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The Canadian Engineer

ESTABLISHED 1893.

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TORONTO, CANADA, DECEMBER 17, 1909.

CONTENTS OF THIS ISSUE.

VOLUME XVIII.

With the issue of December 31st we will close Vol. XVII., and our first issue in January will commence a new volume. So many engineers now bind their copies of The Canadian Engineer that we feel warranted in making special mention of the new volume, knowing many more are anxious to add to their technical libraries by preserving their technical magazines.

During the first six months of 1910 we will have special series of articles dealing with

Railroad Location.
Gas Engine Design.
Practical Astronomy.

Machine Design and Operation.
Steel Bridge Design and Erection.
Concrete and Reinforced Concrete Construction.

Costs and Cost-keeping.
Legal Decisions Affecting Engineering.
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Critical Book Reviews.
Current Construction News.
Lists of Engineering Literature.

Market Conditions.
Railway Signalling.
Locomotive and Stationary Engine Design.

Railway Earnings.
Precipitation at Fifteen Centres.
Orders of Dominion Railway Board.

ANNUAL MEETINGS.

During December and January the annual meetings of most of the technical societies will be held. New officers will be elected, reports adopted, and, this great effort over, we will go to sleep, in some cases, for another year.

A society is like a business. To be successful, someone must regularly, persistently and untiringly work for its advancement.

Look over the history of those successful societies you are familiar with, and you will find they are a "one-man organization." Somebody has made it his own personal business to arrange meetings, get after new members, and enthuse the membership. When he drops out, for a time things go on as before, but very soon the personal touch is lost and things drift.

Let us not be suspicious nor envious of the man who gives hours and hours of unselfish devotion to a public cause.

Technical associations are again like business ventures. To be successful they must give value for money received. No matter how venerable the name nor how beautifully worded the first clause of their constitution, unless they are a working, living force they serve no purpose in the community, they damn the profession they are supposed to represent, and are a useless load to their members. It would be better to have no organization at all than a lifeless, purposeless one.

Every new movement has its day of "little things," but keep it growing, spend more money, open new departments, branch out—grow.

TRAINING MECHANICS.

This is the day of the trained man. To be a leader to-day a man must be a specialist; but, more than that, if a man wishes to keep even a good place in the ranks he must be skilled and trained.

Competition is keen in the business world to-day—keener than it has been for years. The department manager must cut cost down to the very last fraction of a cent. He may do that by lowering wages or by reducing waste and increasing output. It is recognized that the trained mechanic, understanding his work and why he does it, interested and informed, will with the same effort produce better and surer results than the workman who is a mere machine.

The Grand Trunk Railway mechanical department recognized the value of trained mechanics years ago, and were pioneers in attempting to solve the problem of effectually supplying the demand for skilled mechanics. Their solution has appealed to heads of other large industrial corporations, and has been copied in whole or in part.

In a booklet, entitled "Training Modern Mechanics," issued recently, the Grand Trunk Railway tell how this great railway system solved the apprenticeship problem, and furinshed its own shop and those of many other large companies with master workmen and master mechanics.

The boy leaving day school, stepping out into the world to make his own way, must pass a physical test as to sight, hearing, writing, spelling and arithmetic. Having passed a satisfactory examination, he is then taken on under articles agreeing to serve faithfully four or five years with the company. Stripped of all its legal phraseology, "This Indenture" simply means the boy must work where he is put, and out of working hours do a certain amount of study, the company agreeing to pay him for his labor, provide instructors, class-room and courses of study, and foremen who will do more than exact toll, men who will take pleasure in instructing the apprentice.

The apprentice is encouraged, guided, rewarded. The company secure a loyal employee, a man who grows up to respect the company that educated him and made him more than a machine.

The working out of this system has taken years of study, adjusting and revision, but the results to the Grand Trunk Railway and to Canada have justified the effort.

EDITORIAL NOTES.

We have sometimes wondered why members of the engineering profession do not take a more active part in the administrative departments of our country. Perhaps it is because in the ordinary routine work there is so little to do. It is interesting to notice that when the position of Lieutenant-Governor of British Columbia—a real, live position, where much is doing—is vacant, it is filled by an engineering-contractor—by a man who has always been busy doing things.

Lieutenant-Governor W. P. Paterson — railway builder—we extend congratulations.

* * * *

According to returns made under the Mining Act to the Provincial Bureau of Mines, the output of the metalliferous mines and works of the Province for the nine months ending September 30th, 1909, was as follows: Gold, 1,125 ounces, valued at $18,026; silver, 18,751,549 ounces, valued at $9,385,600; cobalt, 427 tons, valued at $79,450; arsenic, 780 tons, valued at $39,221; copper, 5,583 tons, valued at $740,677; nickel, 8,912 tons, valued at $1,921,363; iron ore, 205,262 tons, valued at $473,770; pig iron, 294,698 tons, valued at $4,095,735; zinc ore, 785 tons, valued at $8,000. The gross production amounted in value to $16,762,742, as compared with $12,185,511 for the first nine months of 1908.

SOCIETY NOTES.

Central Railway and Engineering Club of Canada, Toronto.—The regular monthly meeting of the above club will be held in the Assembly Room, Prince George Hotel, on Tuesday, December 21st, at 8 p.m., when a paper will be read on "Gas Manufacture," by Mr. C. G. Herring, chief draughtsman, Consumers Gas Company, Toronto.

* * * *

Canadian Society of Civil Engineers, Montreal.—An ordinary meeting of the society was held on Thursday evening, 16th inst., when Mr. A. D. Swan, resident engineer, Montreal harbour works, gave a description, illustrated by lantern slides and cartoon drawings, of the construction of the new harbour, wet dock, and graving dock, at Bristol, England.

* * * *

Engineers' Club, Toronto.—At the Engineers' Club last Thursday evening Mr. A. Sothman, Dr.E., chief engineer of the Ontario Hydro-Electric Power Commission, took about sixty local engineers for a trip over the Ontario Government's transmission line, which will shortly supply Niagara power to the large towns and cities of south-western Ontario. Mr Sothman presented a map of the country affected, showing the route of line and the points it touches, following which lantern slides illustrating the progress of the construction work and the method of erecting the towers, the type of apparatus used and the lay-out of the different transformer stations were provided together with much information. Mr. A. B. Barry, C.E., presided.

COMING MEETINGS.

Montana Society of Engineers.—January 6-8. Annual meeting at Butte, Mont. Secretary, Clinton, H. Moore, Butte.

American Association for the Advancement of Science.—December 27. Annual meeting at Boston, Mass. Secretary, L. O. Howard, Smithsonian Institution, Washington, D.C.

American Society of Agricultural Engineers.—December 28-29. Annual meeting at Ames, Iowa. Secretary, L. W. Chase, University of Nebraska, Lincoln, Neb.

CONCRETE BRIDGE FAILURE

During the summer of 1909, there was erected on Concession B, Township Etobicoke, York County, Ontario, a concrete bridge. The reproduced photo gives some idea of the style of the structure.

The span was ten feet, making the opening through the bridge for the water ten by six. From the bed of the stream to the top of the concrete guard the height was about twenty-six feet so that when the roadway was filled in there was about thirteen feet of earth over the floor.

The reinforcement consisted of three-quarter inch plain rods placed two foot centres in the walls and twelve-inch centres in the floor.

After the bridge had been completed nearly two months and the thirteen foot fill over the floor completed the centres were struck and almost immediately the floor fell.

The accompanying photo gives a good idea of the break. The floor fell in, the horizontal crack in the face of the wall shows the depth of floor.

On examination the concrete appeared good being of correct proportion and had set well. The weakness appeared to be in the design.

A calculation made from measurements taken after the failure shows a stress of at least 41,500 pounds per sq. in. on the steel in the floor slab and a stress of 1,100 pounds per sq. in. in the concrete.

This certainly looks like a case where the design has been at fault.

Municipalities are slow in learning that they must employ competent engineers in connection with engineering work, and contractors familiar with such work are learning to leave work alone unless it has been designed by engineers known to be experienced.

Cheeney Creek Bridge after failure

Peat fuel for locomotives has been unsuccessfully experimented with by engineers of the Swedish federal railways. The fuel has proven too soft to form a proper fuel bed when fired alone. A type of firebox may be designed which will be more successful. If such a successful design should be evolved it is reported that the railways would place several peat-burning locomotives in regular service.

CONTROL OF WORKMANSHIP ON ASPHALT PAVEMENTS.*

By L. Kirschbraum, Municipal Asphalt Laboratory, Chicago,

Undoubtedly there have been more failures on account of improper mixing and handling of good materials than in the use of inferior ones. To secure good results depends not only on laboratory inspection, but also upon trained inspectors at the asphalt plant when the mixtures are prepared and at the street where the materials are being laid.

Upon the establishment of an asphalt plant inspection bureau for the City of Chicago by the late Andrew Rosewater, M. Am. Soc. C.E., general instructions were issued to plant inspectors which read as follows:

Inspectors at asphalt plants are hereby instructed to take note daily of the materials used in the proportioning of paving mixtures, both as to their physical nature and the quantities, by measurements and weight.

It is desirable for the preparation and maintenance of proper records in connection with work, under contract with the city, to note the name and brand of each kind of material used, and in compounding mixtures to see them measured and weighed and observe, whatever proportions are used in the various mixtures, whether a uniformity is maintained, and if no uniformity or system is observed, to embrace such facts in the reports.

Contractors are expected to afford all necessary conveniences for such inspections. If obstacles are placed in the way of securing desired information, or facilities are denied by any contractor, the inspector must note same in his daily report, with the alleged reasons.

Samples of asphaltic cement used shall be sent daily to the laboratory for testing purposes, also the street surface mixtures. Separate samples of other materials called for by the chemist shall be taken for examination and test to the laboratory. Anything relating to materials received at the plant, or to operations in their mixture and handling, shall be noted on the daily reports sent to the laboratory.

* From a paper in the Michigan Technic.

In addition to these general instructions the points to be watched in preparing the mixtures may be set forth briefly as follows:

In the preparation of the asphaltic cement it is essential that the refined asphalt and flux be weighed into the kettles in such proportion as to produce the desired consistency. The temperature of the kettles must be regulated by the inspector within the limits which the asphalt cement in question can properly sustain. In combining, the flux and asphalt should be sufficiently agitated to produce thorough solution, and with asphalts containing much mineral matter, to avoid settling out of such, with consequent lack of homogeneity in the cement and resulting mixtures.

The consistency of the asphalt cement is varied to produce a hard or soft pavement, or to meet the requirements of a fine or coarse mineral aggregate. It is desirable, other conditions being the same, that for any piece of work the consistency be uniform to a standard which experience with each asphalt has demonstrated to be satisfactory. Consistency is determined by the penetration machine, which operates by measuring in tenths of a millimeter to depth of penetration into a sample of the cement at 77 degress F. of a No. 2 needle under a weight of 100 grams for five seconds. Where there are facilities for testing at the plants it is the duty of the inspector to test each kettle before use. When there are no such facilities an experienced inspector can determine an approximate consistency by chewing a sample of the cement. In any case, samples of each kettle are sent in daily to the laboratory for checking, and close control and record are kept of them.

Two kinds of binder are in use at present in the paving industry, an open and a closed binder, or asphaltic concrete. The open binder is made of well graded stone one and one half inch to quarter inch limiting sizes coated with asphalt cement. Asphaltic concrete, as the term implies, differs from the open binder in having the voids of the stone filled with an asphaltic mortar of sand and fine screenings, making a dense and compact medium. This is much superior to the open binder in its ability to support the surface rigidly and to prevent crushing of the top into the interstices of the binder under heavy traffic.

The main cause of trouble with open binder is overheating—not necessarily on account of injury to the cement, but because of the fact that the coating of cement will run off hot stone to such an extent that at the end of a long haul the top three-quarters of a load will be so devoid of cement as to be insufficiently bonded when laid, while the material in the bottom of the wagon contains an excess of "juice," making it difficult to rake, and forming, when rolled, "a grease spot."

(To be Continued.)

SOME CHARACTERISTICS OF CEMENT BRICK

Although cement brick (or concrete brick) construction is still in its experimental stage enough is known to demonstrate that under favorable conditions it may be a strong competitor of clay brick in both price and appearance.

The extensive use of cement brick by the Plymouth Cordage Company, Plymouth, Mass., has demonstrated several valuable facts. For the construction of their new mill having an aggregate wall length of nearly one fifth of a mile, almost two and one-half million cement bricks were made upon the ground.

The mixture used in the major part of the work was 3 parts sand to 1 part cement. A few bricks were made of 4 parts sand to 1 cement for lightly loaded walls. The brick used on the outside of the buildings had a facing (1/8 inch thick after compression) of 2 parts fine sand and 1 part cement, with the addition of 2 per cent. waterproofing (by weight) to the cement. Enough water was used to make a mortar of such consistency that it would hold its shape under compression, without flushing water to the surface so as to cause the mortar to stick to the plates. No definite percentage can be given as to the amount of water, as that is governed largely by temperature and atmospheric conditions, but the average amount was about 8 per cent.

Table 1. Absorption of Cement Bricks.

Brick	Weight. Dry. lbs.	oz.	Saturated. lbs.	oz.	Absorption. oz.
Face	5	8½	5	10	1½
Common inside	5	8	5	11	3
Facing material*	5	9½	5	10	½
Hard burned body clay brick	4	11	5	7	12

Table 2. Tests of Cement Bricks.

Test "A". Face brick; body 3 parts sand to 1 part cement; facing, 2 parts fine sand to 1 part cement; 2 per cent. waterproofing compound added to cement by weight. Facing 1/8 inch thick after compression.

Age, days	1st Crack, lbs.	Ultimate strength, lbs.	Per sq. in., lbs.
56	87,100	87,100	2,730
120	100,900	108,650	3,400
239	128,500	132,650	4,145
Test "B". Common brick; 3 parts sand to 1 part cement.			
56	69,750	71,200	2,215
92	95,000	99,100	3,080
120	119,700	119,700	3,735
239	129,000	134,100	4,095
275	162,100	164,600	5,160
Test "C". Common brick; 4 parts sand to 1 part cement.			
56	74,150	76,500	2,390
120	89,050	91,450	2,810
239	119,500	126,400	3,905
Test "D". Common brick; 5 parts sand to 1 part cement.			
56	72,150	72,150	2,240
120	80,700	86,650	2,675
239	110,000	119,950	3,710
Test "E". Two hard-burned "body" clay bricks.			
...	101,000	150,000	4,770
...	94,000	162,000	5,470

Care in curing the brick (that is, constant wetting), will overcome to a large degree any minor weakness which is theoretically developed by a "dry mix."

To the uninitiated, the small quantity of water used would seem likely to produce a porous brick having a strong attraction for water, with damp buildings as the result of their use. As a matter of fact, these bricks do not absorb water to any great extent. Bricks 30 days old, carefully dried and then submerged in water for 16 hours, showed the results given in Table No. 1.

Table No. 2 shows the results of tests made under the direction of the Ordnance Department of the United States Army at the Government Arsenal in Watertown, Mass. The figures are averages unless otherwise noted.

*Brick made entirely of the material used for facing the outside brick.

(Continued on Page 672.)

THE

Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

TO THE STUDENT AND OTHERS.

The Sanitary Review wishes to say a few words to the student.

No diploma, certificate or degree can ever make you less qualified to be a student than you are now. Any diploma, certificate or degree simply stamps you as a student, and should act as an incentive to further knowledge.

He who believes that he has attained to the utlimate of knowledge in any subject, chews the cud of his own ignorance.

An engineer who obtains what are termed qualifications and establishes a practice, may consider that his whole efforts are only justifiably spent in earning fees, but he has forgotten that he is an engineer.

He who schemes out a piece of work, and cannot see how and where he could improve it after completion, has stopped dead in the march of evolution, and he is no longer a student.

The beauty of knowledge lies in its teaching of the reality of limitations, and the possibility of reducing limitations.

Beware of the so-called "scientist," who says: "I have discovered a new principle, but the discovery is my secret." He simply cannot explain the new principle, because it does not exist.

Beware of the man who makes a mystery of his profession, for all mystery is quackery and a cloak for ignorance.

The man who looks very wise, shakes his head and says: "I know, but I just cannot explain it; in fact, you would not understand if I did," is on a par with the toy nodding mandarin, and can only hypnotise the weakling by the profundity of monotony.

Never consider your knowledge on any subject as final; to do so is to imagine a point with both length and breadth.

He whose brain has created a fixed circumference has created an imaginary line into a false reality.

A man must be both a teacher and a student; he teaches that which he thinks he knows, and learns that what he teaches he, after all, only thinks.

Do not argue to prove that you are right; that is egotism. Be the champion of your subject only.

Do not attempt to improve another man's mind. That is the action of a conceited prig. You have nothing to do with the other man's mind. Try and improve the sum total of knowledge.

To be a student to start with, to be a student to go on with, and to be a student to end with, is to live and breathe. To be content in knowledge is to cease to be a student, and means stagnation and development of human fungus.

SEWAGE DISPOSAL.*

REMOVAL OF PUTRESCIBILITY.

Chapter VIII.—**Choice of Filter Material.**

Having in previous chapters dealt with the question of methods of distributing sewage over the surface of a filter, it is now proposed to deal more particularly with the material required for filtration purposes in its relation to removal of putrescibility.

It has been said that the problem of artificial biological filtration depends upon substituting in lieu of soil a material which will retain within itself sufficient oxygen to treat the sewage and yet pass off large volumes of liquid. Soil, because of the smallness of its pores, presents too small an air retaining capacity in proportion to its water retaining capacity in order to effect efficiency in purification at high rates of filtration.

Generally speaking it may be said that any sort of hard material not liable to disintegration is suitable for sewage filters. The continued efficiency of a filter certainly depends more upon non-liability to disintegration than to any other factor. The author has in mind a case where laminated sandstone was used as the filtering media, the result being that the material rotted in a short time into soft shale producing a fine sand which clogged up the base of the filter in eighteen months. Any sort of material which is easily affected by the action of frost or is subject to serious water erosion is entirely unsuitable.

