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The Canadian Engineer

ESTABLISHED 1893

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Editor—E. A. JAMES, B.A. Sc.

Business Manager—JAMES J. SALMOND.

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TORONTO, CANADA, SEPTEMBER 18th, 1908.

CONTENTS OF THIS ISSUE.

THE TRACTION ENGINE AND THE HIGHWAY.

The heaviest load the rural culvert or bridge is called upon to carry is that imposed by the traction engine, and, as in other modes of transportation, so in this, the growth in size and weight of engines and size and weight of loads drawn has been great. Ten years ago provision had to be made for a 12 horse-power engine with the greatest load on any wheel of 5,000 pounds. To-day the same district will require a 32 horse-power engine, putting a load of 11,000 pounds on each rear wheel. Ten years ago the traction engine was only expected to look after itself; to-day the engine is required to haul a wheel load of from three to five tons.

This more than doubling of the load has been very destructive of culverts and bridges. Many of these structures built for the lighter load would under that load be good for ten years more, and it is not reasonable to expect the municipalities to at once rebuild them. But they should designate in some way the weak structures, so that persons owning and operating engines of great weight might be required to lay down plank of sufficient width and thickness to fully protect the flooring and covering of all bridges and culverts.

Having done this, they should not be allowed to leave undone those repairs and improvements which, carried on at little cost, will strengthen weak bridges or culverts. Many culverts are in a depression, and another foot or two of gravel placed over them would distribute the load more uniformly and increase the factor of safety many times. Sometimes, at very little expense and without taking from its usefulness, the culvert may be lowered, and thus without increasing the road grade a good cushion over the structure is secured. There are times when these methods are not practical—then require the engine owner to protect the culvert.

With bridges it is usually a question of additional material, new material, or both. To what extent the corporation engineer should advocate rebuilding so as to provide for this increase in weight of one particular line of traffic it is hard to say. It is largely a question of service. There are certain roads that receive all, or nearly all this traffic. Were these roads defined and fitted for the heavy loads they would relieve the necessity of repair or rebuilding of the structures on all roads.

Every municipality would be justified in passing a resolution to the effect that all owners of traction engines file with the clerk of the municipality, in which the machine is to operate, a statement of the engine's weight, both when empty and when supplied with fuel and water, wheel loads and main dimensions. In this way only can the county engineer keep informed of conditions.

The engineer in designing new structures should not only calculate on the present loads with sufficient margin for a large factor of safety, but he should allow for large increases in this load.

The demand each year is for more powerful engines. With the various blowing devices and feeders the present power is always fully taxed. There may not be in the coming decade the same increase in weight as there has in the present, but the engineer who does not provide for at least a very large increase will not be doing his whole duty.

WET OR DRY CONCRETE MIXTURE, WHICH?

The question as to which is the better, the wet or dry mixing of concrete, is much discussed. Recently in Germany there were given out the results of extended experiments covering some four years. From these reports the conclusion is drawn that the smallest amount of water which produces a mixture suitable for ramming gives the strongest concrete.

The results of these experiments confirm that which other experiments, covering shorter periods of time, indicated, and will not occasion any surprise. At the same time the concrete worker who attempts to use the smallest amount of water which will produce a mixture suitable for ramming will find many practical difficulties.

The great obstacle will be the difficulty of securing "skilled" labor. The degree of skill and care required with such a mixture is so great that the ordinary laborer cannot be entrusted with the work, and prices have been cut so low that to train men to perform this work is well nigh impractical.

We recently examined a brick pavement that was being torn up preparatory to relaying. The bricks had been grouted with a comparatively dry mixture of cement and sand. The result was that the grouting only went about one-quarter way down the bricks, and in less than two years the pavement had become so rough that it had to be relaid.

Other pavements were examined where the grouting had been done with a mixture that would flow readily and could be swept into the crevices. In this case the grouting completely surrounded the brick and the roadway was a solid pavement.

Not only does a wet mixture of concrete allow the use of less skilled workmen, but it insures against the injurious effect of the varying amounts of moisture found in the material used.

EDITORIAL NOTES.

It is said that Commissioner Harris is asking Toronto City Council to back him up in a request to the Railway Commission that they pass an order compelling railroads to provide smoke consumers on all engines. If Mr. Harris would arrange for smoke consumers on the city buildings and show the Commission that dense smoke could be prevented it would help more than a bushel of City Council resolutions. Within the city boundaries there is no greater offender against the smoke by-law than the city building's smoke stacks.

* * * *

Great Britain was the last country we would have thought of as likely to refuse recognition of patents on articles manufactured in foreign countries. They are preparing now to cancel the British patents on foreign manufactured articles. Other countries are preparing to retaliate. Germany, Austria, and the United States are expected soon to pass regulations refusing to recognize British patents. The regulations devised by some of our Legislatures are just as ingenious as the work of some inventors—and just as useless to civilization.

* * * *

There are 225,000 miles of railway in the United States. Companies having a length of 168,839 miles—three-quarters of the whole—earned, gross, according to the Finance Chronicle, in the first six months of this year $863,860,000; had operating expenses of $632,606,000, and net earnings of $231,254,000, which last figure is equal to 26.78 per cent. of the gross earnings. These figures, compared with the first half of last year, show decreases of $172,868,000 in gross earnings (equal to 20 per cent. decline), $109,383,000 in operating expenses, and $63,484,000 in net earnings. If so serious a shrinkage is felt this year by people who merely carry things, must there not be a great shrinkage in the business of people who make, buy, and sell things.

CANADIAN PACIFIC RAILWAY, ANNUAL REPORT.

The twenty-seventh annual report of the directors of the Canadian Pacific Railway Company, for the year ended June 30th, 1908, has been issued to the shareholders. It says in part:—

The accounts of the company for the year ended June 30th, 1908, show the following results:—

Gross earnings	$71,384,173
Working expenses	49,591,807
Net earnings	21,792,366
Net earnings of steamships in excess of amount included in monthly reports	1,112,759
Interest, etc.	1,541,874
	$24,446,999
Deduct fixed charges	8,770,076
Surplus	$15,676,923
And after paying $4,625,466 in dividends leaves a net surplus for the year	$5,579,715

In addition to the above dividends on ordinary stock, one per cent. was declared from the interest on land funds.

The working expenses for the year amounted to 69.47 per cent. of the gross earnings, and the net earnings to 30.53 per cent., as compared with 64.96 and 35.04 per cent. respectively in 1907.

The statement of earnings for the year ended June 30th, 1908, shows receipts:—

From passengers	$19,900,432
From freight	44,037,507
From mails	739,755
From sleeping, express, elevators, telegraph and miscellaneous	6,706,388
Total	$71,384,173

The statement of working expenses, for the year ended June 30th, 1908, shows:—

Transportation expenses	$24,112,713
Maintenance of way and structures	10,410,751
Maintenance of equipment	9,358,138
Traffic expenses	1,734,086
Parlor and sleeping car expenses	395,628
Expenses of lake and river steamers	751,197
General expenses	1,942,756
Commercial telegraph	887,534
Total	$49,591,807

HEIGHT OF CAR STEPS.

The Ontario Railway and Municipal Board has set September 24th as a day for hearing Dr. Helen MacMurchy's application in which she will apply for an order by the Board "fixing the height of the first step of street and electric railway cars from nine to twelve inches from the ground, and the other steps with a rise from seven to nine inches one above the other."

The board has notified some twenty-four railways, that are under their jurisdiction, that they will hear the application and make such disposition of the application as may seem just.

Another indication of the general improvement in the outlook is the fact the Grand Trunk Pacific Railway Company have decided to purchase fifty more locomotives, half of which will be passenger and half freight. The passenger locomotives will weigh 122,000 pounds each, and will have eight wheels with 69-inch drivers and 18 x 24 cylinders. The Mogul freight locomotives will have three pair coupled wheels and two-wheeled centre-bearing swing-trucks with 20 x 26 cylinders and 63-inch driving wheels. They will weigh 162,000 pounds each. Delivery is to be completed by July 1909. The company is calling for tenders.

DRAINAGE OF SOFT SPOTS IN OLD ROADBED.*

By W. M. Dawley, Division Engineer, Erie Railroad.

Soft spots may be divided into five classes, according to their origin, as enumerated below:—

(1) Small irregularities of surface of subgrade, where character of soil is such that it will hold water.

(2) Building new shoulder of clay, cementing furnace slag or other impervious material, impounding surface water, which will follow the grade until it meets some obstruction, as a bridge abutment or culvert arch or a low point in sag of grade line.

(3) The settlement of new track in wet cuts or on new clay fills during the soft thawing weather following the first winter's use, forming a trough in the subgrade, along which the seepage water from wet cuts and the rainfall which penetrates the ballast will run until meeting an obstruction.

(4) The construction of new second track or siding by filling the old ditch with porous material, leaving a pocket to collect and retain surface water, which will soften up the roadbed on both sides.

(5) "Sink holes" occurring where an embankment has been built across a swamp and settlement occurs without lateral deformation of the embankment.

Class (1)—A small irregularity of surface of subgrade will permit the formation of a pool of water a few feet in diameter and an inch or two in depth during a rain shower, visible in the subgrade before ballast is applied, but lost to sight and memory when track is laid and ballasted. If the soil is of such consistency that it will not readily absorb this water and the ballast protecting it from the direct rays of the sun and preventing evaporation, it will lie in the pool a long time, softening up a few inches of the subgrade, which, under the pressure of traffic will move laterally, causing a settlement of the ballast and track and increasing the depth and capacity of the pool.

The section foreman surfaces the track, and a few days or weeks, depending on the amount of water available and time required to soften up enough of the subgrade to permit lateral movement, the process is repeated. When the ballast between the ties has been used up the supervisor is appealed to, and, locomotive ashes being the most highly recommended material for use in soft spots, he orders a liberal supply, and these are used in future to surface the track.

The plastic clay forced from under the track by the pressure of traffic has by this time begun to heave up the bottom of the ditch and obstruct the surface drainage. This is dug up and trucked out or thrown up on the bank and the bottom of the ditch reduced to its original grade line. Should this soft spot or several similar ones occur in a cut and the maintenance of line and surface become burdensome, relief will be sought in drain tile. The size of tile is often determined by the number of failures of small tile with which the division engineer is acquainted, and is usually made 6 or 8 inches; the depth, after consulting various authorities, is fixed at 2½ feet below the bottom of the tie, and, if possible, the service of a farmer, skilled in the art, is secured to lay the tile. No effort is made to connect the pool of water under the track with the drain tile, it being assumed that the water will penetrate the intervening clay. If the spot is of long standing under heavy traffic the bottom of the pool has been forced down to a greater depth than the tile and the clay in which the tile is laid is soft enough to move horizontally and vertically under the pressure of the clay forced from under the track. In the course of a few weeks or months, according to season and traffic, there has been sufficient movement at the softest points to separate the joints of the tile and allow the plastic clay to be forced into the tile, completely closing it. The vertical movement of the clay will eventually raise the tile until it is brought to the level of the bottom of the surface ditch, and another failure of tile drainage will be recorded and the tile will be relaid, covering it with cinder, stone or straw to prevent the clay entering the pipe. This tile will remain open longer than its predecessor, but the movement of the clay will, in time, destroy the line and grade and render it useless also.

Class (2)—The building of a new shoulder on a fill almost invariably produces a soft spot at the lowest point of the sag in grade line of the original subgrade, causing a large wart or protuberance to form on the side of the embankment. The low point, or sag, in grade line usually occurs near the lowest point of the original surface where the ground is possibly swampy, the soft spot is attributed to the failure of the original surface to support the roadbed, although it may have performed this function without failure for years.

