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PROGRESS OF MONTREAL HARBOR DEVELOPMENT

OUTLINE OF THE 1914 ACTIVITIES OF THE HARBOR COMMISSIONERS OF MONTREAL AND A SUMMARY OF THIS YEAR'S CONSTRUCTIONAL PROGRAMME.

ADDED to the prominent place of the city of Montreal among financial, commercial and manufacturing centres, its geographical location makes it one of the most important shipping points on the Atlantic coast. The growth of the port is an interesting one and extends as far back as 1830, in so far as attempts to accommodate ocean vessels are concerned. A concise history of its development, including the ship channel of the River St. Lawrence, and an outline of the physical features of the locality and of its importance as an inland ocean port and railway terminal, was brought out in an article by Frederick W. Cowie, chief engineer for the Montreal Harbor Commissioners. This article appeared in *The Canadian Engineer* for January 18th, 1912. It summarized the general scheme of development adopted in Montreal. The work which we describe below as having been effected in 1914 and that under way or proposed for this season form a part of this scheme. The money voted for the improvements decided upon in 1909 was almost entirely expended by the fall of 1913. Parliament thereupon voted $9,000,000 in order that the improvement of the terminal facilities, together with the proper equipment, might proceed without delay.

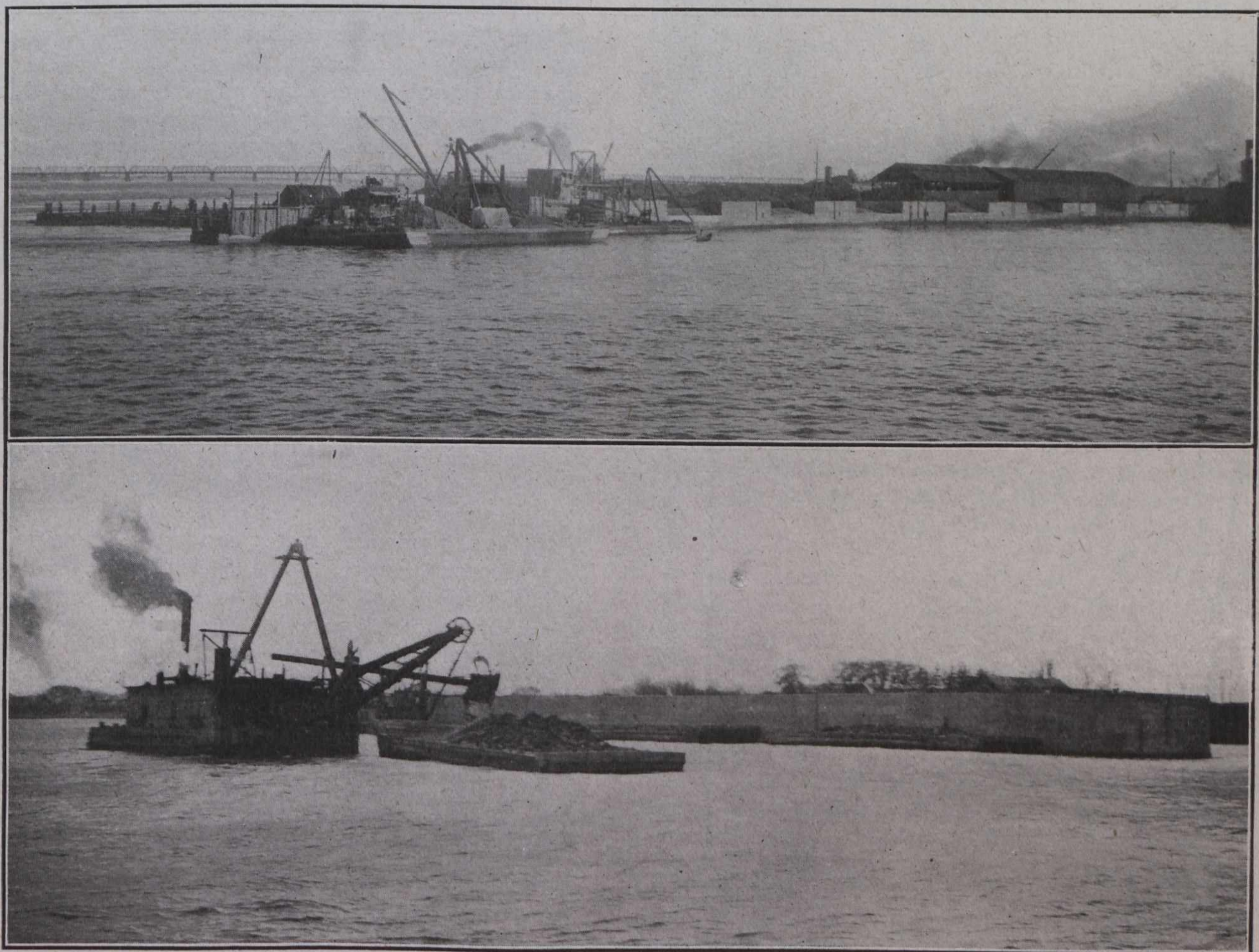


Fig. 1.—Activities in Montreal Harbor: Construction of Inner and Outer Side of New Victoria Pier; Industrial Wharf at Pointe-aux-Trembles.

An interesting feature of 1914 work was a study participated in by the president, Mr. G. W. Ross; chief engineer, Mr. F. W. Cowie, and the assistant secretary,

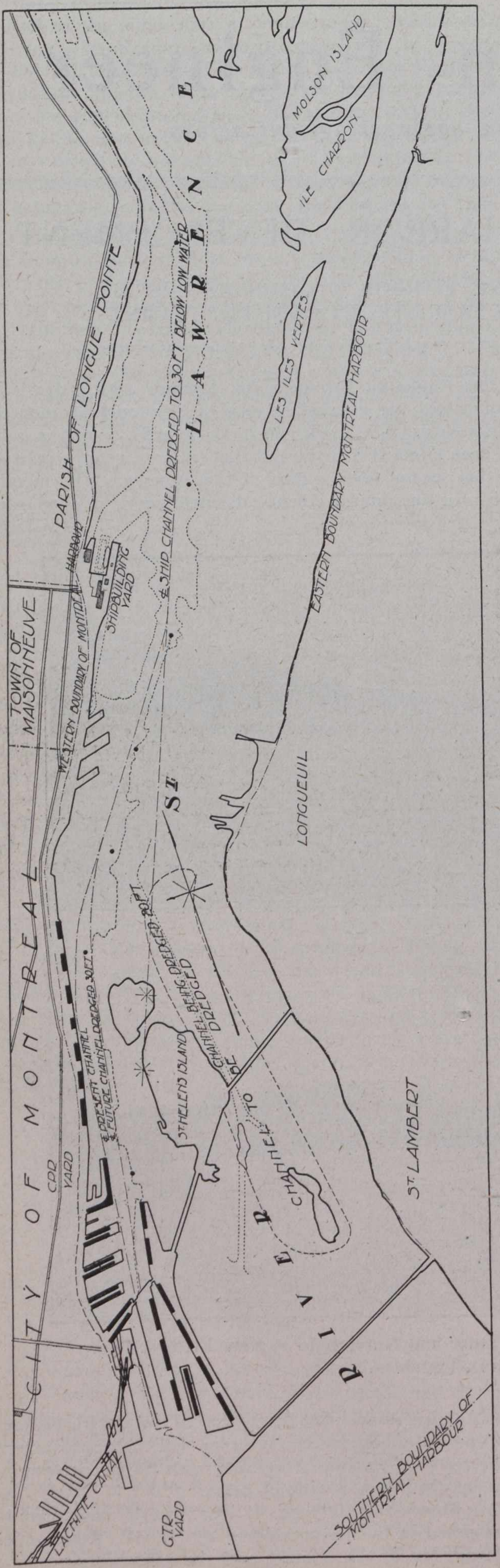


Fig. 2.—Montreal Harbor from Victoria Bridge to Longue Pointe.

Mr. M. P. Fennell, Jr., of the design, construction, equipment and commerce of the ports and docks of London, Havre, Marseilles, Genoa, Hamburg, Rotterdam, Antwerp, Bristol, Liverpool, Manchester, Glasgow, Edinburgh, Rosyth, Hull, and Southampton. This occupied three months and a very interesting part of the report of the Commissioners for 1914 is that relating to the distinctive features of these European ports.

The expenditures on capital account in 1914 amounted to $1,758,368.83 and alluded to the following principal works of improvement: Harbor dredging, $229,808.22; real estate, $39,469.10; wharves, piers and basins, $745,062.04; plant, $83,663.42; shops and buildings, $24,573; railways, $115,236.44; permanent sheds, $345,-246.56; electric hoists, etc., $31,878.10; grain elevators, $143,431.95.

The programme which entailed the above expenditure was very largely of an engineering nature, the engineering department having charge of harbor construction, maintenance and operation. The construction work is almost entirely carried on departmentally and the commissioners' plant of dredges, tugs, derrick, repair shops, etc., is consequently elaborate, adequate and up-to-date.

The 1914 operations involved the following work—Improvement and extension of harbor railway tracks; continuation of construction of new Victoria pier and market basin; continuation of construction of bulkhead high level wharves on the river front, eastwards from Victoria pier; general dredging for widening and deepening of basins and berths; dredging of channels for the amelioration of St. Mary's Current; paving and laying railway tracks on the wharves; continuation, almost to completion, of improvements resulting in the floating dock basin and site for ship building and repair yard; construction and improvement of harbor facilities, such as hoists, flood gates, bridges, subways and freight yards; additions and improvements to Harbor Commissioners' construction plant; construction of an industrial wharf at Pointe-aux-Trembles; construction of addition to Grain Elevator No. 1; construction of a new subway to the harbor at Aylwin Street; construction of two transit sheds, Nos. 24 and 25; maintenance of berths and channels, of wharves, sheds, buildings, roadways, water service, cleaning of wharves and general repairs. The operating of floating crane, electric hoists and the construction and maintenance of industrial connections with the harbor, were all carried on as usual during the season.

The extensions of the harbor railway tracks, on which considerable work was done, are to facilitate the best possible terminal connection between the railway systems and the North Atlantic steamships. They involve the practical conversion of the shore area of the harbor into a convenient railway terminal, the tracks being operated directly by the Commissioners. The Grand Trunk and Intercolonial lines connect with the harbor at its westerly end; the Canadian Pacific and Canadian Northern reach it toward the eastern end.

An important feature is the construction of the new Victoria pier. Up to 1913 the old level Victoria pier had been used, although the new work of construction had almost surrounded it. Early in 1914 the old structure was removed, and the new pier was built to the extent of 300 ft. of high level wall and 1,200 ft. completed to low level.

A bulkhead wharf below Victoria pier, completed last year, gives a bulkhead width of 250 ft. Two new transit sheds were constructed with provision for the installation of a grain conveyer system on the river side of each.

These new sheds are of a steel frame and reinforced concrete type adopted as standard by the Commissioners. One is 264 ft. x 105 ft. and the other 484 ft. x 105 ft., each having a clear head room of 14 ft. The floor is designed to carry a super-imposed load of 600 pounds per sq. ft., while the location necessitated a design of foundation to withstand unusual ice shoves that might occur. The foundations for the sheds were completed in the previous year, while the balance of the piers and shed structure were finished in 1914 and equipped with railway tracks, offices, etc.

A low level quay-wall extending from the low level market basin at Berri Street eastward, was widened and strengthened and rebuilt on a 4 per cent. grade to standard high level, a rise of 12 ft. From the top of the grade the wall was continued eastward. It was extended in 1914 by the addition of cribs and a continuation of the concrete wall. Refilling behind the wall to its full height, the construction of anchor blocks, etc., were executed last year also.

During the season the dry dock site in the eastern part of the harbor was extended by the construction of about 2,500 ft. of standard crib and concrete quay-wall, having a total height of about 60 ft. The docking basin, 500 ft. x 1,000 ft., was dredged to a depth of 30 ft. at the quay-walls and to 50 ft. in that portion of it required for sinking the floating dock. The channel approach required the dredging of an entrance of about 1,000 ft. wide. Reclamation work to the extent of 30 acres was carried on for the ship yard and 6 acres for the right-of-way for harbor tracks and roadways. This practically completed a phase of the work commenced in the summer of 1910.

A wharf at Pointe-aux-Trembles for the Canada Cement Co. was undertaken in September, 1913. A portion of the dredging for the approach channel and about 400 ft. of the concrete wall to half level had been finished in 1913. The work was continued in 1914. Filling to the extent of about 250,000 cu. yds. was involved in addition to about 600 ft. of crib work and concrete quay-wall. Most of the grading and levelling was completed last year and railway tracks were laid to the wharf and to the site of an unloading plant proposed by the company.

The commissioners' harbor plant engaged in the usual work of dredging, included 5 spoon dredges and 1 elevator dredge. The work consisted of the maintenance of harbor berths, dredging to ameliorate the St. Mary's current, dredging for filling and the usual dredging required for construction work and the crib seats for wharves. The total amount done in 1914 was about 1,500,000 cu. yds., consisting chiefly of hard material, ranging from compact gravel, clay and hard pan to rock. None of the material permits of pumping.

One of the most important items of dredging, and which occupied the time of two of the Commissioners' best dredges almost entirely throughout the season, was the construction of a channel 20 ft. deep at low water, on the south-eastward side of St. Helen's Island. The extreme slope of the river from the Victoria bridge down to the lower end of the guard pier causes the St. Mary's current.

The design of the channel behind St. Helen's Island has for a purpose a discharge of a portion of the river flow through the channel on a fixed slope giving uniform current. The work of 1913 and particularly of 1914 has shown considerable effect, estimated to amount to 15 per cent., in ameliorating the St. Mary's current, even at extreme low-water stage of 1914 when it would otherwise have been at its worst.

The ground area dredged in 1914 amounted to about 8½ acres, all of which required the excavation of 20 ft. of material consisting of cemented clay and sand with many embedded boulders. A length of 1,000 feet was dredged for a width of 335 ft., and before the work closed the dredging was in a fair way to approaching deeper water near the head of St. Helen's Island.

Other important items of dredging consisted of dredging between St. Helen's Island and the guard pier, consisting almost entirely of large boulders. Four hundred and seventeen large boulders were removed, many requiring to be blasted before dredging.

A channel was commenced on the city side of the guard pier up to the Bickerdike pier, where the material is shale rock. The cut made was 500 ft. long by 120 ft. wide, all being dredged to a total depth of 30 ft. at low water.

The widening of the main harbor was proceeded with inside the guard pier and an additional width was obtained opposite Jacques Cartier and King Edward piers.

Fig. 3.—Operations Commencing on the Construction of the Second Addition to the Commissioners' Elevator No. 1.

The entrance channel of the dry dock basin was also widened and deepened and several portions of the ship channel opposite Longueuil and St. Helen's Island were also done by dredges belonging to the Department of Marine and Fisheries.

The drilling and blasting boat was occupied throughout the year. The number of holes drilled and blasted was 2,769, the average depth of holes being over eight feet and the quantity of dynamite used was 16,074 lbs., of 75 per cent.

The following important items of construction work and materials used will give an idea of the extent of the Commissioners' operations during the season: Cribwork built, 2,160 lin. ft.; cribwork sunk, 1,820 lin. ft.; quay walls completed, 2,518 lin. ft.; quay walls completed to half height, 1,159 lin. ft.; retaining and abutment walls completed, 1,228 lin. ft.; new track work, 4 miles; paving, 20,000 sq. yds.; dredging, by Harbor Commissioners' dredges, 1,500,000 cu. yds.; by Marine and Fisheries' dredges, 500,000 cu. yds.; refilling by derricks, 1,750,000 cu. yds.; filling obtained from city contractors, 200,000 cu. yds. Quantities of materials used were: Cement, 60,000 barrels; sand, 15,000 cu. yds.; crushed stone, 25,000 tons; rubble stone, 20,000 tons; displacers, 500 tons; gravel, 8,000 tons; stone for macadamizing, 2,500 tons; timber used to amount of $215,000.