It will be at once seen that the success of a biological filter depends largely upon the choice of filter material, and as the material required forms as a rule the most expensive portion of the whole scheme, especially if there is no suitable material at hand, there is a great inducement to utilize and put up with almost any handy material, granted that such can be obtained locally.

Given what may be looked upon locally as a fairly good hard stone, it is difficult to persuade a municipality to pay freight for furnace slag or green trap rock from any distance yet in every case it will ultimately pay to obtain just the very best material if such can be obtained within practicable limits.

Apart from the hardness and imperishability of the material, another factor, that of surface area, is of great importance.

We have seen in previous articles that the action of a percolating biological filter is three-fold, viz., "mechanical straining," "absorption," and subsequent "oxidation" or "nitrification."

The action of mechanical straining does not appear to be of so great importance as that of absorption and nitrifica-

* Prepared specially for the Review by Mr. T. Aird Murray, Consulting Engineer, Toronto.

tion; and the amount of nitrification depends largely upon the amount of organic matter absorbed, or the power of the filtering media to hold back and retain in the body of the filter organic matters in solution or colloidal form.

We have further seen that the absorptive power of a filter is dependent on the growth of a gelatinous film, which gradually covers the superficies of the filter material. Now the greater the area of the superficies of the material, the greater will be the area of the absorptive film and consequent efficiency in absorption of dissolved organic matter. This, however, is only one point in consideration relative to the choice of a rough rather than a smooth surfaced material. It will be obvious that a filter composed of pebbles, say about walnut size, will provide an air space area about equal to a filter composed of furnace slag of about the same size; however, the water retaining capacity of the former will be much less than the latter, owing to the smooth sides of the pebbles providing very little friction to flow, and consequently sewage will drain through pebbles at much quicker rates than through slag with a corrugated surface. Hence it is possible to provide a material which will give a too rapid rate of passage to the sewage to allow of efficient absorption.

This is a most important point relative to the choice of material as it may indirectly affect the depth of the filter beds. If only material of a smooth surface character can be obtained, and relatively large air retention capacity is required, then it will be absolutely necessary that the filters be deep and not shallow. For example, other conditions being equal a good hard furnace clinker may allow of an efficient depth of three feet, whereas with pebbles giving an equal air retention capacity per cubic yard twelve feet depth of filter would be required in order to produce an equal amount of absorption and consequent removal of putrescibility from the sewage.

Before planning out a system of biological filtration the engineer should know exactly the character of filtering material available for his purpose; and must not make the mistake, so often done, of planning out a definite character of work and size of plant, and then finding out that only at an enormous freight expense can he obtain a filtering material suitable to the arranged depth of filter.

The method sometimes adopted of inserting in a smooth surfaced material filter, a layer of coarse sand or other such finer material to arrest the downward flow liquid passage, is radically bad in principle and effect. Such inserted finer graded layers of material should never be necessary, and only serve as a means for clogging the filter and interrupting air circulation. The only change in size of material in a filter bed which is permissible is from a small grade to a large grade commencing from the surface of the filter downwards; and this applies more especially to laying a larger sized material around the sub-drains to facilitate drainage and aeration. Apart from the bottom layer, the best constructed filters are those which have a uniform sized material throughout, with occasionally a thin surface layer to assist in the distribution of the sewage over the surface. However, when the mechanical method of distribution is satisfactory, this finer upper surface layer should be ignored, as it tends to prevent effective aeration.

With reference to the comparative efficiency of certain materials, it will be well here to quote from the British Royal Commission on Sewage Disposal (5th Report). The Commission carried out experiments at York (England) to determine the purification effected in the same sewage liquor by clinker, broken brick, blast furnace slag, and gas coke. The filter was 100 feet diameter, 7 feet 8 inches in depth ond divided into segments, the sewage liquor being continuously supplied by a revolving sprinkler at a rate of 140 gallons per cube yard of filtering media per day. Hourly samples of the effluents were taken from each of the four segments over three complete days after the filter had been in work twleve months. Purification was effected in the order of merit as follows:—

(1) Clinker.
(2) Coke.
(3) Slag.
(4) Broken brick.

The Royal Commissioners state:—

"These experiments tend to confirm the view that the extent of the purification effected by a percolating filter depends upon the length of time taken by the sewage to pass through the filtering material, assuming always that the filter is properly aerated. Having regard to the vesicular nature of the clinker we should expect it to retard the passage of the sewage more than the broken brick, and hence to give a better effluent. The analytical results show that this was the case."

Professor Dunbar (Principals of Sewage Treatment) publishes some interesting experiments which substantiate the theory that a rough material is more suitable than a smooth one. He carried out simultaneously experiments with the same crude sewage on both gravel and coke filters with varying sizes of material.

Gravel 2-3 m.m. size as compared with coke gave a reduction percentage of oxygen absorbed of 52.8 as against 67.7 with the latter. Again gravel 10-20 m.m. size gave a reduction percentage of oxygen absorbed of 44.7 as against 48.7 with similar coke.

It must be concluded that with reference to the removal of putrescibility from sewage, that given equally imperishable material, a rough surfaced material is much more efficient than a smooth surfaced one, and that less filtering depth is required with the former than with the latter.

When we come to discuss the size of material most suitable., although it is admitted that a small sized material will present a greater absorbing surface than a larger sized material, the main factor however is one of mechanical filtration or straining.

Broadly speaking, the finer the material used in the bed of the filter, the purer the effluent will be; the finer the material the slower will be the rate of filtration, and the finer the material the shorter will be the life of the filter. This practically means that if we required an effluent on a par to that obtained by slow sand filtration in water supply plants, we should have to follow similar principles, with the exception that the filter area would have to be enormous as compared with water treatment, and men would be constantly employed removing and washing the surface layer of sand.

The size of material being subject to the question of mechanical straining, it is obvious that it must depend upon the preliminary efficiency in removal of suspended solids. The greater the proportion of suspended solids left in the sewage liquor, the coarser must be the filtering media, with a consequent diminution in removal of putrescibility.

It is obvious then that no hard and fast rule can be laid down as to size of material. Many factors must be taken into consideration, such as the quality of the suspended matter and its liability to settle out by sedimentation. Many failures have been made in biological filtration work, by basing the size of material with reference to some other works without comparison of relative data. This is an error that the amateur or inexperienced engineer is very apt to fall into.

Among the main factors affecting size of material may be noted—the method adopted of removal of solids. If, for instance, septic tank settlement is relied upon it will be found that if septic action is allowed to go on indefinitely, that the amount of suspended solids will increase in the settled liquor by even 100 per cent., so that a size of material which may have been effective in the earlier stages of the tank action may be wholly inadequate to treat with the increase of solids and so result in a clogged filter.

One of the great difficulties in treating septic liquor in biological filters is this consequent increase of solids, and it is for this reason that attention is now being universally drawn to improved methods in immediate removal of sludge from contact with the supernatent liquor, so as to obtain a constant amount of solids in the settled liquor.

Where removal of putrescibility only is required, without any very high degree of purity, continuous flow sedimentation tanks will be probably adopted, as they require little attention apart from the regular removal of settled solids before putrefaction commences. As we have seen in previous articles on "Removal of Solids," given a definite character of sewage, and a certain velocity and period of flow in a tank, a fairly constant removal of solids can be obtained from an average domestic sewage of from 60 to 70 per cent. The 40 to 30 per cent. of remaining suspended solids being of a fine character can be satisfactorily dealt with in a biological filter with a coarse material.

When a greater degree of purity is required than above, quiescent sedimentation, that is, allowing the sewage to stand without movement in tanks for about two to three hours, will precipitate from 70 to 80 per cent. of the solids, and allow of a finer filtering material being used, resulting in a purer effluent.

When an even greater degree of purity is required, and it is intended to treat the liquor in a very fine material and produce a high class effluent, it is necessary to add a coagulant such as sulphate of alumina, lime or other reagent to the raw sewage, by which means over 90 per cent. of the suspended solids can be removed.

Assuming a domestic sewage representing a strength equal to about 30 gallons per head per day water supply on the separate system of sewerage for a water closet town; with an approximate analysis in parts of 100,000 of four parts ammoniacal nitrogen, oxygen absorbed in four hours 12 parts, suspended solids 30 parts, we may approximately conclude for the removal of putrescibility as follows: If 50 per cent. of the solids are removed three inch diameter material may be used at a rate of 100 gallons per cube yard, allowing a life period to the filter of from 10 to 15 years.

If 60 per cent. of the solids are removed, then three inch diameter material—150 gallons—life of filter ten to fifteen years. If 70 per cent. of the solids are removed, then three inch diameter—at 200 gallons—life of the filter from ten to fifteen years.

Filtering material as used for biological filters may be classed (as per the Royal Commission Report) into coarse, medium and fine. Coarse material represents diameters of 2½ inches to 3 inches. Medium ½ inch to 1 inch. Fine ¼ inch to ½ inch. The fine material should not be used except in cases of secondary filtration or in connection with a high degree of removal of solids by aid of a coagulant.

In all cases in treating sewage for the removal of putrescibility by biological filtration, the author is strongly of opinion that it is easy to err in adopting too fine a material, and that even if a high degree of purity is desired, it is much better to first treat the sewage liquor on coarse filters, and then continue the treatment on finer grade filters as secondary treatment, rather than attempt a very high degree of removal of solids in the first instance with a view to direct treatment in fine filters.

The question of the removal of solids, as we have seen, is a very important one indeed, in fact in many cases the whole success of a plant depends upon its efficiency, but just as soon as the engineer departs from the principle of natural unaided sedimentation by reduction of velocity flow, he is face to face with working methods which entail large sums in maintenance, and generally interfere with automatism and simplicity.

(To Be Continued.)

THE QUALITY OF EFFLUENTS IN RELATION TO STANDARDS.*

By Gilbert John Fowler, D.Sc., F.I.C.

(Continued From Last Week.)

The production of green growths, generally consisting of oscillatoria nigra, a green chlorophyllous alga, characterized by the vibratory movements of its filaments, is generally considered as evidence of satisfactory purification. The influence of sunlight seems to determine to some extent whether oscillatoria or carchesium appears chiefly in an effluent. A green organism (probably spirogyra) can, in fact, be seen developing at the Withington works just at a point where the outlet carrier is most freely exposed to the sun; the writer has also noticed that these green growths attain great luxuriance at certain effluent outfalls he has had experience of in India. Luxuriant growths of waterweed may also take place in some cases and become troublesome. . . .

The production of fungoid growths is, indeed, a very sensitive index of pollution, and it is possible, as the example just cited shows, to differentiate between varying sources of pollution by the character of growth developed. This was pointed out years ago by Santo Crimp, but it is doubtful whether the subject has received as much attention as it deserves in the meantime; thus it is well known that small leakages of unpurified sewage passing direct into the land drains of irrigation areas, may produce disproportionately large amounts of fungus, the species depending on circumstances. The growth of fungus in land drains may depend also on the character of the land and of the effluent applied to it, if—e.g., iron is present in the latter, there is a great liability to the development of crenothrix, a filamentous organism which collects large masses of hydrated oxide of iron around it. The effluent from the Birmingham Sewage Farm, according to Mr. Watson's description, had to be screened before passing into the river in order to remove this kind of debris.

Mention has been made of a few of the more typical organisms likely to come under the eye of the sewage works manager, and readily recognized either by inspection or by examination under a low-power microscope. There are, of course, countless other flora and fauna which are charcacteristic of different stages of purification, and their complete investigation will afford occupation for biologists for many years. Good work has already been done by Marsson, Hofer, and others on the Continent. According to Hofer, the self-purification of rivers is in the main a transmutation of dead organic matter into living organisms, and he shows that a river purifies itself more rapidly in a succession of still pools than when the water is broken. He cites several interesting cases showing the dependence of organic growths on specific pollution; thus the sewage fungus sphaerotilus natans requires small quantities of sugar for its growth in quantity, and consequently large volumes of tannery waste containing much organic matter do not cause a development of this organism, whereas small quantities of household sewage or brewery waste produce an abundant growth. It also requires much oxygen, and grows, therefore, best in broken streams. Finally, it needs constant sustenance with small amounts of sugar, and, therefore, a continuous small stream of polluting liquid furthers the growth more than large quantities at infrequent intervals. It is better, therefore, that discharges of effluent should under these circumstances be held up, say, for twenty hours and discharged all together in a short time. . . .

The labors of the scientific biologist can be considerably assisted if those in charge of sewage works would keep systematic records of the more characteristic developments occurring under specific conditions—e.g., of composition of sewage, time of year, temperature, etc. . . .

Careful accumulation of facts is necessary before a conclusion can be reached as to the best means of dealing with these growths when they occur. They can be temporarily arrested, of course, as has been shown, by sterilization. Such a process, however, is costly and open to objection, on the ground of its possibly deleterious effect on the normal life of streams, especially if used at all carelessly. On the other hand, there can be no doubt that many fungoid growths form excellent habitats for larvæ, small worms, such as tubifex, and probably numerous forms of crustacea. The development of gnat larvæ, indeed, is a matter of rather serious moment. This has been carefully watched in connection with the effluent from the percolating filter at Davyhulme already mentioned, and at certain periods of the year gnats appeared in objectionable numbers at the manhole covers of the closed channel through which the effluent passed. The development from the larval to the insect stage has been followed in the laboratory. These forms of life, however, may constitute excellent food for fish, and at the Berlin sewage fields large ponds have been constructed, into which the final effluent flows, together with a stream of fresh water, and in which carp and other coarse fish attain large sizes.

It is now generally recognized that the provision of some kind of tank to arrest deposits from percolating filters is necessary, and the Royal Commission suggest a similar provision in the case of contact beds. It is worth consideration whether this idea might not be developed and such tanks extended to form aquaria. Careful management would be essential in order, by the growth of aquatic plants or otherwise, to maintain an adequate supply of dissolved oxygen.

When this suggestion was made in the paper read at Leeds, certain subsequent critics appeared to think that it could hardly be seriously intended. Apart, however, from its adoption on a very large scale in Berlin, other successful applications of the same methods are cited by Hofer, with actual figures as to the weight of fish produced. A careful study by Marsson of the flora and fauna of a sewage works also leads up to the suggestion that when an effluent is so far purified that small crustacea can live in it, it is then most suitable as a source of food for fish.

It is possible, as pointed out by Sir James Crichton Browne, in his address to the Hygienic Section at the International Congress of Applied Chemistry, that considerable diminution in the bacterial content of effluents would result from such storage, on the analogy of Dr. Houston's observations in connection with the storage of drinking water. The cost of storage might be partly met by the value of the fish produced, and in any event the complete cycle from offensive organic matter through mineral matter and back again to organized life would be under control, instead of, as is at present the case, allowing the effluent to pass direct into the stream with all the possible contingencies which may arise. The suggestion of an aquatic sewage farm has already been made by Dr. Letts, in connection with the ulva nuisance in Belfast. There are probably many cases where analogous provisions might without great difficulty be made at inland sewage works. A typically suitable case would be where land of an impervious character could be excavated for a pond, and where a portion of a fresh-water stream could be diverted through the pond along with the effluent. Such a method might be considered the equivalent of final land treatment.

The general argument of this paper leads, therefore, to the following conclusions:—

1. That the standards suggested by the Royal Commission are, with possible slight modifications, the most practicable and adaptable of any yet suggested.

2. That where the self-purifying power of the body of water receiving the effluent is high, they may be too stringent.

3. That effluents may pass these standards and yet develop considerable growths at the outfall.

4. That the final treatment of effluents in large and well-aërated, scientifically managed ponds can in many cases be advantageously adopted.

5. That careful and continuous research is necessary in order more fully to determine the different links in the cycle of nature, upon conformity with which efficiency and economy in the disposal of the waste products of human life must ultimately depend.

FRAZIL.

The approach of winter recalls the fact that the frazil and anchor ice season is again at hand. It will be interesting to hear what has been accomplished at Hull, Quebec, and Ottawa, Ont., during the last few years in connection with the problem of preventing frazil from shutting down the hydro-electric plants at these places and demoralizing the electric light, industrial power and electric railway services which are supplied from them.

We are informed that some forty water wheels in the power district at and near Ottawa are now equipped with heating devices, which prevent frazil from stopping the wheels and clogging the gates and gate-operating mechanism. The Ottawa and Hull Power and Manufacturing Company, which supplies Ottawa's city distributing system, and also the International Cement Works with power, increased the capacity of its generating station this year, and while this work was in progress it also increased the capacity of its frazil-combatting plant, which has been in successful operation during the last three years. A 30 horse-power boiler was formerly employed, and the new equipment consists of a 100 horse-power boiler, which, it is anticipated, will supply an ample amount of steam to keep the plant in operation in the face of frazil attacks, while the output of the station is as high as 10,000 horse-power. An interesting feature of the latest 3,000 horse-power unit at this station is the arrangement of the water wheels and their controlling gates for heating purposes. The chutes and gate chambers have been cored out, and have pipe connections to the openings, so that steam or hot water may be kept circulating through them when frazil is anticipated.

The power houses of the Ottawa Electric Railway and of the Ottawa Electric Company are also equipped with water wheel heating systems, and these plants have had similar satisfactory experiences to those of the Hull company during the last two and four winters, respectively.

(Continued on page 673.)

A PAGE OF COSTS
ACTUAL, ESTIMATED and CONTRACTED

COST OF CITY PAVEMENTS.

The following tables of costs were given by C. H. Rust, city engineer of Toronto, Can., in a paper before the convention of the American Society of Municipal Improvements at Little Rock, Ark.:—

Cost of Asphalt Paving on Sackville St., Toronto, Canada.

(Medium asphalt, 5-in. concrete, 1-in. binder and 2-in. surface, with 16-in. gutters.)

