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IMPORTANT PRINCIPLES OF BRIDGE DESIGN

SYNOPSIS OF PAPER BY CHARLES EVAN FOWLER, M.CAN.SOC.C.E., M.AM.SOC.C.E., BEFORE PACIFIC NORTHWEST SOCIETY OF ENGINEERS.

THE designing of a bridge structure is not merely a matter of figuring the stresses, fixing the sizes of materials, and making a set of drawings. This may all be completed and a design result, but not the design suitable to the location, not such as it should be architecturally, nor for the traffic the structure will carry.

The true design to adopt must come very largely as an inspiration to the designer, who must have the necessary talent or imagination to conceive a bridge that will be the most appropriate and harmonious for a given location and for the existing or future surroundings.

The tower bridge in London, considered by many writers to be a monstrosity, was conceived by the engineer, Sir John Wolf-Barry, to harmonize with the surroundings, and particularly with the old Tower of London in the immediate vicinity. When considered in this light, it is an appropriate and harmonious design; the medieval towers are monumental and the steel work graceful.

The great suspension bridges of New York City are of the same class and are mostly in harmony with the towering buildings in the adjacent territory. The details, however, are not always carried out in the proper spirit, the towers of the Roebling bridge having never been completed and are thus lacking as truly monumental or architectural features; the towers of the nearby Manhattan bridge are too light to harmonize with those of the Roebling bridge or the nearby buildings, although considered alone it is a complete and pleasing design; the Williamsburg bridge is entirely lacking in architectural features, is out of harmony with the present or probable future surroundings, and is only notable in design by reason of its magnitude and the graceful sweep of its cables.

The great arch at Hell Gate, over East River in New York City, is with its 1,000-ft. span and carefully designed abutment towers a truly monumental structure, and the abutment towers are well designed and appropriate; the great arch demanding this mass for backing to properly satisfy the impression of a great thrust properly cared for or resisted.

The Washington bridge across the Harlem, one of the great bridges of the world, is wonderful in its architectural detail, but lacking in the great essentials for a work of architecture. The main structure consists of two spans instead of three, thus giving a pier in the middle; and the approaches are not balanced, thus causing the structure to lack in symmetry. Some of the other designs for this structure, while more simple in detail, would have made a much better structure and a more pleasing one, as they possessed the fundamental features that are necessary to any real work of architecture, simplicity, symmetry, harmony, and proportion.

This is well illustrated by the Eads bridge at St. Louis, with its three great arch spans and appropriate approaches, and although the details of the structure are very simple, it is one of the most pleasing and dignified of the world's bridges.

The conception of a design depends upon no rules, but upon the inherent ability of the designer, limited as we shall hereafter see by certain theoretical and practical requirements. There may be conceived a number of designs for a given location of different types, any one of which would be appropriate and beautiful, but the final decision as to which one of these to adopt must be made on the basis of relative cost, the most economical being usually selected. On the other hand, the most economical should not always be selected, but the best design architecturally be adopted, especially where the difference in cost is not very large.

The cost, for example, of a four-span structure for a given crossing might be found to be somewhat less than for a three-span bridge, and yet it would be wise from an architectural standpoint to adopt the three-span design, as the risk of one more foundation in the river would be avoided, with a probable saving in cost, should difficulties be encountered, that would make the three-span structure the cheaper in the end. In other words, the four-span design would have to be very much cheaper than three spans to call for its adoption. The reason for adopting a three-span design in place of a two-span bridge, might, on the other hand, be based entirely on the architectural features, as the cost and risk of the three-span structure might be much the greatest.

There are, then, two considerations that govern in making a decision as to what design to adopt for any location, the architectural features and the economy of construction, which latter may well be discussed in full before considering the architecture of bridges, and entirely aside from the esthetics of the problem.

The reactions or loads on piers for various lengths of spans must first be determined in order that foundations, abutments, and piers may be designed and the costs determined as factors in the cost of complete structures with different numbers of spans. The load on the pier and the weight of the pier having been determined, the size of the base of the pier may be arrived at by using the formula for the allowable pressure on the foundation bed, as given in the writer's treatise on "Sub-Aqueous Foundations," the character of the foundation bed having been determined previously by careful core borings. Several trials may be necessary before the proper size of a pier is de-

termined, and then careful calculations as to the stability of the pier must be made, and should it be found deficient, as is often the case with deep trusses, or where bascule or lift spans are employed, then it must be increased in length of base until the maximum allowable stresses and pressures are not exceeded.

Then by means of the cost of abutments, piers and spans, the relative costs of various designs may be determined; the weight of the spans to be calculated from reliable formulae or from actual stress and section diagrams. The design of the approaches may be a factor in the relative costs, and in such cases must be included in making the comparisons.

The fact that some consulting engineers make out certain designs to be the cheaper, when comparing them with other designs made up on an entirely different basis, both as to the character of the construction and the real factors of safety, should make any one suspicious of the character of the services offered and disbar such engineers from reputable practice.

The type and design of the superstructure is such a large factor in its cost that this must be fully decided upon before beginning any of the above investigations, and then all designs be compared upon a common basis. Where the grade is high above the stream, with plenty of clearance for floods and navigation, deck spans of some type are, of course, the most economical to employ. Where the bridge is high or falsework expensive for other reasons, it may be best and cheapest to use an arch or a cantilever design, and where very long spans are necessary, either the cantilever or suspension bridge must be used. Where the clearance for high water or navigation is limited, through trusses must be used, although it will often be best to use cantilever spans instead of simple trusses. Through arches or half-through arches may often be employed with good results both architecturally and economically.

The economical design of the superstructure of a bridge requires careful consideration as to the style of trussing, the panel length, and the truss depths. Longer panels and deeper trusses are more economical for modern heavy loads, but for plate and riveted lattice girders the depths are usually much less than for regular trusses. The span lengths for cantilever bridges should always be decided by careful mathematical analysis, as well as the lengths of the cantilever arms, suspended spans and depths. The height of towers and the depth of stiffening trusses for suspension bridges must also be carefully analyzed.

The design of movable spans should be carefully considered, not only with regard to first cost, but as to cost of operation and maintenance as well, but do not get the idea that revolving draw spans are out of date, for in many locations they are the cheapest and the best to employ. Then there are locations where bascule spans are the best from every point of view, but where used they should harmonize with the remainder of the structure, if there are additional spans, but in any case those forms must be abandoned that have no pretentions to architecture or beauty, and the same thing may be said with regard to other types of movable spans.

The details for ordinary spans have reached a practically permanent basis, so that standards, at least as to type, are usual. Where the structure is of unusual size, like the Blackwell's Island bridge, the Forth bridge, or the Hell Gate arch, each member must be the subject of critical analysis and study.

Lack of such study and analysis was the cause of the failure of the first Quebec bridge, although the writer's one-time assistant, the late A. H. Heller, had fully covered the points in question in his book on "Stresses in Structures." Great suspension bridges, too, are of necessity special problems throughout and must be studied with greater care than any other type.

The floors of railway spans are usually of a standard type, either with steel stringers and ties or else a steel trough floor with ties laid on the ballast; but the types of floor and paving for highway bridges are so numerous that it is often a grave question what to adopt. The cheapest floor that should in any case be used on a good bridge is one having steel joists with spiking strips bolted to them, to which the floor plank is spiked. The very best floor is undoubtedly a reinforced concrete slab, with from 1½ to 2 in. of sheet asphalt surface, although it may be wise to use a creosoted block surface, the thin blocks being set directly in asphalt on the concrete and either filled with sand or grouted.

Having discussed those things which have to do directly with the economy of bridges, with masonry piers and steel superstructures, we may well discuss structures built entirely of stone or concrete, or of reinforced concrete. Such structures must be fully designed and a careful estimate of cost made in order to make any reliable comparisons. The cost of stone bridges is, of course, the greatest of any type that might be considered, and in the case of the Knoxville bridge, where the cost of the arched cantilever was only $250,000, the bid for the stone arch design was about $1,500,000, thus making it out of the question to use stone where low first cost was a necessity. The same is true to a very great degree with concrete arches, but when reinforced concrete arches are considered, they may be designed to cost but slightly more in many instances than steel bridges, and should be carefully considered where a permanent and artistic structure is demanded.

The writer has for many years made a study of the architecture of bridges, and his book of "Engineering Studies" was the first and only attempt that has been made to formulate any rules of architectural bridge design. It will be superfluous perhaps to say that the statement of an eminent engineer, in a recent report on a great bridge, that beauty could not be secured unless economy was sacrificed, does not meet with agreement from the writer.

There are, it is true, no orders of architecture for bridges as for buildings, nor is there any classification of styles for particular ages possible, as in the case of building architecture, but basic rules must be observed, whether the design be for a building or for a bridge.

Simplicity, harmony, symmetry, and proportion must be regarded in any design that would have any pretentions to beauty or to architectural effect. They are the fundamentals of true architecture, no matter what the structure may be to which thought is to be applied in its design.

Simplicity means first a truth-telling structure, no subterfuges about the lines of stress, no covering up of a concrete structure with a stone facing, no frivolous or inappropriate details, but a strict adherence to the necessary features, whether they are to carry the loads or to ornament the bridge.

Harmony is essential to a pleasing design, for without it the structure would be distasteful. Harmony not only as between substructure and superstructure, between the various spans, between the spans and the ap-

proaches, between the utilitarian features and the ornamental details, but with the surroundings.

Symmetry may or may not be essential to a pleasing design, although it usually is necessary if a truly architectural structure is to result. Where the bridge has a great length, unsymmetrical features are not so noticeable as in a shorter one which may be all taken in at a glance. As is often true in a landscape, balance may frequently be secured by including an unsymmetrical feature. That is, where in one portion of a structure such as a draw or other unbalanced feature must be included that will destroy the symmetry, something must be introduced in the other portion to restore the balance, although symmetry does not result.

Proportion is necessary that the three preceding principles may be realized, and usually when the economical proportions have been determined, they are pleasing. However, in many cases modifications must be made to reach the point where economy and beauty can both be satisfied. Proportion of details employed for ornamentation is quite another thing, and to be harmonious they must have the proper balance.

Examples may be seen in every structure of the proper application of some of these principles, but more often we find one or the other flagrantly violated, so that the remark of S. Shaler Smith to one of his assistants, should be well remembered by him who would reach high rank in his profession—"most bridges are examples of what not to do." Seldom, if ever, do we find a structure that complies with all of the fundamentals, although many bridges approach so nearly to the ideal that careful consideration and analysis are necessary to determine just where improvement could be effected.

Simplicity is best illustrated in its pleasantest features by suspension bridges and arches with no decorations or embellishments of any kind. Harmony is best exhibited where no part of the structure seems to be extraneous and where the structure seems part of the surroundings. Symmetry in its simplest form is where one-half of the structure is exactly like the other. Proportion is most nearly reached when the structure is most pleasing and the truth expressed most accurately.

The basis for a real architectural system for bridges must come, of course, from building architecture and on studying the columned or arched facades of buildings we find an uneven number of openings or arches are employed in the great majority of the world's notable and best pieces of architecture. Where there is an entrance it is nearly always in the centre, with one or more arches symmetrically disposed on either side.

Careful study and analysis of the examples of Egyptian, Roman, and medieval buildings discloses the fact that such an arrangement is most pleasing to the senses and where it has been violated the design is unpleasant. This, then, we may take as the starting point of any design, an opening instead of a pier at the centre, with the remainder of the structure arranged symmetrically on either side. Carried to its logical conclusion, where there is an approach it should have an uneven number of openings, and where there are spandrel arches employed in an arch bridge, they should be of an uneven number.

The Knoxville arched cantilever, designed by the writer, was of five main spans and two anchor arms, thus giving an opening at the centre and a perfectly symmetrical structure, except that one abutment was longer than the other, but not apparent to the eye in a structure a third of a mile long. Economy was violated in the depth of the anchor spans in order to make the bridge harmonious, and the basic rules were all as nearly adhered to as is often the case.

The Market Street arch at Youngstown, Ohio, designed by the writer, was a very difficult problem to solve on account of the side spans having to clear the railway tracks, and on account of the 4% grade of the roadway. The design, however, is symmetrical with the exception of the grade and the approaches, and was made quite harmonious by carrying the sub-trussing of the side spans through at the same elevation as the lattice truss over the arch.

The Mill Creek Park arch, while a short span, shows the possibility of designing artistic bridges for ordinary locations.

Comparing the Memphis bridge by Morison with the Thebes bridge by Modjeski, we can readily see how much is gained in architectural appearance by the symmetrical arrangement of the spans in the Thebes bridge. Comparing the approaches of the Thebes bridge with the approaches of the Forth bridge, we see how much more in harmony with the main structure are the approaches of the Forth bridge than those of the Thebes bridge, although considered alone the latter are of the best design architecturally.

The Grosvenor Dee bridge, at Derby, England, with its 200-ft. masonry span, is one of the greatest bridges of the world, but the paneling of the abutments and spandrels, and indeed all the decorations, are so out of harmony with the great span, that they dwarf it and ruin the design. Compare this with similar details of the Eden Park, Cincinnati, reinforced concrete arch and we find such ornamentation entirely appropriate and harmonious for the smaller span.

European bridges are more often well designed architecturally than those of other countries and the great bridge over the Rhine at Bonn, Germany, is an example where simplicity, harmony, symmetry and proportion are all as fully met and satisfied as has ever been the case in any bridge structure.

The Camelback bridge in the Imperial Palace grounds at Peking, China, is also one of the most perfect of the world's bridges from the architectural point of view and satisfies the cardinal requirements of design.

The best design in the United States is the Connecticut Avenue bridge in Washington, D.C., with its five great concrete arches, and very little fault can be found with the design, except the inappropriate decoration of the wing walls of the abutments. The designing of harmonious and appropriate details in the proper proportion is a study in itself and entirely beyond the scope of this paper. Should designers, however, carefully observe the cardinal principles herein laid down much more pleasing structures would result and a great stride forward be made in bridge engineering and architecture.

The necessity for good construction, especially of foundations, is obvious.

The total output of petroleum in the world for 1913 has been compiled from reliable estimates for foreign countries and from preliminary figures of the United States Geological Survey for the United States, and is given as about 378,000,000 barrels of 42-gallon capacity, as compared with 351,178,236 barrels in 1912. In 1906 the world's output was 201,777,228 barrels, so that within a 7-year period, there has been an increase of over 80 per cent. The United States has furnished the greater part of the increase, and is at present providing almost two-thirds of the world's annual output. The 1913 production of the United States was equivalent to about 65 per cent. of the world's total.

REMARKS ON THE THEORY OF THE PITOT TUBE

DESPITE the great number of valuable papers and results of tests published during the past few years on the subject of the Pitot tube, hydraulic engineers have not as yet come to any definite agreement as to whether $h = \frac{v^2}{2g}$ or $h = \frac{v^2}{g}$ is the correct formula underlying its action. The following extracts from a paper read by N. W. Akimoff at the recent convention of the American Waterworks Association in Philadelphia, may be of assistance in clearing up a number of points serving as a foundation for argument. Mr. Akimoff is inclined to believe that the contention inherent in the controversies as to whether $\frac{v^2}{g}$ or $\frac{v^2}{2g}$ is correct, is mostly based upon the fact that entirely different premises are at the bottom of such discussions.

The formula $h = \frac{v^2}{g}$ is the same as $v = 0.7\sqrt{2gh}$ and it is not very difficult to build rods that will yield this result or even slightly less, instead of $v = c\sqrt{2gh}$, where c varies from 0.84 down to 0.75, as is the case in some of the rods now on the market.

It is often "assumed" that c really ought to be unity and, therefore, that smaller values of c are caused by the "suction," due to the "trailing orifice," bent back (Fig. 5, c) in the direction of the flow. It so happens, however, that out of all means available for decreasing the

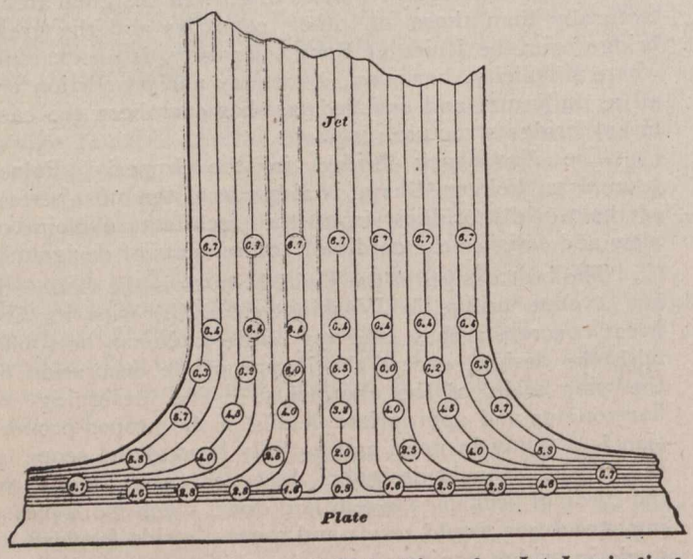


Fig. 1.—Stream Lines and Velocities of a Jet Impinging on a Plate.

value of c, the "trailing orifice" seems to be the least effective; experiments made both in this country and abroad show that the lowest c that can be secured with the trailing orifice is 0.84 and often as high as 0.92, whereas, as said before, other means enable us to bring c down to 0.75 and even to 0.70. Greater "reliability" is claimed by the advocates of the "trailing orifice," however, which point it is not our intention to consider in this paper; our object being to present a few considerations relative to the formula itself of the Pitot tube, and not at all either to endorse or to condemn any particular existing article now on the market.

We shall first take up the impulse tube itself; the "static" tube will be considered later. The writer will assume that everyone is familiar with the article on "The Pitot Tube; Its Formula," by Mr. W. M. White, published in the Journal of the Association of Engineering Societies, August, 1901. This article, which in our time will perhaps be found somewhat unconvincing, and, possibly a trifle obsolete, contains at least one valuable feature, which will be of advantage in our discussion. In

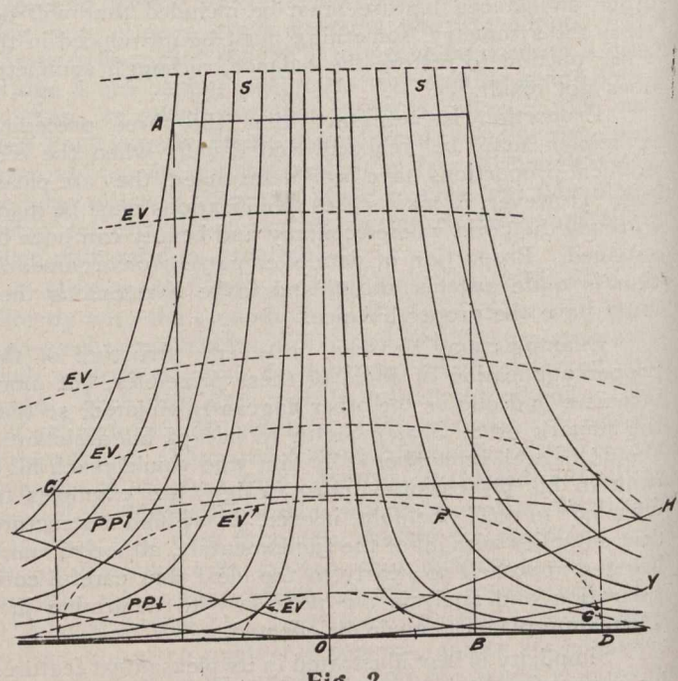


Fig. 2.

order to substantiate his opinion that in an impact tube, whose impinging surface is one of revolution, the coefficient c, of conversion of velocity head into static head is exactly unity, Mr. White has made many tests, the results of one of which are given in a chart (Fig. 1), taken from his paper.

A stream of water was directed against a round plate; individual velocities of separate filaments were measured and the results, in feet per second, are marked on the chart.

At the present time it would not be necessary to take all this trouble, the effects of the stream, directed both against a long, narrow strip (dam) and against a round plate, have been carefully analyzed with the following most interesting results (Fig. 2, for round plate only).

1. The stream lines S are curves of third degree, possessing this most curious property: that all cylinders, inscribed in the surface generated by each stream line are equal, so that, for instance, the volume of A-B is the same as that of C-D. The stream lines began to diverge at a considerable distance from the plate. Of course, the size of the plate proper does not in the least affect the general shape of the curves.

2. The curves of equal velocity EV are ellipses, located as shown and having O as centre. Since, in general, these lines intersect the stream lines at two points, such as F and G, it is clear, that somewhere between F and G there must be a point of minimum velocity, where the corresponding ellipse is tangent to the stream line. The locus of such points of minimum velocity will be a straight line, OH, the angle of which with the base will be about 20°.

3. The curves of equal pressure *PP* will likewise be ellipses, but their common centre will be located below *O* and is not shown on our drawing. The curve of maximum pressures, (that is of points on each stream line, where the pressure is greatest for *that* curve) will be a hyperbola *YOY*, tangent to the plate at *O*.

Careful attention must be paid to the fact that the straight line *OH*, of minimum velocities, and the hyperbola *YOY* (of maximum pressures) do not coincide, so that minimum velocity does not mean greatest pressure, which excessive freedom with Bernoulli's theorem might lead us to think would always be the case. We readily

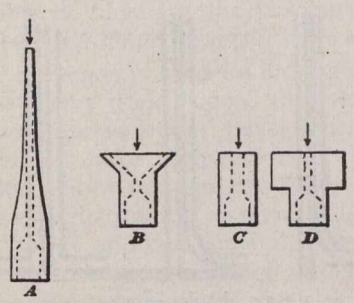


Fig. 3.

forget that Bernoulli's formula has been established for parallel flow only and that it does not hold good for any other kind of flow; at least not in the shape in which it is given in books on hydraulics.

