PAGES

MISSING

Volume 25 Toronto, August 28, 1913

Contents of this issue on page 373

The Canadian Engineer

*A weekly paper for engineers and engineering-contractors*

# SCIENCE IN THE DESIGN OF STREETS

## NECESSITY OF REGARD FOR FUTURE NEEDS—ARRANGEMENT DEPENDENT UPON TOPOGRAPHY, PRESENT ACTIVITIES AND FUTURE OUTLOOK OF SURROUNDING TERRITORY—POINTS IN CONSTRUCTION OF PAVEMENTS.

By J. RUSSELL ELLIS,
Assistant City Engineer, Regina, Sask.

THE problem of proper street design is as broad and varied as any problem could well be. If the matter were always handled in a scientific manner and by a skilled designer there would be little excuse for writing this article. Too often, however, are the very underlying and essential points in the problem which require study and skilled judgment arbitrarily fixed by the legally constituted authorities in charge without proper advice, thought or knowledge. We have probably all seen the street which is too narrow or too wide for the use to which it is placed, in the first instance permitting of insufficient roadway room or width of sidewalk or both, and in the latter case causing an excessive cost of maintenance or suffering for lack of the same. Even when the width of the street is satisfactory the location is often ill-adapted to the fundamental requirements of the traffic to which it is subjected. Again, the width and arrangement of roadway, sidewalks and parking strips are stupidly fixed. Still again, the choice of elevation, gradients, kind of paving materials and facilities for storm water drainage are commonly noticeable as features of which improper treatment has resulted in inexcusable confusion.

The first step required to be taken in dealing with the problem in a scientific manner is a reconnaissance of the territory tributary to the street. For the purpose of this paper it will be assumed that our street has already been laid out and various improvements made upon the abutting property as is the case nine times out of ten when the engineer is given a hand in the design. A map drawn to a fairly large scale—not less than one hundred feet to the inch—should be provided with the street lines and all abutting property divisions accurately shown. This should be used in conjunction with a small scale map if available showing the streets and natural topographical features in the section of the city or town which is traversed by the street under consideration. After a careful study of the maps, in which possible changes in width or location may be noted, the investigation will be carried to the field. Here all improvements along the street will be sketched in upon the large scale map in approximate position; any apparent diversion of traffic to other streets and the reasons therefor will be noted, and any obvious errors or omissions in the map lines or topography will be observed. The general character of the use of the contiguous territory, such as business, manufacturing, residential, residential mixed with business and public use, will be tabulated with the limits of each. Some study of the work involved in improvement, such as the cutting down of hills and the bridging or filling of depressions, should also be made. It will probably be possible at this time to make use of the conclusions drawn from the first study of the maps and to correct them where necessary. Along with these studies a reliable traffic census will be required. For this work it will be necessary to decide to what extent of detail the conditions will warrant the investigations to go. Various forms for recording the observations have been devised and rules established which are available for reference but need not be blindly followed. Certain it is, however, that records should be taken at different times during the day, at different seasons of the year and during different conditions of the weather. Where heavy and fairly continuous traffic is encountered it will probably be advisable to have the reports cover the entire twenty-four hours of the day. Concerning the information necessary to record, Professor A. H. Blanchard has made the following classification:—

1. Differentiation between horse-drawn vehicle traffic and motor car traffic.
2. Division of each of these classes of traffic into pleasure and commercial traffic.
3. Subdivision of commercial traffic into loaded and unloaded vehicles.
4. Determination of the weight per linear inch of width of tire of all types of commercial traffic.
5. Subdivision of the two classes of horse-drawn vehicles traffic, dependent upon the number of horses.
6. Subdivision of pleasure motor car traffic upon the basis of weight and speed, since, in many instances, the greatest damage to certain types of roads is caused by seven-seat touring cars, limousines or laundaulets, travelling at speeds of 40 to 60 miles an hour.
7. Extraordinary character of local traffic; for example, traction engines hauling trailers, motor bus traffic, ice wagons, mill drays, etc.

It would be well to remember, however, that this classification was made for the study of road design in general, and it seems to the writer that some modification might be made when considering street design alone. At any rate, it would be necessary to consider to what extent in any case it is practicable to carry the investigation. For instance, the classification number 6 might well, in many cases, be omitted, since it should be feasible to estimate an average weight and speed of the pleasure motor cars, considering that such cars are generally standardized as to weight and that the speed is limited by law. This average could be obtained accurately enough for our purposes, and would curtail the work involved in taking the census to a considerable extent.

From the data obtained in making these preliminary studies a general tentative plan can be made. This plan will include any changes in location from the original layout that may be considered advisable as well as any changes in width. The considerations governing choice in these respects will, of course, be the class and amount of traffic and the topography of the ground.

The next work in order will be the preliminary surveys to consist of a proper alignment of the street as decided upon for mapping purposes and the taking of elevations for cross-sections and profile. This work should be carefully and accurately carried out, and the records taken will, in the end, be used for estimating purposes. The methods involved in this work are simple and familiar to all engineers. Suffice it to say that sufficient levels are taken to determine accurately the amount of material necessary to be handled in grading the street for improvement and for fixing the grade to suit probable requirements and existing conditions. The plan and profile will then be placed on the same sheet of profile tracing linen. In general, the scales preferable for use in profiles are forty feet to the inch longitudinal and four feet to the inch vertical. The scale for the plan will then be made to conform to the longitudinal scale of the profile, and the one will be placed directly below the other. With this data collected, we are now prepared to begin the detailed scientific study of the problem, and it is this portion of the work which is too often sadly neglected.

The first consideration affecting the question of the proper width of the street should be its classification as regards present or probable future use. The usual classification is placed under three heads, viz.: main thoroughfares, secondary thoroughfares and residential streets. The classification may be carried farther under a number of sub-headings. The traffic census and an estimate of future development, after careful study of the tributary territory, will be used in making the classification. It will be necessary to determine as best we can what facilities will eventually be required for the purpose of rapid transit. In large cities and on certain streets our conclusions will cause us to provide for underground or elevated railways, in other places the surface street railway only will be necessary. With the estimate of the amount of this traffic it is not difficult to calculate the width necessary to provide for taking care of it. For instance, the width required for single track street railway operation is eight to nine feet and for double track from nineteen to twenty-one feet. The general traffic should, as far as possible, be kept off of the railway allowance. Other public utility accessories that present a probability of being required on the street, such as pole lines, pipe lines, conduits, etc., will require consideration as to how much width will need to be excluded from other uses for them. Then the necessity or desirability of considering the ornate side of the problem as affected by planting spaces or parking strips should be given its proper place as going hand in hand with the scientific design. It may be considered that a width of four feet will be necessary for planting one row of trees, but the widths and arrangement of these spaces should not be fixed until after the width of roadway, sidewalks, etc., have been determined in order that the correct division or breaking-up of the space may be made. It might be noted here that the practice of placing sidewalks against the curbs where the roadway is less than fifty feet in width results in an improper division of the space.

The width of roadway exclusive of street railway allowance is a vital feature of the design. This is the point where one of the greatest aids of the traffic census comes in, though we will need to estimate the width that will be necessary for all future requirements as well as those of the present time. This may not call for the entire width being covered with pavement at first, but the estimated requirements should be provided for. After we have made a careful estimate of the amount and character of the traffic the problem of supplying the necessary width for its accommodation is of a more elementary character. It should be remembered that the principal purpose of the street is to provide efficient means for the necessary movement of the public and the opportunity for transporting the commodities required by it. To accomplish this necessitates providing the proper width to prevent congestion or inconvenience. We will need to fix a definite width to allow each vehicle on the street. Some authorities advise a width of eight feet, others nine feet. It would seem that on account of the tendency toward motor cars of wide bodies that where a preponderance of motor traffic is to be taken care of, the greater width should be used. Where it is estimated that most of the traffic will be composed of horse-drawn vehicles eight feet is sufficient. For calculating the widths of sidewalks required two feet is assigned to each pedestrian. Care will need to be exercised here that places where many people gather and leave at certain fixed times do not overtax the sidewalks. In all cases where feasible, however, the widths of the improvements necessary for the present use only should be adopted, with provision made for increasing them from time to time as needed.

The question of limiting gradients requires to be gone into carefully. The points affecting our decision in this matter are the maximum loads to be expected in the street car, motor and horse-drawn traffic, climatic conditions causing slipperiness, the damage accruing to existing improvements along the street by cutting below or filling above the level convenient for their use and, in some cases, the desirability of having the floor levels of large buildings at a distance not too varying from the street pavement. We will also need to begin thinking at this point about the class of paving materials that will be used in the construction, particularly with regard to their slippery tendencies. The grades should not be too steep to prohibit the ordinary desirable heavy loads being transported economically unless the interest value of the cost of reducing them, including all damage to abutting properties, would exceed the loss in cost of transportation. This problem should be figured out in detail where it is evident that large expenditures will require to be made in order to get the desired grades. In general, we may consider that a maximum grade of five per cent. is a desirable limit upon heavy traffic streets, and this maximum should only be employed wherever absolutely necessary and at infrequent intervals. A possible way of reducing the rate of grade upon a street is to have the roadway wind from one side to another. This method, when used, will probably necessitate a greater width of street and a different arrangement of the parking scheme. In this connection it may also be well to consider making detours from the straight line in order that bad hills may be skirted instead of being crossed directly over their summits. By these means a considerable saving in steep grades may often be effected. The minimum rate of grade, too, depends upon the class of pavement used. It must be sufficient to allow prompt drainage of the surface water into the catch-basins. The expedient, however, of what is known as false grading in the gutters will allow roadway, curbs and sidewalks to be laid with a level longitudinal grade, if necessary, but the gutters will have to have sufficient grade to create a flow of water. The minimum grade for this purpose should in no instance be made less than four-tenths of one per cent., and this should be used as sparingly as possible.

The choice of kind of paving materials to be employed in the construction involves a great number of considerations which, however, can be investigated along scientific lines. Experience has already established that certain materials are undoubtedly best adapted for certain purposes, and the results may be made use of without further investigation. For instance, no one denies that Portland cement is the proper material for any permanent street pavement base and for the sidewalks, and the truth is equally as much evident that certain materials for the wearing surface of the roadway pavement are adaptable under certain climatic conditions while not under others. In considering the pavement base, however, we shall need to design the thickness and proportions of the concrete to safely withstand the loads and stresses to which it will be subjected. Ordinary practice has held pretty closely to the limits of four and eight inches, varying with the nature of the traffic and the condition of the sub-base. It is advisable to make an analysis of the bearing power of the soil and the stresses which will be produced by the traffic in each particular case where conditions vary materially from other cases which have been investigated. The principal stresses induced in the base are due to climatic forces and the loads causing compression. Variation in temperature tends to cause disintegration by expansion and contraction of the concrete, and water tends to penetrate through to the sub-base, making it soft and reducing its bearing power. Therefore, the base must be designed so as to expand and contract without breaking the bond, and the water must be kept out by an impervious surface. The loads tend to push the pavement into the sub-base, and hence the base must have strength and rigidity enough to distribute this force safely. In general, the safe load which may be allowed for the sub-base is two or three tons per square foot. It is probably needless to say that the width of tires will be considered as to the manner of transmitting loads to the base.

In designing the pavement wearing surface for the roadway a greater number of considerations enter. First, in the way of stresses we have to consider forces caused by impact, shearing and suction, as well as compression and temperature stresses. The forces caused by impact are received by the wearing surface only, and hence the wearing surface should have sufficient resilience to absorb these forces without damage. Standard tests have been devised for use in this connection. Shearing is induced by the tractive power of the wheels of a self-propelled vehicle and the feet of horses. The wearing surface must have sufficient strength to resist this force, and must have stability enough to prevent its being torn away from the base from the same cause. Hence the study and testing of the bonding properties are obligatory. Suction forces result from the partial vacuum created behind a rapidly moving motor vehicle. The individual parts of the wearing surface must be held together in order to resist this force. Compression and temperature stresses will be handled in a manner similar to that outlined for the concrete base.

Second, a comparison of the value of the different wearing surfaces should be made with especial reference to cost, durability, maintenance, cleaning, traction resistance, slipperiness, sanitary qualities, noise and possibly other qualities made desirable by local conditions. The U.S. Office of Public Roads, working along these lines some years ago, collected reports from the engineers of a number of American cities. The results of this enquiry were published in the form of a table which is reproduced below. Under the percentage column the various qualities desired in a pavement are assigned proportionate values, the total being 100 points. The pavement ranking first under any given quality is given the full quality percentage, the rest grading down from this value in proper proportion.

The table is not given here in order that the results shown may be taken as applying to any particular case, but merely to suggest the proper procedure for the investigation. In any one problem certain conditions of a local nature are bound to enter.

**Comparative Value of Different Pavements.**

| Pavement qualities. | Percentage. | Granite. | Sandstone. | Sheet asphalt. | Asphalt block. | Brick. | Macadam. | Creosoted wood. |
|---|---|---|---|---|---|---|---|---|
| Cheapness (first cost) .... | 14 | 4.0 | 4.0 | 6.5 | 6.5 | 7.0 | 14.0 | 4.5 |
| Durability ............ | 20 | 20.0 | 17.5 | 10.0 | 14.0 | 12.5 | 6.0 | 14.0 |
| Ease of maintenance..... | 10 | 9.5 | 10.0 | 7.5 | 8.0 | 8.5 | 4.5 | 9.5 |
| Ease of cleaning ........ | 14 | 10.0 | 11.0 | 14.0 | 14.0 | 12.5 | 6.0 | 14.0 |
| Low traction resistance .. | 14 | 8.5 | 9.5 | 14.0 | 13.5 | 12.5 | 8.0 | 14.0 |
| Freedom from slipperiness (average of conditions). | 7 | 5.5 | 7.0 | 3.5 | 4.5 | 5.5 | 6.5 | 4.0 |
| Favorableness to travel .. | 4 | 2.5 | 3.5 | 4.0 | 3.5 | 3.0 | 3.0 | 3.5 |
| Acceptability ........... | 4 | 2.0 | 2.5 | 3.5 | 3.5 | 2.5 | 2.5 | 4.0 |
| Sanitary quality ........ | 13 | 9.0 | 8.5 | 13.0 | 12.0 | 10.5 | 4.5 | 12.5 |
| Total number of points. | 100 | 71.0 | 73.5 | 76.0 | 79.5 | 74.5 | 55.0 | 80.0 |
| Average cost per sq. yd. laid in 1905 ........... | | $3.26 | $3.50 | $2.36 | $2.29 | $2.06 | $0.99 | $3.10 |

*Note*: Favorableness to travel is dependent chiefly upon smoothness and freedom from dust and mud, secondarily upon the qualities composing "acceptability." Acceptability includes noise, reflection of light, radiation of heat, emission of unpleasant odors, etc. It chiefly concerns the pedestrian and the adjoining resident. Cost per square yard includes concrete, but not excavation, curbing, etc.: except for macadam, which is not usually laid on concrete.

When the available and seemingly desirable pavement surfaces have been thus compared it will be possible to reject those which do not meet requirements and thereby reduce the field of investigation. With those which are considered suitable the final test will be that of economy. Careful estimates should be made of the initial cost, the annual cost of maintenance and the life of each. Then, using the prevailing rate of interest with the amount of capital required to do the work, we can soon determine which is the most economical material to use.

A vital feature in street design from the aesthetic point of view is the parking treatment. There is no doubt that the average engineer would benefit exceedingly in collaboration with the landscape architect in this phase of the work, when this is possible. Certain elementary considerations, however, may be kept in mind, and a careful study of this question should not be dispensed with.

It is desirable to have residential streets planted with trees and grass in the strips reserved for parking purposes. Ordinarily the most suitable plan to follow is to place these spaces between the sidewalks and curbs, between portions of the roadway pavement where the space is available and, where the building line is at or near the street line, to have a space between this and the sidewalk. Trees should be planted in straight lines as a rule, twenty to thirty feet apart in a row, and the grass should manifestly be carefully cultivated. The selection of the kind of trees will be governed by local conditions, but the rapidly growing varieties are generally preferable. Low, dense growing trees, such as evergreens, are not often suitable for the purpose. They should produce a good shade and be shapely, the size being regulated by the available space and the proximity of buildings. It will be understood that certain varieties of trees will be unsuitable for urban planting on account of the condition of the atmosphere and the environment of surrounding improvements.

No one who is familiar with the methods of dealing with the various phases of the problem of street design as has been outlined will gainsay that no small amount of detailed effort will be involved in proceeding along these lines. It will be evident, however, that the results of the investigation of certain points will be applicable to the design of all streets in one town or city. Still other features will be similar when they apply to streets of like use throughout the municipality, and a majority of the results will coincide when relating to all of the streets of one classification within a limited territory. It should be borne in mind that the design of a street, when once executed, will be in a large measure permanent, and that countless numbers of users far into the future will suffer from any of the original defects. The economical side of the problem alone should appeal to all citizens, for not only will traffic be inconvenienced and made more costly, but abutting and nearby property values will be affected, and the community as a whole will be the loser in proportion to the enormity of the defects.

After all, the principal considerations are practically fundamental. When the reconnaissance and the preliminary surveys have been made, and the observations taken and data collected for determining width, limiting gradients, kind of paving materials and parking treatment, the sound judgment and knowledge of the competent designer, gained from study and experience, enable him to evolve a correct, scientific plan. There can be no excuse for any other.

## A USEFUL ADDITION TO INDUSTRIAL MATERIALS.

A remarkable new material to take the place of hard fibre, glass, porcelain, hard rubber, built-up mica, pressboard, rawhide, moulded compounds, etc., has been developed by the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa. It is known as Micarta.

It is used for commutator bushings and brush-holder insulation, as noiseless gear blanks, as conduit for automobile wiring, as spools for sparkcoil and magnet windings, for refillable fuse tubes, for wireless coil separators, for arc shields in circuit-breakers, for water-meter discs, etc.

Micarta is a tan-brown colored, hard, homogeneous material having a mechanical strength about 50 per cent. greater than hard fibre. It can readily be sawed, milled, turned, tapped, threaded, etc., if a sharp pointed tool is used and the work done on a lathe. It can be punched only in thin sheets and cannot be moulded. Micarta is not brittle and will not warp, expand, or shrink with age or exposure to the weather but takes a high polish, presenting a finished appearance.

Two grades of the material are made. The grade known as Bakelite Micarta will stand a temperature of 150 degrees C. (300 degrees F.) continuously, or 260 degrees C. (500 degrees F.) for a short time. It is infusible and will remain unaffected by heat until a temperature sufficient to carbonize it is reached. Heat will not warp bakelite Micarta, and it will stand an electric arc better than hard fibre, hard rubber, built-up mica, or any moulded insulation containing fibrous or resinous materials. Its coefficient of expansion is low, being approximately .00002 per degree C.

Bakelite Micarta is insoluble in practically all of the ordinary solvents such as alcohol, benzine, turpentine, and weak solutions of acids and alkalis, hot water and oils. It is indifferent to ozone—an advantage over hard rubber, resins, etc., for electrical purposes. It is non-hydroscopic and impervious to moisture.

The other grade, designated as No. 53 Micarta, has the same mechanical and electrical properties as the Bakelite Micarta, but differs in its chemical and thermal properties. The plain Micarta behaves towards chemicals and heat very much as an ordinary resin. This grade is not used in plate form.

## INFLUENCE OF METALLOIDS ON CAST-IRON.

A paper by H. I. Coe before the Iron and Steel Institute shows tests of 54 alloys, containing carbon 3.0, silicon from 0.4 to 2.24, manganese from 0.14 to 2.22, sulphur from 0.11 to 0.45, and phosphorus from 0.30 to 2.88 per cent. The author's conclusions are:—

Silicon decreases the strength and hardness of cast-iron, owing to its effect in promoting the decomposition of iron carbide.

Manganese to the extent of 0.5 per cent. softens silicious gray irons, owing to its effect on the condition of the carbon; the strength is increased by the addition of manganese.

Influence of sulphur is largely determined by the silicon present. Carefully controlled, it should be of considerable value to the iron founder in mixing his iron for any particular purpose.

In the absence of manganese, and with about 2 per cent. silicon present, very strong gray irons may be obtained if the percentage of sulphur be judiciously raised.

Phosphorus, up to about 1 per cent., is useful. It gives fluidity, slightly increases the strength, and also slightly diminishes the hardness of the metal. A higher percentage gives a hard, brittle material.

## A 150-FOOT ARCHBRIDGE WITH SUSPENDED ROADWAY IN REINFORCED CONCRETE.

By V. J. Elmont, B.Sc., A. M. Can. Soc. C.E.

The bridge described below (Fig. 1) carries a 14-foot 8-inch roadway and two 2½-foot sidewalks. It is calculated for a load of 120 lbs. per sq. ft. uniformly distributed and an additional load on the roadway of one road roller, weighing 30,000 lbs.

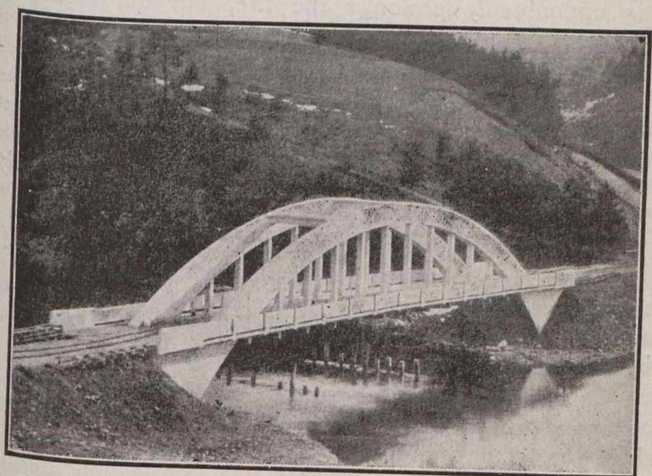


Fig. 1.—View of Finished Structure.