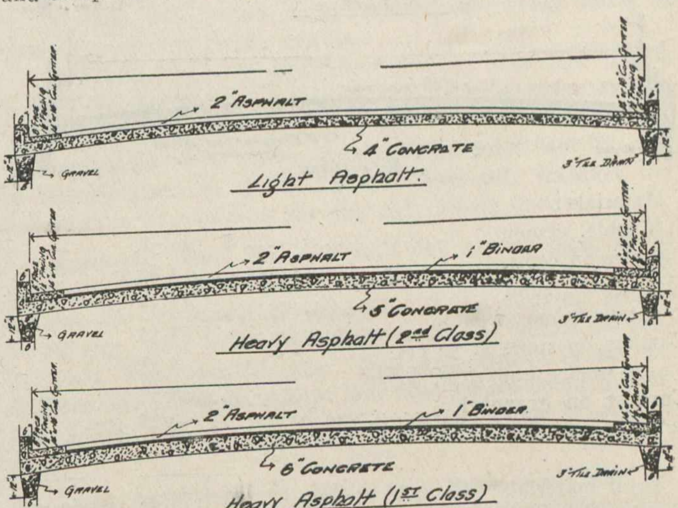
Pavement.	Total.	Per Sq. Yd.
Grading (1,815.5 sq. yds.):		
Labor	$ 321.29	$0.176
45 hrs. roller at $1.40	49.00	0.027
Total	$ 370.29	$0.203
Foundation (1,815.5 sq. yds.):		
Labor	$ 141.44	$0.078
Materials:		
255 bbls. cement at $1.34	$ 342.90	
Cartage at 8.4 cents. per bbl.	21,42	
341.8 tons stone at $1.27	441.87	
Cartage	118.96	
160 cu. yds. sand at 90 cts.	144.00	
Total materials	$1,069.15	$0.588
Total labor and materials	1,210.59	
Deduct for foundation under gutters	160.43	
Actual total labor and materials	1,050.16	$0.666
Surface, 1 in. Binder, 2 ins. Tops (1,651 sq. yds.):		
Labor	$ 70.50	
18 hrs. roller at $1.40	25.20	
Total labor	$ 95.70	$0.058
Materials:		
157 batches binder at $1.98	$ 301.00	
Cartage	24.95	
275 batches tops at $2.70	742.50	
Cartage	36.15	
175 lbs. asphalt cement at 1.87 cents	3.24	
400 lbs. stone dust at 0.3 cents	1.20	
½ cd. slabs at $6	3.00	
Total materials	$1,112.48	$0.674
Total labor and materials	1,208.18	$0.732

Gutter.	Total.	Per Lin. ft.
(1,366 lin. ft. 16 x 3 ins.):		
Labor	$ 23.92	$0.018
Materials:		
25 bbls. cement at $1.34	$ 33.50	
Cartage at 8.4 cts. per bbl.	2.10	
6 cu. yds. sand at 90 cts.	5.40	
10,175 tons granulith at $3.50	32.30	
Cartage	3.33	
34.5 cu. yds. concrete foundation	160.43	
Total materials	$ 237.06	$0.173
Total labor and materials	260.98	$0.191

Header.		
72 granite sills at 70¼ cts.	$ 5.05	
Foundation (labor and concrete)	5.05	
Total	$ 10.10	
Miscellaneous Expenses.		
Foreman and watchmen	$ 68.75	
Cleaning street	8.00	
Carting and placing planks	4.33	
Tools	41.98	
Water for 280 bbls. cement at 4 cts. per bbl.	11.20	
Office expenses	41.98	
Total	$ 176.24	
Misc. charges per sq. yd. pavt.		$0.09
Misc. charges for sq. yd. gutter		0.01

Cost of Laying 496.4 Sq. Yds. of Asphalt Paving and Building Concrete Curb and Gutter on Broadway Place, Toronto, Canada.

(Light asphalt pavement 18 ft. wide and 543.7 ft. long. Estimated cost, $2,801; city tender, $1,793. Began May 27th and completed June 19th, 1909.)

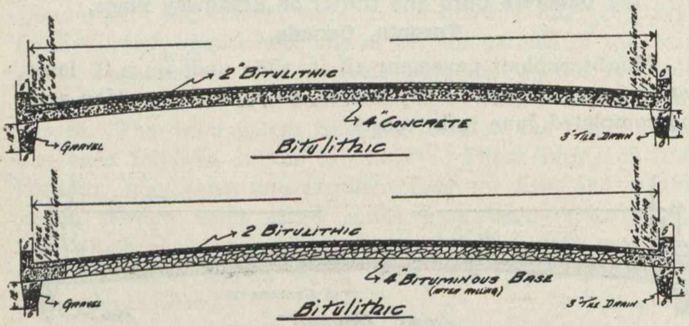


Pavements.	Total.	Per. Sq. Yd.
Grading:		
Labor	$ 339.13	$0.359
Foundation:		
Labor	83.86	0.089
Materials:		
144 bbls. cement at $1.32	$ 188.76	
Cartage on cement at 9 cts. per bbl.	12.87	
75 cu. yds. sand at 92 cts.	69.00	
172 tons stone at $1.29	221.88	
Cartage, 50 cts. per ton	86.00	
Total materials	$ 578.51	
Less $116.21, as below	116.21	
Actual totals	$ 462.30	$0.488

Surface (area 950.4 sq. yds.)		
Labor	$ 16.00	$0.017
Materials:		
150 batches asphalt at $270	$ 405.00	
Cartage on asphalt	31.13	
300 lbs. stone dust at 30 cts. per 100	0.90	
50 lbs. asphalt cement at $1.87 per 100	0.94	
½ cord wood at $5.10	2.55	
5 hrs. roller at $1.40	7.00	
Total materials	$ 447.52	$0.471
Total labor and materials	463.52	0.488
Grand total for pavement	1,348.81	*$1.424

Curb and Gutter.

Grading:	Total.	Per Lin. ft.
Labor	$ 97.51	
Tile on tile	10.10	
20 cu. yds. sand at 92 cts.	18.40	
1,000 tile at 2 cts.	20.00	
Total grading	$ 145.91	$0.134
Lumber:		
Labor	$ 32.71	$0.030
Concrete:		
Labor	$ 47.40	$0.043



Materials:		
31¼ bbls. cement	$ 42.38	
Cartage on cement	2.87	
13 cu. yds. sand	11.24	
8.64 tons stone at $1.29	11.15	
Cartage on stone at 50 cts.	4.12	
6.9125 tons granolith at $3.50	24.20	
Cartage on granolith	3.35	
201.4 sq. yds. 4-in. concrete at 57.7 cts.	116.21	
Total materials	$ 215.52	$0.198
Total labor and materials	262.92	0.241
Grand total for curb and gutter	441.54	*0.405

Headers.

	Total.	Per Sq. Yd.
Labor	$ 2.97	$1.46
Materials:		
½ bbl. cement	$ 0.70	
56 granite blocks at 70 cts.	3.92	
2 cu. yds. sand at 92 cts.	1.84	
2 sq. yds. 4-in. concrete at 57.7 cts.	1.15	
2 sq. yds. grading at 36 cts.	0.72	
Total materials	$ 8.33	$4.165
Total labor and materials	$ 11.30	*$5.65

*To this amount must be added the proportion of miscellaneous charges given under "Miscellaneous Expenses."

Miscellaneous Expenses.

Foreman and watchmen	$ 56.25	
Office expenses	28.01	
Tools	28.01	
Water for 175 bbls. cement at 4 cts.	7.00	
Cleaning up street	21.92	
Labor on culverts, extra	3.00	
Total	$ 144.19	
Misc. charges per sq. yd., pavement		$0.100
Misc. charges per lin. ft., curb and gutter		0.032
Misc. charges per sq. yd., header		0.396

Cost of Laying 809.2 Sq. Yds. of Bitulithic Pavement on Alhambra Ave., Toronto.

(Pavement 24 ft. wide and 303.5 ft. long on 4-in. concrete, with 16-in. gutters and 6-in. concrete curb.)

Pavement.

Grade:	Total.	Per Sq. Yd.
Labor	$ 183.85	$0.252
Foundation, 1:3:7 Concrete:		
Labor	$ 66.03	$0.091
Materials:		
116 bbls. cement at $1.32	$ 154.42	
Cartage at 6.6 cts.	6.50	
125 tons stone at $1.29	161.35	
Cartage at 43 cts.	53.75	
62 cu. yds. sand at 95 cts.	58.90	
Total materials	$ 434.92	
Less 124.1 sq. yds. in curb and gutter	73.47	
Actual total materials	$ 361.45	$0.501
Total labor and materials	427.48	0.592
Surface:		
Labor	$ 35.56	
9 hrs. roller	.12.60	
Total labor	$ 48.16	$0.065
Materials:		
719.4 sq. yds. bitulithic at $1.15	$ 827.31	
Cartage	64.31	
5 gals. oil	0.50	
Total materials	$ 892.12	$1.240
Total labor and materials	940.28	1.308
Grand total pavement	1,551.61	*2.152

Curb and Gutter.

Grading:	Total.	Per Lin. ft.
Labor	$ 34.26	$0.056
Fences	14.49	0.025
100 ft. tile	2.00	0.003
Total grading	$ 50.75	$0.084
Concrete Curb (1:3:5 mixture):		
Labor	$ 8.56	$0.014
Materials:		
5 bbls. cement at $1.32	$ 6.65	
Cartage at 5.6 cts. per bbl.	0.28	
4½ tons stone	5.80	
Cartage	1.93	
2 cu. yds. sand at 95 cts.	1.90	
Total materials	$ 16.51	$0.027
Total labor and materials	25.07	0.041

Facing (1:1:3 Granulithic):		
Labor	$ 10.00	$0.016
Materials:		
10 bbls. cement at $1.32	$ 13.20	
Cartage	0.59	
6¼ tons granolith at $3.50	21.95	
Cartage	5.57	
3 cu. yds. sand at 95 cts	2.85	
Total materials	$ 44.16	$0.073
Total labor and materials	54.16	0.089
Foundation:		
124.1 yds. 4-in. concrete at 59.2 cts.	$ 73.47	$0.121
Grand total curb and gutter	203.45	*0.335
Header.		
Labor	$ 4.75	$1.583
Materials:		
75 setts at	$ 5.06	
1 cu. yd. sand at 95 cts.	0.95	
2½ bbls. cement at $1.32	3.30	
Cartage	0.14	
2¼ tons stone at $1.29	2.90	
Cartage	0.96	
Total materials	$ 13.31	$4.436
Total labor and materials	18.07	6.019
Miscellaneous Expenses.		
Foreman	$ 54.65	
Office expenses	25.21	
Tools	25.21	
134 bbls. water for cement at 4 cts.	5.36	
Cleaning up	30.48	
Total	$ 140.91	
Misc. charges per sq. yd. pavement		$0.17
Misc. charges per lin. ft. curb and gutter		0.03

*To these amounts there are to be added miscellaneous charges as given.

AN EXPERIENCE WITH CEMENT-LINED PIPE.

In recent paper, Leonard Metcalf, consulting engineer, of Boston, cites the experience of the city of Waltham, Mass., in the use of cement-lined pipe, which, though now abandoned, was in use long enough to present some very interesting results as here presented.

Waltham had a population in 1905 of 26,282. Waterworks were constructed in 1872, the mains being cement-lined pipe. In 1887 the further use of this pipe was practically abandoned, and since that time substitutions have been made until at the present time there is left only about one mile of cement pipe. In 1887 there were about twenty miles of cement-lined pipe, ranging in size from 4 inches to 16 inches.

The reason given for giving up the use of this pipe was leaks in the joints; also trouble in making connections and care necessary in opening and shutting gates to prevent water hammer, which is liable to cause breaks.

On July 4th, 1879, lightning caused the destruction of 300 feet of 6-inch pipe, cast-iron being substituted at a cost of $263. July 12th, 1883, lightning again caused a small leak, and it was repaired at a cost of $20. August 3rd, 1889, 32 feet of 4-inch pipe was destroyed, and on August 12th, 1891, 1,070 feet of 6-inch pipe was destroyed by lightning.

The Waltham report for 1895, contains reference to electrolysis in connection with the cement-lined pipe, and states that several pieces dug up near the electric car tracks were badly pitted, and that the pipe was rendered practically worthless.

Year.	No. of leaks in cement-lined pipe.	Total No. of leaks.	Cost of repairs on cement-lined pipe.	Cost per mile.	Cost per mile.
1883	13	19	$ 232 00	$17 84	$11 60
1884	15	27	245 00	16 33	12 25
1885	6	13	45 00	7 50	2 25
1886	7	12	400 00	57 15	20 00
1887	5	12	154 00	30 80	7 70
1888	8	10	179 00	22 38	8 95
1891	37	41	1,092 00	29 52	54 60
Average	13	19.1	$ 353 30	$25 79	$16 76

During this period there were about twenty miles of cement-lined pipe in the system.

The large number of leaks noted in 1891 was partly due to the beginning of construction of a sewerage system in the city. Laborers in digging trenches for sewers caused damage to the water pipes. It should be noted that the cost of repairs given in the above table generally includes the substitution of cast-iron for the old cement-lined pipe.

Brockton, Mass., has a 20-inch and 24-inch pipe, about three miles long, one-half of it running through a country district, the remainder through one of the outlying streets of the city. The latter half of the main has numerous connections. The original pipe shell was dipped in hot asphaltum and rolled in cement and sand before being placed. The lower end of the main is under about 50 pounds pressure.

1908.—Superintendent states that there has been no trouble to speak of with this main during the twenty-eight years of its existence.

Concord, Mass., 1908.—Has two 10-inch pipes, approximately 2½ miles each in length, the first in the year 1874, and the second in the year 1883. Both pipes are still in active service, and have given comparatively little trouble from leakage. The maximum static pressure is aproximately 40 pounds.

COST OF SUBWAYS, NEW YORK AND PARIS.

	New York Subway. Amount.	Per mile mile of single track.	Per cent. of total cost.	Paris Subway. Amount.	Per mile of single track.	Per cent. of total cost.
Total cost of construction	61,338,000	$1,432,000	100	$62,252,000	$1,000,000	100
Total cost of equipment	26,600,000	999,000	69.8	42,100,000	676,000	67.6
Total cost of subway and equipment	$87,938,000	433,000	30.2	20,152,000	324,000	32.4

THE FUNCTION OF THE AIR AND CIRCULATING PUMPS.

Walter Smith*

Of recent years engineers have evinced considerable interest in the improvement of the design and efficiency of the condensing plant. This may be attributed to the advent of the steam turbine and the very high vacuum required to obtain economical running with this type of plant. Another reason for this improvement is the more general adoption of condensing apparatus which nowadays is becoming more and more necessary and in some cases absolutely essential, as, for instance, in many modern power stations. These stations for many reasons are situated a considerable distance away from the towns which they supply and they consequently have a very limited supply of fresh water for boiler feeding purposes, in which case a condensing plant is installed, the amount of water then required being only that lost by leakage and other sources of waste. But even when a plentiful supply of water is available it seems that engineers are beginning to look upon the condensing plant more in the light of a necessity than as a refinement or an additional complication. Of course in considering the relation between condensing plant and locality the ease of obtaining the necessary circulating water has to be borne in mind, but there are so many various types of condensers, some of which require but a small amount of water per lb. of steam per hour that when used in conjunction with a cooliing tower there should be little difficulty in obtaining suitable apparatus for almost any particular case.

With this cursory glance at the present aspect of the condensing plant we must leave the condenser out of the question and confine our remarks to the air and circulating pumps.

As the name suggests the air pump is used for exhausting the air from the condenser, but this is not its only function, for it also pumps out the condensed steam and water vapour. In the jet condenser, which is now almost obsolete, it not only pumped out the water condensed from the steam, but also the injection water. This placed the air pump of that time at a considerable disadvantage in places where pure and soft water was not available for use as injection, as, for instance, in marine work, where the boiler feed was taken from the hotwell. This water was practically as salt as the sea water which was used for injection, the sea water and the exhaust steam being in the proportion of about 30 to 1 weight. This, to a great extent prevented the use of boiler pressures much above 30 lb., and it was also necessary to periodically blow off a portion of the denser water in the boiler so that it could be supplied with a fresh supply of sea water and so prevent the water in the boiler becoming saturated.

With the introduction of mild steel plates and improved methods of construction, higher boiler pressures became general, and the question of using fresh instead of salt water became a serious one. This led to the introduction of the surface condenser, the great advantage of which consists in its providing feed water free from salt in solution. This is effected by keeping the cooling water and exhaust steam entirely separate, but even with surface condensers air pumps are necessary, but they may be made much smaller than would be the case with a jet condenser of the same capacity, as a considerable amount of air is brought in with the injection water.

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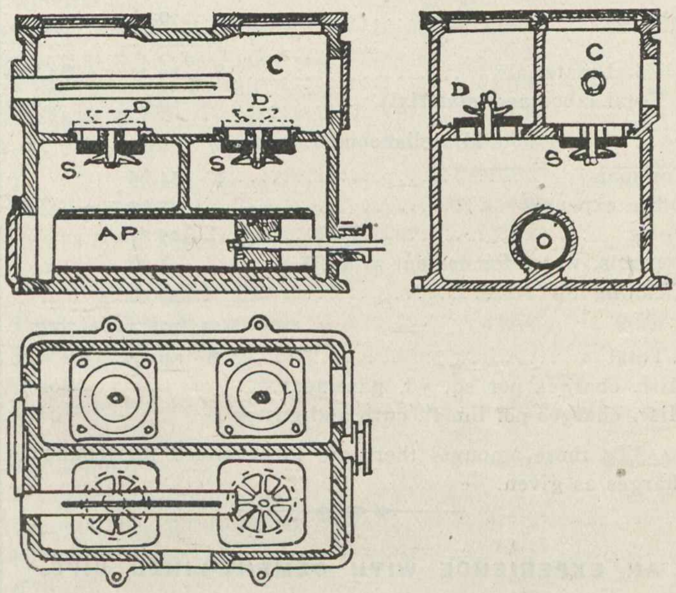
*Institute of Marine Engineers Ritchie Award Prize Essay.

Air pumps are always of the reciprocating type and are usually vertical in action, even when worked by horizontal engines, as this type is found to be more efficient than the horizontal, which is usually of the double acting solid piston variety. A pump of this type is shown in Fig. 1, working with a jet condenser, the whole being of very simple design and construction. C is the condensing chamber and SS are the suction valves and DD the discharge valves, there being two of each of the indiarubber type. The air pump, AP, is fitted with a gunmetal liner, in which works the solid piston fitted with two rings of hemp packing. The next figure (No. 2) shows a vertical single acting bucket pump arranged for working from the L.P. crosshead of a marine engine.