To improve the grade and remove part of the sag, ballast is laid on deeper in the sag, and after several reballastings the slope of ballast has reached the top edge of the original embankment, and the top of ballast slope begins at the end of the tie, and it is impossible to apply more ballast; hence the necessity for building a new shoulder. This is done by throwing up the soil from borrow pits along the embankment if this is not too high, or by cleaning out or deepening the cut, depositing the clay on the side of the embankment and ballast and forming the new shoulder a few inches below the bottom of the tie. Rainfall and seepage water from wet cuts will penetrate the ballast to the original subgrade, and, finding no lateral outlet, will follow the subgrade to the lowest point and there stand until it softens up the embankment sufficiently ot cause a lateral movement under traffic, or possibly to cause a part or even the whole embankment to be reduced to the consistency of mush, when it will slough out, dropping vertically from the ends of the ties and spreading out over the adjoining surface. If the quantity of water is small and the material of the embankment tenacious the settlement and lateral movement will be slower and the result will be a bulge or protuberance on the side of the embankment. Should there be a bridge or open culvert to obstruct the flow of water on the subgrade, the masonry will be constantly saturated and the disintegrating action of frost will be greatly augmented. If the fill behind the abutment is of clay, the hydrostatic pressure under traffic will cause the abutment to bulge out, requiring the rebuilding of the masonry, the cause being usually attributed to poor foundation.

If the opening is covered by an arch the masonry will be subject to disintegration due to the action of the frost

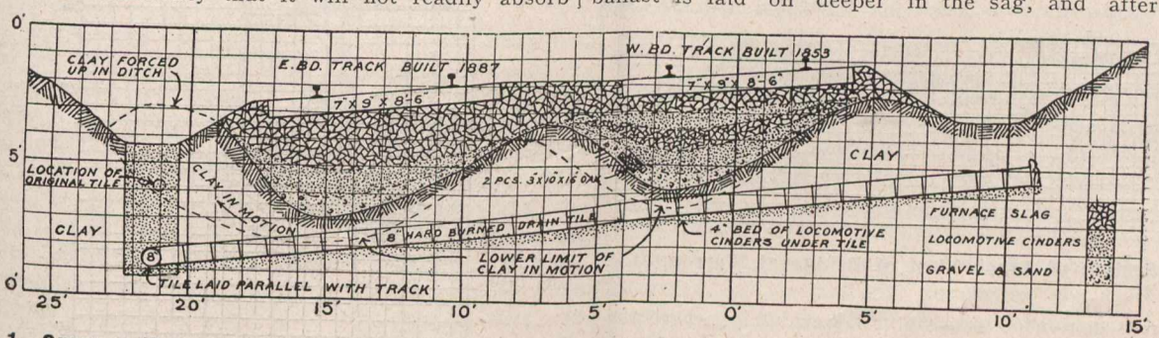

Fig. 1—Cross-section of Tracks at Hiram, O., Showing Distortion of Sub-Grade and Method of Drainage.

*From Bulletin 87, May, 1907, American Railway Engineering and Maintenance of Way Association.

on the saturated masonry, and if the crown of the arch is near the bottom of the ties there will be severe heaving of track in extremely cold weather.

Class (3)—Settlement of track, including ballast into the subgrade in wet cuts and on clay embankments during wet weather or spring thaw, will form a trough which will carry rainfall and seepage water from cuts slowly along the depressed subgrade until it meets an obstruction where it will soften up the embankment and cause constant settlement of the track. Quite frequently these soft spots develop just at or near the lower end of the cuts, there being a difference in the amount of settlement, the subgrade being depressed more in the cut than on the fill; this resulting in an offset forms a dam impounding the water which softens up the clay, causing its lateral movement from under the track and consequent settlement of track.

The track is usually resurfaced, and occasionally the ballast, which has been churned full of mud, is dug out and replaced with locomotive cinder. Where these spots are of long standing it is a common thing to see the ends of pieces of board sticking out from the shoulder of the ballast as illustrated, these having been used under the ties to surface the track in the winter when the ballast is frozen and being carried down and outward by the movement of the ballast and subgrade.

Class (4)—The construction of new second track or siding and the filling of the old ditch with ballast will obstruct the flow of water in the ditch, retaining it long enough to allow it to soften up the subgrade, causing settlement of track, or in case of rock cuts causing track to churn and pump the water up to the top of the ties after a spell of wet weather. A case of this kind is illustrated in Fig. 4,

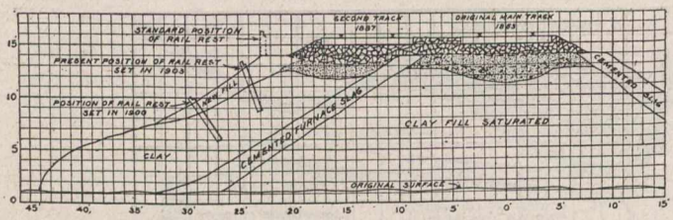

Fig. 2—Section of Track West of Bridge at Warren, O.

showing cross-section of tracks at Phalanx, Ohio, where the subgrade is a shaly soapstone. For a distance of 2,000 feet it was impossible to maintain surface on the westbound track on account of the water from the old ditch overflowing the subgrade of the new track. About five years ago this track was dug out and 18 inches of hard furnace slag ballast put under the ties, which simply increased the storage capacity of water and was of no benefit to the track.

The construction of an additional main or side track on an embankment, at the same time raising the subgrade, produced the result shown in the Fig. 4A. The impounded water from the two adjoining wet rock cuts and from rainfall softened the old fill so that it had about the consistency of mush, a portion of it sliding into the adjoining field.

Class (5)—'Sink Holes.'—The absence of lateral deformation of the embankment distinguishes this from the preceding classes. The settlement will continue until the bottom of the embankment reaches a depth below the surface of the swamp, where the weight of the material of the swamp between the surface and the plane of the bottom of the depressed embankment is sufficient to balance the horizontal force of the material which is being forced out from under the embankment. This depth will vary, increasing as the material of the swamp approaches the "perfect fluid" state.

In the case of the Tamarack Swamp "sink holes," east of Sharpsville, Pa., on the Erie Railroad, this state of equilibrium was obtained when the bottom of the fill had penetrated the swamp from 30 to 40 feet. The depth of the swamp in this case exceeds 100 feet, spliced piles of that length being driven without finding stable bottom. The material displaced by the embankment moved outward and upward, raising the surface of the swamp into ridges and causing large trees to lean or overturn as far as 200 feet away from the embankment. The top of the fill is about 15 feet above the surface of the swamp.

The settlement of the track under traffic is, in all cases, due to the horizontal displacement of the supporting soil, either in the embankment or in the original surface under the embankment (excepting, of course, the natural settlement of new fills due to the compacting of the material). The amount of horizontal movement under a given traffic will depend on the relative fluidity of the soil. Since the fluidity of the soil depends, for the pressure considered, almost entirely upon the amount of water contained, it is apparent that a reduction of the water contained will reduce the rate of movement, and an entire elimination of the water will stop the movement. Naturally, then, the proper remedy for the elimination of soft spots is complete and thorough drainage of a permanent character. For soft spots of the first class, drain tile should be laid in the ditch and at short intervals across the track, the depth being first determined by cutting trenches across the track at all of the worst spots and continuing the excavation down through the ballast and the underlying clay until a point is reached a foot or two down in the clay below the bottom of the ballast where the clay is firm enough not to move under the pressure of traffic. The main tile in the ditch should be laid about 12 inches deeper than the deepest test trench, three or

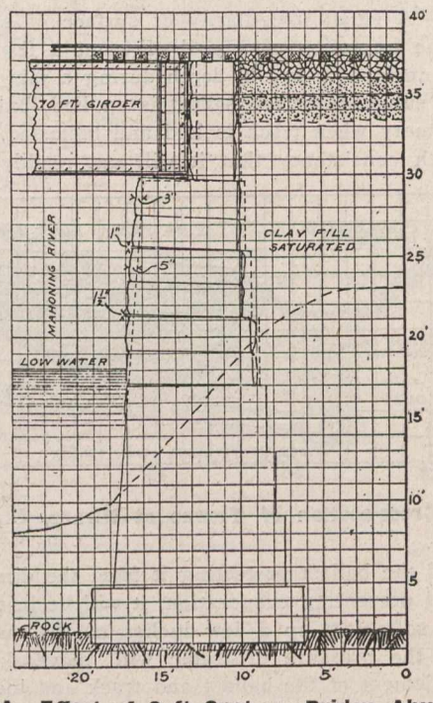

Fig. 2A—Effect of Soft Spot on Bridge Abutment at Warren, O.

four inches of locomotive cinders being put in the bottom of all trenches before the tile is laid and the entire trench filled with locomotive cinders up to the level of the subgrade.

Locomotive cinders should be used, because the clay will not mix with them as it does with broken stone, gravel or furnace slag, this being demonstrated in cutting the inspection trenches across the track where the original ballast had been locomotive cinders. In such cases there was a well-defined line between the cinders and the clay, the clay penetrating the cinders not more than an inch or two after fifty years of service; while coarse furnace slag and clay were mixed for a depth of two feet or more. Cross trenches should be dug and tile laid from the main tile, across the track at the middle of all soft spots and in wet cuts, at intervals of fifty feet or less, the location of each cross drain being marked by planting a piece of tile on end in the side of the bank. The longitudinal trough or depression under the track not having a uniform grade, it may be necessary to put in an intermediate cross drain should a soft spot develop between those already put in.

The accompanying illustration (Fig. 1) shows the conditions found in and remedy applied to a very bad case at

Hiram, Ohio. The wet cut is 2,000 feet long and contains numerous soft spots which required surfacing from two to three times a week. During the winter, when the roadbed was frozen, it was necessary to restrict the speed of trains on this curve. This point is at the extreme outlying end of a five-mile section, and was expensive to keep up, and there was the constant fear that the section foreman might neglect to keep the track in good surface, or that some engineer

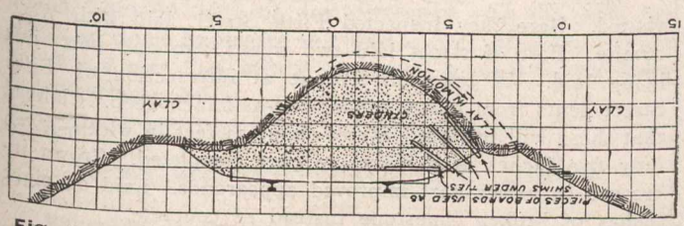

Fig. 3—Section of Track at East End of Summit Hill Cut, Norwich, O.

might disregard a slow order and cause an accident. A heavy increase in traffic also increased the difficulty of keeping a safe track, and it was decided to make a third attempt at tile drainage. Cross-section trenches were cut at the softest spots, which revealed the fact that the ballast under the original main tracks, built in 1853 (now westbound) had been depressed until there was from 44 to 48 inches under the base of rail, and that under the eastbound main built in 1887, had been depressed to a depth of from 48 to 52 inches below the base of rail. The plastic or fluid clay underlying the ballast varied in depth from 10 to 12 inches, below which it was apparently firm enough to resist lateral movement.

The track being on a 4 per cent. grade, the main tile, 8 inches in diameter, was laid at a uniform depth of 74 inches below base of rail. The cross trenches were dug every fifty feet, as narrow as possible, extreme care being taken to have the bottom of the trenches on a uniform grade line. A layer of locomotive cinders about four inches thick was carefully placed in the bottom of the trench and the drain tile laid on this, care being taken to see that the tile was at no point less than four inches from the clay sides of the trench; the entire trench on both main tile and cross drains were then filled with locomotive cinders and the ballast restored over the cross trenches. The main tile was laid from the outlet, up to the point of the first cross trench, then the cross drain was put in. When the excavation for the cross drain reached the pocket or trough under the track, it tapped a body of water, which filled the eight-inch tile two-thirds full, and required half an hour or more to drain it. This was repeated at each cross drain, the quantity of water being almost the same in every case.