Such, then, is the correct aspect of the phenomenon of a jet impinging upon a round plate. A plate, long and narrow, would mean a somewhat different distribution of velocities, etc., and all lines would appear somewhat different from those given in Fig. 2. It follows, therefore, that contrary to the established assumption, the point *O* cannot possibly be considered the true impact point. Here the "static" pressure is indeed maximum, but the velocity is zero and therefore it is really the ideal point from which to determine the true static pressure, undisturbed by any "suction" or "trailing" effect.

It will, of course, be understood that this static pressure represents the conditions somewhere "up stream" from the plate itself; for instance in Mr. White's experiment, it simply shows the height from which the water falls. In other words, we have here not the "velocity due to a certain head" but the head itself. This may be made to serve as a check, but in itself is not especially instructive or interesting in our present problem. But then, it is perfectly possible and feasible so to calculate almost anything of this sort as to give fairly good results; only, our layout, Fig. 2, or, for that matter, the "practical" sketch, Fig. 1, as given by Mr. White, shows that the middle point is merely subjected to the action of dead water. We might as well have a stationary column at that point.

Any other point, in the vicinity of the curve *YOY*, of maximum pressures, will be more likely to register the effect of impact, due to velocity, in addition to static pressure at this point.

All the foregoing refers, of course, to a stream acted upon by gravity and directed downward on a horizontal plate, in other words to the condition, illustrated in Mr. White's sketch. In a pipe, with water flowing under pressure, the foregoing conclusions may require suitable corrections.

It is, nevertheless, quite obvious that the point which is generally assumed to be the true impact point, apparently placed against the greatest action of the stream, may prove to be at a great disadvantage, so far as the determination of velocity is concerned.

The size of the plate, as has been already stated, does not enter into our deductions; and the nozzles *B*, *C* and *D* (Fig. 3, taken from Mr. White's paper) will naturally cause the same distribution of velocities and the same effect. The nozzle *B* is in the same class, because our mere desire to "catch" the energy by means of a funnel-shaped orifice does not in the least alter the fact of the central stream being perfectly neutral, while other stream lines may, indeed, assume a somewhat more fanciful shape than that given in Fig. 2.

So far as the nozzle *A* is concerned (Darcy's shape), it must be remembered that, unless the nozzle itself is reasonably long, the fittings, etc., back of it should not be neglected. It will be easily seen that a large T or L piece immediately back of a very thin nozzle will cause the formation of stream lines similar to the foregoing, with the same inevitable effect, viz., the neutral stream, possessing the greatest static pressure, but inert, dynamically.

That the rod itself, beside the nozzle proper, will exert a certain influence upon the results, has been very clearly demonstrated by Professors Easby and Pardoe, of the University of Pennsylvania. In their experiments a comparatively small pipe was chosen and the rod was of

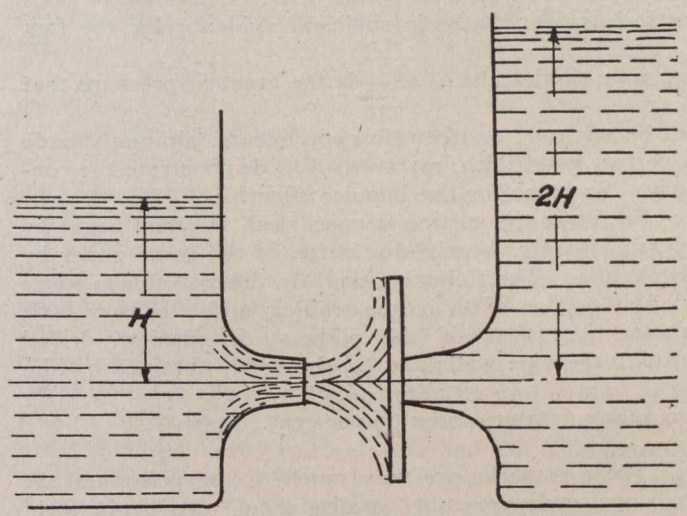


Fig. 4.

uniform blade-like cross-section. By means of suitable stuffing boxes the rod was made to pass completely through and extend on both sides of the pipe; so that traversing the pipe meant merely shifting the position of the orifice, and not, as in other rods, the immersion of an additional portion of the rod proper. Under these conditions the traverse curve was materially different from the one usually obtained from such small pipe (4-inch). The curve was visibly more symmetrical and thus proved, beyond doubt, the experimenters' point.

The fact has been long established in theory and confirmed by experiments of all kinds, that the *force* (*not* the pressure per square inch) due to an impulse of a jet is $M \times V$, mass times velocity, where the mass is the second-weight divided by 32.2 and the velocity is in feet per second, so that the result is in *pounds*. This immediately leads to $h = \frac{v^2}{g}$, in other words, to the conception of *twice the head generated by the velocity.*

That $M \times V$ is the actual force, due to an impulse, can be clearly proved by an experiment, similar to that described in Professor Merriman's *Hydraulics*, in the

chapter on "Dynamic Pressure of Water," where a jet, acting upon a plate in front of an orifice, is capable of sustaining twice the head, to which the jet itself was due (Fig. 4).

Should the plate be removed the head in both vessels tends to the same value, as was almost exactly demonstrated by Professor Unwin; but does such a condition correspond to our initial problem?

In an experiment of this kind, can we possibly expect any result other than an equilibrium, subject solely to corrections due to frictional and other losses?

Zeuner, if an impartial, conservative authority is to be quoted, in his well-known book on *Practical Hydraulics* (German or French), gives 1.25 as a safe value to be used in $h = \zeta \frac{v^2}{2g}$ while demonstrating that its theoretical value is $\zeta = 2$, he likewise cites a few tests made both by himself, in connection with turbine work, and by others, in experimenting on water scoops, etc., where the value of this coefficient was actually 1.25. Was this because the whole jet was utilized instead of only a small central filament?

Summing up the foregoing, therefore, and without the slightest desire to question the accuracy of the numerous tests, made by well-known experts, the writer does not feel, so far, there is sufficient evidence for the fact that in a single tube $h = \frac{v^2}{2g}$ is the greatest pressure that can be secured; and certain experiments, although made in perfect good faith, rather tend to demonstrate the contrary. So much for the impulse effect.

So far as the suction is concerned, we shall begin by referring to Mr. Ferris' discussion of the same paper by Mr. White. The following are Mr. Ferris' conclusions: (1) The suction effect of the trailing orifice is very little greater than that of the plain static opening, drilled through the pipe wall; and (2) the head, obtained by him was much greater, about 60 per cent., than $\frac{v^2}{2g}$.

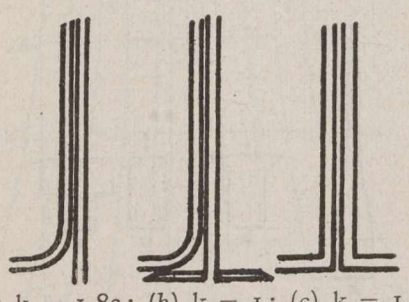
These remarks are very much to the point and we shall now endeavor to generalize them. To begin with, analyzing the suction effect due to the trailing orifice arrangement, one cannot help arriving to the conclusion that, owing to the comparatively low velocities, under which the Pitot tube is operated in practice, there is but little hope to secure any appreciable amount of suction by merely bending back the static tube.

Even in theory it can be proved that there is a certain minimum velocity, beyond which no suction can possibly take place (see Zeuner's book, hereinbefore mentioned).

But there is another point not to be overlooked; the so-called "static" opening, which is sometimes drilled in the pipe or else otherwise finished flush with a horizontal plane, cannot help registering *less* pressure than that corresponding to the "static" head, except, of course, for extremely low velocities. Here water is made to shoot past the opening and it is at this point that some suction effect might reasonably well be expected.

By way of illustration, beside Mr. Ferris' experiment, already mentioned, we might cite a few careful experiments made in Charlottenburg (Fig. 5, taken from Dr. Blasius' article, see *Die Turbine*, January 20, 1910). By k is meant the coefficient in $h = k \frac{v^2}{2g}$. It will be observed from c that the arrangement, which from the standpoint of "trailing" effect should yield the greatest k, actually is much inferior in this connection to the arrangement shown on sketch a, where the static pipe is finished at right angles to the flow.

It is perfectly easy further to intensify the real suction effect. It is well known that, as explained in hydrodynamics, a sudden change in the direction of velocity can cause very abrupt changes of pressure. For instance, in flowing around a sharp corner, even moderate velocities will cause zero pressures or even negative pressures (vacuum, and corresponding interrupted flow). This, then, seems to the writer to be the correct principle on



(a) k = 1.82; (b) k = 1; (c) k = 1.18.

Fig. 5.

which to work to secure the real suction effect, so that the value of c can be reduced to 0.70 and lower (in $v = c\sqrt{2gh}$).

This has been experimentally demonstrated by Mr. Paul Lanham, engineer in charge of pitometer division at Washington, D.C., who had a special rod made according to a sketch suggested by the writer. In fact, the coefficient given by this rod seemed to be a trifle less than 0.70, although this rod was not standardized beyond establishing the above point of giving a very low value of c.

CANADA CEMENT COMPANY'S PLANT AT DAUNTLESS, ALTA.

Building operations are about to commence on the proposed $2,500,000 plant of the Canada Cement Company at Dauntless, Alta. There will be five kilns, each 10 feet in diameter, 240 feet high, and will weigh 600 tons. Including the fire brick lining and an average load of material, the weight will be 720 tons. These are the largest cement kilns in use in Canada and will be second largest in the world. A 10-ton gear, is required to drive each kiln and bearings, weighing 15 tons support the weight; while 16 cars are required to transport each together with bearings and gear. Over 3,000 yards of concrete are required for the five foundations. The cost, including installation, will be $75,000 for each kiln. The plant at Dauntless when completed, will have a capacity of 4,000 barrels daily, and will be one of the largest in Canada.

A bill has been submitted to the General Assembly at Uruguay for the construction of a canal to connect La Picada de Almeida, on the River Santa Lucia, in the department of Canelones, with the bay of Montevideo. This new waterway will be named the Zabala Canal. It will be accessible throughout its course by vessels of 200 tons displacement. The cost is estimated at £3,080,000.

The Pennsylvania Water and Power Co., has let contracts for the installation of an additional unit of 16,000 h.p. at its Holtwood (Pa.) plant. This will make the eighth unit, and will bring the capacity of the plant up to 111,000 h.p., with provision made for the installation of two more units, when required. Along with this improvement a new transmission line is to be erected between the Holtwood plant and Baltimore, which will take care of the increasing business in the latter city. This work will cost about $400,000.

ENGINEERING AND ACCOUNTING—THEIR RELATION WITH SPECIAL REFERENCE TO PUBLIC UTILITIES.*

By J. B. Scholefield.

AMONG the many changes brought by time none has been more complete than the change in the relations between Finance and Engineering. In times past the successful promotion of any undertaking involving the use or development of physical means was largely dependent upon the possibility of finding an engineer capable of handling the problems to be faced. The financial backing could be much more easily secured.

With the tremendous advance in engineering knowledge, and the heavy drain upon the world's finances caused by the unprecedented developments of recent years, the positions have been reversed. The necessary engineering skill can be more or less easily obtained, but, owing to the ever increasing demand and the multitudinous opportunities afforded, capital is becoming more and more difficult to interest. The requirements of capital are becoming more exacting and must be complied with to the best of our ability.

It is not now sufficient for the man of vision to paint a picture, for him to be overloaded with the necessary funds for its realization. Few projects are absolutely "in the rough" and estimates of the future must generally be verified from experiences of the past. This is particularly the case to-day when so many undertakings involve the replacement or reconstruction of the result of previous efforts. In many cases the profit to be gained is not what might be called an "original" profit but is often in the nature of a commission on increased efficiency or improved methods. The old gives place to the new but the latter pays for the sins of the former and the margin of profit is therefore reduced.

It is in these circumstances that the accountant has come into his own. Starting as the humble scribe to the "creative genius"—the engineer—he has to-day, in some instances, attained a position where the hopes of the engineer rest upon his decision. In all cases greater demands are made upon the accountant and the initiation and continuance of important undertakings depend largely upon the figures he supplies and not so much upon the sanguine expectations of the promoter or the developer.

The foregoing is even more true when we turn from the entrancing realm of exploitation to the mundane sphere of operation. With the increasing population and the disappearance of virgin fields for commercial development, financial attention is increasingly focussed upon existing enterprises and the possibilities for their betterment and economical expansion. Competition, including the competition between different means of production and sources of supply, calls for a closer watch upon the results of operation. Figures supply the medium.

Under these circumstances it should be apparent that it is to the mutual interest of the engineer and the accountant that they should co-operate to the fullest extent and should have a thorough understanding of the difficulties under which they each labor.

When I was asked to address your society it was with considerable misgivings that I consented, for "there is nothing new under the sun" and the setting forth of concrete facts such as an organization like this is interested in appear to me to be probably beyond my ability. However, it occurred to me that some brief remarks on the problems confronting the accountant in which he is dependent upon the co-operation of the engineer might be of value and, at this present stage of the country's political progress, a brief discussion of some points in the valuation of public utilities, in which they are both vitally interested, might be of interest.

In times past there have been unfortunate divergencies between the accountant's final figures of cost and the engineer's original estimates. This was doubtless the fault of the accountant but perhaps may be forgiven as attributable to his inordinate desire for accuracy.

The chief mutual interest of the engineer and the accountant centres round the question of costs. I do not now refer to manufacturing costs, with which we in this part of the country are not greatly concerned, but to the construction costs.

It is essential that the cost of construction be properly kept for the following objects:

(1) The vindication of the engineer.

(2) The scientific provision of depreciation.

(3) The reliable adjustment of cases of renewal and replacement.

(4) The provision of figures on which to base future developments or to recommend new and similar enterprises.

(5) The valuation of property for sale or amalgamation.

(6) The valuation of property for regulation or absorption by the state or federal governments.

The history of most undertakings has been one of small beginnings, and here occurs the first difficulty of the accountant. It is naturally felt, when capital is small and hardly obtainable, that the energy of the organization must be concentrated upon the physical work in progress. The accounting end is given small consideration and the records kept are meager and unreliable. In many cases the engineer is the paramount authority and is able, if he will, to insure the starting of a simple yet complete system which shall be of use in the future and can be elaborated as the enterprise grows. I have experienced instances where it was quite impossible to ascertain from time books or payrolls where the work was actually done and, as expenditure on similar work at several locations was all charged to one account, it was impossible to arrive at the cost of each plant.

The books are often kept at a point remote from the actual work of construction. The bookkeeper is unfamiliar with the nature of the work and the lay of the land and is consequently unable to provide intelligent and appropriate records. A preliminary outline by the engineer, showing the general plan to be pursued and the more important items comprised therein, should be provided.

In large undertakings it is worth while to keep elaborate detailed cost accounts in a separate set of books, the balances of which tie in to the controlling accounts in the general ledger. In smaller projects this is not possible and considerable unnecessary expense and trouble is incurred because the engineer insists on keeping his own records of cost for various parts of the work. This is probably necessary in such instances as require records of cost of excavation, grading, concrete work, etc., so that daily costs may be obtained as a check upon the progress made, but the cost of sections of the work can be adequately shown by the general books if there is a proper understanding between the engineer and the accountant.

*Read before the Utah Society of Engineers, January 16th, 1914.

The former sometimes complains that the divisions adopted by the latter are of no service to him. Some preliminary agreement would doubtless have eliminated this excuse.

Unless the work will bear a heavy accounting cost, simplicity of accounting distribution is essential. I suggest that the following divisions will sufficiently cover the majority of cases (excluding large enterprises):

Material and freight.
Labor.
General expense.
Overhead expense.
Financial expense.

The first three divisions would be titles of accounts for each part of the work sufficiently important to call for separate accounts. Overhead expense and financial expense would, of course, be each in one account for the whole project.

The reason for choosing the first distribution is that, in the West, at least, the delivered cost is the important figure. This account should therefore include hauling and handling. By arriving at the unit cost under this head at the completion of the work it will be possible to make comparison in future years when the questions of replacement, renewal, or reconstruction come up.

The common labor cost should be a separate item because rates change so frequently and much of this work is eliminated from time to time by inventions and improvements.

General expense would include all other expenditures directly chargeable to the section of the work. It may be that engineering is so large an item that a separate account would be desirable. This depends upon the individual circumstances. I shall probably be told that my distribution makes no provision for stores accounts. Needless to say, stores accounts are extremely desirable if properly kept. Unless, however, a regular store-keeper is kept and a proper system followed, the result is more unreliable than that obtained by making direct charges to the accounts estimated to incur the expenditure for material and supplies.

Overhead expense should not include Financial expense but should cover only such supervisory and executive expenditure as cannot be directly charged to any one section of the work.

Financial expense, which includes promotion expense, discount on bonds and stocks, interest during construction, incorporation fees, etc., should be kept separately. It is absolutely unjust to charge this as a part of the cost but it is often spread over the property so as to hide the expenditure. The conservative method is, of course, to hold this expenditure apart and charge it off to profits over the life of the indebtedness incurred or as a yearly charge over the estimated life of the assets created by the work.

It will readily be seen that the accountant depends upon the engineer for the proper distribution of expenditure and it is therefore the business of the latter to see that he has the means of supplying reliable information. I need only mention two or three desirable methods in this connection:

(1) Blind check on material received.

(2) Proper issuing requisitions.

(3) Individual daily time slips. The usual time book is a delusion and a snare and leaves the way open for a shirker to neglect the conscientious discharge of his duty.

(4) In case of a more or less elaborate distribution the adoption of letters, numbers, or symbols as a means of reducing the labor of distribution.

(5) Correct records of material returned either to seller or to general stock.

(6) Correct records of material remaining on completion of construction.

Let me point out some errors which are not infrequent and which can be avoided if the necessary information is furnished to the accountant:

(1) Construction originally charged to property account is torn down and replaced by improvement. The cost of tearing down should not be a property charge.

(2) Supplies are charged to property by one company and then sold to an allied company. The sale is credited to earnings.

(3) Property is "junked" and turned into storehouse without record. There is a surplus on inventory which is credited to profits.

(4) Property is torn down and the material used for maintenance without charge.

(5) Overhead and financial expense are omitted from original cost figures when writing off property replaced.

(6) Supplies left over from construction are not turned in to stores or records furnished. They are later sold as operating supplies or used in maintenance without charge.

In the course of the work the main plan will often be modified and the accountant should then be supplied with a simple and timely notification of the change involved.

The distribution of overhead expense cannot be done intelligently without the advice of the engineer. It is entirely wrong to spread this over according to the total cost of the work. In some cases there will be a large labor charge, involving much overhead expense, with little material charge. In another case there may be a low labor charge with the same amount of overhead expense. In another case there may be a comparatively small material charge on work which has occupied much time in contemplation, planning and supervision. In some cases a low labor charge may mean that the class of labor employed required constant supervision and in other cases a high labor charge may mean that much could be left to the intelligence of the men employed.

The engineer should take the completed cost figure and, from his files and his personal knowledge, make a concise report on each division of expenditure so as to indicate the proportion of overhead expense which should be borne by each.

On other points the engineer can and should furnish information. Take, for example, the question of the charge to be made by one project for equipment loaned to another. This charge may be made either by way of interest and depreciation charge upon the value of the equipment when received, or by the difference between its estimated value when received and when returned, plus in each case an agreed profit.

It often happens that the construction and operation overlap and that the construction force is used to a greater or lesser extent in the commencement of operations. In that case operating must be charged with certain time, both ordinary labor and supervision, for supplies used and facilities provided. The information must come from the engineer. This also applies to the proper division of revenue obtained in the transition period.

Certain parts of the work bear, in some instances, what appears to be excessive cost. Only a proper engineering report can interpret the accountant's figures in the light of the difficulties actually encountered so that future valuation and present opinion may be correctly informed.

When actual construction is completed, the engineer can greatly assist the accountant in two ways:

(1) By giving information as to desirable division of operating and maintenance expenditure so that the records kept may afford valuable information. He may also be able to suggest proper classification of earnings. This side of accounting is often neglected but is very necessary in comparing periods and in arriving at facts relative to progress and the probability of increase in the future and the justification for additional construction.

(2) The fixing of logical and adequate rates of depreciation. This can be done by a detailed report on the class of construction in each account, its probable life, the estimated maintenance charge and any other useful points. The general practice of using a blanket rate of depreciation to cover a whole plant or even large sections is absurd. The whole question of depreciation calls for a change in treatment. To my mind, the only correct method for a large plant or system is the provision of a depreciation and maintenance fund. After proper consideration by engineers and all concerned the probable yearly depreciation and maintenance cost on the several sections should be determined. This cost should be charged up by even amounts monthly and credited to the depreciation and maintenance fund. Against this fund should be charged the actual expenditure for maintenance, replacements, and renewals and complete reconstruction if the property is rebuilt (if the original construction is exactly replaced). The division of the actual expenditure can, if desired, be kept in subsidiary books.

The advantages of this plan are that comparative accuracy is insured in the rate of depreciation and that the cost of maintenance is equitably distributed so that the earlier years, in which the plant is new, and the expenditure on maintenance is small, bear their fair share. It may be objected that the business is built up in the earlier years for the benefit of the later years. This has been the excuse for manipulations which are responsible for many of the evils we suffer from to-day. In any event, if this contention be allowed, the honest method would be to make allowance for the "building up" process by crediting earnings with an estimated amount and carrying a corresponding charge as deferred for distribution over later years.

Where assets are replaced by improved or enlarged units or parts it is naturally claimed that the increased value should not be charged against earnings. It is necessary, therefore, to charge the cost of original plant cost to earnings and the improved value to capital. The accountant must obtain his data from the engineer as the one familiar with the actual physical change. It is hardly necessary to say that the present day cost of the lost asset should be charged to earnings, not the original cost.

The operating statements issued under this system show a uniformity which is extremely useful as a basis for further capitalization or the marketing of present securities.

A periodical reconsideration of the depreciation and maintenance funds and charges thereto must be had in order to correct the results of any exceptional occurrences or conditions.

The rates fixed should take into account the residual value of the property in reduction of the annual charge.