New Construction Plant.—Three new flat scows of the standard type, dimensions 100 ft. long, 30 ft. beam, 9 ft. depth, were launched during May and June. A new derrick, hull dimensions 88 ft. by 31 ft. by 9 ft., was launched October 19th, to be completed for the opening of navigation, 1915. The machinery of this derrick, under construction at the Commissioners' machine shop, will embody the following features in relation to the older plant.

The steel boom will be of stronger construction and more rigid, the bottom connection of the steel A frame will be of pin type instead of rigid. A further improvement will be made in the turntable pivot casting to prevent rocking. An entirely new type of friction for the hoist and trip drum has been designed and the foundations of the spud operating machinery will be stronger.

A new tug hull was laid down on the shipways, May 26th, and launched November 21st; dimensions 77 ft. by 18 ft. by 10 ft., being nearly all of oak. The engines being constructed are of compound type, 13 ins. and 26 ins. by 22 ins., jet condensing. The boiler is of Scotch Marine

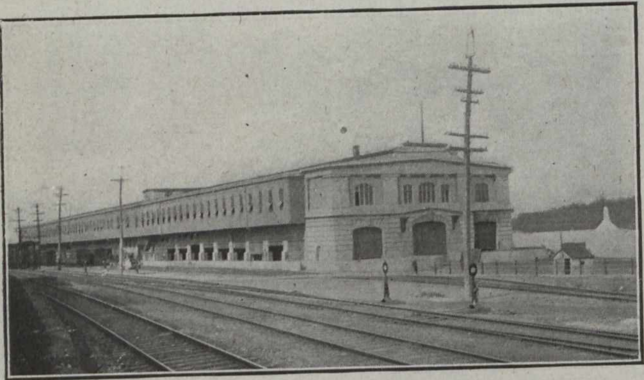


Fig. 4.—Typical Shed, Montreal Harbor Commissioners' Development.

type, 10 ft. diameter by 10 ft. 1 in. long over all, having two furnaces 38 ins., I.D., and to carry a working pressure of 150 lbs.

Aylwin Street Subway.—A new subway, the construction of which was urged by the city authorities, was built at Aylwin Street, under the existing railway yards of the Harbor Commissioners, and the yard was relaid to suit the new conditions.

The subway has a minimum head room clearance of 13 ft., with a teamway 30 ft. wide and a 5-ft. footpath, the whole spanned with a seven-track plate girder and steel trough floor system bridge, the tracks being laid 13 ft. centres and the steelwork designed in accordance with the Canadian Government specification for railway bridges and viaducts, type heavy.

The concrete abutment walls and the paving of the subway were done by the Harbor Commissioners' departmental organization, while the steel superstructure, of a total weight of 234 tons, was let by contract and erected by the Dominion Bridge Co., Limited.

Proposed Warehouse at Market Basin.—Preliminary studies were made on a warehouse which is proposed to be erected on the high level at Beaudry Street, the construction of which is under consideration by the Commissioners.

The building is designed to be about 400 ft. long and 100 ft. wide, to have six storage floors, of which five can be used the year round, and one 4 ft. above the low level wharf, will be available only the summer months when the river level is normal.

All floors will be designed to carry a live load of 300 lbs. per square foot of floor, and the six floors will be connected with four high-speed electric cargo elevators.

This Season's Work.—It is expected that an expenditure of about $2,000,000 on capital account will be made during 1915. Of the new works involved the most important is the construction of a second addition to Elevator No. 1, which will increase its present capacity of 2,500,000 bushels by another 1,500,000 bushels, making this the largest elevator at any Atlantic seaport. When completed, it will give Montreal a storage capacity of 11,250,000 bushels. In Fig. 3 the present elevator is shown against which the addition is to be built. Piles have been made on the site and are now in course of driving. The office building, shown on the right, has been moved from its original location a distance of over 100 ft. to make way for the new addition.

It is expected that the new Victoria pier and market basin will be completed by the fall. It will give, on its inner side, 4,800 ft. of low level quay wall for the accommodation of river and lower St. Lawrence craft, and on the outside some 2,700 ft. of high level quay, providing berthing for five ocean liners. Fig. 1 is a view of the industrial wharf being built at Pointe-aux-Trembles for the accommodation of the Canada Cement Co. and other industries located in that section of the port.

The very large amount of dredging work will be executed in different parts of the harbor, particularly in the channel between St. Helen's Island and the south shore. It is to be remembered that the entire south shore of the river from Victoria bridge to Varennes is under the control of the harbor authorities. The dredging of the south shore channel to a depth of 20 ft. is also to be pushed forward. As stated, this work so far has had the effect of reducing the St. Mary's current by 15 per cent. The dredged material is being used for filling in the wharves that are being constructed on this side of the river. The two dredges that lowered an area 1,000 ft. x 335 ft. last year are in operation there.

The government farm has been deeded to the Harbor Commissioners, and work will be commenced at once upon the construction of a concrete roadway connecting the municipalities of St. Lambert and Longueuil.

Commencement will also be made upon the extension of the Jacques pier. It is proposed to make additions to two of the high level piers of 250 ft. each which will support, in future, steel freight sheds covering their entire width for the accommodation of lake and river vessels. Several new wharves are to be built, giving extra berths for trans-Atlantic traffic. The harbor railway system will be extended to high level from Racine pier to the Vulcan wharf at Longue Point.

Work will also be commenced this year on the construction of 400 ft. of south extension to the Bickerdike pier to handle the enormous quantities of coal being brought to that part by the different coal companies located in the western part of the harbor.

The Harbor Commissioners of Montreal are: W. G. Ross, Esq., president; Farquhar Robertson, Esq., and Col. A. E. Labelle. Mr. F. W. Cowie, M.Inst.C.E., is chief engineer; T. W. Harvie, assistant chief engineer; J. Vaughan, superintendent, and L. Mercier, assistant superintendent of railway terminals. Mr. Geo. Gendron is mechanical superintendent for the Commissioners. We are indebted to Mr. M. P. Fennell, Jr., assistant secretary, for the greater part of the above information and for the illustrations.

TREATED WOOD BLOCK PAVING.

THE Forest Products Laboratories, recently established as a division of the Forestry Branch of the Department of the Interior, have under consideration an extended investigation of the possibilities of treated wood blocks for road paving, dealing with the relative merits of different native woods, details of seasoning and preservative treatment and methods of laying, having particular regard to the climatic and traffic conditions to be met in Canadian cities. It is the intention of this department to place under close observation several stretches of wood-block paving which are subject to representative conditions of service, in the hope of obtaining more or less direct correlation between the data gathered from periodical inspections and the results of laboratory investigations.

Pending the completion of such parts of this undertaking as will justify the publication of further reports, the Laboratories have issued a bulletin which is largely a compilation of the information available to date and a summary of the published work of other investigators. We extract the following from the bulletin:

Apparently the first use of wood blocks for road-making, according to authentic records, was in Russia several centuries ago. In England and the United States wood-block pavements were adopted in a small way about eighty years ago. The record of such paving was far from satisfactory; in all cases the blocks were untreated, and in earliest practice were merely sawn from the log and laid as closely as this form would permit. Such paving was quite widely used in the Western States and in some Canadian cities, more particularly before the adoption of brick and asphalt surfaces. The foundation in most cases was of untreated planks, which after a short service decayed, permitting unequal subsidence of the blocks. In the case of round blocks the traffic wear was concentrated at the edges, and the interstices were collecting places for water and street refuse. Under such conditions the pavement soon became unsanitary, and deterioration was very rapid. Later, rectangular blocks were adopted with some improvement, but absorption of water was a cause of trouble, and after appreciable wear and settling of the foundation, it was practically impossible to maintain the condition of the surface. In part these early difficulties may have arisen from the indiscriminate use of woods most easily available, but the rapid decay was largely due to absorption of water and the collection of organic refuse around the blocks. In America, during comparatively early practice, a great many varieties of native woods were used for paving service. In London, England, particularly, and to some extent in New York, Australian wood was introduced, but in general the cost of such pavement was prohibitive, and the results not satisfactory. The woods so imported were chiefly of two species of eucalyptus, and were of hard dense structure, and their durability was supposed to have been due to some extent to their content of certain antiseptic gums.

Although the successful practical introduction of preservative treatment for timber dates from quite early in the last century, apparently its first adoption in connection with wood paving-block manufacture was about forty years ago. A case is noted of the laying of creosoted-block pavement in Galveston in 1873. The wood used in this case was southern pine, and, while the pavement was not laid in accordance with what is now recognized as best practice, it gave excellent results, and lasted until its destruction in the flood of 1900.

Briefly, the processes of wood preservation which have survived the tests of practice are: (1) kyanizing, (2) burnettizing, (3) creosoting, and (4) treatment with crude petroleum. The former, so-called from the inventor, Kyan, was introduced in England in 1832. The method as first employed was the immersion of timber in a solution of mercuric chloride, a subsequent modification of the process providing for more rapid impregnation under pressure. In 1838 Sir William Burnett published a method of preservative treatment based on the antiseptic properties of zinc chloride. Pressure impregnation was also later applied to this process. Creosote oil—the heavy oil of tar—first made its appearance as a wood preservative in 1837, and in 1838 was used by John Bethell by injecting under pressure. The use of petroleum oils is of comparatively recent adoption. However, in modern practice this latter treatment is not so widely used as creosoting and burnettizing. Mercuric chloride and zinc chloride are both in use at the present time as wood preservatives, but the latter, because of its somewhat lower cost based on the quantities necessary for effective treatment, has been more extensively adopted than the corrosive sublimate. More recently, sodium fluoride and other fluorine compounds have been adopted as wood-preservative agents to a considerable extent in Europe. The antiseptic properties of sodium fluoride are relatively high, and it is probable that further experience will indicate that under certain conditions it is well adapted for such use. However, because of the solubility of these preservative agents, timber so treated is only available for conditions of service where it will not be exposed to excessive moisture, since otherwise the salts would be partially leached out and the value of the treatment greatly reduced. Moreover, it is essential that wood blocks to be used for paving purposes shall be as nearly as possible impervious to water; otherwise serious troubles will develop due to swelling and buckling of the pavement. Obviously impregnation with a water solution is of no value as a waterproofing treatment. These limitations preclude the adoption of such methods for paving-block treatment.

Treatment with creosote oil or heavier tar products is, therefore, practically the only method applicable for paving-block manufacture. During recent years very considerable progress has been made in all lines of the timber-preservation industry both in Europe and the United States. Improvements in method of treatment, perfection of mechanical equipment used, the careful study of such factors as selection and seasoning of woods, and design and methods of laying pavement have combined to bring the development of wood-paving practice to a point where its adoption may no longer be considered an experiment, and where its possibilities in modern city-street paving merit most careful study.

Method of Laying Blocks on Concrete Base.—In England the custom is to lay the blocks in courses at 90 degrees to the street line, and with staggered joints. They are placed directly on the smooth concrete surface, and, after laying, a heated coal-tar-pitch filler is applied, and squeegeed into the joints. This is flushed with a comparatively thin Portland cement mortar wash, and later a surface dressing of clean coarse sand is applied, and left to be worn in by traffic. This method of construction requires, of course, that the blocks be sawn to an absolutely uniform depth. Longitudinal expansion joints of 1-inch to 1½-inch width are provided along either curb, and are filled with the bituminous filler.

Methods of pavement construction in France closely resemble those adopted in England. No cushioning medium is used, and in addition to the usual longitudinal expansion joints, transverse joints are provided at intervals of 100 feet or more. All such joints are filled with heavy paper box fillers, or in some cases with collapsible metal joints. Cement grout is generally used as a joint-filling material, although apparently pitch is adopted in some cases.

In America there is at present an even greater variety in methods of construction. Until comparatively recently sand cushioning has been in favor for all types of brick or block pavement. Such a cushion varies from one-half inch to 1½ inches or more in depth, according to the regularity of the surface of the foundation. This has been a frequent source of trouble. Particularly on grades and on heavily crowned streets the sand flows with the water which finds its way below the block surface, and this results in unequal settling of the blocks. This tendency to shifting of the cushioning material is apparently greater where the pavement is subjected to excessive vibration, as between car tracks. This defect is now being generally recognized, and leading authorities in pavement construction in the United States and Canada advocate a modification of European practice. They prefer a cement mortar bed of from one-half inch to 1 inch in depth of 3 : 1 sand and Portland cement mixture, laid dry and struck off to a uniform depth with a template. The blocks are laid on this, and the pavement is sprinkled before and after laying and rolling the blocks. Sand filling for body joints has also been largely used, but is being displaced by bituminous material which should be selected of such composition that it will not run or become brittle at the extremes of temperature to which the pavement is exposed. American practice closely agrees with methods in vogue in England as to expansion joints and sand surfacing. It is claimed by some authorities that a more liberal allowance is necessary for expansion in American pavements. Whether this difference is due to climatic conditions, or to the difference in the woods used and methods of treatment is not entirely clear. A feature of construction that has been introduced into the United States, apparently with successful results, is the laying of the block courses at an angle to the street line something less than 90 degrees. Inclinations of 45 degrees and 67½ degrees have been adopted, the latter apparently having given the best results. This practice was first introduced as a possible means of more evenly distributing the joint-wear from traffic, and to provide a longitudinal component of expansion movements.

It is generally admitted that the success of European wood-block paving has been largely due to the high standard of workmanship secured. American operators now require more uniform methods and more careful work in actual construction than were formerly thought necessary.

Defects of Early Wood-Block Pavements.—In earlier wood-block paving practice, faulty methods of treating and failure to appreciate the importance of such factors as the selection of proper timber-stock and careful workmanship in construction were responsible for unsatisfactory results which have developed a prejudice which has been slow to disappear. Insufficient impregnation was an error in French practice which has persisted until quite recently. The absorption of 3 pounds or 4 pounds per cubic foot, secured by simple immersion, proved quite inadequate to prevent decay, and the blocks so treated had a comparatively short life. In England, practice has become well settled in the adoption of a 10-pound or 12-pound impregnation. In America a much heavier treatment is generally favored, and this is held by some authorities to be at least partially responsible for another difficulty which appears to have been peculiar to American pavements. "Bleeding" or exudation of the oil from treated blocks has been a rather frequent source of trouble in the United States. This condition, where it appears, develops in hot weather during the first season of use, and is probably due in large part to excessive treatment with an oil that is not adapted to such conditions of service. The character of the wood is probably to some extent a factor in causing this condition, inasmuch as heavier treatment is permissible, or even necessary, for some species. It has been claimed by some investigators that bleeding is largely due to the stresses developed in the pavement sheet as a result of the absorption of even comparatively small amounts of water. It is doubtful if this idea is confirmed by actual observation. A case has been noted of a pavement laid on a Chicago street, where the blocks used on the north side and south side of the street were obtained from different manufacturers. "Bleeding" developed on one side only (the north side) and apparently, all other conditions being uniform, the cause lay in the character of the oil used.

However, the responsibility for this trouble has not been finally distributed to the several factors which have been suggested as causes, and the matter is now under investigation in the United States.

Heaving and buckling of the pavement sheet have been frequent causes of trouble where insufficiently treated blocks have been used, and where adequate provision for expansion has not been made. Apparently not much difficulty is experienced from this cause in English practice, and it is probable that climatic conditions are in part responsible for the freedom from expansion troubles. It has been suggested that because of the comparatively high humidity, the blocks are in a condition of maximum expansion during the greater part of the time, and are not subject to the extremes to be met in the United States or Canada.

A criticism which has been directed against wood-block paving from some quarters is that it presents a dangerously slippery surface, when newly laid or when wet. However, this difficulty has been overcome in part by the adoption of a clean hard sand surface-dressing, as a final step in construction or at such later intervals as may be necessary. The sand is worked into the blocks by traffic, and serves the manifold purpose of developing a hard, resistant and non-slippery wearing surface, and reducing the nuisance from exudation of oil, where that occurs.