After surfacing the track several times over the cross trenches, no further attention was required for thirty days, when two soft spots developed, one at a point where a cross

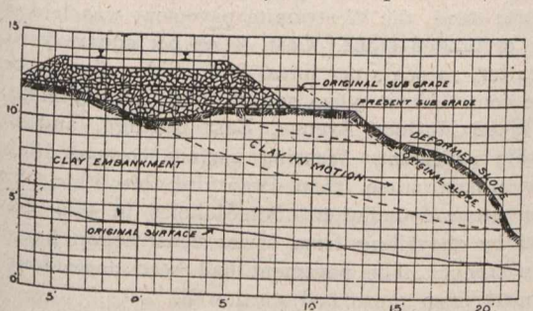

Fig. 3A—Soft Spot in Clay Embankment.

drain had been put in and another between two cross drains. The first was dug up, and it was found that the layer of cinders under the tile had been omitted, and that the tile had been laid on top of the plastic clay. This clay had been forced into the tile and completely filled it for a length of five feet, there also being sufficient horizontal movement to separate the tile 12 inches at a point under the low rail. The cross trench was deepened by removing the layer of plastic clay, the four-inch bed of cinders put in and the trench refilled. In the other case an intermediate cross trench was dug, tapping a pocket of water, which the first cross section had failed to drain; a cross drain was laid, and for the past two years no further trouble has been experienced with this cut. Since the drain tile is laid below the clay, which is saturated with water and in constant motion, and the trench of cinders intercepts all seepage water from the

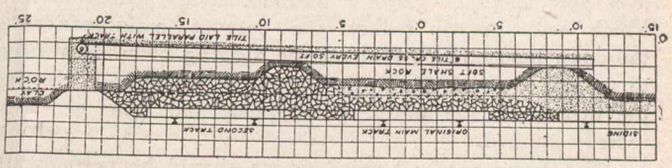

Fig. 4—Section of Tracks at Phalanx, O., Showing Original Ditches Filled and Method of Draining.

adjoining hillside, the cross drains rapidly removing all rainfall, the roadbed will soon be dried out so as to avoid all lateral movement and consequent settlement of track.

Soft spots in either Class 2, 3 or 4 can be cured by the construction of cross drains as outlined above at intervals of from 30 to 250 feet up the grade from the soft spot, constructing a drain parallel with the track where necessary to secure an outlet from the cross drains.

The maintenance of stable track over sink holes is one of the most difficult problems we have to contend with. If the ground water level can be lowered the dried-out surface of the swamp will offer a much greater resistance to the upward movement of the underlying fluid mass, and this will in turn resist the horizontal movement from under the embankment. This will reduce the penetration necessary to secure equilibrium. The saving in cost of filling will often justify the laying of a line of large drain tile miles in length, if necessary, to secure an outlet.

The elimination of soft spots is of prime importance in securing that degree of perfection in surface and line of track necessary for safety under present high speeds and heavy wheel loads. The daily amount of settlement of track at any soft spot depends on the character and degree of saturation of the material supporting the track and the intensity and frequency of the wheel load.

The character of the material being constant and the degree of saturation approximately so for days or weeks, a doubling of the traffic will about double the amount of settlement in a given time, and an abnormal increase, such as the handling of a cargo of iron ore over a branch line in twelve hours, being the equivalent of four or five days ordinary traffic, will cause four or five times the daily settlement, which might be sufficient to cause the derailment of a fast train. At one very bad soft spot careful measurements have shown a depression of one-half inch per day and corresponding movement out of line.

The large increase in modern wheel loads and traffic will develop soft spots at points which have heretofore sup-

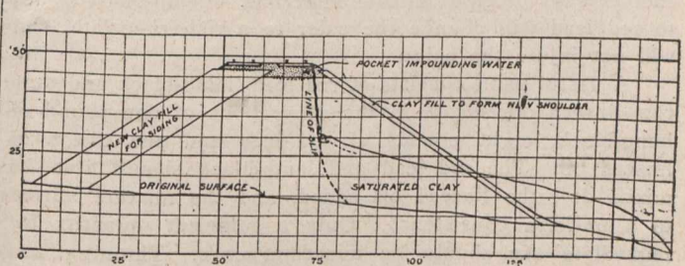

Fig. 4A—Section of Track near Bethesda, O., Showing Slip Occurring at Bottom of Sag.

ported the lighter wheel-loads and traffic. These new spots, as well as the old ones, should be thoroughly drained as promptly as possible, since each inch of settlement adds to the depth of the trench necessary to secure permanent drainage and materially increases the cost of the work. In cuts where there is seepage water on both sides, tile should be laid on both sides of the track with the necessary cross drains.

The cinder-filled trenches will intercept the seepage water and prevent it from reaching the roadbed, and the cross drains will remove the surface water and rainfall before it has time to soften up the subgrade, thus affording a dry and stable roadbed that will support the heaviest traffic with a minimum amount of section labor.

A large proportion of the section labor on many railroads is expended in maintaining surface and line of tracks over soft spots of varying magnitude, the elimination of which will greatly reduce the cost of maintenance. A thorough inspection, including the digging of cross trenches to firm soil under the track, should be made in each case, the origin of the water determined, and the necessary remedy applied.

The location of all cross drains should be permanently marked on the ground and the ends of longitudinal drains well protected from frost, and so located that the outlet will not require any attention to keep it free and open. A complete record of drains should also be kept in the division office.

PAINTING STEEL BRIDGES.

The Ontario Highways Department in their annual reports deal in a practical manner with the many questions that confront the highway superintendent. The painting of steel bridges is a most important matter that is too often neglected. In a recent report this matter is referred to.

The life of a steel bridge is largely dependent upon the manner in which it is first painted—and afterwards kept painted. Unless kept properly painted, they deteriorate very rapidly. Railway bridges are greatly injured by the vibration caused by heavy moving loads. But in the case of highway bridges, rust is the chief destructive agency. If they could be fully protected from rust, steel highway bridges would practically last forever. It is found that painting is required about once in five years; oftener if the bridge is in a much exposed situation by a lake shore.

Before painting steel, the surface should be absolutely free from rust, scale, moisture and grease. Rust is removed by scraping with steel scrappers, and scale by the use of stiff wire brushes. Rust left beneath the paint will spread, in time the paint will flake off, and the metal is then wholly exposed to the destroying action of air and moisture. As portions of the metal in a bridge are only ¼ and 9-10 of an inch thick, it is evident that rust, acting on both sides, can greatly weaken the structure. Connections, too, require special care, to see that they are fully protected. Bridge companies rarely exercise sufficient care, when erecting a bridge, to see that the scale is fully removed and the bridge properly painted.

The materials commonly used in painting bridges are red lead mixed with linseed oil, and oxide of iron, with linseed oil. The former is much the more desirable paint. These are subject to much adulteration, and care has to be exercised to procure reliable materials. Lamp-black added to red lead will change the color to a rich chocolate, and will not injure the paint.

A useful paint consists of red lead, lamp-black and pure raw linseed oil, mixed in the proportions of one pound of lamp-black, eight pounds of red lead and one gallon of linseed oil. The red lead and lamp-black should first be mixed dry, the linseed oil added, and the mixture stirred to a uniform consistency. Only a sufficient quantity for immediate use should be mixed at once. Thinning and drying ingredients should not be used.

Of the 141,006 tons of asphalt exported from the Pitch Lake, Trinidad, the United States took approximately 100,000 tons, the United Kingdom, 17,000; Germany, 18,000, and France, 6,000; there is none noted for Canada. In 1906-7, the export was 115,875 tons. Manjak to the amount of 1,806 tons was shipped from Trinidad, as compared with 1,548 of the previous year. The greater part went to America, and one ton to Canada.

A NEW ROAD PAVEMENT.*

Some months ago a Canadian company was formed to handle Westrumite, and on August 30th the city engineer of Brantford, accompanied by a committee, inspected Westrumite pavements in the vicinity of Chicago and reported to the Brantford council.

Goshen, a town with 11,000 population, was first visited. Here they inspected Fifth Street, laid with Westrumite. Part of street laid two weeks ago and part just being laid. At Jefferson Avenue at intersection of Fifth Street dents from horses' shoes one-half inch deep. Claimed that these will roll out. Street about 33 feet in width, given only five inches at a crown in part completed. Crown increased in newer part improved appearance. Laid on eight inches of broken limestone instead of concrete.

Upon layer of limestone is spread a wearing surface composed according to weight of two parts broken limestone to pass through a quarter-inch ring, two parts of fine limestone dust and two parts of coarse, clean, sharp sand, and eight parts of the best quality broken limestone, broken to a size that will pass through a ring of one-inch internal diameter and be held on a ring of one-half inch internal diameter, the exact proportions being such that a compact mixture is obtained containing not more than 25 per cent voids). One and one-half parts of a bonding material, consisting of asphaltic cement manufactured from natural asphalt and proper fluxes. These materials in proportions as specified above are thoroughly mixed cold by hand or machine, and spread upon said roadbed in such quantity that after being covered with clean sand to the depth of one-sixteenth of an inch it shall have a thickness of two inches in the centre and 1½ inches at the sides. This wearing surface is rolled till it is even with a steam roller weighing not less than three tons and not more than six tons; afterwards it is thoroughly compressed with a ten-ton roller.

It is stated this two inches of surfacing rolls down to 1½ inches, and after a top dressing is applied of one part Westrumite to one part water and one part screenings. Contract price for pavements, $1.65 per square yard, with stone delivered on the work at 85 cents per cubic yard; if laid on five inches of concrete, the cost would probably run to $2.10 per square yard.

At Lincoln Park, Chicago, they inspected about 500 square yards of pavement laid in park. Stated that old macadam broken up and about 1½ inches of Westrumite surfacing done on old stone. Stated that this pavement had not been repaired since laid in July, 1907.

Visited Oak Park, a suburb of Chicago. Population about 3,000, about fifteen miles out. Superior Street paved with Westrumite about two months ago. Length of street about 60 feet, width 28 feet of street, no curb or gutter. Laid on broken stone. Pavement less noisy than brick and asphalt pavements at either end.

At Indiana Harbor, a town of some 17,800 people, and soil light sand, the Westrumite pavement was laid on eight inches of broken stone. Cost, $1.98 per square yard. Curb and gutter, 70 cents per lineal foot. Sidewalks, 13 cents per square foot. About 9,600 square yards of pavement.

Visited McGoon Avenue, East Chicago, and inspected bitulithic pavement. Wearing surface composed of much larger broken stone than Brantford bitulithic. Laid on broken stone foundation. Some holes in this pavement, caused by shovelling from sewer construction having been left in trench. The pavement had been down four years, and apart from those had worn well.

Visited Whiting, Ind., where Westrumite works are established. Trinidad and California asphalt inspected; tasteless. They and Bermuda asphalt mixed with a flux to form Westrumite. Tests made to show that when first used it is soluble in water, and readily absorbed by the stone with which it is mixed, but that afterwards, owing to a chemical change, insoluble and waterproof. Poured on paper and at first would wash off, but later washing made no impression, and water poured on the paper would not stain.

*Abstract of a report by Mr. T. Harry Jones, city engineer, Brantford, Ont.

LEGAL NOTES.

[This department will appear in the third issue of every month. Should there be any particular case you wish reported we would be pleased to give it special attention, providing it is a case that will be of special interest to engineers or contractors.—Ed.]