The action is as follows: — On the up stroke of the bucket, B, a vacuum is formed in the pump chamber, C, causing the air and water to flow in through the foot valves, F, owing to the higher pressure in the condenser. On the down stroke the air and water are forced through the bucket valves, A, until the bottom of the stroke is reached, when the cycle is repeated and the contents of the pump discharged through the head valves into the hotwell; at the same time a fresh charge is drawn in as at first explained.

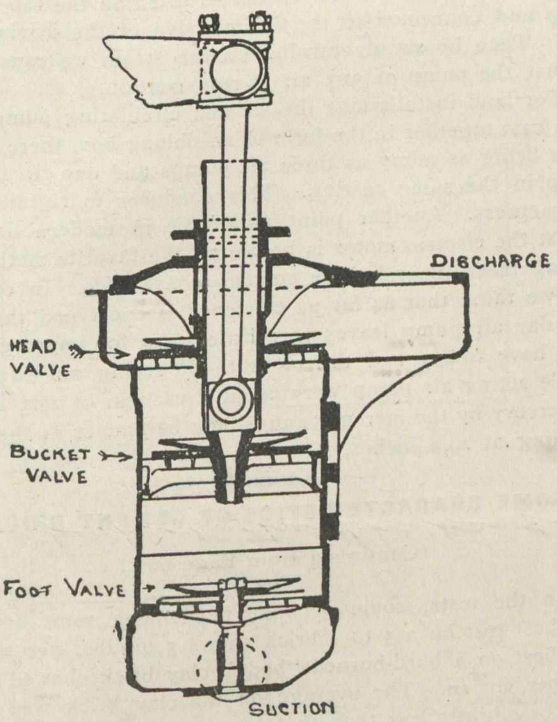


Mention must next be made of the "Edwards Patent Air Pump," its distinctive feature being the absence of foot and bucket valves, head valves only being required. The pump is of the vertical single acting type, and the water flows by gravity from the condenser into the base of the pump, then on the down stroke of the bucket the water is projected silently through the ports in the pump barrel into the chamber above the bucket. The up stroke is now commenced and the bucket in rising closes the ports and discharges the air and water through the head valves. It will also be noticed that as soon as the ports are open there are clear air inlets, the water following immediately afterwards has the slight effect of an injector and so carries in more air than would otherwise be the case, thereby slightly increasing the vacuum.

Another point that contributes to the high efficiency of this pump is that top clearance is reduced to a minimum. This is obviously very important, for before any air pump can discharge, the pressure in the pump must be greater than that of the atmosphere, and consequently all air remaining in the pump is compressed. Now when the bucket descends the pressure is reduced and the air in the clearance water is given off and expanding occupies space which should really be available for a fresh supply from the condenser

But efficient as is the Edwards pump there has, during the last few months, sprung up a tendency to fit very elaborate pumping equipment in turbine installations. This is due, as before mentioned, to the increased efficiency of the turbine with increased vacuum. In a paper by the Honorable C. A. Parsons, and G. G. Stoney read before the Institution of Civil Engineers the increase in efficiency was given as follows:—

"On a test of a 1,500 kilowatt turbine plant at two-thirds the normal output, the effect of an increase of an inch of vacuum at 26 inches is to diminish the consumption by about 4 per cent., at 27 inches by 4½ per cent., at 28 inches by 5½ per cent., and between 28 inches and 29 inches by 6 to 7 per cent. A good vacuum is thereby seen to be much more essential for the turbine than the reciprocating engine. This is shown diagrammatically in Fig. 3, which represents the combined indicator cards of a good triple-expansion engine, working with a vacuum of 25 inches. Now if we were to



increase the vacuum in the case of the reciprocating engine to 28 inches, the extra energy obtained from the steam is represented by the area of the black portion of the diagram marked R horizontally and dp vertically, while in the case of the turbine an increase of vacuum from 25 inches to 28 inches would mean that extra energy would be obtained equal to the area of the strip of the black portion of the diagram marked dp as before but T horizontally, or in other words the dp × R portion produced to T which will be seen to be a much more considerable portion than in the case of the reciprocating engine.

To maintain this high vacuum there have been introduced two new appliances, namely the "Dry Air Pump" and the "Vacuum Augmenter." The object of the "Dry Air Pump" is not so much to obtain a good vacuum as to maintain it, as no matter how carefully the condensers, pipes, etc., are erected there is always the liability of air leakage which would at once mean loss of power, therefore an air pump running at a comparatively high speed and dealing with a large volumetric area was considered to be necessary, and so we have the Dry Air Pumps.

This pump works in conjunction with the ordinary air pump, on the suction side of which a large air vessel is fitted; the suction of the Dry Air Pump being taken from the top of this air vessel, and is fitted with a special valve which ensures that air and vapour only may reach the "Dry Air Pump." Under ordinary conditions the Dry Air Pump runs at normal speed, but should difficulty be found in maintaining the vacuum owing to a leak or other contingent reason the speed is increased until the original vacuum is obtained. A small quantity of fresh water is kept circulating in the pump for cooling purposes. The Vacuum Augmenter is

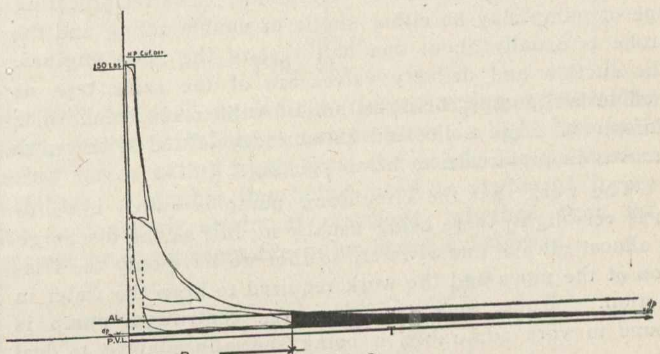


FIG 3.

connected between the air pump and the condenser and consists of a small steam jet placed in the contracted portion of a pipe which leads from the bottom of the condenser to a cooler. The jet draws the water from the condenser and through the cooler to the air pump, so reducing the air to a very small amount.

Before closing the subject of air pumps it is necessary to mention one or two of the different types of valves in more or less general use. At one time vulcanized indiarubber was used without exception, it being especially prepared to resist the action of the oils. When used for naval work the composition was as follows: Oxide of zinc 70 per cent., sulphur, 1¾ per cent., the remainder being best caoutchouc. But nowadays although often used, indiarubber is rapidly giving place to metal valves, the best known type being the Kinghorn, shown in Fig. 4. These valves are made of thin phosphor bronze about 1/32 to 1/16 inch thick, there being three plates to each valve, and one on top of the other, of gradually decreasing diameters. They are made to fit loosely on the guide spindle so as to be perfectly free to rise and fall, and it will be noticed that the two bottom plates have holes in them about 3/16 to ¼ inch diameter, there usually being three to four in number drilled at different radii; this allows the valves to come back on their seats quicker and with less noise than would otherwise be the case. Another type of valve in considerable use is that known as the Beldam and which consists of a currugated brass plate about 1/16 inch thick with a valve guard corresponding in shape.

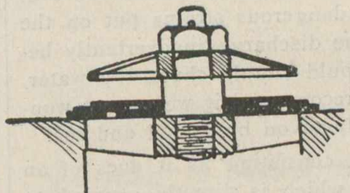


Fig. 4.

We now pass to the circulating pump, Fig. 5, which in marine work is either of the double or single acting piston type or the centrifugal pump. If the piston type of pump is fitted it usually forms part of the main engine, being driven by means of levers from the L.P. crosshead; but in a few cases it is independent, it then being of the direct-acting steam-driven type. Centrifugal pumps are always direct coupled to a high speed steam engine. The independent circulating pump has many advantages over the main engine driven type, for instance, when the main engines are stopped the independent pump may be kept going and so keep the condensers cool.

In many cases where the pump is worked off the main engines it has been found necessary to arrange connections from one of the independent auxiliary pumps to the condenser for circulating when the ship is stopped. Another advantage of the independent type is that when fitted with a bilge suction, which is usually the case, they can be used to pump out the ship in case of emergency. The reciprocating type of pump may be either single or double acting and the stroke is usually about one half that of the main engines. The suction and delivery valves are of the same type as used in air pumps, being either of rubber or metal. The plunger is made solid and is nowadays fitted with water grooves in preference to hemp packing.

The work that the circulating pump is called upon to do is very light, there being usually no lift, as the discharge is almost always under water, so that we have only the friction of the pipes and the work required to keep the water in motion. Under such conditions the centrifugal pump is found to work admirably, it being specially adapted to deal

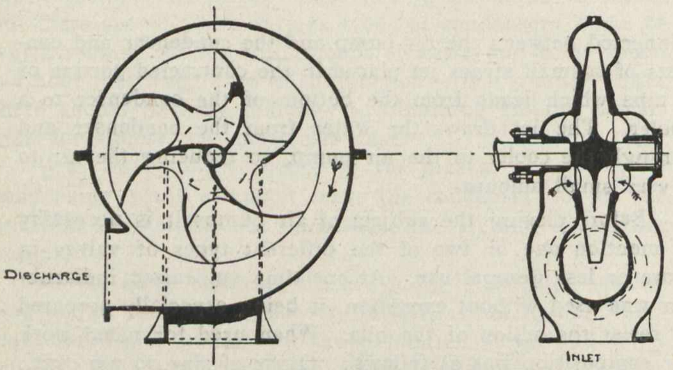


Fig. 5.

with large volumes at small lifts. It has no valves and consequently there can never be dangerous strains put on the pumps or pipes, for should the discharge inadvertently become blocked, the impeller would simply churn the water. With such points as these to recommend it we cannot wonder that it is rapidly gaining favor on both land and sea.

The pump is very simple, consisting as it does of an impeller mounted on a shaft which is directly coupled to the shaft of the engine or motor from which it obtains its power. This impeller works inside a casing of gradually increasing area in the direction of rotation. In this casing are cast the suction and discharge branches. The water enters the impeller at the centre, either from one or both sides, the latter being almost always the case. Should, however, the water enter from one side only, it sets up an unbalanced axial thrust on the wheel, which must then be taken up by means of thrust collars. The impeller is made of brass or gunmetal to resist the action of the water, and consists of two side plates, tapering from the centre to the extreme radius, between which runs a central rib to guide the water into the vanes which are cast between the side plates and extend from the boss to the circumference.

These vanes are curved away from the centre in the opposite direction to rotation and are designed so that the water enters the impeller with the least shock. The shaft on which the impeller is mounted is made of gunmetal or steel cased with gunmetal, the impeller being keyed on. There are two bearings, one at either end fitted with lignum vitae bushes which are lubricated by the water. At the end of the outside bearing there is fitted a brass cap, the impeller shaft not passing right through. This ensures water tightness. The inside bearing is, however, more complicated, as in this case the shaft passes right through; it is therefore necessary to fit the bearing with a gland and stuffing box, sometimes a gunmetal bush is fitted inside the gland to take the wear.

This bush is split to allow of renewal without taking out the shaft. The casing is made either of cast iron or gunmetal, being divided at the centre to admit of fitting the impeller.

The pump, to work efficiently, must not contain any air, as this seriously interferes with its working; therefore they are always fitted with an air cock at the top of the casing which is connected to a condenser or air pump chamber so that they may be exhausted at starting. When there is no air pump or condenser available from which to obtain the necessary vacuum, a small ejector is fitted on the top of the pump and connected to the steam valve of the driving engine. Then by simply turning on the steam we can easily exhaust the pump of any air it may contain.

For land installations the air and circulating pumps are often cast together in the form of an oblong box, there sometimes being as many as three air pumps and one circulating pump in the same casting. This conduces to rigidity and compactness. Another point noticeable in modern designs is that the electric motor is becoming the favorite method of driving these plants where current is available. In conclusion we think that as far as efficiency is concerned the present day air pump leaves very little room for improvement, as I have to-day had the pleasure of seeing an Edward's double acting air pump working at a vacuum of 29.5 inches of mercury by the mercury gauge, the barometer at the time standing at 29.8 inches.

SOME CHARACTERISTICS OF CEMENT BRICK.

(Continued from Page 662.)

In the tests, some peculiar phenomena were noticed. The best test on a 3 to 1 brick shows 5,460 lbs. per sq. in. The best on a hard-burned "body" clay brick showed 5,470 lbs. per sq. in. The average on the clay brick was 5,120 lbs., or slightly less than that for the average cement brick at nine months.

Two bricks made at the same time, from the same stock, show varying results. For instance, two bricks (3 to 1) 275 days old; first crack at 155,200 lbs. and ultimate strength 155,200 lbs., first crack at 169,000 lbs. and ultimate strength 174,000 lbs. Compare that with the clay bricks; first crack at 94,000 lbs., and ultimate strength 162,000 lbs.; first crack at 101,000 lbs., and ultimate strength 150,000 lbs. Average results show the first crack to be at 0.974 per cent. of the ultimate strength for 3 to 1 cement brick, 0.96 per cent. for 4 to 1 brick, and 0.943 per cent. for 5 to 1 cement brick; and 0.625 per cent. for clay brick. The lowest percentage shown in any cement brick was 0.876 per cent.

Six kinds of cement brick were made and used: (1) common brick, output 13,500 to 14,000 per day; (2) face brick, 9,400 to 9,800 per day; (3) 2-in. radius brick for inside jambs, 8,400 to 8,800 per day; (4) outside corner brick (face and one end waterproofed), 8,000 to 8,400 per day; (5) headers, with one end faced, for arches and header courses, 9,000 to 9,400 per day; (6) white brick (faced with white cement for interior of the engine room), output the same as for the face brick.

PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

Fig. 91 is the Statical Diagram for the forces acting at the point ACE. Constructing the Vector Polygon (Fig. 92) for this set of forces, it is seen that the force CE acts away from the point and the force EA against the point. The member CE is, therefore, in tension, and the abutment reaction EA acts upward as would be expected.

Fig. 94 is the Vector Polygon for the forces acting at the point DBF as represented in the Statical Diagram (Fig. 93). The force BF evidently acts against the point and the force FD acts away from the point. The abutment reaction BF, therefore, acts upward, and the member FD is in tension.

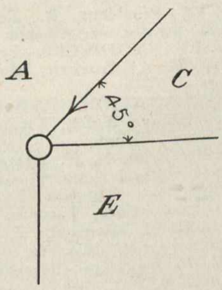


Fig. 91.

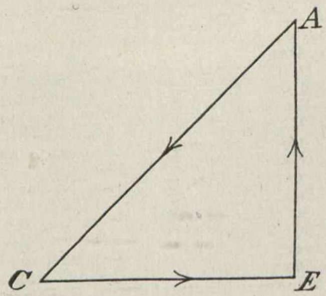


Fig. 92

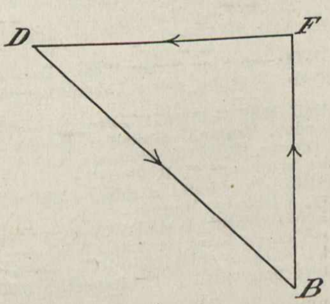


Fig. 94.

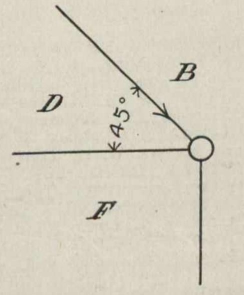


Fig. 93.

Stress Diagram.

The construction of the Stress Diagram for the truss (Fig. 82) is as follows: It will be primarily assumed that the reader has found the stress in the member CD by the method previously indicated. The reason for this assumption is that the construction necessary to find the stress in the member CD will not fit in harmoniously with the subsequent construction of the Stress Diagram.

Considering the point ABDC of the truss (Fig. 82), it is seen that the lines AB, DC (dotted line), BD (dotted line), and CA (Fig. 95) form a Vector Polygon for the forces acting at this point. Reconstructing this polygon by the method outlined in the discussion of the forces indicated in Statical Diagram (Fig. 89), a new Vector Polygon, AB, BD, DC, and CA (Fig. 95), is had, and instead of placing sense marks on the lines composing this last polygon, and any polygons to follow, **a heavy**

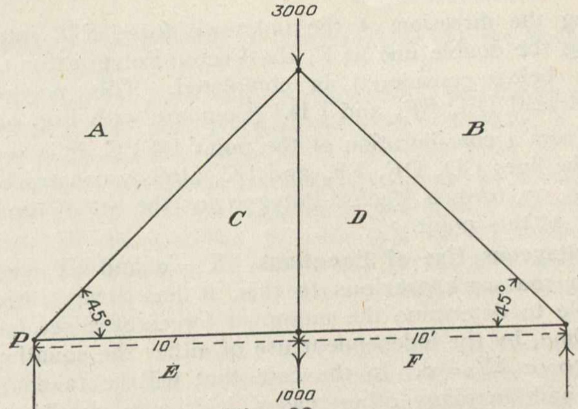


Fig. 82.

line will be used to indicate forces acting against the point, due to members in compression; a light line indicating forces acting away from the point, due to tension members; a double line being used to represent forces due to loads or abutment reactions, whether they act against or away from the point being considered.

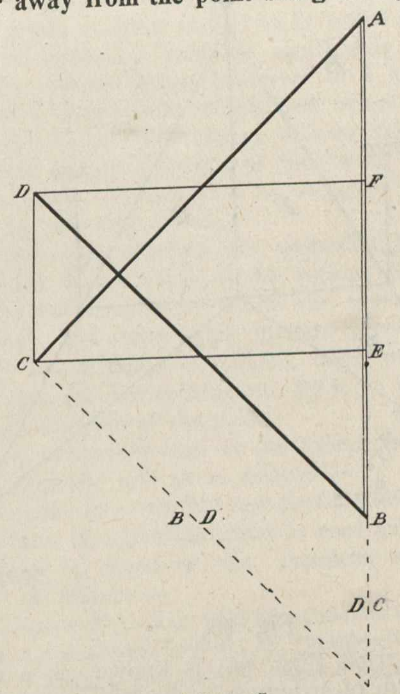


Fig. 95.