The difficulties due to insufficient impregnation are fairly clearly recognized. American practice is perhaps inclined to err on the other extreme, and, comparatively recently, attention has turned to the possibilities of certain processes which are claimed to secure maximum water-proofing and antiseptic effects with the use of less creosote oil than has heretofore been regarded as necessary.

Expansion troubles have been largely overcome by the provision of ample longitudinal joints. The American practice of laying the block courses at an angle of from 60 degrees to 70 degrees to the street line is claimed to reduce the tendency to buckling, in addition to reducing the wear along the joint lines.

The difficulties from the use of sand cushioning have already been referred to, and it is significant in this connection that there is now in the United States and Canada almost unanimous agreement upon a cement sand mortar cushion, or a very thin sand cushion, if on level streets.

Special Uses of Wood-block Paving.—Wood-block paving has been adopted quite generally in America for such special service as bridge floors, and for flooring warehouses and industrial plants. For bridge flooring it would seem to offer particular advantages, which will commend it to engineers. The practice is to lay the blocks on a base of treated planking varying in thickness from 3 inches to 5 inches, which is carried directly on the steel floor members. The reduction of dead loading accomplished by the adoption of such construction offers considerable opportunity for economy in design.

Brick or asphalt surfaces for highway bridge floors require a heavy concrete base, which adds greatly to the weight of the structure. The experience of a number of cities of the United States and Canada indicates that wood-block paving has amply and conclusively demonstrated its advantages for such use.

For flooring warehouses, loading platforms, and many types of industrial plants, wood paving would seem to be well suited. The peculiar requirements of such service make the choice of a flooring material of considerable importance. Trucking and handling of heavy materials result in rapid deterioration of non-resilient floors, and it is claimed that wood-block floors have given records of remarkable durability in this class of service.

In general, the construction of such flooring is in accordance with the methods used in street paving. A concrete base is prepared and the blocks are laid with or without cushioning. Since for such use there is comparatively little exposure to water under ordinary circumstances, there is apparently not the same objection to sand cushioning as in street work, although vibration and impact of heavy loads may develop uneven setting on such a cushion layer. In bridge-floor construction and in building block floors laid on plank base, it is usual to provide a single layer of heavy pitch felt as a cushioning medium. This may or may not be swept with pitch filler before laying blocks.

Cost-Figures in Canadian Practice.—Vancouver, Victoria, Calgary, Moose Jaw, Winnipeg, Toronto, Hamilton, Ottawa, and Montreal are among the Canadian cities where wood-block paving has been adopted to some extent. Douglas fir has been used almost exclusively on the Pacific coast for paving-block manufacture. Hard (southern or yellow) pine blocks have been imported by some of the eastern cities, and Norway pine, tamarack and hemlock blocks are also in use. Birch and maple are regarded as valuable woods for such service by some authorities, although these species have not yet been adopted to any extent in Canada.

Initial and ultimate cost, durability, availability of supply and adaptability to conditions of traffic are factors upon which the choice of a pavement surface depends. The factor of availability of supply will influence Canadian practice, because of high transportation costs. In the east the supply of timber for paving-block manufacture will be drawn from Norway pine, tamarack, birch, hemlock, and maple. At the present time imported yellow pine blocks compare favorably in price with native wood blocks, but this is an anomaly due to present market conditions, and can hardly be expected to continue. The coast cities have hitherto used Douglas fir blocks almost exclusively. It is possible that such other species as tamarack or hemlock may replace fir for this purpose. At present there is a considerable diversity of opinion as to the suitability of Douglas fir for paving-block manufacture. Difficulties of treatment have hitherto been responsible for the development of some prejudice against this species, although it is claimed that this trouble has been overcome by recent improvements on methods of seasoning and impregnation.

The initial cost of wood-block paving is rather higher than for other types of pavement. Compared with asphalt surface on an equal foundation its first cost is considerably greater. The cost of wood-block pavement will vary considerably according to design, and more particularly in proportion to the cost of timber stock, cost of treatment and labor for construction. This variation ranges from $2.50 to $3.90 per square yard.

A cost-figure is reported from Minneapolis of $2.50 per square yard, representing an average of several years' construction. The cost of a 3-inch treated-block pavement in Moose Jaw is reported as $2.84 exclusive of excavation. Vancouver reports as low a cost as $2.10 per square yard, exclusive of excavation and foundation. In this case the cost per yard of treated blocks was $1.35, half of which represents the actual cost of treatment. The timber stock was Douglas fir and a twelve-pound impregnation was required.

These figures can hardly be assumed as representative of costs in the east. Probably a fair cost-figure in Eastern Canada would be from $3.25 to $3.85 per square yard for a 4-inch pavement on a 6-inch foundation.

It is claimed by some of the most extensive and successful users of treated wood-block pavements that when properly constructed, the relatively high durability of such pavement liberally discounts the greater initial cost, and reduces ultimate cost to a figure which compares very favorably with other types of road surface. Remarkably low maintenance costs are claimed for treated-block pavements, some of which have been in use for ten to fifteen years. It may be said that there are no cases of American wood-block pavements laid according to best recognized practice, which have been in service for a sufficient length of time to yield conclusive information as to the ultimate life of such pavements. However, the performance records to date of well constructed wood-block pavements, under a wide variety of service conditions, are such as to commend them to the careful and impartial consideration of all highway engineers.

PAN-AMERICAN ROAD CONGRESS.

The executive committee of the Pan-American Road Congress has decided to run a train, to be known as the Pan-American Road Congress Special, to accommodate delegates to the meeting to be held at Oakland, California, during the week of Sept. 13th next. More complete details of the arrangements will be announced at an early date. Letters have been received from various municipalities and organizations, inviting the delegates to stop at points along the way and make local tours of inspection. It is probable that some of these invitations will be accepted.

For the purpose of carrying on its work with the highest efficiency possible, it has been decided to appoint local representatives or chairmen in all the principal cities throughout the United States and Canada. Each local representative will look after the interests of delegates from his section and help to arouse interest in the Congress.

TEMPERATURE CHANGES IN MASS CONCRETE.

SOME very interesting conclusions have attached themselves to a study of the temperature variation in mass concrete, according to tests made at the Arrowrock dam, Boise project, by a number of United States engineers. It has been found that relatively small daily and seasonal variations in temperature occur, at distances of one foot and over from the face of the structure. The effect of chemical action during the setting of the cement in the summer season results in a temperature of 90 to 95 deg, within a period of about 30 days. A paper presented on May 5th to the American Society of Civil Engineers, and prepared by Messrs. C. H. Paul and A. B. Mayhew, two of the engineers on the dam, deals with the temperature tests carried out. The following is a summary of the tests and conclusions.

According to the paper, which appeared in the Proceedings of the Society for April, nine electric-resistance thermometers have been installed in the dam to date, and have been in place for periods ranging from about 3 to about 19 months. Although some of the experiments have been in progress for more than a year, the greater part of the result is still affected by the high temperatures produced by chemical action while the cement is setting. It will probably be several years before a complete study can be made of the temperature changes.

The resistance bulbs were placed at various elevations and at different distances from the exposed faces of the dam. Ultimately, there will be one resistance bulb near the top of the dam, one about half-way between the original river level and the bed-rock foundation, and eight more at intermediate elevations. When each resistance bulb was placed in the masonry, the lead-covered cables were encased in ½-in. steel tubing and carried to an inspection gallery in the body of the dam, where the switchboard and indicator were installed. When the concrete in the dam was built to the approximate elevation at which it was desired to place a resistance bulb, concreting in that immediate vicinity was usually discontinued temporarily, and the concrete was allowed to set for a few hours. The bulb and conduit were then embedded in a trench about 6 in. deep, excavated in the concrete, great care being taken to provide a soft, uniform bed for the bulb, and to cover it carefully. The distance of the temperature bulbs from the face of the dam varies from 1 ft. to over 76 ft.

The accompanying diagram for temperature variations of the concrete at three typical locations (1 ft., 3½ ft. and 20 ft. from the face) shows the large differences between the temperature of the concrete and that of the outside air, the rise of temperature due to chemical action, and the seasonal variations (at thermometer 5) after the effect of chemical heat is dissipated. On Oct. 19th, 1913, thermometer 3 was placed 20 ft. from the west face on concrete poured two hours earlier, and within two days about 4 ft. of concrete was poured above it. On Oct. 29th, 1913, thermometer 5 was placed 3½ ft. from the east face on concrete one day old, containing considerable steel reinforcement, and concrete was poured about 1 ft. thick above it. On Aug. 29th, 1914, thermometer 9 was placed 1 ft. from the east face on concrete about twelve days old and concrete about 2 ft. thick was poured above it.

The duration of the rise in temperature, due primarily to chemical action, is undoubtedly largely dependent on the speed of placing, season of the year, consistency, brand of cement, and quantity of cement per cubic yard of masonry. From some incomplete results obtained by placing a mercury thermometer inside the forms of the regulating outlets, it was found that a temperature of 99 deg. was produced in about 24 hours by the chemical action caused by the setting of the 1:2 Portland cement mortar composing the lining of these outlets. It is evident from the diagram that the duration of this higher temperature was much shorter at thermometer 5 than at 3, possibly due, in part, to the greater distance of No. 3 from the base of the dam.

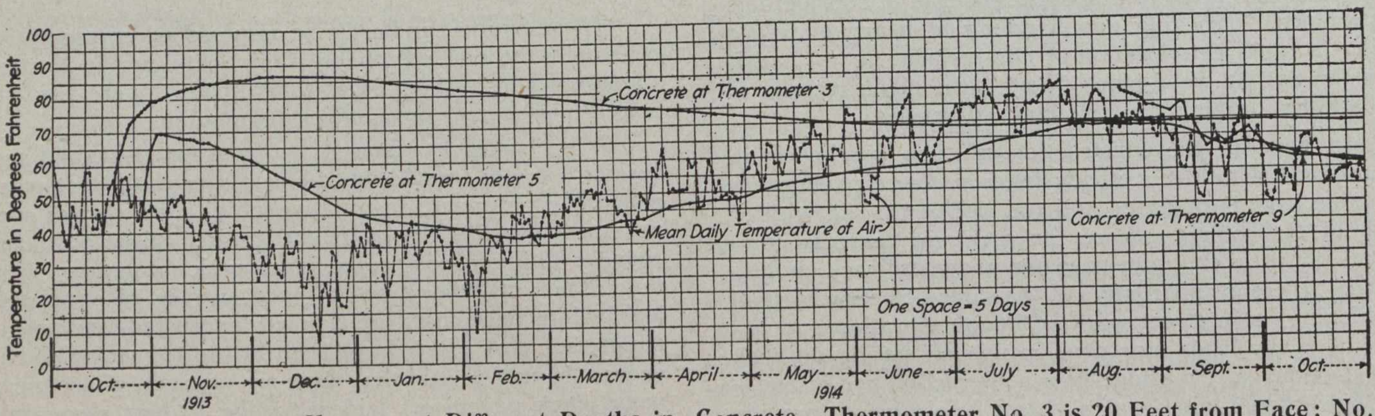
The results of daily variations, not given in this abstract, show conclusively that high or low temperatures of the air for short periods do not materially affect the temperature of the concrete 3 ft. or more from an exposed face, and that it takes some 4 or 5 days for the effect of continued high or low air temperature to appear in the temperature of the concrete at that distance from the face. The results obtained from thermometer 3 indicate that there is very little seasonal variation in the temperature of the concrete 20 ft. or more from an exposed face.

Among the conclusions already reached are the following:—

1. Large bodies of concrete deposited rapidly during the summer season develop a temperature of from 90 to 95 deg. within a period of about 30 days, and maintain nearly that temperature for several months.

2. In the case of concrete 1 ft. from an exposed face, there is a daily variation in temperature of about 2 deg. when the daily variation of the temperature of the air is about 50 deg.

3. In the case of concrete 2 ft. from an exposed face, there is a daily variation of less than 1 deg. when



Record of Temperature Changes at Different Depths in Concrete. Thermometer No. 3 is 20 Feet from Face; No. 5, 3½ Feet, and No. 9, 1 Foot from Face of Concrete.

the daily variation in the temperature of the air is about 50 deg.

4. In the case of concrete 3½ ft. from an exposed face, no daily variation in temperature is apparent when the daily variation in the temperature of the air is about 50 deg.

5. The seasonal variation in the temperature of concrete 3⅝ ft. from an exposed face is about 32 deg. when the seasonal variation in the mean daily temperature of the air is about 75 deg.

6. The experiments have not yet been carried far enough to show the seasonal variation at other distances from exposed faces, but it is probable that they become very much less as the distance from the face increases.

BRASS IN WATERWORKS CONSTRUCTION.*

FOR many years hydraulic engineers and manufacturers of equipment and materials to be exposed to water and atmospheric moisture have sought a strong, uncorrodible, moderate-priced metal or a method of rendering iron and steel greatly resistant to corrosion. For about forty years several kinds of forgable copper alloys have been produced having high tensile strengths, for which very broad fields of usefulness seemed open in engineering construction. These alloys have been commonly known as bronzes or brasses.

Claims of brass or bronze makers backed up by tests and experience led the engineers of the Catskill aqueduct, after careful investigation, to adopt some of these copper-zinc alloys for extensive use where their non-corrodibility and other good qualities claimed for them made them especially suitable. It is safe to say that on no other single engineering enterprise have such large quantities ever been used, the total being nearly three million pounds. More than two million pounds of this was in the form of castings ranging from a fraction of a pound to 22,000 pounds each. Forgings constituted a large proportion of the remainder, varied from small bolts to sluice gate stems about 6 inches in diameter and 31 feet long, weighing 3,200 pounds each. The balance was made up of plates, rods and shapes. Manganese bronze constitutes a very large proportion of the total, "naval brass," including Tobin bronze, was used in large amounts and various common brasses and special compositions made up the relatively small remaining quantity. As an illustration of some of the larger castings may be mentioned the shaft caps.

It was not in these large castings, however, that trouble was experienced, but in the smaller objects, such as bolts, ladder rungs and pipes. These numerous and various brass articles had been made by a number of manufacturers scattered through New England, New York, Pennsylvania and New Jersey. The experience of the Catskill aqueduct with these brass articles may be summarized as follows: Large numbers of brass bolts have been found cracked and broken in their packing boxes after storage through a winter, but having never been stressed; others never exposed to low temperatures and never stressed have been found in similar condition. These bolts ranged from ½ inch to 2¼ inches in diameter.

*Abstract of an article before the Municipal Engineers of the City of New York by Alfred D. Flinn, deputy chief engineer, Board of Water Supply of New York City.

Similarly, flat bars, rolled plates and long rods supporting only their own weight have been found cracked or severed after a lapse of a few or many months. Flanged ¼-inch plates riveted together, after careful inspection being in apparently good condition, were found some months later to have incipient and well developed cracks, with many rivets cracked or yielding to relatively light blows from a hand hammer. Many upset rivet heads have come off. Hundreds of bolts have broken under tension after short or long intervals. The failures have been so numerous and important as to have caused the gravest apprehension and led to the substituting of steel for brass in many cases, in spite of the recognized disadvantage of steel as to corrosion which the engineers had sought earnestly to avoid.

No brand or make of brass or bronze has wholly escaped. Manganese bronze, naval bronze (including a well-known bronze, and its imitation), and Muntz metal, from all the manufacturers who have furnished any considerable quantity, all have failed. Hitherto castings and large forgings have been exempt, or at least failures in them have not been discovered, except in a few cast bolts and nuts.

When studying the extent and cost of these failures, it was found that other users also have had trouble of one kind or another, knowledge of which has come to hand within relatively recent time. At just what date or when in the state of development of brass manufacture these troubles began, or how extensive they have been, has not yet been learned. Possibly they might have been considered occasional or accidental but for the large use of these alloys on the Catskill aqueduct under supervision which led to a detection of these defects.