Depreciation should not be provided on such expenditure as does not require replacement. Therefore, real estate, perpetual right-of-way, excavation and grading, and like items should not be included as depreciable.

The income tax law allows "reasonable depreciation." At first the deductions made under this head will doubtless escape minute scrutiny, but as the Act works more smoothly the authorities will certainly turn their attention to this feature. We shall depend upon the engineers to substantiate our contentions as to rates and conditions. It would probably be of great benefit if this society were to take up the question of depreciation in this section of the country, having special regard to the effects of atmosphere, water, and soil conditions and set forth a schedule of depreciation on well-known standard apparatus and material so that these figures could be used to combat the generally erroneous conclusions of government officials. A result of government rate fixing can be seen in the maximum rate of "5 per cent. of the annual gross outfit" allowed to mines under the income tax law. In the case of one mine with which I am familiar, a mine which is a big producer, it would require 42 years to wipe out the investment if the allowance were based on last year's production, or 30 years if the market value of the stock is considered.

The Supreme Court decided that mining companies could not deduct, for depletion of assets, the difference between the value of ore sold and the cost of extraction. This leaves us without any measure of depreciation, if, indeed, any is permitted to mining companies on other than constructed assets—another instance of governmental accounting. The income tax law corrects this but the decision may serve as an instance of what we may expect from cases brought before the courts.

When we turn to the special instance of public utilities we find that the relation of the engineer and the accountant is particularly important. These undertakings depend for their financial life upon the contributions of a class daily becoming more sensitive—the investor. No longer can the word of one financial power call forth unlimited means for any project receiving his benediction. Facts and figures, verified to the utmost possibility, are demanded and given.

In large projects the continual progress must be shown so that an idea may be gained of the eventual outcome. Additional capital can only be obtained after thorough investigation and, in the capital-limited future, the most favored treatment will be received by the corporation able to show actual and provable figures so arranged as to form useful guides to the twice shy investor.

There is another phase of the future which is of even more importance. I believe that most of us will agree as to the practical certainty of one of two things in the near future: (1) State or government ownership; (2) absolute regulation as to rates or capitalization or both. In either instance some valuation must be made and it will not be the same in both cases. Presumably the government would decline to pay for money not actually invested, whereas if rate regulation only were desired, some provision would be made for the risks attendant upon continued ownership. It may be claimed that court decisions concede the value of some intangible costs, but it would appear reasonable to assume that, in the event of a federal scheme for ownership of interstate utilities, some means would be adopted of overcoming the restrictions imposed by past decisions—some of them contrary to a reasonable conception of public rights.

If the valuation be for purposes of rate fixing it is certain that the value must include all money actually expended, together with the cost of obtaining same and a reasonable compensation for unproductive years. This may include some excessive items but the community

must assume some responsibility for its errors of the past or for the provision of facilities before the locality was ripe for them. The question of depreciation cannot concern the rate-fixing body as a factor in the price to be calculated but only as a factor increasing the rate to be allowed. The depreciation should be allowed on the new value of the plant and cannot be claimed at a figure sufficient to make good the ravages of time in a plant where repairs and renewals have been neglected. On the other hand, appreciation of value cannot be claimed for this is the result of the gift or increase of the very public for whom relief is claimed. In the same way a franchise can have no value other than the actual legitimate cost of obtaining same.

Valuation of public utilities for absolute purchase may be affected by a government right to install competitive plants in case of alleged exorbitant demands on the part of the public utility companies. Assuming that both sides are reasonable in spirit, we may fairly claim that the corporation is entitled to payment for cash actually expended, a reasonable financial cost, the average market valuation for some period prior to proposals of government ownership for the stock issued purely as bonus, a reasonable compensation for the market building period (such compensation to become less as the company grows older) and some value for appreciation where the far sightedness of the promoters can be shown. Depreciation not made good would undoubtedly be deduced and regard would be had to the conditions of ownership and operation as they had affected profits.

The ethics of government acquisition may be said to rest upon the assumption that value conferred by the people may be taken by the people, after allowing reasonable compensation for private capital employed and risks undertaken. Assuming the accuracy of this assumption it is evident that little value will be attached to franchise rights, appreciation through increase of population or age of property, promoters' bonus (except where represented by stock which has acquired a market value in the hands of "innocent" holders) and similar terms. It is therefore essential to show all the legitimate expenditure involved and that records should be easily verified and explained. Corporations able to supply information readily and clearly are likely to receive better treatment than those which must resort to estimates and put forward claims not represented by actual figures.

The presumption stated above excludes all question of replacement value. This method of valuation must be resorted to when original records are not available but is fraught with dangers. If credit is taken for the increased prices of the later date it would be perfectly reasonable to insist that the heavy promotion and financial bonuses imposed in the past, but no longer tolerated by public opinion, be eliminated. If, however, by replacement value we mean the cost to replace the original construction at the original figures, the value of correct records is again evident. There are, however, some values which, under ordinary bookkeeping methods, would not be recorded. Such values are those for right-of-way and land donated and taxes remitted. These have a legitimate value to the company and should be recorded by the man on the spot, the engineer, through his report or by notification to the accountant who can record same by a ledger account note or in some other appropriate book. On the other hand, there are certain recorded expenditures which are not represented by assets to which the corporation has title. These include such expenditures as are made on city streets and in other public places in consideration of rights or privileges acquired. A physical valuation of the property might overlook this cost unless specially segregated on the books or specifically reported.

In conclusion, let me express the hope that this somewhat random paper will stimulate interest in the accounting work of enterprises with which you may be connected. Interest is prone to wane when construction is completed and the humdrum work of operating begins. You can, however, usefully give some attention to the operating records. By suggestions or instructions as to proper division of earnings, by information as to which parts of the property or types of the construction are deserving of special record as to operating costs and results you can ensure useful records. Correct and reliable statements breed confidence, and confidence is the forerunner of enterprise. When enterprise is widespread we all gain, and in the creation of confidence one project successfully constructed and operated is worth a hundred glowing prospectuses.

This paper does not exhaust the subject and is written more as a basis for discussion than as containing only incontrovertible facts. I shall therefore be glad to endeavor to answer any questions which you may care to ask.

SMALL STONE FOR ROADS.

It is a usual custom to specify that no stone in a broken stone road shall be over 2½ inches in diameter, because it is claimed that if larger it will work to the surface. If a mass of loose stone of various sizes is passed over by wheels there is no doubt the larger stones will tilt up when the weight comes upon one end of them and the smaller stones will roll down into the place made vacant; but it does not follow that in a broken stone road rolled with a steam roller and bound together with the addition of fines, that a stone will work to the surface if it is 2 inches below the surface to begin with. In fact the mass is so perfectly bound together that it is impossible for tilting to take place, therefore larger stones than 2½ inches can be used in road construction, especially for the lower course.—Canadian Municipal Journal.

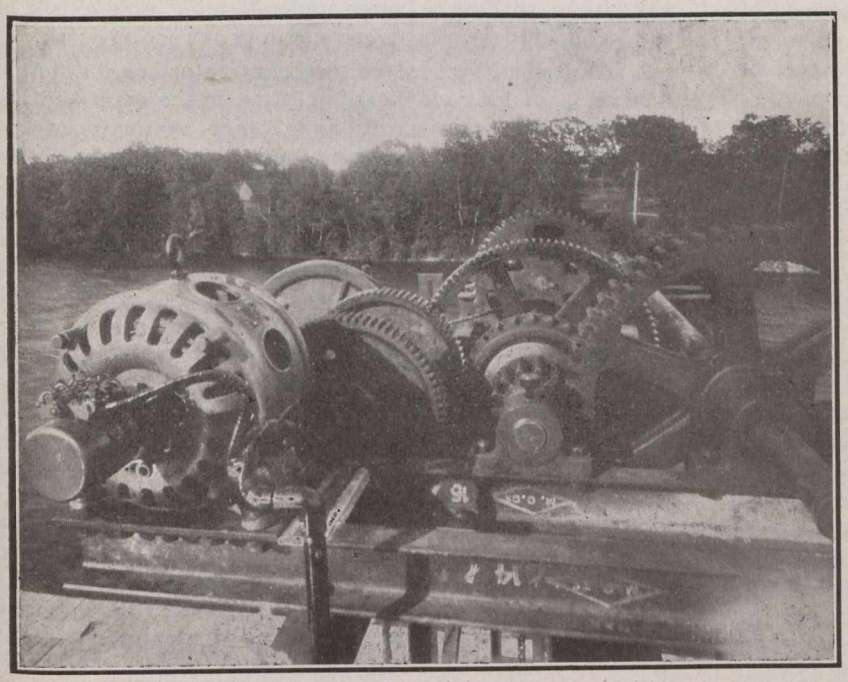
A steel car of special design is being adopted by the C.P.R. The roof of the car has been made in the form of a compromise between the clerestory and the turtle back types, and seeks to retain as far as possible the advantages of both, offering the maximum of light and ventilation. The car is 10 feet in width and 82 feet in length and seats 84 persons.

A compromise bill to regulate the water power diversion rights at Niagara Falls has been agreed upon at a conference held on May 13 between the Secretary of War and representatives for the United States of the House of Foreign Affairs Committee. The bill gives the Secretary of War the right to issue revocable permits for a daily diversion averaging 15,600 cubic feet per second on the American side, and the importation of 250,000 h.p. from the Canadian side. The control over the rates, tolls and service is to be left to the state of New York.

A contract has been recently made between the Italian State Railways and the Società Italiana Westinghouse, of Vado, Liguria, for the electrification of the 27-mile railway between Genoa and Savona; and the electrification of the 30-mile railway between Savona and Ceva, has already commenced. Work of electrification of the Genoa-Savona line is to be completed within 3 years, this line forming part of the railway between Genoa and Marseille, France. By June 1st the railway between Savona and Ceva will have been electrified as far as San Giuseppe (11 miles), one of the principal thoroughfares for the coal-carrying trade of northern Italy. Electricity will be utilized for the freight as well as the passenger services of these lines, and the electric locomotives to be used will be the same as those now in use on the Italian railways from Genoa through the Apennines and the Giovo, which were made by the Società Italiana Westinghouse.

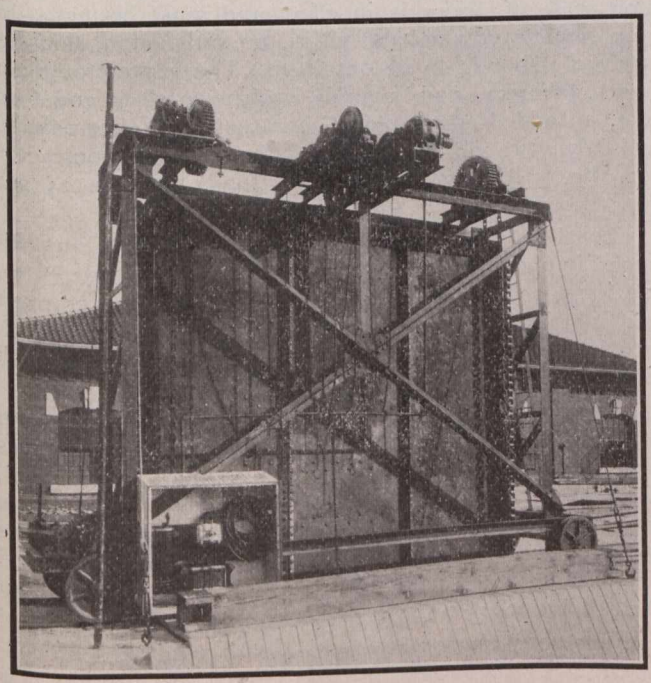
NOTABLE SLUICE GATE ON OTONABEE RIVER.

THE Auburn Power Company development on the Otonabee River possesses a number of interesting features, among which might be mentioned the specially designed travelling sluice gate by means of which the water can be shut off from any of the five wheel pits. The accompanying illustrations show this sluice gate and the gearing whereby it is operated.



Operating Mechanism of Travelling Sluice Gate.

The Auburn Power Company, which was purchased about four years ago by the Electric Power Company, operated a plant for a number of years consisting of one 250-kw., 2,300-volt, three-phase, 60-cycle generator and exciter; one 100-kw. and one 40-kw. unit, both 550-volt, d.c., compound-wound railway generators. These were driven by water wheel and supplied light and power to Peterborough and power to the Peterborough Radial Railway Company. Upon purchasing the plant, the Electric Power Company planned a larger development, the construction of which took place in 1911.



Sluice Gate in Raised Position.

The main dam is situated about 1,200 ft. north of the power house and is constructed of concrete with piers 6 ft. thick and stop-log sluices 20 ft. wide. Its maximum height is 24 ft. and its length 452 ft., including the intake to the head canal, which occupies a total width of practically 100 ft. Each sluice has a depth of 10 ft. below normal head water level and provides a total discharging capacity of 26,000 cubic feet per second. The stop-logs of both intake and dam are handled by chain winches.

The head canal, 1,200 ft. long with sides sloping 1½ to 1, and faced with 9 inches of reinforced concrete, varies in width from 74 ft. near the head works to 83 ft. immediately above the power house.

Articles dealing with the design and construction of this interesting plant appeared several years ago in *The Canadian Engineer*, but the above data are given to better describe the sluice gate with which this article deals.

Of the five wheel pits, four were designed for power units and the fifth for the exciter turbine unit. Each wheel has a net entrance area of 224 square feet to shut off the water quickly and completely in cases where repairs or examination of the turbine gates or runners are necessary. The Stoney sluice manufactured by Ransomes and Rapier, Limited, and illustrated herewith, was installed. The dimensions of this gate are 15 ft. 3½ in. wide and 14 ft. 3 in. high. It is constructed of a riveted boiler plate and supported by a travelling gantry of structural steel, as shown. The apparatus is mounted on cast-iron wheels 2 ft. in diameter with a 9-ft. 8-in. base. It operates on rails at standard gauge.

The arrangement whereby the sluice gate can be lifted or lowered even under a full head of water with the turbine gates opened full, consists of a set of circulating rollers on each side to run in the concrete stop-log gains. When the gate is closed leakage is minimized by the settling into place of adjustable side bars.

The gate is fitted for both electrical and hand operation. It may be raised or lowered against quickly running water passing through the opening under the maximum available, in the space of 2¼ minutes by electric motor. If operated by hand, lowering takes 4 minutes and raising 60 minutes.

The mineral production of coal and coke in British Columbia for the two years, 1912-1913, is given in Bulletin No. 1, 1914, of the British Columbia Bureau of Mines as follows:

Minerals.	Production, 1912. Quantity.	Value.	Estimated production, 1913. Quantity.	Value.	Increase or decrease.
Coal tons, 2,240 lb.	2,628,804	9,200,814	2,136,694	7,478,429	—1,722,385
Coke tons, 2,240 lb.	264,333	1,585,998	285,123	1,710,738	+ 124,740
Building materials, etc.	.....	3,435,722	.....	3,400,000	— 35,722

ENGINEERS' ESTIMATES AS THEY AFFECT THE CONTRACTOR.

THE following article, from a paper read by P. R. Fletcher, to the Illinois Association of Municipal Contractors, of which he is president, has to do with a number of points of interest both to engineers and contractors.

The United States government, the legislatures of all the states, the officers of every city, village and town, annually levy an appropriation to pay the expenses of running their respective governments for the succeeding year. Every railroad company and industrial corporation in like manner makes an estimate and appropriation for their corporate expenses. This must be done in order to keep the cost of operation and maintenance in reason and to limit the entire cost to a fixed sum of money which they anticipate receiving.

In like manner the engineer in preparing his estimate of the cost of any improvement should with care and deliberation go into all details and arrive finally at a sum which will be sufficient to pay the total cost of this improvement and all expenses connected therewith. This estimate should be ample and liberal to allow for all the requirements of construction and the contingencies which might arise.

There is occasionally an estimate for public work in the territory in which I have operated, that I would call reasonable; there are some that are fair, more that are low—and some, very low. Engineers' estimates are invariably low. I have therefore taken for my text the following clause, found in every special assessment proceeding in the state of Illinois: "I hereby certify that, in *my* opinion, the above estimate *does not exceed* the probable cost of said improvement and the lawful expenses attending the same and connected therewith."

In that one word "my" lies the authority for the estimate, the value of the estimate, and whether or not it is adequate for the construction of an improvement. By that one word the state of Illinois has given its authority to an individual to carry out its constructions and to prepare an estimate for vast sums of money. It has not hampered him except as to the word "exceed" and, as everything is left to his personal opinion, the value of that word is negative.

At the first sight of this certificate, one would think that this estimate must be exactly what the proposed work would cost, and could not exceed that sum. That is what it is intended to be, but, with the fluctuations of labor and material, and other causes, estimates vary a great deal, and if not made with due care, by an engineer who has had a great deal of actual experience and who has kept cost accounts on construction work, will often prove insufficient.

The city engineer who does all his work in one city becomes familiar with all the conditions entering into the cost of work in that city, and usually makes conservative and reasonable estimates. On the other hand, if he uses the same schedule of prices of labor and material upon going to some other city or village, the estimate may vary either way, and if too low may cause the non-letting of the contract. Again, there are many instances where the engineer has made fair and liberal estimates, according to his judgment, but has been compelled to lower them on account of the opinions of some members of boards of local improvement, who consider the estimate too high for that particular locality. Low estimates often result in the failure to let the contract and the abandonment of the proceedings, the letting of the contract above the estimate necessitating a supplemental assessment, or the letting of the contract to undesirable contractors.

Less than a decade ago estimates of cost, both by engineer and contractor, were generally mere guesses. Both, however, are beginning to realize the value of keeping construction costs. Both in estimating and in carrying on construction, methods and costs are taken into consideration, so that a better understanding now exists as to the difficulties to be overcome in construction work.

Though every engineer and contractor has a different method of making estimates of costs, in the main and important details they are similar. For example, anyone estimating the cost of concrete per cubic yard can obtain prices from the dealers on the aggregate, sand, cement, steel and lumber. The exact amount of each material needed for a cubic yard can be calculated and set down without any guessing. There are only two items—the cost of mixing and placing and the cost of erecting and removing forms, both items of labor—that remain to be estimated. By consulting some practical concrete man who does this kind of work, or taking it from cost records, the estimator can ascertain the cost of these items. Adding to it allowances for plant and general expenses, the contractor's legitimate profit and discount of paper, he has a fairly accurate estimate. This method reduces guesses to a minimum, and instead of a guess in a lump sum, what little must be done is confined to a few items, generally a small per cent. of the whole. Those who follow this method and do much estimating will soon learn the various man and machine units of work per hour or per day, so that the only uncertain element of labor cost will be the fluctuation of wages.

There are many conditions which affect the fluctuations of wages. Men may be plentiful when a job starts, but wages may increase, due to the beginning of other work in the same locality or generally good business conditions, and labor become difficult to obtain. In many cities, labor unions are in control of the situation and a union scale of prices is in effect and must be met. In many smaller villages and cities, no satisfactory floating supply of labor is to be obtained. The contractor must import laborers and provide a place to sleep and feed them, an added cost on small contracts. Wages paid to local labor are always higher for an outside contractor than the prevailing local scale, usually about a 25 per cent. increase.

Local laws may also affect the labor costs. City ordinances imposing regulations on maximum loads, etc., may increase the cost of the work. The engineer must look fully into the wages paid in any locality where work is to be done and also into the many conditions which might arise.

Look Out for "Contingent Costs."—In the case of materials to be used, there should never be any guess work as to their cost. Before the estimate is compiled, prices of all the materials, based on the approximate amount needed, should be obtained in writing from the manufacturers or dealers. In the request for such prices, it should be stated what the materials are for, and about when and where they will be required.

Every contractor is familiar with the items of contingent cost encountered in nearly every specification. He reads them over and says to himself, "Oh, that isn't much; that doesn't amount to anything." It does not, if there were only one; but, taken in the aggregate and put into dollars and cents, it represents a large item of cost. If he does not figure it, his profit is reduced; and the

probable reason he has never figured it out is that he could not get his bid under the engineer's estimate if he had—for the very reason that the engineer had omitted it also. Here is the big question: "Do engineers ever figure the contingent cost and add it to their estimated cost?" I believe that here is the true reason why many estimates are too low.

The following items of contingent cost enter into nearly every contract:

1. Expense of looking over the proposed work, attending the letting and closing the contract, if successful.
2. Attorney's opinion as to legality of the special assessment proceedings and bond issue.
3. Cost of the surety bond.
4. Cost of maintenance bond.
5. Cost of the liability insurance policy.
6. Moving outfit to and from the work.
7. Plant maintenance.
8. Tools lost, broken and stolen.
9. Wasted material.
10. Demurrage.
11. Losses due to weather conditions and damages of the elements.
12. Pay roll and expense of outfit in rainy weather.
13. Pay roll of superintendent and foreman for three months of the year, when not at work.
14. Local charges for use of water.
15. Broken drain or water pipes.
16. Unforeseen damages to walks and private property.
17. Cost of inspection of materials.
18. Stakes and help for the engineer.
19. Barriers and red lights.
20. Lost, torn or damaged cement bags.
21. Being a good fellow.

I could explain each of these items more fully, but the mere mention of them will suggest many instances to every contractor. Every one of these items enters into the cost of an improvement. Each is as much an item of cost as labor and material. Taken separately, they amount to but a small sum, but in the aggregate they total from 10 to 15 per cent. of the cost of an improvement. How many engineers take cognizance of these items and include them in their estimate? Yet their specifications and contracts call for them.

No business can succeed without profits, and no contracting company can succeed, and stay in business, without them. This leads to the question, "What constitutes a fair net return on municipal work?"

The contractor's profit depends on the price he bids for the contract, and often varies for the same class of work. In early spring he may bid very low, to get his organization ready for the season, especially if he carried no work over from the preceding year. Later on he, perhaps, obtains contracts at legitimate prices, thus averaging up on the year's business.

On force account work, with every facility at hand to do work, the usual allowance for use of tools and profit is 15 per cent. Gillette figures profit on the basis of 10 per cent. on the cost of material and 33⅓ per cent. on the cost of labor. This would probably average about 20 per cent. on the whole contract.