CONSTRUCTION—COLLAPSE OF WALL.

Valiquette vs. Fraser & Co.—The defendants who were a lumber company carrying on operations in the Province of Quebec undertook to erect an engine house on the bank of a lake and in connection with one of their mills. The plaintiff was wife of a boilermaker employed by them and brings action for death of her husband. The company got plans from another company operating near by and used these with slight variations for the new structure. The walls were already up, the roof on, and the engine was being brought in through the yet vacant opening for doors, when on August 7th, 1903, a violent storm of wind took off the roof and caused the fall of the wall and consequent death of the boilermaker, Valiquette.

The defendant disclaimed liability, pleading that he had employed both a skilful architect and a contractor of experience; it was pointed out that the duty rests upon the person under whose control and for whose purpose the structure is maintained to use reasonable care and skill that no danger result to employees; and that the employment of a competent architect and an experienced builder will not protect the owner of there be carelessness in any other respect. In other words the duty is not a personal but a general or absolute one and he cannot screen himself behind his contractor.

It was further pleaded in defence that the storm being in the nature of a hurricane or tornado, was such that it is unreasonable to expect provision to be made against it, precaution was taken against all likely dangers, but who could always be prepared against an event which occurs only once in years? The court held that precaution against such a storm does not come within the duty of reasonable care resting upon the defendants, but is rather an act of God or force which could not be reasonably foreseen or provided against. Held also that there is a difference in the degree of care called for in an unfinished and a finished building. The incomplete building could not be as safe as a completed structure, and it was not reasonable to claim that the doors and windows should be closed in against the storm. The case is therefore dismissed with costs against the plaintiffs. 39 S. C. R.—1.

SUNKEN VESSEL—DUTY OF OWNER.

Re "The Snark."—The defendants were owners of a large barge called "The Snark," which was by no fault of theirs sunk in the River Thames, England, on August 1st, 1897. They thereupon warned the harbor authorities who put proper lights upon the wreck temporarily, and in the course of a few days the defendants contracted with a salvage man of some experience to raise the barge. The authorities then removed their lights and the defendants provided the contractor with another barge to carry on the salvage operations. The contractor anchored this craft beside the wreck as a warning to passing ships, but did so in such manner that she swung out to stream and lay at some distance instead of hardby. A German steamer coming in saw the anchored barge and gave her ample berth but in doing so ran upon the wreck.

The rule of law is that the owner of a wrecked vessel may abandon her in which case no responsibility rests upon him to remove the derelict nor yet to warn others except that when in navigable rivers he must for protection of the public warn proper authorities; but in this case the owners do not abandon their property but place a contractor in charge of same. The defendants plead that having placed a skilful salvager in control of the sunken barge they are excused from further responsibility. They claim that the salvage being in charge of an independent contractor they have no say as to the manner in which he carries on the work and no responsibility for the results.

The court points out that after the wreck they were under obligation to protect other ships from injury by the hidden wreck. The defendants could not divest themselves of this obligation by the employment of a salvage contractor, for they were still bound to see that the contractor did for them what they themselves were bound to do, namely, mark the position of the wreck. The owners of the sunken craft have failed in discharging this liability and are therefore liable.—1899, Probate 74.

SPRINKLER SYSTEM—DAMAGE FROM FROST, INTERPRETATION OF CONTRACT.

Boulter, Davies & Company vs. Canadian Casualty and Boiler Insurance Company.—The plaintiffs, who were wholesale merchants in the city of Toronto, applied to defendants for, and obtained a policy insuring property in their warehouse as follows:—"The Canadian Casualty and Boiler Insurance Company does insure Boulter, Davis & Company, ... against all **immediate** loss or damage to property of the assured, ... situate within their premises by the accidental discharge or leakage of water from automatic sprinkler system now erected in said building. .....This policy does not cover loss or damage resulting from freezing."

This policy had been in force for some months and was still extant when the water in a pipe connected with the sprinkler system froze; pipe then burst at the seam, and when the flow resumed the discharge of water caused the damage complained of.

The insurance company argued that the exception as to damage resulting from freezing saved them from liability, but it was argued on the other side that as the insurance is against **immediate** loss the exception must also be as to immediate loss, for the contract must be interpreted as one consistent whole. Now the damage was certainly an immediate result of the leakage or discharge, and the only question is as to whether the company is protected by the exception as to damage resulting from freezing.

But the loss was not an immediate result of the freezing; that in itself caused no damage but the bursting of the pipe, and the flooding and consequent damage which followed were secondary or indirect results, and do not come within the saving clause. Held therefore that the insurance company are liable under their policy and must pay the loss.—39. S. C. R., 558.

DRAINAGE: DOMINANT TENEMENT—ABATEMENT OF NUISANCE.

O'Cain vs. Audette.—The defendant who was the owner of certain lands in the Province of Quebec, erected upon his premises a large ice house and proceeded to stock the same and carry on business as a wholesale ice merchant. In erecting the structure no sufficient provision was made for drainage with the consequence that the water from melting ice proved to amount in one season to some 50,000 gallons escaped and though it did not flow upon the surface it found

its way onto the adjoining and lower lands of the plaintiff, causing excessive moisture, of which the latter complained.

The defendant argued that he had a perfect right to use his lands in any manner not prohibited by law, and that his neighbor owning lands which were lower and naturally servient to his own, was obliged to receive the escaping water. The plantiff points out that this water is no part of the natural discharge, nor a matter of which he had any warning at the time of purchase, but an increase in the vo'ume of water sent down by adding waters artificially brought to the higher land.

The text writers show that the owner of upper lands may improve his drainage in such a way as to hasten the escape of waters from his land, but without increasing the volume of waters sent down; and even here the owner below may complain if the rapid discharge cause a marked or sudden disturbance below. Held that to discharge waters brought by man to the higher level is an aggravation of the natural servitude, such that the owner of the servient tenement may recover damages and have an order for abatement of the nuisance. Judgment for plaintiff.—39, S. C. R., 103.

ESCAPING VAPORS—NUISANCE TO PROPERTY.

Tipping vs. St. Helens Smelting Company.—The defendants carried on the business of a copper smelting company and had had works erected and in operation for several years in the County of Lancaster, England, when the plaintiff purchased some 1,300 acres of an adjoining estate. The plaintiff had seen the works and chimneys nearby when making the purchase, but thought then that they were not causing any trouble or inconvenience. Later he found they were and brought this action alleging that the escaping fumes permeated the air to the injury of trees, shrubs, fruit, and even persons upon his property.

The defendants relied on the fact that their works were already in operation at the time the plaintiff came to the locality, and that the whole neighborhood was studded with tall chimneys, and that such works were a necessity in that locality.

The court disposed of the argument seriatim. It makes no difference that the plaintiff came to an existing trouble unless the defendants had by long continuance acquired a prescriptive right to continue such work, which is not the fact in this case. The answer that there are many others is no sufficient answer, for it does not make the particular one complained of any less a nuisance. The argument that such work is a necessity in this particular county and locality has some weight, for in such localities these things are unavoidable and must be encouraged; thus what would be considered a nuisance by smoke in an open country could not be considered such in e.g., the town of Shields, where an additional factory creates no nuisance but only adds infinitesimally to the volume already afloat. But even this argument has undoubted limits and when the business complained of causes sensible injury to the property of any particular person, that person will have a right of action. Persons in such localities must not stand on extreme rights but be willing to waive trifling inconveniences for the benefit of the general community. Every circumstance must be regarded and taken into consideration from a reasonable standpoint; but every man must so use his own property as not to injure that of his neighbor. Held that in this case the injury was not trifling but such as to sensibly depreciate the use and enjoyment of the plaintiff's land and residence.

Judgment for plaintiff.—(1865), 11, H. L. C., 642.

This is a leading case on the subejct of nuisance, and it appears from applying it to the facts in the case that it would be no answer for the owner of the dominant tenement to say that his icehouse was there and discharging water before the plaintiff purchased the lower lands. The injury did not exist until the plaintiff took actual occupation, and the lower lands or wished to make such use that the water would be a detriment to his property.

ENGINEERING SOCIETIES.

CANADIAN RAILWAY CLUB.—President, L. R. Johnson; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, E. A. Evans, Quebec; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, J. Galbraith; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1908.

QUEBEC BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, E. A. Hoare; Secretary, P. E. Parent, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, C. H. Mitchell; Secretary, T. C. Irving, Jr., Traders Bank Building.

MANITOBA BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, J. G. Sing; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN MINING INSTITUTE.—413 Dorchester Street West, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. G. Chace, Secretary, Confederation Life Building, Toronto.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, H. L. Holman; Secretary, Calvin W. Rice.

SOCIETY NOTE.

American Institute of Electrical Engineer.

The Executive Committee of the Toronto Section of the A.I.E.E. has arranged an excursion to Niagara Falls, Ont., on Saturday, Septembr 19th, via N.N. Company steamer, and Niagara Belt Line, leaving Toronto at 7.30 a.m. and leaving Niagara Falls at 5.15 p.m. The party is invited to visit the properties of the three Canadian Power Companies and programme for the day is being arranged. Round trip tickets good for two days, $2. W. G. Chace, Secretary Toronto Section.

The "Scientific American" calls attention to an extraordinary appearance in the heavens all over the continent which appeared during the period of drought and thunderstorms of middle August. It describes it as having a spiral and curling appearance, which from its intensity in places made the Galaxy or Milky Way across the heavens invisible. No explanation is made of its appearance except to disassociate it from the aurora borealis or from electrical storms, as no disturbance was reported on the wires. Nor did it appear to be in connection with the magnetic pole. In Nelson the astronomical reporter of the "Daily News" mistook the appearance for the smoke of a forest fire conducted upwards by a warm upward current of air into the upper regions of the atmosphere. This explanation although given elsewhere, is not accepted by the "Scientific American" which points out that the smoky appearance was luminous.

CORRESPONDENCE

[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Ed.]

NEW DRY DOCK—NOVA SCOTIA STEEL COMPANY—STREET CAR FRANCHISE.

(From Our Own Correspondent.)

Montreal, September 17th, 1908.

The American Locomotive Company, of which the "Montreal Locomotive Works, Limited," is a part, has decided, in view of the industrial situation, to conserve its capital and surplus by passing its dividend of 1¼ per cent. The Canadian plant, which has hitherto been known as the Locomotive and Machine Company, has for three years received advances for the completion of its works from the parent firm. In payment thereof, the Montreal firm has issued to the American Locomotive Company additional capital stock at par, to the amount of $2,485,000, making $3,000,000 outstanding, all of which is owned by the American Company.

During the year ended June 30th last the cost of operation of the American Locomotive Company amounted to 86 7-10 per cent. of gross earnings, against 86 3-10 per cent. for the previous year. Working capital on June 30 last totalled $16,135,588, against $15,113,455 previous year.

Some rather damaging reports were current regarding the injury caused by a recent fire at the mines of the Nova Scotia Steel and Coal Company. The following telegram received from Mr. Thos. Cantley, manager at North Sydney, on Saturday, allayed all fears:—

"Understand sensational reports current as to situation here. I have just returned from place where fire was, having been personally actually at spot; roof and walls in close proximity still warm, but two lines hose now playing on same will soon cool them. Please advise Stock Exchange and Montreal papers."

The town of Montreal West evidently has its own ideas regarding the value of a street car franchise. The town years ago refused the advances made by the Park and Island Railway, and the railway passed it by. Recently, the municipality of Notre Dame de Graces granted a franchise which brings the railway to the limit of the town of Montreal West. The company made the town another offer, asking in return a franchise for fifty years. The town took a vote of its ratepayers and the offer was refused by an overwhelming majority. The company, however, was offered a 25-year franchise, on certain conditions, among which was a stipulation that the company was to pay half the cost of snow removal.