The discovery of these failures in the fall of 1913 was all the more disappointing because the specifications had been drawn carefully in the light of information which is in hand and practically all the metal accepted had been subjected to careful inspection, including the standard physical tests and chemical analyses. Much of the metal accepted had shown physical qualities in generous excess of the specified requirements, and it is quite unthinkable that the manufacturers were not honestly endeavoring to fulfil the specifications and furnish satisfactory materials.

Among the physical characteristics required were that manganese bronze should have a tensile strength of not less than 65,000 pounds per square inch, an elastic limit of not less than 45 per cent. of the ultimate tensile strength and an elongation of not less than 25 per cent. That rods for brass rivets should have a tensile strength of not less than 55,000 pounds per square inch, an elastic limit of not less than 30,000 pounds, and an elongation not less than 20 per cent. It is known that in brasses the elastic limit or yield point is not well defined and, judging from some experiments recently performed, must under prolonged stress be regarded as the ultimate strength. It was known that apparently sound brass pipes and some kinds of brass wire would occasionally crack without evident reason; but leading manufacturers of brass pipe have discovered how to modify the details of manufacture so as to overcome these troubles in a large measure, and little trouble has been experienced with pipes furnished by reputable manufacturers in recent years. There is, therefore, small excuse for supplying other than dependable brass pipe nowadays.

Experiments carried on by Inspector Jonson of the Catskill aqueduct laboratory demonstrated that improperly cold-worked rods were in a state of initial stress, and that these stresses were frequently of important magnitude, so that in many cases a small or moderate increment of stress, like temperature change or load, would produce failure. By placing round rods in a lathe and removing their exterior surface, accurate measurements showed that the length of the rod gradually increased, demonstrating that the interior metal had been under compression and the exterior surface in tension. Conversely, on boring a good sized core from the inside of rods, the rods shortened, again demonstrating the same condition. From the amount of expansion or contraction in length it was possible to calculate with close approximation the stresses and strains in the material.

Martens and Heyn, German physicists, developed a method for determining the tendency of brass to crack by applying a solution of mercury salt to the surface of a brass rod under initial stress. Cracks would be developed almost instantaneously or in a few minutes in some specimens, while in others the cracks would not become apparent for a number of days. This mercury test has been used by the Board of Water Supply and, while useful, has not proved infallible, some rods which gave negative results under this test subsequently cracking. Moreover, it would be manifestly impracticable to apply this test to the whole surface of every rod of a large shipment, and a more practical test is desired by which one can make sure that brass rods or other articles being purchased or already in place are permanently free from the tendency to crack.

After the discovery of the extensive cracking referred to, it was decided to use plain extruded or hot-rolled rods wherever practicable and to anneal all material which had to be drawn or rolled whole. Unfortunately, this method of manufacture did not avoid further trouble of this kind. Plain extruded, hot-forged and annealed brass rods supposedly free from initial stress have also failed in disturbingly large quantities.

Some experiences and observations indicate that corrosion has much to do with the cracking of brass under some circumstances. Apparently certain kinds of corrosion greatly reduce the cohesion of the affected part of the material, thus destroying the ductility so that cracks develop as soon as the deformation extends to or beyond the yield point. If this conclusion be true, it should be possible to produce season cracking in bars free from appreciable initial stress by stressing them by means of an external force and then corroding the surface. Experiments made in the laboratory of the Board of Water Supply demonstrated that such results were obtained, both strong ammonia and mercury salt solution being used as corroding agents. Tests made indicated that brass, especially when subjected to a tensile strength approaching the yielding point, is liable to inter-granular oxidation which may penetrate indefinitely along certain planes of weakness. This opinion is confined by the appearance of breaks, which indicates that the metal is not torn apart, as in a tensile test, but parts gradually along the boundaries of the grains, which are supposed to be groups of very small and intimately mixed copper, zinc and tin crystals.

The author concludes as follows:

For the designing and constructing, civil and mechanical engineers, the following questions should be satisfactorily answered, if they are to continue the use of these brasses or bronzes for important purposes:

Can a brass or bronze of high tensile strength be reliably produced which can be used safely for important permanent structures in such parts as bolts and other rolled, drawn, extruded or forged shapes?

What should be the specifications for such brasses or bronzes?

What inspection methods and tests should be used?

By what tests can the tendency to subsequent failure be detected at any time after manufacture?

What working stresses may be used safely for these various alloys?

Will these brasses, or bronzes, deteriorate by reason of constantly applied or frequently repeated stress;—*i.e.*, will they fail from fatigue?

DUST IN TOWNS.

By Henry J. Scott.

In an article last week on this subject the writer dealt with the subject of dust as applied to country roads made of macadam, earth, and gravel. Of course, there are numerous roads in towns and cities of this character to which the remarks in that article are applicable. One has to differentiate, however, between the dust of towns and that of the country; firstly, from the fact that the roads in towns are largely composed of a material different to that of country roads, and secondly, the very important factor of public health takes a prominent part. On country roads we can call the dust clean dust and practically its only menace to public health is of what we may call a mechanical nature, since the enhalement of such dust acts as an irritant to the mucous lining of the respiratory organs.

The dust of crowded cities and towns, however, is a menace of a very different character. It is saturated with the germs of every prevalent disease and the breathing of such into the lungs is liable to affect persons who are in such a state of health as to be susceptible to them.

The dust problem to the country road superintendent means mainly disintegration of the roads under his charge and secondarily the convenience of the travelling public. But to the town and city engineer, to the street cleaning departments and to the medical officers of health, dust means the convenience and the health of the public, as well as the maintenance of good roads. We are indebted to Louis Pasteur and Lord Lister for much of our present knowledge concerning the malevolent influence of dust on the human system, both directly by inhalation and indirectly by its effect on articles for food consumption exposed to it. A genial medical friend of the writer's, who has been in practice many years in New York, quotes in favor of his arguments about fresh air that the mortality among the road sweepers in New York City is higher in proportion than that of any other class in the community, in spite of the fact that they live in the open air all day. Without advancing his own argument, my friend supplies the strongest possible case against dust, if such were required.

The problem before us is to find the best method for guarding the safety of the public from this danger. It must often strike anyone as wonderful where the dust comes from in a street laid with asphalt or any of the non-dust making materials now used. The fact remains, however, that it is there and in its worst and most concentrated form, so to speak, from the very fact that none of it comes from the disintegration of the road material but from more unhealthy causes.

The methods for solving this problem at the present time are beyond all doubt crude in the extreme, both in inception and practice. They are as follows: Hand sweepers, mechanical brushes and the universal watering cart.

The hand sweeper is perhaps better from the health point of view of the public than the mechanical brush as usually operated, though very unhealthy for the road sweepers. The usual method of operating these is to send them up and down a dry street, certainly collecting some of the heavy dust but dissipating clouds into the atmosphere.

There are several varieties for watering carts, varying from the small hand cart to the large sprinklers and flushers that operate on the car lines. The most familiar form is the horse-drawn cart. While not detracting from the merits of the method, it must be admitted that there is much to be desired in their efficiency. The lighter dust lying on a road surface is disturbed and dissipated into the atmosphere by them, as can be readily seen by the cloud of dust accompanying their passage. This is especially noticeable with the large trolley-driven ones, which, as we see them in action on a dusty road, are the vortex of a cloud of dust. This dust is the direct result of the impact of the numerous jets of water. The sprinklers wash the streets to a considerable extent but they dissipate the lighter dust into the atmosphere and it settles again in due course—it may be on some article of food, it may be drawn into someone's lungs, or perhaps it comes to rest once more on the street.

The injurious organisms in dust which are so inimical to health are of two kinds—animal and vegetable. Both are well represented in street dust. The dust remaining on a watered road makes an excellent breeding bed for these germs and here they increase only to be dissipated once more into the atmosphere with the assistance of the machine brush or the jets of the watering cart. While it is now an accepted fact that dust is so deleterious both to food and health it is not so generally known that the vegetable micro-organisms in atmospheric dust are as a rule very light and float about in lightest dust. Disease microbes are of a heavier nature and are to be found in the lower strata of dust.

The mechanical sweeper and the watering cart do harm in stirring up this dust and dissipating it in the atmosphere. The action of the former in doing this is obvious, while that of the latter is due to the fact that the lighter dust is not caught by such jets as are ejected by the sprinklers. Some of it can be seen floating on the top of the water in the gutters while some of it is dissipated into the atmosphere. Fine dust, like most powdered material, does not assimilate easily with water in bulk.

The writer has had considerable experience in combating dust in many industrial processes, and has found that following the law of nature is the only way to catch the minute particles of dust with water as the agent. In nature, the minute particles of moisture in the atmosphere are attracted to the particles of dust in the air when the atmosphere becomes saturated with moisture. Thus the dust is the nucleus for condensation and every rain-drop is the result. By the same process of reasoning watering carts should emit fine spray as well as jets of water, in order to make the fine dust settle and not be dissipated into the air. There are numerous mechanical difficulties attached to obtaining this fine spray but these can and should be overcome in the interests of the public health. The ideal watering cart should be the vortex of a saturated atmosphere. Enough water should be discharged in its passage over the road to moisten and deposit the finer dust in the surrounding atmosphere as well as that lying on the surface of the road. It should also, to a great extent, wash it down the drains.

Mechanical brushes should only be operated after the passage of a watering cart. Imperfect watering appliances, uneven surfaces of roads, and want of good judgment in the use of mechanical brushes militate most strongly in perpetuating the dust menace to public health.

Now, as the agitation against dust and microbes is gaining ground, we may hope to see rapid improvements made in the appliances and the treatment of this important detail so necessary to our comfort and our health.

LIME CONCRETE IN THE EAST.*

STONE LIME of great purity, and consequently non-hydraulic, is used largely in India and Burma, and engineers have learned to place considerable confidence in the material. To enable it to set under water, it is mixed with "Soorkhee," a finely powdered red brick. To the present day, engineers in India do not know exactly how much soorkhee is required by each kind of lime, and this ignorance is due to the want of scientific laboratory tests, of the kind so frequently made in Europe. It seems no advantage to send lime and soorkhee to England to be tested, since the difference in climate, the sea voyage, and the lapse of time in transit might vitiate the results. Conservative Indian opinion, based on long experience, approves of a mixture of a half part of under-burnt with a half part of well-burnt soorkhee to one part of slaked lime and one part of sharp, clean sand, all measured in bulk, dry. The materials are thoroughly incorporated and ground in a mortar-mill, either under one wheel pulled round a circular track by a bullock, or in a pan-machine under a pair of wheels. The mortar should be a thick reddish paste, in which the particles of lime cannot be distinguished by the naked eye. A mortar made in this way sets very well indeed in still water, but it sets comparatively slowly, and some engineers add, when necessary, a proportion of Portland cement to the mixture. The introduction markedly hastens the setting to an extent depending on the proportion of the cement to lime. One part cement to one part lime by volume sets apparently as quickly as cement mortar. In the early stages of setting the strength of the concrete is much increased, admitting of early handling and removal of moulding boards. The addition of cement preserves soorkhee mortar in wet foundations from the evils of percolation, and the cement, besides, seems to have a chemical effect on the lime, fixing the particles and aiding in a more solid set.

First-class soorkhee mortar, several centuries old, it has been asserted, exceeds Portland cement mortar, 1 to 3, in strength and impermeability, and is said to be often equal to 1 to 2½.

* From a paper by E. A. W. Phillips, M.Inst.C.E., before the Concrete Institute (Great Britain) May 20, 1915.

The $121,000 dyke, that is being constructed by Tomlinson and Fleming for the Greater Winnipeg Water District at Indian Bay, is about completed.

It is stated that there is a potential value of $3,600,000,000 in metallic minerals alone in British Columbia that could be recovered in a comparatively short time. The coal resources of the province are estimated by the same statistician at 7,600,000,000 tons of a value of $216,000,000,000. The mines of British Columbia of all classes have to date paid $25,000,000 in dividends and in profits not distributed as dividends.

SEWER DISCHARGE DIAGRAMS.

In *The Canadian Engineer* of the 5th June, 1913, there appeared a sewer diagram drawn by Mr. J. M. M. Greig, A.M.I.C.E. We have just received from Mr. Greig the accompanying diagrams, which have been worked out by Mr. William Lockhart, A.M.I.C.E., on the same principle as the original one. The formula was:—

Discharge in cu. ft. per sec. $= A.C.\sqrt{R}.\ \sqrt{S}$

where A = sectional area.

C = Kutter's coefficient for different values of $\sqrt{R}$ and N. (Taken from "Wollheims Sewerage Note Book".)

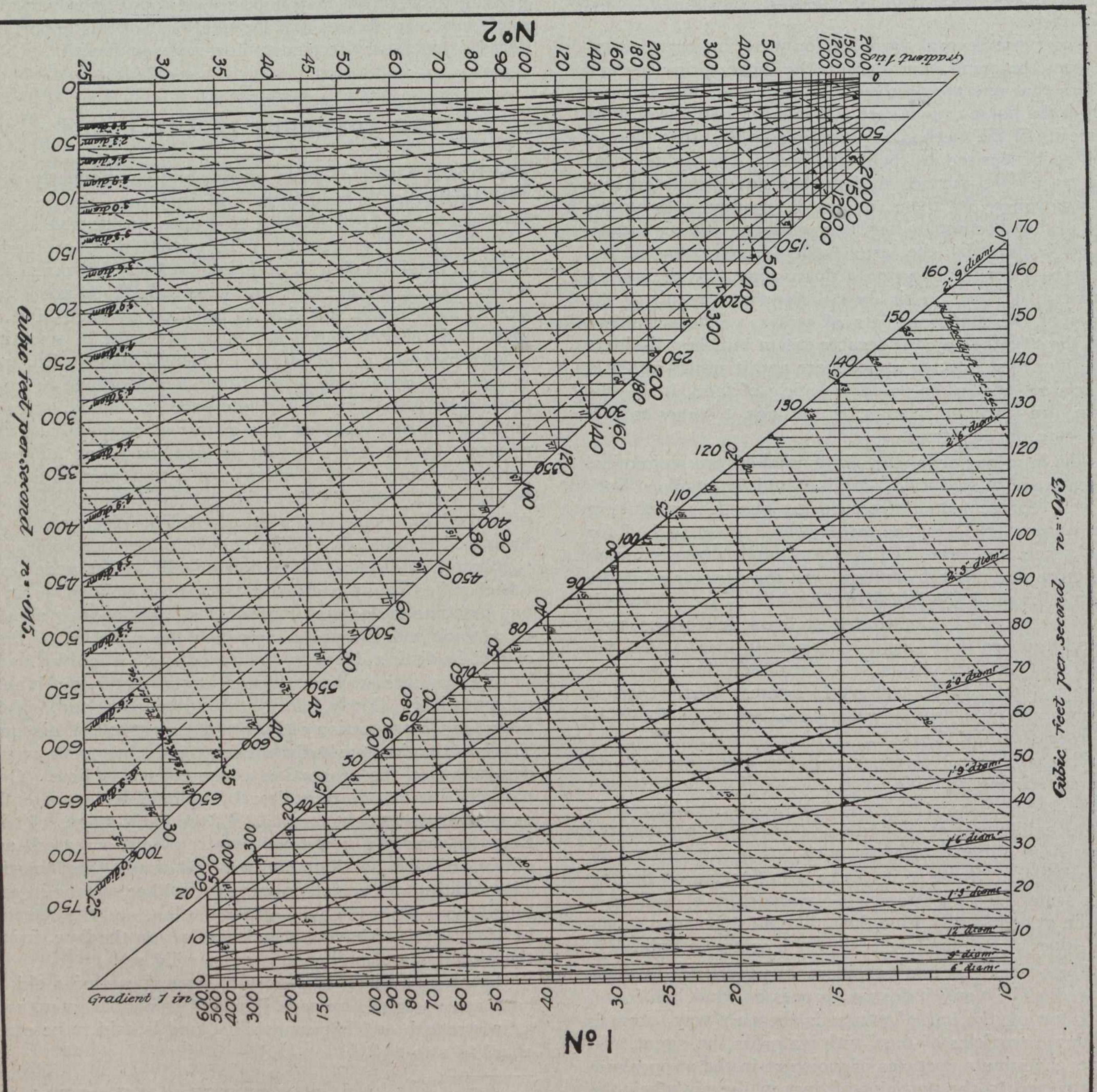
R = area of cross-section divided by wetted perimeter.