Contractors for municipal work are paid in cash or bonds. The occasions when they are paid in actual currency are so rare that they need not be discussed. These bonds are of two kinds: the municipal bond, guaranteed by the city or village as a whole; and the special assessment bond, issued by the city or village in anticipation of the collection of the tax upon each lot or parcel of land benefited by the proposed improvement. Here are two classes of bonds issued by the same city or village for the payment of the same class of work, each drawing 5 per cent. interest, each taken by the contractor at par, yet of very different market value.

The special assessment law of the state of Illinois is considered very much superior to the similar laws in Iowa, Wisconsin and Indiana, irrespective of the fact that where only 5 per cent. interest is paid in Illinois 6 per cent. is paid in these other states. The special assessment bonds of these states readily sell for par, owing to the increased rate of return on the investment, and the public buys them for the reason of that particular attraction. The illinois bonds assessed on relatively the same kinds of property are sold at a discount of from 5 to 10 cents on the dollar, in order to net an average of 6 per cent. or more for the time that they have to run.

Here, then, we see the propertyholders paying nominally 5 per cent. on an inflated cost of an improvement according to the state law, but paying 6 per cent or more on the actual cost. This difference of cost of the work, ordinarily termed discount, must be added to the engineer's estimate as a part of the cost of an improvement. This discount is not always 5 per cent., but varies as the money market changes. When money is plentiful, bonds can be marketed at 95, but during the last year many have sold for less, if they could be sold at all.

Special assessments are levied against every lot or parcel of land benefited by the improvement, according to such benefits, and the assessment must be equitable. The amounts so assessed are spread irrespective of the value of the lot or the owner thereof. If the property assessed is improved, the value is greater and the security behind the bond is increased. If the property is vacant and poor in value, it has a tendency to decrease the security of the bond, unless it is so located that its improvement or the growth of adjoining property enhances its value.

Again, many assessments are spread against property which has been sold for taxes and been forfeited to the state. In this case, the state pays no special assessments. Hence, in looking over proposed improvements before the letting, the contractor usually examines the assessment and if he finds property forfeited to the state, it reduces the amount available for the construction of the improvement by the total amount of the forfeitures. If the estimate, after taking off the forfeitures, is too low to do the work, the contractor either must not bid at all or else must bid above the estimate. From these facts it follows that it should be the duty of the engineer to look over property before making his estimate, to ascertain its condition, and make his estimates accordingly.

Make Sure of Value of Bonds.—The first duty of the contractor, when he receives bonds for work, is to see that they are good. He must depend upon the expert attorney to advise him. But such advice, however favorable, will not force a propertyholder to pay his tax for an improvement, nor will it force the state to pay a tax upon a lot which has been forfeited to the state for non-payment of taxes. No special assessment bond becomes forfeited if every lot or parcel of land pays its tax. If property that is assessed for special assessment improvements is clear as to title and is worth as much or more than the assessment, there is not much doubt of the assessment being paid. It is this doubt or possible chance of a forfeiture that bankers and bond-buyers shy away from. They use it as a club to force the contractor to sell his bonds at their price. After having the opinion of the expert and of

their own legal talent as well, they send representatives to look over the property assessed, and if there is no possible chance of a loss, the contractor may be offered 95 per cent., if 30 per cent. of the property is vacant, 92 per cent. If there is a forfeited lot, he will get no offer at all.

I am going to suggest two remedies that I am positive, if made law, would have a good effect on the market value of these bonds. As they depend upon the engineer's estimate they may properly be included here.

First, the engineer's estimate should be ample; enough so that after paying the contract and the 6 per cent. allowed by law for the expenses of making the assessment, court costs, etc., there would be left a residue. Our present law requires that after the cost of an improvement is determined, the residue shall be rebated to the propertyholders before they pay their assessments. They pay only what is actually required. My suggestion is that no rebate shall be made until the final bond is paid. I contend that if the property owner elects to take five or ten years to pay his debt, he should pay all expenses connected with it. I contend that the contractor should not assume the collection nor stand the responsibility of the non-collection of special assessments. If there were a residue or reserve left in the special assessment fund, over and above the obligation or requirements of that assessment, it would undoubtedly go far as a guarantee toward insuring the full payment of every bond and the interest thereon, in case of a possible default in the payment of some installment.

Secondly, 6 per cent. is allowed by law to reimburse general fund accounts for cash advanced on account of the expenses of levying all assessments, and this 6 per cent. is always drawn from the first installment. Thereafter there is no fund to pay any expenses which may develop on account of the special assessment. If some of the propertyholders pay their assessment in full, the interest stops on their portion but the bonds continue to run until called. Here is a loss of interest and no fund to pay it. There might be a default on some payment of an assessment and no fund to pay it. The bonds are obligations of all the propertyholders, and inasmuch as the state has seen fit to assess them 6 per cent. for the making of an assessment, I can see no valid reason why another assessment of, say, 5 per cent. should not be levied and held as a sinking fund or reserve, to pay the loss of interest and forfeiture, if any, and at the final payment of the last bond to be rebated to the propertyholders.

The assessing and creation of this reserve will, in my opinion, bring the value of special assessment bonds to a higher plane as marketable and investment securities. Contractors who, in bidding heretofore have figured a return of 90 to 95 cents on the dollar, would, if these provisions were a law, be able to figure on the basis of nearly par. If the creation of this reserve acts as I think it will, I cannot see that the propertyholder eventually pays any more than he does at the present time. What he now pays for as discount will be offset by the increased value of the bond.

The present state law requires that interest shall be paid upon all of an assessment except improvements put in upon the one-year plan. There are a great many such improvements, so small in total amount as to dollars and cents that it is impossible to make them in 5 or 10 installments, where each installment must be a multiple of $100. Very often these improvements are put in in the early part of the season or late in the fall, and in either case, the contractor must wait a year or year and a half for his money without interest. I believe the laws should be amended so that this kind of paper would bear interest, putting it in the marketable class of securities.

There seems to be a dark cloud in our special assessment law in regard to interest on the first installment where there are deferred installments. The ordinance usually sets forth that all installments except the first shall draw interest at the rate of 5 per cent., yet all municipalities collect the interest on the first as well as on successive installments.

Some municipalities issue vouchers on the first installment which bear no interest, but more of them issue those bearing interest. The former apparently have the law with them; the latter do it because they think it fair and honest, believing that as long as they collect the interest on the installment they should in turn pay it out on the voucher or bond. The special assessment law should be so amended that all installments shall bear interest and that all vouchers issued against the first or succeeding installments shall draw interest.

Summing up, an engineer's estimate, to be fair, conservative and reasonable, must be based on the following:

1. The actual cost of material and labor.

2. Contingent costs, amounting to from 10 to 15 per cent. of the above.

3. Contractor's profit, amounting to from 10 to 30 per cent. of the first two items. This will vary according to whether the contract is hazardous and difficult, requiring a large amount of special equipment, or whether it is comparatively easy, requiring but little equipment.

4. Allowance for converting the bonds into cash, amounting to at least 10 per cent. of the total amount of the contract.

C.P.R. TO USE FUEL OIL IN BRITISH COLUMBIA.

The chief engineer of the C.P.R. has investigated the cost and feasibility of using oil in the locomotives on the Cascade subdivision of the British Columbia division of the road with the result that, both in passenger and yard engines, oil tanks will be established at Vancouver, Coquitlam, Mission Junction and North Bend to supply the fuel for the locomotives. Oil has been used for fuel purposes for some time on the sections between Kamloops and Field, and also on some of the branch lines of the province. After the engines on the Cascade division have been changed and placed in commission it is intended to extend the plan to the section between North Bend and Kamloops, completing the change on the entire British Columbia division.

Fuel oil consists essentially of carbon and hydrogen, and the proportion of the latter is high enough to add materially to its heating power. It contains little or no oxygen to reduce the heat units obtainable from it, and it gives out much more heat, weight for weight, during its combustion than coal. Fuel oil also owes part of its superiority over coal in heating power to its greater freedom from moisture, ash and other agents. It is sufficiently accurate to regard the reducing effect of mineral matter, moisture, etc., on the heating power of coal as due to displacement of combustible matter. A coal containing 5 per cent. of ash and 5 per cent. of moisture would, so far as these constituents are concerned, contain only 9 lbs. of combustible matter in each 10 lbs. of coal. The ash and mineral matter in coals vary greatly. The moisture may rise to 10 per cent. and over, and ashes of 40 per cent. and over have been recorded. Fortunately these are excessive figures, and the proportions often run below 5 per cent. When the ash and moisture are low (and in some coals they may be as low as between 2 and 3 per cent.) the higher values for the heating power are possible. Fuel oil, however, is readily obtained free in a high degree from these constituents. The United States Government refuses consignments containing more than 2 per cent. of moisture, and insists on its being practically free from mineral matter. The higher proportions of carbon and hydrogen in fuel oil, and the practical absence of substances exerting a depressing effect on the heating power, explain the greater number of heat units obtained during the combustion of oil.

COST KEEPING IN COUNTY ROAD WORK.

IN a paper read by Mr. R. P. Boyd, assistant state highway engineer of Alabama, at the annual meeting in January of the Alabama Association of Highway Engineers, the importance of cost keeping in all road work done by counties was emphasized, and the benefit that might be derived from an accurate system of cost keeping brought out. The following argument is presented:—

It is the engineer's duty to keep the cost of all work done by the county, and it should be one of his first duties to find out what work the county is doing is costing and to reduce that cost by engineering skill, good judgment and common sense.

A few engineers, some foremen and nearly all county commissioners object to cost keeping and the expense incurred.

It is unnecessary to argue here that an engineer on road work is necessary. But does the expense of cost keeping pay a county? Why does every business house go to the expense of keeping cost sheets and accounts and employ bookkeepers and auditors? Because it is absolutely necessary that that business know what each item of expense is and try to reduce the expense to a minimum. Why do the railroads keep the cost per ton-mile of each class of freight hauled? Why does the United States Government keep the cost per cubic yard of all classes of work done on the Panama Canal? Because these corporations and the government realize that they must know these small items of expense, which, if overlooked, soon amount to big sums. If this is true in business, why is it not true in county road work? Isn't that a form of business and shouldn't it be handled in a business way?

One of the first questions asked the Highway Department on going to a county, is: What will a road cost, or what will the grading cost? That same county has been doing road work since the county was established and does not know what its work is costing per cubic yard or per mile. Would you handle your own business in such a manner? How can you handle your road work in a businesslike way? Employ a competent engineer and demand that he show you results. If he can reduce the cost of your work to more than pay his salary the county has a good proposition and knows what it is doing.

For argument's sake, say that you have one outfit of ten teams working on the roads. Under ordinary conditions that outfit should move in grading from 200 to 300 cu. yds. per day, or an average of 250 cu. yds. Suppose that they work 20 days during the month, making 5,000 yds. moved for the month. Suppose that your engineer stakes out the work, cross-sections it and keeps the cost, and he finds it is costing 30 cents per cu. yd.—and we have found that in many counties it is costing that and more. If this is the case, something is wrong with the management of the outfit and the cost should be reduced. Contracts are being let all over the state for grading from 20 cents to 25 cents per cu. yd. Suppose the engineer can reduce the cost to 25 cents per cu. yd. In the one month you have saved on the outfit $250, and if there are more outfits the saving is increased. Can you afford to employ a competent engineer to make this saving?

Again, suppose that the engineer finds that the outfit is moving only 1,000 yds. of earth during the month, and under the conditions it should be moving 2,000. He knows that something is wrong and takes steps to correct it and by careful study finds the trouble and increases the output 1,000 yds. for the month, thereby reducing the cost to half.

The cost keeping is only one of the many duties of the engineer, but it is one that is often neglected in counties that have engineers. It is very easy to keep a system of cost accounts, and unless your engineer is on the job the entire time, the foreman must be required to keep the time.

Of course, on contract work it is necessary to know the cost of each item in order to make a fair settlement with the contractor, and no contract work should be undertaken without an engineer, for either the country or the contractor will lose by it.

The most complicated cost keeping arises when convicts are being used and it is desired to find the cost of different classes of work. The first thing necessary is to find the cost per day of each convict and each team. Suppose the outfit has only 30 convicts, 3 guards, 10 teams and a foreman. If these 30 convicts work 26 days during the month, then there are 780 convict days during the month. To find the cost per day, divide this 780 convict days into the total cost of all convicts, including supervision, guarding, feeding, clothing, medical attention and every item of cost. Suppose this amounts to $273 for the month, then the cost per day per convict is 35 cents. In the same way we find that the teams have cost, say, $390, or $1.50 per day. Now, if the foreman keeps on his time sheet or book what each man and team is doing and turns it over to the engineer, it is an easy matter to figure the cost of each class of work. For instance, suppose 10 teams and 15 men are working on a fill for three days. The cost of that fill would be:

15 x .35 x 3 =	$15.75
10 x 1.50 x 3 =	45.00
Total,	$60.75

If the fill contains 400 cu. yds., then the cost per yard is 15.18 cents. These figures are assumed. Some actual cost data on convicts taken from a state aid road in Bullock County are: Cost of maintenance of convicts per day, 39.2 cents; cost of teams per day, $1.29. At this rate the grading cost 15.2 cents and sand-clay cost 15.3 cents per cu. yd.

Occasionally you find a foreman who rebels at keeping these cost items, but generally that man is afraid to know what his work is costing and he is not honest with himself or the county. In most cases the foreman is glad to find what the cost is, and tries to improve his work and his own efficiency as a foreman.

These figures are not mythical or hearsay, but are tried and proven facts. Think of what your county is doing and try to better road conditions. And the first step is to get an engineer, and the next to keep cost accounts.

A definite announcement has been published to the effect that the Northern Navigation Co., one of the most important corporations operating in Alaskan waters, has sold its steamers, barges and terminal facilities to the American Yukon Navigation Co., and the latter will continue to transact the transportation business to all points on Yukon River and its tributaries. The Northern Navigation Co., which was controlled in San Francisco, operated 43 steamers and 54 barges, and owned terminal facilities in Alaska. The American Yukon Navigation Co. is stated to be backed largely by English capital, and to be a part of a big organization which includes the White Pass and Yukon Route owning and operating the railway from Skagway to Whitehorse and steamers and winter stage lines thence to Dawson.

NEW BRIDGE AT PORT COQUITLAM.

As announced in the Construction News columns of May 14th issue, a new bridge is to be erected by the Department of Public Works of British Columbia over the Pitt River, at Port Coquitlam, about 20 miles east of Vancouver. It will be located about 400 yards above the Pitt River bridge of the Canadian Pacific Railway, the substructure of which was described in *The Canadian Engineer* for June 19th, 1913.

The proposed bridge will have timber trestle approaches 540 ft. and 270 ft. at the west and east ends respectively. The bridge proper will rest upon 9 concrete piers, constructed upon timber cribs, the two outer piers being protected by timber piling. At this point borings have indicated a light clay and mud river bed, for a depth of approximately 150 ft. The maximum depth of water at high tide is about 56 ft. and at low tide 50 ft.

The superstructure is to consist of 7 spans which formed a part of the bridge purchased from the Canadian Pacific Railway Company, this bridge being the one that has just been replaced by the new double track bridge described in the article referred to above. It is a single-track construction and has been in use approximately six years. The entire bridge was purchased intact for the sum of approximately $70,000.

The swing span is designed to give a clear opening of 93 ft. on either side of the pivot pier. It will have a clearance of 24 ft., while the trestle approaches will be 24 ft. in width. The deck of the bridge will be so constructed as to provide for electric railway tracks if necessary at some future time.

The portions of the bridge for which tenders are now being called are the complete substructure, including guide piers and trestle approaches. The contract for the transfer of the Canadian Pacific Railway bridge to its new site was let some little time ago.

The estimate of cost for the construction of the complete bridge is $450,000.

The distance of a sea mile varies in different parts of the globe. At the Equator a knot would be 6,045.95 feet; at the Poles it would be 6,107.76 feet, and in the latitude of the ocean route from Europe to New York about 6,080 feet. Nautical surveyors take into account these small differences, and the measured nautical mile for speed trials on the Clyde, where the Lusitania was built, is longer than the nautical mile used for the same purposes more southerly. The British Admiralty knot is 6,080 feet, and the recognized knot of the United States Navy 6,080.27 feet. A knot in very general use measures 1,000 fathoms, and a fathom being 6 feet, this knot would be 6,000 feet.

In *Stahl and Eisen*, attention was recently drawn to the fact, by A. Müller of Gutehoffnungshütte, that a Girod furnace has been running for 4 years, without interruption, at the Gutehoffnungshütte Works. He claims in contrast to many early assertions that this type of furnace is distinguished by great durability of the hearth and simplicity of construction; and that the furnace has behaved admirably in practice. The advantages of the Girod electric-arc furnace are that in melting down cold charges it also works as a resistance furnace, in consequence of the passage of the current through the whole mass of scrap, and is of undeniable value as regards the rapid melting down of the charge, especially at the beginning of the smelting process. The slow and continuous leaping of the numerous arcs from particle to particle of scrap proceeds very quietly and without producing any appreciable rushes of current, the result being that the electrodes can be regulated automatically during the longest stage of the melting-down period. In this way the operation goes on very smoothly and in conjunction with the uniformity of current distribution and generation of heat on the steel bath, and also the low tension at the poles, the difficulties of insulation are diminshed.

TOWN-PLANNING CONVENTION IN CALGARY.

THE Alberta Town Planning and Housing Association will hold a convention in Calgary, June 16th, 17th and 18th. Invitations have been issued to municipalities and interested organizations throughout Canada. In connection with the convention, a city-planning exhibition will be held, the various exhibits of which will, in general, come under the following heads:

Railways.—Railway stations; railway bridges; plans of railway elevation, or depression; street railway systems; city and radial railways; street railway "fare" zones, if any.

Transportation (and Streets).—Bridges, civic and other; views of principal streets; parked streets; street plans; street planning.

Population.—Maps showing increase in area, by annexation, each increment to be distinguished by shading or color; maps showing density of population; plans showing present and prospective development; plans showing railway lines and industrial sections; factories, kind of, and factory districts.

Water Supply.—Reservoirs; stand-pipes, artistic and the reverse; pumping stations.

Sewers.—Plans showing lines of sewers; cross-section, etc., of principal sewers; sewage disposal plant.

Fire Protection.—Fire-swept areas, plans and photographs; high-pressure and low-pressure systems.

Parks and Squares.—Views in parks; parks at street intersections; maps of park systems, existing and proposed; swimming baths; monuments.

Housing.—Model houses; model subdivisions; tenements, illustrations, plans, costs and rentals; playground scenes; schools; municipal buildings, post offices, custom houses, museums, university buildings, etc.; public libraries; public markets.

Smoke investigations, and water-falls.

A feature of the convention will be the consideration of a proposed housing bill for the province of Alberta. The civic plans for Calgary and other cities of the Dominion will be on exhibition. His Honor Lieut.Governor G. H. Bulyea will begin the proceedings and various ministers of the government will take part in the deliberations. Mr. T. T. John, City Hall, Calgary, is Secretary-Treasurer of the Association.

At Nelson, B.C., a local syndicate has been formed to carry on placer-mining on Forty-Nine creek, a few miles west of Nelson, and lumber for a flume has been ordered. It is stated that the syndicate has obtained control of placer leases covering 4 miles of ground on the creek. In early years placer-miners worked successfully on the creek and obtained gold to a considerable total value.

Concerning mining in Saskatchewan, it has been reported that at Prince Albert, approximately 500 mineral claims had been staked by the middle of April at Beaver Lake since public attention was several months ago turned to that part of the province as a promising field for gold. On Saturday, April 11, registrations of 104 locations of claims were made at the Dominion Land office there, which constituted a record for any one day, but there has lately been such a rush to the new field that it is expected this will be surpassed.

A syndicate, recently incorporated under the name of the Vancouver Oil and Natural Gas Company, is carrying on careful and thorough prospecting of the oil possibilities in the flat district around Pitt River, B.C. Extending from the southern end of Pitt Lake, through towards Port Haney, they have thousands of acres of land under oil lease from the Government. Several other companies are prospecting in the Fraser delta, and quite a showing of oil indications is said to have been met with in Hatzic, further up the Fraser River from Mission, B.C.

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THE MONTREAL ROAD CONGRESS

Road building in Quebec and Ontario was given an impetus by the First Canadian and International Good Roads Congress held in Montreal last week. Unfortunately, there were less than a score of delegates in attendance from other provinces, but the interest shown by Ontario and Quebec was manifested by an attendance of sixty-seven men from Ontario and one hundred and sixty-six from Quebec Province outside of Montreal. There were registered at the Congress one hundred and seventy-two residents of Montreal. Thirty speakers, visitors and guests came from the United States.

The Congress had the official support of the Quebec Government, being attended by the Lieutenant-Governor, the Premier, the Minister of Roads and the Deputy Minister of Roads. Many interesting announcements were made by these officials, including the fact that another ten million dollars will be voted by the Quebec legislature to lend to municipalities for road construction, the ten million dollars which was previously voted, having been practically all expended.

Hon. Louis Coderre, Secretary of State, represented the Dominion Government at the Congress, and promised that Federal aid to good roads would soon be available upon terms which he thought would be acceptable to the provinces. At the banquet Hon. Mr. Coderre and Hon. Mr. Tessier, Minister of Roads for the Province of Quebec, announced the construction of various roads and bridges amidst enthusiastic cheers.

The announcement made by Hon. Mr. Tessier that the municipalities of the Province of Quebec now owned one hundred and fifty complete road outfits occasioned considerable surprise as, so far as is known, most of these outfits were purchased without public calls for tenders.

A prominent official of the Quebec Government voiced the hope to *The Canadian Engineer* that slightly different methods will be used in the spending of the next ten million dollars to be voted by his Government. Instead of a municipality that had, say, thirty thousand dollars of money borrowed from the Government to be expended on roads, paying six or seven thousand dollars for a road outfit, and then having the roads constructed by a newly organized gang, this official urged the letting of these contracts to experienced road contractors who own their own plant.