Referring to Statical Diagram (Fig. 91) for the point ACE, it is seen that the force AC exerted by the compression member AC acts against the point, and is necessarily equal but opposite to the force exerted by the same member at the point ABDC. It is evident, then, that the heavy line AC (Fig. 95) may represent the force AC (Fig. 91). If, now, a line be drawn from C to represent the direction of the unknown force CE (Fig. 91), and if a double line be drawn from A to represent the direction of the unknown abutment reaction EA, intersecting the last line at E, the lines AC, CE, and EA will form a Vector Polygon for the forces being considered. It is quite evident that the force EA, being a vertical force, the line EA (Fig. 95) representing it will coincide with the line AB.

Considering the forces acting at the point DBF (Statical Diagram, Fig. 93), it is seen that the heavy line DB (Fig. 95) may represent the force DB (Fig. 93). Drawing from B a double line to represent the direction of the unknown abutment reaction BF (this line will, of course, coincide with BA), and from D a line representing the direction of the unknown force FD, intersecting the double line at F, the Vector Polygon for the forces being considered is completed. This polygon should read DB, BF, and FD. (Compare with Fig. 94).

From a consideration of the point DFEC, it is seen that the lines CD, DF, FE, and EC, already constructed in Fig. 95, form a Vector Polygon for the set of forces acting at this point.

Simultaneous Use of Equations $\Sigma X = 0$ and $\Sigma Y = 0$.

In the work previous to this, it has always been possible to determine the unknown forces of a set, one at a time, by the independent use of either the equations $\Sigma X = 0$ or $\Sigma Y = 0$. In the case that will be taken up next, and in many other cases, it is only possible to arrive at results by the simultaneous use of the two equations $\Sigma X = 0$ and $\Sigma Y = 0$, and in such cases certain precautions must be observed.

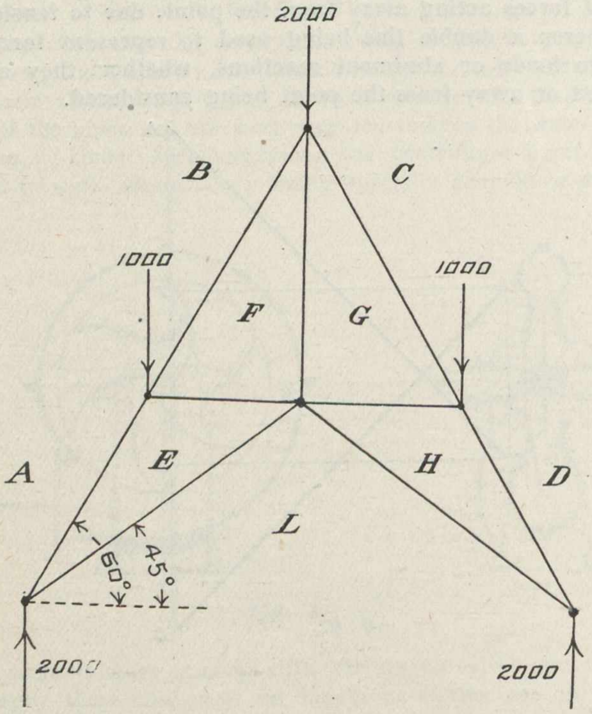


Fig. 96.

The roof truss (Fig. 96) is known as a German Truss. This form of structure is obsolete as far as practice is concerned, but is taken up because it serves very well the purpose of illustrating the point under discussion.

FRAZIL.—(Continued from page 666).

At all of the plants above mentioned the racks or screens are kept free of ice by electric motor-driven rakes, and at present none of them is supplied with heat. Mr. John Murphy,* under whose advice the heating schemes were installed, recommends that the racks be submerged or otherwise protected from the atmosphere, and contends that then only a small amount of heat is necessary to keep ice from clinging to the racks. The operators of the plants, however, think that the electro-mechanical rakes afford sufficient protection and do not employ heat at the racks.

The coming winter's experience will add another interesting chapter to the subject of protecting Canadian hydraulic power plants from ice troubles.

* The Canadian Engineer have in pamphlet form Mr. Murphy's article on "Ice Troubles in Hydraulic Power Work."

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THE PURCHASE OF COAL BY THE B.T.U. METHOD.

By Samuel A. Taylor.*

In these days, when conservation in all things seems to be the watchword of the leaders of our nation, the question of purchasing coal by the British thermal unit method has been attracting the attention of large consumers of fuel.

This method has attained considerable prominence, because a superficial knowledge of the condition under which coal is consumed will bring to the mind of the consumer the question of economy by using a coal containing the highest number of B.t.u. per pound of coal, and he will figure out this economy by the simple rule of proportion.

For illustration, we will assume that the consumer will figure that if he can buy a coal at the mine containing 13,000 B.t.u. for $1.30 per ton, to which he must add the cost of freighting the same to the place of consumption, plus the cost of handling—which we will assume is the same as on a higher B.t.u. coal—it becomes a simple calculation for him to see that his coal is costing him at the rate of one cent for every 100 B.t.u. at the mine; and if he can secure other coal at the same price at the mine at this rate per 100 B.t.u. it is economy for him to pay this rate of one cent per 100 B.t.u. in excess of the 13,000 B.t.u. in the common

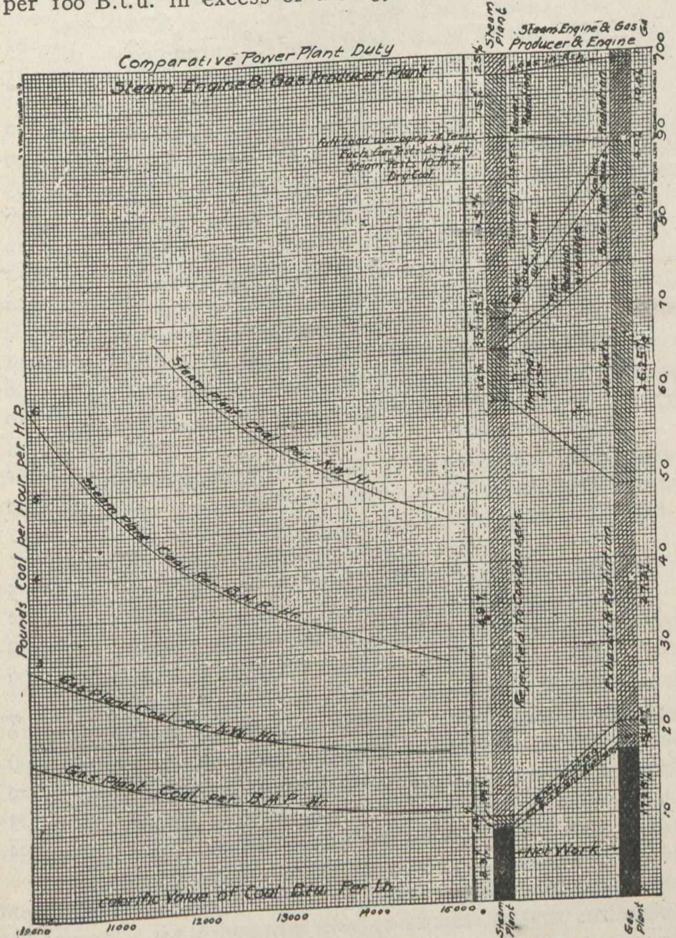

Diagram No. 1. Diagram No. 2.

Diagram No. 1 shows comparative power plant duty. Diagram No. 2 shows approximate distribution of losses and comparative thermal efficiency of steam engine and gas producer and engine.

grades of coal, and, as a rule, he is very willing to do this.

If this were all that is in the question, the matter would be simple, and the consumer who would not take advantage of this condition would be considered, to say the least, very short-sighted.

In order to get at the real significance and consequences of putting this into practical operation generally, a much more comprehensive study of the question must be given.

In order to discuss the subject properly, we should first get clearly in mind the meaning of the term B.t.u. and the method of determination, in order that we can arrive at a logical conclusion as to what would be the best method of practical procedure in any case we might have before us for consideration.

The B.t.u. is defined as being that amount of heat which is necessary to raise one pound of water from the temperature of 32 deg. to 33 deg. Fahrenheit. It is, however, not practised exactly as stated. In some cases it is from 59 to 60 deg., but is usually determined at the temperature of 103 to 104 deg. F., which corresponds to the French practice in the metric system of 40 deg. of the Centigrade scale.

The method of determining heat units now generally practised is by use of the bomb calorimeter, in which is placed a certain quantity of fuel to be tested in an air-tight crucible and burned to complete combustion by the use of oxygen, the crucible being immersed in a known quantity of water at a temperature determined before and after the burning takes place. The change of temperature, the quantity of water and the amount of fuel being determined, it is a mere matter of calculation to ascertain the heat units contained in the fuel tested.

Physicists and chemists are somewhat at variance as to the details of operation of the various calorimeters, as well as the temperature at which the experiments should be conducted, and some other matters pertaining thereto; so that, by this diversity of opinion, there are a number of formulæ given for determining the B.t.u. in any fuel based on chemical analyses of the coal.

The one commonly used by the French is known as the "Dulong" formula, and is as follows:—

$$8080\ C + 34460\ (H - 1/8\ O) + 2250\ S = \text{Calories} \times 1.8 = \text{B.t.u.}$$

Then there is a formula which is used quite extensively, and practised by some of the chemists, known as the "Mahler," as follows:—

$$8140\ C + 34500\ H - 3000\ (O + N) = \text{Calories} \times 1.8 = \text{B.t.u.}$$

Third, a simplified formula of "Mahler," which is:—

$$20050\ C + 67500\ H - 5400 = \text{B.t.u.}$$

For this last formula it is claimed to be accurate for coal, and fairly accurate for wood and oil.

In all of these formulæ C = the carbon present by weight, H the hydrogen present by weight, O the oxygen present by weight, S the sulphur present by weight, and N the nitrogen present by weight; all expressed decimally as to the total weight of the fuel.

In order to show the range of results given by these various methods, I will refer to the report of the United States Geological Survey Coal Testing Plant, which gives a test of Pittsburg coal, designated as Pennsylvania No. 10, in order to show the comparison, the ultimate analysis of which is as follows:—

Carbon	77.14
Hydrogen	5.21
Oxygen	8.65
Nitrogen	1.57
Sulphur	1.26
Ash	6.17
B.t.u.	13,997

By taking this same analysis, and figuring the B.t.u. by the Dulong formula, we get 13,832 B.t.u. From the Mahler formula we get 13,986 B.t.u., and from the Mahler simplified formula we get 13,583 B.t.u.

*Paper presented at Goldfield meeting of American Mining Congress.

From the foregoing statements it will be readily ascertained that, in order to avoid misunderstanding after a contract has been consummated and coal is being furnished thereunder, it should be definitely stated how the B.t.u. are to be determined. Possibly the most satisfactory way at present would be by bomb calorimeter.

Another matter pertaining to this determination, which is also a subject of a great deal of controversy, is the question of sampling the coal to be tested. I am decidedly of opinion that the proper place to take these samples is in the mine, in order to get a fair test to the producer of the coal of the entire output of the mine; for, in the last analysis of the matter, the deductions, if any are to be made, must come off the producer, as will be shown later.

The ordinary method of taking small amounts of coal from different positions in the car may or may not represent fairly the coal in the car. Unless a large amount of coal is taken and crushed and mixed before taking sample for test, it is not very likely to be a fair test of the coal, and will always lead to dissatisfaction to one or both of the parties interested.

In addition to the question of taking the sample on the car at destination, unless the coal is shipped in closed cars, the coal will lose some of its volatile hydrocarbons and take up moisture. Especially is this true in the case where transportation consumes a considerable period of time in reaching destination. It has recently been demonstrated by the United States Government that the additional oxygen taken up by coal in transit materially reduces its B.t.u., which is certainly a matter that the producer of the coal should not be taxed for, as it is a matter over which he has absolutely no control. If anyone should be assessed for this, it should logically be the transportation company. This would, of course, lead to such a complicated situation that it would be practically out of the question; and without some equitable way of adjusting all of these questions the whole scheme must fail of the results desired to be obtained.

Another question that is often raised is: Who should be the party to make these tests? It will always be unsatisfactory for the purchaser himself to make the tests, for, by so doing, he will always be subject to criticism, in case of the coal showing up as of lower quality than guaranteed, that the tests were unfair. Therefore, the necessity for some person to make these tests who would be employed jointly by both parties to the contract, or having the tests made by some Government arbitrator, is essential, in order that anything like satisfactory relations may exist between the seller of the coal and the purchaser thereof.

The United States Government has recently made public the result of purchasing coal under its own specifications in Bulletin 378 of the United States Geological Survey. As set forth in this bulletin, the two items which the Government penalizes and premiumizes are ash and B.t.u. It specifies a certain amount to be deducted or added from an agreed upon per cent. of ash, as the coal is found to contain more or less ash by analysis than a fixed standard, at an agreed upon price for each 1 per cent. of difference, and, likewise, an amount to be added or deducted as the B.t.u. are increased or diminished above or under a fixed number of B.t.u. at an agreed upon price per hundred.

The result of some thirty different contracts is published in a table of the above bulletin, a copy of which is given herewith in order that we may be able to compare the results in a practical way as they obtain them by this method of purchasing coal.

	Contract Basis.				**Contract Fulfilment.**					
	Tons of 2,240 lbs.	Price per ton.	B.t.u. coal as received.	Ash in dry coal.	Tons delivered	Average B.t.u. in coal as delivered.	Average ash in dry coal, per cent.	Average moisture, per cent.	Cost per ton.	— = Penalty. + = Premium.
1	2,250	$3 31	14,200	8.00	1,791	14,130	1.84	2.18	$3 29	— .02
2	350	3 41	14,200	8.00	1,318	14,190	6.43	3.40	5 19	— .21
3	1,500	5 40	14,750	6.25	862	12,543	13.40	3.82	2 29	— .61
4	1,350	2 90	13,770	4.75	6,242	*11,155	11.55	12.59	2 34	— .56
5	8,000	2 90	*13,400	7.50	413	*11,310	11.30	11.89	2 41	— .49
6	500	2 90	*13,400	7.50	2,658	14,574	5.67	2.02	2 97	— .03
7	3,000	3 00	14,700	5.00	1,189	13,440	9.07	3.66	3 10	— .20
8	1,400	3 30	14,000	4.36	1,416	11,458	13.82	7.97	1 81	— .14
9	1,850	1 95	12,200	11.50	1,192	12,909	10.39	4.45	3 26	— .14
10	1,600	3 40	13,466	9.67	550	11,927	9.99	8.56	4 58	— .12
11	500	4 70	12,250	8.60	981	13,916	9.36	1.34	3 73	— .02
12	1,050	3 75	14,000	8.50	2,067	14,022	7.93	2.58	3 35	— .11
13	2,500	3 46	14,474	7.80	9,300	13,982	8.39	2.64	3 37	— .08
14	10,000	3 45	14,315	6.80	1,323	12,709	11.91	4.21	4 89	+ .20
15	1,700	4 69	12,299	13.00	1,520	13,861	9.63	1.92	3 43	— .15
16	1,500	3 58	14,474	7.80	2,958	13,980	9.37	3.06	3 07	— .11
17	4,500	3 18	14,474	7.80	7,479	13,898	9.34	2.36	2 85	— .04
18	1,226	2 89	14,100	8.00	374	14,490	5.54	2.59	3 06	+ .17
19	300	2 89	13,700	6.00	721	13,648	9.71	4.15	2 68	— .21
20	624	2 89	14,500	6.00	3,396	11,278	13.35	10.26	2 30	— .25
21	4,700	2 55	12,500	12.00	145	11,303	15.65	6.54	4 08	— .62
22	250	4 79	12,250	8.00	1,201	11,425	13.34	8.11	4 31	— .39
23	1,200	4 70	12,250	8.00	395	11,789	9.61	9.28	4 21	+ .09
24	500	4 12	11,475	6.91	6,267	14,589	7.12	1.51	3 55	
25	7,000	3 55	14,600	6.00	1,124	14,237	6.55	3.59	3 88	— .10
26	500	3 98	14,600	6.00	276	14,371	6.79	2.65	3 97	— .06
27	350	4 03	14,600	6.00	3,050	13,493	11.63	2.38	2 69	— .20
28	3,000	2 89	14,300	8.00	20,100	14,166	7.70	2.52	3 47	— .03
29	15,000	3 50	14,300	7.50	540	13,851	9.69	2.58	3 71	— .04
30	300	3 75	14,000	10.00						

1—Baltimore Vintondale, Pa.
2—Baltimore. Vintondale, Pa.
3—Boston, Pocahontas, New River or Georges Creek.
4—Buffalo. Oak Ridge, Hillville, Pa.
5—Chicago. Pawnee-Himrod, Ill.
6—Chicago. Pawnee-Himrod, Ill.
7—Cincinnati. New River Sewell coal.
8—Detroit. Kanawha, Oakland, W. Va.
9—Louisville. St. Charles and Fox Run, Ky.
10—Milwaukee. Youghiogheny screened, Pa.
11—Minneapolis. Ziegler, No. 1, Ill.
12—New Orleans. Pratt City, Ala.
13—New York. Acme, Hawk Run, Pa.
14—New York. Delta, Spangler, Pa.
15—Omaha. Fleming, run-of-mine, Kan.
16—Philadelphia. Acme, Hawk Run, Pa.
17—Philadelphia. Acme, Hawk Run, Pa.
18—Philadelphia. Irvona, run-of-mine, Clearfield, Pa.
19—Philadelphia. Run-of-mine, Clearfield, Pa.
20—Philadelphia. Imperial, run of mine.
21—St. Louis. Staunton lump, Ill.
22—St. Paul. Ziegler No. 1, Ill.
23—St. Paul. Ziegler No. 1, Ill.
24—Toledo. Milton, Jackson lump, O.
25—Washington. Sugar Loaf, Twin Rocks, Pa.
26—Washington. Sugar Loaf, Twin Rocks, Pa.
27—Washington. Sugar Loaf, Twin Rocks, Pa.
28—Washington. Irvona, run-of-mine, Clearfield, Pa.
29—Washington. Georges Creek, run-of-mine, Md.
30—Washington. Orenda, run-of-mine, Somerset, Pa.

