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STORAGE OF WATER IN EARTHEN RESERVOIRS.*

BY SAMUEL FORTIER, M. CAN. SOC. C.E.

(Concluded from last issue.)

In cold climates like those of Canada and the Northern States, it is important that the high water line be kept below the frost line in the upper portion of the dam. Failure might also be caused in weak embankments by the formation of ice at the flow-line.

In both cold and warm climates there is the danger of waves over-topping the embankment. The maximum height of waves which may occur on the surface of any reservoir of known dimensions may be roughly estimated by Stephenson's formula $H = 1.5 \sqrt{F} + (2.5 - \sqrt[4]{F})$ in which H is the height of the waves in feet and F the fetch or distance in nautical miles through which the waves act. According to the above formula, the heights of waves on ordinary reservoirs would vary from two to three feet. On the smallest the waves would be more than 2 feet high and seldom more than 3 feet on the largest. It is evident, therefore, that this formula does not apply to small surfaces of water, but as the error is on the side of safety, and since the top of even small reservoirs should be raised at least two feet above high water; the formula can be trusted to give approximate results.

The practice of the writer for years in designing the cross-sections of reservoir embankments has been to determine first the breadth at the flow-line. Then through the extremities of this distance converging lines can be drawn to suit the angle of repose of the material and other necessary conditions. Great differences exist as to this dimension. While writing this article there lie before the author the descriptions of five reservoirs each 30 feet deep, and their respective breadths at the flow-line are 28 feet, 34 feet, 40 feet, 45 feet and 53 feet. After making ample allowance for a difference in the quality of the materials, there should not be a difference of nearly 100 per cent. in the widths of the embankments, providing the work in each case has been carefully done.

With a view to unifying the results and economizing material, the writer obtained by circular letters, private correspondence and otherwise, descriptions of about 100 reservoirs located in nearly every State of the Union. Out of the hundred 75 were chosen as typical of existing conditions, and their depths of water and breadths of embankment at the flow-line were plotted on cross-section paper. The co-ordinates for each of the 75 reservoirs were the abscissa (x) which represented the breadth in feet of the embankment at the flow-line, and the ordinate (y), which represented the depth in feet of the water in the reservoir. The curve formed by joining all the points was so nearly that of a straight line that the following equation of a straight line was adopted.

$$y = x - 5.$$

For outer and inner slopes of two horizontal to one vertical, and with the top of the embankment from two to six feet above the flow-line, the above empirical formula gives top-widths and flow-line widths for depths of water from 10 feet to 45 feet as follows:

TABLE VI.

Depth of water in reservoir. Feet.	Outer slope.	Inner slope.	Top width. Feet.	Distance between top of embkt. and surf. of water. Feet.	Breadth at flow line. Feet.
10	2 to 1	2 to 1	7	2	15
15	"	"	8	3	20
20	"	"	11	3½	25
25	"	"	14	4	30
30	"	"	19	4	35
35	"	"	22	4½	40
40	"	"	25	5	45
45	"	"	31	6	55

In impounding water to a depth greater than 40 or 50 feet, safe construction requires the introduction of berms. Thus, in a reservoir 60 feet deep, there should be near the middle of each slope a berm of 5 or 6 feet in width, and when we deduct the width of these two berms, the top width is limited to about 30 feet, while the formula still holds approximately true.

Regarding the 75 typical reservoirs referred to, it may be here stated that their inner slopes varied from a maximum of 4 to 1 to a minimum of 1 to 1, and averaged 2.61 to 1, while their outer slopes averaged 2.1.

TABLE VII.

Outer Slopes.					Inner Slopes.				
2	reservoirs	1	to	1	2	reservoirs	1	to	1
23	"	1½	"	1	23	"	1½	"	1
2	"	1¾	"	1	2	"	1¾	"	1
41	"	2	"	1	31	"	2	"	1
1	"	2¼	"	1	1	"	2¼	"	1
3	"	2½	"	1	1	"	2¾	"	1
3	"	3	"	1	11	"	3	"	1
					2	"	4	"	1
75 reserv's aver. 2 to 1.					75 reserv's aver. 2.61 to 1				

It is evident from the foregoing that American

*A paper read before the Canadian Society of Civil Engineers.

practice in adopting slopes to earth embankments does not often vary from 2 horizontal to 1 vertical. No unprotected earth slope will long withstand the action of waves, even on a 3 to 1 incline, and since some kind of paving is necessary, a 2 to 1 slope of suitable materials and properly constructed is preferable to one flatter. In paving with hydraulic cement concrete, the cost can be considerably lessened by adopting a 1½ to 1 slope on the water side, without lessening to any extent the strength or efficiency of the embankment.

To prevent the destructive effects of waves, ice and frost, to facilitate the removal of silt and aquatic vegetation, to prevent animals from burrowing into the bank, and in many cases to prevent percolation through the bottom and sides, some kind of paving is usually required.