The National Dry Dock and Shipbuilding Company, with a capital of $50,000,000, has been organized by Montreal, New York, and Chicago capitalists. The chief promoter is Mr. J. F. Stephens, of New York, and Mr. Robert Bickerdike, M.P., is one of the prominent local people interested in the company. An organization meeting is to be held here shortly. A site for a repair dry dock has already been selected in Montreal, and it is proposed to build in St. John, N.B., a second dock for the construction of steel ships and International Automatic Lifeboats. The company will take advantage of the subsidy granted by the Dominion Parliament for dry dock construction and operation.

At a meeting of the officials of the Algoma Steel Company at Sault Ste. Marie, it was decided to open the steel plant on September 15th, instead of October 1st, as formerly announced.

It was said that several rush orders for rails have been received, including some 5,000 tons for the Grand Trunk Pacific.

A general meeting of the shareholders of the Electric Service Company, of Canada, Limited, was held here last week. The directors elected were Mr. W. L. Haskell, Mr. F. W. Hibbard, Mr. J. J. Murphy, Mr. John Murphy, Mr. A. C. Barnhart.

After the adjournment of the shareholders, the directors held their meeting, electing Mr. W. L. Haskell, president; Mr. A. C. Barnhart, vice-president and general manager; Mr. C. B. Godwin, treasurer. The reports of the secretary and general manager showed the company to be in excellent shape, and in a position to go ahead with extensive operations.

The cargo carried by the S.S. "Cacouna," which recently sailed from Three Rivers for the Baie des Chaleurs, indicates active lumbering operations. She carried 250 lumbermen and a large number of horses, sleighs, and shanty outfit.

The Public Works Department, Ottawa, has awarded the following contracts:—

Wharf and warehouse at Port Hastings, Inverness County, N.S., to W. J. Landry, of Antigonish, $10,550.

Wharf at Macpherson's Cove, Cape Breton, to Reid & Archibald, of Halifax, $3,973.

THE QUESTION OF PRESERVATION UNDER NEW CONDITIONS.*

By Logan Waller Page,
Director Office of Public Roads, U.S.A.

It is to Tresauget, engineer-in-chief of the district of Limoges, that we are indebted for the first scientific treatise on broken stone road construction. He clearly specified several types of broken stone roads, one of which, in quite general use throughout England and America to-day, is known as the Telford Road. It is a matter of interest that while roads of the Tresauget type are in extensive use throughout England and America, they are rarely seen in France, the macadam type having almost entirely superseded it. Tresauget's report to the Council of Bridges and Roads, written in 1775, on road maintenance, is, in my opinion, the best ever written on the subject. Following Tresauget, McAdam made his splendid contribution. Since the time of these great engineers many improvements and modifications have been made in road building, the most important of which have been largely brought about by time and labor-saving machinery.

It is not my purpose to consider the history of road building, and I have only alluded to it for the purpose of showing that the broken-stone road of to-day has been of slow development. Although the methods of construction vary somewhat in different countries and different localities, the main object sought has always been the same—to withstand the wear of iron-tyred horse vehicles at a reasonable cost. Until the last decade these conditions have been successfully met and the broken stone road was all that could be desired. Under modern motor traffic, however, the conditions have changed. Roads which formerly withstood the wear of horse vehicles are now quickly denuded of the fine binding material, and become loose and disintegrated. On the principally travelled roads the great clouds of dust

* An address delivered before the Legislative and Good Roads Convention at Buffalo, N.Y.

raised by rapidly-moving motor vehicles are not only a great waste of the material of which the road is composed, but this dust is carried by the wind and disseminated over adjacent property to such an extent that it has, in many instances, affected the value of real estate as well as the comfort of near-by residents and pedestrians. The road surface becomes so loosened that water makes its way to the foundation, and in general the cost of maintenance has very greatly increased. With a constantly increasing motor traffic, these are, briefly, the conditions we find to-day, and which have to be met. The problem is such a serious one that it has called forth the best efforts of highway engineers in every civilized country. By the proper use of bituminous materials the mechanical difficulties have in a large measure been overcome, but the cost of such treatment is so great that it is hard to believe, at present, that such methods can ever be generally used on the many thousand miles of rural highways affected.

As already stated, the broken stone road has been developed to withstand the wear of iron-tyred horse vehicles, and has met successfully the demands of suburban and rural traffic until the advent of the motor vehicle. When in its highest state of perfection, the rock from which such a road is made is so suited to the volume and character of traffic which passes over it that the amount of dust worn off is only sufficient to replace that removed by wind and rain. The dust remaining should be just enough to bond the surface stones thoroughly, forming a smooth, impervious shell. A road of this character wears uniformly under the traffic for which it was designed, and when properly mantained always presents an even surface.

When such a road is subjected to continuous fast motor traffic, entirely new conditions are brought about. Since the advent of this new traffic its effect on the road has been the subject of much study, by both highway and mechanical engineers, and many highly interesting and ingenious theories have been advanced to account for the injury to roads derived from it. While the slipping of the tyre, skidding, shape of car body, suction and other causes contribute more or less to the injury of the road surface, I think it is quite generally agreed that the suction of the pneumatic tyre on the surface is the main cause of the trouble. The object of this paper is to show, however, that the great tractive force, or shear, exerted by the driving wheels of motor-cars is the main factor of injury.

It has been demonstrated by connecting both front and rear wheels of motor-cars with separate speedometers that there is a considerable amount of slipping of the driving wheels on the road surface, and, on account of the numerous irregularities on the average road surface, this is what should be expected. This slip, due to the decrease in the bearing surface of the tyre, undoubtedly increases the amount of finely divided material of the road surface thrown into the air. The increased amount of damage done on this account will be in proportion to the irregularities in the road and the speed of the car. While it is an important factor, its effect is greatly reduced if the road has a smooth surface.

The effect of skidding is only observable on roads that are subjected to a considerable volume of fast motor traffic, and only then on curves. The result of this is to shift the crown of the road tangentially to the gutter. While very annoying to those having the maintenance of such roads, it is not one of the serious or costly causes of injury, as it is generally confined to rather sharp curves.

It is my belief that too much stress has been laid upon the effect of the car body and its shape in removing dust from the road surface. After a number of experiments and observations, I am now convinced that little or no dust is removed from the road surface by this means, except on very dusty roads. The dust lifted by the wheels, however, is greatly accelerated by the action of the car body and the air currents set up in its rear, which has much to do with the dissemination of dust. This is one of the important factors to be considered, as much of the dust lifted by the wheels would not be carried from the road but for the air currents developed by the car body, and these, of course, are much affected by its shape.

Probably no single factor has been considered of as much importance as the so-called suction of the pneumatic tyre. Some writers have even gone so far as to maintain that a slight vacuum is created in the rear of each tyre, which is sufficient to lift the finer particles of the road surface in the air. In my opinion, entirely too much importance has been given to this phenomenon, for if it exists at all, its effect is probably so slight that it can be considered a negligible quantity, and I shall endeavor later on to give my reasons for this view.

Beyond a doubt, the most injurious action of motor traffic is the great tractive, or shearing, force exerted by the driving wheels of these cars. The fine dust which ordinarily acts as a cementing agent to the road surface is thrown into the air to be carried off by the wind, or that remaining on the road is so loosened that it is easily washed into the gutters by rain. The pneumatic rubber tyre wears off from the broken stone of the road little or no dust to replace that thus removed, and the result is that the stones become loose and rounded, giving the greatest resistance to traction and allowing water to make its way freely to the foundation of the road.

For the purpose of studying this phenomenon I recently conducted a series of tests with motor-cars of various shapes and sizes, from the 4,000-pound limousine to the small runabout. These cars were run at various rates of speed, and their effect studied on a section of average broken stone road. The most interesting result was obtained with a 60 horse-power car stripped for racing. The wheels of this car were 36 inches in diameter, with 4-inch front tyres and 4½-inch rear tyres. The weight of the car with driver and mechanism was 2,800 pound. This car was driven over a level section of broken stone road at speeds varying from five miles an hour to sixty miles an hour. The road used was a section of a Government road which had been resurfaced two years previous to the test and was in very good condition. Up to fifteen miles an hour little or no effect was produced on the road, and even at twenty miles an hour it was judged by those present that no serious damage was done. From twenty miles an hour on, however, the effect was markedly noticeable with each increase in speed. At a point on the road designated for the proper speeds, photographers with the necessary high-speed cameras were stationed for the purpose of taking photographs from different points of view of the effect produced. I have some photographs which I think illustrate the action of the wheels very clearly. They show the car travelling at various rates of speed, from five miles an hour to 60 miles an hour.

The chief point of interest in these photographs is the difference in effect on the road between the front and rear wheels. Now, if it is true, as has been claimed, that a vacuum is formed in the rear of the pneumatic tyre, or that it possesses any power of suction, this should be equally true of both front and rear wheels. I am convinced after most careful observation that this is not the case, and I think this point is illustrated by the photographs.

To sum the matter up briefly, the pneumatic tyre, or any type of tyre which propels a vehicle, must have sufficient tractive resistance to overcome the load of the vehicle. This, of necessity, must cause a shear on the road surface, which varies with the weight and speed of the vehicle. The broken stone road surface has little power to resist a shearing stress, consequently the fine material of which it is composed is thrown into the air. Once lifted from the road, this fine material is subject to the effect of air currents generated by the car body, and subsequently by the wind. In this manner large quantities of the material of which the road is composed are carried from the road and must eventually be replaced or the road will rapidly deteriorate. This action may be greatly accelerated by other causes, but in the main it is sufficient to account for the observed results. Apart from the dust carried from the road in this manner, this shearing force of the motor-car has a decided disintegrating effect on the surface of the road.

SHEARING VALUES OF STONE AND CONCRETE.*

By H. H. Quimby.

A very common failure of stone lintels is by shear—rupture in a slightly diagonal direction up from one of the points of support. It is not at all as uncommon as it should be for the seats of lintels, and similarly loaded corners of brickwork and concrete, to shear off, although the line of rupture is at a considerable angle with the direction of the stress. The seat of the proscenium arch girder of a well-known theatre some years ago sheared in this way and caused the girder to drop and wreck the roof, which was carried by it. Reinforced concrete girders were designed and built somewhat extensively before their tendency to fail by shear was generally recognized and treated with special reinforcement. There was considerable and sometimes acrimonious controversy in public print between engineers holding opposite views as to whether shear as such actually existed in the girders and caused the failures in question or not. And with the advent of light concrete arches the question of the need for adequate resistance to shearing forces in an arch ring becomes pertinent.

The substitution of one material for another, such as concrete for stone masonry, in any class of structure may not unreasonably be expected to develop some failure to make provision for stress of a kind that with a previous material has not required special provision. In the common type of stone arches any shearing stress that there may be is so low per unit of section, because of the great thickness of the haunches, that it is more than abundantly cared for; besides, the shearing value of any stone that will be regarded as good enough for an arch is quite high, compared with what is generally considered a safe compressive loading for stone masonry. Ordinary concrete, however, has a low shearing value, and the fact must have consideration in designing structures to be built of it.

The shearing failure of lintel seats and arch rings is of the character of the usual compressive failure of a concrete prism or short column—a diagonal shear at an angle of anywhere from 35 to 40 degrees with the direction of the force of compression, and it is characteristic of a material of low relative shearing value.