From an analysis of the table it will be noted that only in four cases out of the thirty contracts have premiums been paid on the purchase of coal, viz.:—

No. 2 paid a premium of 8 cents per ton.
No. 15 paid a premium of 20 cents per ton.
No. 19 paid a premium of 17 cents per ton.
No. 24 paid a premium of 9 cents per ton.

The others range from a penalty of 2 cents to a maximum of 62 cents in the case of No. 22; and only in one case in the thirty has the price remained equal to the contract price.

From a study of the table on the opposite page it will readily be seen that at least one or more of three things will be the result of this method of purchasing coal should it come into general practice.

1st.—The defeat of the principles of conservation.
2nd.—The increased cost of coal to the consumer.
3rd.—The introduction and installation of new methods of using coal of various grades.

In the first case, that of the conservation of the coal for future generations, which has been strenuously advocated by officials of the Government, as well as by various public-spirited citizens outside of the employ of the Government, will be affected in a directly opposite way to that which has been the desire of the conservationists; for the reason that, if this method of purchasing coal were to become generally practised, only the highest quality of coal could successfully meet the strictures of this competition at a profit to the producer; and the further result that the poorer quality of coal would either remain unmined, or, as in the case of much of the Pittsburg seam of coal, probably one-half of the coal in the vein would have to be wasted. As the same conditions will exist in a number of other seams of coal, the inevitable result would be the wasting of a great quantity of the coal from these seams as at present produced and used, and might, therefore, overbalance, in the end, any benefits which might temporarily be gained by this system.

In the second place, the final cost to the consumer, if this method became general, would mean that the general price of coal would have to be increased, and that the basis of purchase must be that of the poorest grade of coal. The cost to produce this poorer coal, together with a fair margin of profit, must, of necessity, be the basis of calculation, for the reason that the poorer grade of coal cannot be mined unless the above condition is maintained; and, if it should not be mined, the better grade of coal would naturally rise in price, and continue this upward trend until the prices would be equal to the cost of the cheaper grade of coal at such price as the producer thereof would be willing to sell it, which, in the end, would have the effect of maintaining a much increased cost of coal to the consumer over the present method of purchase.

To simplify this, let us put the matter in the form of an equation. Assume, for instance, that the price of coal delivered at some point, say, Cincinnati, would be $3 per ton on whatever specifications might be agreed upon. In the making up to this price of $3 we will place as the first member of the equation the cost to the consumer; we will place as second member the cost of production at the mine, say, 90 cents per ton, plus an average profit of, say, 10 cents per ton, plus a freight rate from the mine to the point of consumption of, say, $1.50 per ton, plus a handling charge through the office, yards, or wherever it may be, of 50 cents per ton. This equation, therefore, as written out, is:—

Sales price.	Production.	Profit.	Freight.	Handling.
$3.00 =	90 cents +	10 cents +	$1.50 +	50 cents.

This equation is normal, and, so long as all the factors entering into the selling price of coal are maintained, it still remains normal; but let us consider the change resulting from the B.t.u. method of purchase.

Say, the first member of this equation is based on the fact that it will produce a certain number of B.t.u. and a fixed per cent. of ash, a variation in either of which will change the first member of the equation, and it will readily be seen that the changes susceptible of being made in this member, as per Government specifications, could have a very great range in amounts, and, consequently, by a similar number of changes, in the price. Therefore, we must inquire what function in the other members of the equation can be changed in order to offset this change in the first member so as to still maintain the normality of the equation, and, on investigation, we find that the freight rate and the handling charges practically cannot be changed; therefore, these two factors of the second member are eliminated from consideration.

The final cost of production at the mines, if susceptible of any change at all, is so small that it is almost negligible, and, for all practical purposes, may be ignored, although, with the introduction of new factors in the method and costs of production, may be increased.

It must, therefore, remain that any change that can be made must be made from the second function in this second member of the equation, namely, the profit; and, as this profit is fixed at a nominal amount, as soon as the amount of deduction mentioned in the first member of the equation exceeds the amount allowed for this profit it becomes a minus quantity, or a loss to the producer. While it is quite likely that the contract would be drawn sufficiently rigid to hold the producer to the furnishing of the coal, provided he had sufficient capital back of him to carry out the contract or his bondsmen were liable for the amount which would cover his loss, the contract would likely be fulfilled; but, in any event, whether he had the capital or not, if he would lose on this contract it would only be fair to assume that he would not enter into another of the same character without getting a price sufficient to overcome any possibility of loss by reason of his coal not coming up to the specifications in ash and B.t.u.; for it will be accepted without controversy that no company can or will continue to operate at a loss for any considerable period of time, and that whatever is purchased must be paid for by somebody.

The argument in favor of this method, however, is that it makes the producer much more careful in preparing his coal, and, therefore, being better prepared, it contains less slate and other objectionable material which go to make ash, and he will be more careful to maintain it in good condition. This, from a theoretical viewpoint, is largely true, but at the majority of mines, under present labor conditions, it is almost impossible for the producer to improve much on his production without a very material increase to present cost, which will again increase the first function of our second member of the equation, and consequently require an addition to price in the first member of our equation.

It is, therefore, quite evident that the practical end of this production, so far as ash is concerned, can be an increased cost of production somewhat improved, but the second feature of the specifications, which require a certain fixed number of B.t.u., is largely a chemical question, not one over which either operator nor miner has control, other than to reduce the amount of ash as much as possible.

It must, therefore, be readily seen, in order to continue on this basis of selling coal, that the first member of this equation must be raised sufficiently high to take care of the probable penalties which may be assessed against it by reason of the fact of the coal containing more ash or less B.t.u. than the contract calls for, and still allow the producer to have a fair margin of profit over and above the actual cost of production, and would be accomplished by making the standard for both ash and B.t.u. such as the lowest grade of coal within the competitive district would produce, together with a fair margin of profit for the producer of that coal, which, of course, would mean a much higher price for the better grades of coal. This would probably be only fair to both consumer and producer, but it will take time to have this consummated.

There is, to my mind, no other way out of this; it is inevitable. There must be a normal equation in the business of the country between the producer and the purchaser, although it may take some time to bring it about; to do so may leave some financial wrecks by the business wayside, but it can have no other final solution than this.

In the third place, we are brought face to face with the fact that the present practice of purchasing coal by the B.t.u. method is the beginning or preparation for a course which will, in the end, probably result in real conservation of our fuels, notwithstanding that the present rapid advance of this method of purchasing coal, without apparent attention being given to other functions relating to the consumption thereof, leads the consumer into the path of erroneous economy, which may be restored by returning to the due consideration (and what, to my mind, seems to be the most rational method of economy) of that fuel which will give the greatest results in actual practice by continuing the present methods in use with some modifications, or by adopting some new method of utilization which will, in the end, give to the consumer the same required amount of work for less money, after due allowance is made for additional cost in the necessary preparation to use the cheaper grade of fuel economically.

I refer to a chart, appended hereto, data for which were obtained from the "Westinghouse Diary," showing approximate distribution of losses and comparative thermal efficiency of steam engine and gas producer and engine, in order to more clearly set forth what I have in mind.

From an examination of the chart it will be seen where the loss occurs, and the per cent. of loss at the various stages of application of the heat units in actual practice of a stationary steam boiler and engine plant.

In the initial proceeding, that of the boiler plant, practically 35 per cent. of the total heat is lost. This will at once call attention to the fact, as it exists in many plants, that three to four times more heat is lost than is actually secured by the steam engine, which will range from about 3 or 4 per cent. in locomotives to about 12 to 15 per cent. in triple-expansion stationary engines.

By purchasing coal by the B.t.u. method, an economy of from ¼ to ½ of 1 per cent. of the heat units is sometimes obtained, while, with some care, and, possibly, expenditure, 5 to 12 per cent. of the heating value of the coal would be saved by doing away with some of the waste taking place in the boiler and engine plant, and when this fact is brought to the attention of the consumer it would make him think he had placed the cart before the horse, and himself in the penny-wise and pound-foolish class.

The saving in consumption of fuel in the gaseous state is about 50 per cent. of that required when used in the raw state. It may be interesting in this connection to observe that, for small units of about 50 horse-power, the gas-producer plant alone would require about the same space as the boiler plant for the same power, and would cost about the same as the boiler plant. I believe that in some cases it would be economy to dispose of the present method of generating power and install an entirely new plant.

In this connection it may be interesting to note that the Government Testing Station has conclusively shown that by this method of gasifying fuel a poor grade of coal will produce more power when thus treated than a high grade of fuel used in the raw state. I might also state that there is a method of gasifying fuel and saving some of the by-products without serious diminution of the fuel value, and the by-product thus saved will amount to from $2 to $3 per ton of raw material used. Various methods of achieving economies might be enumerated which, I think, will amount to a very great deal more in actual money value, without raising the price of the fuel, than that secured by purchasing by the B.t.u. method.

In conclusion, therefore, it is my opinion:—

First—That while the B.t.u. method of purchasing coal, so far as the purchaser is concerned, may temporarily prove a good thing, it will, in the end, result in his paying much more for his coal.

Second—That so far as it affects the conservation of fuel, it will prove a failure.

Third—That it is quite possible to so study the method and conditions under which fuel may be used as to effect a very great deal more economy to the purchaser, at the same time not destroying the stability of the business of the producer of coal, which is a condition very much to be desired, as a matter of fact, a necessity, and something which will not obtain should the B.t.u. method of purchasing fuel come into general practice.

Fourth—That where the B.t.u. method is used the agreement should state specifically the following:—

(a) The method of sampling the coal for testing, which is the most important item in connection with this method.

(b) The method of determining the B.t.u., preferably with the bomb calorimeter.

(c) The person who would make the tests, and, in case of dispute, to have an arbitrator, agreeable to all parties in any way interested, named in the contract.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	Earnings Week of Dec. 1909	Earnings Week of Dec. 1908	Stock Quotations Toronto: Price Dec. 10 '08	Toronto: Price Dec. 2 '09	Toronto: Price Dec. 9 '09	Toronto: Sales Week End'd Dec. 9	Montreal: Price Dec. 10 08	Montreal: Price Dec. 2 '09	Montreal: Price Dec. 9 '09	Montreal: Week End'g Dec 9
Canadian Pacific Railway	8,920.6	$150,000	$100	1,905,000	1,548,000	180 177¾	178¼	181	595	178⅝ 178¼	178¼ 178⅛	181½ 181⅜	3105
Canadian Northern Railway	3,180	....	....	321 300	217,500	....	....	....	....	....	....	....	....
*Grand Trunk Railway	3,536	226,000	100	798,837	691,243	....	*1st. pref. 103½, 3rd pref. 50½, ordinary 20½					....	....
T. & N. O.	334	(Gov. Road)	....	32,279	17,147	....	....	....	....	....	....	....	....
Montreal Street Railway	138.3	18,000	100	73,527	64,505	....	....	....	....	203½ 202½	212½ 211	215 214¾	1148
Toronto Street Railway	114	8,000	100	75,500	68,850	107½ 107	125 123¾	125⅞ 125⅝	292	107⅝ 107⅜	124½ 124	126 125⅞	1116
Winnipeg Electric	70	6,000	100	....	....	166	185	185	10	....	....	....	....

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

ONTARIO ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

Previously Given:—

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London St. Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto & York Radial Railway.
Windsor, Essex & Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.

NIAGARA, ST. CATHARINES AND TORONTO RAILWAY

Some of the particulars published in our issue of November 26th, in reference to the above company, were incorrect. Below we give a revised list of the officials and the equipment of the road:—

President, D. B. Hanna, Toronto.
General Manager, E. F. Seixas.
Superintendent, W. R Robertson, St. Catharines, Ont.
Chief Engineer, Walter P. Chapman, Toronto.
Master Mechanic, William Pay, St. Catharines, Ont.
Secretary-treasurer, A. J. Mitchell, Toronto.

Kind of Road: Interurban, suburban or street railway.

Length of Road, in miles:

Total in single miles, 50.

Character of Service:

Car equipment, 36; type, open, closed semi-convertible
Number of motors, 4 per car; power of motors, 50 h.p.
Method of controlling, K and multiple unit.
Method of braking, air.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 80 lbs.

Power:

Direct current, D.C.
Voltage of transmission, 11,000 A.C.
Trolley voltage, 625.
Frequency of transmission for A.C., 66 C.
Number of phases, 3.

PETERBOROUGH RADIAL RAILWAY COMPANY.

President, Mr. Robert Stuart.
General Manager, Mr. J. H. Larmonth.
Electrical Engineer, Mr. H. O. Fisk.

Kind of Road, Street Railway:

Length of Road, in miles:

Total in single miles, 5.1.

Character of Service:

Car equipment, 14; type, single truck.
Number of motors, 2; power of motors, 35 horse-power.
Method of controlling, K. 10.
Method of braking, Peacock and ordinary brakes.
Gauge of track, 4 ft. 8½ inches.
Weight of rails, 60 lbs.

Power:

Direct current, 500 v.

RAILWAY ACCIDENTS FOR NOVEMBER.

Eighty-five Killed, Thirty-five Injured.

The record of fatalities on Canadian railways during the month of November was rather extraordinary, no less than eighty-five persons being killed. Two accidents which occurred in the neighborhood of Vancouver were responsible for over fifty per cent. of the killed. A bridge near Sapperton, on the Great Northern Railway, which had been undermined by a sudden flood, collapsed under the weight of a heavy work train carrying a gang of Japanese track laborers who had turned out at midnight to repair the damage, resulting in twenty or thirty deaths, while a tragedy on the electric railway between New Westminster and Vancouver, caused by a runaway freight car, was responsible for fourteen deaths.

Accidents causing neither loss of life nor injury, but resulting in more or less damage to rolling stock and the right of way, occurred in the neighborhood of the following stations: Sudbury, Ont., Campbellton, N.S., Morrisburg, Ont., London, Ont., Hillsboro. N. B., St. Vincent de Paul, Que., Calgary, Alta., Coatsworth. Ont.

Steam Railways:—

Character of Accident.	Passengers. K.	Passengers. I.	Employees. K.	Employees. I.	Others. K.	Others. I.	Total. K.	Total. I.
Derailment	.	.	36	7	..	..	36	7
Trespassing	.	.	1	..	13	1	14	1
Level crossing	.	.	..	..	8	7	8	7
Adjusting couplings	.	.	..	2	..	..	..	2
Couplings broke	.	.	..	1	..	..	..	1
Shunting	.	.	3	1	..	..	3	1
Switching	.	.	1	1	..	..	1	1
Fell off cars	.	.	1	..	..	..	1	.
Head-on collision	2	.	1	4	..	..	3	4
Broken flange	.	.	..	2	..	..	..	2
Boiler exploded	.	.	1	1	..	..	1	1
Attempt to board moving train	.	1	..	..	..	..	..	1
Totals, November	2	1	44	19	21	8	67	28
Totals, October	3	4	25	30	11	6	39	40
Totals, September	0	5	18	15	15	7	33	27
Totals, August	4	5	6	8	22	2	32	15

Electric Railways:—

	Total, Killed.	Injured.
Collision	..	3
Struck by car	1	3
Coupling broke	14	.
Fell off	..	1
Run over	3	..
Totals, August	3	27
Totals, November	18	7
Totals, September	7	32
Totals, October	2	28

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.—Tenders will be received until 20th December, for the construction of Public Baths. Zotique Trudel, architect, 238 St. Andre. A. F. Vincent, secretary-treasurer, Town Hall, St. Louis.

MONTREAL.—Tenders will be received up to Friday, the 17th December, for the construction of an addition to the Superintendent's House and the construction of a stable in the Corporation Yard. L. O. David, City Clerk.

QUEBEC.—Contractors for bridge superstructure are invited to visit the office of the Board of Engineers in the Canadian Express Building, Montreal, after January 3rd, 1910, where information may be had to enable them to prepare bids for the superstructure of a 1,758 feet span bridge 88 feet in width. The contractor is invited to submit alternative designs, which must conform to the conditions laid down in the general specification. L. K. Jones, secretary, Department of Railways and Canals, Ottawa. (Advertised in the Canadian Engineer.)

MONTREAL.—Tenders will be received until Wednesday, the 22nd December, for the supply of one planer, matcher and moulding machine to plane four sides up to 13 or 14 inches, and tongue and groove, also one tenoning and boring machine for wheels. L. O. David, city clerk.

MONTREAL.—Tenders will be received until Wednesday, 22nd December, for 573 new breakwheels and circuit-breaking springs for fire department. L. O. David, city clerk.

Ontario.

OTTAWA.—Tenders will be received until Thursday, 30th December, for supply of calcium carbide required by the Department of Marine and Fisheries for one year, estimated at 425 tons. Further particulars may be obtained from the purchasing agent of the Department at Ottawa. G. J. Desbarats, Deputy Minister.

TORONTO.—Tenders for the construction of sewers will be received until Tuesday, December 21st. Specifications may be obtained from Mr. C. H. Rust, city engineer.

TORONTO.—Tenders for counter, screens, book stacks, etc., for branch library on the northwest corner of Gerrard street and Broadview avenue, will be received up to Monday, 10th January. E. S. Caswell, Secretary-treasurer, Toronto Public Library Board.

TORONTO.—The city of Toronto will shortly invite tenders for sixteen tons cast iron manhole covers, sludge valves, penstocks, one hundred and fifty tons of cast iron pipe, twenty-six tons special castings, four 24-inch, two 18-inch, and two 8-inch centrifugal pumps, two 175 h.p., two 125 h.p., two 10 h.p. motors and two 200 h.p. gas engines, garbage destructor, sewage screens and centrifugal dryers. Mr. C. H. Rust is the city engineer.

TORONTO.—Tenders will be received until Monday, December 20th, for alterations and fittings, Drill Hall. Toronto. Further particulars obtainable on application to Mr. Thos. Hastings, Clerk of Works, Toronto; Napoleon Tessier, secretary, Department of Public Works, Ottawa. (Advertisement in the Canadian Engineer.)