The following brief notes obtained by circular letters describing the mode of paving and the materials used in more than thirty reservoirs in the United States, will give the reader a fairly correct idea of existing conditions:—

Waterworks Reservoir, Charlottesville, Va., 47 Feet Deep.—" Inside slope of dam is paved 12 inches thick with ordinary stone rip-rap."—E. F. Harris, supt.

Lake Montebello Reservoir, Baltimore, Md., 31 Feet Deep.—" Inside slope is rip-rapped with broken stone for a distance of 2 feet above and 3 feet below the flow line."—Wm. Benthall, ass't engineer.

Tatnuck Brook Reservoir, Worcester, Mass., 30 Feet Deep.—" Paved 24 inches thick at top and 18 inches thick at bottom of inside slope with field stone of large size, having interstices filled with smaller stones."—Fred A McClure, supt.

Waterworks Reservoir, Grand Rapids, Mich., 16 Feet Deep.—" Bottom of reservoir is paved 12 inches thick, inside slope from 12 inches at bottom to 2 inches at top with cobble stone laid in cement concrete. Frost has loosened some of the cobble stones at the water line."—H. A. Collar, city engineer.

Indian Creek Reservoir, Boise, Idaho, 50 Feet Deep.—" Inside slope rip-rapped with basalt 18 inches thick."—Chas. L. Swain, engineer.

Storage Reservoir, Amsterdam, N.Y., 65 Feet Deep.—" Face of dam is rip-rapped 1½ feet deep, hand placed. Frost never affects rip-rap. Don't believe in paving."—S. E. Babcock, engineer.

Storage Reservoir, Rochester, N.Y., 15 Feet Deep. —" A berm five feet wide at middle of slope; rip-rap below berm; paved with stone above. Paving laid on gravel lining a few inches thick."—E. Kinchling, chief engineer.

Distributing Reservoir, Rochester, N.Y., 17 Feet Deep.—" On bottom of reservoir 4 inches of gravel spread over surface of clay puddle 12 to 18 inches thick, hauled from brick yard. Rip-rap 24 inches thick below berm. Stone paving 18 inches thick above berm." —E. Kinchling, chief engineer.

Schuyhill River Reservoir, Conchohocken, Pa., 13 Feet Deep.—" 12 inches cement concrete on bottom, 4 inches brick on 12 inches cement concrete on slopes. Concrete composed of 1 cement, 3 sand, 5 broken trap rock."—W. E. Ferrier, supt.

Waterworks Reservoir, Sherburne, N.Y., 30 Feet Deep.—" Paved with stone 12 inches thick set at an angle of about 60°. Space filled with gravel."—W. E. Davis, supt.

Storing and Receiving Reservoirs, New Bedford, Mass.—" The inside slope of storing reservoir dam is protected by a paving of large sized boulders. The inside slope of the receiving reservoir has a lining of granite blocks 1 foot thick."—R. C. P. Coggeshall, supt.

Waterworks Reservoir, Waltham, Mass, 15 Feet Deep.—" Bottom and water slopes paved with granite slabs 12 inches thick, laid dry as closely as possible."—L. Brown, supt.

Hartford, Conn.—" We have six reservoirs from 20 to 41 feet deep, paved with stones about what two men can lift, placed close together and filled in with smaller stones."—Henry A. Ayers, supt.

Low Service Reservoir No. 2, Portland, Oregon, 21 Feet Deep.—" Paved with brick, coated with ¼-inch California asphalt laid flatwise in paving pitch."—J. Henry Smith.

Easton Lake Reservoir No. 2, Bridgeport, Conn., 51 Feet Deep.—" Cobble rip-rap 24 inches thick at bottom of slope and 15 inches at top."—S. G. Stoddard, jr., engineer.

Waterworks Reservoir, Covington, Ky., 47 Feet Deep.—" The water slopes are riveted with stone blocks 12 inches thick, laid in cement on a foundation of broken stone 12 inches deep."—W. H. Glore, supt.

Waterworks Reservoir, Erie, Pa., 26 Feet Deep.—" Bottom of reservoir puddled with 18 inches of brick clay put on dry and rolled solid every three or four inch course. Paved with brick laid flat on bottom (2 inches thick), and laid on edge on sides (4 inches thick) with cement, after being laid."—Wm. Hinnel, secretary-treasurer.

Birmingham Reservoir, Birmingham, Ala., 42 Feet Deep.—" Rough sand stone rip-rap 12 inches thick."—W. J. Milner, supt.

Storage Reservoir, Peoria, Ill., 24 Feet Deep.—" Six inches of concrete laid on bottom in about 10 foot squares separated by two rows of brick placed on edge. Water slopes lined with brick eight inches thick. Frost in winter occasionally cracks the bricks at the water surface."—Dabney H. Maury, supt.