The macadamizing of the road rests on a crosswise reinforced slab, which again is supported by the floor-beams, spaced 9 ft. 10 in. centre to centre, and stringers. These are placed in the planes of the two archgirders and in the centreplane of the bridge. The sidewalks are supported by cantilevers from the floor-beams. The load from the floor is carried over to the arches through hangers.

The statical computation for the arches is made as for arches without hinges and by employment of influence lines. As basis for the figuring was used an allowable tensile stress in the steel of 14,000 lbs. per sq. ft. and

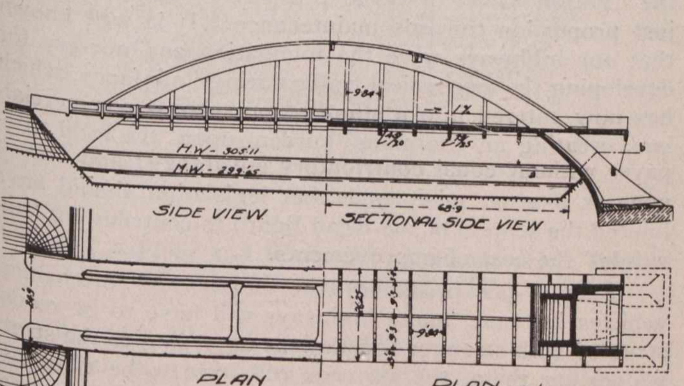



Fig. 2.—Details of Design Showing Continuous Arch-girders.

compression stress in the concrete of 550 and 700 lbs. per sq. ft. for roadway and arches respectively. Special care was taken in the investigation of the stresses due to change of temperature, which plays quite an important part in long-span arches with fixed ends, though, of course, much smaller than for a steel arch, as the conductivity of steel is much higher than that of concrete.

Fifty degrees F. was considered as an average temperature at the time the bridge was constructed, and the limits of the temperature of the concrete in the finished structure were taken as 10° F. and 80° F. By this assumption the maximum bending moments produced by the live load and dead loads were increased by 20% at the crown and 69% at the springing line. This proves once more that the approximate figuring usually employed by designers without knowledge of calculating statically indeterminate structures, is nothing less than a menace to safe construction. As result of the statical computation the necessary depth at the crown of the arches was found to be 4 ft. and the width 2 ft. 2 in.

The usual design of placing the tie-rods for the arches in the roadway slab was not employed in this case, owing to the high value of the maximum horizontal pressure (290 tons for each arch). It would have been difficult to arrange the steel, necessary to resist this great pull, in the longitudinal beams between sidewalks and roadway, and also to ensure a safe connection between tie-rods and arches. The arches are stiffened by means of three cross T-beams, placed at their crowns.

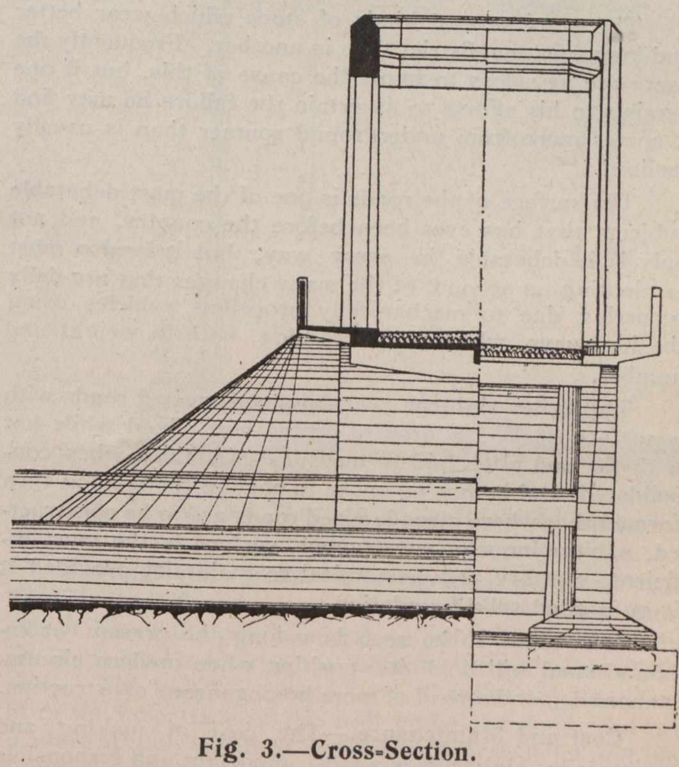


Fig. 3.—Cross-Section.

A somewhat unusual, but very economical, design, as compared with the solid concrete abutments, was employed for the abutments. The arch-girders are continued through the roadway to meet the foundation slab, which extends under both arches. (Fig. 2). Between the arches, and having the same curvature, a slab is constructed which, together with the extensions of the arches and two triangular wing-walls resting on the arches, form a container for the earth filling. The wing-walls and the arches are tied together by two cross-beams in each abutment. (Fig. 3).

---

The quantity of coal used for coke-making in the United States in 1912 was 65,485,801 short tons. The coke produced from this coal amounted to 43,916,834 short tons, valued at $111,523,336, besides large quantities of gas, tar, ammonia, etc., as by-products from the 11,048,489 tons of coke produced in by-product ovens.

## ROAD MAINTENANCE IN ENGLAND.*

**By Charles Vawser, A. M. Inst. C.E.I.**

IT is generally accepted that municipal engineers can construct the best and most suitable roads for their particular districts, and, provided they have a free hand in the choice of materials and so forth, they can so construct them that they will be efficient and, at the same time, economical to maintain; but, unfortunately, in the case of main roads, and particularly old turnpike roads, many are found to be without efficient foundation, and the extent of their durability or life is limited to the surface or covering crust.

Foundations should be sound and solid in construction, so that they may withstand the weight, wear and tear of the present and future traffic, and, in addition, act as a protector to the surface against the many unknown evils which from time to time arise from underground air, fluctuating water levels, and other matters which have more or less evil effects, according to the chemical composition and geological construction of the material used.

There are several kinds of stone which wear better and longer in one district than in another. Frequently the users are at a loss to know the cause of this, but if one persists in his efforts to ascertain the failure he may find it comes more from underground sources than is usually realized.

The surface of the roads is one of the most debatable subjects that has ever been before the country, and not only is it debatable in every way, but it is also most fascinating on account of the many changes that are daily occurring due to mechanically propelled vehicles using the highways, which are increasing both in weight and number.

The writer eighteen years ago constructed roads with a surface of Welsh granite heated and mixed while hot with tar and pitch laid to measure 4 in. thick when consolidated, and he has no cause to change the opinion then formed that where macadamized roads are to be constructed, a bituminously constructed surface is the most efficient, sanitary and economical to maintain, provided it is on a good solid foundation.

It remains to be seen how long the present waterbound road will hold its position when modern circumstances demand a road of more homogeneous construction.

**Cost and Maintenance.**—The cost of making and maintaining highways is a most important and responsible obligation to all highway authorities, and while they all have to "pay the piper," unfortunately they are not always in a position to "call the tune," because they cannot regulate the class of traffic using the roads.

The cost is not so keenly felt in urban districts and towns where the roads from the first laying out are usually well constructed, and as the districts prosper and develop the increasing rateable value corresponding with such development prevents them from feeling the pinch of poverty to the same extent as in rural districts and large agricultural county areas where there is comparatively no increase in development.

In rural districts and county areas there are frequently long lengths of roads to maintain, through poor, agricultural districts, and their efficient upkeep is a source of grave anxiety to those in control on account of the great amount of touring traffic using the roads, and for which there is no return. The cost of maintenance falls very unfairly and unjustly upon the shoulders of highway authorities who have to maintain important trunk roads which, by their geographical position, form a connecting link from one centre of industry to another.

Until quite recently all roads were waterbound, and many mainly repaired with water binding; these, when dry, have been surfaced with a bituminous or tar coat. This undoubtedly prolongs the life, but unfortunately trunk roads leading from town to town are placed at a considerable disadvantage owing to it not being practicable to close the road until the bituminous material has become "set," with the unfortunate consequence that much damage is done. Furthermore, many roads are narrow, thus making it more or less impossible efficiently to carry out the work upon one half of the road and allow it to "set" before turning the traffic on to it.

Another point which the surveyor has to consider is the weather, and in this uncertain climate he endeavors to carry out the greatest amount of work when climatic conditions are most favorable.

This surfacing or tar-painting is both efficient and economical so far as it has gone, and has been suitable where the traffic was light. It is apparent that, while it may be suitable at present, the day is not very far distant when the surface of the tar-painting will have to be superseded by something more substantial. Circumstances are changing day by day, and one may anticipate future development of traffic in ratio to the progress of the last few years; consequently it seems obvious that motor and mechanical vehicles will increase as time proceeds. Should this prove to be the case, the annual cost of roads will become a serious matter to the authorities responsible for their maintenance.

When such eminent men as Sir John Macdonald state "the money value of good roads to the nation is enormous," and Sir George Gibb states that good roads constitute "the basis of national prosperity," it is apparent that good roads are appreciated; but up to now neither the "nation" nor "national prosperity" have paid their just proportion towards maintenance. It is well known that our highways were the foundation and nursery for developing the mechanical traffic during its infancy, which has now entered into a stage of prosperous commercialism, creating an enormous burden upon the local ratepayer without equal contributory advantage; and thus it appears a great misfortune that legislation should have limited the powers of the Road Board to contributing "towards" the cost of improvements.

Should (as predicted) the motor and mechanical vehicles increase, many highways will have to be reconstructed with stronger foundations according to the strata supporting them, the surfaces will have to be efficiently drained, made dust and waterproof with bituminous material of such thickness as will stand the heavy mechanical traffic without fracture, the fast motor traffic without ill effects from vacuum, and, at the same time, form a good foothold for horses and other animals. This will entail great expense, and it is to be hoped that this reconstruction necessitated by modern and future traffic will be met by monetary grants for capital reconstruction, and annual maintenance payments from the industries which have placed the obligations upon the authorities responsible for the efficiency of the highways.

*From a paper read at the Annual Meeting of the Institution of Municipal and County Engineers, Great Britain.

# THE TOR HILL RESERVOIR, REGINA

DETAILS OF DESIGN AND CONSTRUCTION OF ONE OF REGINA'S TWIN RESERVOIRS FOR WATER SUPPLY—CONNECTIONS FOR INLET AND OUTLET MAINS—ITEMS OF COST.

By R. O. WYNNE-ROBERTS, M. inst. C.E., M. Can. Soc. C.E., F.R. San. Inst.,
Consulting Engineer, Regina, Sask.

THE city council of Regina, on the recommendation of Mr. A. J. McPherson, then city commissioner, now chairman of the Provincial Board of Highway Commissioners, decided to adopt a scheme which the writer had submitted, whereby an ultimate daily supply of ten million gallons of water can be made available, at an expenditure of about $2,000,000.

Such scheme included two five-million-gallon reservoirs. The construction of the first of these was commenced last summer, but owing to unforeseen delays in the supply of certain materials, it was found impossible to complete the work before the winter had set in. Immediately it was safe to proceed in the spring, the structure was finished as quickly as possible, and the reservoir has now been in use some four months. No signs of defects have been observed and the depth of water has been maintained at about 23 feet for about a month.

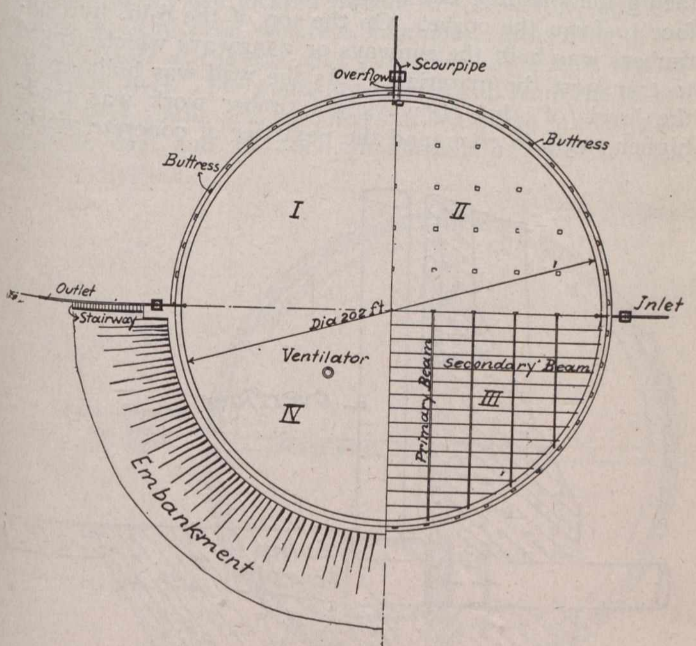



**Fig. 1.—Floor and Walls (I.); Columns (II.); Roof-Beams (III.); and Cover (IV.).**

Tor Hill reservoir is 202 feet in diameter, holds 25 feet depth of water, and its capacity is five million imperial gallons. This reservoir is circular in plan, reinforced concrete, and is located on a hill close to Boggy Creek waterworks, at an elevation of about 105 feet above the city; the top water line being about 120 feet above Regina level. It is so situated that it will answer in connection with future extensions of the water collecting works into five other watersheds.

The following is a description of the work as carried out:—

**Excavations and Embankment.**—The excavations averaged 9½ feet deep, the material removed was of a heterogeneous character, common to glacial formation, ranging from fine sand to heavy clay. This was excavated by horse-drawn wheel scrapers and the material deposited at convenient points, to be afterwards utilized in forming an embankment round the reservoir, in which work ordinary scrapers were employed. The quantity handled was about 12,500 cubic yards.

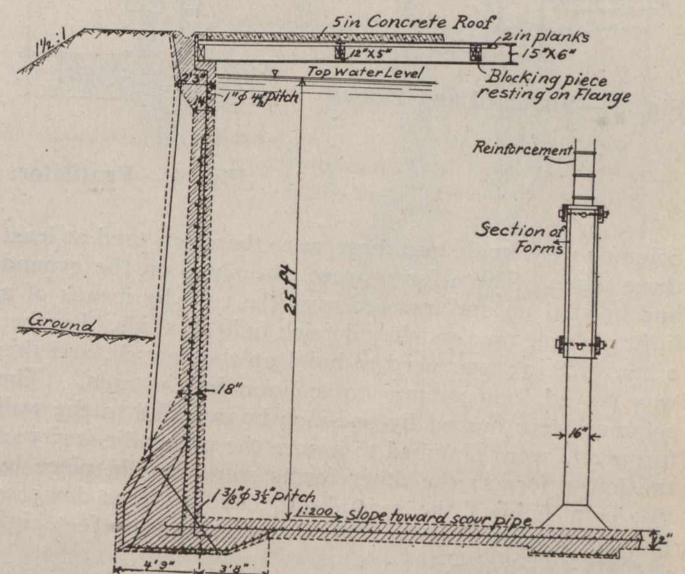



**Fig. 2.—Section Through Wall, Roof and Base.**

**Footings of Walls.**—The footings were first laid. They are one foot lower than the underside of the floor, except where the pipe connections are located, where the thickness was made two feet beneath the underside of the pipes. The footings extend for a distance of 3 ft. 8 ins. from the inner face of the wall under the floor, and are reinforced with half-inch round bars laid radially and circumferentially, and also a diagonal brace laid radially, at six-inch centres so as to form a strong tie between the wall and the floor.

**Floor.**—The reservoir floor is 12 inches thick, having a crossfall of one foot to the scour pipe, which is laid to a sump-hole at a depth of 2 ft. 3 ins. below the floor level. The floor was laid in two layers, each six inches thick, and between them were laid half-inch mild steel bars at six-inch centres, in two directions, at right angles to each other, tied together at every fifth intersection in one way and at every intersection in the other direction. The top surface of the concrete was worked to a fine close texture.

**Columns.**—There are 69 reinforced concrete columns, each 16 ins. by 16 ins., supported on truncated pyramidical bases 4 ft. by 4 ft., and 1 ft. 3 ins. high, which, with 6-inch sub-base, form an integral part of the floor. The sub-base was reinforced with half-inch bars laid at six-inch centres in cross directions.

The columns are reinforced with four ¾-in. round bars tied by 1 in. by 1/16 in. hoop iron links at 10-in. intervals. Where the bars join the base they are inserted into wrought iron tube sleeves one-quarter inch larger in diameter and grouted with neat liquid cement. After the bases had set these rods kept the forms from rising when they were filled with wet concrete.

The forms for the columns were made in three sections built of two-inch planks with 4 ins. by 4 ins. cross pieces at three feet centres and held together by ⅝ in. bolts. Each section was numbered so that three forms made a complete column. Sufficient forms for twenty

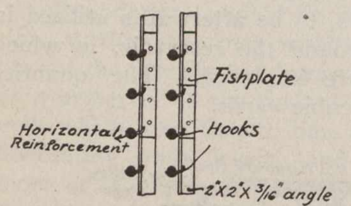



**Fig. 3.—Standard and Hooks.**

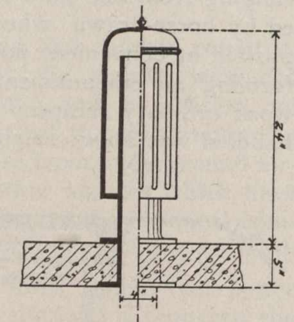


**Fig. 4.—Ventilator.**

columns were made and these were therefore used at least three times. These forms were assembled on the ground and hoisted up and lowered over the rods by means of a light gin pole on a monkey derrick built of skids. Lumber 2 ins. by 8 ins. was used to build up the derrick, and this was moved fom column to column by the men. The columns were braced by one-inch boards tied to the wall forms and were plumbed to assure the perpendicularity of the lower forms; the other forms were held in place by two bolts holding the second and third sections down to the one already filled in. One section about 9 feet high was filled each day.

**Wall.**—The wall is 57 inches thick at the floor level, while seven feet above the floor a steep batter on the outside reduces it to 18 inches, and from this point it tapers to 14 inches at the top water line. The wall then corbels out to allow a base for the roof beams and for a rain-water gutter. In the original design the wall was to be 9 ins. thick at the top and 14 ins. at a height of 5 feet above the floor, with three external reinforced concrete rings placed at points of equal pressure, to provide extra strength, as the work would be carried out under somewhat unusual conditions, but, owing to the delays already mentioned, it was deemed expedient to alter the design by eliminating the rings and thickening the walls by an equivalent volume of concrete and steel, so as to simplify the construction and thus expedite the work. The inside face of the wall is vertical.

The horizontal reinforcement in the wall was designed to take up the tensional stresses proportional to the varying depths of water. At the floor level there are two 1⅜-in. round bars at 3 ins. centres, curved to template to fit the curvature of the wall, and at the top 1 in. at 4½ ins. centres. These bars are held in place by 2-in. by 2-in. by ¼-in. angle steel standards in which holes were drilled at prescribed distances apart and ¼ in. steel hooks inserted to clip the rods. Such standards are 3 ft. 6½ ins. apart along the perimeter of the reservoir, and fixed so that there are 5 ins. of concrete between the horizontal steel reinforcement and the water face at the bottom, and 3 ins. at the top. This method of placing and fixing the hori zontal bars resulted in a firm and satisfactory frame work which could not be disturbed when the men were placing the concrete.

The vertical reinforcement consists of half-inch bars at 8½ ins. centres, and are tied to the horizontals by black wire at every fifth intersection vertically and at each intersection on the fifth rows horizontally.

There are 45 buttresses spaced at 14 ft. 2 ins. around the outside of the wall. These buttresses are 2 ft. wide and project beyond the 14-in. wall at the top about 11 ins. and die out at the base. These are reinforced vertically by half-inch rods, spaced 4 ins. apart.

The walls, etc., were built in courses about 12 ins. high. Exery horizontal and vertical joint was thoroughly cleaned before the next layer of concrete was laid. Any concrete work which had been standing twenty-four hours or more had the laitance removed by picks, wire brushes, and plenty of water, so as to ensure a thoroughly sound bond. The concrete was well worked into the spaces between the steel rods, etc.

On the completion of the work, the wall, floor and columns were painted with hot liquid bituminous asphalte and afterwards limewashed.

The timber work necessary to form the internal surface of the wall consisted of bents erected about 14 ft. apart; the girts were spaced every five feet and on each row of girts were placed 6-in. by 6-in. beams. The one facing the studding had a segmental piece nailed on to its face to form the curve. On the top of the 6-in. by 6-in. timbers was built the runways or gangways which served to transport the materials. As the wall was built up to the level of the runways the timber work was made higher so as to command the next tier of concrete work.