A permanent organization of the Congress has been effected with W. A. MacLean, of Toronto, as president, to make the Congress an annual affair. Therefore, the voicing of a suggestion or two as the result of close observation of the proceedings at Montreal might be appropriate.

The Canadian Engineer has nothing but praise for the efficient work done by the executive committee of the Montreal Congress. There was nothing to be improved upon in regard to the handling of the exhibits, but the business sessions or papers of the Congress appeared, to technically trained men, to lack effectiveness in some particulars. A brief period of discussion should be provided for at the termination of each paper. There is probably always an interested listener who desires to obtain further light upon some portion of the treatment of a subject, or who has valuable opinions to express. With the session commencing at 3 p.m., however, and with seven or eight papers of varying lengths to be disposed of during the remainder of the afternoon, there is no opportunity for discussion, nor even for the speakers' best treatment of their subjects. The addition of a morning session and a

reduction by half in the number of papers for any session, would allow time for discussions.

There was some objection at Montreal to a few papers against which the charge of "commercialism" was laid. Some delegates thought that the speakers had taken advantage of the opportunity to present the methods of their particular type of pavement in an unnecessarily forcible manner. Municipal and highway engineers and road contractors, however, would not object to these papers, as much was to be learned from them. No man is so likely to be able to give valuable and comprehensive data regarding a pavement as the manufacturer of that pavement. There are only two possible objections to the so-called commercial papers: First, the possibility of unfair play by permitting a few types of pavement to be so presented while equal opportunity is not given to other types; secondly, the lack of time for an open discussion of the papers after they are presented, so that by argument and counter-argument between the manufacturers, engineers, road contractors and others who have experience in regard to the pavements, the merits and demerits of the respective pavements could be established.

From a technical standpoint, far more work would be accomplished by such a Congress were every paper to be printed and distributed about two weeks previous to the Congress, and the papers taken as read instead of being actually delivered. The entire time could then be given over to discussions and to the answering of questions by the authors of the papers. Of course, certain rules of debate, such as time limits, would be necessary, but the data that would be brought out in this way would be most valuable.

The Congress owes a vote of thanks to the American speakers who gave their time to assist the cause in Canada. Half of the speakers were guests from the United States. It is to be hoped that next year's Congress will see more Canadian engineers and officials accept the invitation to prepare papers, so as to get the benefit of their experience regarding climatic and other conditions peculiar to Canada.

STREET CLEANING AND ITS IMPORTANCE.

Many of our cities have awakened to the realization that spring house-cleaning is as much a necessity for the community as for the individual housekeeper. There appears to be a widespread appreciation in our cities that cleanliness and health go hand in hand and some are entering into the work with commendable zeal. The cleaning-up process has outgrown in numerous instances its magnitude of a few years ago, with the result that such operations cannot be carried out to civic satisfaction in a single day. The result is "clean-up week," such as the City of Montreal held during the week of May 18th.

The purity of the public water supply is generally recognized as a necessity in the promotion of public health. The same applies to the food supply, and, as is evident in cities large and small, the importance of providing a pure air supply for the community is such as to warrant continual effort in the matter of proper cleaning of streets and lanes. These become soiled and dirty as a result of, and in proportion to, their use. The materials gather thereon, partly due to carelessness, but are partly the result of conditions beyond control. They harbor large numbers of bacteria, of the nature of which little is known. While disease-producing organisms probably do not exist for long periods of time on our streets, they may be present and may thus become direct causes of infection. When dry, the material lends itself to transportation by currents of air, thus entering offices and homes, discoloring buildings and lawns, and generally affecting atmospheric conditions even to the extent of irritating the respiratory organs of citizens.

The problem of maintaining the streets of a city in a clean and healthful condition has been given considerable study in the principal European cities. The average city in this country, however, has not adequately recognized the importance of it and the work of the street cleaning department has not progressed to a careful study to determine the most efficient and economical methods of street cleaning and the nature of the results thereby obtained. The street cleaning department is not considered one of such importance as to necessitate the care and supervision of a trained expert, and where such a department exists it is generally under the direction of a man who knows little or nothing about sanitary science. The results to be expected are lack of system, inefficiency, unsightliness and danger to health.

Mr. W. H. Dittoe, chief engineer of the Ohio State Board of Health, has made a study of the methods usually followed in the cleaning of city streets and the manner in which they differ in various cities. He has stated that his investigations appear to show that the experiences of other cities are seldom taken into account. In those cities where the greatest advance has been made water is used as an adjunct, if not as a principal means of removing the material.

"The early methods of cleaning streets," states Mr. Dittoe, "utilized the machine broom, a horse-drawn vehicle with a cylindrical brush which in rotating throws the material toward the gutter. The use of this machine is often accompanied by the production of clouds of dust and the cleaned surface is not freed of the fine particles which adhere to the pavement, later to be transported by the wind. This method has been discarded in the most progressive cities in favor of more proper and advanced methods. It is now generally conceded that a street can be properly cleaned only by washing with water. Numerous devices have been proposed for the application of water to the surface of the street and all have their peculiar advantages. The European cities utilize a hose for street flushing. In the principal American cities a flushing machine is used by the operation of which the water is applied from a tank wagon under a pressure sufficient to remove the dirt from the surface. A somewhat more recent device is the combination sprinkler and squeegee machine. In the operation of this machine, the water is first applied to the surface and shortly after the wetted material is removed by a rotating cylinder fitted with rubber squeegees set spirally. The action is similar to that which takes place in the washing and drying of a window. These machines have been adopted in a number of American cities. In Berlin, Germany, an attempt has been made to utilize a vacuum machine similar in its principles to the machine almost universally used for the cleaning of carpets. This machine has not been tried out a sufficient length of time to determine its merit but it offers a method of removal of waste materials entirely satisfactory in its sanitary aspects. In general, it may be said that while marked advance in methods of street cleaning have taken place during the past few years, considerable study remains to determine the most efficient and economic methods to be used."

TECHNICAL TRAINING FOR HIGHWAY ENGINEERS.*

By A. T. Laing, B.A.Sc.,
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IN dealing with questions of debate one is more or less liable to be hampered with certain prejudices. The old adage that to err is human is perhaps equally clearly expressed if we say that to have a prejudice is human, and the extent to which we are so hampered is a measure of our liability to be led astray.

Coming as the writer does from an educational institution it might be supposed that he was prejudiced in a desire to promote the employment of young graduates, but while indulging a legitimate desire to give such assistance whenever possible he holds no such brief on this occasion.

Primarily the motive of the writer is to show the sympathy of the University of Toronto with this movement and to tell you something of the contributions it is making, and secondly to show a personal interest in the convention, at the same time placing some emphasis on features which he believes have an important bearing on the aims of this meeting.

Let us look briefly at what the aims are, of a course of technical training for engineers. It should greatly extend his horizon, instil a spirit of inquiry, suspend prejudice, enable him to approach a question with a clear and analytical mind. It should give him an increased sense of responsibility and more highly fit him for "the art of directing the great sources of power in nature for the use and convenience of man." A student of average endowments who has taken advantage of the instruction of an approved curriculum has been given a mental equipment which he might otherwise never acquire, and the institution which gave the instruction has been at least in a measure successful. Let us not forget, however, that there is one thing that has not yet been accomplished, the young man has not been made an engineer. That is above the might of an institution and should never be confused with its aims.

The technical graduate has only been given a start and if he is ever to become an engineer it must be through subsequent experience.

What, then, are the functions of the man thus equipped with the mental training and the subsequent experience? In brief it is the complete investigation of a given problem and with the conditions as he finds them to arrive at a solution. In other words, he must diagnose the case and prescribe the remedy, the difference between the engineer and the physician being that in many instances the filling of the prescription is the most costly part, and further, there is no specific remedy, the means employed must be governed by local conditions, and this is precisely what engineering means, the providing of one thing in one case and another thing in another to bridge over the exact same difficulty. Were it not so, all engineering problems might be reduced to a mere set of rules and all we would need would be skilled workmen to put them into execution.

Let us now see what bearing this has on the road problem. There is possibly no branch of engineering work in which a wider variety of conditions may be found. In many instances the problems demanding solution are such as to require the highest skill and experience and the conditions may alter many times in every mile of length. Among his duties might be mentioned the following:

1st. To make a survey of the road, to make profiles, establish grades, provide drainage and to relocate where necessary to avoid cuts and fills.

2nd. Prepare plans and specifications for the construction of the road and for all bridges and culverts, making ample provision for the areas to be drained.

3rd. He should be able to direct the work, provide thorough inspection, keep records of progress and all costs.

4th. He should know his machinery, its capacity, when it should be repaired, in fact mechanical appliances are employed to such an extent that he should be a mechanical engineer.

Reviewing briefly the history of road work, what do we find as touching the employment of engineers? If we go back to the time of the Romans it is not doing them an injustice to say that with all their engineering skill displayed in other works, the remarkable roads which they built were utterly lacking in the principles of sound engineering. The fact that they were able to disregard economy could scarcely be taken as an explanation for the enormous amount of labor involved in the construction of their Royal roads. There was an absence of the spirit of inquiry. They built well, but not wisely.

During the dark ages which followed the Roman period, very little road work was done. The revival of road building in France during the early part of the eighteenth century although a modification of the Roman method was marked by the introduction of more scientific principles and certainly of economy. This work was followed by that of Tresagnet, and later by Macadam and Telford and others, men of outstanding engineering ability who were among the first to employ scientific principles in the solution of the road problems of the day. Of the success of their achievements it is unnecessary to speak. The attention given to drainage, location, gradients, uniformity of cross-section, the construction of bridges, etc., were all high tributes to their engineering skill. And so with subsequent movements in road improvement we find that they have been headed by leaders in the engineering profession.

We see, therefore, the part that has been taken by technical men in the past, but where do we find ourselves in Canada to-day? There is one point at least in which we resemble the Romans, our efforts have lacked in sound engineering principles but alas the contrast—we have no roads while the Romans had. We are now on the verge of a movement which is bound to do more for our national development than all our railroads are doing. The railroads have developed the large commercial centres but they cannot supply the need of our highways. To this movement our technical institutions must contribute their share.

The place that is given to technical training in Europe will be of interest; France holds the leading place in all Europe in matters pertaining to roads. The military operations of Napoleon gave great impetus to the movement as it materially aided in the mobilization of troops. The work was recognized of such importance that it led to the creation of the Department of Roads and Bridges, which department continues to the present, and under the Minister of Public Works it has the direction of a comprehensive national road policy which has made France famous in this respect. And what do we find as an outgrowth? Recognizing the importance of trained men for the work, the School of Roads and Bridges was

*Read at First Canadian and International Good Roads Congress, held at Montreal, May 18th, 1914.

established and while the curriculum is designed to give instruction in other branches of engineering, the object for which it was designed and the outstanding feature, as name would imply, is the technical training of men for positions on staff of highway engineers.

The young men desiring to qualify for service in the department are required to take a short technical course where mathematics and science make up the major part of the work. From this they pass on to the School of Roads and Bridges and receive a three-year course of instruction in civil engineering. The vacation periods are for the greater part spent in the field under the department. It will be seen, therefore, that a very thorough course of theoretical and practical training is established.

As to the justification of the establishment of this institution one need only point to the splendid system of highways which extend throughout the republic. This influence of France in this respect has been felt in the other countries on the continent, Germany, Switzerland, Italy and others have profited by her experience, and while organization in these countries has not reached the same degree of perfection, great stress is laid on both the practical experience and the technical training of men seeking appointment as highway engineers.

In Great Britain a very different system is followed. There are many instances in which surveyors are appointed who have not had technical training, but this practice is not working out satisfactorily and the tendency now is to lay greater stress upon thorough technical training. The apprenticeship system is in vogue and the long and tedious training through which the pupil has to pass is surrounded by numerous limitations. A young lad with ordinary schooling articles to a county or municipal engineer for a period of three or four years. By hard work and study during this time he may pass the preliminary of the professional examinations and at the close of his pupilage he is qualified for appointment as an assistant and so he works his way up by stages to a chief appointment. It will be seen that by this method no standard of excellence is set, although his membership in the various professional associations will help in this respect. Furthermore, the duties of his chief may have been such that the pupil gained very little insight into road construction and management, and in the nature of the case the knowledge of the subject gained must be limited to the field within which his experience lay.

The consensus of opinion, however, is in favor of a thorough technical training and a recognition of its importance is given in the fact that a student with an engineering training may reduce the period of pupilage to one year.

Coming to this continent, what do we find? Alas in the past there has been little disposition to recognize the office of a highway engineer. An assumption far too common has been that anybody can build roads, and what is the result? Either that illusive personage has given up the job or he has been bluffing, for we are still, in a large measure, without roads.

In both Canada and the United States many municipalities have paid heavily to prove that the township clerk, or the assessor or some other official could not build a culvert, a concrete bridge abutment or a road that would last, and many a lamentation has gone up that enough money has been spent to have paved the road in gold and still the road is bad. It is true that engineers, even the best of them, at times may make mistakes, but it is safe to say that their achievements in other lines is sufficient to warrant the recognition of their services in the solution of the problems in highway work.

With the changes that have been brought about in recent years through the introduction of the motor-driven vehicle the problems have become more complex and our treatment of the question has not kept pace with the demand, due largely to a disinclination to abandon old methods.

That the universities of this continent are not lax in dealing with this question may be seen by a brief review of what is being done. In the United States remarkable advancement has been made. In nearly every technical institution where a course of civil engineering is taught the subject of highway engineering is given a prominent place, and in many cases is made a major subject of the final year. Five years ago less than half of these institutions touched the subject. The Department of Public Roads at Washington, through the efficient directorship of Logan Waller Page, has also given a great impetus to the training of young men. By giving a special course of instruction in the department and then placing these men in charge of work on the field a practical demonstration has been given of the value of such training.

In Canada, we are glad to see that a like recognition of the subject is being given. It is not possible, at this time, to go into details but we are pleased to note that highway engineering is given a prominent place in the curricula of nearly all the universities and technical colleges throughout the Dominion. In this, Laval University has been the leader, having begun such a course over twenty years ago. In the University of Toronto the subject is combined with sanitary engineering in the fourth year of the civil engineering course. The time is devoted to a lecture and reading course dealing with the design, drainage, foundation and the construction of all types of roads from the ordinary clay road up to high-class city pavements. A lecture course on the geology of road metals, a lecture course on municipal structures, including highway bridges, culverts, retaining walls, etc., a laboratory course for the examination of the properties of sands, gravels and the various kinds of rock employed in road construction and also for the physical properties of bituminous materials, all of which have a direct bearing upon the efficiency of the young engineer.

One feature of this work is worthy of special mention. Laboratory investigations will continue to form an important adjunct to our highway work and it is of utmost importance that the engineer in charge of work should know how to interpret such reports and there is no way in which he can do this more intelligently than by having conducted a series of experiments himself.

In view of the facts cited with respect to practice followed in Europe, what should be our attitude in Canada? Can we afford to disregard the features in training to which they in Europe give such prominence? Certainly in many respects our problems are beset with conditions more difficult and such as tax to the resources of our best engineering skill and ability, and this congress will have conferred a lasting benefit on our community if it does nothing more than to educate public opinion to a fuller recognition of the importance of utilizing the services of our technically trained young men in the improvement of our highways.

This is mentioned as one feature of our pressing needs, not unmindful of the fact that there are others. As much more might be said regarding a systematized national policy, but even this must be organized and put into execution by engineers who can fully grasp the problem. His status must be recognized and the rewards for his services commensurate with the high office he is called on to fill.

ROAD CONGRESS AT MONTREAL.

THE First Canadian International Good Roads Congress was held in Montreal last week. It was marked by the attendance of a goodly number of men whose prominence in road matters in Canada and the United States is well known, their presence serving as an indication of their optimistic feeling and their eagerness to be of assistance on this particular occasion. The Good Roads Show was well patronized and the entire arrangement was such as to provide every delegate with an opportunity of taking full advantage of the entire proceedings of the convention.

The opening session on Monday afternoon was largely devoted to inaugural addresses. Mr. U. H. Dandurand, chairman, in his opening remarks, bore out the good and substantial aims upon which the Congress has been founded. Sir Francois Langelier, Lieut-Governor of Quebec, and Sir Lomer Gouin, Premier of Quebec, attended this opening session and took part in the ceremonial speeches. The former outlined the condition of the roads in Quebec as it was many years ago, and traced the development of the idea that good roads were a necessity from the time when the people in Quebec Province looked only to the St. Lawrence River and other great water routes, as well as to the snow roads of winter, for their means of transportation. The Premier spoke of the aims of the Province of Quebec in the matter of good roads, and indicated that a very substantial progress was being made. They had spent seven or eight millions of dollars on roads and had some exceedingly good roads to show for it.

Hon. Louis Coderre, Secretary of State, voiced the hope that the Federal and Provincial governments would come to an early arrangement respecting a grant for road construction and improvement.

The next address was that of Mr. W. A. McLean, Provincial Highway Engineer for the Province of Ontario, and president of the American Road Builders' Association. Mr. McLean spoke on highway legislation. In this connection he maintained, as principles of highway legislation that could have a general application, that cities should assist in the payment occasioned by the building of public highways; that municipal self-administration should be encouraged, and that the central administration should be relied upon for assistance when circumstances demanded.

Dr. E. M. Desaulmiers, M.L.A., Chambly County, St. Lambert, P.Q., spoke briefly concerning road legislation for the Province of Quebec compared with other provinces.

Mr. A. N. Johnson, chief state highway engineer of Illinois, presented a very interesting paper entitled "Planning of System of Public Roads," but owing to the lateness of the hour Mr. Johnson was obliged to follow the example of the previous speaker by reading only brief portions of his address. His chief contention was that the first necessity in road construction was to make a plan of the work to be done over a wide area, so that in future years whatever work was done they would be working on the recognized system which, when completed, would be twice as valuable on account of its unity.

In the evening and on other evenings throughout the convention special illustrated lectures were given by the manufacturers of road-building materials and machinery, represented at the Congress. They were well attended and displayed many interesting features in the solution of problems commonly met with.

The next session of the Congress took place on Tuesday afternoon. In his opening address, Mr. Dandurand reviewed the work of the previous day. He introduced the subject of a permanent organization. Later in the afternoon he brought the subject again before the meeting, putting it in the form of a motion, which was unanimously carried. The following committee was appointed to make a report to the Congress: Mr. Geo. A. McNamee, secretary-treasurer of the Good Roads Congress; Mr. W. G. Robertson, secretary of the Canadian Automobile Federation; Mr. I. S. Pennybacker, secretary of the American Highways Association, and Mr. H. W. Pillow, president of the Automobile Club of Canada.

In an address entitled "Important Considerations Entering Into the Selection of Pavements for Roads and Streets," Mr. W. H. Connell, chief of Bureau of Highways, Department of Public Works, Philadelphia, emphasized the necessity for trained men for the construction and maintenance of highways. Enormous sums of money had been uselessly expended by those who employed untrained men not only to construct but to maintain their roads. Next in importance to the personnel, careful consideration should be given to the drainage, the present and probable future traffic, foundation gradient, social and sanitary conditions, and wearing surface. Rigid inspection of a road in the process of construction was an absolute necessity.

Mr. E. A. James, consulting engineer to the York County Highway Commission, presented a paper, read by Mr. W. Huber, of the Ontario Department of Public Works, on "Maintaining Macadam Roads." It was claimed that nine-tenths of the objections to macadam roads arose from an improper observation of the rules which govern their maintenance, rather than from difficulties of construction. A list of the various agencies tending to deteriorate such roads was given prominence among which were mentioned narrow tires. The paper favored the patrol system of maintenance and expressed both the statute labor and the contract labor systems of maintenance as generally satisfactory.

"Points Worth Knowing in Connection with Road Improvement," was the subject dwelt upon by Major W. W. Crosby, consulting engineer, Baltimore. Any comprehensive scheme, according to the speaker, necessitated the selection of the most important roads and also the selection of methods and means to be employed. The construction of good roads should be regarded as an investment which must show both direct and indirect benefits. Borrowed money should be used entirely for construction purposes, and the cost of maintenance should be guaranteed out of annual levies. Major Crosby emphasized the fact that there was no such thing as a permanent road. Every road requires maintenance and careful attention, no matter of what type it may be constructed.

Lieut.-Col. W. N. Ponton, honorary president of the Ontario Associative Boards of Trade, read a most interesting paper on good roads as a factor in the progress of cities and towns. The speaker did not endeavor to present anything in the nature of a technical paper, but his address was a rousing elucidation of the effect upon the country which is sure to follow the establishment and proper maintenance of good roads. He suggested that the Congress should be made a constant and permanent element of influence and that it should appoint a committee to lay before Parliament a well-digested plan for accomplishing the best work by the best methods.

Mr. R. Lehmann, engineer of the French Government Service, New York City, gave a very interesting address

in French on the administrative organization by which French roads are constructed and maintained. As numerous references had previously been made to the excellent roads in France, the observations of Mr. Lehmann were followed with close attention.

On Tuesday evening a banquet in honor of the guests of the Congress was held at the Hotel Windsor, and was attended by approximately 100 delegates. The speeches were such as to arouse enthusiasm in the building of roads, while several announcements of importance were made pertaining to appropriations in Quebec for the same.

On Wednesday morning tours of investigation were held whereby the delegates had an opportunity of seeing for themselves roads and streets in and around Montreal and the adjoining towns.

At the Wednesday afternoon session Mr. C. L. Shorey, of Beaconsfield, P.Q., began the proceedings by a brief talk on road improvement in that town.

"Concrete Roads and Streets" was the subject of a paper by Mr. L. R. Ferguson, assistant secretary, Association of American Portland Cement manufacturers, Philadelphia.

Mr. Ferguson's paper dealt largely with the cost of construction of cement roads as compared with that of other types, and dwelt upon the relative costs of maintenance. He spoke of the burdening of municipalities to the extent of $650 to $1,000 per mile per annum in the case of several types, whereas the cost of maintenance of the cement roads was placed by him at from $25 to $50 per mile per annum.