If, in addition to the direct compressive stress in such a prism or column, we apply force at one side deflecting the first force, unless the axis of the member be adjusted to coincide with the resultant of the two forces, the side force will constitute a true shear, and if it be applied at the point where the diagonal rupture would happen to occur from compression alone it must have the effect of lessening the resistance of the prism by both increasing the component and causing the rupture to become more nearly tensile in character. If we do, as we try to in an arch, correctly adjust the axis of the member to the change in direction of the force, the resultant force delivered to the abutment skewback is theoretically a simple direct compressive stress resisted by a bearing that should be normal to it; but in practice it is rarely quite normal, and never can be uniformly so, because of the change in position and direction of the line of pressure, due to the variation in temperature and loading. A rocking and bending motion is thus induced, and actual shearing stress is, therefore, clearly developed.

In certain recent tests of small-model concrete arches such of them as were loaded in a manner to preclude buckling from eccentricity of stress failed by shear, one wherein the depth of ring was made uniform throughout punching itself down between the abutments, the line of shear being inclined up from the edge of the skewback, the action appearing like shear in a simple beam or lintel. Exactly similar failure occurred in a number of specimen prisms made and loaded to imitate the same condition of stress. It would, therefore, seem that the fact of shearing action at the edge of an arch abutment is sufficiently established to command attention to it and require provision for it.

The compressive shear of the prism appears, by dividing the component along the line of rupture into the ruptured area, to show a unit shearing resistance of about four-tenths that of the unit direct compression. In a test for shearing value alone so high a result can be obtained only by some fanciful conditions of test that do not represent service. It is convenient to express the shearing value of concrete in terms of the compressive value, although there is not necessarily any relation between the two, for a prism might be made of flat plates not cemented together and yet develop very high compressive resistance without having any tensile or shearing strength. But if the pile be compressed at the same time by a direct pressure the friction between the plates will develop positive shearing resistance. This effect is supposed to obtain in ordinary concrete, but is evidently more than offset by the lessened resistance to the compressive stress. The problem, therefore, becomes somewhat complex. Records of tests of the shearing quality of concrete are somewhat meagre, and vary so widely that different investigators have evidently not only used widely different methods, but have varied ideas of what constitutes shear. Text books variously give the shearing value of cement mortar and concrete, one as low as 16 per cent., another as high as 104 per cent. of the compressive value, one experimenter using cylindrical specimens and shearing them like a pin in eye-bars. Results obtained by tests can be intelligently used only with a clear knowledge of the exact circumstances, and always some arbitrary allowance must be made for what formerly was called personal equation, but clearly goes far beyond that.

It is very desirable that a designer should himself make the tests upon which he depends for his knowledge of the sustaining value of the material that he uses in important structures, for ideas develop under observation of the action of forces and the behavior of material.

The character of shearing failures indicates the manner in which shearing tests should be made. The line of least resistance should be sought and the testing force applied there. As the shearing value seems to bear a fairly close relation to the tensile strength, the line of rupture in a service failure is more or less diagonal. Tests made under fanciful conditions may be misleading. A shearing test of a granular material like concrete, stone, brick or mortar should not be made as if it were of steel. Academic tests in general are liable to be more interesting than practical.

As a general proposition, a shearing test of concrete should have the cutting edges offset at least as much as the diameter of the largest particles of the aggregate in the specimen, and tests should record the facts of the amount of offset and thickness of specimen to give the angle of the line of rupture. Roughly, the nearer this line is to 90 degrees—that is, the closer the knives—the higher the result. As the inclination increases the resistance decreases, for the rupturing stress approaches tensile in character.

A large number of recent tests of concrete and stone and brick seem to fix the most desirable angle of shear for test at one in eight—the upper cutting edge set back from the lower one-eighth of the thickness of the specimen, and in the case of the concrete test this approximates the ratio between the thickness of the test piece and the diameter of the larger particles of the aggregates used in making them. Greater offset was found to be liable to cause failure by bending rather than by shear. The results obtained varied about as widely in each class as those of compressive and tensile tests of

* Paper presented at the Convention of the American Society for Testing Materials.

such materials do. The lowest in concrete, which was of pebble aggregate, was about 10 per cent., and the highest, which was of shale-chip aggregate, was about 25 per cent. of the crushing strength. Crushed limestone aggregate, as also quartz sand mortar, gave an intermediate value. A fair quality of gneiss stone sheared at about 1,000 pounds, limestone at about 1,200, Conshockicken laminated mica schist about 1,400, and Rushland black shale at about 2,500 pounds per square inch. A fair sample of red stretcher brick, such as is used for building houses, gave from 100 to 200 pounds; medium burned shale brick, from 400 to 900 pounds, and vitrified shale street paving 1,000 pounds per square inch. Specimens 6 inches square of plain 1:3:6 crushed limestone concrete, 1 inch aggregate, two months old, that would have about 2,000 pounds per square inch crushing strength, sheared at 200 pounds per square inch, with inclination of cut 1¾ in 6, 300 pounds with inclination of 1½ in 6, and 400 pounds with inclination of 1¼ in 6.

The special rig designed for the investigation of the effect of shear in combination with compression, itself failed by shear, want of knowledge and consequent lack of proper judgment having invited disaster and interrupted the work. All of the partial tests made indicate that where shear operates in a member stressed in compression, as in the case of an arch ring, ordinary concrete at ordinary unit stress does not give the margin that should be allowed. At the abutment skewback of a hingeless arch the compression in the arch is, or may be, resolved into horizontal and vertical components, and in present knowledge of the science conservative practice treats these components as actual shear, and provides for it with corresponding resistance in the arch section in horizontal and vertical lines.

In this view of the forces at work a concrete arch, especially of the lightened spandrel type that is being more and more widely adopted for both railway and highway bridges, unless it be clumsily heavy, will have higher unit shearing stress in it than modern practice warrants, when it knows it, for plain concrete. In a large arch with open spandrels the weight of the ring itself is a large part of the total load, and, therefore, increase of section will be attended with such an increase of load that higher value cannot be thus obtained economically. The alternative is some species of reinforcement, not longitudinal, but transverse. If steel be used for the purpose it should be horizontal in the column and radial in the arch. Longitudinal steel reinforcement is of doubtful value for any but tensile stress, and transverse reinforcement partakes of the nature of hooping, and must, therefore, increase the compressive strength as well as the shearing resistance. The simple expedient of making a composite or hybrid material of concrete with embedded flat stone seems to meet these requirements of transverse reinforcement, and it has been adopted in a number of cases with very satisfying results. It is a combination of stone masonry and concrete, and it has been found to combine also increased strength with reduced cost. The process consists of placing layers of concrete mixed wet and sinking into each layer as many flat stones of any convenient size as can be embedded properly. Without special effort to secure it, a very satisfactory overlapping for bond is obtained by the mere law of chance in depositing, and skilled masons are not required. This construction produces the most compact possible class of masonry. A large number of compression tests have been made on 6 and 12-inch cubes, made with embedded flat stone having a shearing resistance about six times that of the mortar of the concrete, and they gave from 30 per cent. to 50 per cent. higher ultimate crushing resistance than the similar cubes of plain concrete. A number of shearing tests of small prisms made of the same construction show even greater gain in the shearing value. Certainly, if the line of cleavage passes through the embedded stone the result will be high for concrete, provided, of course, that the embedded stone has a higher value than concrete, and stone that has not as high a shearing value as 1,000 pounds should not be used for the purpose. The further facts that this hybrid construction increases the lateral tensile strength which operates to resist settlement or other cracks and reduces the shrinkage of the mass, thus minimizing internal stresses, are incidental but important.

The science of structural design is still incomplete, not because the mathematics may be inexact, but because the materials to which the mathematics must be applied are not yet thoroughly known as to their characteristics. We learn Nature's laws by running against them—not by reasoning, and, therefore, investigation is necessary to equip us for handling its products properly, and, as the margin between success and failure—between safety and disaster—may be, and undoubtedly often is, very narrow, it behooves us to study thoroughly by tests all the peculiarities of our materials of construction.

THE COMING CONVENTION AND EXHIBITION.

Toronto will be the meeting place for the first Convention and Exhibition to be held under the auspices of the recently formed Canadian Cement and Concrete Association during the first week of February. This decision was reached at a meeting of the Executive held at Toronto, Monday evening, September 7th. This is the first convention of its kind to be undertaken in Canada. It will be a meeting-place for all Canadian cement and concrete interests, where some of the highest authorities on cement and concrete will be present to address the assembly and to give their best unbiased knowledge on many of the more important subjects. Questions of general interest that have for their object the betterment of the industry at large, will be given due attention. They will form the foundation for what is hoped to be a Canadian National organization for advancing the best interests of the industry in Canada. The primary object of the Association is to give to the general public reliable, serviceable and economical methods of construction. If it accomplishes this work it has fulfilled its mission. Now that definite plans are under way for the first Convention and Exhibition, cement men everywhere are requested to lend a hand to the good work of making the first Canadian Cement and Concrete Convention one to be proud of.

IRON ORE CEMENT.

A number of cements made in Germany are recommended by the various companies as suitable for hydraulic purposes. The "sea-water proof" cement or ore cement (Erzcement) is manufactured about fifty miles from Hamburg. It is claimed that the Erzcement is a product which can be used with economy and efficiency for works constructed in sea water, in tunnels, etc., where ordinary Portland cement will deteriorate. The raw materials used in the manufacture of the product are: (1) Pure chalk, that is, chalk containing 99½ to 100 per cent. of pure carbonate of lime; (2) roasted flint stone, very finely ground; and (3) finely ground ferric oxide.

RAILROAD EARNINGS.

	Week ending.	1907.	1908.	Change.
C.N.R.	Sept. 7	$188,700	$175,300	— $13,400
C.P.R.	Aug. 31	2,243,000	2,008,080	— 235,000
G.T.R.	Sept. 7	831,054	990,736	+ 159,682
T. & N. O.	Aug. 31	31,000	26,000	— 5,000
Montreal Street.	Sept. 5	73,248	74,739	+ 1,491

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS.

Quebec.

MONTREAL.—Tender for lighting unit will be received at the office of the City Clerk, City Hall, until 12 o'clock noon, on Friday, the 18th September, 1908, for the supply and erection at the Low Level Pumping Station, Point St. Charles, of one direct current electric generator, of about 17 k.w. capacity direct coupled to steam engine for electric lighting. L. O. David, City Clerk.

Ontario.

HESPELER.—Tenders, addressed to the undersigned, will be received up to 6 p.m., Monday, September 21st, 1908. (1) For the supply of cast iron pipe, special castings, hydrants, valves, and valve boxes, for a system of waterworks; (2) for the excavation, laying pipe, setting hydrants and valves, and backfilling. Plans and specifications may be seen, and forms of tender obtained at the office of the engineers, Davis & Johnson, Berlin, or the Town Clerk, Hespeler. W. Brewster, Town Clerk.

WELLAND.—Tenders, addressed to the undersigned, will be received at the office of the Town Clerk until 8.30 p.m. on Saturday, September 19th, 1908, for the construction of a trunk sewer in the town of Welland. Each tender must be accompanied by a marked cheque for $2,500. The lowest or any tender not necessarily accepted. G. R. Boyd, Acting Clerk, Welland, Ont.

TORONTO.—Tenders will be received until September 22nd for the construction of four sections of asphalt pavement: One section bitulithic pavement; two sections vitrified brick; two sections common brick; two sections concrete pavements; three sections concrete curbing; thirty-nine sections concrete walk; four sections of sewers. Joseph Oliver, Mayor, Chairman of Board of Control.

BRAMPTON.—Tenders will be received by the chairman of the Sewerage Committee until noon, Saturday, September 19th, 1908, for the furnishing of all materials and labor for the putting in 8 and 10-inch pipe sewers in the town of Brampton upon about 5,000 feet of street line. Also for the construction of laterals. Plans, specifications, etc., may be seen at the office of Banks Rushford, Esq., Town Engineer, Brampton. T. J. Blain, Clerk of the Municipality of Brampton.