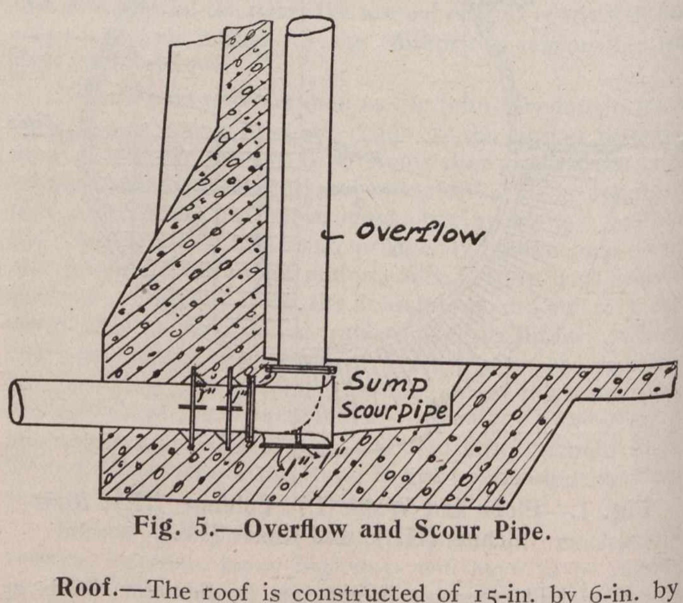



**Fig. 5.—Overflow and Scour Pipe.**

**Roof.**—The roof is constructed of 15-in. by 6-in. by 60-lb. rolled steel primary beams, cut to fit the 20-ft. spans and resting on the columns which are 20 ft. apart each way. The secondary beams are 12-in. by 5-in. by 31-lb. rolled steel joists fixed at 6 ft. 8 ins. centres and attached to the primary beams by angle iron brackets. The whole of the roof beams were rivetted together. The cover of the roof consists of 6 ins. concrete, reinforced with half-inch steel bars laid crossways at 6 ins. centres. The roof has a dome formation, being twelve inches higher at the centre than at the perimeter. The surface of the concrete was washed with hot liquid asphalte to prevent frost disintegrating the same.

Rolled steel joists were selected for the roof construction, as it would otherwise mean erecting false timber work to a height of 27 ft. to support the reinforced concrete beams. With the steel joists, however, the forms rested on the flanges, and this was a simpler and equally effective mode of construction.

The steel joists were elevated to the roof level by means of a fixed boom attached to the hoisting tower, which was used to raise the concrete and then landed on loose dollies and run within reach of a derrick. This placing derrick was built of 6-in. by 6-in. timber in the form of a double boom traveller, having a reach of 60 ft. when both booms were spread. It was slid along greased rails and carried a set of chain blocks at the end of each boom.

There are four cast iron ventilators in the roof.

**Pipe Connections.**—The 16-in. inlet and outlet pipes are placed diametrically opposite, and the overflow standpipe, and the scour outlet, which are together, are located half-way between the inlet and outlet. The overflow standpipe is held in place by 4-in. by ½-in. stays anchored into the wall.

All castings fixed in the concrete were uncoated and had puddle rings cast on, to prevent any water finding its way along the outside of the pipe. These rings are 6 ins. wide and 1 in. thick, strengthened by brackets 1 in. thick. All inside pipes have bell-mouths. The inlet and outlet pipes stand 6 ins. above the floor level.

All valves are located outside the reservoir, and enclosed in reinforced concrete manholes, measuring 3 ft. 6 ins. square at the top, and 3 ft. 6 ins. by 4 ft. 6 ins. at the valve level. The mains leading to and from the reservoir are of ample size to deliver at least five million gallons per day, and of such dimensions as to fit in with future extensions.

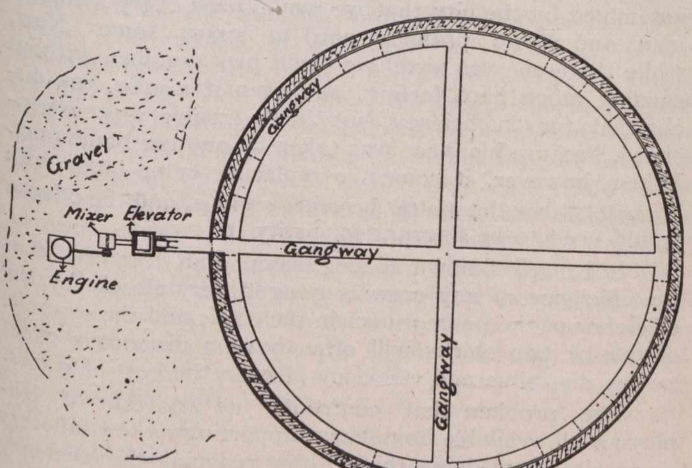



**Fig. 6.—Arrangement for Mixing and Conveying Concrete**

Wrought iron step ladders built of 4-in. by ½-in. stringers 18 ins. apart and ¾ in. rungs. The ladders are fixed into the concrete work at the top and bottom.

Reinforced concrete stairways are built at opposite points of the diameter to afford access. Stringers, 5 ft. apart, 15 ins. by 6 ins., and the treads are built monolithic and reinforced with half-inch rods lengthways and crossways.

**Steel Reinforcements.**—All bars or rods are medium steel, having an ultimate strength of 60,000 pounds per sq. in., and an elastic limit of not less than one-half of the ultimate strength, and elongate not less than 22 per cent. in eight inches, and bend cold 180 degrees round a diameter equal to the thickness of the piece tested, without fracture on the outside of the bend.

Steel bars were joined together by overlaps equal to forty times their respective diameter and tied with black wire. The working stress on the steel was limited to 15,000 pounds per sq. in. tension.

**Portland Cement.**—All the cement had to comply with the specifications prepared by the Canadian Society of Civil Engineers as revised in 1911, and the methods of testing were as near as possible those referred to in such revised specifications.

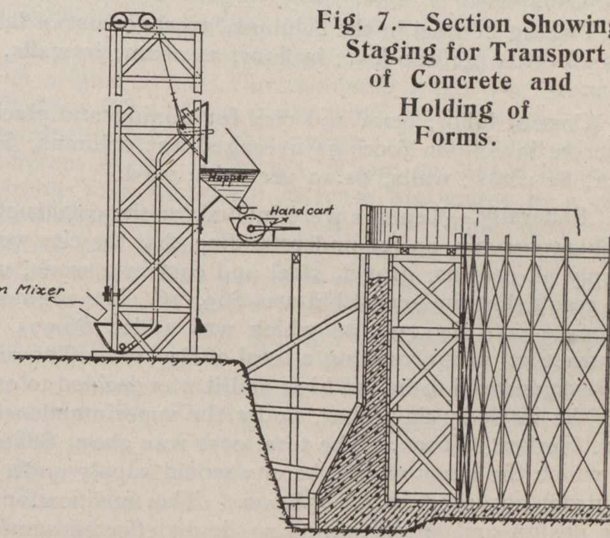



**Fig. 7.—Section Showing Staging for Transport of Concrete and Holding of Forms.**

**Concrete.**—The concrete was specified to be as follows: Floors, columns and wall, three parts of broken stone and gravel, one and one-half parts of sand and one part cement. The mass work round the pipes, in the valve chambers and in the roof cover were to be four, two and one, respectively.

The pit gravel obtained close-by, however, was found to conform fairly close to the specified proportions that a mixture of one cement to five pit gravel was substituted, care being taken to add more cement when necessary. About 3,400 cubic yards of concrete were laid. The limiting compressional stress in concrete was 500 pounds per square inch.

**Mixing and Placing Concrete.**—The concrete was mixed in a ¾ cubic yard Smith mixer, steam-driven. The concrete was mixed wet and was elevated by means of an Insley automatic roller hoist from the bottom into an Insley receiving hopper at the top, situated a few feet above the level of working operations from time to time. The concrete was then discharged into hand-drawn concrete hopper carts and wheeled over the gangways to all parts of the work. As the work proceeded the hoisting tower, gangways and forms were extended upwards.

**Miscellaneous.**—A Ham Baker water level indicator is being fixed to indicate the varying water level and by electric transmission to record the same at the Barton Pump House, half a mile distant.

A 20-in. by 10-in Simplex Venturi meter supplied by Messrs. Francis Hankin & Company, has been installed on the delivery main to the reservoir and near to the above pumping station. This meter automatically records the quantity of water pumped and also registers the total volume.

**Supplies.**—The ½ in. and ¾ in. steel rods were supplied by the Provincial Steel Company, of Cobourg, Ont.; Other steel was supplied by the Western Steel and Supply

Company, of Regina; cement by Canadian Cement Company, Calgary; cast iron by the Canada Iron Corporation, and the concrete machinery by Mussens, Limited, Winnipeg.

**Some Itemized Costs.**—The following are some of the itemized costs: Cast iron pipes, class C, 2¼ cents per lb.; special castings, 5 cents; cast iron covers and ventilators, 4 cents, all delivered Regina. Cement was $2.85 per barrel; steel, ½ in. and ¾ in. bars, 2.44 cents per lb.; 1 in. 2.80 cents; 1⅜ ins. 3.21 cents; 15-in. joists, 3.60 cents; 12-in. joists, 3.90 cents; standards, 3.90 cents, all deliverel f.o.b. Regina.

Placing of steel in the columns, average cost of labor was 26 cents per 100 lbs.; in floor, 12 cents; in walls, 30 cents.

Cost of labor, team and coal for mixing and placing concrete in column footings averaged $2; columns, $10; floor, 82 cents; walls, $1.10 per cubic yard.

**Generally.**—Tenders were invited for the construction of this reservoir, on the understanding that the city would supply all cement, gravel, steel and cast iron work, with the result that the lowest bid was $63,176. The engineer's estimate was $46,497, to which was added $6,974 for contractors' profit, making a total of $53,471. The offers were considered to be too high and it was decided to carry out the work by day labor, under the superintendence of Mr. Herbert Gibson. The total cost was about $88,000, of which the items which the city would supply under the contract absorbed about $58,000. The modifications in the design and specifications no doubt effected some reduction in the cost.

Mr. Theo. Brockman was resident engineer during the first season. Mr. L. A. Thornton, the city works commissioner, took an active part in the organization of the work, and Mr. J. McD. Patton, followed by his successor, Mr. J. Mackay, waterworks superintendent, attended to the matter of supply of materials. The reservoir was designed and supervised by the writer.

An important scheme has been put forward by the Egyptian Government for the Mahmoudieh Canal at Alexandria. It involves transforming the canal into a great fluvial harbor, seven miles in extent. At present the canal from the docks to Atfeh is under conflicting administrations. The importance of the canal to commerce and shipping is well borne out by statistics of vessels passing through it during 1910, when 6,512 lighters and sailing vessels and 165 steam tugs and steam barges passed down, and 6,507 and 179, respectively, up stream. These went through the tail locks of the canal at Alexandria, while for the Kafr Dawar lock 14,722 and 665 sailing and steam vessels, respectively, passed down and 13,323 and 680 up stream, and 19,713 boats passed through the Atfeh lock. The Government's scheme is to take away all control from the municipality and the other departments and transfer the canal to a single responsible body. From Hagar Nawatieh to the Mahmoudieh locks (seven miles) a fluvial harbor will be built along the banks, which will enormously improve the discharge of merchandise and facilitate the discharge of cotton. At present boats have been jammed for three weeks owing to the block of traffic and lack of control. Lewa Gedge Pasha has sounded the canal, and it is to be dredged soon and convenient landing stages constructed of concrete, each fitted with a crane capable of lifting four tons. The whole seven miles will not be dealt with at once, but the new fluvial harbor will first be made up to the Farkha Canal.

## PIECE WORK SYSTEM APPLIED TO CITY FORCES.

MR. J. E. TUPPER, city engineer of Pomeroy, Wash., has an article in Municipal Engineering on the construction of municipal work by a new plan, some features of which, and the article describing them will be interesting to our municipal engineers, even although they, perhaps, cannot concur in all respects with the position taken by the author.

When the city of Pomeroy, Wash., was about to install its sewerage system the question of how it should be done, whether wholly by contract, partly by contract and partly by the city, or wholly by the city, was an important one and caused much discussion. We had no local contractors capable of handling the work and we were averse to letting the work to contractors from other places, even though there might be an apparent saving by doing so. The previous experience of the city in doing its work with city force had been so generally satisfactory that the council was strongly in favor of that method if some means could be devised of overcoming the one apparent defect in the system. While we had some men who would do as good work for the city as they would if working for a private individual, or even for themselves, a large number of the laboring men are inclined to take it easy when working for the public, and a by no means negligible element will "soldier" whenever and wherever possible. In all of the previous undertakings of the city the crews had been comparatively small, and it had been possible to eliminate the undesirable element, either by refusing them work when their traits were known, or by discharging them as soon as they began shirking.

In preparing for the installation of the sewers it was evident that a new factor entered the problem. The necessary force would be so much larger than any previously assembled by the city that we would need every available man, and would probably need to import some. Now, while the crew was small we could pick our men without causing much hard feeling, and even if a man was discharged for inefficiency, but little trouble was experienced, because his place was taken by another home man. When, however, it comes to replacing home labor with imported labor the matter becomes serious, and the offense would need to be flagrant to justify it.

It is well known to engineers and foremen that the efficiency of any crew is gauged very closely by the efficiency of the poorest man in the crew, and the example of one or two shirks will often have a disastrous effect on the discipline and efficiency of even the best of crews.

The problem that confronted us was that of employing all available home men, importing as few laborers as possible, and doing this without reducing the efficiency of the force below that of a picked crew.

The nature of our work was such that the employment of machinery to any considerable extent was impractical. Our water supply system, if system it could be called, is such a maze of pipes, the location of which is unknown, that the employment of a trenching machine would result in such utter demoralization of the water supply that the expense of repairing breaks in private pipes or cutting out and replacing them would more than offset the reduced cost of trenching. The water mains had been placed without any survey or record of location. In one case where the sewer location presumably paralleled a water main for 2,600 feet at a distance from the main of three feet, we found the water main in our trench for nearly one-third of the distance, and it crossed our trench eight times.

We knew that these conditions existed, and had a very good idea of the obstacles we would be likely to meet. The conditions were not favorable for letting a straight-out contract for the trenching. It was certain that a large portion of the trenches must be dug by hand, and the amount that might possibly be better handled by a machine was too small to warrant bringing in a machine for the purpose. In the purchase of supplies the city was in position to secure fully as advantageous terms as any contractor could possibly get. The manner in which the pipe was laid and the back-fill tamped was of such paramount importance that we felt that the city should retain full control over the workmen who were doing this work. This could only be secured by having the work done by city forces.

After a full canvass of the situation in all of its phases the council decided to have the work done entirely by city forces. It was then up to the engineering department to devise some scheme for overcoming, in part at least, the most objectionable features of that system.

The writer suggested the piecework method of payment, and advised its application to as much of the work as could be done without too much trouble. Many doubts were expressed as to the feasibility of the plan, and the council seriously objected to allowing it to be applied to the pipe-laying because of the danger of the work being slighted.

After considerable discussion the council agreed to allow a test of the method to be made on the trenches only, all other work to be done by day labor. The trenches could be handled by the new method more easily than any other part of the work, and if there should be any tendency to slight the work on the part of any of the workmen it could be easily corrected without endangering the perfection of the sewer. The accounting was a simple matter. Cross timbers for alignment and level purposes were set by the engineering force at 25-foot intervals, thus dividing the trenches into convenient one-man sections. The records of the engineer's office gave the amount of excavation in each 25-foot section, and a single setting of the slide rule gave the compensation. There was a little additional bookkeeping involved, but no complications. A simple method of numbering the sections was adopted, by means of which each man could keep track of the sections excavated by him, and the location of each section could be quickly determined if its number was given. The engineer's record was kept in the ordinary field book, and as there would be no embankment that column was used for entering the compensation for that section computed on the earth excavation basis. As the timekeeper's reports came in, the name of the one excavating a section was entered under the head of "Remarks." In this way complications were rendered impossible and omissions were quickly run down.

As fast as the classifications reports came in from the engineers they were entered on the same book and the proper compensation correction for each section was entered in red ink. The credits shown on the field book were transferred to a single-entry ledger and payments made bi-weekly. We found that though the accounting took a little more time than the day wage system, it was negligible as compared with the advantages that were found to accrue from the new plan.

We had very little data from which to determine what would be a fair scale of prices. Taking what we had, because of it being something of an experiment at best, preferring to be liberal in our prices, we fixed the following scale: Excavation per cubic yard: Earth 15 cents, hardpan 30 cents, loose rock 60 cents. What solid rock we encountered was excavated by day labor men. The amount was small. As it was a little doubtful whether we would be able to secure as many men as we needed for the trenches at these prices, it was announced that if, after a two weeks' trial it was found that the prices were too low to enable the average man to earn ordinary wages, then we would either increase the schedule or return to day wages. With this encouragement enough men were secured to begin operations, and before the first week ended the success of the plan was assured. In fact, the trenchers were able to earn such wages that we were forced to increase our day wage scale in order to hold the men we wanted on the other work. While at first glance this might seem to be a disadvantage, in actual practice it proved to be the reverse.

It gave us the advantage of a sliding scale in place of an arbitrary one. Our minimum wage was $2.50 per eight-hour day. When a day wage man wanted to go in the trenches we had this option. If he was a poor or indifferent worker we would let him go, but if he was a desirable man we would increase his wages to a price that would hold him. If a man was found shirking or slighting his work we would manage to get him in a position where there would be nothing for him to do just then except to go ahead into the trenches, and once in the trench, he would not get on the day wage force again. On the other hand, if there was a man in the trench that we wanted on the day force we could usually secure him. In this way we were able to keep a force of select men, and there was practically no complaint of unfairness or favoritism.

There was much less of this than we expected, and, as they had but two grounds for complaint, yardage and classification, it was very easy to get rid of them. As a whole, the trench men were perfectly satisfied with the deal we gave them. We were very liberal in our classification, were not unnecessarily insistent on having the sides of the trenches trimmed to line, and when unusual difficulties or obstructions were encountered we either gave them extra pay or took over the section to be excavated by the day men. There were a certain number of the trench men who were kept there throughout the entire job. They were worth more there than anywhere else, both to themselves and the city. These men averaged $4.00 a day or more, one of them averaging $5.00. Their example was a stimulus to the entire trenching force. To watch the twenty or more men we had in the trenches for one day was one of the best object lessons on the relative efficiency of common laborers that I ever received. The incentive for efficient work was the same in each individual case. Each man knew that he would get full pay for what he accomplished, and no more. And yet the variation in the amount of the day's work was astonishing. It ranged from 16 to 35 yards of earth in an eight-hour day.

So great a variation must have some reason for its existence. As a rule, the ordinary foreman would not see enough difference to warrant a remark. To all appearances the men were working equally hard, and on the whole with equal diligence. Jones was a husky specimen of the laboring class, above the average in intelligence, especially shrewd and quick to catch on to short cuts and ways of saving his muscle at the expense of his brains. As a day-wage man he was the most persistent, unscrupulous and shrewd hand at "soldiering" that we had in the city. Working in the trenches by the yard, he drew down the largest pay checks of any man in the crew. He worked no harder than other men, but he knew how to make every move count, and, having no incentive for shirking, he kept his shovel in motion. He spent no time talking, looking around or loafing on the job. He simply worked intelligently and persistently. The only chance to get ahead of the job was in the width of the trench, and these he dug as narrow as he dared. Sometimes he overstepped the limit and had to be called back to trim up, and he always did so cheerfully. He was never a "kicker."

Brown was another husky man. He was the equal of Jones in intelligence, but was less shrewd and more conscientious. He knew how to take advantage of his work, and could, for a short time, move dirt as rapidly as Jones could. The trouble with him was that he could not keep from talking, and could not talk and work. As a result, he spent but little more than half of his time in actual work, and though his pay check was up to the average, it was not what it ought to have been if he had only been reasonably diligent.

Davis was probably the best man of the three, physically and intellectually, but he was inherently so abominably lazy that he had never learned to work and was the despair of all foremen. He was kept in the trenches because he was not worth his salt in any other place and we did not want to actually discharge him. Placed where he had to earn his money, he did make an effort to hold his own, but though to all appearances he worked harder than either of the other men, he was barely able to make minimum day wages. He had plenty of strength, but did not know how to apply it. He failed because he had no system, failed to give any thought to the way he was trying to do the work, and was actually too lazy to use his brain to save his muscle. The same condition existed all along the line.

**The Results of the Experiment.**—The first marked advantage was that noted above, the opportunity that it gave us of weeding out the undesirable workers from the day-wage forces. The next and undoubtedly most important feature was the marked esprit-du-corps that grew up rapidly in the entire force. It started with the emulation among the trenchers and extended rapidly back through the day-wage men. The knowledge that every man would be expected to "make good" or lose his position was very soon disseminated throughout the force, together with the further certainty that each man would be paid according to what he was able to accomplish, whether he worked in the trenches or by day wage, at least so far as we were able to adjust the compensation under the system pursued. This spirit was so marked and the stimulation that it exerted over the entire force was so great that we would have been decided gainers financially even if the actual cost of the trenching had been more than it could have been contracted for. As a matter of fact, the cost was about four cents per yard below what we could have hoped to get it done by contract.

**Where Piecework Payment is Practicable.**—The unanimous verdict was that the experiment had proved an unqualified success, and the only regret was that we had not applied it farther than we did. It is very evident that it would be impracticable to attempt to put all of the city forces on the piecework basis, but it was the consensus of opinion that, so far as it was practicable to apply the system, it should be done. The city will on the whole get better work for this reason. The foreman or inspector is anxious to keep the unit cost down, and will frequently pass up shabby work rather than put the city to the expense of making it good when it has been done by day-wage men, but if it was done by piecework he would insist on having it made good before certifying the job up for payment. Then the men themselves are much better satisfied. They get pay for what they accomplish. If there are any strikes under such a system it is because the employer is trying to squeeze out that last penny. The unit price should be such that the poorest man in the crew could make average wages. The cost would then be little, if any, more than under the day-wage plan, while the men would be getting so much more that there would be no incentive for a strike, and the indirect gains to the employer would be ample to warrant the adoption of the plan.