When the bonds matured, the latter road still remained in good condition, whereas other roads were frequently found to require replacing before the expiration of the usual 20 years. Another advantage voiced was the low crown of the concrete roads which reduced the danger from side-slipping, thereby being a distinct advantage both to horse and automobile traffic.

Professor Arthur H. Blanchard, of the Department of Highway Engineering of Columbia University, New York, gave an illustrated talk on modern bituminous surfaces and bituminous pavements. He dealt to considerable length with the construction of such roads and the improvements which the practice of later years have presented. Various types of machinery were illustrated and the most satisfactory methods of construction and maintenance clearly outlined. Professor Blanchard showed a number of interesting views of roads and road work in America, and in England, France and Germany.

Mr. A. T. Laing, of the Department of Highway Engineering in the University of Toronto, read a paper entitled "Technical Training for Highway Engineers," in which was clearly brought out the value to the road movement which would accrue from the courses of instruction that were being given at the principal universities and colleges throughout the Dominion.

"Road Designing" was the subject of a paper by Mr. R. A. Meeker, engineer, Department of Public Works for the state of New Jersey. In the course of his paper he emphasized the importance of selecting the best route and also the importance of proper grading. Mr. Meeker reiterated the words of the prophet Isaiah who, over 2,600 years ago wrote, "Every valley shall be exalted and every mountain and hill shall be made low, and the crooked shall be made straight and the rough places even."

Mr. Will P. Blair, secretary, National Paving Brick Manufacturers' Association, read the next paper, which was entitled "The Economy of the Brick Highway." Mr. Blair based his remarks upon the value of making careful comparisons with respect to the relative merits of paving material and outlined the elements in the economy of the road and the relation which they bear to each other.

"The Relation of the Technical Press to the Good Roads Movement," was commented upon by Mr. H. Irwin, editor of *The Canadian Engineer*. His paper dealt with the classification of the engineering literature at the service of the man associated with road administration and development. Respecting the selection of technical books on road work, he emphasized the value of dependence upon unprejudiced and straightforward reviews which are to be found in the recognized technical journals published from time to time. He outlined the growth of engineering literature on the subject of roads and suggested a plan whereby the road man could equip himself with a valuable library of information upon his subject. He strongly emphasized the value of the card index system in the preservation of articles of interest. The road man was warned against limiting the scope of his reading to that which pertained only to his immediate needs. It was claimed that the successful road engineer should read much more than that which deals with his own special work.

At Thursday's session Mr. O. Hezzelwood, chairman of the Canadian Automobile Federation, presented the first paper, which was entitled "The Relation of the Motorist to the Good Roads Movement." Following him, Mr. H. W. Pillow, president of the Automobile Club of Canada, made some observations and some valuable suggestions regarding the road movement.

The secretary of the American Society of Engineers, Architects and Constructors, Mr. T. Hugh Boorman, presented a paper entitled "Modern Road Construction in the United States and England." Mr. Jean De Pulligny, chief engineer, bridges and roads and the director of the French Mission of Engineers to the United States, spoke concerning the International Good Roads Congress, while Mr. J. W. Levesque, of Montreal, gave an address entitled "The Improvement of Rural Roads as a Source of Considerable Economy to the Farmer.

Another paper, entitled "Automobile Organization and Harbor Improvement," was read by Mr. W. G. Robertson, secretary, Ontario Motor League.

Mr. H. M. Capron, of Chicago, addressed the Convention on the subject of the bulk handling of cement.

Mr. Lucius E. Allen, consulting engineer, Belleville, Ont., read the last paper of the session, entitled "The Construction of Modern Highway Bridges."

Toward the close of the Congress the committee which had been appointed a few days before to make a report respecting a permanent organization, brought in their report, which was received and unanimously adopted. The officers elected were: Honorary President, A. U. Dandurand, Montreal; President, W. A. McLean, Toronto; First Vice-President, D. Michaud, Quebec; Second Vice-President, O. Hezzelwood, Toronto; and Secretary, G. A. McNamee, Montreal. Directors: H. W. Pillow, Montreal; W. J. Kerr, Vancouver; Col. W. N. Ponton, Belleville; Ald. R. J. Shore, Winnipeg; R. S. Henderson, Winnipeg, and J. Duschatel, Outremont, Que.

The list of directors has been left incomplete in order that the present executive may add to their numbers representative men from all parts of the Dominion.

Among the delegates who attended the convention from the United States were the following: J. S. Barron, Baker & Barron, New York; Col. T. H. Boorman, secretary American Society of Engineers, Architects and Con-

structors, New York; C. C. Blair, Youngstown, Ohio; Prof. A. H. Blanchard, Columbia University, New York City; A. G. Batchelder, New York; M. M. Campbell, C.E., American Road Building Association, New York; Major W. W. Crosby, Baltimore, M.D.; W. H. Connell, Philadelphia, Pa.; J. R. Draney, General Sales Manager, United States Asphalt Refinery Co.; W. DeWind, Austin Mfg. Co., Chicago, Ill.; A. N. Johnson, Chief State Highway Engineer, Springfield, Ill.; R. Lehmann, Engineer of French Government Service, New York; R. A. Meeker, State Highway Engineer, Plumfield, N.J.; A. F. Masury, New York; I. S. Pennybacker, Washington, D.C.; M. D. Powers, New York; E. S. Powers, New York; O. R. Parry, New York; Wm. A. Perkins, Connsant, Ohio; H. K. Salmon, Netcong, N.J.; Gordon Smith, Albany, N.Y.; H. Spencer, New York; Geo. D. Steele, Germantown, Pa.; H. C. Tattersall, The Troy Wagon Works Co., Troy, Ohio, care Wm. McNally & Co., and Maurice R. Young, New Jersey, Robeson Process Co.

Four hundred and fifty delegates, guests, speakers, exhibitors, etc., registered at the Congress. Of these, one hundred and seventy-two were from Montreal and one hundred and sixty-six from Quebec Province, outside of Montreal. One hundred and twelve registered from without the Province of Quebec, these being divided as follows: Ontario, sixty-seven; New Brunswick, seven; Manitoba, four; Alberta, two; Nova Scotia, two; India, one; United States, twenty-nine.

The exhibition of road machinery and materials which was held in connection with the Congress was very well managed and made a good impression upon those in attendance. It compared very favorably indeed with any similar exhibition that has ever before been held in every respect, excepting, of course, in the number of exhibits. Not only was the exhibition very pleasing to the eye, but to those who took the time to study carefully the machinery and materials presented and to listen to the information given by those in attendance at the booths, there was much to be learned.

Asphalt and asphaltic road oils were exhibited by the Aztec Oil and Asphalt Refining Company of Canada, British American Oil Company, Elder-Ebano Asphalt Company, Limited, and Imperial Oil Company. Tarvia and Barrett Specification Roofing were exhibited by the Paterson Mfg. Company. The Canada Creosoting Company, Limited, exhibited wood paving blocks and methods of creosoting railroad ties and bridge timbers. The Canada Cement Company, Limited, exhibited methods of concrete construction for roads and streets, in addition to a number of novel ways of using cement. The Dunn Wire Cut Lug Brick Company and its licensees had a joint exhibit.

Among the machinery manufacturers, the largest exhibits were those of Mussens, Limited, and of the General Car and Machinery Works, both of these firms exhibiting some machinery of almost every type necessary for road construction.

The Canadian Fairbanks-Morse Company, Limited, had a large exhibit of mixers, pumps, Koppel dump cars and other contractors' equipment.

Road rollers were exhibited by Mussens, Limited, General Car and Machinery Works, Albion Motor Car Company of Canada, and the J. I. Case Threshing Machine Company. Sawyer-Massey Company had a booth, but were unable to get one of their rollers to Montreal in time for the exhibition.

Foss and Hill Machinery Company exhibited London concrete mixers, sidewalk forms and other contractors' equipment. The Pedlar People, Limited, constructed within their booth a Toncan metal garage, within which they exhibited corrugated culverts, Clinton wire cloth, ferro-dovetail and their various other lines. Corrugated culverts were also exhibited by the Canada Ingot Iron Company.

Baker-Barron, Inc., exhibited scrapers, graders and other road machinery. Alex. Bremner, Limited, exhibited builders' materials and municipal supplies. J. H. McCarty & Company exhibited Waterous road machinery. William McNally & Company, Limited, exhibited a Troy dump wagon and contractors' supplies. Jones & Glassco had in their booth a Foden steam truck.

The Decauville Flexible Armor Company of Canada exhibited a patented method of reinforced concrete brick construction for protecting embankments. Thomas Davidson Mfg. Company, Limited, showed samples of street signs, house numbers and other enameled steel products.

The technical and trade press was well represented, as there were exhibits by Good Roads, Canadian Municipal Journal, Good Roads of Canada, Contract Record, and *The Canadian Engineer*.

INTERNATIONAL ENGINEERING CONGRESS, 1915.

Among the general subjects to be treated before the International Engineering Congress, 1915, probably the one having the broadest interest is that of Materials of Engineering Construction, which enters into all phases of engineering activity. The list of topics which will be treated in this section is as follows:—

(1) Timber.
(2) Preservative Treatment of Timber.
(3) Substitutes for Timber in Engineering Construction.
(4) Brick in Engineering Structures.
(5) Clay Products in Engineering Structures.
(6) Probable and Presumptive Life of Concrete Structures made from Modern Cements.
(7) Aggregates for Concrete.
(8) Slag Cement.
(9) Waterproof Concrete.
(10) Cements containing Additions of Finely Ground Foreign Material.
(11) Economics of the World's Supply of Iron.
(12) The Life of Iron and Steel Structures.
(13) The Employment of Special Steel in Engineering Construction.
(14) The Place of Copper in the Present Engineering Field, and the Economics of the World's Supply Thereof.
(15) Alloys and Their Use in Engineering Construction.
(16) Aluminum in Engineering Construction.
(17) The Influence of the Testing of Materials upon Advances in the Designing of Engineering Structures and Machines.
(18) Cement Testing.
(19) Testing of Metals.
(20) Testing Full-Sized Members.
(21) Proof Testing of Structures.

The papers to be presented from the United States have already been arranged for from the recognized leading authorities on the various topics. Arrangements for the papers from authors in other countries are being rapidly concluded, and the aggregation of papers which will be presented will constitute a broad review of the field and be of the highest value.

ENGINEERS' LIBRARY

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

CONTENTS.

BOOK REVIEWS.

Heat.—By E. M. Shealy, Assistant Professor of Steam Engineering, University of Wisconsin; published by McGraw-Hill Book Co., New York City; 262 pp.; 110 illustrations; 6 x 9 in.; cloth. Price, $2. Reviewed by R. W. Angus, Professor of Mechanical Engineering, University of Toronto.

This book is one of the series prepared by the Extension Division of the University of Wisconsin and deals with the application of heat to various types of machinery, such as steam and gas engines, air compressors, etc. It is evidently written more from the view of the practical than of the technically trained man, as the use of formulas has been very largely avoided and where they do appear, they are not of a complicated nature, so that they are easily understood.

The first six chapters deal with the general principles required in studying the action of heat—e.g., temperature, work and power, transferring and measuring heat, as well as its generation and effect on gases. In many cases the discussion is illustrated by a simple physical experiment showing the meaning. Some attention has been given to insulation and heat transmission, through various substances, coefficients being supplied for practical application.

After the preliminary chapters the book follows along the same general lines as other books on applied thermodynamics except that the treatment is rather more elementary than is usual. Chapters VII. to IX. discuss the working fluids; gases and vapors, and include a table of the properties of vapors. The chapters on the steam engine are too brief and attempt to deal with too much—e.g., the Carnot's Cycle is dealt with in one paragraph and would not be of much help to a beginner whose ideas are not well formed.

The parts dealing with air compressors, gas engines and refrigerating machines are also brief but contain some very helpful material.

The work concludes with a chapter on house heating and should prove of help to men desiring an elementary general knowledge of the important applications of heat in the production of power, etc.

Engineers' Costs and Economical Workshop Production.—By Dempster Smith and P. C. N. Pickworth. Published by Emmott & Co., Limited, Manchester, Eng. 248. pp.; illustrated; 6 x 9 ins. Price, $1.25.

Shop superintendents and others responsible for carefully watching and keeping down costs in engineering workshops will appreciate the truth of a statement in the first chapter of this book which says "The acuteness of present day trading, however, has removed, in the majority of cases, the happy days of ample margins and has produced a state of affairs in which only by accuracy in the estimation of costs can a profit be relied on."

The book has avowedly been written "from the engineer's standpoint rather than from the accountant's."

After treating in the earlier chapters of the various qualities and grades of pig iron, wrought iron, steel and copper in commercial use, the authors pass on to specifications of materials as formulated by the British Engineering Standards Committee, thence to wage systems, shop organization, the time necessary for performing various operations, inspection work and classes of it, establishment charges, reserve maintenance and depreciation, freight charges, shipment of goods, cost keeping and estimating.

The foregoing shows that all the essential ground relating to cost of production has been covered and perusal of the book leads one to believe that the writers' know the subject with which they are dealing. It is evident that a great deal of time and care has been expended on this work, the subject matter is well put together and the diagrams are very clearly drawn. Avoidance of very abstruse mathematics is perhaps another point which will form a recommendation to some.

Practical Sanitation.—By George Reid, M.D., University of Cambridge; 17th edition. Published by Charles Griffin & Co., Limited, Exeter Street, Strand, London; 354 pp.; illustrated; 5¼ x 7½ ins.; cloth. Price, $1.50 net.

It will be noticed that this book is in its 17th edition and has evidently, therefore, filled a want in Great Britain.

Like most of Messrs. Griffin's publications, the book is a good one, and will be found to contain much information useful to "Insanitary Spectres" (as the maid of all work termed them), and others interested, for whom it has been written.

The first half deals with water supplies, ventilation, drains and plumbing work generally, and examples of both good and bad work are given; owing to differing methods of working, and to the fact that some of the appliances used here are not quite the same as those employed in the old country, portions of this section will hardly apply here, but this does not detract from the value of the book as a whole. Since the author is a medical man he has been able to incorporate into the later portions of the book a good deal of information regarding infection and disinfection, food, etc., which is well put together and apparently up-to-date.

Hydraulics. By Ernest H. Sprague, A.M.I.C.E., Assistant at University College, London; formerly Professor of Engineering at the Imperial Chinese Railway College, Shan-Hai-Kuan; 184 pages; 89 figures. Cloth, 4¾ x 7½-in. Published by Scott, Greenwood and Son, London, Eng. Price $1.

The author of this little book states that it has been compiled from his lecture notes and that it is intended to be

a text book for students and engineers. The title itself has been somewhat misapplied as the scope which the book includes is rather limited and does not cover the subject of hydraulics in any way exhaustively. It will be found, nevertheless, to be a concise, well-balanced text supplemented by a collection of very useful data for hydraulic engineers.

The chapters have the following arrangement: Introduction and principles of fluid pressure; liquids in motion; discharge through orifices, weirs, etc.; flow in pipes and channels; pressure of water and application to motors; pumps. The text is supplemented by 143 examples which can be strongly recommended to the student of hydraulics. The illustrations which the book contains are not well drawn, and are lacking in uniformity throughout. Otherwise they are of great value to the text.

The author has made free use of the Calculus, but his deductions have been carefully made and no engineer is apt to consider that he has over-rated its value to the subject at hand.

Practical Locomotive Operating.—By Clarence Roberts, Assistant Road Foreman of Engines P.R.R., and Russell M. Smith, Air-Brake Instructor P.R.R. Published by J. B. Lippincott Company, Philadelphia, Pa. 292 pages; fully indexed; 92 illustrations; 5 inserts. Cloth. Price, $2. Reviewed by Geo. S. Hodgins, Mechanical Engineer, Transcontinental Railway, Ottawa.

This book is a "practical" book written by practical men for practical men. The subjects taken up are those that locomotive enginemen ought to know, and those who take a lively interest in railroad work, ought also to know. In Part I., the classes of locomotives are given, and the processes involved in locomotive operating, the power of locomotives, train resistance and locomotive efficiency are explained.

The processes involved are combustion, the generation of steam, its utilization and the impulsion, by adhesion, of the driving wheels. Some remarks are made about mechanical stokers. The point is clearly brought out, that such a stoker is not intended to surpass hand-firing in the matter of economy, it takes its place, and it is a most important place, when it does work far beyond the physical ability of the fireman to do.

The whole rationale of steam generation is gone into and a table of the properties of saturated steam is given. The authors admit that it is not definitely known how fast heat transfer through the firebox plates takes place, but good practice has at least empirically (that is by trial and experience) found that if the heating surface goes below 60 or 65 times the grate area, heat will be lost, as there will be more than the plates can transfer to the water. If the ratio between the two is much greater, the additional efficiency gained will be too small to compensate for the extra weight and cost. Next comes tractive effort and horsepower. The correct formulas are given and the whole matter is very clearly set forth. The important part played by adhesion is explained. This matter of adhesion is not, as a rule, made to occupy the position that it should have, and that its close connection to tractive effort, entitles it to.

The friction of the locomotive itself receives attention, and train resistance formulas are given and examples worked out. There is one ratio constantly given in technical papers which needs explanation. It is that got by dividing the tractive effort by the heating surface. To many this seems like a meaningless performance, but its value becomes clear, when, as the authors point out, the available tractive effort decreases while the speed increases, because at high speeds the cut-off is early and the mean effective pressure in the cylinders is thereby reduced. Take a given locomotive for example. Its wheels and cylinders remain constant, and the mean effective pressure is the variable. As the mean effective pressure changes, the tractive effort changes also. Several curves are plotted on a diagram and these show how this takes place. When the horsepower is calculated, mean effective pressure and speed are the two variables, and so at the highest speeds the indicated horsepower is a maximum, though the tractive effort is quite small as compared with slow speed. Tractive effort is drawbar pull, less internal friction, but it does not of necessity imply motion, while horsepower is the rate of doing work, that is the drawbar pull actually producing motion. Work is spoken of here in the mathematical sense of pressure acting through space or against resistance.

It is not our purpose to give a close or complete analysis of the whole book, or go into every detail. We have instanced these points to emphasize the plain practical nature of the work. Under the head of Classification of Locomotives Part II., the ordinary types come in for definite treatment, and the compound is dealt with in detail. The subject is well illustrated and the reasons for the various operations involved are told in plain language. There is a table of dimensions and characteristics in which a large number of locomotives, running on many railways, are given.

Part III. opens with a general and easily-understood explanation of physics, mechanics, dynamics, heat, temperature, etc., etc. Under the head of chemistry coal is defined technically, and its composition, heat values, etc., are made clear. The meaning and use of the British Thermal Unit is important, as many fuels are bought on the basis of the heat units they will give. The volatile and solid constituents of coal are distinguished. It is easy to see that carbon mon-oxide (CO) is the result of incomplete combustion, and this results in the loss of heat which would otherwise be given off, if carbon di-oxide (CO_2) was formed. An interesting proof of this may sometimes be seen by looking at the top of chimneys of rolling mills, etc. When carbon mon-oxide is formed in the furnace it is carried up the flue as very hot smoke. At the top of the chimney when meeting the air, it bursts into flame, and CO burns to CO_2, thus completing the combustion without raising the temperature of the furnace. The loss thus becomes actually visible.

Part IV. deals with steam, states Boyle's or Mariott's law, and gives a comprehensive table of physical properties of saturated and superheated steam. The generation of steam and the work done in its formation are interesting subjects and the expansion of steam and cylinder condensation naturally follow in the book. The advantages of superheated steam are set forth and it easily becomes clear to the reader what happens and where economy comes in, with cylinders which may be supplied with superheated steam, approximately to a perfect gas with margin enough to meet inevitable cooling; and the same cylinders filled with saturated steam close to the dew point and which is little better than high pressure fog. Part V. is devoted to boilers, and in this section classes and types appear, construction features, superheaters, draft appliances, safety devices, parts and appurtenances; with boiler power data, and it concludes with remarks on injectors.

Part VI. takes up lubrication and lubricants. Part VII. follow with cylinders and valves and valve gear. Part VIII. is eminently practical and deals with running and firing. Here the rationale of the whole process of firing and running an engine with care and economy is brought out. The values of the volatile hydro-carbons and the fixed carbon are given, as they theoretically are, together with the results

of experience and tests. These facts are placed before the reader in concise form and the why and wherefore is followed out to the end.

Part IX. deals with disorders, deterioration, pounds, blows, and breakdowns. Part X. takes up appliances and parts such as the brick arch, injectors, water gauges, lubricators, pop safety valves, flexible staybolts, and all the many etceteras that should be understood and studied by all those running, repairing, caring for, or designing engines. Part XI. is concerned with operating conditions, qualifications and responsibilities of the operating staff. The selection of men, co-operation between enginemen, health of employees, first aid, etc., and it closes with a series of questions on the subjects with which the book deals in detail. Part XII. gives the United States Federal laws respecting boilers and safety appliances.

The work is "a new book" in more senses than one, and may be said to be the latest word on running and firing. Locomotive engineers and firemen spend about half their time on an engine and it is therefore important for them to become familiar with all the parts and appliances of the machine, and to know the latest approved practices in running and firing, particularly about those types of engines equipped with superheaters, brick arches and improved valve gears. These appliances have caused a great increase in locomotive efficiency, and for their proper operation, a demand has been created for progressive locomotive engineers and firemen, possessing a high standard of intelligence. This book contains information that engineers and firemen ought to have, in order to pass examinations and fit themselves to do good work. The study of this book will encourage them to think and to develop their faculties by solving, or endeavoring to solve, the various problems which daily arise in locomotive operating. The scope of the work is designed to teach the high value of efficiency; for the knowledge of the science of locomotive running gives to the man possessing it, a legitimate feeling of security and self reliance and he is therefore worth more to himself and to the company he serves.