TORONTO.—Tenders will be received until December 21st for a supply of 48-inch special castings for the connection between the waterworks tunnel and the new 15 million gallon engine. Mr. Joseph Oliver, (Mayor) Chairman Board of Control; Mr. C. H. Rust, City Engineer. (Advertisement in the Canadian Engineer.)

Manitoba.

WINNIPEG.—Tenders are invited until Tuesday, 21st December, for annual supply of fuel for Government institutions in the Province of Manitoba. R. Rogers, Minister of Public Works.

WINNIPEG.—Tenders will be received up to Tuesday, January 18, for removing the present superstructure and furnishing and erecting new steel superstructure and floor, complete, for Louise Bridge across the Red River. Plans, specification and forms of tender may be obtained at the office of Colonel Ruttan, the city engineer. M. Peterson, secretary Board of Control.

WINNIPEG.—Sealed tenders, addressed to the Chairman Board of Control, for supply of labor and materials necessary for additions to piers of Louise Bridge, across the Red river, will be received at the office of the undersigned up to 11 a.m., on Thursday, December 30, 1909. Specifications and forms of tender, together with conditions governing tenders as prescribed by by-law, may be obtained at the office of the City Engineer, James Avenue. The lowest or any tender not necessarily accepted. M. Peterson, Secretary. Board of Control Office, Winnipeg, December 8th, 1909.

WINNIPEG.—Tenders will be received up to Friday, December 31st, for the supply of about eighteen thousand posts, for the manufacture and delivery of about forty-two miles of woven wire fence, and for the erection of the fence along the right-of-way of the City's Transmission Line, between the Brokenhead River and the city. M. Peterson, Secretary, Board of Control.

Saskatchewan.

SASKATOON.—Tenders will be invited by the Governors of the University of Saskatoon for the construction of a college building, a dormitory and a power house.

Alberta.

MEDICINE HAT.—Tenders will be received until Tuesday, January 4th, for clay products plant, including three high-pressure boilers, 120 horse-power Corliss engine, generator and engine, pumps, pans, elevator, pulley, belting, sewer pipe press, structural steel, 4 horse-power gas engine, four side-dump cars, gap lathe, iron planer, forge and blacksmith tools, 500 horse-power heater and fire hose. Address communications to Warren Overpack, 404 N. Des Moines Street, Webster City, Iowa.

British Columbia.

PRINCE RUPERT. — Tenders will be received up to Wednesday, the 19th January, 1910 for the construction and completion of a portion of the permanent system of sewerage. Plans, etc., may be seen at the office of Public Works Department, Victoria, B.C., the Government Agent, Mr. James H. Bacon, Harbor Engineer, Prince Rupert, B.C.; the Government Agent, New Westminster, the Provincial Timber Inspector, Vancouver. F. C. Gamble, Public Works Engineer, Victoria, B.C.

VANCOUVER.—Tenders will be received until Wednesday, January 12th, for next year's waterworks supplies, including ten miles of steel and iron pipe, as follows:—Three and a half miles of six-inch, one mile of eight-inch, and two and a half miles of twelve-inch. This pipe is to be three-sixteenths of an inch thick, and to stand a pressure of 300 pounds. 250 tons of four-inch cast iron pipe, are also required. Mr. W. A. Clement is city engineer.

VICTORIA.—The Grand Trunk Pacific Railway is inviting tenders for the construction of large wharves at Victoria, to cost $100,000.

U. S. A.

ALBANY, N. Y.—Tenders will be received until Tuesday, December 28th, for improvements to the Erie and Champlain canals. Further particulars on application to F. C. Stevens, superintendent of Public Works, Albany, N. Y., and at Canal office, Spaulding's Exchange, Buffalo, N. Y.

DETROIT, MICH.—Proposals will be received up to Tuesday, December 28th, for furnishing and erecting the structural steel and iron work for Engine Room building of the New Pumping Station. Benj. F. Guiney, Secretary.

PITTSBURG, PA.—Responsible parties can secure opportunities of figuring on 400,000 cubic yards of dirt work, provided they have the proper shovel plant and can give proper references. R. L. McKallip, 2835 Smallman Street.

HOLTON, KANS.—Tenders will be received until January 12th, for the construction of, (a) About 45,000 feet of 8-in. sewer; 64 M.h.; 35 ft. (b) About 14,000 feet of 10-in., 12-in. and 15-in. sewer; 41 M.h. (c) A disposal plant. William C. Bryant, Engineer.

CONTRACTS AWARDED.

Nova Scotia.

HALIFAX.—Tenders for three thousand feet of fire hose were considered at Monday's meeting of the firewards, and the following contracts, for 2½-inch hose, were awarded:—Canadian Rubber Company, of Montreal, 1,000 feet "Keystone" brand at $1; 1,000 feet "Paragon" brand at $1 to the Gutta Percha & Rubber Company, of Toronto; 500 feet of "Para" at $1 to Stairs, Son & Morrow, of Halifax, and 500 feet "Crescent" at $1 to Austen Brothers, of Halifax. The La Franc Company, of Elmira, N.Y., U.S.A., will supply 200 feet of chemical engine hose at 60 cents, while the Dunlop Rubber Company, of Toronto, received an order for a hundred feet at 50 cents and a quantity of suction hose.

SYDNEY.—William Little has been awarded a contract for sewer construction at 23 cents a foot.

Quebec.

ARTHABASKA.—For the construction of a steel bridge on the Becancour River, the County of Arthabaska received the following tenders, that of Joseph Gosselin being accepted:—

J. Lacoursiere, N. Nolin and J. D. Lachance, Quebec	$21,570
The Laurentian Construction & Engineering Company, Montreal	20,910
MacKinnon, Holmes & Company, Sherbrooke	20,225
The Phoenix Bridge & Iron Company, Montreal, P.Q.	19,925
Pepin & Michaud, Arthabaska	18,300
The Jenks-Dresser Company, Sarnia, Ont.	17,360
Joseph Gosselin, Levis, Que.	16,000

MONTREAL.—The Fairbanks-Morse Company were awarded a contract for supplying steam power plant and electrical equipment for the new plant of the Soledan Mining & Milling Company, of Mexico.

MONTREAL.—The town of St. Louis received the following tenders for the construction of a subway under the C.P.R. tracks:—W. Duquette, $80,000; Henault & Heffernan, $120,000; the Clinton Company, $187,467. The contract was not awarded.

Ontario.

COBALT.—The Temiskaming & Northern Ontario Railway have awarded a contract for rock work in the station yards here to Canadian Contracts, Ltd., of Toronto.

HAMILTON.—The tender of the London Machine Company for a punching machine for the board of works yard was accepted at $422.50.

HAMILTON.—The Smart-Turner Machine Company of this city have been awarded the following contracts, amongst many others:—Page Hersey Iron Tube Company, Toronto, a side suction centrifugal pump; the Toronto Ferry Company, Toronto, triplex power pump; Shea's new theatre, Toronto, automatic feed pump and receiver; John C. Mundell & Company, Elora, a duplex pump.

LONDON.—The engineers of the Hydro-Electric Commission will report to the Utility Board at their next meeting that they found the lowest tender for the power station equipment was submitted by the Canadian Westinghouse Company, who will probably receive the contract.

NIAGARA FALLS.—The Canadian Contracts, Ltd., has been awarded a contract by the Ontario Hydro-Electric Commission, for the construction of an underground conduit system, whose purpose will be to form a connection between the sub-station of the Hydro-Electric Commission and the distributing station of the Ontario Power Company. The system will carry cables with a capacity of 12,000 volts.

TORONTO.—The Waterous Engine Works Company, of Brantford, Ont., were awarded the contract for two new steam fire engines at $10,500.

TORONTO.—The tender from the Jenks-Dresser Company, of Sarnia, for $1,000, for the supply, erection, and completion of steel floor beams and posts for the new engine-room at the main pumping station was accepted.

Alberta.

FRANK.—General Manager Alfred Muller, of the Canadian Consolidated Coal Company, has let the contract for supplying machinery to H. Y. Lloyd. The proposed plant will be the largest in the Crow's Nest Pass.

British Columbia.

VICTORIA.—A contract for construction of Lampson Street School at $14,854 was let to Thomas Ashe, Foul Bay Road.

NORTH VANCOUVER.—The following tenders were opened by the district council for a quarry railroad equipment. Mussens, Ltd., $676, and $25 additional for delivery at the quarry. Langley & Williams, $873. Bayfield & Williams $536, and Robert Ward & Company, for wire rope only.

VANCOUVER.—A. Morrison has been given a contract for grading Ash Street, at $41 a chain and 23rd Avenue at $43 by the municipality of Point Grey.

VANCOUVER.—In response to invitations for tenders on materials, supplies, labor, tools, etc., required in the construction of a reinforced concrete dock in North Vancouver, the North Vancouver Ferries Company, whose stock is controlled by the city, received the following:—

*Mr. P. Cotton, Vancouver	$28,952
Patterson Timber Company, Vancouver	35,900
Booker & Campbell, Bellingham, Wash., U.S.A.	33,815
Engineer's Estimate	26,796

* Accepted.

George S. Hanes, engineer for city and Ferry Company.

U. S. A.

NEW YORK (N.Y.)—The contract for placing 1,200 Raymond concrete piles in the foundations of a reinforced concrete shop building to be erected at the Schenectady works of the General Electric Company by the Stone & Webster Engineering Corporation, has been awarded to George W. Van Vranken, Schenectady, representative of the Raymond Concrete Pile Company, of New York and Chicago.

RAILWAYS—STEAM AND ELECTRIC.

New Brunswick

ST. JOHN.—It is stated by Mr. C. O. Foss, superintending engineer of the National Transcontinental in New Brunswick, that ninety per cent. of the grading in that province is now completed. The line through New Brunswick is not very extensive, although the work is heavy and expensive. During the past summer 140 miles of track have been laid, nearly half of the entire section. With the large amount of grading done it is expected that the rest of the track laying will be finished early next summer.

Quebec.

HULL. — The Gatineau and Ungava Railway, with a capital stock of two million dollars, will apply to Parliament for power to construct and operate a line from a point on the Transcontinental Railway in Quebec to Leaf Lake, on Ungava Bay, about 800 miles.

QUEBEC.—The Northern Quebec Colonization Railway Company, want power to build a railway from Tadousac, Que., to Hannah Bay, Ontario, with a branch line. Smith & Johnston, Ottawa, Ont., solicitors.

MONTREAL.—It is reported this week that the C.P.R. is not considering any extensive introduction of electric traction on its present system.

Ontario.

BRANTFORD.—J. S. Clark and H. C. Zwetsch of Buffalo, are applying to the city council for a franchise in connection with a railway from here to Port Dover.

DESERONTO.—The Bay of Quinte Railway Company, will apply to Parliament for permission to construct a branch 15 miles long from Bridgewater, Ontario to Actinolite Mines, Ontario.

OTTAWA.—The Grand Trunk Pacific Branch Lines Company will apply for permission to build numerous branches in the West and to issue bonds to the extent of $30,000 a mile.

OTTAWA.—The following notices appear in The Canada Gazette for Dec. 11th:—

Western Alberta Railway Company will apply for extension of time for commencing and completing its line.

The Ottawa, Rideau Valley and Brockville Railway, will apply for power to build a railway from Ottawa, to Brockville, Ontario.

Western Canada Power Company, Limited, want to enlarge the scope of their charter, so as to build and operate railways, telegraph and telephone lines. Code & Burritt are their Ottawa agents.

Manitoulin & North Shore Railway want extension of time for completing their Sudbury-Little Current branch and for commencing construction of other branches.

The Toronto Central Terminal Company apply for power to construct and maintain passenger and freight stations and other terminal facilities.

The Hudson Bay and Northwestern Railway will probably amalgamate with the Manitoba & Keewatin Railway.

The Ontario & Ottawa Railway apply for power to build and operate a line from Lake Couchiching to the Township of Snowden to Renfrew, to Hull, to Ottawa.

Hamilton, Waterloo and Guelph Railway will apply for permission to build an extension to Toronto.

TORONTO.—The Canadian Northern Railway will probably construct a spur line along the east bank of the Don into the Ashbridge's Bay district.

TORONTO.—The Grand Trunk Railway have been ordered to build a viaduct at Sunnyside.

Saskatchewan

REGINA.—The Saskatchewan Central Railway will apply for permission to build and operate a line through Battleford to Edmonton, with five branches. Smith & Johnston, of Ottawa, Ontario, are solicitors for the railway.

YORKTON.—A locating party of the Grand Trunk Pacific, under the charge of Engineer Greaves, has started to locate a line from Yorkton north to cross the Canadian Northern main line at Canora or Tiny and thence to the Hudson Bay. The line will be commenced in the spring and 42 miles built next summer.

OTTAWA.—Mr. M. J. Butler, deputy Minister of Railways, reported on Monday at some length in connection with the Hudson Bay Railway. Two routes were surveyed. Fort Churchill route of 477 miles would cost, including terminal facilities, $19,108,672; the Nelson route, 410 miles, is estimated to cost, with similar facilities, $16,426,340. The latter is favored. The line is not only 67 miles shorter, but Nelson has a better harbor, while the country through which the line would run is better. A fair proportion of it is available for settlement, whereas on the Churchill route there is no such probability beyond Split Lake. The distance from Liverpool to Port Nelson is 3,200 miles, as against 3,007 from Montreal to Liverpool. The grades are 21 feet to the mile. The Deputy Minister has altered the surveyors' estimates so as to provide for an 80-pound rail instead of 60 pounds.

Manitoba.

WINNIPEG.—Construction contracts will be let in March by the Alberta and Great Waterways Railway officials, who expect to have the line in operation to a point 150 miles to the north of Edmonton by the middle of next summer. The remaining 200 miles of the line to Fort McMurray is also expected to be completed by the fall of 1911.

British Columbia.

VANCOUVER.—In addition to the Canadian Northern and Kettle River Railway Bills which will be among the first to be considered at the session of the Legislature which opens on January 20th, are many other schemes for new railways in this Province. Last week's "Gazette" contains notices of nine railway bills, seven of which are for new lines. Messrs. Abbott & Hart-McHarg, of this city, are applying for the incorporation of a company to build and operate a railway from Vancouver to New Westminster. A bill is also promised for the revival of the Vancouver & Nicola Valley Railway Company charter of 1908, and another to extend the time for the commencement of operations on the enterprise of the Graham Island Railway Company. Barnard & Robertson have charge of a bill for a rival Graham Island project. Frank Higgins has the interests of another Graham Island road; Taylor, Hulme & Innes are looking after the Robson Bight & West Vancouver Island Railway Bill; and Wilson & Bloomfield the projected road from Menzies Bay to the junction of the Salmon and Memekay rivers.

NELSON.—The portion of the V. V. & E. between Keremeos and Hedley and from Hedley to Princeton, a distance of about 42 miles, which has been under construction for two years, has been accepted by the Government Inspector of Railways, Mr. H. A. K. Drury, and has now passed from the construction department of the Great Northern Railway to the operating department. Chief Engineer J. H. Kennedy is transferring his headquarters to Abbotsford, and is leaving Mr. H. M. Hale to take charge of construction westward from Princeton. Mr. Hale is moving from Hedley to Princeton.

VANCOUVER.—Plans for building a subway between the inlet front and the False Creek railway yards have been marked out by the local engineering staff of the C.P.R.

SEWAGE AND WATERWORKS.

Quebec.

MONTREAL.—Messrs. Quinlan & Robertson have commenced the enlargement of the old conduit.

Ontario.

GUELPH.—Contractor Conn, who constructed the new waterworks pipe line, is suing the water commissioners for extras amounting to $9,083.48, claiming that work which had to be done over again to stop leaks in the conduit was not called for in the contract.

ORILLIA.—The Water Committee have recommended extensions of water mains. The acceptance of the Canada Foundry Company's tender referred to on page 606 of our issue for November 26th, was confirmed.

Saskatchewan.

SASKATOON.—Sewer and water extensions for 1910 are estimated to cost $200,000. Mr. George S. Clark is city engineer.

British Columbia

NEW WESTMINSTER. — The Vancouver Power Company have been granted a patent for a tract of land comprising eighteen thousand acres surrounding Coquitlam Lake and, according to the latest issue of the Canada Gazette, they are prepared to enter into an agreement to supply this city with water.

VANCOUVER.—Waterworks superintendent Maddison reported that it would cost $8,000 to repair the damage done to the civic water system by recent floods.

VICTORIA.—Assistant City Engineer Bryson submitted his preliminary report on the Sooke Lake water scheme at a recent council meeting. He estimated that it would cost $1,500,000 to construct the necessary dam, tunnel and pipe line, and recommended a more detailed survey in the spring.

LIGHT, HEAT, AND POWER

Ontario

LONDON.—There is a movement on foot to sell the plant of the London Electric Company to the city, to be used as a reserve steam plant for Niagara power.

OTTAWA.—A by-law to give the Metropolitan Company a 25-year franchise, for heat and power only, conditional on the company being in a position to deliver 1,000 horse-power in three years, will be submitted to the ratepayers at the January elections.

PETERBOROUGH.—On January 3rd, the ratepayers will vote on a by-law drafted to grant the Peterborough Light & Power Company the right to erect poles and supply power for thirty years.

PORT ARTHUR.—The ratepayers of the city are to have an opportunity of declaring their opinion on the respective propositions of the Ontario Hydro-electric Commission and the Ontario & Michigan Power Company at the municipal elections in January.

TORONTO.—The St. Catharines Hydraulic Company are suing the Dominion government for unstated damages in connection with the cancellation of their lease of the water power privileges of the old Welland Canal. Mr. Justice Cassels, in the Exchequer Court, reserved judgment.

British Columbia.

VANCOUVER.—A new unit which will mean an increase of 10,500 horse-power for the British Columbia Electric Railway, has just been installed at Lake Buntzen, and is now in partial operation. The final test of the new machnery, the installation of which was completed last week, has not yet been made as the governors are not yet placed in position, but it has already carried over 8,000 horse-power with ease.