## METHODS OF HANDLING LIGHT EARTHWORK.

Mr. H. C. LANDON, general manager of the Watauga and Yadkin River Railroad Company, in North Carolina, writing in the *Railway Age Gazette*, makes some very useful observations from experience gained in the moving of 330,000 cu. yds. of earth, on 14 miles of his company's line. He includes details bearing upon labor employed and cost of work that should be of value. The article, as it appears, is as follows:—

The equipment necessary to grade a railroad depends largely on its location with reference to connections with other roads, the characteristics of the profile and the yardage to be moved in the several cuts to make the fills. In the construction of the Watauga and Yadkin River Railroad, which is building from North Wilkesboro, N.C., westward toward Boone, the fills are generally light and the cuts are not very heavy, although there are some comparatively heavy side hill cuts with a large percentage of rock. The difficulty of moving steam shovels far into this country on account of the very poor roads and lack of bridges, eliminate them from consideration, and a study of the profile therefore determined that the greater portion of the earth and rock must be moved with drag scrapers, wheel scrapers and explosives.

**Scrapers.**—The drag scraper can be used for very short hauls, but it was soon found that wheelers should be used for hauls over 60 ft., except in special locations where it is desired to move earth quickly and the distance is very short. A motion study developed the fact that with drag scrapers the speed of the mules was not over 7,200 ft. per hour, with a haul of 150 ft. on account of the frequent stopping to load the drag, and with a scraper force of six teams and a plow team the cost was about $0.20 per cu. yd. When the distance was not greater than 50 to 70 ft. the cost of moving by drag scrapers was not more than $0.12 per cu. yd., and earth has been moved for about $0.11 per cu. yd., where little or no plowing was necessary. Observations made on 110 ft. hauls with drag scrapers indicated that under the best conditions 25½ trips were made per hour, giving a speed of 5,600 ft. per hour and approximately 25 yds. per team at a cost of $0.17 per cu. yd.

As a general proposition the drag scraper is expensive in moving earth and should not be considered. A few drags on the job, however, are valuable and convenient, especially for special purposes. In one instance it was questionable whether it would not be cheaper to make a fill with drag scrapers from a borrow pit alongside and waste earth from a cut approximately 600 ft. away. It developed that the cost to make the fill from the adjoining borrow pit was approximately $0.12 per cu. yd., while the cost of hauling the material from the cut with wheelers was only $0.14 per cu. yd. To waste the cut and make the fill with drag scrapers would have cost not less than $0.24 per yd.

Observations of the wheeler forces showed that the speed of the wheelers with the above haul was about 133 ft. per min., or about 1.5 miles per hour. An average of 300 yds. per day was handled with this wheeler force of one foreman, nine wheelers, one plowman, one loader, one dumper, one snatch team and one four-mule plow team, at a total cost of approximately $34 per day. This force, therefore, handled 300 cu. yds. at an approximate cost of $0.146 per yd., and the amount handled could probably be increased if some system of premiums were devised. The low cost per team is due to the fact that the company owns its own teams and that $3 per day is considered a high price for teams in the locality in which this road is being constructed.

Careful observation showed that with a haul of 300 ft., nine wheelers averaged 55 cu. yd. per day per wheeler at a cost per cu. yd. very little above $0.09. The material handled was river bottom material, which is easily plowed and not difficult to handle, or a side hill cut with a subsoil of a reddish clay not much more expensive to handle than river bottom soil. Thirteen wheelers with 800 ft. average haul handled 300 cu. yds. per day at a cost of $0.168 per cu. yd. With this haul it was cheaper to move the material out of the cut into a fill that attempt to make the fill from the side ditch alongside, provided it was necessary to waste the material in the cut.

The advantage of the wheeler is in its capacity. The drag scraper requires from eight to ten loads per yd., while a No. 2½ wheeler requires but little more than two loads. The average speed of the teams operating wheelers in general is about 1.5 to 1.9 miles per hour, and on long hauls where there is no delay in loading, teams will make an average speed of 2.3 miles. On December 31, 1912, observation was made of two wheeler forces, both handling stiff red clay on side hill work. In the first instance, the force consisting of one plow team, one snatch team and six wheelers, with an average haul of 415 ft., made four trips in exactly 20 min., travelling through some mud, or at a speed of 9,960 ft., or 1.9 miles per hour. The second wheeler force using nine wheelers, one plow team, one snatch team and with an average haul of 510 ft., made seven trips in 48 min., equal to 1.7 miles per hour. Each wheeler in the first force should, therefore, make approximately 12 trips per hour, or 120 trips per day and handle nearly 60 yds. of material. In checking the record of one-half day this was approximately what the teams were doing. The longer haul should have been made with greater speed per hour, but the condition of the ground over which the material was deposited made the movement somewhat slower than that of the other force. Even at this rate the labor cost per cubic yard would not very much exceed $0.10, and under these conditions each team would handle 89 loads per day, or nearly 44 yds. per team.

With good teams and careful arrangement of the work the cost of wheeler work, even with hauls of 600 or 800 ft., can be kept down to a moderate price, provided the material is earth and can be plowed without much difficulty. The handling of material with drag scrapers where there is much rock is not very successful, although cuts have been handled successfully where material had to be blasted.

**Dump Cars.**—Four small dump cars of 2 yds. capacity were used in the work. As it was difficult to get light steel rails, wooden rails made of 4-in. x 4-in. timbers were provided. These cars were used to move rock at a tunnel approach and in short cuts where most of the material was rock, which was required for the fills. The cars were loaded by hand and the hauls averaged about 250 ft. The cost per cubic yard with this haul did not exceed $0.17. Where the haul was over 100 ft. the average gang loading cars, including drillers, was 14 men. This force would move about 150 yds., largely rock, at a cost of about $25.

Dump cars for short hauls, of approximately 100 cu. ft. capacity, have proved very convenient for disposing of earth, where the haul was short and speed was not a requirement. The average gang employed loading carts was about ten men, and such a gang would handle 75 cu. yds. per day at a cost of approximately $19.50.

**Powder and Explosives.**—The location of the line being largely on side hills and in places where there was little or no danger in moving earth and rock with powder, it was decided to move a large portion of the side hill cuts by this means. Up to this date approximately 5,000 kegs of powder have been used, moving approximately 50,000 cu. yds. At first it was difficult to get the foremen to use the powder, but we finally succeeded in arranging the work so that the entire section lying between the small runs on the hillside was drilled with the proper number of holes; about on the centre line, if in soft rock, or near the ditch line, if in hard rock, and from 10 to 17 ft. apart, depending upon the depth of the cut. These side hill sections were usually from 300 to 400 ft. in length, requiring from 30 to 40 holes. A No. 3 blasting machine was ordinarily ample to handle the shots. The first order of powder was for only 400 kegs, which was used in small units, but to very good advantage, moving approximately one yard of rock to every 2 lbs. of powder used.

One 80-ft. cut offered a serious problem. After a study of the situation it was decided that it might be possible to construct powder tunnels and blow off the top of the hill, thereby making an open cut. The line crossed a narrow ridge on a sharp skew which would enable the powder if properly used to throw the material away from the line. The first attempt was made at the west end of the cut, tunnels being driven at right angles to the line to the ditch line, and then both ways on the ditch line approximately 25 ft. above grade. It was supposed that a thorough study had been made of the material, which was generally stiff, hard clay or rotten rock, but it developed that a very hard rock existed on the west end of the tunnel parallel to the line. This disturbed the calculations somewhat. Only 400 kegs of powder were used to make the blast, the powder being placed in paper flour sacks and loaded in a compact manner in the tunnel, approximately filling it, the tunnel being 4 ft. wide and 5½ ft. high. Electric exploders attached to five or six sticks of dynamite were placed in the tunnel at intervals of approximately 25 ft. on the connecting wire lines. The end of the tunnel was tamped very thoroughly. The explosion which followed moved a large amount of earth, and earth which would have had to be removed finally to get to the mouth of a tunnel, which is now being constructed. However, while about 8,000 cu. yds. of material was moved the blast did not do the work expected. The hard rock west of the main tunnel proved of such great resistance that scarcely any material was moved at the summit of the cut, indicating that not enough powder had been used at any point in the tunnel and that the powder tunnels were not properly loaded to move the earth above and beyond the tunnels. The tunnel at the east end was then more carefully planned. Small tunnels were extended out 25 ft. at right angles to the main bore so as to reach approximately the north ditch line. The powder tunnel indicated that most of the material was rotten granite rock, not very difficult to move. It was estimated that about 15,000 yds. were to be moved and it was decided to use only 20,000 lbs. of powder. This powder was loaded in the tunnel in paper sacks as in the previous case. The exploders and the line were placed in the tunnel at approximately the same intervals as in the first instance and were all carefully tested. The total length of this tunnel was 245 ft., the powder filling all but 30 ft. of it. This blast moved approximately 14,000 yds. of earth.

Several other large blasts have been successfully made along the route in side hill cuts on different sections of the line, moving almost one-half yard of material for every pound of powder used. In one cut, estimated at 8,000 yds., 95 per cent. of which was solid rock, 33 holes were driven in two rows, the upper row being approximately 20 ft. deep and extending 2 ft. below grade, while the lower holes were 16 ft. deep, extending 6 ft. below grade. The holes were expanded twice; first by using five or six sticks of dynamite, and then by using 25 or 30 sticks. This material was all rock, and the second expansion of the holes was necessary, although it is believed that one expansion of the holes, using 10 or 12 sticks of dynamite would have given better results, as the second expansion tended to fill the holes rather than open them up to sufficient size. An average of 11 kegs of powder was used in expanding the upper holes and 13 in the lower holes. The results of this blast were very satisfactory, 378 kegs of powder being used, moving fully 7,000 cu. yds. of rock. A No. 3 push down battery was used in this explosion, although this was overloading the battery slightly.

In all the smaller shots that are being made, the foremen are instructed to use powder judiciously, and they are getting good results with a minimum amount of powder. The holes made on the centre line to a point about 2 ft. below the grade line and are spaced a distance apart equal to the depth of the holes. It is found that the holes drilled on the centre line and to this depth below the grade will ordinarily pull down the grade about the amount desired, and will not move the earth too far back of the slope line where soft rock is handled. In some locations where we have encountered a very hard granite the upper holes are placed on the ditch line. Steam drills are used with hard rock, while a large percentage of the other holes are put down by hand and churn drills.

The total yardage in grading 14 miles of the road is 330,000 cu. yds., 20 per cent. of which is rock. This was moved with an average of 72 teams, 200 men, 150,000 lbs. of powder and ten tons of dynamite in less than six months. The average labor cost of moving earth was $0.15, and rock, $0.36. The wages paid for common labor were $1.40 per day, drillers $1.60, and hired teams $3 per day.

## DRYING PEAT FOR GAS PRODUCERS.

A recently issued French patent describes a process whereby disintegrated peat is pressed into a thin cake between two endless filtering bands which pass between perforated metal supporting plates or over a metal pulley and are suitably tensioned. The moisture in the peat is thus reduced 60 to 80 per cent. The peat is then further dried by exposure to hot air or to the heat of the sun. A suitable hot-air dryer comprises a chamber through which large quantities of hot air are blown in the upward direction, whilst the peat cake, in small pieces, travels from the top downwards in a zig-zag path on a series of endless bands.

## SHOP TRANSPORTATION SYSTEMS.

By Henry Grattan Tyrrell.
Consulting Engineer, Evanston, Ill.

ALMOST all industrial works are now provided with shop cranes for lifting heavy weights, but many are lacking in facilities for the economic handling of small parts. It is still a common sight to see slow-moving cranes of large capacity lifting pieces that are just too heavy for loading on trucks by hand.

The principle must be maintained that materials in process of construction should pass through the works in the most direct course, with the fewest side detours and no backward movements. The production from a shop may be compared to the discharge of water through a pipe. In the latter case, the volume of discharge depends on two factors: (1) the size of the pipe, and (2) the rate at which the water moves. The size of the pipe corresponds to the proportions of the buildings and the number of employees and machines, and the velocity to the rate at which the men can perform their work. With the plant limitations fixed in reference to its equipment, the rate of performing work is, perhaps, the chief factor in production. Much has been written in reference to human efficiency, and the best methods of securing a full day's service from the workmen, and too little about assisting him with convenient appliances. A man's producing power in a factory is limited by his tools, and the lifting and transporting systems are among the most important. As every hour of a workman's time is a definite expense, he should have enough assistance that no time need be wasted.

The subject of "Shop Cranes" is so large that little or no attention can be given to it here, for it is thoroughly covered in several comprehensive volumes. The other transportation facilities include: (1) locomotives, (2) hand-cars, trucks and carts, (3) trolleys on mono-rails, (4) conveyers, moving platforms, transfer tables, etc.

At a first glance it might seem best to install a single lifting appliance large enough to meet the maximum requirements of size and weight. But further thought will show that principle to be erroneous, the economic arrangement being to handle large pieces with heavy machines and smaller pieces with lighter ones. The principle corresponds with the well-known one on railroads, that smaller cars are preferable to larger ones for small loads and frequent stops. Neither is it economical to invest so much money in handling appliances, that the whole needs of the plant in this direction can be served in a small portion of the day and then remain idle, for a large proportion of capital invested is then unproductive for much of the time. Between a lack and a surplus of transportation system there is a mean where only enough money is expended to just suit the regular needs.

**Trolley Systems.**—Overhead trolleys carry their loads in suspension from an elevated track, and in this way differ from floor transportation. They are appropriate when a floor is covered with litter where trucks would be obstructed in their movements. They are cheaper than travelling cranes, and most efficient for continuous service. In crossing a stream between buildings the trolley may run on a wire rope. They are suitable for handling weights up to a maximum of five or six tons, though they have occasionally been used up to ten tons. Out of doors they can hang either from a light trestle or from brackets on the side of buildings, and they can turn corners of small radius. For continuous service, the loaded trolley on a down grade will haul back the empty one, and for passing from one story to another the trolleys move on an incline, though for intermittent service they can be taken on an elevator. They are suitable when only a simple arrangement of trolley tracks are needed, and not when the tracks would be numerous or complicated. They have the advantage of turning sharp corners easily, and in winter are free from obstruction from snow and ice when yard tracks on the ground would be blocked up. For conveying small parts, they may be supplied with a metal basket carrier, similar to those commonly used in stores, and for heavy loads of a ton or more they should have a motor. In some cases it will be economy to use a "man trolley," with an operator's cage and a man aboard for controlling all movements, as in some of the modern coal and ore-handling machines, where the trolleys travel at the rate of 1,000 feet per minute.

The best form of track is that of curved metal in inverted U form, with treads for double wheels, with the weight suspended between them. It is similar to a common form of track used for large rolling doors. Flat bars on edge are also used with a single line of wheels, and rolled steel beams with double wheels running on the lower flange. They can have switches and cross-overs, but, after all, trolley systems serve only the floor directly beneath them.

**Conveyer Systems.**—Shop conveyers are of many kinds, including those of chain and belts, with fingers or boxes attached for carrying packages. Plain belts, held in a grooved position by side rollers, are good for certain purposes, and are often preferable to those with baskets. Table conveyers, or moving platforms, are used for carrying boxes or lumber, and circular conveyers are often convenient in foundries for sand and moulds. Multi-story shops should have elevators or moving stairs, especially where women are employed, for the energy wasted in stair-climbing could better be spent in useful work. Electric elevators with automatic floor signals, which need no operator, but which stop at the floor indicated by the button which the occupant presses, are now a favorite for workshops, but should be often and carefully inspected.

Where the floor is clear enough to permit the movement of floor trucks, these are often very convenient, as they can be shoved about anywhere. For cement or granite floors, they should have a slightly rounded tire, preferably covered with hard rubber.

Pneumatic tubes, like those in department stores, may be installed for the transfer of mail or small goods, and speaking-tubes are convenient between adjoining floors or rooms. A private telephone system connecting all departments is a great economy, and it should have branches wherever time can be saved thereby.

**Yards and Tracks.**—The arrangement of the yards includes the driveways, pavements, tracks, switches, yard-cranes, scales, car and locomotive sheds, watch-houses, fencing, etc. Brick pavement around works is easy to walk on and gives horses a good foothold, though preserved wood blocks are often preferred.

The track arrangement will require careful study, and the best plan will depend on the plant. A small manufactory with only very light products can, perhaps, be well enough served by a stub-end track or spur, while a works where many cars are handled must have a better system. A loop arrangement may then be the best, on which cars can move continuously in one direction and avoid much switching. Yards should generally have a system of narrow service tracks, but a broad gauge for receiving, storing and shipping is of the first importance. None but very small plants can afford to be without a railroad connection, three or four cars per month being reason enough for installing at least a spur track. Large plants should, to avoid congestion, either have a loop system, as mentioned above, or a double connection to the main line, with enough track for storing the maximum number of cars. Unless material moves freely and without useless switching, there will be loss of time.

In choosing between circuits and stub-ends switches, the latter may be good enough, though continuous track is better. The economic arrangement of yards is more difficult to plan in an old plant than a new one, where space is unlimited and unobstructed. Parallel tracks can be arranged in the form of "ladders," with switches, on which cars can be sorted. Wide-gauge curves should have a radius of not less than 235 feet, and the cost may be roughly estimated at $1.50 to $2 per lineal foot.

Narrow-gauge tracks should usually connect all buildings and yards, and they should be freely used about the plant wherever goods are carried. They are, in fact, a necessary supplement to the broad-gauge lines, which cannot be generally used because of the long radius required at the turns. Double lines should not be closer together than about six feet on centres, and if turntables are used at the junctions, their base should be down below the frost line. The gauge of these narrow tracks may be anywhere from 15 inches up to the standard width of 4 feet 8½ inches, though 30 inches is about the best. The minimum radius for curves is 12 feet for 21-inch gauge, and 40 feet for 30-inch gauge. Rails weighing 40 pound per yard are heavy enough for ties 24 inches apart, though in some places I have prescribed lighter rails. Their tops should never stand above the shop floors, and wheel flanges on the trucks should not be flat, but slightly tapered as on steam railroad cars.

**Yard Motors and Hoists.**—Yard motors include locomotives, propelled either by steam, electricity or compressed air. Where electric power is available, the electric locomotive is usually the cheapest, cleanest and most convenient, but the steam railroads often object to electric locomotives using their tracks. Where much inflammable material is piled about, such as in lumber yards, a steam engine is dangerous, and electric or compressed air motors are then preferred, though the latter requires the installation of expensive compressors especially for this purpose. When tracks enter buildings, steam engines are not desirable because of their smoke and gas.

Where the overhead trolley wires would interfere with cranes or other appliances, electric locomotives can have a connection through a continuous floor slot, or when entering a building, the trolley wire may be made to uncoil in advance of the car and furnish it with power, and coil up again as the car is withdrawn. A combination of electric motor car and derrick is a very convenient yard machine.

Yard cranes covering the whole storage and loading space are economical in many places, and for heavy goods gantry cranes need no obstructing ways, and in this respect are desirable. They may be of either the bridge or cantilever type, the load capacity in the latter case being limited by the resistance to overturning on the central track. In many large works, such as steel plants, material in course of manufacture is never touched by hand, all operations being mechanical from receiving the raw material to shipping the finished product. Shop cranes may be arranged to run outside of the buildings and connect with the yard system.

The rule generally in installing shop transportation systems is to use mechanical appliances wherever the saving of time and labor would more than pay the interest on the money invested in such extra equipment.

## CANADIAN PACIFIC RAILWAY BARGE FOR NELSON, B.C.

The car transfer barge which is being built by the Polson Iron Works, Limited, Toronto, for the Canadian Pacific Railway will be used for transferring cars on the Kootenay Lakes. Its length over all is 224 feet, beam 42 feet 6 inches, and 8 feet in depth. The accompanying figure shows general plan, longitudinal bulkhead and bracing.

The frames for the bottom of the barge are 7 x 3½ x 3½ x ½″ channels. The sides are 5 x 3 x ⅜″ angles, and brackets 18 x 18 x ⅜″, and to the side framing at bilge by 30 x 36 x ⅜″ flange brackets.

The decking consists of ⅜-inch steel throughout. The shell plating is also to be ⅜ inch in thickness, while the sheer strake and keel plate will be of 7/16-inch steel.

The fender channel will be of 8-inch shipbuilding section. It will be provided with bosom plate of 7/16-inch steel, and flush riveted holes in the channel web for receiving the wooden fenders.

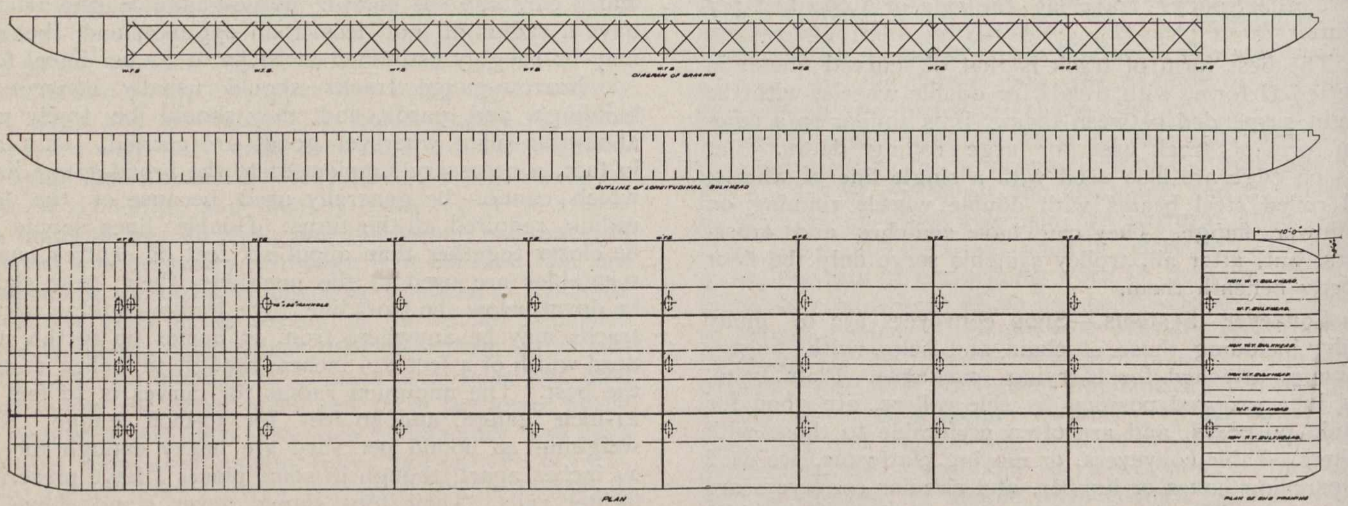


Fig. 1.—Plan and Sections of C.P.R. Transfer Barge.

scarphed for 18 inches to the channels. They are spaced 23 inches between end bulkheads. The frames in the fore and aft compartments are to be 5 x 3 x ⅜″ between tracks and increased to 6 x 3½ x 7/16″ in the way of the tracks, as shown on plan. It will be noticed that they are placed fore and aft instead of athwartships. The vertical side framing will also consist of 5 x 3 x ⅜″ angles placed 24 inches apart. In the end compartment the framing will be bracketed at the end to the end bulkhead and deck with 5/16-inch bracket. The channel frames themselves are to be bracketed to the longitudinal bulkhead by

The barge will have nine transverse bulkheads of ¼-inch plate and six longitudinal bulkheads, each 5/16 inch in thickness. They will be extra heavily stiffened and braced with plates, channels and angles.