Alloys and Their Industrial Applications. By Edward F. Law. Second Edition, published by Charles Griffin & Co., London; pp. 332; 6 x 9 ins.; cloth. Price $3.50 net. Reviewed by A. S. L. Barnes, Hydro-Electric Power Commission of Ontario.

The main purpose of this book is indicated in the pre-fact to the first edition, to be the summarizing of "the existing state of our knowledge of mixed metals, paying special attention to the general principles and essential facts. . . . An attempt has also been made to present the subject in such a manner that it will be intelligible, not only to the student but also to the manufacturer and the engineer, for whom the volume is primarily written."

The author was at one time assistant to that master of metallurgy, the late Sir William C. Roberts-Austen, who has contributed so largely to our knowledge of metals, and particularly of alloys.

If association with so great a mind be of any benefit we should expect to find the subject in the present work dealt with in a thorough fashion; in this the writer has not failed, but has presented a vast amount of detailed and interesting information in well arranged form.

A great many problems connected with alloys still remain unsolved, and there is a wide field for research still open in connection with them.

Engineers with some knowledge of electricity will be interested in the fact that while, as is well known, the pure metals all show a tendency to become perfect conductors of electricity at the absolute zero of temperature, alloys by no means do so; this difference in behaviour is said to be due to the fact that in the latter electric currents circulate within the materials owing to the presence of dissimilar metals, an opposing electro-motive force being set up, thus making their ability to oppose the passage of an external electric current through them greater than is the case with pure metals. The union of certain metals bringing about a great evolution of heat is a fact now familiar to all through the well-known "thermit" process so largely employed for railwelding, etc., but a combination of metals is referred to in this volume in the union of which there is an absorption of heat to such an extent that the temperature of the mixture falls from +17°C. to —10°C., or a drop of nearly 50°F. The book contains tables setting forth the properties of many different alloys, together with, in some cases, remarks as to their suitability for certain purposes. Chapters on brasses, bronzes, aluminium alloys, silver and gold alloys, iron and miscellaneous alloys and analysis are given as well as much information as to methods of investigation, influence of temperature, etc. As to the last named item, however, it is remarkable that a vain search was made through the whole book for any information relating to the temperature co-efficient of expansion of alloys; apparently this point has been completely overlooked, as it can hardly be argued that it is one of no importance in practical work—in some cases it is necessary to have this information.

One unusual, though by no means objectionable feature, may be noted, and that is the insertion of a brief bibliography at the end of some chapters relating to their subject-matter, instead of putting them all together at the end of the book.

PUBLICATIONS RECEIVED.

Nova Scotia Steel and Coal Co., Limited.—Report of the thirteenth annual general meeting of shareholders, held on March 25, 1914.

Bathurst District, New Brunswick.—Memoir No. 18-E, by G. A. Young; issued by Geological Survey branch, Department of Mines, Ottawa. A report on the Bathurst District, New Brunswick, and the Nipisiguit iron ore deposit together with maps.

Geology, and Mineral Deposits of the Tulameen District, B.C.—Memoir No. 26, by Charles Brock, and issued by the Geological Survey, Department of Mines, Ottawa. An illustrated report on the general characteristics, geology, and mineral deposits of the Tulameen District, B.C.

Some Myths and Sales of the Ojibwa of Southeastern Ontario.—Collected by Paul Radin and issued by the Geological Survey, Department of Mines, Ottawa. This interesting memoir contains myths collected by Mr. Radin in connection with the study of the ethnology and linguistics of the Ojibwa of Southeastern Ontario.

Proceedings of the First Annual Industrial Safety Conference.—This conference was held at Reno, Nevada on January 26 and 27, 1914, a report of the proceedings being published by the University of Nevada. This report includes papers, talks, and discussions by prominent members of the conference, in connection with the "Safety First" movement in Nevada.

The Quantity System of Estimating.—By G. Alexander Wright, President of the Technical Society of the Pacific Coast. This leaflet is a brief treatise on the quantity system of estimating, a subject in connection with which Mr. Bell has devoted considerable thought and activity. By this system, Mr. Bell maintains, present estimating and contracting methods will be greatly bettered.

Clay and Shale Deposits of New Brunswick.—Memoir No. 44, by J. Keele, published by Geological Survey, Department of Mines, Ottawa. This report is on the result of investigations to determine whether the clay and shale deposits in New Brunswick were of sufficient extent to be of economic value, or of use to manufacturers of burned clay wares, for structural or other purposes.

Electrical Furnaces for Making Iron and Steel.—Bulletin No. 67 of investigations carried out by the Bureau of Mines with a view to increasing safety efficiency and economic development in metallurgical industries. The application of electricity to various processes, and especially to those in the manufacture of iron and steel, is given special attention. This bulletin gives some of the results of work already done, a brief historical review of the development of electric furnaces for making iron and steel, and discusses the problems that remain to be solved in the use of electric furnaces for the smelting or iron ores and the production of pig iron at a profit on a commercial scale.

CATALOGUES RECEIVED.

Rope Drives.—An 8-page pamphlet issued by the Mesta Machine Co., Pittsburg, Pa., and describing installations of rope drives for almost all conditions of service.

Sewage Disposal Plants.—Bulletin, series "G," No. 1, describing apparatus, equipment, and complete plants for sewage disposal. Issued by the Sanitation Corporation, New York.

Watthour Meters.—Circular No. 1137 containing 24 pages descriptive of watthour meters for alternating and direct currents. Issued by Canadian Westinghouse Co., Limited, Hamilton, Ont.

Turbine Pumps.—Bulletin No. 2001, issued by Canadian Allis-Chalmers, Limited, descriptive of the construction, working principles and applications of the Mather and Platt patent high-lift turbine pumps.

Axtec Asphalt.—The Interocean Oil Co., of New York, have issued a well gotten-up catalogue describing Aztec asphalt, its composition, use and advantages. This catalogue is well illustrated and contains 28 pages.

Cochrane Meters.—Engineering leaflet describing the practical uses and advantages of Cochrane meter heaters, feed water meters, and independent meters. Issued by the Harrison Safety Boiler Works, Philadelphia, Pa.

Iroquois Road and Street Paving Machinery and Tools.—A 16-page catalogue illustrating and describing road rollers, bituminous mixing plants and other road-making appliances Issued by Barber Asphalt Paving Co., Buffalo, N.Y.

Low Voltage Lighting Outfits.—A comprehensive bulletin describing the simplicity, adaptability, and convenience of low voltage lighting outfits for minor lighting purposes. Issued by the Northern Electric Co., Limited, Montreal.

The Lighting of Wood-Working Plants by Modern Methods.—A 12-page bulletin, describing and illustrating the possibilities of Mazda lamps for wood-working establishments. Issued by the Canadian General Electric Co., Limited, Toronto.

Motor-Driven Pumps.—A 24-page illustrated catalogue describing the advantages of the motor drive for pumps, the application of motors to pumps, and various pumping data, issued by the Westinghouse Electrical and Manufacturing Co., East Pittsburg, Pa.

Morris Trolleys.—Illustrated bulletin issued by the Herbert Morris Crane and Hoist Co., Limited, Toronto, dealing with the various types of travelling trolleys made by that company. Illustrations, diagrams and tables of dimensions are arranged in handy form.

Giant Cranes.—An elaborate 116-page catalogue issued by the Deutsche Maschinenfabrik, A.G., Duisburg, Germany, describing their stationary, travelling, slewing and floating cranes. This catalogue is profusely illustrated with fine half-tones of cranes in operation.

The Lighting of Machine Shops and Metal-Working Plants.—Illustrated bulletin No. 43,402 describing the importance of perfect lighting, the method of lighting and the superiority of Edison Mazda lamps for such lighting. Issued by Canadian General Electric Co., Limited, Toronto.

Forging Ahead in Business.—An interesting 88-page catalogue published by the Alexander Hamilton Institute, of New York. This catalogue is descriptive of their modern business course and service, and gives a brief biological sketch of each of the Advisory Council and staff and of the special lecturers.

Tarvia, The Modern Binder, Road Preserver, and Dust Preventative.—A finely-illustrated 48-page catalogue issued by the Barrett Manufacturing Co., New York, describing the preparation and application of their tar dust layers and tar binders. The illustrations are of fine roadways, streets and drives treated with or constructed from Tarvia.

Avery Automatic Scales.—20 pp. of illustrated and descriptive information of this type of automatic scales for coal and water in power plant installations and of totalizers, crane scales of various types for industrial service, issued by the Avery Scale Company, for whom Canadian Allis-Chalmers, Limited, Toronto, are Canadian agents.

Railway Sign Apparatus:—A 24 pp. catalogue descriptive of model 2-A signal of the General Railway Signal Co., Rochester, N.Y. Also a 64 pp. pamphlet descriptive of the same in a very convenient size containing numerous circuit diagrams, instructions for installation and maintenance, etc. The company have also issued a 12 pp. bulletin descriptive of their plate rail clips and detector bars; also an 8 pp. description of their improved lightning arrester.

United States Steed Products Company.—General catalogue 1914, third edition, dealing completely with their many products, including rails, cross ties, switches, bonds, billets, blooms, etc.; also structural steel for buildings, bridges, derricks, etc. The catalogue comprises 635 pages, and covers almost every conceivable product, such as horse shoes, wire springs, tacks, nails, spikes, cables, ropes, fence wire, reinforcing mesh, music wire, etc.; conversion tables of weights, measures, specifications for structural work, steel railway bridges, steel axes, etc., etc.

Demag Cold-Rolling Machinery.—A handsome, finely-illustrated catalogue issued by Deutsche Maschinenfabrik A.G., Duisburg, Germany, describing their cold-rolling machines for the manufacture of long bands of steel, brass, iron, copper, tin, zinc, etc. Other types of rolling mills, circular and roll shears, straightening machines and other auxiliary equipment for rolling mills are described and illustrated. This catalogue, containing 48 pages, is representative of a high-grade manufacturing plant.

AREA OF THE PROVINCE OF ONTARIO.

On page 739 of our issue of May 14th, the division, by the Public Roads and Highways Commission of the Province of Ontario, as set forth in their recent report, does not include the addition of the district of Patricia in 1912. Two hundred and sixty thousand square miles represented the approximate area prior to this addition. The total area of the Province is now four hundred and seven thousand two hundred and sixty-two square miles, according to published statistics of the Department of the Interior, Ottawa.

Coast to Coast

Clinton, Ont.—Hydro-electric power was officially turned on at Clinton on May 20.

Hamilton, Ont.—$400,000 is being expended on extensions to the street railway system at Hamilton this year.

Neepawa, Man.—Recently, the waterworks dam has broken at Neepawa, Man., at a loss to the town of $3,000.

Toronto, Ont.—A report of statistics issued recently by the city waterworks department shows a deficit for 1913 of $141,371.

Baxter, Ont.—The centre span of the new viaduct over the Nottawasaga River at Baxter, sank recently, and will require to be repaired.

Moose Jaw, Sask.—The cost of the street paving, for which the city of Moose Jaw is now calling tenders, is placed at between $50,000 and $60,000.

St. Boniface, Man.—The Western Tire and Rubber Co., will locate its new factory, which will cost $175,000, at St. Boniface, rather than at Regina, as previously intended.

Regina, Sask.—Without taking into consideration the cost of labor, Regina will spend $28,075 in extensions to the electric light distribution system during the present year.

Calgary, Alta.—It is reported that lack of funds will cause the Grand Trunk Pacific Railway Company to delay starting the work of constructing its $300,000 station at Calgary.

Guelph, Ont.—Grading has been completed from Toronto to Guelph on the Toronto Suburban Railway line, and for the greater part of the distance ties have been distributed and rails unloaded.

Preston, Ont.—A proposition from the Building Product Co., manufacturers of sand bricks and other building material, offering to establish at Preston a $50,000 plant, is being considered by the municipal council.

Montreal, Que.—It is reported that 170 tenders were received at Montreal for 1914 street paving, and deposit cheques to the amount of $2,250,000 were received. The city will expend this year on pavement about $1,500,000.

Leaside, Ont.—The work on waterworks and sewage plants and systems, for which contracts have just been let, will entail an expenditure of around $100,000, which will be supplemented by the expenditure of $50,000 on roadways, pavements and other general improvements.

Quebec, Que.—The new 40-inch water pipe being laid in Quebec is almost completed. The whole of the lower portion of the city is already being supplied with water from this new main, and connection is being completed in the upper part of the city, while tests are being made.

Regina, Sask.—An effort is being made by the business men of Regina to have the Dominion Government extend its telegraph line from Qu'Appelle to Regina. It would be necessary to extend the existing line 70 miles to connect it with Regina, and the cost per mile would be approximately $160.

Winnipeg, Man.—The sum of $371,000 is being advanced to the city council by the sinking fund trustees for concrete lanes, street openings, granolithic sidewalks and No. 2 asphalt pavements for residential districts. This is in addition to $125,000 already loaned this year to the council, and will total $496,000.

Brantford, Ont.—The civic authorities and the Dominion Railway Commission have approved the general plans of the Lake Erie and Northern Railway Company for the raising of Lorne bridge, and for the construction of the inner retaining wall of the railway; and it is expected that this work will commence at once.

St. John, N.B.—Mr. A. R. Gould, contractor for the railway being constructed down the St. John River valley from Woodstock, N.B., to the city of St. John, known as the St. John Valley Railway, when in Montreal recently, stated that the line between Gagetown and Centreville will be finished this year, and the track will be laid.

Montreal, Que.—Objections have been raised to the city conduit plant and construction work, and these must be considered by the Electric Service and Public Utilities commissions before final approval can be given for proceeding with the work. The chief objection to the St. Catharine Street conduit is that it was not provided for ventilation.

Winnipeg, Man.—After deducting the total operating expenses of $41,252.09 from the total revenue, the balance sheet of the city of Winnipeg hydro-electric system shows a surplus of $10,666.77 for the month of March. The deficit, which was incurred during the early months of the system's operation is gradually being reduced and this month stands at $86,156.60.

Sault Ste. Marie, Ont.—The amount which the city of Sault Ste. Marie will pay the Tagona Water and Light Co. for the water and light system on October 14 next, when their franchise expires, has been fixed by the arbitrators at $413,537.51. To this is to be added the statutory 10 per cent., which brings the total up to $454,891.26. The Tagona Water and Light Co.'s original figure amounted to $724,561.03.

Galt, Ont.—In his report on the waterworks system of Galt, Norman L. Wilson, the inspector for the Fire Underwriters' Association, pointed out an inadequate reservoir supply, and an inadequate source of water, artesian wells, showing evidence of diminishing the flow therefrom. He urged immediate steps to enlarge the visible supply reservoir to 3,000,000 gallons. The water commission has been considering means to increase the water supply for some time.

Yorkton, Sask.—The Yorkton board of trade sent a delegation recently to Winnipeg to endeavor to induce the C.N.R. to hasten the construction of its Yorkton branch, which is at present completed to within 18 miles east of the town, and graded as far as 20 miles west. The delegation was also commissioned to ask both the C.P.R. to extend its yards and to make improvements generally, and the G.T.P. to continue its train service which was in operation a year ago. It is stated that the last request has practically been granted.

Vancouver, B.C.—It is expected that by June 1, a portion of the wharf of the new dock which is being established on the south side of False Creek near the Great Northern bridge at Vancouver, by Messrs. McNeill, Welsh and Wilson, Limited, will be completed. The wharf is 308 feet long and 176 feet wide, and will be approached by a roadway from the present end of Front and Ontario Streets. A large tract of foreshore between the railway bridge and the dock is to be reclaimed in connection with the dockage scheme, and will be used for trackage facilities.

Chatham, Ont.—The Chatham Gas and Electric Light Company has renewed its offer to sell its plant to the city for $410,000, plus the amount spent on capital account since the valuation of the plant made by the Hydro-Electric Commission. It is the intention of the city to use the plant of the gas company as a distributing station for Niagara power and to operate the gas end of the business as a public utility. The Hydro-Electric Commission recommended this deal to the city as the best business proposition when the city installed hydro-power. The council will give a decision within two weeks.

Winnipeg, Man.—What is stated to be a record piece of railway construction work has been accomplished by the

C.P.R. in the building of its Bassano-Swift Current line. This line is now complete from Bassano to Saskatchewan River, a distance of 125 miles. Track laying was started on March 1 last and was completed on May 15. In the last three days 12 miles of track were laid, 6 of these being done on the last day. The rails used are 85 pounds, and in the construction of the line, 2,900 ties to the mile were used. There are also 15 miles of passing and side tracks in the 125 miles completed.

Calgary, Alta.—No remaining doubt is now held concerning the commercial value of the oil which has been struck at the well of the Calgary Petroleum Produce Company near Black Diamond, and about 40 miles south-west of Calgary. The latest reports show that the fluid is almost pure gasoline, and that there were 500 feet of oil in the well, when it had reached a depth of 2,718 feet. Moreover, it is reported that on May 20, oil spouted from the Dingman well fully 90 feet into the air, and that after baling for more than four hours, there was no perceptible decrease in the height of the oil in the pipe, which remained at 2,000 feet. It is now estimated that within the next 60 days, drilling on about 100 wells will be commenced.

Victoria, B.C.—The decision has been announced from Ottawa that the new Government telescope, which is to be the largest in the world, and which is to cost $90,000, will be erected at Victoria, B.C. The instrument will be placed at the summit of Little Saanich Mountain, 7 miles from Victoria. Atmospheric conditions at Victoria have been found to be almost ideal for observation purposes. Tests at various places throughout Canada were made, but the decision was in favor of Vancouver Island. The new telescope has a reflecting lens of 72 inches and is 30 feet long. It weighs 8 tons, while the moving apparatus weighs 40 tons. The telescope costs $90,000 and the cost of the whole plant will be $200,000. The telescope and observatory were designed by Dr. Plaskett, of the Observatory Staff at Ottawa.

Regina, Sask.—In August a new 3,000 k.w. electric light unit will arrive at Regina to be installed at the new power house, and will give sufficient equipment in the two power houses to handle double the city's load, and to ward off inconvenience to consumers in case of a breakdown. The new machine will have twice the capacity of any of the units at present installed; though in appearance it will not be very much larger than the 1,500 k.w. units. The consumption of electric energy is increasing very rapidly, and at the present rate of increase the new machine will be needed for constant use soon after it is installed. Wilson and Wilson, who were awarded the contract for the completion of the new power house, are assembling machines on the ground, and it is expected that actual construction work will be under way this week.

Vancouver, B.C.—As proposed by H. J. Kaiser, a contractor on one of the city's paving works, a new pavement, which may take the place of macadam on Vancouver's streets, will be laid on a section of Fourteenth Avenue. It is a bituminous mixture 5 inches in thickness made up of sand and gravel, bound together with bitumen. There is no concrete base, but the mixture is laid on the surface of the ground and rolled smooth. It will cost $1.35 a square yard as compared with 90 cents to $1 for macadam. The pavement will be guaranteed for five years, and it is believed may last twice that time; and it is declared that the extra cost will be more than saved in the lower expense of maintenance. It is stated that this pavement has been used extensively in United States cities.

Victoria, B.C.—The Burrard Engineering Company, of Vancouver, to which has been let the contract for the fabrication and laying of the pipe in connection with the Sooke Lake waterworks system, has secured the pipemaking plant of the Westholme Lumber Company at Thetis Cove, Esquimalt Harbor, and will use this for the fabrication of the pipe. The company expects to be in a position to deliver pipe in about two or three weeks; and, so that no delay may be encountered when the pipe is ready, within the next week or 10 days the city will commence work on the excavation of the 10-mile trench in which the steel pressure pipe will be laid from Humpback Reservoir to the city. With the commencement of the laying of the reinforced concrete pipe along the section from Sooke Lake to Cooper's Cove, and a start on the laying of the steel pipe line from the reservoir to the city, the operations on the waterworks system for Greater Victoria will enter its final stage. The city will soon complete its work and there will be nothing in the way of the pipe line contractors pushing ahead their part of the contract.

Vancouver, B.C.—Tracklaying has been commenced on the extension of the P.G.E. Railway from Dundarave to Horseshoe Bay, and it is expected to have the line completed to the Howe Sound end early in June. The section is to be ready for operation by July 1. The railway company, in order to expedite operation on the Dundarave-Horseshoe Bay portion of the route, is building bridges in advance of the tracklayers. This involves greater expense in transporting materials; for timbers and steel have to be floated on rafts to the different bridge sites. Additional orders have just been placed by the P.G.E. for gasoline locomotives and rails. Two heavy engines of the consolidated type have been purchased from the Canadian Locomotive Works of Kingston, Ont., and three large passenger coaches have been bought. The company already had previous to these orders two locomotives on order and four in service. Sufficient steel to lay more than 300 miles of track has been ordered from the Algoma Steel Co. of Sault Ste. Marie, for delivery during the present year and up to the end of 1915. These consignments will aggregate between 30,000 and 40,000 tons. Contractors are now preparing to start active construction operations on the sections south of Fort George and north of Clinton; and a number of subcontracts are expected to be let at an early date for other portions of the line.

Regina, Sask.—In addition to many large buildings to be erected at Regina, the city has this year entered upon a programme of local improvement work which will require an expenditure of $2,033,264.03. The works and the expenditures estimated are as follows: waterworks general, $360,000; water main extension, $127,752; domestic sewer extensions, $142,145.23; storm sewers, $170,000; sewage disposal works, $61,520; street railway extensions, $250,000; pavement, $452,946.80; sidewalks, $65,000; and electric light and power, $404,000. Some of the many large buildings which at present are either under construction or are proposed to be erected at Regina, are given as follows, together with their estimated costs: G.T.P. Railway hotel, $1,000,000; G.T.P. station, laundry, train sheds, power house and tunnel, $1,000,000; Methodist College, towers and residence, $125,000; Rose theatre, $50,000; two business blocks, $75,000; Dominion Government buildings, $225,000; Campbell, Wilson and Strathdee warehouse, $112,000; General Hospital addition, $75,000; police station, $180,000; power house, $450,000; Woolworth's stores, $50,000; Nurses' Home, between $80,000 and $90,000; Metal, Shingle and Siding Co.'s building, $50,000; Oak Lake Milling Co.'s mill, $300,000; Regina incinerator (now completed), $65,000; Presbyterian College, $1,000,000; Merrill and Gardner block, $20,000; and Swartznell block, $30,000. It is stated also that the Roman Catholic Church will erect a college at Regina, and that construction will likely commence this year. Moreover, many large apartment blocks, and other buildings to cost less than $50,000, will be erected this year in this city.