S = slope.

N = coefficient of friction.

Diagram No. 1 gives discharge and velocity for pipes from 6 inches diameter up to two feet nine inches diameter flowing full and it is used as follows:

Required: Velocity and discharge of a 2′ 0″ diameter pipe at a gradient of one in twenty. Follow the slope line marked 2′ 0″ diameter until it intersects the vertical line 20. The horizontal line from this point shows



50 cubic feet per second as the discharge and the curved line gives 16 as the velocity in feet per second.

The diagrams marked 12-inch pipe, etc., are to be used in exactly the same way as the others, but the slope lines bearing figures such as 7″, 8″, etc., if followed out will give discharge and velocity, for the particular pipe in question, flowing 7″ or 8″ deep, etc.

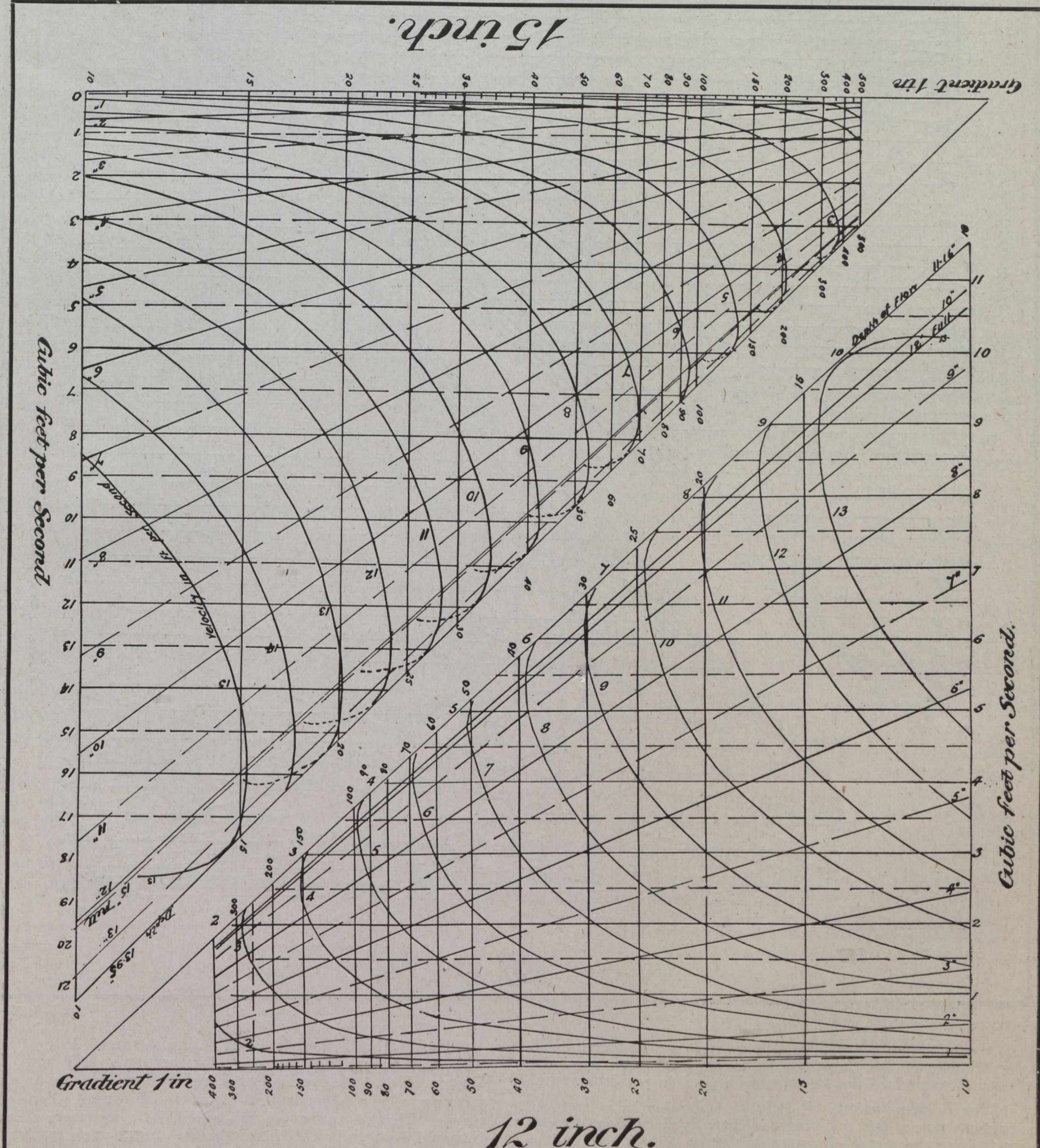
To construct one of these diagrams it was necessary to go through the following process: The spacing for the gradients 1 in 25, 1 in 100, 1 in 400, and so on, was obtained by finding the square root of the reciprocal of these numbers, thus: 1 in 25 = 0.04 and $\sqrt{0.04} = 0.2$, 1 in 100 = .01 $\sqrt{0.01} = 0.1$.

Starting with the origin at the left hand a vertical line was erected at a distance corresponding to each particular gradient and thus a scale of gradients was plotted which could be used for any of the diagrams. The values of $A.C. \sqrt{R}\sqrt{S}$ for each size of sewer were worked out for a gradient of 1 in 100 and these values marked off on a vertical line at 1 in 100 to a suitable scale.

The points for each sewer were then joined to the origin and extended into the quicker gradients to the right.

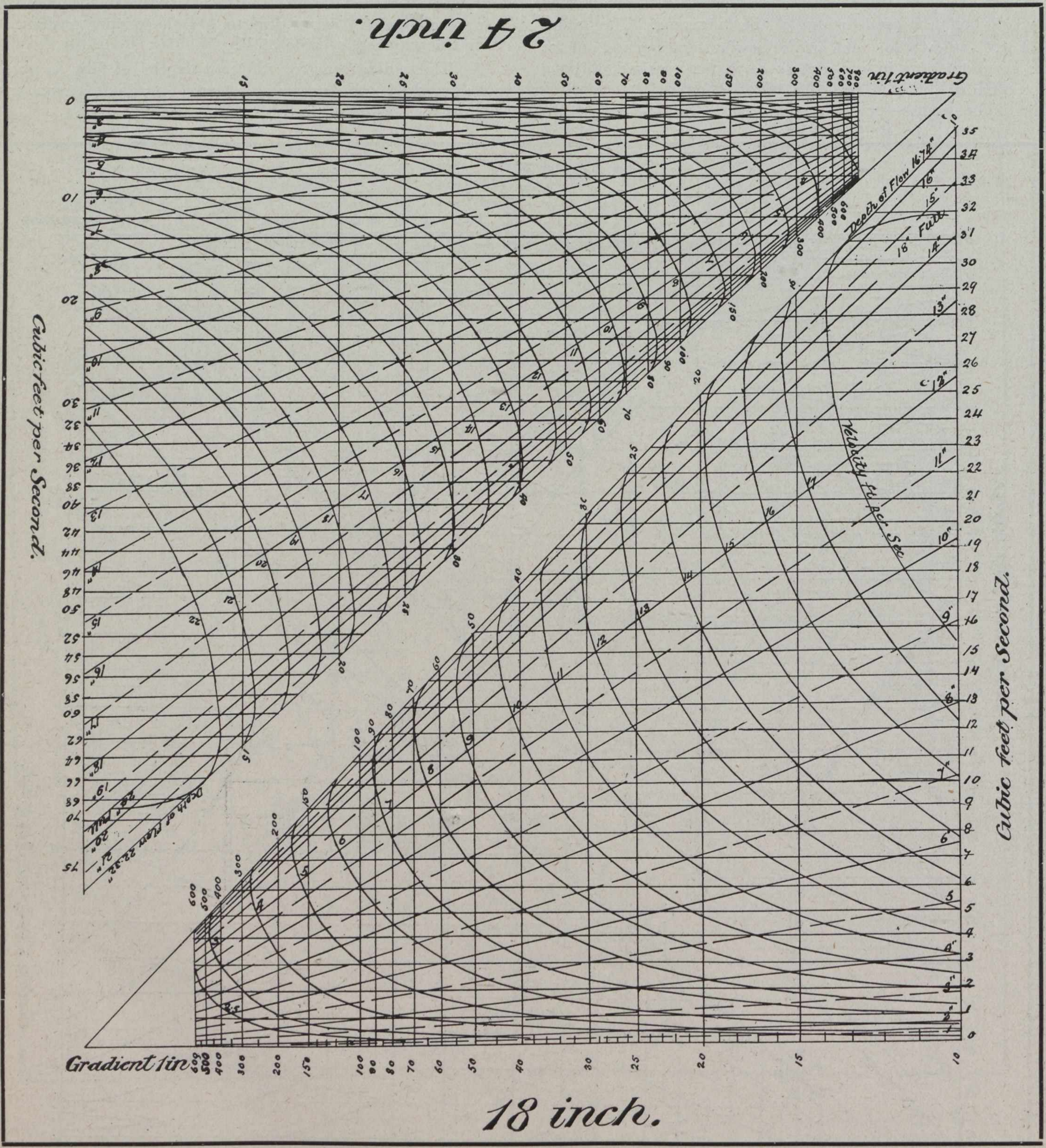
A considerable amount of work was entailed in arriving at the values $A.C. \sqrt{R}$ for the different depths of flow in the pipes as, of course, it was necessary to find the area, and wetted perimeter, of each segment of the circle for each inch in depth and to get the proper coefficient for this particular value of R.

These diagrams for different depths of flow in pipes are worked out for much steeper gradients than are usually to be found in tables of discharge.



It is well in laying pipes at very steep gradients to allow a margin in capacity, for with these sharp velocities some irregularities in the pipes may cause considerable reduction in the discharge.

In gauging the flow of existing pipes or in estimating the velocity of small dry-weather flows in pipes designed to carry combined storm and sewage flow these diagrams should prove useful.



A new 60-foot concrete road has been constructed through the Midway of the Canadian National Exhibition grounds, Toronto, to replace the sawdust walk used in previous years.

The copper output of British Columbia is at present about 50,000,000 lbs. per year and there is about $100,000,000 invested in the mines, the greater portion of which is United States capital.

The National Paving Brick Manufacturers' Association will hold its annual meeting, October 11th and 12th, at Dayton, Ohio. During this week also will be held the annual meeting of the American Society of Municipal Improvements. This arrangement will enable the members of the National Paving Brick Manufacturers' Association to attend the meeting of the American Society.

WHAT CONSTITUTES A COMPLETED JOB OF ROAD WORK.*

By A. McGillivray,
Highway Commissioner for Manitoba.

IT would be a source of profoundest gratification indeed to road builders, municipal men and ratepayers alike, if at some time in the history of a road, it would be possible to say that it was completed and that no more attention need be given it. This is an ideal condition in the life of a road that cannot be hoped to be attained. However, there are certain factors that enter into the building of a road that can be settled definitely and remain permanent fixtures therein.

The first point that should be settled before actual construction begins, is the location of the road. This is determined by its relative position in the district to be served, the comparative cost of construction with other locations and its general suitability to the purpose intended. The allowances set apart for road purposes in the prairie provinces of Canada are defined in the original survey of the country into its legal subdivisions, and follow the boundary lines of the sections. This in itself, while providing a right-of-way for road purposes at regular intervals throughout the country, often proves a source of extra engineering difficulties and expense when they are being transformed into travelled ways. The lines of demarcation of the townships and sections are run in set directions—north and south, and east and west—regardless of the topography or physical feature of the country. The efforts of the highway engineer, in so far as selecting the most suitable location for a road are, therefore, very much circumscribed and limited by having to accept the allowance thus provided for that purpose.

The alignment of the road should receive careful attention when construction work is being undertaken and improvements are being performed.

Whether the right-of-way selected be a government road allowance or a diversion therefrom, which latter course in some instances is absolutely necessary in order to avoid large bodies of water or hills which could only be crossed by following a straight course at prohibitive gradients or unwarranted costs, the centre line of the road-way should be fixed and the proposed improvement made about it so that where subsequent improvements or alterations in standard of road are found desirable, they may be made without disturbing work previously done.

It is customary, when laying out road work in Manitoba, for the engineer to make the centre line of the roadway coincide with the centre line of the road allowance, and unless there be good and sufficient reasons present in a given case for deviating from this by placing the travelled road in some other relative position on the allowance, this rule should be strictly adhered to. The point to be emphasized in this connection is, that the finished roadway, the necessary drains, culverts and bridges should conform to such well defined lines and courses that their positions on the road allowance may become, practically, permanent fixtures. It might be here stated that the width of roadway on rural main roads should be 18 feet. This width should be increased at the approach of towns and cities, to 20 and 24 feet, depending altogether on the amount of traffic to be accommodated. The inside lines of the ditches should be parallel with the centre line of the roadway, and not closer than 14 feet thereto. This arrangement will give a stretch of ground twenty-eight feet in width upon which to construct the roadway. The slopes of embankments and cutting, except in rock, should have at the least, a slope of one foot and one-half horizontal measurement to one foot vertical.

Another very important feature in connection with the building of a road is the determining of the profile which the surface of the finished roadway should assume. This is accomplished by a study of the profile of the natural surface of the ground to be traversed, and by so altering the same by means of embankments over stretches of comparatively level country, or by cutting down hills and elevating the intervening depressions where the surface of the country is rolling or broken, until a finished profile suitable to the nature and conditions of the soil met with is obtained. It is largely a matter of judgment based on knowledge gained from experience that enables an engineer to determine the proper height of fill which should be constructed across a certain stretch of country or the depth of cutting that should be made through a ridge. No set standard can be fixed to meet the varying conditions met with. If the land is low and flat and is liable to be affected by the accumulation of water in times of freshets, the embankment will necessarily have to be higher than over land where drainage is more easily effected. Where the country is very rolling and the profile a series of ridges and depressions, an excellent road can be made by cutting the ridges and filling in the depressions, and a grade line so established that the amount of excavated material from the ridges and the amount of the material in the embankment would balance. Again, there may be met with tracts of country where the soil is light, and natural drainage good, where the surface of the ground may be but little disturbed to provide a splendid roadway.

It is when building a road over a steep hill or across deep ravines, or across valleys of some of the larger rivers in this country, where the determining of a proper profile for a road requires consideration and thought. The maximum gradient which might be permitted on a main highway is six per cent. or a rise of six feet in every one hundred feet horizontal measurement. A much less gradient should be first sought and the maximum aforementioned only adopted when the engineer's difficulties encountered are of such a character that the cost of securing any substantial reduction might be considered prohibitive or unjustifiable.

The gradient of a hill may be reduced by increasing the depth of the summit cutting or by increasing the length of the road. The latter method is preferable. Deep cuttings are objectionable especially as in the winter seasons unless protected by snow fences they are liable to drift full of snow and cause blockades on the road. While it is almost impossible to entirely avoid them in rough mountainous regions, still, in endeavoring to reduce the gradient, distance should be increased by following the most practical course open along the slope of the hill until the bottom is reached, where the direction may be corrected on the flats below.

The bad effects of the steepness of hills are especially felt in the winter, when the ice covers the road, because the slippery surface causes danger in descending, as well as increased labor in ascending. If a hill has to be ascended, the road up it should nowhere have the smallest descent for that would make two hills instead of one. It should be so located, and have such cuttings and fillings, as will secure a gradual and uninterrupted ascent the whole way. In this respect engineering skill can make

* Read at the Manitoba Good Roads Congress during the week of March 1st, 1915.

wonderful improvements and will assist wonderfully in selecting the best possible location for the road.