The barge when completed will be capable of handling fifteen loaded cars at a time. It will be provided with three tracks upon deck for this accommodation.

The hull is being erected at the contractor's yard in Toronto. After completion it will be taken down, shipped to Nelson, B.C., and there re-erected and riveted. It is expected that the delivery will be made this fall.

## CEMENT PRODUCTION FROM RAW MATERIALS.

Covering a period of fifteen years, the following table shows the United States production of Portland cement in barrels, and the percentage of total output, for each type of raw material used in its manufacture, as prepared for the United States Geological Survey report on the United States mineral resources for 1912:—

| Year. | Cement rock and pure limestone. Quantity. | Percentage. | Limestone and clay or shale. Quantity. | Percentage. | Marl and clay. Quantity. | Percentage | Blast-furnace slag and limestone. Quantity. | Percentage. |
|---|---|---|---|---|---|---|---|---|
| 1898 | 2,764,694 | 74.9 | 365,408 | 9.9 | 562,092 | 15.2 | ...... | .... |
| 1899 | 4,010,132 | 70.9 | 546,200 | 9.7 | 1,095,934 | 19.4 | ...... | .... |
| 1900 | 5,960,739 | 70.3 | 1,034,041 | 12.2 | 1,454,797 | 17.1 | 32,443 | 0.4 |
| 1901 | 8,503,500 | 66.9 | 2,042,209 | 16.1 | 2,001,200 | 15.7 | 164,316 | 1.3 |
| 1902 | 10,953,178 | 63.6 | 3,738,303 | 21.7 | 2,220,453 | 12.9 | 318,710 | 1.8 |
| 1903 | 12,493,694 | 55.9 | 6,333,403 | 28.3 | 3,052,946 | 13.7 | 462,930 | 2.1 |
| 1904 | 15,173,391 | 57.2 | 7,526,323 | 28.4 | 3,332,873 | 12.6 | 473,294 | 1.8 |
| 1905 | 18,454,902 | 52.4 | 11,172,389 | 31.7 | 3,884,178 | 11.0 | 1,735,343 | 4.9 |
| 1906 | 23,896,951 | 51.4 | 16,532,212 | 35.6 | 3,958,201 | 8.5 | 2,076,000 | 4.5 |
| 1907 | 25,859,095 | 53.0 | 17,190,697 | 35.2 | 3,606,598 | 7.4 | 2,129,000 | 4.4 |
| 1908 | 20,678,693 | 40.6 | 23,047,707 | 45.0 | 2,811,212 | 5.5 | 4,535,300 | 8.9 |
| 1909 | 24,274,047 | 37.3 | 32,219,365 | 49.6 | 2,711,219 | 4.2 | 5,786,800 | 8.9 |
| 1910 | 26,520,911 | 34.6 | 39,720,320 | 51.9 | 3,307,220 | 4.3 | 7,001,500 | 9.2 |
| 1911 | 26,812,129 | 34.1 | 40,665,332 | 51.8 | 3,314,176 | 4.2 | 7,737,000 | 9.9 |
| 1912 | 24,712,780 | 30.0 | 44,607,776 | 54.1 | 2,467,368 | 3.0 | 10,650,172 | 12.9 |

# The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of
CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MINING, MUNICIPAL HYDRAULIC, HIGHWAY AND CONSULTING ENGINEERS, SURVEYORS, WATERWORKS SUPERINTENDENTS AND ENGINEERING-CONTRACTORS.

Present Terms of Subscription, payable in advance
Postpaid to any address in the Postal Union:

| One Year | Six Months | Three Months |
|---|---|---|
| $3.00 (12s.) | $1.75 (7s.) | $1.00 (4s.) |

Copies Antedating This Issue by More Than One Month, 25 Cents Each.
Copies Antedating This Issue by More Than Six Months, 50 Cents Each.
ADVERTISING RATES ON APPLICATION.

JAMES J. SALMOND—MANAGING DIRECTOR.
H. IRWIN, B.A.Sc., EDITOR.
A. E. JENNINGS, ADVERTISING MANAGER.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont.
Telephone Main 7404, 7405 or 7406, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."
Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum, Editorial Representative, Phone Main 8436.
Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.
Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor
The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910

NOTICE TO ADVERTISERS:
Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

NOTICE TO SUBSCRIBERS
When changing your mailing instructions be sure and give your old address in full as well as your new address.

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

Vol. 25. TORONTO, CANADA AUG. 28, 1913. No. 9


## CONTENTS OF THIS ISSUE.



## MUNICIPAL ENGINEERING AND PUBLIC HEALTH.

At the convention of the Public Health Association in Regina, September 18th, 19th and 20th, the municipal engineers of Canada should have a strong representation, this branch of the profession being so closely associated with the health and development of communities. A special section has been arranged for engineers and architects and, in glancing over the list of papers to be read to this section, as appearing in last issue of *The Canadian Engineer*, the proceedings of the meeting will be carried on largely by and for the benefit of municipal engineers, which should be an incentive for them to attend. Papers to be read at other sections have a similar bearing upon the development work of municipalities, and, taken altogether, city and town engineers should turn out from quite a distance to this three-days' convention. The fact that some of them are not overburdened with development work at present is another argument in favor of their participation.

A suggestion has been made that those municipal engineers who attend this convention should hold an informal meeting at some convenient hour during its progress to discuss the feasibility of forming an organization primarily for municipal engineers. The idea of an association has certainly met with favor as many engineers have taken the time to write approving of the suggestions made in discussing the subject in our issue of July 10th. The opportunity, then, for exchanging views on the proposed organization will be welcomed, and should act as an added incentive for all to attend the Regina convention who possibly can. Although the gathering will not be sufficiently representative of Canadian municipal engineers to take any inaugural steps, the wisdom of collection of as many valuable suggestions as possible is apparent. Further, those who contemplate being present should signify this intention so as to add weight and make the proposed informal gathering a surety and a success.

## ORGANIZATION AMONG MUNICIPAL ENGINEERS.

There seems to be unanimity of opinion among municipal engineers in Canada with regard to the lack of an official body as exists in other branches of engineering. Doubtless the municipal engineer, in his isolated position, needs an organization whereby his branch of the profession can stand alone. Municipal engineering is one of the younger branches of the profession, and like it, is an evolution of the artisan rather than of the early scientist. The engineer's work is becoming more scientific because of his relations and associations with the scientific world. These relations must become closer for the more direct application of science, through the municipal engineer, to the growth, health and general development of his municipality. He stands between a scientist and the work-a-day world with a keen appreciation of the value of the work of the one, and a ready understanding of the needs of the other; and his work consists in transforming the abstract results of the former into practical usefulness for the latter. His number is increasing and the intricacies associated with his professional duties will probably never subside. He is an indispensable member of the learned profession of civil engineering, whose growth during the past decade would support claim to being a veritable profession of progress. As the larger portion of the immense material advancement of the world during the past century is due primarily and pre-eminently to its engineers, so has the tendency towards concentration of population, devolving from this advancement, necessitated the employment everywhere of the municipal engineer.

Again, the function of the municipal engineer appears to include everything but boundary. Civil engineering, as the term is understood generally, includes so many phases of useful construction that the ordinary citizen unfamiliar with the scope of municipal work, is disposed to consider this a very specialized branch. Yet it is scarcely practicable to draw a line between the profession, as a whole, and the duties of the municipal engineer. The former includes the design and construction of bridges, viaducts, wharves, piers, docks, canals, dams, irrigation works, retaining walls and other heavy masonry; tunnelling and extensive and difficult foundations; river improvements, harbors and waterways; water supply, sewerage, filtration and treatment of refuse; highway construction, surveying; railways (steam and electric); the general design and construction of power plants (steam, electric and hydraulic); of lighting plants (electric and gaseous); the heavier structural features of office and industrial buildings; the general problems of transportation, etc., etc. Has not the municipal engineer to be equipped with an up-to-date working knowledge of practically every item that one may classify under the heading of "Civil Engineering?"

Further the term "Civil Engineer," as upheld by the Canadian Society of Civil Engineers, the American Society of Civil Engineers and the Institution of Civil Engineers, covers thoroughly the field of the municipal engineer.

This brings us back to the opinion we expressed in July 10th issue of *The Canadian Engineer*, concerning the contiguity that would exist between the two if an association of municipal engineers were formed as a body separate from the Canadian Society of Civil Engineers. We believe that the existing Society will be more useful to a man engaged in municipal work, in establishing for him an association with engineers who, like himself, must keep in touch with the activities of all branches of engineering, and with the newer methods of scientific investigation, than would an institution, newly formed expressly for municipal engineers, many of whom are now members of the Canadian Society. The assertion is made with a belief that there are too many engineering and technical societies now existing in Canada, and also that among them there is none with a membership more difficult to build than that of the prospective organization.

A municipal engineers' section in the Canadian Society of Civil Engineers will give its members the best opportunity of forming for themselves a strong institution, coherent in itself and bearing directly upon all engineering applied to municipal development. It will have a strong organization behind it, and will continue to add strength to that organization as its membership increases.

Once formed, the establishment of sub-sections in the present branches of the Society throughout the Dominion and of other advantages, as for instance, a circulating library among these sections, equipped with the latest works on subjects allied to municipal engineering, will not be long in elevating that branch of the profession to what it should be, viz., one of the most inviting, from its present status, one of the least.

## LEAGUE OF AMERICAN MUNICIPALITIES.

The seventeenth annual convention of the League of American Municipalities held recently in Winnipeg, brought forth a number of addresses and discussions on topics of more than usual importance. Mayor Deacon opened the convention with an address of welcome, responded to by Mr. John J. Ryder, superintendent of police, sanitation and public safety, Omaha, Neb., as president of the League.

Among the addresses made and topics discussed were the following:

C. J. Driscoll of the Bureau of Municipal Research, New York, formerly a police commissioner of that city, spoke of "Municipal Efficiency" with particular reference to the police departments. Mr. Driscoll's paper was a consistent argument for the expert in municipal affairs, mainly on the ground that municipal business is like any other business and requires long study and the application of scientific principles, if it is to reach the state of efficiency to which the people as ratepayers are entitled.

W. A. Larkin, street commissioner, Baltimore, read a paper on "Baltimore Street Cleaning and Garbage Removal." He mentioned particularly the good work of washing machines in keeping down the dust. In the discussion following, C. L. Willert said that Buffalo is one of the cleanest cities in the country.

Ossian Lang, Mt. Vernon, N.Y., president of the board of aldermen, read a paper on "Popular vs. Expert Government," in which he argued strongly for the popular representative form on the ground that the people themselves are nearly always right and that they have an unerring faculty for disposing of the man who has not proved his worth or efficiency. He described the professional expert as a man who thinks more of his job or his profession than of the interests of the community he may happen to be serving, and who is always ready to move along to any place that offers him more money.

In speaking on "Municipal Finance," W. Sanford ex-mayor of Winnipeg, reviewed briefly the history of municipal loans, noting that they were unknown two hundred years ago. Drawing from his own experience, Mr. Evans said that Winnipeg had found London to be the best market for the sale of its securities. The demand in London was for listed securities regularly dealt with in the stock market. Winnipeg is now issuing 1943-63 stock, that is, securities redeemable in that period. A large volume of securities was a benefit and a large list of holders as tending to make transfers possible without loss.

Charles L. Willert, councilman, Buffalo, N.Y., spoke on "Small Parks." He said that large parks chiefly benefited the owners of carriages and automobiles. Small parks attract the common people.

John B. Martin, election commissioner, Boston, Mass., spoke on "New Charter and Election Laws." The paper dealt principally with the new charter of the city of Boston and other local conditions.

Col. H. N. Ruttan, city engineer of Winnipeg, presented a paper on "Physical Construction of Cities," which brought out a lengthy discussion. "Municipal Light and Power" by J. W. Cockburn, controller, Winnipeg, and "Recent Development in Municipal Administration in Canada," by T. A. Hunter, K.C., corporation counsel, Winnipeg, were among the papers presented by Canadians at the convention.

## QUANTITATIVE ESTIMATION OF GROUND WATERS FOR PUBLIC SUPPLIES.*

By Myron L. Fuller, Consulting Engineer, Boston, Mass.

THE development of water supplies from surface sources has long received the careful consideration of hundreds of engineers, including many of the most prominent in the country. The questions involved have been earnestly attacked, thoughtfully considered, carefully weighed, and painstakingly solved, not only for the large cities, but for the smaller municipalities, towns, and villages as well. The best thought of our best men has been freely given to the subject.

Ground-water supplies, on the other hand, with a few exceptions, have rarely received more than the passing attention of engineers. The problems, lying, as they do, outside the usual limits of the engineer's training and experience, have seldom been studied with anything like the same degree of thoroughness as the surface supplies. Too often, he has assumed, because they have been obscure to him, that the occurrence and movements of ground waters follow no definite laws, and that the securing of adequate supplies is, in most cases, a mere matter of luck.

In reality, the principles controlling the collection, absorption, storage, motions, and recovery of the waters within the ground are as definite as those governing upon the surface, and are worthy of the same serious consideration that has been given to the latter. If this is given them, their problems are equally open to solution, and the prediction of supplies will become a matter of comparative certainty rather than a mere conjecture.

**Factors in Ground Water Estimates.**—In any attempt to estimate available ground waters, a certain number of factors common to all localities must be carefully considered if the deductions are to be of value. These may be stated as follows: 1. Nature of water-bearing materials. 2. Storage capacities of water-bearing formations. 3. Availability of supply. 4. Area tributary to wells. 5. Velocity of underflow. 6. Rate of replenishment.

In the vast majority of cases the knowledge of the foregoing factors is practically confined to the first. In not more than one out of ten wells is there an adequate knowledge of storage capacity, rate of yield, or tributary area, while in hardly one in a thousand is the velocity or rate of replenishment seriously investigated. All the factors enumerated are susceptible of approximate determination and, when known, greatly restrict the range of errors of estimation.

**Determination of Water-Bearing Materials.**—The determination of the character of materials to be encountered in a well is not simple. In many instances the surface affords little indication of what lies beneath. The glacial deposits which overlie the rock in New England are highly variable in character and may range from loose sand to dense hardpan within an interval of a few feet. The depth of such deposits is subject to abrupt changes within short distances.

The character of the solid rock lying beneath the surface deposits is often even more difficult to determine, for although some formations are of nearly uniform character over wide areas, others change rapidly. In a large number of cases the changes occur beneath valleys where the rock is deeply buried.

The determination of the character of the rocks at considerable depths below the surface is seldom an impossible task; it may usually be made with a reasonable degree of accuracy. This work is properly that of the geologist, and the judgment of the engineer will ordinarily be of little value if the conditions are at all complicated. Too often he does not even know whether they are complicated or not.

An accurate determination of the character of the water-bearing materials is important, for upon it will depend the storage, the rate of yield, and the quality of the supply. The best information obtainable should be secured before drilling is begun.

**Storage Capacities of Water-Bearing Formations.**—The volume of the ground water depends directly upon the containing material, and if a quantitative estimate is to be made, the nature of the water-bearing bed must be accurately known, for upon it depends the character of the storage—whether in pores, in joints or fissures, in cleavage or schistosity plains, in solution passages or cavities, etc.

An intimate knowledge of the occurrence of ground water is again indispensable. Open cavities are encountered in rocks, but such openings are found only in limestones; in granites, sandstones and slates, there is no possibility of encountering such a passage. The supposed openings in the latter rocks, assumed to exist because of the sudden dropping of the tools while drilling, are simply soft streaks, consisting of clayey products of decomposition through which the drill penetrates at a single stroke. They are the result of the circulation of water within the rock, and will afford considerable water to wells. Water is found in the joints or fissures of granites, but the width of these is seldom more than 1/20 in. and is often less than 1/50 in., and few of them extend more than a few hundred feet, thus cutting off the possibility of a distant supply. These and other similar factors are of vital importance in the estimation of the yield of proposed wells.

**Availability of Supply.**—The availability of ground waters, or the quantity yielded to wells, has no relation to the storage capacity of the materials in which they occur. Often the formations containing the largest supplies will yield the least. In Table I. the first column indicates the volume of water actually contained in rocks and soils of various types, while the second shows the usual yield from the pores.

Table I. does not tell the whole story. For instance while clays will yield practically nothing to wells, they are of great value as feeders to underlying rocks, to which they slowly give up their water. In many instances the capacities of rock wells are probably doubled by the presence of their clay covering. Again, while the sandstones may show an ultimate yield of from 1 to 15 per cent. of their total supplies, the water often enters a well too slowly to be of value as a source of supply.

In fact, there are so many modifying conditions that the determination of the probable quantity of a proposed supply demands a thorough knowledge of ground waters and a careful study of local conditions.

**Area Tributary to Wells.**—The ultimate quantity to be derived from wells at a given point will be, other things being equal, proportional to the extent of the tributary area. It is not always a simple matter to determine the distance from which water will find its way

*From an address delivered March 12th, 1913, to the New England Waterworks Association, and appearing in the Journal of the association for June, 1913.

to a well, and a separate determination based on a careful examination, must be made at each locality. There are, however, certain general facts regarding the distances traversed by ground waters. Some of these are summarized in Table II.

The wide variations in the areas tributary to different sets of wells will be appreciated from an examination of Table II. The problems of source and tributary area are, naturally, geological in their nature and will require the services of a geologist for their solution. To one trained in this line they will ordinarily present few difficulties.

**The Velocity of Underflow.**—As in the case of a surface stream, the quantity of available ground water at a given point is determined by multiplying the cross-section of the moving water body by the velocity of its movement. This will give us the normal underflow, or, in other words, the maximum available supply; for, although it is possible to pump for a time from the reservoir (accumulated storage) within the ground, no more water can be obtained in the long run than is normally flowing within the limits of the area tributary to the wells.

Only in a very few cases has the velocity of underflow been determined in connection with the development of municipal supplies, although it is perfectly practicable where the water occurrs in unconsolidated material of reasonable uniformity and would undoubtedly prevent the waste of large sums in injudicious prospecting or unwarranted development.

**TABLE I.**

**Porosities and Yield of Rocks and Unconsolidated Materials.**

| Material | Storage Capacity or Porosity. Per Cent. of Volume | Normal Yield to Drilled Wells from Pores.* Per Cent. of Volume |
|---|---|---|
| Quartzites (average) ....... | ½ | None |
| Granites (average) ......... | 1 | None |
| Slate and shale (average) ... | 4 | None |
| Limestone and marbles (average ................... | 5 | None |
| Sandstones ................ | 5 to 25 | 1 to 15 |
| Gravel (mixed with sand) .... | 20 to 30 | 10 to 20 |
| Sand (medium to coarse) .... | 30 to 40 | 10 to 25 |
| Sand (fine) ................ | 30 to 40 | 5 to 20 |
| Clay ..................... | 40 to 70 | None |
| Till or bowlder-clay ......... | 20 to 60 | 0 to 20 |

* The figures in this column do not include the yield from fissures, joints or cleavage planes. Water remaining in rock is largely residual moisture held by capillarity.

The most successful process of measuring underflow is the Slichter method, described in the succeeding article. It can be applied by any mechanical or other engineer, but for the interpretation of results and more especially the determination of the extent of the tributary area, usually demands considerable geological knowledge and experience.

**Rate of Replenishment.**—An accurate determination of the rate of replenishment is of the first importance, for, no matter how great the storage and how large the tributary area, a large permanent supply will be obtainable only when the average absorption is at least equal to the quantity of water withdrawn.

In New England, the determination of the rate of replenishment is a comparatively easy matter, for we are here dealing with an area of abundant and well-distributed rainfall, relatively low evaporation and fairly simple absorptive conditions. In the western arid and semi-arid regions, on the other hand, the problems are more complex. There, the rainfall and evaporation are very irregular and it takes but little to disturb the balance and change a net gain to a net loss. When the loss by evaporation becomes greater than the rainfall, the replenishment can take place only by absorption of water from the streams, which often pour down more or less transient floods after heavy rainfalls. In such instances careful field observations, supplemented by laboratory tests to determine porosities and rates of percolation, are necessary to determine the rate of absorption and additions to the ground-water reservoir.

In the East, the problem requires a careful computation of the rainfall and an analysis of its seasonal distribution, together with a similar investigation of seasonal evaporation and plant transpiration and an accurate determination of the porosity, size of grain, rate of percolation, nature of vegetation and other minor factors regulating absorption.

