tact, good judgment and constant adherence to the high ideals which actuate 99% of our engineers, to so mould public opinion that within a very few years the civil engineer may attain the social and economic status which is rightfully his, especially in the administration of public business and affairs. To most engineers, the idea of mixing or entering into politics is repugnant, but the present political system and the appointment and election of misfits and unfits will continue until the people of this great nation are educated to demand trained, experienced, practical men for the conduct of public affairs.

*From an address before the New York Chapter of the American Association of Engineers.

W. B. Redfern, 84 Close Ave., Toronto (Telephone Adelaide 2938), desires a copy of the November 9th, 1911, issue of *The Canadian Engineer*. Some subscriber may be able to oblige.

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PRINCIPAL CONTENTS

METHODS OF PUMPING IN ONTARIO

ACCORDING to a private report recently made by an engineer who had investigated the water works and fire protection systems of practically all the municipalities of Ontario, three-quarters of the municipalities depend for their water pressure upon steam only, electric power only, gravity only or a combination of steam and electric power. No less than 43 municipalities out of a total of 171 (or 25%) last year had facilities for pumping by steam only; while 39 (or 22.8%) had both steam and electric pumping; and 27 (or 15.8%) pumped by electric power only; 18 municipalities (or 10.5%) having gravity systems. The following table indicates comparatively little change in the situation since 1916:—

NUMBER OF MUNICIPALITIES IN ONTARIO, IN YEARS 1916-8, HAVING WATER SUPPLY AND FIRE PROTECTION SYSTEMS, AND KIND OF POWER UPON WHICH THE PRESSURE DEPENDED

	1918	1917	1916
Steam only	43	46	50
Water power only	6	7	8
Electric only	27	23	24
Gas* only	9	8	9
Gravity only	18	17	16
Steam and water power	5	5	4
Steam and electric	39	43	39
Steam and gas*	2	3	2
Steam, water power and electric	1	0	0
Steam, electric and gas*	1	0	0
Water power and electric	8	7	7
Water power and gas*	1	1	1
Electric and gas*	11	8	8
Total	171	168	168

*Gas, gasoline or oil.

STRAIT OF BELLE ISLE DAM

REFERENCE was made in a recent issue of *The Canadian Engineer* to a daily newspaper dispatch stating that "the climate of Newfoundland would be changed if a breakwater were built across the strait of Belle Isle, between the island and the mainland, and the cold Labrador current shunted out into the Atlantic Ocean.

"Such a dam is being seriously considered," continued the newspaper article. "It would cost an immense sum of money, but engineers say it presents few difficulties. The Labrador current, at present, is the chief factor in moulding the climate, not only of Newfoundland, but of the Maritime Provinces and New England. Coming down from the Arctic Ocean, it pours through the strait of Belle Isle, and, circulating around the gulf of St. Lawrence, washes with its cold flood the coasts of Newfoundland, Quebec, New Brunswick and Nova Scotia."

James White, deputy head of the Commission of Conservation, Ottawa, calls our attention to the fact that the strait of Belle Isle, at its narrowest point, is 11 miles wide, and that it has a maximum depth of 330 feet and an average depth of 215 feet.

Ignoring such "details," moreover, there is the further drawback that the Labrador current does not "pour through the strait" and does not wash with its cold flood the coasts of our Maritime Provinces. Several years ago Dr. W. Bell Dawson, superintendent of Tidal and Current Surveys, ascertained beyond doubt that such current as there is, ebbs and flows with the tide, and does not set through the strait, either from the east or from the west.

PULVERIZED FUEL

THE Commission of Conservation has just issued a report on "Pulverized Fuel: Its Use and Possibilities," by W. J. Dick, which may be had on request by those interested in economy of fuel for power and large heating plants.

One of the pressing problems of industry in Canada is that of fuel supply. This is especially the case in manufacturing processes requiring heat. The rising costs of coal and the difficulty of transportation have proved handicaps of considerable importance, and are rapidly becoming accentuated. This situation demands that all the available heat contained in the coal be made use of. In the utilization of run-of-mine coal, a large proportion is lost in the form of cinders and clinkers. To overcome this waste, a process for using coal in pulverized form is now in successful use.

Under this process the coal is first dried to reduce the moisture content to approximately 1%. It must then be ground until 95% will pass through a 100-mesh screen and 85% through a 200-mesh screen. The coal is then transferred, usually by screw conveyors, to the furnace supply, whence it is blown into the fire-box by means of compressed air. Consumed in this way, the coal burns like a gas and the flame has the characteristics and appearance of a gas flame. Results of tests have shown that there is no formation of slag in the furnace or on the tubes, there is no shower of cinders or ashes emitted from the smokestack, and there is no damage done the boilers from heavy overload conditions.

Canada is particularly interested in the use of pulverized coal. At the pit-head and underground at the mines in Nova Scotia and British Columbia are great piles of unmarketable coal dust and slack, while in Alberta and Saskatchewan there are immense reserves of lignite which is high in moisture content. This lignite rapidly disintegrates on evaporation of the moisture, and, consequently, will not stand transportation. It is also unsuitable for locomotive fuel on account of its liability to start fires from excessive sparking. But these coals, by drying and pulverizing, make excellent fuels for either heating or power-development purposes. They are lower in price, less expensive to handle and give greater heating value. The Dominion Coal Co., at New Waterford, N.S.; the International Nickel Co., at Copper Cliff, Ont.; the

British Columbia Sugar Refining Co., at Vancouver; and, with one exception, all the cement companies in Canada, are using pulverized coal with very satisfactory results.