LATCHFORD.—Tender for dam at Latchford will be received at this office until 4 p.m., on Monday, September 21st, 1908, for the construction of a dam across the Montreal River at Latchford, and dredging channel at Pork Rapids, district of Nipissing, Ontario, according to a plan and specification to be seen at the office of J. G. Sing, Esq., Resident Engineer, Confederation Life Building, Toronto, on application to the postmaster at Latchford, Ont., and at the Department of Public Works, Ottawa. By order, R. C. Desrochers, Assistant Secretary, Department of Public Works.

OTTAWA.—The National Transcontinental Railway Commissioners are calling for new tenders for the two sections of the road in "D" and "E" divisions, not yet under contract. The districts comprise a stretch of 104 miles westerly from the end of Faquier Bros.' Abitibi contract, and a stretch of 100 miles westerly from a point about 60 miles west of the easterly boundary of district "E," north of Lake Nipegon. When tenders for all the remaining unfinished sections of the Transcontinental were called for last month only one tender for each of these two sections was received. The commission found that these tenders were not strictly in accordance with the conditions prescribed, and have accordingly called for new tenders. Tenders are also being called for the construction of locomotive shops for the Winnipeg terminals.

Manitoba.

BOISSEVAIN.—Tenders will be received up to 12 noon of Monday, September 28th, 1908, for apparatus for an electric light plant, including boilers, engine, generator, switchboards and street lighting apparatus. Alternative tenders for a gas producer plant instead of steam plant will be considered. Plans, specification and all information may be obtained on application to the undersigned. or to W. E. Skinner, Limited, Consulting Engineers, 518 Somerset Block, Winnipeg, Man. G. C. Smith, Clerk.

CONTRACTS AWARDED.

Ontario.

NIAGARA FALLS.—Queen Victoria Niagara Falls Park Commission has let the contract for section 4 of Niagara Boulevard to Messrs. Upper & Lobb, of St. Catharines. The section is two and three-quarter miles long and the price stipulated is $32,500. Section 1, which is being done by the Queenston Quarry Company, is now about half finished, and the Commissioners made an inspection on Saturday.

NIAGARA FALLS.—The Ontario Power Company is preparing to add two units to the six units in their power house. The contract for the extension to the power house has been let to H. D. Symmes. The building is to be completed by December 1st, but the electrical apparatus will not be fully installed until eight months later. The two units will bring the total productive capacity of the plant up to 85,000 horsepower. The increase is made necessary under the contracts with the Hydro-Electric Power Commission. Work on the new buildings begins at once.

THOROLD.—Three tenders were received for the gate house for the waterworks, viz.: Duncan Mavor, concrete block, $668; W. R. Cave, wood, $629; W. R. Cave, brick, $729. Duncan Mavor's tender was accepted.

PORT ARTHUR.—Ten tenders were received for construction of the Current River dam, and on a basic figure per yard were figured out by the engineer as follows: Stewart & Hewitson, $34,908.50; Labbe & Roberge Co., $37,141; Wm. Newman & Co., Winnipeg, $37,055; J. Paananen & Seppala, $38,617.50; E. T. Ross, $39,844.50; Chas. Sherwood, $42,-684.50; Archibald & Co., Winnipeg, $42,880; O'Boyle Bros., Soo, Ont., $44,069; A. T. Fifield, St. Catharines, $45,590. Pease Bros., no basic prices, but lump sum $34,000, tender did not conform to specifications and was not considered. According to the plans prepared by Smith, Kerry & Chace, the dam will be an ornate structure. It will be of cement erected on top of the solid rock, 600 feet long, and with retaining wall and embankments of 1,300 feet, the latter 13 feet wide at the base and 10 feet at the top. The dam at the base will be 14 feet wide, and will have a 4-foot walk with hand rail on top, so that visitors to the park can pass over from Court Street and visit the opposite side of the river.

OTTAWA.—At the Exchequer Court on September 10th orders were issued for the sale of the Baie des Chaleurs and Atlantic & Lake Superior Railways. There were only two tenders, both from the Royal Trust Company, Montreal. The Baie des Chaleurs bid amounted to $1,050,000; that of the Atlantic & Lake Superior Railway amounted to $350,000. An order of the court was made accepting the tenders and requiring the Royal Trust Company to give a bond of $600,000, as a precaution against a claim by the Northeastern Banking Company, of England, which has a claim that will come up

for hearing on appeal at the next sitting of the Supreme Court of Canada.

GLENCOE.—The contract for the public building here was awarded to George A. Proctor, of Sarnia, at $16,238.

TORONTO.—The contract for the construction of the concrete magazine at the Fort was awarded to Baker and Jordal. Price, $3,467.

WELLAND.—The contract for the public buildings here was awarded to Nagle and Mills, of Ingersoll. Price, $56,526.

TORONTO.—Messrs. Bake & Jordahl, of Toronto, have secured the contract for the concrete foundations for the new buildings for the Harris Abattoir Company, Toronto, Ont.; the equipment, trucks and cradles for marine railways, for Royal Canadian Yacht Club, Center Island, Toronto, and the electrical installation at new factory of Spirella Manufacturing Company, Niagara Falls, Ont.

TORONTO.—Tenders were open by York Township Council for the Holly Bridge, near Weston. The tenders were as follows:

	Lump Sum.	Extra Concrete.	Extra Excavation.
McLennan & Alexander.	$1,299	$5.00	$0.40
O. L. Hicks	1,365	....	....
E. C. Lewis	1,480	6.50	0.40
Merrill & McAllister	1,525	6.50	0.45
Baker & Jordall	1,690	5.50	1.00

The contract was awarded to McLennan & Alexander.

Manitoba.

WINNIPEG.—The Dominion Government has awarded the contract for the whole of the steel work at St. Andrews locks to the Canada Foundry Company, and the Canadian General Electric Company. This contract, which amounts to nearly $600,000, includes all the steel work on the locks, dam and bridge, together with the steam and electrical installations for handling the curtain locks. The work of getting out the steel will be begun at once and will be completed next summer.

British Columbia.

VANCOUVER.—British Columbia Electric Railway awarded the contract to John McDougall Company, of Montreal, for the installation of the new eleven thousand horsepower turbine at Lake Buntzen, which, with other improvements, will cost $300,000.

Foreign.

NEW YORK.—We are advised that the Niles-Bement-Pond Company have just sold to the American Steel Company of Cuba, one Allen Jaw Riveter, 25-inch reach, 15½-inch gap, 10-inch cyl., same being intended for special work. A short time since John F. Allen also shipped a riveter to the Ansonia Copper Company, Matanzas, and another to Krajewski-Pesant Company, Havana.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—During the period May 1st to August 31st the Grand Trunk Railway System have added to their equipment the following new rolling stock: 2 standard dining cars, 25 first-class cars and 3 mail cars, also 10 ten-wheel passenger locomotives, 10 switch cylinder, 10 Simplex Mogul Freight Locomotives and 20 Richmond Compound Consolidation Freight Locomotives.

The Grand Trunk Pacific have also added to their equipment in the same period, 3 first-class cars, 9 second-class cars, 4 baggage cars, 2 sleeping cars, 2 baggage and smoking cars, 19 Hart Convertible cars, 1,582 box cars and 15 cabooses.

Ontario.

NELSON.—The C.P.R. are constructing a new spur on their Lardo branch for the Canadian Granite and Marble Co. The manager of the company, Wm. Shackleton, intends opening up an extensive quarry at this place and a large steam derrick is to be installed for that purpose. The business of the company is assuming large proportions, more especially at Fernie, Lethbridge, Edmonton and Regina. At the last two mentioned places large contracts with the Governments of Alberta and Saskatchewan are under consideration.

LONDON.—There is talk of two new railway lines into London. One through Aylmer and Belmont direct to the city. This line will be about 35 miles and a subsidy has already been granted by the Government to the extent of $6,400 per mile for construction. The road will be run by steam. The promoters, chief of whom is J. H. Teall, of Tillsonburg, who pioneered and built the present Tillsonburg & Port Burwell line, now part of the C.P.R. System, hope to commence breaking up the ground immediately after the frost goes in the spring. Estimated cost $1,000,000.

The other line is the Stratford Radial Railway, which will run from Stratford to Exeter, Hensall, St. Joseph and the shore of Lake Huron. A commencement will be made almost immediately; in fact, Engineer J. Lewis Thomas, of this city, has been retained as engineer for both lines, and in the case of the Stratford line has already staked out a section of the road ready for the contractors.

Manitoba.

WINNIPEG.—The final location party of division F. of the Transcontinental Railway, in charge of F. P. Moffat, C.E., and consisting of 18 men, finished work and returned to Winnipeg. The party left Trout Lake on Friday, September 4th, and took the water route to Nepigon. The party has been engaged in location work between Sturgeon Lake and Lake Nipigon for the last 14 months and completed the location in the district some weeks. The men have since been engaged in building shacks for the construction gangs which will follow. The country in which they have been working they say is wild and rocky. There are indications of iron and gold in the Sturgeon Lake district.

WINNIPEG.—The Government is calling for tenders for the erection of locomotive shops for the N.T.R. The building will be 800 x 130 feet. The entire expenditure on the shops, including the company's portion, is expected to involve five million dollars.

Saskatchewan.

LUMSDEN.—The C.N.R. between here and Regina and the eight-mile stretch of new grade west of the town on which the steel has been laid, will be ballasted this fall and the entire twenty-eight miles put in first-class shape.

British Columbia.

VANCOUVER.—The Grand Trunk Pacific Railway has just adopted a cut-off in Northern Cariboo that will effect a saving in mileage of between one hundred and one hundred and fifty miles. The main line as now finally located, will run across the country due west from Grand Rapids, on the south fork of the Fraser to Fort George on the main river. The original surveys followed the south fork of the Fraser to its junction with the north fork, where the main stream takes a big bend to the north before swinging south to Fort George.

HOWE SOUND.—The Pemberton Meadows & Northern Railway have filed plans of their proposed route, and are negotiating for right of way.

LIGHT, HEAT, AND POWER.

Ontario.

CAMPBELLFORD.—The Smart-Turner Machine Company, Limited, Hamilton, have received an order for a Duplex power pump from the Northumberland Paper & Electric Co., Campbellford, Ont.

OTTAWA.—The Ottawa district is suffering from a severe drought, the result of which is that the water in the Ottawa River has seldom been lower. The effect on the industries at Chaudiere is serious. Mr. J. R. Booth is the heaviest sufferer. His large pulp mill of fourteen grinders stands idle during half of the time. The E. B. Eddy works has also been seriously affected.

BRANTFORD.—In connection with the Galt Electrical Manufacturing Company, the Lyons Electrical Company of this city is installing a large generator at Burford. The lighting at that village has not given satisfaction of late, but the installation of the new machinery will ensure good lighting for the village in future.

SEWERAGE AND WATERWORKS.

Ontario.

TORONTO.—The Provincial Board of Health have passed upon a number of matters affecting different parts of the province. City Engineer Ker, of Ottawa, reported having made a number of floating tests to ascertain the possibility of the contamination of the water supply by the pouring of raw sewage from Aylmer into that part of the Ottawa River known as Lake Deschenes. The necessity of Aylmer treating its sewage will be pointed out to the Quebec health authorities. The board did not approve of the pouring of raw sewage into the Detroit River from Sandwich. Partial treatment by liquifying at least is recommended. The plans for the new Oakville waterworks system and the tuberculosis sanitarium at Ottawa were approved. Satisfactory reports were received of the tuberculosis exhibit at the fall fairs. Dr. Connell reported the results attained at the branch laboratory at Kingston. A disposal plant near the Rideau River is a feature of the sewage system for Ottawa South, which will have liquefying tanks and a bacteria bed. It will drain 135 acres with a tributary area of 65 acres.