**TABLE II.**

**Distances Traversed by Ground Waters.**

| Material | Usual Distance of Source from Well | Ordinary Maximum Limit of Transmission in United States |
|---|---|---|
| Surface sands and gravels | Less than 1 mile | 25 miles |
| Deep sands and gravels beneath clay or other confining layers ...... | Several miles | 100 to 200 miles |
| Sandstones near surface.. | ½ to 1 mile | 5 to 10 miles |
| Deeper sandstones ...... | Several miles | 100 to 300 miles |
| Limestones near surface.. | ⅛ to 1 mile | 10 to 20 miles |
| Deeper limestones ...... | Several miles | 100 to 200 miles |
| Slate or shale near surface | Less than 500 ft. | Rarely over 1 mile |
| Deeper slates or shales .. | Possibly several miles | Rarely over 10 miles |
| Granites ................ | Less than 1,000 ft. | Rarely over 2 or 3 miles |

NOTE.—Some rocks are water-bearing at greater distances from the outcrop than is indicated in the table, but it seems probable that the water has been absorbed by capillarity from overlying materials rather than derived by transmission from remote catchment areas.

**Limited Value of Test Wells and Pumping Tests.**—Engineers have frequently remarked that the only way to tell whether or not one has a supply is to put down a test well and make a pumping test.

With this view the writer does not at all concur, for it may be readily shown that pumping tests come far from furnishing complete data as to the availability of permanent supplies. What a pumping test shows and what it does not show is concisely summarized in Table III.

That a knowledge of the materials at the well is insufficient is indicated by the fact that it is the average section for the whole area and not its character at a single point that determines both storage and movement of the ground water. This is not furnished by a single test well.

The pump may deliver during a test very large volumes of water, but, except where the supply is very limited and hence readily depleted, the test shows nothing as to the supply permanently available. Many wells tap ground-water reservoirs containing the accumulated supplies of long periods, but the fact that half a million gallons may be withdrawn daily for a few days is no indication that the permanent yield will be more than a small fraction of this amount.

When the water table stands high in the ground, the entrance of the water into a well is relatively rapid, but the rate of entrance declines as the water table becomes lowered. The extent to which the supply will be affected can be determined only by a study of the tributary area, velocity of underflow and rate of replenishment, no indications of which are afforded by pumping tests.

It is well known that in heavily pumped wells the quality of the ground-water supply often deteriorates with the passage of time, although possibly not for some months or years, but the nature and extent of the change is to be predicted from a study of the character of the materials and of the geological structure rather than from a necessarily brief pumping test.

### TABLE III.—DATA FROM PUMPING TESTS.

Pumping tests show—

1. Character of material at well.
2. Presence or absence of water at time of test.
3. Rate of delivery when water is at maximum height.
4. Quality of water at start.

Pumping tests do not show—

1. Average character of material of tributary area.
2. Permanency of the supply.
3. Rate of delivery from depleted reservoir.
4. Quality of water after continued pumping.
5. Direction of movement of ground water.
6. Velocity of ground-water movement.
7. Source of water.
8. Extent of tributary area.
9. Rate of replenishment.

The direction of movement of the ground waters is of considerable moment in determining the liability of pollution by contaminating matter from the surface, or of the likelihood of the penetration of sea water or other mineralized waters from clays, shales, bog iron ores, peats, etc., but is not usually indicated by the pumping test.

Notwithstanding the limitations of the data furnished by pumping tests, they are of much value when their limitations are understood. They should, however, be regarded as adjuncts to ground-water investigations rather than as final in themselves.

## WATER POWERS OF ICELAND.

The undeveloped water-power of Iceland is receiving attention this season. The Delbi Falls, 35 miles from the coast, have been acquired by an English concern, engaged in the manufacture of nitrogen products, and with 410,000 horsepower at its command, the company will move all its factories from Peru and Chile to Iceland. Big factories are to be built in the vicinity of the falls and a railroad constructed to the coast. The ownership of the falls was purchased for the sum of $60,000.

What is claimed to be the largest bascule bridge in the world has just been completed at Portland, Oregon. This new bridge, which is 4,800 feet long, crosses the Willamette River, connecting Broadway Street on the west side with Broadway on the east side. It provided an easy grade thoroughfare from the business district to the large residence district on the west side. This type of bridge allows practically unobstructed water traffic up and down the river. It was built by the city at a cost of about $1,300,000. The bridge is lighted at night by 250 5-light and 2-light fixtures, together with an outline scheme of 7,000 lamps spaced 18 inches apart. One hundred-watt tungstens are used in the pole fixtures and 32-candle power lamps on the outline system. Current is supplied to the lamps over more than 12 miles of wire in metal conduit.

## TOWN PLANNING.*

**By Christopher J. Yorath, A.M. Inst. C.E. (Eng.), City Commissioner, Saskatoon.**

GREAT BRITAIN, by the passing of the Town Planning Act of 1909, took the first step towards the undoing of mistakes of centuries, and hopes by planning the future growth of existing and new cities to avoid the enormous expense occasioned through the lack of planning.

Until recent years it was thought that the checkboard system of planning was all that could be desired, but anyone who has studied the subject of town planning will realize at once that it is a failure, and has necessitated even in what are known as the New World cities large expenditure to rectify some of its many defects. How can a system be called a plan which does not take into consideration local characteristics, such as the undulation of the ground, a winding river, thickly-wooded spots and other amenities?

If Great Britain realizes the necessity of passing a Town Planning Act, surely such an Act would be of infinitely more use to Canada, which at present has only a population of about eight millions, or slightly more than that of London, while its area is 3½ million square miles compared to 112,000 square miles comprising Great Britain.

A careful study of what wise town planning, the liberal provision of attractive amenities can do, and has done, for some of the cities of Europe will convince the greatest anti-town planner of the wisdom of looking well ahead.

It invariably happens that town planning is not thought of or put into operation until a certain amount of development has taken place. In Great Britain this does not interfere to any great extent with the planning for the future, as the undeveloped land is not staked out into lots and held by numerous land-holders, but is usually in possession of a few; whereas in Canada, owing to the checkboard system and the selling of outlying plots far in advance of the time when the land is ripe for development, the proper planning of the future is rendered far more difficult, and probably in many cases the difficulties will be so great as likely to make a scheme impracticable without special legislation.

A city attractive by its beauty, by its artistic symmetry and design and convenience which it offers will gain a reputation and an individuality which not only its council and its landowners, but also its citizens, may be proud.

What, then, should be the aim of every city? and to answer that question we are at once thrown back upon the question of what should be the individuality by which the city should be marked and known. Bacon says in his "Essay of Gardens": "God Almighty first planted a garden. And, indeed, it is the purest of human pleasures, it is the greatest refreshment to the spirits of men, without which buildings and palaces are but gross handiwork." Surely, then, the aim should be the one implied by the term "Garden City," beautiful, well planted, and finely laid out, known and characterized by the charm and amenities which it can offer to those who seek a residence or dwelling removed from the turmoil, stress and discomforts of a manufacturing district.

The various systems of planning which have been adopted in the past are rectangular, radial and circumferential, and curvilineal, but the latest schemes for town

* Extracted from paper read at the Convention of the Union of Canadian Municipalities in Saskatoon, July 15th, 1913.

planning are generally a combination of all three, which allows for the best fulfilment of town planning ideals.

The problem, then, for the town planner is to consider his scheme in respect to:—

(a) The configuration and undulations of the site.

(b) Direction of main radial and circumferential avenues and boulevards.

(c) The layout and construction of avenues and boulevards.

(d) Open spaces, parks and recreation grounds.

(e) Tramways.

(f) Civic centre.

(g) Buildings—The space about the same; the limitation of the number of houses per acre, and the height and character of same.

(h) Restrictions of factories and works to special areas.

**The Configuration and Undulations of the Town Site.**—The beautiful sites which the Great Architect of the Universe has provided for many of our cities have been wantonly spoilt by the worst form of vandalism and the lack of a proper system of planning instead of providing a setting and vista by which the beauty of monumental and public buildings may be shown.

The first essential preparatory to the drawing up of a town planning scheme is to make a contour map of the site, with contours showing the rise or fall of the ground every five to ten feet. In addition, the map should show existing trees, places of historic or local interest, railways, existing public and industrial buildings, waterways, etc.

This map will enable the town planner to lay down the main avenues with the easiest possible grades; to preserve places of beauty; to establish the sites of the most important buildings so as to be in commanding positions; to design his storm and sanitary sewers so as to obtain the maximum amount of gravity flow, and to arrange his water supply in the most suitable zones to that the whole system of public utilities can be built up of units, which will ultimately become parts of a completed whole.

**Direction of Main Radial and Circumferential Avenues and Boulevards.**—In London and New York, and many other large cities, great inconvenience and expense is occasioned through not having the most direct means of transit between business, factory and residential districts, and proper connections between these centres and the different railway depots. Again, through the lack of circumferential avenues the traffic in the centre of the city becomes greatly congested.

It is imperative, therefore, in the planning of a city to exercise the greatest care and judgment in fixing the position and direction of main avenues. If possible, they should radiate from the centre towards the principal outlying districts north, south, east and west of the city, and be linked up with inner and outer circumferential avenues. By this means traffic desirous of crossing from one side of the city to the other can avoid the centre and more heavily trafficked streets, and in so doing prevent the congestion which so often occurs in the centre of old cities.

London is at present contemplating the construction of circumferential avenues in order to relieve the congestion which occurs in the centre.

In Vienna the Girdle Linie, or Outer Boulevard, is about eight miles in length; the total width between buildings is 248 feet. A separate strip of the road is set apart for the tramways and fast traffic; a continuous recreation ground or playing space is included in the scheme, well planted with trees to provide shade during the hot season.

Another circumferential avenue in Vienna is the Ring Street, or Hub, 178 feet wide. It has a central carriageway 41½ feet wide, which is principally used by fast and through traffic vehicles. On either side are the tramways on the electric conduit system. A riding track and promenade for foot passengers occupy the spaces between the trees, and slow and stopping vehicles find accommodation on the two outer roads.

These circumferential routes, which connect up the various parks and open spaces, are largely used by residents, motorists and cyclists as circular drives.

**The Layout and Construction of Avenues and Boulevards.**—It must be borne in mind that all objects in the street, utilitarian or otherwise, are things to be seen, part of an organic whole, each having their respective part and place.

Athens and Rome were each crowded with such objects, arranged for the most part in picturesque association. Although it will be impossible for young cities to expend much money, if any, upon beautification, beyond the planting of trees, a town planning scheme should allow for such improvements at some future date at a minimum of expense.

Long, straight avenues, with buildings of approximately the same height and no object to break the horizon, should be avoided. If natural scenic effect cannot be obtained, then provision should be made for some architectural feature to break the skyline. By careful planning it can generally be arranged to place a church, a public building, or artistically designed residence to break the monotony of long streets.

In Germany this branch of town planning is given careful consideration, and long avenues are usually broken by means of "squares," so that the line of sight will be met by a building, the architecture of which has been previously approved by the local authority.

In planning out the widths of main roads it is difficult to estimate what the future will demand, but in any case it will be better to err on the wide side rather than the narrow.

The various types of streets usually required in a city are:—

(a) Main business avenues, with provision for tramways and boulevards—width from 100 to 200 feet.

(b) Secondary business avenues, without provision for tramways—width from 80 feet to 150 feet.

(c) Semi-residential avenues, with provision for tramways, side and centre boulevards—width from 80 feet to 120 feet.

(d) Semi-residential avenues, without provision for tramways, but with side and centre boulevards—width from 80 feet to 100 feet.

(e) Residential avenues, without provision for tramways, but with side and centre boulevards—width from 60 feet to 80 feet.

(f) Secondary residential avenues, with carriageways to take local traffic only, with side boulevards and an established building line of 30 feet—width from 40 feet to 60 feet.

The main avenues should be laid out with 12-feet sidewalks, slow traffic carriageways next sidewalks, and boulevards on either side of a centre carriageway for fast traffic and tramways.

The secondary business avenues should have sidewalks of a minimum width of 10 feet, with a centre boulevard with wide grass margins, so that the actual paved carriageway can be widened as the business of the city extends.

In main and secondary business thoroughfares provision should be made for laying all sewer, water, electricity and other mains in underground conduits of sufficient size to allow of proper inspection at all times. The advantages of this method are:—

(1) The pipes being open to inspection at all times, leaks can be more easily located and repaired.

(2) The traffic is not inconvenienced by frequent openings for repairs.

(3) The enormous annual expense of opening trenches is saved.

(4) The surface of the carriageway, which soon becomes uneven if many trenches are made, retains an even contour.

The residential avenues can be so formed that the sidewalks have a boulevard on either side, which will provide space for pedestrians in the hot weather.

Railways, usually an ugly feature of every city, should be made less objectionable by boulevarding.

**Open Spaces, Parks and Recreation Grounds.**—In locating open spaces and parks, special consideration should be given to the preservation of places of natural beauty, such as woods, waterways, etc.

With the checkboard system of planning, a large amount of valuable ground is often wasted in the unnecessary provision of paved streets and passages. By carefully planning the main and secondary avenues, through traffic can be avoided and residential districts can be laid out in a far less costly manner, and part of the space occupied by paved streets being utilized for open spaces, tennis courts, and children's playgrounds.

Where individual gardens are not wanted, part of the land between the houses might be laid out as allotment gardens, or as gravel playgrounds, or as paved playgrounds, to prevent a lot of derelict gardens being attached to the houses.

People's parks are universally provided on the Continent within or close to the city's gates, namely, a large woodland garden or forest, intersected by drives and walks, and interspersed with spinnies and glades typical, as far as possible, of rural country.

It is the duty of every city to provide as early as possible, and before development makes the price of land prohibitive, suitable parks within easy access of the public.

Country life is acknowledged to be more healthful, more restful, more natural and less wearing than that of town. It should, therefore, be the aim of town planners to introduce into the home life of the worker conditions as far as possible which are common to the country, viz., quiet, the absence of distracting sights, sounds and influences and the introduction of works of nature.

It has become a very general rule in making arrangements for the development of land on modern lines in Great Britain to stipulate that one acre in ten shall be set aside as public or semi-public open spaces; this in addition to limiting the number of houses per acre.

**Tramways.**—The tramway system should follow the main avenues, and, as far as possible, each route should be linked up, one with the other, to form easy and suitable means of transit for the public to and from every part of the town. It should be arranged so that new lines could be constructed as the development of the town in a particular district required, yet be part of what would ultimately become a completed scheme.

The tramway system of Vienna is an admirable one. It has been described as follows: "The trams circle round the Ringstrasse, and the outgoing routes branch off like the spokes of a wheel. It soon becomes an easy matter to know where to leave the hub and take the necessary spoke."

**Civic Centre.**—The creation of a fitting civic centre is one of the most important matters which should be considered.

It should be dignified, impressive, whilst at the same time in harmony with the characteristics of the town itself and in keeping with the resources of the public.

Its situation should be as near the centre of the city as is possible, so planned that its architectural features and beauty can be seen from many points of vantage.

The buildings usually comprised in such a centre are the town and public halls, offices, sessions courts, museum, and art galleries, which, suitably designed and arranged in relation to each other, can, and should, form a civic centre worthy of the community.

**Buildings—The Space about Same; the Limitation of the Number of Buildings per Acre; Their Height and Character.**—The regulations with respect to buildings will be one of the most important parts of a town planning scheme, and will need very careful thought on the part of the local authorities.

In order to obviate overcrowding, it is essential that a maximum number of houses per acre should be adopted for different grades of property.

In limiting the number per acre it should be sufficient, in the case of land that is not planned out in detail, if it be stated that the rule should be so many houses to the acre, but that the requirements of the local authority would be satisfied if the average number was obtained over a certain area with due safeguards for the space about each house not being too small. There should also be a maximum number of houses stated, more than which should not be erected on any one acre.

Thus, if the number limited was 12 to the acre, the local authority might be satisfied if on any ten acres no more than 120 houses were built.

In residential areas the height should also be limited. Houses should not be built more than three stories, or more than a maximum height, to be defined.

It would seem desirable in planning an area that certain centres should be fixed where shops, schools, churches, institutes, and such like buildings should be grouped together.

The grading of districts and the planning out of the constituent parts which build up a city is an important consideration. The higher buildings should be fronting on the main arteries, gradually grading back to the residential property. Stores and offices will, of course, be placed along the main thoroughfares, and workmen's dwellings as close as possible to the factories in which the work people are employed.

**Restrictions of Factories and Works to Special Areas.**—It is very desirable in a town plan that the position of these should be fixed, and the people should not be allowed to place them where they like.

There will nearly always be natural places in a district which will be suitable for factories and workshops. Contiguity to the railway, easy gradients to same, and the position of the rivers, canals and streams should govern this in most cases.

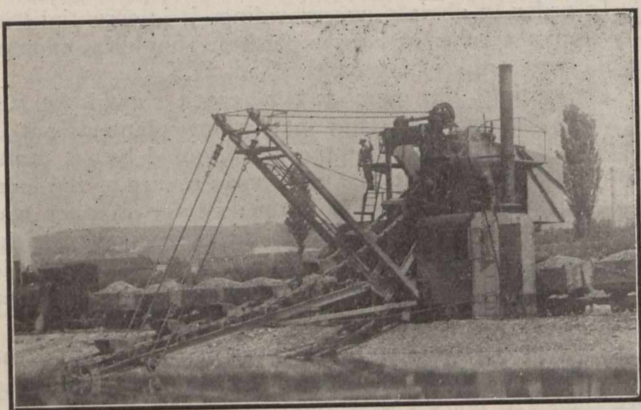
It is usually accepted as an established fact that factories are unsightly, with untidy and dirty surroundings, but in many places, particularly in Bourneville, in England, the headquarters of Cadbury's factory, the reverse is the case. The whole of the surroundings of the factory and the workers' houses adjoining are laid out on garden city lines, and is a model of what can be done to make a factory district more amenable than is generally the case.

## BUCKET LADDER EXCAVATORS FOR CANAL CONSTRUCTION.

While bucket ladder excavators are almost unknown in North America, they are extensively and with much success used in other countries for canal building. The canal, Alfons XIII., in Spain, joining Sevilla with the Atlantic, and projected to accommodate ships up to 10,000 tons capacity, is now nearing completion.

Four excavating plants, each consisting of one bucket ladder excavator, with portable water depot, two locomotives and forty square box dump cars, with the necessary track, switches, etc., built and supplied by the Orenstein-Arthur Koppel Company (general offices and plant, Koppel, Pa.), have accomplished the excavation in a surprisingly short time and at low cost.

The four bucket ladder excavators built for the construction of the canal, are designed for an actual capacity of somewhat over 200 cubic yards per working hour, excavating heavy soil. All four excavators are constructed to gauge and template, to make the repairs and the replacing of worn-out parts as easy as possible.



**Excavator Working in Gravel Pit.**

Bucket ladders of different patterns were supplied with each machine, firstly, for cutting down hills, thus fulfilling the same work as the steam shovel; and further, ladders for digging the bed of the canal to a depth of 50 feet, the digging being performed with buckets of special shape, mounted to a chain, which is supported by a ladder.

Two of the excavators supplied for this contract are fitted with the so-called "flexible" chains, and the others are equipped with "rigid" chains. The flexible chain is only in its upper part supported by the ladder, the lower part is hanging free, which means, that the chain has a fair amount of play in every direction. This is a great advantage should the buckets meet with large rocks, logs, etc., when digging, as on account of the flexibility of the chain, they will be able to jump over such obstacles or pass sideways. These excavators with flexible chains are constructed to dig to a depth of 33 feet below the rail level, and the embankments will have an inclination of 1 to 1.

The ladder is constructed of large dimensioned steel girders, well braced by diagonal and cross stays. The chain links are hand-forged, joined by connections made of a high-grade steel. Every fourth link carries a bucket of about 9 cubic feet capacity, making a total of 33 buckets to a machine.

The two excavators with "rigid" chains are constructed to dig to a depth of about 50 feet. This enormous depth necessitates the use of a bucket ladder of especially strong construction. The chains of this machine are guided all over by rollers working in ball bearings, thus cutting the embankments perfectly straight. The ladder can be set to work at depths of 25, 33, 40 and 45 feet. The adjusting requires a comparatively small amount of labor. The number of buckets furnished with the excavator is 26, of about 7 cubic feet capacity each. If these buckets meet with extraordinary obstacles, as rocks, logs, etc., which they cannot pass on account of the "rigid" chain, an hydraulic clutch automatically stops the movement of the chain, the engine running free until the obstacle is removed.

The lifting and lowering of the ladder on all the machines is effected by pulleys fitted to a double beam, as clearly illustrated on the cut. The transmission of power from the engine to the chains is made by means of tooth and cog wheels; strong springs are provided where it is necessary and advisable to diminish the effect of the shocks occurring during the work.

The excavator is constructed for running on track, the transmission from the engine to the axles being made by means of chains. It runs on 14 wheels, 10 supporting the front part and 4 the rear. The necessary power is provided by a large dimensioned boiler of locomotive type, located at the rear part. A water tank of about 750 gallons capacity, fitted underneath the boiler, supplies the necessary feed-water; further, coal bunkers are placed into this part of the machine, and a space for a counter weight, consisting of scrap rails, stones, etc., the quantity of which has to be increased the deeper the excavator is digging.

On a bridge joining the front and rear part the engine and a platform for the engineer are provided. All levers are worked from this platform, and this arrangement makes it possible to watch all parts of the machine during operation. The engine is of the compound type, having a rating of about 100 horse-power.

The earth lifted drops into a funnel chute when the buckets turn over the top part of the ladder. At the bottom of the chute a flap controls the filling of the dump cars, which are standing on the track, while the excavator travels along by its own power.