No job of road construction can be considered completed that does not provide adequate drainage facilities. By this is meant the construction of the necessary surface drains, or underground system of tile drains, and the placing of all culverts required in connection therewith, so as to permit the escape of all water which may accumulate along the road.

The cross-section of the road should be so shaped that water will not lie upon its surface, but will have free and uninterrupted access to the gutters or side drains. This is a very essential factor in the life of a road. The construction and preservation of a properly shaped cross-section adds to the comforts and conveniences of travel upon it and lengthens the life and usefulness of the road to an inestimable extent.

The cross-section of an earth road will require a greater rise at the centre than a hard surface road but care should be taken not to make this excessive because it will have the effect of concentrating the traffic at the centre—that being the only part of the road where a vehicle can retain an upright position and thereby cause ruts to be formed which will prevent the rain water falling on the surface to escape to the side gutters: very much to the injury of the road. The rise given to the crown of a road should bear a certain proportion to the width of the roadway. For earth and gravel roads this rise should be about one twenty-fourth of the width of the road surface. Macadam roads do not require this amount and possibly about one-fortieth of the width would be sufficient. On asphalt, brick, creosoted wood block or other surface, the rise may be reduced still more.

Upon the foundation depends the permanency and stability of any road whether it be the common earth road or the highest class of pavement. If the foundation is weak and faulty the surface will soon become broken and impassable. The character of the natural soil over which the roadway is to pass has an important bearing on the forming and kind of foundation. But whatever be the character of the soil, it must be kept dry. Sands and gravel which do not hold water present no great difficulties in securing a solid foundation. It is with clays and soils of retentive nature where the greatest difficulties are encountered.

The essentials necessary to forming a good foundation are:—

(1) The entire removal of all perishable or yielding material.

(2) The drainage of the sub-soil wherever necessary.

(3) The compaction of the natural soil by a roller of proper weight and shape.

Where the traffic demands a more substantial and unyielding foundation than the natural soil will afford, a fourth essential may become necessary, as the placing upon the natural soil compacted as aforementioned, a sufficient thickness of hard durable material such as rock or concrete.

It is the foundation of a road alone, where even relative permanency is possible to be secured, and this can only be accomplished by exercising the greatest care in forming it and afterwards protecting it from the destroying actions of traffic and the elements by a suitable wearing surface.

This wearing surface may consist of a coating of gravel, macadam, asphalt, or other pavement that will act as a protection to the foundation. Upon it comes the inevitable wear and tear of traffic and in a well designed and constructed road this should be the only portion requiring repairs or replacement so long as the original design of the road remains suitable for the traffic upon it or capable of withstanding any extra traffic that it may through time be exposed to.

A completed job of road work should include permanence of location, adequate drainage facilities, foundations and surface covering compatible with the demands of traffic upon it so that transportation and intercommunication can be carried on with safety to the public with the least possible inconvenience and the lowest possible cost.

IMPORTANT BLASTING POINTERS.

In loading any kind of a borehole, the Du Pont Magazine advises contractors to insist on the blaster cleaning the hole to the bottom. All sludge and mud from the drills should be pumped or blown out. Air spaces anywhere in the blast hole also cut down greatly the work done by the explosive. A blaster who is not careful to fill all the air spaces is liable to be an expensive man to his employers.

In loading dynamite cartridges, where it is necessary to fill air spaces, each cartridge should be slit lengthwise with a knife once. One cut is as effective as two or three when the tamping stick is pressed against the cartridge, and the powder is not smeared along the sides of the borehole as much as when the cartridge is slit a number of times.

In loading very deep well-drill holes, it is always advisable to place a primer with an electric blasting cap every 15 feet in the load. This is not only insurance against expensive misfires, but makes for more perfect detonation of the entire charge, greater efficiency and increased economy. Remember, however, that a blasting machine is limited as to the number of electric blasting caps that it will fire, and do not overload it.

In loading "lifters," or holes drilled horizontally, or nearly so, and especially when they are "sprung," it is a very good idea to have a loading tube, made of zinc or galvanized iron, as large as will go into the hole, and then load the explosive through this, withdrawing it as the charge rises. Where the loading tube is not used, a bamboo fishing-pole makes an effective loading stick, as the small end can be used as a needle on which one cartridge at a time may be stuck, placed in the bottom of the hole, and shaken off. The pole is then reversed and the charge packed in carefully with the large end. Bamboo tamping sticks have the advantage of being very light, straight and inexpensive. The blaster can load many more holes with a bamboo stick without getting tired than he can with a heavy oak, hickory or other hardwood stick, and in addition, it is safer to have a light tamping stick than one with which the blaster can strike the explosive a heavy blow.

Sand imported from Europe is being used in construction of the new subways in New York City. This is not because suitable sand cannot be obtained in the vicinity, but because the war in Europe has cut down the cargoes which steamships ordinarily bring from the other side of the Atlantic to such an extent that it is necessary for many ships to come over in ballast. They have been using beach sand as ballast. Upon arriving in New York this ballast is discharged to make room for the returning cargoes and is practically given away by the steamship company to anyone who will haul it away and dispose of it.

WATER STORAGE ON SURFACE AND UNDERGROUND IN AUSTRALIA.*

FEW people realize what immense stores of water are always latent in the surface of the subsoils. Approximately it may be assumed that the voids in sands and gravels average forty per cent. of their total volume. Assuming on the average only half this quantity in the upper seven feet, and the surface evaporation to abstract during the summer the equivalent of the contents of the upper two feet, then the effective storage of this surface crust is equivalent to one acre foot per acre. Such vegetation as can tap this reservoir is drought-resisting. At the same time it must not be assumed that all soils, or even a small proportion of soils, are saturated to within two feet of the surface, or that soils so saturated will sustain vegetation. On the contrary, such soils as are completely saturated to this level are fatal to most forms of vegetation. What does happen, is that the moisture, which is assumed here as half what would suffice to completely saturate the subsoil, is in a state of continual circulation; a portion, when the surface is drying under summer heats and dry winds, rising to supply the loss, while the great bulk is continually passing down towards the bedrock, and the soil, in a sponge-like state, contains also quantities of air. The storage in the porosity of the lower rock gradually finds its way by fissures to the surface or the deeps below sea-level. The quantity of water so held in suspension varies from the limestones and sandstones, where it may reach to, perhaps, fifty per cent. of the total volume down to less than one per cent. in the more compact igneous rocks. It has been assumed that there is less loss by this seepage in Australasia than the average in other countries. The run-off of our rivers, where recorded, hardly bears out this view, and the very large area of forests in the Australasian coastal lands certainly should help to feed the underground waters. The factors which make for penetration of water to the depths are chiefly those which retain the moisture longest on the surface, so that it has time to soak in, and, of course, the absence of stiff clays between the surface and the bed rocks.

Of these factors, all the forestry exponents claim that the forests give the best ground water spring flows, while the majority of engineers seem to regard the effect of forests on run-off as negligible. The views held on both sides have been so forcibly put, and are so conflicting, that a brief consideration here may not be out of place.

The engineers, while admitting that forest denudation is invariably followed by the scouring out of ravines and gulches by the storm-water, where formerly little or no water channels existed, and the consequent necessity to enlarge the smaller culverts on roads and railways, yet point out that the maximum flood records on the large streams and rivers are usually found in the periods before the forests have been denuded, and gather from this that forests have practically no effect in moderating floods, and consequently in conserving water to be given off in the drought seasons. They point to the fact that the areas which give the best drought flows are the bare mountain sides, where the snow lies in deep drifts, and persists almost throughout the whole summer. The regions within the perpetual snow-line do not come within the consideration of Australian engineers, and in any case, owing to the great evaporation at those high levels, where surface tension is low, the flow-off is seldom so great as from such elevations as are found in the Dividing Range in Victoria and New South Wales from, say, 2,000 to 7,000 feet above sea level. Such a range is much more favorable to a moist climate than the Rockies, or other snow-clad mountains, where the coastal winds are effectually dried of their moisture before reaching the continental side. In our case, then, the conflicting theories of the engineers and the foresters are easier of solution. Here we have mountains thickly covered with forests, and having practically the same rainfall as mountains where there is less timber and more snow-drifts, and yet the former give the better summer run-off.

Briefly, the snows that fall in timber country are evenly spread, and lie melting for a sufficient time to give off most of the snow-water to the ground beneath, while in the bare, rocky country a vast quantity of the snow disappears by evaporation direct into the atmosphere. Then, too, the efficiency of forests as breakwinds will have a most remarkable effect in keeping the surface of the ground moist long after it has dried off on the cleared lands. It is perfectly true that trees abstract an immense amount of moisture from the soil, which is continually rising in the summer as sap, and gets dissipated by evaporation from the leaves. To this even more than the shade must be attributed the cool temperature of forests in the summer. In the primæval forests in Gippsland of a summer morning, an hour or two after sunrise, a beautiful effect is often seen. The trees up to 80 or 100 feet from the ground are practically bare trunks; at that level they spread out, and are well covered with leaves. These leaves catch the moist air rising from the ground—the dew that has just evaporated—and hold it half condensed again in the shape of a horizontal gossamer wreath of beautiful white cloud. This illustrates one of the most marked benefits of the forest country. Whatever else its effects may be on winter rains or on torrential equinoctial rains, there can be no doubt but that they are a most effective condenser to catch and hold summer rains.

This can any summer be noticed on the range from Healesville to Baw Baw, the Yarra watershed of which has been marked off for Melbourne's water supply. Here a repeated experience is to find frequent showers above the 1,500 foot level often sufficiently heavy to even influence ground flow during summer months, when below that level on the cleared lands there has been no rainfall.

If these forest ranges are not conserved for water supply, and if the irrigationists work on the lower Goulburn only, then in process of time the fruitgrowers will find that it is cheaper to clear the rich forest lands, where there is sufficient natural rainfall, to save their charges of 10s. an acre foot for irrigation, and so the fruitgrowing areas in the upper Goulburn, in spite of the cooler climate, will ultimately outvie those in the irrigation areas, with the consequent result that the forests will, before the pressure of population, be infringed, and gradually denuded to the ultimate heavy damage of the whole country.

There can be little doubt but that much of the desolation which swept away the irrigation works in North Africa and in Asia Minor came from similar causes to this. The solution to this difficulty is met by the modern method of appropriating all the mountain valleys for

* From a paper on "Water Storage" read before the Victorian Institute of Engineers, Melbourne, by Mr. J. T. N. Anderson, Past-president.

reservoir sites. Then not only will it be unprofitable to use the forests for anything except regulated saw-milling, but the climate will be so far chilled that there will be little temptation to embark on agriculture or dairying. Without such preventives it is hardly possible that these forests will long stand before the pressure of increasing population, and popular clamor to get on the good lands.

One word more on ground waters. It has been remarked that the proportion of rainfall that finds its way into our rivers points to the fact that there is a very considerable proportion of ground water in Australia. In most countries at the same latitude, or rather with similar isothermals, spring water of a perennial character is found within five hundred feet lower elevation than the top of the range feeding it. Here in the part of the country mentioned, forming the watershed of the Goulburn and the Yarra, exactly the same is found, and at the higher elevation, say, 4,000 feet and upwards, where barometric pressures are lighter, and the atmosphere is cooler, with frequent rains, these perennial springs are found close to the summit. Elsewhere in Victoria, unless the slope of the range be very flat, indeed, such springs are in existence, but do not come to the surface. This continent, being almost the oldest in the world since its formative eruptions, has a greater depth of alluvial and aerial deposits than are found elsewhere, and hidden in the gravels and sands of these are the springs which in other climates would be running on the surface. It is only necessary to quote the Ballarat and Maryborough, or the Rutherglen alluvial fields, to satisfy the enquirer on this point, and elsewhere in Australia, not only stock and domestic uses are served from our wells, but they also supply water for irrigation.

The future will see far more use made of such ground storages than the past, when it becomes realized that if a horse-power cost one penny an hour, sufficient water to irrigate one acre one foot deep can be raised from fifty feet at a cost of only 4s. 2d., or less than any of our irrigation trusts charge per acre foot for water from their gravitation channels. The trouble that the bulk of our ground storages contain too much alkali is one which often corrects itself with constant pumping.

The author is aware that in passing over the question of natural surface storage he has neglected what is, perhaps, the most important of all the aspects of the water storage question. Its bearing on irrigation, as well as water supply questions, is too important and too complicated to be adequately dealt with in a general paper on water storage. But there is one aspect of the question too prone to be lost sight of, namely, the effect on the health of the community of the large shallow basins. In the mountains, and surrounded by eucalypt forests, no evil effect need be feared. But shallow surface basins in irrigated areas, with the consequent hot, moist summer atmosphere, and the sanitation of an agricultural or horticultural community, are veritable fever beds.

In view of the fact that so many of our Canadian soldiers are fighting on the battlefield of Flanders, the model military camp which will be one of the special features at the Canadian National Exhibition this year, will attract great interest. In this camp will be quartered a detachment of the Royal Canadian Dragoons, artillery, Royal Canadian Engineers, Royal Canadian Regiment, as well as machine guns and armored cars. The work of the A.M.C. Transportation Corps, A.S.C. and field kitchen will be an interesting feature. The camp will vividly portray life under active service conditions, showing trench digging and landing of hydroplanes.

USE OF THE ROAD DRAG IN MAINTAINING EARTH ROAD.*

By S. R. Henderson,
President Manitoba Good Roads Association.

It does not matter how well drained and graded an earth road may be, if the maintenance is neglected, a large amount of the money expended on construction will be lost, and the benefit will not be derived by the taxpayers for the amount invested. The earth road is by far the most common type of highway in this country. Its cheapness in comparison with other types of construction, and the absence in many sections of our country of stone, gravel and other hard materials for road building will render its use necessary for many years to come.

The split-log drag is of great service on roads of this class. It is now coming into general use in Manitoba, and its adoption in most localities where there are earth roads will doubtless increase the construction and use of the drag. Two mistakes are commonly made in constructing the drag. The first lies in making it too heavy; it should be so light that one man can easily lift it, besides a light drag responds more easily to various methods of pitching and to the shifting and weight of the operator, both of which are essential considerations. A drag can be made heavier at any time by proper weighting.

The other mistake is the use of square timbers instead of those with sharp edges, whereby the cutting effect of the sharp edges is lost, and the drag will glide over instead of levelling the irregularities on the surface of the road. These mistakes are made because of badly constructed drags and also the wrong idea that a large amount of dirt must be moved at one time.

To construct a drag is almost more simple than to describe it, for the implement is simplicity itself. A log from 5 to 8 feet long and 8 to 12 inches in diameter is split in half. The halves are placed parallel to one another, the edges down and the flat face to the front. They are firmly braced together with three cross bars wedged into holes bored through the logs. A chain hitch is attached in such a manner as to incline the drag to the desired angle—about 45 degrees, the forward corner being at the outer edge of the road and the rear corner at the centre. By dragging this implement up one side of the road and down the other, making a number of circuits and using two horses, the edges of the log plane off the top of ridges and rough places, drawing the material sideways and forward to fill hollows and ruts. This drag used a few times during the season on an earth road while the earth is in a moist condition after a rain, will keep an earth road in the best condition that an earth road can be made to reach.

Drags are often constructed of planks instead of logs. There is nothing in the construction of a plank drag that calls for special mention except the strengthening of the planks along their middle by a 2 by 6-inch strip and a strip of iron about four feet long and four inches wide; quarter-inch thick may be used for the blade. This should be attached to the front slab or plank so that it will be one-half inch below the lower edge of the plank at the ditch end, while the end of the iron toward the middle of the road should be flush with the edge of the plank. The bolts holding the blade in place should have flat heads, and

*From paper read at the Good Roads Congress, Agricultural College, Manitoba.

the holes to receive them should be countersunk. Many construct them with the blade full length of the plank. A platform of inch-boards held together by three cleats should be placed on the bars between the slabs.