PERSONALS

LEWIS W. WYNNE-ROBERTS, who has just returned to Canada after three years' military service in India and Mesopotamia, was born November 14th, 1891, in Carnarvon, Wales. His father is R. O. Wynne-Roberts, consulting engineer, Toronto, who went to South Africa in 1898 as city engineer of Capetown. Consequently L. W. Wynne-Roberts received his primary education at the South African College School in Capetown, subsequently studying engineering at the Day Technical College, University of London, Eng., where he was a gold medallist and graduated with honors in 1912. Shortly after his graduation he followed his father to Canada and joined the staff of the Provincial Board of Highway Commissioners at Regina, Sask., as assistant engineer on design of concrete bridges.

Among other work, he assisted in the design of the Saskatoon bridge, one of the largest and most notable of its kind in Canada. In October, 1915, he resigned from the staff of the Highway Board in order to go to England for the purpose of enlisting in the army. He obtained a commission as lieutenant in the Royal Engineers, and in the fall of 1916 was sent to India, where he was loaned to the Indian government and became engineering instructor to British officers who were connected with the 2nd Sappers and Miners of Bangalore. After six months of this work, he requested a more active post and was sent to Mesopotamia with reinforcements for a field company of engineers. In Mesopotamia Mr. Wynne-Roberts was engaged under Generals Maude and Marshall in general field engineering work, including water supply, bridges, demolition work, etc. In July, 1918, he was promoted to the rank of captain and was sent to Northern Persia as one of a party of five engineers who were entrusted with the contruction of a water-bound macadam road from Ruz to Hamadan, a distanct of 370 miles. This road formed a part of the Bagdad to Baku route and was necessary for the transportation of supplies to the British force operating in the vicinity of the Caspian Sea. The five engineers divided the work and each had less than 10 weeks in which to make passable over 50 miles of highway solely with the aid of native labor and without any machinery or tools excepting those made for them in the Persian bazaars. The entire route had been impassable the previous spring, and there were also a large number of antediluvian bridges that needed repair in order to carry the army's motor trucks. The stone for the repair of the road was broken with sledges by women and children and carried to the job in bags on the backs of donkeys, in some cases for a distance of 6 miles. These animals also transported the water in old kerosene oil cans. Mr. Wynne-Roberts left Persia in April of this year but upon his arrival in India was sent to the Afghanistan frontier for several months and was unable to sail to England until August. He was released from military duties upon his arrival in England and landed in Halifax two weeks ago.

L. D. WALKER, of Ottawa, has received an appointment on the Welland Ship Canal engineering staff.

W. S. ATWOOD and A. D. NEALE have been appointed vice-presidents of the Canadian Car and Foundry Co., Ltd., Montreal.

H. H. VAUGHAN, general manager of the Dominion Bridge Co., Ltd., Montreal, has resigned in order to devote his attention to other interests.

W. F. MCKNIGHT, sales manager of the wire and cable department, Northern Electric Co., Ltd., Toronto, has been transferred to the head office at Montreal and has been appointed educational director for the company.

S. L. SQUIRE, of Toronto, and GEO. A. MCNAMEE, of Montreal, who are respectively president and secretary of the Canadian Good Roads Association, expect to visit Winnipeg at an early date in order to arrange the details of the annual convention which will be held in that city next May.

C. A. MAGRATH, of Ottawa, chairman of the Canadian section of the International Joint Commission, has been reappointed to the office of Dominion Fuel Controller in view of the serious situation that has arisen in regard to the importation of bituminous coal from the United States, due to labor troubles in that country.

OBITUARY

JOSEPH A. DOWNEY, contractor, Toronto, died last Saturday, at the age of 45. The late Mr. Downey was born in Dixie, Ont., but entered contracting work in Toronto when he was 20 years of age.

TOWN PLANNING CONFERENCE AT HAMILTON

THE preliminary program for the third annual Town Planning Conference of South-Western Ontario, which is to be held next Thursday and Friday in Hamilton, Ontario, includes suggestions for discussion on the following proposed legislation: Power to adopt a town planning scheme with suitable regulations for housing, sanitation, height of buildings, width of streets, etc., and for establishing zones for industrial, commercial and residential purposes; the formation of town planning commissions on which city councils are to be represented, these commissions to have their powers limited by having to submit to the city councils any schemes involving large expenditures; power to provide for gradual and economical street widening in congested areas by fixing a building line; reasonable limitation of damages claimed on account of town planning schemes, and permission for town planning commissions to share in increased values caused by the carrying out of their schemes; permission to buy, own and sell land other than that actually required by town planning commissions, such purchase to be for the purpose of profiting by the increased values caused by the carrying out of the schemes, thus assisting in paying for same; power to co-operate with suburban areas in developing along lines consistent with mutual interests. Other discussions will be on housing problems in the United States and Canada, municipal government and reconstruction, legislation and town planning, beauty and health in relation to town planning, town planning in relation to industrial development, zoning, and the question of whether town planning is profitable. The speakers at the conference will include Lawrence Veiller, Dr. Horace L. Brittain, S. Baker, J. A. Ellis, Sir John Willison, Thomas Adams, Noulan Cauchon, Mrs. Dr. S. Lyle, C. A. Kirkpatrick, and W. J. Donald.

J. C. Davies, managing director, and Roger Beck, director, of Baldwin's, Ltd., Swansea, Wales, are in Toronto to supervise the initial operations of Baldwin's Canadian Steel Corporation, Ltd.