For each machine a transportable water car of 2,000 gallons capacity is in attendance. This car, combined with the water tank underneath the boiler, supplies sufficient feed-water for 10 working hours. The boiler is fed by an injector and a steam pump.

A three-rail track is necesssary for carrying the excavator, two rails for the front part, one rail for the four wheels of the rear part. Any 100 to 120-pound relaying rails can be used. Tracks for the dump car trains are running between these rails.

For moving the earth, stones, etc., 8 locomotives and 160 square box dump cars are used. The locomotives have cylinders 13″ x 16″, and work with 176 pounds boiler pressure. They are built with an underslung water tank, following the usual practice of the Koppel locomotives, as this arrangement puts the centre of gravity low and insures a smooth running of the locomotive, even if the track is not laid perfectly level. The tank will carry about 750 gallons of water and the bunkers about 3,000 pounds of coal. The dinkeys weigh about 54,000 pounds. The cars used are five cubic yard square box dump cars.

The track for the excavator is laid down parallel with the axis of the respective canal section. The machines are put to work, and, after digging a stretch of considerable length to the necessary depth, they will work their way back again, now running on a track which has been shifted further away from the edge of the canal, thus excavating another layer of 4 to 5 feet to the depth required. This shifting of the track backwards will be continued until the full profile of the canal is excavated. The earth drops into empty cars standing underneath the delivery chute, as mentioned above; as soon as one train is filled it is shifted away and an empty train is pulled along. A reasonable arrangement of the track will always provide empty cars in good time.

## BARGES PROPELLED WITH PRODUCER GAS ENGINES.

A fleet of large self-propelled barges, 15 in number, to ply between New Orleans and the coal fields of Northern Alabama is of peculiar interest in that they are the first craft of their kind in America to be propelled by producer gas engines.

The barges are of steel construction, and are similar in design to those in use on the canals of Holland. Their measurements are as follows:—Length, 240 ft., width on deck, 32 ft., width at bottom, 28 ft., depth, sides, 8ft., depth, centre, 8½ ft. Their capacity is 1,000 tons. Draft, when fully loaded, 7 ft. They are propelled by twin screws driven by twin engines and have a speed of approximately seven miles an hour when fully loaded. The weight of each barge and equipment is close to 240 tons.

The screws are driven at 300 r.p.m., by two 75 h.p. vertical producer gas engines. Gas is furnished by a 150 h.p. producer. The fuel used for the producer is what has heretofore been a waste coke from the ovens of the Birmingham district and which consequently is secured at a very low price. This coke is practically pea size. It has a calorific value of about 11,000 b.t.u., and the consumption is approximately 1 lb. per horse power. Bunkers are provided to hold about 15 tons of fuel. Each producer is equipped with scrubber, gas tank, tar extractor and is fitted with water bottom.


**Fig. 1.—First of Fleet of Fifteen Barges, Propelled by Producer Gas Engines.**

While the main power plant is of primal interest the auxiliary power equipment of the barge also merits mention. This consists of a 9 h.p. gasoline engine, which drives a centrifugal pump handling the ballast and bilge water, a blower, an air compressor and a 5½ k.w. direct current generator. Current is used for electric lights throughout the boat, fans in cabin and engine room, a 3,200 candle-power search light and a 5 h.p. motor. The arc light is mounted on the roof of pilot house and galley, which are immediately over the engine room. The motor is for operating an anchor winch. The generator is so mounted that when the large engines are running it may be belt driven from one of them. A second 4 in. centrifugal pump is also installed to be driven by one of the large engines through friction wheel contact.

A decided advantage of the self-propelled barge for use in these waters is that they can negotiate the numerous locks on the Warriors and Tombigee Rivers in much less time than if towed. Each lock can be passed in 20 minutes by these vessels, whereas more than an hour would be consumed by the towed fleet system.

The barges will make the trip from the mine region to New Orleans in 72 hours and with all 15 vessels in service, it is estimated that coal will be moved into New Orleans at the rate of 50,000 tons a month. Added revenue will be derived by the barges carrying freight on the return trip to the coal field. All the power equipment for the barges—engines, gas producers, motors, generators, pumps, air compressors, etc., was designed and furnished by Fairbanks, Morse and Company.

**Fig. 2.—Showing Barge Being Loaded.**

## SAWDUST FOR FLOORING.

Floorings are now being made out of sawdust concrete. The cement used consists of a solution of magnesium chloride to which pulverized magnesia is added. The sawdust is then used in any desired quantity. Floors manufactured in this way are more resilient than concrete, and are not good conductors of heat. They wear well, and do not burn, charring under the fire test.

## WATER WASTE IN NEW YORK CITY.

During 1911 and 1912, on account of a threatened shortage in the supply, a vigorous campaign to prevent water waste was carried on in New York city. The methods generally employed were as follows:—

(1) The attention of consumers was called to the necessity for checking waste.

(2) A house-to-house inspection was carried on in order to detect and repair leaks.

(3) An examination was carried on with the object of locating and repairing underground leaks.

(4) Connections were metered where the cost of metering and the existing conditions of the supply warranted this measure.

The results obtained were noteworthy in many respects. The estimated daily reduction in consumption in Manhattan and the Bronx reached a maximum of 71 million gallons in August, 1911, averaged 65 million gallons for the last six months of 1911, and almost 50 million gallons for the year 1912. The aggregate value of the water thus saved, if figured at meter rates, $133 per million gallons, would be nearly $6,500,000, while the total cost of the work was only $167,000.

# ENGINEERS' LIBRARY

**Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.**

**Book Reviews:**



## BOOK REVIEWS.

**Switches and Switchgear.**—By Prof. R. Elder, translated by P. Laubach, A.M.I.E.E. Publishers, Constable & Company, Limited, London, W.C. 397 pages; 6 x 9 inches; illustrations and tables; cloth. Price, $4.50 net.

**Reviewed by M. B. Watson, B.A.Sc.**

Ever since electricity became of commercial importance no branch of the art of applying this force has received more attention than the switchgear used for opening, closing and connecting together of circuits; and rightly so, because in the early stages of the science this was the operation which was of necessity performed manually in the control of circuits and the operator's protection was of primary importance; also in the present day of high tension electrical installations it has been found necessary to protect the apparatus in the circuit as well as the operators, hence the necessity for automatic switching devices, and the scientific study of the whole subject of switching.

The volume under discussion treats mostly of present day practice although confined largely to continental European practice touching somewhat on English and slightly cn American practice. The subject discussed is one on which there is much variety of opinion as there is variety in the types of apparatus manufactured, and it is a task of no mean proportion to summarize and give intelligent descriptions of practically all types of switches and switchgear on the market. This book is, however, the first really comprehensive work on the subject of switchgear that has been presented in English language.

The opening chapter contains a few general remarks on the requirements of and the materials used in the manufacture of switches. Chapter 2 deals with the materials most commonly used for the manufacture of switches, giving tables and formulæ for the design of bus-bars, cables, cable terminals and switch blades for different allowable rises in temperatures. Chapter 3 gives descriptions, formulæ and tables for the design of the current carrying parts of switches, such as blades, spring clips, and brush contacts with regard to both current carrying capacity and mechanical strength.

In chapter 4 we find a discussion of low and medium voltage switches for small and large currents, also data for the mechanical design of springs for use with quick opening switches. There are also empirical formulæ for the design of the assembled switches, accompanied by tables for use with the formulæ according to European practice. Note is also made of the prevalence of the brush contact switch in Europe in contrast to the multiple blade knife switch in use in America. This chapter is apparently somewhat revised by the translator.

Chapter 5 gives data on high tension switches. A great deal of this chapter is relative to the older types of switches for what is known in American practice as medium voltage, i.e., between 1,000 and 6,000 volts, while there is practically no data of value on switches for voltages above 50,000. However, there are thorough descriptions and discussions of the characteristics and theories of operation of medium voltage switches, including a discussion of oils for use in oil switches, also of the mechanical and electrical properties of porcelain as an insulator. A good discussion of the relative merits and reasons for the use or disuse of the different types of switches is also included.

Chapter 6 treats of fuses, discussing ..e several materials used in their construction, including formulæ, tables and curves for the design of fuses for different conditions. This part of the chapter is very complete. The descriptions of fuses in use are practically all of European types and a few obsolete types. None of them are used to any great extent in America.

Chapter 7 describes in detail, the construction and operation of automatic and self-acting switches, being well illustrated with cuts and circuit diagrams. The types most fully discussed are overload cut-outs, no-load circuit-breakers and reverse current cut-outs, also combinations of the above at present in use and on the market. The theories of operation and the circuit diagrams are especially valuable, though the types of construction described are wholly according to European standards. Practically no data of value to designers or manufacturers is given.

Chapter 8, which is the part of the book on which the most pains have been spent, begins with a practical analysis of the characteristics of motors during starting, developing examples of designs for starters and controllers to meet the different conditions of starting both A.C. and D.C motors. Data, equations, tables and curves for the design of generator regulators, line voltage regulators and armature and field regulators for variable speed motors are given, also descriptions and operating characteristics of the above. A discussion of designs for resistance feeder regulators is given as are also tables, formulæ and discussions of resistance materials and typical designs of resistances to meet different conditions of load. This subject is quite fully covered with the exception of data on dimensions of the assembled apparatus. A fine analysis of resistances with methods of assembling and mounting same is also included. A good general description of automatic and relay switches is given, also descriptions of starters and controllers of the cylinder type, such as traction controllers.

The final chapter, dealing with accumulator switches, gives diagrams and explanations of hand-operated and automatic end cell switches, constant voltage regulators, charging and booster regulators and remote control and indicating switches, also the anti-arcing devices in use with same.

On the whole the book contains valuable information for erection and lay-out men but little of value to the designer. There are many references to foreign technical papers and books. One item which the translator might have improved considerably is the use of units, which are not at all consistent. English units, or parallel English and metric units should have been used throughout, also in tables of areas of cross-sections of conductors, etc., the square inch, instead of the circular mill, has been taken as the unit.

In many parts of the book the matter is poorly arranged, the continuity being lost in several instances. Some of the cuts used are not of the best, but the line diagrams are both plentiful, intelligible and well produced.

**The Resistance of the Air and Aviation.**—By G. Eiffel, translated by Jerome C. Hunsaker. Published by Constable & Company, London, Eng. 442 pages, 10 x 12¾ inches; 137 illustrations in the text, 27 plates; cloth. Price, $4.50 net.

**Reviewed by J. E. Burns, B.A.Sc.**

The aeroplane, like the hydraulic turbine, has been, and is being, developed by two classes of experimenters, who work in very different ways. One is the mechanic, often of consummate skill, who pins his faith to the method of trial and compromise. The other is the engineer, or man of science, whose design is always rational and based on facts; who often suspends operation of a direct nature for years in order to ascertain the facts by which he may proceed. To the latter class belongs M. Eiffel, the author of the work under consideration. As early as 1902 he began experimenting upon the resistance offered by air to moving bodies by means of a "dropping apparatus," and in 1910 published the results of his labor with a review of the subject.

The present work is a description of a method of investigating the resistance offered by air to moving objects which has been developed by M. Eiffel, together with the results obtained by the use of his methods in an immense amount of painstaking experiment carried out in an aerodynamic laboratory established by the author at the Champ de Mars, in Paris, and in a much larger but similar laboratory established later at Auteuil.

The book is divided into two parts, the first of three chapters. The first chapter describes the laboratory and method followed, and presents a complete calculation of the resistance of a given plate. The second chapter presents general results obtained from experiments on plates of various form and on many bodies of different shapes. Chapter III. presents results obtained from model aeroplane wings and complete models of many well-known types of machines The second part is a supplement of the first, containing the numerical results of the experiments described, and the general conclusions of the author.

Much of the work of M. Eiffel is already classical, for he has demonstrated beyond doubt that, to use his own words: "In aeroplane design, careful tests with a model aeroplane, or with model wings, permit the designer to predict the conditions of normal flight."

To those who are interested in aerodynamics or in aviation the book will prove of profound interest, though it is far from easy reading. The experiments recorded give ground for believing that the problem of stability in aeroplanes, the bugbear of the birdman, is capable of solution, and through the consequent safety of flight the future of the art is established. Even at the present date very gratifying results have been obtained in actual flight by designs growing out of the Eiffel experiments. Although the author does not indulge in any mathematical theory, the work is intensely technical, but it is written in a clear and pointed style, and is one of the most pregnant books on the subject in print. We may thank the translator for having so well rendered a valuable work into English.

**The Gas Engine Handbook.**—By E. W. Roberts, M.E. Published by the Gas Engine Publishing Company, 224 E. 7th Street, Cincinnati, Ohio. 323 pp.; 4½ x 7 inches; 80 line illustrations; bound in limp leather. Price, $2.00.

This little pocket manual appears in its seventh edition, the publishers stating that it is entirely re-written and enlarged. It contains much information that gas and gasoline engine men find indispensible and frequently find difficulty in securing in the form of a book of reference. The text comprises three parts: description, design and points concerning operation, which include installation, testing, troubles, selections, etc. The reading matter is attended by the usual tables on areas and circumferences of circles, strength of materials, specific gravity of metals, etc.

Although the handbook has a fair index, the text is devoid of sub-headings which are generally considered a necessity in engineers' handbooks. When twenty or more pages are devoted to a single chapter without a single sub-heading, such as the chapter on "Testing" on can only infer that the book might have been greatly improved in this respect, if it is to fill the requirements of a handbook. The information, however, is carefully compiled, although little of it is new, and for engineers and designers there are few books in print that contain in better form, with the exception of the deficiency mentioned above, the results that are to be derived from a close study of gas enginery.

In the chapter on design the discussion starts with a chapter on the indicator diagram, and in another chapter shows the method of arriving at the general dimensions of a motor desired to fulfil certain conditions. Then follow chapters on the design of the specific parts such as the cylinder, the piston, rods, shafts, etc. Of special interest, however, is the chapter on frame design in which not only are the formulas given and explained in detail, but a method of design without the use of the general formulas is given. In the chapter on flywheels, the treatment has been brought up-to-date, without being pedantic. Governor design in its especial application to the gas engine has been treated quite fully and to an extent not found in any other work on the subject.

Of more than ordinary interest is the chapter on the design of two-cycle engines, this chapter in many ways tending to lift a veil of mystery from this subject. It gives not only the formulas for design but shows that instead of being an everlasting puzzle, the design of the two-cycle is a very simple matter indeed.

There is a chapter on the design of aeroplane motors in which there is given a few simple rules for the design of engines of the lightweight required in this service. While the author does not go into minute details on this subject as much as might be desired, it is touched upon in the chapters on the design of details.

In the third part a chapter on installation describes the arrangement of the engine room and gives many useful and practical hints on the arrangement of piping, cooling tanks, meters, etc., and goes into the whole matter of engine room fittings in a thorough manner.

The chapter on installation is followed by others on starting and stopping, care of gas engines and a very full and complete chapter on troubles. The latter is arranged under various heads and gives both the cause of the trouble and the remedy.

The next chapter on testing is the most extensive in the book. It describes in detail the method of making a complete test to the extent of a thermal analysis or the determination of a complete heat balance. In this chapter there is described the construction and the operation of the gas calorimeter, the manograph, etc. A form for a test log and another for a test report leaves nothing undone to make the treatment of this important subject, the most complete.

The book ends with a chapter on the selection of a gas engine, which is well worth reading by the intending purchaser of a power plant.

**Principles of Setting Out—Securing and Tooling Operations, for Engineering (Machinist) Students and Apprentices, and Students in Manual Training in Metal Work.** By Alfred Parr, lecturer on Workshop Practice, University College, Nottingham. Published by Longmans, Green & Company, London. 280 pages; 6 x 9 inches; 250 illustrations, 1913. Price, $1.50 net.

**Reviewed by Chester B. Hamilton, B.A.Sc.**

The mechanical execution of this book is good. The numerous illustrations, many of them half-tones, are well selected for their purpose. The composition of the book has two large faults, however. In selecting material the author has wandered over almost the length and breadth of machine shop practice. Probably this was intentional, for in the introduction it is said:—

"The man who sets out work must be well acquainted with the construction and use of such appliances, and with the proper tolerance and allowances for various classes of fits, as well as with the best methods of holding work and the proper cutting speeds. No apology is, therefore, needed for the inclusion of such information in a book on setting-out."

Following this train of thought, the author might say that a good setter-out should have some knowledge of elementary mathematics, and proceed to instruct him, and that he should be a sober man, and, therefore, include a temperance lecture. However, it should hardly require argument to prove that information on a specialized subject should apply definitely to that subject.

The other point to be criticized in this book is more serious. There is an absolute and total lack of logical order or arrangement of subject matter. The author flits from one unrelated subject to another with the happy unconcern of a butterfly in a flower garden. The most provoking point is that the material itself is really good, and a little careful editing and arranging in logical form would make the work really valuable.

Broadly speaking, machine work may be divided into three classes by its relation to setting-out: (1) Where various lines and marks are placed on the rough stock and the tool is made to conform to them by the skill of the operator. (2) Where the copying principle is used and the actual form of the finished work is given by the tool used. Examples: Gear-cutting, form-milling, planing or turning with form tools, punch and die work, etc. (3) What is commonly known as jig work, where the stock is held in some fixture, which usually also guides the tool, and by giving tool and work definite relative positions produces work of superior accuracy in an easy way.

In the strictest sense it is only in the first case that the work is set out or marked off. In the second case this is done only on the tools when they are first made, and in the third it is the holding apparatus or jig which was marked off.

**Concrete Roads and Pavements.**—By E. S. Hanson. **Published** by the Cement Era Publishing Company, Chicago, Ill. 227 pages and advertising; 4½ x 7½ inches; illustrated; cloth. Price, $1.00, postpaid.

This book opportunely appears in the midst of a season when the construction of roads is receiving the greatest attention in history, and when there is an acute demand for carefully compiled data on road materials, construction and maintenance.

The subject is treated in thirteen chapters, containing general information on concrete as a road and paving material for rural and urban highways, supplemented by examples descriptive of some roads in Michigan that are claimed by road engineers to be deservedly famous for their careful construction, and of similar roads in Illinois, where valuable data pertaining to costs is also given. The theory and practice of joints, problems relating to bridges, culverts, sidewalks and curbs and gutters are admirably dealt with, and Chapter XI., describing tests made on concrete as a paving material, contains results and methods with which every road engineer should be familiar.

The work is supplemented by twelve appendices, dealing with specifications for various pavements, for bridges, culverts, etc., which obtain in the States mentioned above. The book is admirably edited, as one might expect, as the author is the editor of The Cement Era. His presentation of the subject is concise and carefully condensed, and as such will be of great value as an up-to-date treatment on concrete road construction.

**Manual of Industrials, 1913.**—(Fourth annual number). Published by Poor's Railroad Manual Company, 535 Pearl Street, New York City. 2,268 pages; 6 x 9 inches; 124 pages of index. Price, $7.50, postpaid.

This manual is associated with two other manuals published by the same company, viz., Railroad Manual and Manual of Public Utilities, the one under consideration completing the set for 1913. It refers entirely to manufacturing, mining and miscellaneous corporations. It contains an exhaustive list of new companies, and is particularly valuable for its comparative and analytical statistics.

The Railroad Manual is a well-recognized standard authority on railroad operations, and the present constitutes the forty-sixth year of its existence. The other manuals are more recent publications, but are almost all equally recognized in their respective fields. The Manual of Public Utilities was reviewed in the Engineers' Library of *The Canadian Engineer* in the issue of June 26th, 1913. The publishers claim that the three books contain over 6,000 pages, thereby superceding any other manual in volume of information The price of the three volumes complete is $20.00.

Each of the three volumes for 1913 is a decided advance upon its corresponding predecessor of last year.

**Industrial Plants, Their Arrangement and Construction.**—By Charles Day. Published by the "Engineering Magazine," New York. 294 pages; 5 x 7 inches; illustrated; cloth. Price, $3.00 net.

This little book in twelve chapters is a product of Mr. Day's wide experience as consulting engineer in the construction of some most successful plants and structures. Chapters I. to VIII. inclusive are founded upon a series of university lectures covering the broad industrial principles upon which the arrangement and the planning of the industrial plant are based. Chapter IX. goes more into the specific problems entering into machine shop practice. Chapter X. depicts the advantages of logical planning by a number of descriptions of plants in operation, illustrative of the trend of modern practice. The two closing chapters admirably supplement the work by a treatment of the relationship between the client and the engineer, dealing from the standpoint of the former, with the value of an engineering organization to a proposed plant layout, and upholding for the latter a considerate and judicious opinion relative to compensation for engineering services, and the preferred basis for reasonable commission.

The book does not guarantee a plant to be successful. It is well known that inefficient management is the governing factor; but the plant that is arranged along the line of Mr. Day's elucidation of the many factors covering the project and the product from its raw state until the bill of lading is affixed, will prove to be one susceptible to economical management in its own field.

**Excavating Machinery.**—By A. B. McDaniel, B.S., Assistant Professor of Civil Engineering, University of Ilinois. Published by McGraw-Hill Book Company, New York City. 327 pages; 134 illustrations; 6 x 9 inches; cloth. Price, $3.00 net.

The book is a careful treatise upon all types of excavating machinery and apparatus used in modern practice, and covers its subject in two parts, supplemented by two appendices. Part I. deals with scrapers, graders, and shovels of various kinds, while Part II. takes up the subject of dredges and excavators. A good deal of usable information concerning costs relating to the operation of excavating machinery has been included and will be of service. Although the condition and circumstances dependent upon such work are so variable that the cost data can be of very general value only, it nevertheless should be serviceable regarding efficient operation of machinery and the systematic arrangement of work.

In his introductory paragraphs the author lays stress upon the importance of closer attention to cost, and advises the keeping of accurate and complete records of cost of all work, by engineers and contractors alike, as valuable data for future use. He has supplemented each section by carefully selected bibliographical references, to which the reader may turn for additional information.