British Columbia.

VERNON.—Messrs. Galt & Smith, Toronto, Ont., have been instructed to make surveys and report on the possibilities of B. X. creek as to the quantity of water that may be impounded on its banks, possible storage, etc. They now have a party of engineers in the field collecting data.

MISCELLANEOUS

Ontario.

NIAGARA FALLS.—The plans for the proposed armory at Niagara Falls have been received. The plans show a three-company armory to be constructed so that it may be enlarged. It will be built of brick, with stone facings, two storeys and basement, the outside measurements being 40 by 75 feet. The basement will contain a shooting gallery, bowling alley, store rooms, etc., and the ground floor will have a lecture room, band room, store rooms, etc., and the first floor will contain rooms of the officers' mess, etc. The estimated cost is $40,000.

New Brunswick.

DOVER.—Orders have come to repair the two stone bridges in Dover that are in a tumbledown condition. These bridges were built only three or four years ago, on the dry masonry principle. Owing to error in design, however, no provision was made for pressure from the roadway, and the walls over the culverts were pushed outward, carrying parts of the roadway with them. It is proposed to give the "facing" a natural slope, or batten, which will stand any pressure that can be put upon it. It is thought when the work is done according to this design it will last for an indefinite period.

Manitoba.

PORTAGE LA PRAIRIE.—A Government engineer has been sent to supervise the straightening by new channels the abrupt bends in the Assiniboine River between Portage la Prairie and Winnipeg. This in order to prevent the river overflowing and flooding the farm lands, which misfortune has occurred more than once and harmed the repute of the district.

Saskatchewan.

INDIAN HEAD.—The Dominion Forestry Department has fitted up convenient and roomy offices here. The work of autumn distribution of trees throughout the West, is now in full operation.

REGINA.—Suits for eight thousand dollars commission are to be commenced against the City Council for failure to accept any one of the plans submitted for the new municipal hospital. Each one of the architects who entered competition is asking one per cent. commission.

YORKTON.—The work of extending the Yorkton gas works commenced this morning. A brick addition to the present building is being constructed and inside this a gasometer with a capacity of 1,400 cubic feet will be built at a total cost of $7,000. The plant now has a gasometer with a capacity of 1,125 cubic feet, but owing to the great demand for gas it was found necessary to increase the capacity. The company's total capacity will now be 2,525 cubic feet and this can be generated as often as it is found necessary.

British Columbia.

VICTORIA.—The work of installing the new wireless telegraph station being installed at the Driard Hotel is proceeding rapidly, and it is expected that the station will be ready for business in a few days. L. C. Dent, who established wireless stations at many of the signal stations of the United States, and G. B. Cooper are installing the apparatus. R. H. Armstrong, superintendent of construction and operation for the United Wireless Telegraph Company on the Pacific coast, is in the city superintending the work.

VANCOUVER.—The Canadian Pacific Railway Co. are equipping their new boats on Kootenay Lake with Duplex Outside Packed Plunger Pumps with pot valves, being built by The Smart-Turner Machine Company, Limited, Hamilton.

PERSONAL.

MR. F. M. SPAIDAL, superintendent of the Canadian Northern-Quebec & Lake St. John Railway, is visiting in Toronto.

MR. W. E. STEWART has removed from Revelstoke, B.C., and is now resident engineer E. & N. Railway, Wellington, B.C.

MR. JOHN BAKER, contractor of Bracebridge, Ont., has sold his plant to Mr. Robert Findley and removed to Vancouver, B.C.

MR. D'ARCY SCOTT, K.C., Ottawa, Ont., Hon. Thos. Greenway, Winnipeg, Man., and Prof. S. J. McLean, of Toronto, Ont., have been appointed to the Dominion Railway Commission.

The firm of John L. Richardson & Company, agents for the well known brand of Atkins steel, has just moved its headquarters from 132 Bay Street, to the corner of Front and Church Streets, this city.

MESSRS. SINCLAIR & SMITH, consulting engineers of New Liskeard, Ont., have re-arranged their business arrangements, and the work will now be carried on under the name of Sinclair, Sutcliffe & Neelands.

MR. R. E. W. HAGARTY, B.A. Sc., Toronto, Ont., who has just recently returned from the Yukon, where he was engaged with the Guggenheimers, has accepted a position with Hazen & Whipple, Consulting Engineers, New York.

MR. M. H. A. Hoy, M. Inst. C.E., has been appointed manager of the Imperial Locomotive Company, Montreal. This is a new company now building works at Lachine. They are said to be an offshoot of Beyer, Peacock & Company, Limited, of Manchester, Eng.

OBITUARY.

MR. WM. G. ELLIOTT, managing director of the Ontario Portland Cement Company, and one of the most prominent of Brantford's business men, died suddenly on September 13th, 1908. A week ago he had a stroke of paralysis. Mr. Elliott, who was 44 years of age, organized the company in 1902. He was senior member of the firm of Elliott & Nihan, which constructed the cement portion of the Canadian approach to the Sarnia tunnel. Afterwards the same firm had the contract for the construction of the Brantford to Water-

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HORIZONTAL BOILERS.

1 refitted 66" x 14' 7" with 106 3" tubes.
1 refitted 60" x 14' 7" with 74 3" tubes.
1 refitted 60" x 12' with 74 3" tubes.
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1 refitted 50" x 14' with 64 3" tubes.
1 refitted 56" x 12' with 60 3" tubes.
1 refitted 50" x 13' 11" with 50 3" tubes.
1 refitted 46" x 11' 10" with 52 3" tubes.
1 new 44" x 10' with 38 3" tubes.
1 refitted 44" x 11' 3" with 36 3" tubes.
1 refitted 40" x 12' with 21 3" tubes.
1 refitted 38" x 13' 2" with 33 3" tubes.

HORIZONTAL ENGINES.

1 nearly new 15" x 20" slide valve, heavy duty.
1 refitted 14" x 20" R.H. rocking valve.
1 refitted 13" x 20" R.H. rocking valve.
1 refitted 12" x 16" L.H. slide valve.
1 nearly new 11" x 15" C.C. slide valve.
1 refitted 10½" x 14" C.C. slide valve.
1 refitted 10¼" x 16" R.H. slide valve.
1 refitted 11" x 11" C.C. rocking valve.
1 refitted 9" x 14" R.H. slide valve.
1 new 9" x 12" L.H. slide valve.
1 refitted 8⅜" x 12" L.H. slide valve.

DUPLEX STEAM PUMPS.

1 new 8" x 5" x 12", 122-224 gallons per minute.
1 rebuilt 7½" x 4½" x 10", 103-172 gallons per min.
1 new 7½" x 4" x 8", 82 gallons per minute.
1 refitted 7" x 4½" x 8", 75-150 gallons per minute.
4 new 6" x 4" x 7", 76-114 gallon per minute.
2 refitted 5¼" x 3¼" x 5", 50-100 gallons per min.
1 new 4½" x 2¾" x 6", 30-60 gallons per minute.
10 new 4½" x 2¾" x 4", 20-40 gallons per minute.
4 refitted 4½" x 2¾" x 4", 20-40 gallons per minute.
12 new 3" x 2" x 3", 8-20 gallons per minute.

New modern sand lime brick plant complete, a bargain, immediate delivery.

A copy of our supply catalogue or monthly stock list for the asking.

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PILE DRIVERS.

10 x 24, 4000 pounds "Warrington" Steam Hammer, slightly used.
10,000 pounds Drop with Leads and Turn Tables, An extra good rig.

CONCRETE MIXER.

Gould, Shapley & Muir, slightly used.
P. Dierlamms' Cement Block and Brick Machine. New.

GENERATORS.

4, 150 Arc Machines.
1, 2½ K.W. Exciter.

MOTORS.

2, 250 H.P. A.C.
1, 10 H.P. D.C.

TRANSFORMERS, ETC.,

4, 40 K.W. Oil Cooled. New.
4, 50 Light Western Arc Regulators.

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14" x 28" "Meyers Valve" Engine, Fly Wheel Governor complete with boiler.

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New 40,000 ft. "Moist Air" Dry Kiln with 36 steel trucks and Morehead Steam trap.

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Sault Ste. Marie, Ont.—Pratt, Limited, $40,000; R. G. Pratt, J. H. Bryan, Sault Ste. Marie; N. B. Gould, Port Hope.

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have the following :

1 Horizontal Boiler 36 x 12.
1 Horizontal Boiler 38 x 14.
1 Horizontal Boiler 48 x 11' 6".
2 Horizontal Boilers 48 x 12.
2 Horizontal Boilers 54 x 12.
1 Horizontal Boiler 60 x 14.
2 Horizontal Boilers 60 x 16.
6 Fitzgibbon Type Portable Boilers 60 h. p. each, good for 60 lbs. steam pressure.
1 Heine Water Tube Boiler, 70 h. p.
3 Heine Water Tube Boilers, 125 h. p.
2 Yarrow Water Tube Boilers, suitable for Tugs or Steamers.

Mountainview, Alta.—Montana Lumber Company.

Wainwright, Alta.—Wainwright Lumber Co.

Taber, Alta.—Monarch Collieries.

Du Rochervill, Alta.—Sentinel Sawmill Company.

Campbelltown, N.B.—J. & D. A. Harquail Co., $50,000; D. Richards, Dalhousie; H. H. Gunter, J. Harquail, Campbellton.

British Columbia.—Gulf Stream Ranch, $50,000. International Hydraulic Mining Co., $100,000. Prince Rupert Transfer and Storage Co., $10,000. Skeena Lumber Co., $75,000. Structural Material Co., $100,000.

TRADE INQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commis-

(Continued on page 26).

ford branch of the T., H. & B. Railway. Mr. Elliott also had contracts on the Erie, the New York Central and the Rochester and Pittsburg Railways in the United States. Forming a partnership with Mr. W. E. Phin, now a successful contractor of Welland, Mr. Elliott rebuilt the Wilkes dam on the Grand River, and was associated with him in other works. Some nine years ago, Mr. Elliott seeing the great possibilities of cement and the varied uses to which it was destined to be used, bought the marl beds at Blue Lake and formed the Ontario Portland Cement Company. After three or four years of indefatigable work the company, capitalized at $450,000, was successfully put into operation, and this may be looked upon as the crowning effort of a varied and strenuous career. The company to-day is one of the strongest in Canada, and the directors and shareholders have to thank Mr. Elliott for placing it in that enviable position. He well deserved a place among the successful ranks of Brantford's captains of industry.

MARKET CONDITIONS.

Toronto, September 17th, 1908.

Among building materials, bricks have been active but the demand is declining, and the price has weakened perceptibly. Cement keeps low, and large orders are scarce, but retail dealers report active movement. Such goods as fire bricks, sewer pipes, building paper and felt show a moderate consumptive demand. Lumber is neither active nor particularly firm. Shingles and lath are decidedly low in price.

The metal market cannot be said to show briskness. Enquiries continue to be made for heavy goods, but transactions are limited. Little or no movement in pig-iron, structural steel also quiet; in the Old Country the depression in shipbuilding greatly lessens the steel output. The statistical position of copper is unfavorable, but there are signs of improvement in both demand and price.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—Price unchanged at 8¾c., with better demand.

Bar Iron.—$1.95 base, from stock to the wholesale dealer.

Boiler Plates.—¼-inch and heavier, $2.40. Fair supply, prices weaker. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Demand limited. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15.30; 4-inch, $19.45 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Decidedly more active.