Cherry Valley Reservoir, 35 Feet Deep.—" The inside slope of the dam is covered with rubble paving from 12 to 24 inches in thickness, covered with about six inches of selected hard pan to fill the interstices in its surface."—J. C. Hancock, supt.

Cache la Poudre Reservoir, Northern Colorado, 30 Feet Deep. Larimer and Weld Reservoir, Northern Colorado, 22 Feet Deep.—" Inside slope of both reservoirs rip-rapped with mountain sandstone one foot thick laid on two feet of gravel."—Ed. Baker, engineer, Greely, Colo.

Waterworks Reservoir, Ann Arbor, Mich., 14 Feet Deep.—" Slopes protected by rubble or cobble stone."—Chas. E. Green.

Marlette Lake Reservoir, Virginia City, Nevada, — Feet Deep.—" Front of dam paved with rubble. Stone and ice sometimes displace or disarrange the rubble, but not seriously."—J. B. Overton.

Storage Reservoir, Southington, Conn., 25 Feet Deep.—" The water slope of the dam was covered 18 inches in depth with small broken stone, over which was laid a paving of large stone 15 inches in depth." —J. H. McKenzie.

The use of brush or willows tied together and anchored by means of galvanized wire is not uncommon. The small private irrigating reservoirs of Western America are frequently protected from wave action by wheat straw held down by strands of barbed wire. Occasionally brush and stones or slag are used. The author employed as a temporary expedient for the Ogden Distributing Reservoir, until a more permanent paving could be put down, a paving of red pine boards extending 3 feet above and 6 feet below the flow-line along the slope and nailed to joists 3x8 imbedded in the bank and anchored at intervals. A very common method is to use a foundation, a compact, impervious and stable bank, on the inner slope of which is spread a layer of gravel or broken rock of sufficient depth to prevent the water from washing away the earth beneath. Upon this porous layer is laid the stone pitching or rip-rap, which may vary in depth from 1 to 2½ feet, depending upon the height of the waves and the action of ice and frost, the interstices of the stone pitching being filled with gravel spalls or broken stone. The usual form of cement concrete paving is a layer of screened gravel or broken rock well rammed, upon which is laid the requisite thickness of concrete. For a short distance, both above and below the flow-line, stone-pitching laid in cement mortar upon a thin layer of cement concrete should be substituted for the cement concrete paving. A concrete composed of clean sand, gravel and liquid asphalt in about the following proportions is sometimes employed:

Gravel	70 per cent. by weight.
Sand	30 " "
Liquid Asphalt	10-15 " "

The sand and gravel are heated to a temperature of over 300 Fahr. and mixed with the liquid asphalt at a slightly lower temperature.

It is put on hot in a manner similar to street paving and varies from 1 to 4 inches in thickness.

A paving formed of brick and asphalt is also advocated. The brick on the bottom may be laid flatwise on the lower portion of the slope 4 inches and near the flow line, 8 inches, in thickness. to prevent the brick from absorbing moisture a thin layer of asphalt mortar, composed of 90 per cent. by weight of clean sand mixed with 10 per cent. by weight of liquid asphalt, is first spread over the rammed gravel; the brick are then dipped in hot asphalt, and after being laid grouted with the same material. A thin surface coating of asphalt of about ⅛th of an inch in thickness completes the lining. In discussing the relative merits and demerits of each type of paving represented above, little need be said of the first two named, since the early decay of both willows and lumber render periodical renewals necessary.

Many failures are recorded of stone pitching or rip-rap, but in nearly every instance they were caused by the washing away of part of the embankment immediately beneath the rip-rap. Under ordinary conditions wash can be prevented by placing a sufficient thickness of gravel or broken rock back of the pitching, and carefully filling all interstices of the latter with coarse sand and gravel. The general success which has attended this kind of paving does not warrant, in the opinion of the writer, the following severe censure from the pen of Samuel McElroy, C.E., of Brooklyn, N.Y.:—