This additional power unit brings the total number up to five, operating on four transmission lines. The machinery of the new unit includes an electrical generator, made by the Dick Kerr Company, of Preston, England, and a water wheel, the largest of its kind ever made, designed by the Doble Company, of San Francisco, and manufactured by the John McDougall Caledonian Ironworks, of Montreal, Que. From the entrance in the dam, a stave pipe line seven feet diameter runs to the crest of the hill, and from there a steel pipe of about the same diametrical dimensions takes the water to the new wheel in the power house. Work has been proceeding on this addition all summer.

FINANCING PUBLIC WORKS.

The following municipalities recently sold debentures:—

Point Grey, B. C., $28,000.
Kipling, Sask., $14,000, schools.
Ottawa, Ont., $160,000, schools.
Winchester, Ont., $12,249, cement sidewalks.
Lucknow, Ont., $3,500, civic buildings.

Ontario.

BELLEVILLE.—By-laws for a bridge over the River Moira and to grant permission to the Seymour Power & Electric Company, to erect poles and string wires on certain county roads, have passed second reading in the Hastings County council.

PENETANGUISHENE.—This municipality will apply to the Legislature for permission to issue debentures amounting to $24,220 for sewer extensions now under way, for completed works and for bonuses to the North Simcoe Railway and several factories.

NEWMARKET.—Debentures for cement walks, bridges, etc., amounting to $20,000, are offered for sale by J. E. Hughes, town clerk.

WATERLOO.—The ratepayers will vote on the following by-laws:—$3,000, gravel pit; $8,000, new market building. Mr. F. S. Kumpf, town clerk.

SARNIA.—A water main by-law is at present before tne council.

OTTAWA.—The ratepayers will vote on a $45,000 garbage by-law.

AMHERSTBURG.—The council are considering a $20,000 public school by-law.

PETERBOROUGH. — The ratepayers will vote on a $19,000 isolation hospital by-law.

ST. THOMAS.—The ratepayers will vote on a $25,000 street railway extension by-law.

WELLAND.—The ratepayers will vote on a $13,500 by-law to meet the Methodist Church debt. A new paving by-law is before the council.

NEW LISKEARD.—The ratepayers will vote on the following by-laws; $28,000 for macadamizing streets, and $2,500 for the purchase of fire apparatus.

Manitoba

WINNIPEG.—The following by-laws carried: $150,000 for underground conduits for power wires, $50,000 for municipal baths. The by-law for $50,000 for a civic art gallery was defeated.

CARBERRY.—By-laws have been passed to issue $1,-561.75 5 per cent. 20-year, and $1,418.75 5 per cent. 20-year local improvement debentures. Geo. Balfour is town treasurer.

GRANDVIEW.—Sewer debentures amounting to $3,000 are offered for sale by William Dickie, secretary, of this town.

Saskatchewan

MAIDSTONE.—J. L. Courtice, secretary-treasurer, offers for sale, $2,000 permanent improvement debentures.

Alberta

CAMROSE.—Applications will be received up to January 1st, for $6,000 debentures. O. B. Olson, secretary-treasurer.

LETHBRIDGE.—The Parks by-law carried by a large majority, while the street railway and gas franchise by-laws were defeated.

British Columbia

POINT GREY.—The ratepayers will vote on a $250,000 street improvement by-law.

VICTORIA.—The ratepayers will vote at the forthcoming election on a $52,000 cemetery extension by-law.

MISCELLANEOUS.

Quebec.

MONTREAL.—The Road Committee has made a list of requisitions to meet next year's administrative expenses, amounting to $2,036,284, including:

For macadam	$930,333.00
Wooden sidewalks	179,310.40
Repairs to pavements	262,050.00
Repairs to sidewalks	176,489.25
Crossings	43,714.20
Curbstone	15,924.20
Gullies	52,675.00

QUEBEC.—Preliminary work on the reconstruction of the Quebec Bridge was commenced on Wednesday, December 8th.

Ontario.

NORTH BAY.—The town clerk has been authorized to write for prices and particulars of snow ploughs.

OTTAWA.—Hon. G. P. Graham recently stated that the contract for the sub-structure of the new Quebec Bridge had been awarded to M. P. Davis. The contract calls for two pneumatic caissons, two abutments, two anchor piers and one intermediate pier, at a total cost of $2,448,475. The cost of the masonry work in the two pneumatic caissons will be $2,800,000, and these will be required whatever type of superstructure is decided upon. Pending such decision, it was not considered wise to give an estimate of the cost of the superstructure. The total cost to date to the Government of the bridge has been $6,905,852, which includes subsidies to the amount of $374,353.

Manitoba.

WINNIPEG.—At a recent meeting of the Board of Control, Mr. W. F. Fallman, city street commissioner, recommended the use of oil for street sprinkling.

WINNIPEG.—Col. Ruttan, city engineer, has prepared particulars of the proposed quay wall along the Red River. The area would be approximately ninety square yards and the bulk thirty cubic y ards per lineal foot. Including concrete, excavation and foundation work, the cost would probably be $400 per lineal foot, say, $2,000,000 per mile. The first thing necessary would be to make a survey, which would give the necessary definite information by boring, etc., and would cost from $3,000 to $4,000 per mile.

British Columbia.

VANCOUVER.—The Dominion Railway Commission have granted this city permission to erect a bridge on the C.P.R. tracks at Carrall Street.

VICTORIA.—Plans are said to be completed for a forty million dollar steel industry on the coast. The syndicate, which is known as the Western Steel Corporation, recently purchased large iron deposits on Vancouver Island. Herbert E. Law, of San Francisco, and James A. Moore, Seattle, are interested.

VICTORIA.—Mr. Bayfield, engineer of the Public Works Department, who was previously connected with the Montreal Harbor Works, has outlined plans for a new steel steamer for use as a dredge tender. The department is also considering the purchase, at a cost of $350,000, an elevator dredge for use in improving the First Narrows at Vancouver, for which surveys and plans have been made. One and a half million yards of material will be taken away.

PERSONAL NOTES.

MR. HUGH C. BAKER, manager of the Bell Telephone Company in Hamilton, Ont., one of the fathers of telephony in Canada, and a builder of the original Hamilton Street Railway, has resigned.

MR. THOMAS LEOPOLD WILLSON, of Ottawa, Ontario, receives the first award of the McCharles prize, which will be given from time to time, like the Nobel prizes in a small way, to any Canadian who invents or discovers any new and improved process for the treatment of Canadian ores and minerals, or for any important discovery that will lessen the dangers and loss of life in connection with the use of electricity in supplying power and light. Mr. Willson was born in Princeton, Oxford Co., Ontario, and is the inventor of the Willson Acetylene Flare Light, manufactured by the International Marine Signal Company, of Ottawa.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

8783—November 30—At St. Antoine Street, Tetraultville, P.Q.; across the C.P.R.

8784—November 30—At public crossing one-quarter mile east of Shaw Station, Ont., and the C.P.R. at public crossing 400 yards west of St. Cuthbert Station, P.Q.

8785 to 8793 Inc.—November 22—Granting leave to the Manitoba Government Telephones to erect, place, and maintain its wires across the tracks of the C.P.R. at three points; the C.N.R. at five points; and the G.T.P. Railway at one point in the Province of Manitoba.

8794 to 8798 Inc.—December 1—Granting leave to the Government of the Province of Alberta, to erect, place, and maintain its telephone wires across the tracks of the G.T.P. Railway at two points; C.P.R. at two points, and the C.N.R. at one point.

8799—December 1—Granting leave to the Saskatchewan Government to erect, place, and maintain its wires across the track of the C.N.R. at Hague, Sask.

8800—November 30—Directing the C.P.R. to reconstruct the culvert under its tracks at mileage 3.3 Sudbury Section, to carry off the water at Lily Lake, Township of Humphrey, Ont.

8801—December 1—Amending Order No. 7746, dated August 5th, 1909, approving location of C.N.R. from Tp. 15, R. 17, west of the 6th Mer. to Sec 11, Tp. 14, R. 17, west of the 6th Mer., mileage 0 to 5, B.C., by changing the reference to Range 17 in said Order to read "Range 27."

8802—November 29—Authorizing the C.P.R. to open for the carriage of traffic that portion of the second track of its line of railway from mileage 59.4 to mileage 59.6, on its Fort William Section.

8803—November 18—Authorizing the C.N.Q. Railway to construct, maintain, and operate a branch line of railway, or spur from near St. Marc's Junction, through the parishes of St. Marc, Grodines, and St. Albans, County Portneuf, P.Q.

8804—December 1—Approving stress sheets of the C.N.R. Company's Lac Ouareau-Rawdon Extension.

8805—December 1—Granting leave to the C.N.O. Railway to construct its line of railway across six highways in Township of Whitechurch, County York, Ont.

8806—November 30—Extending until June 1st, 1910, the time within which the Bell Telephone Company may file with the Board tariffs of tolls of telephone tolls.

8807—November 30—Extending until June 1st, 1910, the time within which the North American Telephone Company may file with the Board tariffs of tolls of telephone tolls.

8808—November 30—Certifying that amended plan of the right-of-way of the C.N.R. as constructed across the S.E. ¼ of Sec. 24, Tp. 43, R. 4, west of the 3rd Meridian, north 28 miles from Dalemy, has been accepted.

8809—November 27—Dismissing application of the city of Edmonton, Alta., to provide that the G.T.P. Railway and the C.N.R. each install and maintain its own diamond crossing, in the city of Edmonton, Alta.

8810—November 27—Dismissing application of the city of Edmonton, Alta., to provide that the G.T.P. Railway and the C.N.R. each install and maintain its own diamond crossing, and that street barriers or gates, together with home signals, to be operated by a watchman, in said city.

8811—November 30—Authorizing the G.T.R. to construct, maintain, and operate branch line of railway, or siding, in the city of Hamilton, Ont., to and into the premises of the Otis-Fensom Elevator Company, Limited.

8812—November 30—Authorizing the C.P.R. to construct, maintain, and operate a siding to and into the premises of the Noxon Company, at Ingersoll, Ont.

8813—November 30—Directing that the G.T.P. Railway construct highway crossing and road diversion between Secs. 25 and 26, Tp. 35, R. 12, west of the 3rd Meridian, District Saskatoon, Sask., in accordance with and subject to the General Regulation of the Board Affecting Highway Crossings.

8814—November 29—Authorizing the C.P.R. to construct, maintain, and operate industrial spur in Lots 15 and 16, R. 7, Tp. of Aylwin, P.Q.

8815—November 30—Dismissing application of the Townships of Tilbury East and Raleigh, for construction of bridge over Jeannette's Creek and Baptiste Creek by the G.T.R. Company on its Southern Division.

8816—December 3—Authorizing the C.N.O. Railway to open for the carriage of traffic that portion of its line of railway, Ottawa-Hawkesbury Division from Rockland to Hurdman's Bridge, near Gladstone Avenue, Ottawa, Ont.

8817—December 3—Approving by-law of the C.N.O. Railway authorizing D. B. Hanna, Guy Tombs, and W. H. Jordan, each, or any of them to prepare and issue tariffs of tolls to be charged by the C.N.O. Railway between and including Hawkesbury and Ottawa, Ont.

8818—December 3—Approving Standard Passenger Tariff C.R.C. No. 153, providing for maximum passenger rate of three cents per mile between all stations on the C.N.Q. Railway and Ottawa Section of the C.N.O. Railway.

NEW INCORPORATIONS.

Alex. Bremner, Limited, Montreal, Quebec, $200,000; to manufacture and sell cement, drain pipes, lime, plaster, bricks and to deal generally in builders and contractors' supplies.

The National Engineering Company, Limited, Montreal, Quebec, $20,000; mechancial and electrical engineers. Richard T. Heneker, K.C., of Montreal, is a director.

The General Land & Industrial Company, Limited, $2,000,000, Toronto, Ontario; lumber merchants. Jas. S. Lovell, accountant, is interested.

NEW GRAB DREDGE.

A powerful self-propelling grab dredge has just been completed to the order of the Egyptian Government for the Upper Nile. This is the third dredge which the Soudan Irrigation Department designed for the work of rectification of the Upper Nile, upon which it is engaged and by means of which the potentiality of the river for irrigation purposes will be greatly increased. The first dredge is of the dipper type for embanking purposes and is already in service. The second is of the hydraulic type and is now being erected at Khartoum, while the third dredge is intended to deal with the "sudd" and will be provided with appliances for cutting the sudd as well as removing it. This vessel is built in the form of a light draft river steamer, 160 feet long by 32 foot beam and 2 feet 9 inches draft, and was built by Wm. Simons & Company, Limited, Renfrew, Scotland. The three dredges have been built to the designs and specifications of Mr. A. W. Robinson, M. Can. Soc. C.E., of Montreal, Consulting Engineer to the Soudan Irrigation Department.

MARKET CONDITIONS.

Montreal, December 16th, 1909.

The steel trade in the United States is now occupied in laying the foundation for prices of finished material in 1910. Notification has been given of an advance of 50c. per ton in the price of Lake Superior ore for next season, beginning with May.

Already there has been an advance in ore prices in other parts of the United States and abroad. The situation largely depends, however, upon the future of coke. Already furnaces are trying to get $2.80, and it is said that some sales have taken place at that figure for the first half of 1910. Railways have not been conspicuous as buyers during the present month but it is expected that they will place heavy orders during the coming two or three months. There is business in sight for structural material, outside the railways, involving a heavy tonnage. This includes the Quebec Bridge, for which about 60,000 tons will be required, this being one of the largest structures now before the trade. Sheets, tinplates and other iron products, continue in heavy demand, but other classes of material are not being ordered in as large volume as during November. This was only to be expected, as the rate of specifications during October and November was too large to continue. The trade, generally, anticipates higher prices, not only on pig-iron but on finished material of all kinds, for 1910 delivery, especially for such as will require to be made from orders based on last year's costs. At the moment, trade is a little quiet and will probably continue so for some weeks into the new year.

In England, conditions throughout the trade do not show any improvement and, as a matter of fact, little hope can be held out for an improvement during the remainder of this year or for some time to come. The political situation is undoubtedly affecting trade prejudicely and, until this is cleared up, material resumption of activity is unlikely to take place. Prices on pig are being fairly well maintained, especially for steel making grades. Foundry irons are a little weaker. The situation in Scotland is much better than in England, local conditions being more satisfactory. German and Belgian conditions show some improvement and prices evince an upward tendency. All classes of products from pig-iron are held at higher figures than for some time past. This condition will, no doubt, be reflected later on in the English markets, especially if American conditions continue to improve. Meantime, however, local conditions in Great Britain are not satisfactory, and stocks of pig-iron are accumulating.

In Canada, the situation is entirely satisfactory. So far as pig-iron is concerned, conditions are becoming more strained than ever. Another furnace is now out of the market, so far as supplying new business is concerned, the reference being to the Midland furnace, its output being sold up till the end of October next. Even the output of the large new furnace, which is expected to go into blast about the beginning of March next, is included in the above statement. When it is remembered that the Nova Scotia Steel and the Dominion Iron companies are both out of the general market, their own output being required for their own steel plants, and that the Algoma plant is in a similar position and in fact is also a buyer, it will be seen that there is little Canadian pig-iron for sale. The Algoma plant, however, has made its purchases for many months to come, it is said. Demand for all classes of iron is on the increase and foreign iron will have to be largely drawn upon in order to supply requirements.

Dealers in all sorts of finished and semi-finished material, including plates, sheets, iron and steel bars, pipe and structural steel, report a very dull demand for their various lines. Some months and even weeks ago they looked forward confidently to a more active trade and to a stiffening of prices but, up to the present, neither has made its appearance. They have now given up looking for any improvement for the remainder of this year and will be well enough satisfied if it comes along within a reasonable time after the beginning of 1910. That an improvement is coming they confidently predict. Meantime, the market continues as follows:—

Antimony.—The market is steady at 8 to 8¼c.

Bar Iron and Steel.—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20.

Building Paper.—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for

(Continued on page 686.)

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(Continued from page 684.)

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Laths.—See Lumber etc.

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Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., factory.

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Nails.—Demand for nails is better and prices are firmer, $2.40 per keg for cut, and $2.35 for wire, base prices. Wire roofing nails, 5c. lb.

Paints.—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

Pipe.—Wrought and Galvanized.—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch $95; 4-inch, $108.

Plates and Sheets.—Steel.—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

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Spikes.—Railway spikes are firmer at $2.45 per 100 pounds, base of 5⅜ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch

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Tin.—Prices are unchanged, at 32½ to 33c.

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Cheese.—Late makes, 11¼ to 11¾c.; finest makes, ½c. more.

Coffee.—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c.

Dried Fruits.—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6c.; California, seeded, 7½ to 9c.; Sultana, 8 to 10c. Evaporated apples, prime, 9¼ to 9¾c.

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Potatoes.—Per 90 lbs., good quality, 50 to 60c.

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Rolled Oats.—Oatmeal, $2.45 per bag; rolled oats, $2.20, bags.

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, greens, 25 to 50c.; low-grades, down to 15c.

Provisions.—Salt Pork.—$30 to $32 per bbl.; beef, $15 per bbl.; smoked hams and bacon, 15 to 18c. per lb.; lard, 17c. for pure and 12c. for compound.

Fish.—Salted.—Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to $1.25.

* * * *

Toronto, December 16th, 1909.

Ice and snow are lessening the activity of building in both city and country, and for the same reason the movement of many materials for exterior use has declined. Pitch and tar, roofing felt and paper, sewer pipe, and bricks are less active except for repairing purposes, but structural steel, iron pipe, rails and sheets, continue in fair request, and lumber is still moving. Pig-iron shows good activity and holders are firm as to price, the like may be said of boiler plates and tubes. In fact the metals trades, shelf goods included, are more active than is usual at this time of the year.

It is not easy to obtain at this point a clean-cut quotation for cement. The close of navigation makes it hopeless to expect as low prices as have prevailed for recent months, while it is too early to obtain quotations for next spring. Apparently the managers of the Canada Cement Company have not resolved upon any serious or immediate advance, while those mills outside the combine are in no hurry to quote prices.

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

Antimony.—Demand active and price higher at $9.25 per 100 lbs.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 lbs.