## PUBLICATIONS RECEIVED.

**Foundry Cupola Gases and Temperatures.**—By A. W. Belden, Bulletin No. 54, United States Bureau of Mines, Washington, D.C., 29 pages; illustrated with photographs and drawings.

**Elevators and Warehouses.**—Eighty-seven page list of licensed elevators and warehouses in the Western Grain Inspection Division. Issued by the Department of Trade and Commerce.

**Ontario Land Surveyors.**—Annual report of the association and proceedings of the 21st annual meeting, including reports of committees, papers, examinations papers and membership.

**Manitoba Department of Public Works.**—Report of the Department of Public Works of Manitoba for the fiscal year ending November 30th, 1912, by Colin H. Campbell, Minister of Public Works, Winnipeg, Man.

**Summary of United States Commerce and Finance for June, 1913.**—Covering the foreign commerce of the United States and its non-contiguous territories. Published by the Department of Commerce, Washington, D.C.

**The Canadian Chamber of Commerce, London, England.**—First annual report of the Council "for the encouragement and promotion of Anglo-Canadian trade and commerce and the development of Canadian industries by British capital."

**The Territory of New Quebec.**—Extracts from reports on the district of Ungava, recently added to the province of Quebec. Issued by the Department of Colonization, Mines and Fisheries, Quebec, Que.

**Revenues and Expenses of Steam Roads in the United States.**—Bulletin No. 54 of the Inter-State Commerce Commission. Prepared by the division of Statistics from the reports of expenses and revenues of steam railway operations during the month of May, 1913. Published by the Commission.

**Commission of Conservation, 1913.**—Report of fourth annual meeting held at Ottawa, January 21st and 22nd, containing reports of committees on public health, minerals, forests, fisheries, waters and water powers; papers on oyster farming, forest surveys, claybelt conditions of New Ontario, smoke prevention, etc.

**Coal and Power Investigation, Sask.**—Report by R. O. Wynne-Roberts. 133 pages; 10 plates and maps. A compilation of data and conclusions therefrom resulting from an inquiry into the practicability of producing power at coal centres and distributing it throughout the province. Published by the Board of Highway Commissioners, Regina, Sask.

**Portable Electric Mine Lamps.**—Technical paper No. 47, Bureau of Mines, United States Department of the Interior. Written by H. H. Clark. Discussing the advantages that such lamps possess and suggesting some characteristic which they ought to have as now designed and constructed, portable electric lamps having been already introduced in a number of mines.

**Investigations of Detonators and Electric Detonators.**—By Clarence Hall and Spencer P. Howell. Bulletin No. 59 of the United States Bureau of Mines, Washington, D.C, 72 pages; illustrated. Numerous tables. Containing a comprehensive treatise on the theory of detonation of high explosives and the result of tests for determining directly and indirectly the strength of various electric detonators.

**Brick Fire Places.**—A handsomely illustrated booklet of 32 pages containing suggestions for modern designers of interior woodwork and furnishings, in the matter of brick as a material for fireplaces. The compilers have used Arts and Craft's motifs in their design and by the neat decorative schemes which the booklet displays, much has been added to the architectural effects to which the fireplace lends itself. Published by the Thomas Moulding Company, Chicago, Ill.

**Report of Minister of Mines.**—Annual report by Mr. F. Robertson of mining operations for gold, coal, etc., for 1912 in the province of British Columbia. Contains statistical tables of mineral output, and shows in detail the actual mineral production of the past year, as based on smelter or mill returns; also a summary of the production of each of the last four years, thus illustrating by comparison the progress made in productive mining during that period. Issued by the Bureau of Mines, Victoria, B.C.

**The Nickel Industry, with Special Reference to the Sudbury District, Ont.**—By A. P. Coleman, Ph.D. Professor of Geology, University of Toronto.—Issued by the Department of Mines, Ottawa. A book containing 206 pages; 6½ x 10 inches; well illustrated; 53 plates, 14 figures, and 8 geological maps. The development of the nickel industry in the Sudbury district is a prominent feature in the history of Canadian mining industry. Dr. Coleman has made a very thorough investigation extending over a period of three years, and the information gained thereby, together with his own comprehensive knowledge of the geology, has enabled him to produce a very excellent monograph, which covers in every detail the activities of the industry in the Sudbury region. The accompanying maps of the district and of the more important mines, together with the descriptions of all the known nickel ore deposits in Ontario, and concise accounts of methods in vogue for the mining and melting of nickel ores, go to make the publication one of greatest value.

## CATALOGUES RECEIVED.

**Mechanical Dwarf Signal.**—Illustrated catalogue on G. R. S. mechanical dwarf signal and R. S. A. design. Issued by the General Railway Signal Company, Rochester, N.Y.

**Train Dispatchers' Telephone Selector System.**—Illustrated 35-page catalogue. Issued by the General Railway Signal Company, Rochester, N.Y.

**Railway Motor Cars.**—Illustrated catalogue dealing with Rockford motor cars. Issued by the Chicago Pneumatic Tool Company, Chicago and New York.

**Peebles' Motor Converters.**—Illustrated catalogue dealing solely with the company's converters. Issued by Bruce, Peebles & Company, Limited, Edinburgh, Scotland.

**Lucal Liquid Fuel Company** issues a 24-page illustrated catalogue on Lucal appliances for burning oil. The Lucal Liquid Fuel Company, 203 Hope Street, Glasgow, Scotland.

**Fuel Oil Data.**—Twenty-page illustrated catalogue on various types of installations and information regarding the burning of fuel oil. Issued by the Tate, Jones & Company Inc., Pittsburg, Pa.

**Couplings and Pulleys.**—Illustrated catalogue dealing with friction clutches, couplings and wood pulleys. Issued by the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., and Toronto, Ont.

**Compressors.**—Illustrated catalogue dealing with enclosed, self-oiling, single-stage, steam and belt-driven compressors. Issued by the Chicago Pneumatic Tool Company, Chicago and New York.

**General Catalogue.**—Water metres, hydrants, sluice valves, tanks, sewerage fittings, pumps, hot water and steam fittings, etc. 272 page catalogue. Illustrated. Beck and Company, Limited, Hydraulic, Sanitary and General Engineers, London, England.

**Engineering Instruments.**—155-page illustrated catalogue, showing the various types in their wide line of engineering instruments. Issued by Bausch & Lamb Optical Company, Rochester, N.Y., through the Toply Company, their Canadian representatives at Ottawa.

**The Squires Steam Trap.**—An 8-page folder descriptive of the trap giving directions for connections and operations under various fittings, showing section illustrations and tables of capacity. Representatives in Canada, Canada Allis-Chalmers, Limited, Toronto.

**Continuous Current Motors and Dynamos.**—Illustrated catalogue dealing with continuous current motors and dynamos, 2 and 3-phase motors and dynamos, continuous current starters, alternating current starters, motor generators, etc. Issued by Wright & Wood, Limited, Century Works, Halifax.

**The Foos Pumping Engine.**—An illustrated 12-page booklet descriptive of the application of the Foos gas engine for all kinds of pumping service, is Bulletin 89 of the Foos Gas Engine Company, Springfield, Ohio, containing a number of tests from deep-well, irrigation and ordinary water supply systems.

**The Monahan Trench Digger.**—An illustrated catalogue descriptive of this and other Monahan machines, e.g., backfiller, pipe-laying derrick and steel forms for concrete manholes and catch basins, of which Wm. Heggie, Joliet, Illinois, is the manufacturer and W. B. Louer, 900 Old Colony Building, Chicago, is sales manager.

**The Imperial Positive Water Meter.**—A twenty-two page catalogue handsomely printed and illustrated in colors dealing with the characteristics, construction, maintenance, of the type, including also price list and shipping particulars. Issued by the Manufacturers, Beck and Company, Limited, 130 Great Suffolk Street, London, S.E.

**Ceresit.**—A handsomely printed booklet descriptive of the product of the Ceresit Waterproofing Company, and containing information on the waterproofing of concrete. The attractive catalogue covers many topics in an individual manner and will be found a helpful addition to engineers' and contractors' bookshelves. Published by Ceresit Waterproofing Company, 446 Commercial National Bank Building, Chicago.

## COAST TO COAST.

**Windsor, Ont.**—The Hydro-Electric Power Commission has decided on the route of the transmission line to Windsor, and has the location almost completed between Chatham and this city. The foundations have been also placed between Belle River and Chatham for the transmission line towers.

**Quebec, Que.**—The Canadian Northern Railway has made it known in this city that the company expects to be operating grain trains over its line from the Canadian North-West to Quebec this fall. All connections between Quebec and Ruel, Ont. (384 miles) will be ready for train service early next month, and the road from Sudbury to Port Arthur opened for traffic a month later, which will give the Canadian Northern Railway direct communication from Quebec to the end of its present line in the North-West.

**Edmonton, Alta.**—Roused by recent discoveries of rich, undeveloped mineral, asphalt, gas and oil resources in various parts of the western provinces, scores of prospectors and experts, known in many camps throughout the United States and Canada and Mexico, are making exhaustive searches in the Peace River country and other northern districts. Central and Southern Alberta are also being prospected. The Dominion and provincial governments likewise have their experts in the field. Seventeen parties are prospecting in the Canadian Rockies, west of Edmonton, but most of the work at present is being carried on in the north country.

**Sarnia, Ont.**—For some time past Sarnia's water supply has been showing a serious state of pollution, as mentioned in last issue of *The Canadian Engineer*. So much is this in evidence that the provincial health authorities have ordered that double the quantity of chlorine be added to the water supply. This has been done, but in several instances where tests of the water have been made the pollution continues to exist. This leads to the opinion that there must be a break or leak in the intake pipe, through which sewage is being allowed to find its way into the waterworks well, and thence into the waterworks pumps.

**Le Pas, Man.**—That the Saskatchewan River, working in conjunction with the Hudson's Bay Railway from Le Pas, will prove of immense value to farmers and other shippers as far west as Edmonton, is the opinion of L. A. Voligny, Dominion Government chief engineer, in charge of the surveys and works in connection with the navigability of the Saskatchewan. Work is now completed to Le Pas, and orders have been received to continue to Grand Rapids. A channel ten to twenty feet was found the entire way from Cumberland House, and hardly any extra work was necessary, though some dredging will be required about Moose Lake and Cedar Lake, and this will be started immediately, as will also the construction of a wharf at this point. The government insisted on Prince Albert building a lock at LaColle Falls, and this indicates that the fullest use is to be made of the North Saskatchewan as soon as possible. Mr. Voligny estimates that the entire project can be carried through within five years, and no doubt eventually through Winnipeg. In conjunction with the government road to the Bay this navigable channel, tapping all the northern part of the Canadian prairie west, will go a long way to reducing the cost of marketing grain, and the cheaper water rates should bring freight tariffs of the transportation companies into line. Nor is this all. Mr. Voligny feels confident also about the navigability of the south branch of the Saskatchewan, which, he says, will soon receive attention. All the railway bridges have been built to this end, and all that is required is a demand by cities and towns along its course. Curiously enough, these municipalities appear apathetic as regards navigability of the south branch, while their neighbors on the north branch have been agitating for a long time, and now get served first.

**Calgary, Alta.**—Forty-six line elevators will be built in Alberta this year in time to handle this season's crop by the Alberta Farmers' Elevator Company, Limited, authorized under the Farmers' Elevator Bill, passed at the last session of the Alberta legislature. The work of construction of half of these elevators is in progress now, and materials for the others have been purchased and are on the ground at the various locations. For the erection of these elevators, forty-six local companies have been formed, which are under the direction of the parent company. The preliminaries for all this had been arranged by the provisional directors of the Farmers' Elevator Company, and to ratify and confirm the action of those officials and to properly launch the company a meeting of the shareholders of the company was held recently. The necessary confirmation of the work of the provisional directors was accorded, the company was organized upon a permanent basis, and the Minister of Agriculture assured the shareholders that the necessary money to pay for the elevators was ready and waiting their pleasure.

**Sault Ste. Marie, Ont.**—The installation of the chlorination plant of the Tagona Water and Light Company has just been completed, and was immediately put to work. Inspection showed it to be in excellent order. Its completion dates just twenty-eight days from the issuing of the order for its construction. It was ordered as a result of the investigative work of Dr. Amyot and F. A. Dallyn, C.E., of the Provincial Board of Health. Analyses of the water taken at various intervals across the river, which is the source of the town's supply, showed the presence of bacteria. Up to the present time twenty cases of typhoid have been reported, two of which came from the neighboring municipality of Steelton, and one, it was found, had come from an outside point along the line of the Algoma Central Railway. So far, only one death has occurred.

The two municipalities of Sault Ste. Marie and Steelton are devoting their attention to choosing the most suitable place for a joint intake pipe which will serve the two towns when the present franchise of the Tagona Water and Light Company expires, which will be in 1914.

**Ottawa, Ont.**—The chief architect's branch of the Public Works Department has issued the conditions for the competitive designs for the new departmental and courts buildings. Not only is there the booklet containing the conditions, but there are also extensive plans of the grounds and a set of beautiful half-tones of the site between Wellington Street and the cliff. One feature of the conditions is that the successful architect will erect the buildings. The conditions state that the successful architect will be allowed regular fees and must maintain an office in Ottawa while the work is in progress. The conditions point out that the work on the new buildings will start very soon after the final award has been made. The final designs entered in the competition will be on exhibition in Ottawa with the author's name on them for seven or more days subsequent to the award. The plan for the treatment of the site prepared by Mr. E. White and Sir Aston Webb is submitted, but the conditions leave the competitors a free hand to develop their designs regardless of that plan. The conditions provide that all plans be delivered to Ottawa by January 2nd, 1914. The award of the preliminary competition will be made as soon as possible afterwards. The assessors will be Messrs. T. E. Collcutt, J. H. G. Russell and J. O. Marchand. The complete scheme is to build a supreme court, exchequer court, railway commissioners' court, and the necessary offices in connection with these courts, also a block or blocks of departmental buildings having 500,000 superficial feet of floor area The competition is restricted to architects who are British subjects practising in the British Empire.

**Toronto, Ont.**—Acting City Architect G. F. W. Price and Deputy Fire Chief J. C. Noble were very favorably impressed with the new system of fireproof flooring, consisting of gypsum and wood chips, reinforced by wire cables, and capable of carrying a live load of 125 pounds per square foot. It is claimed that the new floor is much lighter and cheaper than reinforced concrete, inasmuch as it does not require such heavy steel reinforcements. Experiments with the material are attracting much attention from engineers and architects, and a specially severe test recently conducted in New York by Messrs. Perrins & Miller, of Columbia University, in which the average temperature maintained for three hours was 1,757° F., the floor sustaining its load and withstanding the test in a most admirable manner.

**St. Catharines, Ont.**—Port Weller is to be the name of the new townsite at the Lake Ontario entrance to the new Welland Ship Canal, described in *The Canadian Engineer* for August 21st. This decision has been reached by the syndicate that has purchased several acres on each side of the new harbor. It was supposed that the harbor would be called Port McCalla, on account of an old private park there, but the above choice has been made in honor of J. L. Weller, of this city, chief engineer in charge of the canal, who has done all the planning in connection therewith. The syndicate has purchased all the land adjoining the entrance of the canal, the Government is beginning the erection of an office building on part of the land which has been expropriated, houses and stores will be erected without delay to provide for the workmen to be employed on the canal, the owners of the property hope to secure a factory, and expect that before long a thriving town will be springing up where now are only farms.

**Vancouver, B.C.**—In order to facilitate the driving of the 22 by 30 foot double-track Canadian Pacific Railway tunnel, of five miles long, through Rogers' Pass, at the summit of the Selkirks, Messrs. Foley, Welch & Stewart, the contractors, have decided to adopt a new method, which will be watched with great interest by the engineering world. The expedient consists of first boring a parallel tunnel, 7 by 8 feet, for virtually the same length, and from this tunnel cross-cuts will be made at short intervals to the site of the proposed large tunnel. This will enable gangs of men and machine drills to attack the work simultaneously at scores of points. Incidentlly, the "pioneer" tunnel, as it is called, will also provide ventilation, and will, for a considerable time, provide an exit in removing the rock material. The railway company and the contractors have figured that it would take too many years to construct the large size bore, starting only from the two ends.

**Montreal, Que.**—Although companies like the Dominion Steel Corporation and the Nova Scotia Steel and Coal Company are experiencing an active demand for their entire output of iron, the situation is somewhat different with the merchant furnaces. Companies such as the former are able to use up in their own finishing departments the greater portion of their output of pig iron. Dominion Steel practically uses its entire output; Scotia has but a small quantity for sale, and has no difficulty in disposing of it. The 300-ton Midland furnace of the Canada Iron Corporation is cold, and will remain so until the situation improves. The 150-ton furnace, however, is kept actively employed. The Deseronto plant is operating full blast, as are probably most other plants throughout the country. At the same time, Canadian plants now have to meet the low prices being made by American furnaces. Buffalo has been selling at $17.25, Toronto, and it is said quite a large tonnage was disposed of. The Steel Company of Canada is reported selling at $17.25, Hamilton, equivalent to $19.25, Montreal.

## TRACTION ENGINE COMPETITION IN BELGIUM.

According to its weekly report the Department of Trade and Commerce, Canada, is informed that the Belgian Minister for the Colonies has organized an international competition of traction engines and other ploughing machines. A sum of 70,000 francs will be appropriated for the best machines, and indemnities up to 15,000 francs will be granted to the competitors who have received no orders.

Canadian manufacturers are invited to take part in this competition, which will be held at Chassart, near Fleurus, Belgium, from the 24th to the 27th of September next.

## PERSONAL.

FRANK BARBER, C.E., bridge and structural engineer, Toronto, has recovered from an illness extending over several months and is at his office again.

ERNST POENSGEN, general manager of the tube department of the Phœnix Steel Works, Dusseldorf, Germany, arrived this week in New York City. He will make a tour of United States and Canada in his firm's interests.

A. WOODROFFE MANTON, M.I.C.E., B.Sc., resident engineer in Constantinople for the engineering firm of S. Pearson & Son, Limited, with headquarters at London, England, is in Toronto at present forming a Canadian office for his firm.

W. B. STOKES, formerly of London, England, has opened a store on Notre Dame Street, Montreal, for the sale of engineering and surveying instruments. He has the sole Canadian agency for Cassella's instruments, and also for Watson's microscopes.

H. V. HUTCHINSON, of Baldry, Yearberg & Hutchinson, contractors, Westminster, London, England, is visiting Canada to determine the possibilities in this country for profitable contracts for his firm. He is making arrangements for Canadian representation.

WM. GIBBS BAIN, contracting engineer and metallurgist, of Philadelphia, is at present in Toronto. Mr. Bain was a student at the University of Toronto in the early eighties, but has resided since then in the United States. He is making a tour of the Dominion, and is particularly interested in the hydro-electric development

H. T. ROUTLY, B.A.Sc., has this summer severed his connection as engineer of the Township of Coleman, after having had charge of the highway and other engineering work during the past four years. In the course of that time the standard of high-class road construction which he set in Coleman township has been an object lesson for other and older parts of the province. Mr. Routly has established an office in Toronto.

JAMES D. ROBERTSON, formerly sales manager for the Pittsburg Valve, Foundry and Construction Company, has again assumed charge of the sales of this company, returning as second vice-president after two years' absence. Mr. Robertson in the meantime has successfully completed the organization, plant, and launching in business of the Warren Tool and Forge Company, of Warren, Ohio. He began his business career with Atwood & McCaffrey, and when that concern was absorbed by the Pittsburg Valve, Foundry and Construction Company, he continued his services, and up to the time of his withdrawal had completed his twenty-first year with the company.

In last week's "Personal" column we made mention of a trip west of Gustave Kahn, of the "Trust" Concrete Steel Company, of Canada, Limited. The Trussed Concrete Steel Company is so widely known that it seems superfluous to call attention to the typographical slip in the item as it appeared. We mention it, however, just to remind ourselves of its occurrence.

## OBITUARY.

JOHN C. BAYLISS, a well-known contractor of Toronto, died at his summer residence at Dixie on August 17th. Mr. Bayliss came to Toronto some twenty years ago from Islington, England, and was engaged in contracting work in this city for the past eighteen years, his firm having built many of Toronto's public schools, the latest one being the Duke of Connaught School. The firm also built St. Anne's Anglican Church, and is at present working on the Church of St. Mary the Virgin. Mr. Bayliss also had charge of construction work in Meaford and Walkerton, Ont.

JACOB SERSON, Provincial Superintendent of Bridges for British Columbia, and a resident of Kootenay, died in Nelson, B.C., on August 12th, at sixty-nine years of age. Mr. Serson joined the construction forces of the Canadian Pacific Railway Company at Pembroke, Ont., thirty-eight years ago, when the first great transcontinental line was in its infancy. A greater part of his connection with the company was in the building of bridges throughout the West. About eight years ago Mr. Serson left the railway service to accept the position which he held with the province at the time of his death.

## COMING MEETINGS.

**ONTARIO MUNICIPAL ASSOCIATION.—Annual Meeting to be held in Toronto, August 28th and 29th. Secretary-treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.**

**THE NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in Philadelphia, Pa., September 10th, 11th and 12th, 1913. Secretary, William Kent, Narragansett Pier, R.I.**

**THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.**

**CANADIAN PUBLIC HEALTH ASSOCIATION.—Third Annual Meeting in Regina, September 18th, 19th and 20th. General Secretary, Major Lorne Drum, Ottawa; Local Secretary, R. H. Murray, C.E., Regina.**

**AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington.**

**AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.**

**UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.**

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN CONCRETE INSTITUTE.—Tenth Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.