PERSONAL.

C. E. FOWLER, C.E., of Seattle, who is the author of the article entitled "Important Principles of Bridge Design," in this issue, on May 15th, delivered an illustrated lecture before the Vancouver branch of the Canadian Society of Civil Engineers on the harbors of the world.

H. D. MAPLES has been appointed superintendent of building construction for the C.P.R. in succession to F. L. Ellingwood. For a number of years Mr. Maples was vice-president of J. V. Schafer, Jr., and Company, a contracting firm of New York. He entered the service of the C.P.R. two years ago as assistant to Mr. Ellingwood. Mr. Maples has had 22 years' experience as an engineering contractor.

Recent appointments to the staff of the Topographical Surveys branch, Department of the Interior, Ottawa, includes, Messrs. E. A. Hodgson, Toronto; R. H. Field, Fort William; D. H. Campbell, Rodney, Ont.; H. C. Johnson, Ottawa; C. C. Fitzgerald, Parry Sound; G. L. Wallace, Toronto, and J. H. Hawes, Toronto.

OBITUARY.

The death occurred last week of Mr. A. C. Morris, secretary-treasurer of the Ontario Wind Engine and Pump Co. Mr. Morris came to Canada 27 years ago at the age of 23. He became connected with the Brockville Motor Co., but afterwards came to Toronto, and has been in the employ of the Ontario Wind Engine and Pump Co. since.

We regret to record the death of Alex. K. Kirkpatrick, C.E., of Queen's University, Kingston. Professor Kirkpatrick was prominently known among Canadian Civil Engineers. His connection with the Canadian Pacific Railway on several of its important projects, and his latest work, viz., the design of the Government car ferry service between Prince Edward Island and Cape Tormentine, N.B., have been well worthy of professional approval, and are an indication of his ability. Prof. Kirkpatrick was at the head of the Department of Civil Engineering at Queen's University. He was a member of the Canadian Society of Civil Engineers. At the time of his sudden death he was at Cape Tormentine in connection with the construction of the car ferry.

DESIGN OF THE OSHAWA POWER PLANT.

In the issue of May 21st, we overlooked mentioning, in connection with the article entitled "Oshawa Sub-Station of the Electric Power Co.," that the plant was designed by the engineering firm of Smith, Kerry and Chace, Limited, Toronto.

OFFICERS OF ELECTRIC RAILWAY ASSOCIATION.

At a recent convention, in Ottawa, of the Canadian Electric Railway Association, the following officers were elected:—President, C. B. King, manager, London Street Railway; vice-president, J. D. Fraser, secretary-treasurer and director Ottawa Street Railway; secretary-treasurer, Acton Burrows, Canadian Railway and Marine World, Toronto; executive committee—E. P. Coleman, general manager Dominion Power and Transmission Co., Hamilton; A. Eastman, vice-president and general manager Windsor, Essex and Lake Shore Rapid Ry., Kingsville; A. M. Hopper, general manager St. John, N.B., Street Ry.; Wilson Phillips, superintendent Winnipeg Electric Ry.; C. L. Wilson, assistant manager Toronto, York Radial Ry.; Patrick Dubee, secretary-treasurer Montreal Tramways Co.

REORGANIZATION OF WINNIPEG ENGINEERING DEPARTMENT.

At the resignation of Col. H. N. Ruttan, after 29 years of service as city engineer of Winnipeg, a reorganization of the city engineering department was decided upon by the board of control and the city council. As stated in a recent issue of this journal, Col. Ruttan is being retained as consulting engineer, and W. P. Brereton, B.A.Sc., chief assistant engineer, has been appointed to fill the vacancy on the engineering staff.

Whereas in the past, Col. Ruttan has been head of the entire department, and responsible for all matters pertaining to its branches, the new policy divides the department into sections with recognized heads over each, directly responsible to the board of control, although the new city engineer will be vested with the same authority as in the past. Thus Mr. Brereton, in his new position, will have general supervision. Mr. Wm. Aldridge, who has been in the city service for 14 years, is to have charge of office work, designing and detail specifications. Mr. Byde Hallock, who has also been in the city's employ for many years, having been in charge of outside construction work, is to be field engineer, thus continuing for the most part, the work upon which he has been engaged, including pavements, sewers, water mains, sidewalks, etc, The operation of the waterworks department will be under Mr. Thos. H. Hooper. This sub-department will not include construction, but only operation of the whole system, including the wells outside the city limits. Mr. Paul Schioler will be in charge of bridge construction and maintenance. He has been bridge engineer to the city for the past five years.

COMING MEETINGS.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Seventeenth Annual Meeting to be held in Atlantic City, N.J., June 30th to July 4th, 1914. Edgar Marburg, Secretary-Treasurer, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF ENGINEERING CONTRACTORS.—Summer convention to be held at Brighton Beach, N.Y., July 3rd and 4th, 1914. Secretary, J. R. Wemlinger, 11 Broadway, New York.

UNION OF CANADIAN MUNICIPALITIES.—Annual Convention to be held in Sherbrooke, Que., August 3rd, 4th and 5th, 1914. Hon. Secretary, W. D. Lighthall, Westmount, Que. Assistant-Secretary, G. S. Wilson, 402 Coristine Building, Montreal.

AMERICAN PEAT SOCIETY.—Eighth Annual Meeting will be held in Duluth, Minn., on August 20th, 21st and 22nd, 1914. Secretary-Treasurer, Julius Bordollo, 17 Battery Place, New York, N.Y.

CANADIAN FORESTRY ASSOCIATION.—Annual Convention to be held in Halifax, N.S., September 1st to 4th, 1914. Secretary, James Lawler, Journal Building, Ottawa.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Seventh Annual Meeting to be held at Quebec, September 21st and 22nd, 1914. Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal.

CONVENTION OF THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—To be held in Boston, Mass., on October 6th, 7th, 8th and 9th, 1914. C. C. Brown, Indianapolis, Ind., Secretary.

AMERICAN HIGHWAYS ASSOCIATION.—Fourth American Road Congress to be held in Atlanta, Ga., November 9th to 13th, 1914. I. S. Pennybacker, Executive Secretary, and Chas. P. Light, Business Manager, Colorado Building, Washington, D.C.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

21749—April 27—Authorizing Cedars Rapids Mfg. and Power Co., of Montreal to take additional width of 24.8 ft. for right of way for its transmission line across East Half Lot 31, Con. 1, Tp. Lancaster, Co. Glengarry, Ont., property of D. Ross Ross, subject to and upon certain conditions.

21750—May 1—Appointing P. H. Drayton, Esq., K.C., as arbitrator to inquire into and determine what, if any, damages have been sustained by Heward Estate, in connection with construction of C.P.R. spur (Government Spur Line) in city of Toronto, Ont., and to fix compensation therefor.

21751—April 29—Directing that C.P.R., and O. and N.Y. Ry. Cos., on or before June 1st, 1914, schedule trains No. 30 and 305 (C.P.R.) and No. 20 (O. and N.Y.) at Finch, Ont., at 9.52 a.m., and to carry out certain directions in connection wih said trains; and rescinding Order No. 19265, dated May 13th, 1913.

21752—May 2—Approving and authorizing clearances as shown on C.P.R. plan showing clearances on Rogers Pass Tunnel, subject to condition that Ry. Co. keep its employees off top and sides of cars operated through said tunnel.

21753—May 2—Relieving G.T.R. from providing further protection at crossing of highway first west of Stoney Creek, Ont.

21754—May 4—Approving revised location G.T.P. Branch Lines Co., Moose Jaw Northwest Branch from North Boundary of Sec. 19-22-7, to East Boundary of Sec. 25-22-8, W. 3 M., mileage 73.34 to 77.98, Dist. Moose Jaw, Saskatchewan.

21755—May 4—Authorizing C.P.R. to construct bridge No. 18.1 on Moose Jaw Subdivision, Sask. Division, Saskatchewan.

21756—May 4—Authorizing C.P.R. to construct diversion of Old Trail to Medicine Hat, in Sec. 36-22-29, W. 3 M., Sask.; and construct, at grade, track of its Swift Current Northwesterly Branch Line across said diversion.

21757—May 4—Directing that, within 90 days from date of this Order, C.P.R., install improved type of automatic bell at crossing of first public highway east of Central Ontario Junction, and thereafter maintain bell at own expense; 20 per cent. of installation of bell be paid out of "The Ry. Grade Crossing Fund," remainder by Railway Company.

21758—May 6—Approving revised location portion of C.P.R., Swift Current Northwesterly Branch Line, from point in Sec. 14-36-11, W. 4 M., mileage 0, in northwesterly direction to point in Sec. 6-38-11, W. 4 M., mileage 10.82 of said Branch Line (mileage 0-105.60 Lacombe Subdivision).

21759—May 5—Authorizing C.P.R. to construct tracks of storage siding, at grade, across public road between city of Guelph and Tp. Guelph, Co. Wellington, Ont., at mileage 30.33, Ont. Div. Hamilton and Goderich Subdivision.

21760—May 6—Authorizing, subject to conditions contained in Order in Council, Dominion Atlantic Ry. to reconstruct bridge over Bear River, Co. Digby, N.S., and approving plan No. B-1-1261, marked plan "A," showing location of proposed temporary lift span in old bridge.

21761—May 5—Authorizing C.P.R. to construct spur for Builders Supply Co., Limited, Winnipeg, Man., in Sec. 36-11-4. E.P.M., on lands owned by Builders Supply Co., Limited.

21762—May 5—Authorizing C.P.R. to take certain lands in city of Ottawa, Ont., for purpose of enlarging Sussex St., terminals in said city of Ottawa.

21763—May 6—Authorizing C.P.R. to construct change in location of spur for Security Lumber Co., Limited, Moose Jaw, Sask., from point on existing spur in Subdivision Lot 35, thence across Subdivision Lots 35 to 22, both inclusive, Block 98, city of Moose Jaw, Sask.

21764—May 6—Approving location and details of C.N.Q. Ry. station at Lac aux Sables, Quebec.

21802—May 13—Approving Bell Telephone Co.'s agreement entered with Pontiac Rural Telephone Co., Limited, dated April 3rd, 1914, for interchange of telephone messages or service passing to or from their respective telephone systems, division or apportionment of tolls, and management, working, or operation of respective telephone systems, etc.

21803—May 14—Approving location C.P.R. station at Ringold, Lot 8, Con. 3, Tp. Raleigh, Co. Kent, Ont., mileage 70.99, Windsor Subdivision: Provided, whenever highway is blocked for more than 5 minutes at any one time by reason of location hereby approved, Board shall be at liberty to re-locate said station.

21804—May 14—Authorizing C.P.R. to construct spur for George White & Sons, Co., Limited, city of Moose Jaw, Saskatchewan.

21805—May 14—Authorizing C.P.R. to construct spur for Mond Nickle Co., Limited, Coniston, Ont., in Lots 5, 6, and 7, Con. 6, Tp. of McKim, Dist. Sudbury, Ont., mileage 2.5 on Stobie Branch.

21806—May 14—Authorizing C.P.R. to construct spur for Thomas Fletcher, of Calgary, Alta.

21807—May 14—Relieving C.N.R. from speed limitation of 18 miles an hour over its line from Oak Point to Gypsumville, a distance of 97 miles; and directing that fencing of its line from mileage 69 be erected and completed by Oct. 1st, 1914.

21808—May 15—Authorizing C.N.O.R. to construct bridge to carry its line over Raimbault Creek, parish St. Laurent, Co. Jacques Cartier, Que., mileage 48.07 from Hawkesbury; and rescinding Orders Nos. 19657 and 21650, dated respectively June 21st, 1913, and April 15th, 1914.

21809—May 11—Approving G. T. P. Ry. plans showing stress diagram of superstructure and details of substructure of bridge across Nechaco River, mileage 371.4 Prince Rupert Easterly, B.C.

21810—May 16—Amending Order No. 20002, dated August 11th, 1913. 1. by substituting plan dated April 24th, 1914, for plan approved under Order No. 20002, and 2. by adding to last line of operative part of Order following words,—"and the Applicant Co. is hereby authorized, at its own expense, to raise the tracks of the C.P.R. Co., six feet at the point of crossing."

21811—May 11—Directing that classification of maple cheese be made same as that fixed by Order No. 21745, dated May 2nd, 1914, for maple butter; addition to be included in Supplement No. 3 to Canadian Freight Classification No. 16.

21812—May 16—Authorizing C.N.R. to reconstruct bridge over Sturgeon River, station 403, mileage 8.1, River Lots 53 and 25, St. Albert Settlement, Alberta.

21813—May 14—Authorizing C.N.O.R. to construct bridge over Indian River, Tp. Richards, Co. Renfrew, Ont., mileage 107.85 from Ottawa; and rescinding Order No. 120888, dated November 21st, 1913.

21814—May 16—Authorizing C.P.R. to open for traffic its line from mileage 0 to 10, Snowflake West Branch, Manitoba.

21815—May 13—Directing that, within 60 days from date of this Order, C.P.R. install automatic bell at crossing of Laviolette Avenue Three Rivers, Que., 20 per cent. of installation to be paid out of "Ry. Grade-Crossing Fund," remainder by Railway Company.

21816—May 14—Authorizing C.P.R. to construct spurs from point on north-easterly limit of right of way of main line, mileage 2.26, Muskoka Subdivision, Ont. Div., in Lot 1, Con. 4, west of Yonge St., Tp. York, Ont., on land owned by Canadian Kodak Co., Ltd.

21817—May 14—Authorizing G.T.R. to construct siding into premises of Brantford Industrial Realty Co., Ltd., south of Alice Street, city of Brantford, Ont.

21818—May 16—Approving and authorizing clearances as shown on C.P.R. plan showing clearances of overhead pipe line crossing sidings of Standard Paint Co. of Canada, Ltd., in Lot Cadastral No. 954, parish Lachine, Co. Jacques-Cartier, Que., at mileage 0.49, on South Bank Branch, subject to condition that Co. keep employees off top and sides of cars operated over said siding.

21819—May 11—Authorizing Hamilton Radial Electric Ry. Co., to construct spur, Tp. Saltfleet and Tp. Barton, Co. Wentworth, Ont. to and through lands of Sir Henry Pellatt and Dominion Power and Transmission Co., Ltd., at or near point marked "B," subject to certain conditions.

21820—May 11—Authorizing C.P.R. to construct extension to trackage for Gordon, Ironside and Fares Co., Ltd., Winnipeg, Man., and approving all clearances as shown on plan dated Winnipeg, April, 1914, subject to condition that Company keep employees off sides of cars when operated over said spur.

21821—May 11—Directing that C.P.R. construct roadway 66 ft. wide, commencing from north and south road allowance and running north-westerly to point south of dam, and thence north-westerly joining east and west road allowance in centre of Sec. 17 and 8; and reserving question of apportionment of cost.

21822—May 18—Approving revised location G.T.P. Ry. main line mile 220.60 to mile 230.30, Yellowhead Pass West, Dist. of Cariboo, B.C.

21823—May 18—Authorizing G.T.P. Ry. to operate crossing of Canadian Northern at Empire Ave., Fort William, without bringing trains to a stop.

21824—May 18—Authorizing G.T.R. to re-construct overhead bridge carrying farm crossing over tracks Lot 33, Con. 1, Tp. of South Dumfries.

21825—May 14—Amending Order No. 138, dated June 17th, 1904, which authorizes crossing by Sarnia Street Railway of G.T.R. (Point Edward Blackwell Branch) by adding clause that the Applicant Co., bear and pay the cost of maintaining and repairing the diamond.

21826—May 18—Authorizing C.P.R., to use and operate Bridge No. 144.6 on its Portal Subdivision, Saskatchewan Div.

21827—May 18—Extending until June 30th, 1914, the time for completion of siding for McCormick Mfg. Co., London, Ont., authorized by Order No. 20710, dated November 4th, 1913.

21828—May 11—Rescinding Order No. 21518, dated March 18th, 1914, which directed the C.P.R., to restore the old clearance at the bridge over North Branch of Clyde River, just north of Flower Station, Ont., by raising under side of top of culvert eleven inches.

21829—May 18—Extending until November 1st, 1914, the time for construction and completion of subway under C.P.R., in Regina, authorized by Order No. 12801, dated January 20th, 1911, on application of city of Regina.

21830—May 19—Authorizing Board of Highway Commissioners, Sask. to construct highway crossing over C.P.R., in S.W. ¼ Sec. 21, Tp. 19, R. 18, W. 3 M., Sask.

21831—May 16—Authorizing Cedar Rapids Manufacturing and Power Co. to take certain lands in Lots 3, 4 5, parish of St. Ignace du Coteau du Lac, properties of Mrs. O. S. Bissonnette.

21832—May 18—Authorizing town of Mont Laurier, Que., to construct highway crossing over C.P.R. at mile 134.45, Laurentian Subdivision, Tp. of Campbell, Labelle Co., Que.

21833—May 19—Authorizing C.N.R. to cross public road between Secs 14 and 15, Tp. 51, Rge. 12, W. 4 M.

21834—May 18—Authorizing C.N.Q. Ry. to construct spur to Dansereau's Mill, and to cross Bay St., Grenville, Que.

21835—May 18—Authorizing G.T.R. to construct spur from a point on the 16th Dist. of its railway on Ferguson Ave., Hamilton, to the Co.'s property west of Ferguson Ave.

21836—Directing the G.T.R. to change the grade of approaches to crossing between Danby and South Durham, known as Bergevin's Crossing.

21837—May 18—Authorizing G.T.P.B.L. Co. to construct a bridge across South Saskatchewan River at mile 86.5 Young Prince Albert Branch. Saskatchewan.

21838—May 18—Directing that the C.P.R. within 60 days date of Order install electric bell at crossing in Mun. of Maple Ridge, Port Hammond, B.C.

21839—May 16—Approving change in location of C.P.R. station at Kreuzburg, Man.

21840—May 18—Approving plan showing subway proposed to be constructed at Anthony St., Strathcona, Edmonton, by the C.P.R.

21841—May 18—Approving C.P.R. plan showing clearances at its coaling plant at Aldersyde, Alta.

21842—May 19—Authorizing C.N.O.R. to construct crossing of Con. Road between Lot 10, Con. 5, and Lot 10, Con. 6, Tp. Nepean, Co. Carleton, Ont.; rescinding Order No. 17859, November 6th, 1912, in so far as it approved road diversion at said point; and rescinding Order No. 20110, dated August 18th, 1913.

21843—May 20—Authorizing Rural Mun. Colonsay No. 342, Sask., at its own expense, to construct highway crossing over G.T.P. Ry. Co.'s Prince Albert Branch in N.W. ¼ Sec. 28-34-27, W. 2 M., Sask.

21844—May 20—Authorizing C.P.R. to construct spurs for White Falls Lumber Co., Limited, Sudbury, Ont., from point on Northeasterly limit right of way of main line, Lake Superior Div., Algoma Subdivision, at Blind River, Lot 5, R. 1, Tp. Cobden, Ont.

21845—May 20—Authorizing G.T.R. to construct siding into premises of Messrs. Aitken and Sons, on Lots 60, 59, 58, 57, 56, 55 and 54 west of Dayfoot St., village of Beeton, Ont.

21846—May 19—Authorizing C.P.R. to construct temporary sidings for Dominion Bridge Co., Limited, Montreal, from point on main line right of way, across Cushing Road and Provincial Government lands in parish of Lancaster, Co. St. John, Province of N.B., mileage 1.92, St. John Subdivision, authority granted herein be effective for one year from date of this Order.

21847—May 19—Directing that C.L.O. and W. (C.P.R.) lay and maintain a 12-inch pipe under its embankment, in West ½ Lot 30, Con. 2, Tp. Pickering, Ont.; Frederick Roach of Cherrywood, Ont. (Applicant), to have right to lay water pipe through said 12-inch pipe for purpose of conveying water from spring to pasture.

21848—May 18—Refusing application of Bell Telephone Co., for leave to construct lines of telephone upon, along and across Concord St., Grey Ave. and Harvard Ave., city of Montreal; and granting leave to said Company to erect and maintain an overhead line on east side of Mountain St. said city, pending construction of permanent pavement on said street, when wires shall be placed underground.

21849—May 20—Amending Order No. 21734, dated May 2nd, 1914, by adding after word "Streets" in clause (2) of paragraph 1 of operative part of Order, the following: "the said wires forming part of the circuits which are dealt with under clause (1) of this Order."

21850—May 18—Directing that C.N.R. construct and maintain a dam on creek diversion near north boundary Sec. 16-31-15, W.4 M., Alta., the crest of dam to be 6 inches higher than top of pipe under railway embankment; work to be completed within one month from date of this Order; and rescinding Order No. 21139, dated December 31st, 1913.

21851—May 22—Authorizing C.P.R. to open for traffic its second main line track from Iberville Station, mileage 19.2, to mileage 20.02, St. Johns, Quebec.

21852—May 16—Approving location G.T.R. station at Penetanguishene, Ontario.

21853—May 22—Amending Order No. 10457, dated April 28th, 1910, by adding "that all moneys expended in acquisition of any property required for work, including lands required for diversion of Upper Lachine Road, and all moneys paid in satisfaction of damages and taxed costs resulting from work, or any part thereof, shall be considered as forming part of cost of work directed by this Order and shall be borne in the proportions above set out."

A report has been made to the effect that Vickers Maxim Company has secured control of the plant of the Collingwood Ship Building Company, and also the Kingston Ship Building Company, and that these works will be operated in conjunction with the navigation companies.