The successful operation of a drag involves two principles which, when thoroughly understood and intelligently applied, makes road maintenance with this implement very simple. The first concerns the length and position of the hitch, while the second deals with the position of the driver on the drag. Each influences the other to a large extent, and a successful use of the drag is dependent upon an understanding of both of them. The distance from the drag at which the team is hitched affects the depth of the cutting. If your roadway is very badly rutted and full of holes it may be well to use the drag when the ground is slushy. Clay, when mixed with water and thoroughly worked, becomes remarkably tough and impervious to water. If compacted in this condition it becomes remarkably hard.

Another valuable result of dragging is the reduction of dust. If the surface is smoothed after each rain and the road dries hard and even, no edges are exposed to crushing, and the only dust which forms is that due to actual wear of the road surface. Conditions are so varied in different localities that it is quite impossible to lay down a general rule for the number of treatments needed to keep a road in good condition. For instance, a tough clay will resist the action of traffic for a longer period than a loam. Certain sections of a roadway will require more attention than others, because of steep grades or flat grades. The best guide for meeting these conditions is the knowledge and experience gained while dragging the roadway. There is one condition in which special treatment should be given—grades with persistent dragging becomes too high in the centre. To correct this it may be advisable to drag the earth away from the centre occasionally. Some of the advantages to be gained from the persistent use of the road drag are as follows: The maintenance of serviceable earth roads free from ruts and obtaining these conditions with expenditure of very little money, in comparison with money and labor required for other methods, and the reduction of mud in wet weather and of dust in dry weather. No municipality should be without a number of drags, so that they may be applied to their work on the roads whenever they are needed. It requires a little study of the nature of the ground and a little experience to determine the best time to use a drag after a rain storm. The shoulders along the side of the road should not be permitted to project above the general surface of the road, for they will prevent the water getting into the side drain, so that they should be cut down and made to conform to the road surface.

The berms, if any, between the grade and side ditches, should be kept smooth and free from weeds, brush or litter of any kind, so as not to interrupt the flow of water in the side ditches, water being the great enemy and destroyer of the earth road and good drainage the only remedy for it; that is to see that all water escapes from the foundation of the road through side ditches, culverts and outlets.

The split-log drag has come to stay; it will come more quickly if the men who actually work on the roads will investigate the claims of the split-log drags, and use them instead of graders for the maintenance of our roads. They will find that the drag and two horses will do more work, better work and so much cheaper work than the grader with four to eight horses and two to four men.

AIR SEASONING OF RAILWAY CROSS TIES.*

By A. H. Noyes.

THE successful handling of softwoods, particularly beech and gum, is a matter that is worthy of serious consideration. The ever-increasing shortage of oak timber of all species makes the adoption of softwoods a necessity, but the character of softwood timber requires careful handling to insure the delivery of sound timber to the treating plant, and thereby a serviceable tie to the consuming road.

Throughout the central section of the United States, and more particularly that part known as a tie-producing region, there is probably a larger acreage of beech and gum than any other tie material, pine excepted; beech being common in most of the bottoms and gum in the low lands, Missouri and Arkansas having thousands of acres of gum that will eventually come in for tie purposes.

Owing to the structure of the timber, beech ties are nearly always sawed, beech timber being too hard to hew, and on seasoning, get rough or scaly. On the other hand, gum timber hews easily and makes a smooth, pretty tie.

When gum or beech ties are produced tributary to a railroad, it is advisable that they be shipped into the treating plant as promptly as possible, after being made, and seasoned at the plant in preference to seasoning on the line of the road, as, in this event, the ties can be stacked for seasoning under more satisfactory conditions, and can be loaded for treatment at the proper time; in fact, the entire process kept under more complete supervision and control, than under other conditions and in this manner avoid the possibility of damaged timber reaching the treating plant.

It is an accepted fact that all ties, softwood ties especially, should be carefully piled, never on the ground, but on sound stringers, and either with spacing strips between layers, or that they be piled so that the faces do not have full bearing against each other, as experience has shown that ties piled close soon show damage.

Experience on river territories shows that it is not safe to buy softwood ties while the sap is up, no matter how carefully the ties are piled for proper seasoning, as transportation during the summer is not to be counted on with any amount of security and ties are liable to be damaged before they are loaded for shipment. Besides this, softwood ties piled on river landings are, in some cases, in deep shade, or, where in the open, are frequently surrounded with a rank growth of weeds, that tends to hold the moisture, creating conditions favorable to rapid damage. For this reason, the practice of buying softwood ties at small landings should be avoided, and ties should be hauled to only such landings, where they are handled in large quantities; where the timber will be exposed to sunlight and free air currents; where landings are free from weed growths and where shipments can be made by date rather than by appearance of the timber.

That softwood must and will be used for ties is positive, as the supply of oak is diminishing in quantity and accessibility. That beech and gum make a good tie, when properly handled and properly treated, is an accepted fact and with an available supply of softwood timber in easy reach of transportation, it is desirable that the question be given serious consideration and the methods and means

* From paper read at the 11th Annual Convention of the American Wood Preservers' Association, January, 1915.

of handling be freely discussed to promote a more general demand among consuming roads and to offset a well established unjust prejudice against their use.

SAND CUSHION vs. MORTAR BED FOR WOOD BLOCK PAVEMENTS.*

It has been the custom for many years to lay wood block pavement on a concrete base with a cushion of sand or a bed of mortar between the base and the blocks. At present in European cities the concrete is laid perfectly smooth and the blocks are placed directly thereon, though 15 years ago a mortar bed was used in London. In order that the reasons for the American practice may be discussed with understanding, the specifications as used in the Borough of Richmond, City of New York, follow:

On the surface of the concrete shall be placed a bed of [sand] dry mortar, composed of one (1) part of cement to four (4) parts of sand, one-half (½) inch thick.

On the surface of the mortar bed shall be set strips of wood three (3) inches wide by one-quarter (¼) inch thick, of strips of steel of the same width by not less than one-eighth (⅛) inch thick, and of the greatest length convenient for handling. These strips shall be carefully set parallel and about eight or ten feet apart, running from curb to curb, and be imbedded in mortar throughout their lengths, so that the top surface shall be the required depth below and parallel to the grade of the finished pavement. The space between two strips having been filled with mortar, a true and even top surface shall be struck by using an iron-shod straight-edge on the strips as a guide, and as soon as the bed has been struck, the strips which would interfere with laying the blocks shall be removed and their places carefully filled with mortar.

On this mortar surface, spread and smoothed as above to the proper crown and grade, the blocks are to be laid with the grain up, with close joints, and uniform top surface, in courses at right angles to the line of the street, except in and between car tracks, in intersections and in other special cases, when thy shall be laid diagonally, as shall be directed.

When laid, the blocks shall be covered with clean, fine sand, entirely free from loam or earthy matter, perfectly dry and screened through a sieve having not less than twenty (20) meshes per linear inch. The sand to be swept and brushed into the joints. The pavement shall then be rolled with a four or five-ton roller, and sand spread over the pavement and left on the surface until such time, when, if required by the engineer, the pavement shall be swept clean for final inspection, and any defects then noted shall be remedied.

It would seem from the foregoing that a sand cushion was intended primarily to smooth out the roughness and inequalities in the concrete, so that the blocks might rest evenly thereon. Secondly, the yielding surface of the sand permits the roller to press the blocks into it until they present a smooth surface adjusting the slight inequalities in the depth of the blocks, and thirdly, the sand has a slight resiliency and protects the blocks somewhat from surface wear. The mortar bed performs the same office as the sand as an equalizer of the concrete surface and the surface of the finished pavement, but there the similarity ceases, for, as the mortar gradually sets it forms a hard, unyielding bed for the blocks to rest upon, sacrificing resiliency for immobility.

There are two objections, in the writer's opinion, to the use of a sand cushion. First, when cuts are made for any purpose through the pavement, it frequently happens that weeks and months elapse before repairs are made; during this time, storm water works its way between the blocks and base and disturbs considerable quantities of pavement that will have to be relaid. This is especially noticeable on streets with a considerable grade, and could not occur with a well set mortar bed. Second, it would seem that even the slight resiliency of the sand cushion would mean the unstable condition of each block with respect to its neighbors, and a consequent lack of support on sides and ends which is of the utmost importance.

The one objection to a mortar bed has always been that the mortar has been mixed damp and time must be allowed for it to set hard (three or four days), before traffic could be admitted, whereas wood block pavement on sand cushion can be thrown open for traffic as soon as completed. The writer has overcome this objection by mixing the mortar dry, and allowing it to set as moisture reaches it through the joints, which are always of sand. The roller and immediate traffic work the blocks down to their final beds before the mortar sets. Work of this kind has been examined at plumbing cuts and it has been found that the mortar was set up hard, though traffic had been allowed on the new pavement as soon as completed, and the surface was still uniform.

The fact of the lack of use of sand or mortar cushion in the practice of European countries would appear to indicate their opinion that a firm and unyielding bed for the blocks was the main consideration, relying entirely on the fibre of the wood for resiliency.

Asphalt blocks have for many years been laid on a mortar bed and this method has evidently been adapted for use in laying wood block pavement. Some six years ago the writer used a damp mortar bed for a wood block paving contract. One day the roller broke down at a time when a large yardage of block had been laid and was ready for rolling. Before the roller was repaired the mortar had set and the pavement on this section was never as perfect as on those adjoining. For this reason a sand cushion was substituted for a mortar bed in the specifications until last year, when dry mortar was permanently adopted. In the writer's opinion, mortar is superior to sand for a bed for wood block pavement.

* Read before American Association for the Advancement of Science by Theodore S. Oxholm, Bureau of Engineering, Richmond Borough, New York City.

TRANSVERSE TESTING OF CAST IRON.

In the Journal of the Iron and Steel Institute Mr. G. Hailstone describes a special machine which has been designed for making transverse tests on cast-iron bars of different dimensions. A series of tests has been made on a range of mixtures from weak to strong cast-irons using test-bars 2 x 1 inch in section tested on 36-inch centres and 1 inch square bare tested on 12-inch centres. The results show that the ratio of the strengths is 1.153 for machined bars and 1.146 for bars tested with the skin on, instead of 1.333 as originally allowed for in the standard English specifications. The best standard test-bar, giving the most consistent and comparable results is the one cast to 2⅛ x 1⅛ inches in section and 42 inches in length and machined to 2 x 1 inch and tested on 36-inch centres. The rate of loading should not exceed one hundredweight in 15 seconds, this being a very convenient rate.

Editorial

THERE IS WORK FOR MORE ROAD ENGINEERS.

We read the other day, in a paper delivered recently at a good roads convention in Ohio, that in the last hundred years there has been little or nothing done toward improving our methods of locating and constructing earth roads. The statement will hardly pass without a challenge, and will be accepted with a good deal of reservation and amendment, if accepted at all. It may apply in but a few instances. Still it is worth a thought.

Methods of country road location have not undergone much substantial improvement in the past century. There are places where the old system of locating by viewer is still in vogue. It met the requirements of the early 19th century fairly well. Engineers were few, the population was sparse, labor and funds were not available to build roads of the character needed to-day. The system served the purpose in those days, just as did the flail and scythe and sickle, but should have passed with them. The present age demands the abandonment of primitive methods of road location. The work should surely be put as squarely on an engineering basis as is the location of railroads and traction lines. There would, of course, be differences in detail but none in principle.

It is again a matter demanding the services of the road engineer. Because the roadbed of a modern highway requires the same care and judgment in its location, construction and maintenance as does the roadbed of the railroad. The road engineer not only has the problems of alignment, grades and drainage to contend with, but in order to produce the best results he must thoroughly understand the properties of different materials encountered in road construction and maintenance, how they can be combined satisfactorily and how to use these combinations after they have been made. While the above comprises but a few words, the carrying out of the ideas involves a large amount of intelligent and patient study.

We have in Canada some capable and efficient road commissioners. We have others that have only a general idea of what is being done on the roads, and while they may be gentlemen who stand high in their particular callings, these callings have nothing to do with engineering or road building, and their actual services along these lines are of little value. To argue that an engineer is not necessary to advise and counsel with the commissioners in the matter of roads and bridges, that they as good business men will suffice, is not logical. One would at once see the absurdity of having a commission of shoemakers to stamp out an epidemic of scarlet fever. Then why a commission of business men without engineering advice to direct the expenditure of thousands of dollars annually on our country roads?

A great deal of the work on our country roads is being done by men without technical training; few of them being close students of economy, methods, or cost, and some with little conception of the work they are trying to accomplish. Under an engineer they could be instructed and advised in the various phases of road work. A grading outfit thoroughly equipped for all classes of road work could be organized, thereby greatly reducing the cost of concrete and other classes of bridges. This outfit could be kept busy almost continuously, and well drained and graded roads could be had on mail routes and between towns, at a small cost; also a system of cost data could be compiled in a few years which would be of great value.

The road engineer, in his preparation as such, becomes familiar with the design and construction of the different classes of bridges, the proper location, and drainage of roads. This knowledge alone would result in the saving of thousands of dollars. It is now common knowledge that a country road properly located and drained, will save hundreds of dollars in its upkeep.

DOMINION PUBLIC WORKS PROGRAMME TO BE CARRIED OUT.

During the recent convention in Ottawa of the mayors of Canadian cities the Federal Government was approached in the matter of unemployment. By way of reply, the delegation representing the convention was assured that the Government would continue the construction of all its public works under contract. This means a good deal to engineers. Estimated outlays for the current year includes expenditures upon public works of over $25,000,000 on railways and canals, of $27,000,000 on capital account alone, and on works of harbor commissioners of over $3,500,000. The total expenditure of the Dominion for the year, apart from the war, will reach $200,000,000, while the war expenditure will add another $100,000,000. The Federal Government is therefore raising about $1,000,000 per day, exclusive of Sundays, to maintain its existing programme and carry on the war. To do this, the Government has its revenues under the recent taxation measures and such funds as it can borrow in London, the latter being strictly limited by the British treasury to expenditures upon works under contract, the Imperial Government desiring to conserve the money market for its own issues for war purposes.

The works toward the continuance of which particular effort is being put forth include the Intercolonial Railway terminals at Halifax, Welland Ship Canal, Quebec bridge, N.T.R. and Hudson Bay Railways, terminal elevators and harbors at Halifax, St. John, Quebec, Montreal, Toronto, Hamilton, Port Arthur and Fort William, Vancouver and Victoria.

BOUNDARY WORK BETWEEN CANADA AND UNITED STATES.

Since 1908 surveyors have been at work marking the boundaries between the United States and Canada. These land surveys are now nearing completion. The water line has also been run.

Charts of the international boundary as the surveyors of the two countries have laid it down on maps of the water frontier were presented to Premier Borden by Mr. J. W. Stewart, head of the Canadian Hydrographic Survey, last week. The Prime Minister, in receiving the charts of the boundary line from St. Regis Island in the St. Lawrence, through Lakes Ontario, Erie and Huron and Superior, to the head of the Lake of the Woods, referred thus to the relations existing between Canada and the United States:—

"The fact that the great nations whose interests are concerned have chosen this method of bringing to a happy conclusion every possible difference is not only an example but a happy augury of future good relations. I trust that the work of delimiting the land boundary will be equally successful and when this is done, there will be set at rest every possible dispute or controversy over boundaries between the two countries."

Sir Robert Borden received the charts in his capacity as Secretary of the State External Affairs, and Mr. J. B. Hunter, Deputy Minister of Public Works.

AMERICAN SOCIETY FOR TESTING MATERIALS.

The 18th annual meeting of this Society will be held at Atlantic City, N.J., June 22-26. The following is a summary of the programme:—

Tuesday a.m.—General.
Tuesday p.m.—Non-ferrous metals.
Wednesday a.m.—Steel.
Wednesday p.m.—Heat treatment of steel.
Thursday a.m.—Testing apparatus.
Thursday p.m.—Cement and concrete.
Friday a.m.—Ceramics, gypsum and lime.
Friday p.m.—Preservative coatings and lubricants.
Saturday a.m.—Road materials, timber and rubber.

In detail the programme is as follows:—

First Session, Tuesday, June 22, 11 a.m.

Minutes of the seventeenth annual meeting; annual report of executive committee. Report of committee D-5 on Standard Specifications for Coal; J. A. Holmes, chairman. Report of committee D-6 on Standard Specifications for Coke; J. A. Holmes, chairman. The Fusibility of Coal Ash; A. C. Fieldner, A. E. Hall and A. L. Field. Report of committee E-5 on Technical Committees; Edgar Marburg, chairman. Report of committee E-6 on Papers and Publications; Edgar Marburg, chairman. Election of officers. Miscellaneous business.

Second Session, Tuesday, June 22, 3 p.m.

Report of committee A-2 on Standard Specifications for Wrought Iron; S. V. Hunnings, chairman. Report of committee A-3 on Standard Specifications for Cast Iron and Finished Castings; Richard Moldenke, chairman. Report of committee A-5 on Corrosion of Iron and Steel; S. S. Voorhees, chairman. Report of committee D-9 on Standard Tests of Insulating Materials; C. E. Skinner, chairman.

Third Session, Tuesday, June 22, 8 p.m.—On Non-Ferrous Metals.

Annual address by the president. Report of committee B-1 on Standard Specifications for Copper Wire; J. A. Capp, chairman. Fatigue of Copper Alloys; Ernest Johnson. Battery Zincs—Some Causes for Defective Service; Robert Job and F. F. White.

Fourth Session, Wednesday, June 23, 10 a.m.—On Steel.

Report of committee A-1 on Standard Specifications for Steel; C. D. Young, chairman. Report of committee A-8 on Standard Specifications for Cold Drawn Steel; C. E. Skinner, chairman. Report of committee E-1 on Standard Methods of Testing; G. Lanza, chairman. Elastic Limit; T. D. Lynch. The Elastic Limit of Steel Determined by Transverse Test, and Its Relation to the Tensile Elastic Limit; W. K. Shepard.

Fifth Session, Wednesday, June 23, 8 p.m.—On Heat Treatment of Steel.

Micrographic Determination of Surface Decarburization in Heat-treated Steels; J. G. Ayers, Jr. The Relation Between Tensile Strength, Brinell Hardness and Scleroscope Hardness in Treated and Untreated Alloy and Plain Steels; R. R. Abbott. Some Neglected Phenomena in the Heat Treatment of Steel; M. E. Leeds. The Charpy Impact Test on Heat-treated Steel; J. J. Thomas. Internal Stresses Developed by Different Quenching Mediums and Their Effects; H. V. Wille.

Sixth Session, Thursday, June 24, 10 a.m.—On Testing Apparatus.

The New Physical and Chemical Laboratory of the Pennsylvania Railroad Company at Altoona; C. D. Young. The Failure of Materials Under Repeated Stress; H. F. Moore and F. B. Seely. A Laboratory Method of Determining Pressure on Walls and Bins; J. Hammond Smith. A Universal Strainometer of Simple Design; S. H. Graf.

Seventh Session, Thursday, June 24, 3 p.m.—On Cement and Concrete.

Report of committee C-1 on Standard Specifications for Cement; G. F. Swain, chairman. Report of committee C-9 on Standard Tests of Concrete and Concrete Aggregates; S. E. Thompson, chairman. Microstructure of Concretes; N. C. Johnson. The Effect of Finer Grinding and a Higher SO_3 Content Upon the Physical Properties of Portland Cement; P. H. Bates. An Investigation of the Strength and Elastic Properties of Concrete-filled Pipe Columns; A. F. Holmes and F. W. Swain. Method of Weight-volumetric Proportioning of Concrete Aggregates in Testing; J. A. Kitts.

Eighth Session, Friday, June 25, 10 a.m.—On Ceramics, Gypsum and Lime.

Report of committee C-3 on Standard Specifications for Brick; A. V. Bleininger, chairman. Report of committee C-4 on Standard Specifications and Tests for Clay and Cement Sewer Pipes; Rudolph Hering, chairman. Report of committee C-6 on Standard Tests and Specifications for Drain Tile; A. Marston, chairman. The Legal Interpretation of the Word "Vitrified" as Applied to Ceramic Products; Edward Orton, Jr. Report of committee C-7 on Standard Specifications for Lime; J. S. Macgregor, chairman. Report of committee D-3 on Standard Specifications for Gypsum and Gypsum Products; R. J. Wig, chairman.

Ninth Session, Friday, June 25, 3 p.m.—On Preservative Coatings and Lubricants.

Report of committee D-1 on Preservative Coatings for Structural Materials; P. H. Walker, chairman. Report of committee D-2 on Standard Tests for Lubricants; C. P. Van-Gundy, chairman. A Cylinder Friction and Lubrication Testing Apparatus; A. E. Flowers.

Tenth Session, Saturday, June 26, 10 a.m.—On Road Materials, Timber and Rubber.

Report of committee D-4 on Standard Tests for Road-Materials; L. W. Page, chairman. Some Experiments on Technical Bitumens; S. R. Church and J. M. Weiss. Report of committee D-7 on Standard Specifications for Timber; H. Von Schrenk, chairman. A Fungus Bed Test of Wood Preservatives; Cloyd M. Chapman. Report of committee D-11 on Standard Specifications for Rubber Products; E. A. Barrier, chairman. Report of committee D-13 on Standard Tests and Specifications for Textile Materials; W. D. Hartshorne, chairman.

COAST TO COAST

Newmarket, Ont.—The new 125,000-gallon reservoir was completed on June 4th and put into operation.

Winnipeg, Man.—The city has detected numerous instances of damage to water mains by electrolysis.

Chatham, Ont.—Kent County Council propose to take some action forthwith in the matter of good roads.

London, Ont.—Negotiations for running rights over the London and Port Stanley Railway were opened by the Michigan Central last week.

Saanich, B.C.—The litigation which has been delaying pavement work in the municipality has been disposed of, and the season's programme of road work is proceeding.

Ottawa, Ont.—Negotiations are said to be practically completed for the acquirement by the government of the Lake Superior branch of the Grand Trunk Pacific Railway.

Essex, Ont.—By the end of the year the town will have completed 1¼ miles of concrete pavement. The road was started last year. Mr. B. Oldain is the contractor.

Hamilton, Ont.—A survey of the harbor is being made by the Department of Public Works, Ottawa. Mr. J. M. Wilson, acting district engineer at Toronto, is in charge of the work.

Fort William, Ont.—Construction work is progressing on three large elevator additions, *viz.*, the Ogilvie Flour Mill elevator annex, the Western Terminal elevator annex, and the Dwyer elevator annex.

Prince Rupert, B.C.—The Grand Trunk Pacific officials announce that the fuel oil tank equipment at Prince Rupert is now completed; and that oil-burning locomotives have now commenced to run on the system.

Ottawa, Ont.—A commission is to be appointed to manage the municipal electric department, which, under a new provincial act, is taken out of the hands of the board or control. The new commission will take office next year.

Calgary, Alta.—The city is preparing an attractive booklet on water power possibilities in the vicinity, for select distribution at the San Francisco-Panama Exposition. The booklet will also refer to the coal and natural gas resources of the district.

St. John, N.B.—With reference to the cancellation of the Courtenay Bay contract, mentioned in last week's issue, Hon. J. D. Hazen, Minister of Marine, states that the difficulty with the contractors for the Courtenay Bay harbor works does not mean that the works will be abandoned, rather they will be proceeded with as soon as new arrangements are made.

Vancouver, B.C.—Messrs. Hodgson, King & McPhalen made a new Canadian record in building the Central Park trunk sewer for the Joint Sewerage Commission. During May they laid 2,309 feet of 27-inch concrete pipe at an average depth of 16 feet below the surface and at the same time completed 1,000 feet of tunnel six feet six inches in diameter in the vicinity of Central Park.

Edmonton, Alta.—At a sitting of the Dominion Railway Commissioners last week the city representatives took up again the question of railway crossings. The city is seeking to open up Athabasca Avenue, through the C.P.R. yards, Shand Avenue, over the G.T.R., and Stephen Avenue, over the C.N.R. The first application had previously been refused by the Commission some time ago.

Victoria, B.C.—The civic asphalt plant was completed and put into operation last week. It has a daily capacity of 1,500 cu. yds. It is of the semi-portable type and uses oil fuel in its 50 h.p. boiler, which drives a 36 h.p. horizontal engine. Among the principal parts of the plant are a sand drier, dust collector, three melting tanks, each of 24,000 gallons capacity, and an air compressor. There are various bins for the storage of material and a storehouse has been built recently convenient to the plant.

Vancouver, B.C.—Up to the end of May over 1,500,000 cu. yds. of material had been deposited by the C.N.T. Railway on its terminal track in False Creek. Of this amount 400,000 yards have been pumped into the area enclosed by a bulkhead extending traversely down the creek since the reclamation operations were resumed in January. A 64-acre section of the company's holdings are barricaded, the entire tract being nearly 165 acres. It is estimated that it will take 3,250,000 yards of dirt to reclaim the whole of the property.

Trail, B.C.—Arrangements are well under way for the refining under government auspices and possibly with government assistance of copper and zinc mined in British Columbia, and for the manufacture of brass in the Dominion. At present the copper from the British Columbia mines is shipped across to the United States in the face of a freight of $10 per ton and of a heavy duty. It is refined there and must pay a further heavy freight rate when reimported into Canada. It is computed that at Trail, B.C., a refinery plant could be established for a million and a half dollars, and the cost of refining the copper and manufacturing the brass would be more than compensated for by the saving in price of the manufactured article. This is the only part of the shells being made here which is not manufactured in Canada at present.

ROAD IMPROVEMENTS IN QUEBEC.

Hon. J. A. Tessier, Minister of Roads for the Province of Quebec, informs *The Canadian Engineer* that the total amount to be expended on road work this summer in the province will be about $3,000,000. The Montreal-Quebec road, which is of macadam construction, is being proceeded with vigorously, and will probably be finished before fall. Last week there were five gangs of men engaged on the section between Quebec and Ste. Anne de la Perade, three gangs from Batiscan to Three Rivers and four between Three Rivers and Maskinonge. The plant and labor forces are steadily being increased.

The Sherbrooke-Derby road, another macadam road, will also be completed this season. The Levis-Jackman road, of gravel construction, upon which the government made such excellent progress last year, was recommenced last week. It is approximately 100 miles in length and will likely be completed, or nearly so, by fall. The King Edward road, from Montreal to Rouse's Point, will be put in first-class shape during the next month. The work of repair is progressing rapidly.

Over 200 municipalities in the Province of Quebec are building macadamized or gravelled roads this year.

PERSONAL.

J. B. FIELDING, F.L.S., of Barrie, Ont., has been appointed fisheries engineer for the Ontario Government.

A. M. HARVEY, Moncton, N.B., has been appointed signal supervisor on the Canadian Government Railways.

DR. J. H. RADFORD is the water commissioner of the city of Galt, appointed last week to succeed Lieut-Col. A. J. Oliver, resigned.

J. W. EBER has resigned as general manager of the T. H. & B. Railway. The office has been taken over by Mr. J. N. Beckley, president of the road.

SIR HARRY L. DRAYTON, chairman of the Dominion Board of Railway Commissioners, was one of those to receive birthday honors from King George.

M. L. SMITH, B.A.Sc., has been recommended by the advisory industrial committee of the Central Technical School, Toronto, for the position of director of engineering.

THOS. WRAGG, of the Hamilton Bridge Works, Hamilton, Ont., left for St. John, N.B., last week to join the Railway Construction Corps under the command of Lieut.-Col. C. W. P. Ramsey.

HENRY HADLEY, Jr., city engineer of Verdun, Que., has resigned his position and is entering active service with the 5th Mounted Rifles. Mr. Hadley is a graduate in civil engineering of McGill University.

ALBERT S. FAIRN, of the engineering staff of the C.P.R. at Calgary, is a lieutenant in the 12th Battalion, Argyle and Sutherland Highlanders. Prior to enlisting, Mr. Fairn was a construction engineer on the C.P.R. irrigation project in Alberta.

W. P. BRERETON, who succeeded Col. H. N. Ruttan as city engineer of Winnipeg last year, has assumed new and greater responsibilities, the positions of field engineer, bridge engineer, designing, computing and consulting engineers having recently been abolished.

R. O. WYNNE-ROBERTS, until recently consulting engineer for the city of Regina, has been elected a member of the American Society of Civil Engineers. He is a member of the Canadian Society of Civil Engineers and also of the Institution of Civil Engineers of Great Britain.

OBITUARY.

The death occurred at Merritton on June 7th of Mr. William Andrew, an electrical engineer in the employ of the Canada Carbide Co. Death was accidental, and due to contact with a high-voltage circuit.

VANCOUVER BRANCH, CANADIAN SOCIETY OF CIVIL ENGINEERS.

The annual meeting of this Branch was held recently, Mr. G. R. G. Conway presiding. The following officers were elected for the 1915-16 term: President, R. F. Hayward; vice-president, H. C. Carry; secretary-treasurer, A. K. Robertson; committee, Donald Cameron, E. C. Cartwright, A. G. Dalzell, E. G. Matheson. On this committee Mr. G. R. G. Conway, T. H. White and N. J. Kerr will act as ex-officio members because of their connection with the council of the parent society.

A.S.M.E.—SPRING CONVENTION.

The spring meeting of the American Society of Mechanical Engineers will be held in Buffalo, June 22-25; with headquarters at Hotel Statler. The following is a partial list of papers to be presented, at the professional sessions:—

Wednesday Morning.—"The Study of a Shaft and Its Improvement by Heat Treatment," by John Younger. "A Comparison of the Properties of Nickel, Carbon and Manganese Steel," by Robert R. Abbott. "Use of Corrugated Furnaces for Vertical Fire-Tube Boilers," by F. W. Dean. "On Measuring Gas Weights," by Thos. E. Butterfield.

Wednesday Evening.—Illustrated lecture on "The Engineer as a Citizen," by Dr. F. H. Newell, formerly chief of the U.S. Reclamation Service.

Thursday Morning.—"Rational Design and Analysis of Heat Transfer Apparatus," by E. E. Wilson. "Influence of Disk Friction on Turbine Pump Design," by F. zur Nedden. "Surface Condensers," by C. F. Braun. "Some Mechanical Features of the Hydration of Portland Cement and the Making of Concrete as Revealed by Microscopic Study," by Nathan C. Johnson. "Design of Rectangular Concrete Beams," by Howard Harding. "Model Experiments and the Forms of Empirical Equations," by Edgar Buckingham. "The Effect of Relative Humidity on an Oak Tanned Leather Belt," by W. W. Bird and F. W. Roys.

Friday Morning.—"Laws of Lubrication of Journal Bearings," by M. D. Hersey. "The Relation Between Production and Costs," by H. L. Gantt. "Laps and Lapping," by W. A. Knight.

COMING MEETINGS.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—Annual meeting to be held at the Iowa State College, Ames, Iowa, June 22nd to 25th, 1915. Secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

AMERICAN SOCIETY FOR TESTING MATERIALS.—Annual meeting to be held in Atlantic City, N.J., June 22nd to 26th. Secretary, Prof. E. Marburg, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Annual convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Charles Warren Hunt, 220 West 57th Street, New York.

INTERNATIONAL ENGINEERING CONGRESS.—To be held in San Francisco, Cal., September 20th to 25th, 1915. Secretary, W. A. Catell, Foxcroft Building, San Francisco, Cal.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—Annual convention to be held in San Francisco, Cal., October 4th to 8th, 1915. Secretary, E. B. Burritt, 29 West 39th Street, New York.

Poul Lindholm, Engineer of Highways, Copenhagen, Denmark, has been awarded the travelling fellowship of the American Scandinavian Foundation for 1915-1916. He will devote the year to graduate work in highway engineering at Columbia University.