"The only way to protect an earth reservoir bank, or floor, is to keep it dry; otherwise pressure, storm wash, motion, leakage, frost or animals may weaken and destroy it. Dry work, properly laid, requires much more time for selection and fitting than cement work, for the same section and slope; it requires a better class of stone throughout; and the cost of hydraulic cement mortar, in itself, does not add more than $1.20 per cubic yard, or about the cost of the cement mortar, to that of dry work, for the same stone. At Ridgewood we paid $1.50 for the dry stone lining, and $2.50 for similar wall in cement with full joints. The repair accounts of dry walls on various public works has been a formidable item. Experience also shows that a well-puddled and brick-covered reservoir floor would have prevented some costly bottom leaks and ruptures. In a Report on the Hudson River and Champlain Canal Improvement, made to the State Engineer of New York in 1867, I had occasion to show that a solid masonry canal slope wall one-third to one with 4½ feet concrete footing and 30-inch wall, could be built and coped for less than the 1¼ to 1 dry slope wall, which has been an endless cause of wash, rupture and repair along the entire canal system of the State. If the experience of our reservoirs similarly lined was collected it would certainly end their construction, as it would similar constructions for mill-power races, dams and other faces exposed to wash and frost. For both Brooklyn reservoirs the following specification was adopted: The inside slopes to be carefully puddled for two feet in depth, then covered with a substantial layer of cement, mortar and gravel (concrete), not less than three inches thick, over which a wall of brick masonry shall be built eight inches thick to the embankment top, and covered with a flag coping not less than three feet wide by five inches thick. The bottom of the apartments to be similarly puddled and covered with best paving brick laid on their edges and carefully grouted. In the Ridgewood case this theory was fully confirmed by negative experience. A change in the direction took place in 1856, and some changes in plan in 1857. The slope lining was thus specified: The water-slopes, unless otherwise directed, to be paved with a well-laid stone paving one foot thick, the stone used to be sound and of proper shape to make neat and compact work; and openings between said stone to be well pinned and packed; to be equal in every respect to the receiving reservoir of the Croton work. The paving to be laid on a bed of gravel or small stones. A considerable length of slope was lined under this specification, under Mr. Kirkwood's personal inspection, as a pattern for the rest; it was as cheap for the sub-contractors to use 15 to 18-inch stone, and the wall was thus laid, with about five inches of small stone backing. When about seven feet of water was pumped into the eastern division in 1858, the wave-wash cut the embankment behind the wall so rapidly that the water was drawn down, the injured sections repaired, and the entire lining carefully filled in with cement, grout and pointing. This involved a change in the dry wall of the new Croton reservoir, then under contract, to cement-stone masonry. The Mount Prospect reservoir, built according to the original specifications, illustrates to-day its advantages. For convenience of construction, however, it is best to increase the concrete thickness and reduce that of the puddling."

In the case of the Ridgewood reservoir, cited by Mr. McElroy, five inches of broken stone behind rip-rap is too thin to prevent wash. Again in the paving for the Brooklyn reservoirs, which he recommended, it is not good practice to lay cement concrete on clay, since the weight of the water which may accumulate back of the lining, or the liability of both clay and water freezing, will loosen and break the concrete.

Water slopes lined with cement concrete fail usually in one of two ways; either the foundation is insecure or the bank settles. Quite often a layer of clay is first put down with no intermediate porous stratum of gravel or small stones, and when the water is rapidly drawn down in the reservoir the wet mass of clay is liable to slump and carry with it the concrete lining.

Engineers and superintendents frequently build reservoirs in earth and line the inner slopes and bottom with cement concrete before the banks have properly settled, and without first thoroughly soaking the interior walls. In a properly made bank there will be no subsidence to speak of, but to pave a reservoir without first allowing the water to remain up to high-water mark for days and even weeks, is to invite failures. The Cemetery Hill reservoir of Colorado, built in 1886 87 by the writer as engineer-in-charge, in accordance with plans and specifications prepared by chief engineer Allan, was not lined until 1890. In the spring of that year it was paved with Portland cement concrete, of which the greatest thickness did not exceed four inches. Five years later (1895) the writer examined the lining and found no failures, not even a crack. He attributes the success of this paving to the stable condition of the banks and to the water-soaked state of the interior. In the vicinity of Beaver Brook, Colorado, the farmers can get no water from wells, and they obtain their domestic supply from the irrigating canals in summer, which is run into cisterns lined with cement mortar or concrete. After many failures the writer suggested that they soak the bottom and sides of the newly excavated cisterns for weeks, then remove the water, ram gravel over the entire interior and line with cement concrete. It was found that a much thinner coating would suffice when the foundation was prepared in the manner just described.

The toughness, elasticity and imperviousness of asphalt concrete render it a suitable material for reservoir lining. It has, however, one serious defect which engineers have not yet been able successfully to overcome. A hot sun, or warm weather, will cause it to slide down the slope. In this kind of paving the thin coating of asphalt mortar which completely surrounds the paving brick renders the lining impervious and difficult to crack, while the rigidity of the brick prevents the wall from sliding upon its base. Stone rip-rap based on a thin coating of asphalt concrete can be substituted for the brick, and the entire wall well grouted with asphalt mortar.

In the New England States perhaps 85 per cent. of all the earthen dams now in existence have been built with core walls of puddled clay, masonry, or concrete. In California, the Rocky Mountain Region and as far east as Pennsylvania and New York, masonry core walls are seldom introduced.

About a year ago, the writer sent the following questions to a large number of hydraulic engineers and waterworks superintendents:

Ques. 1. If the reservoir dam is built with a centre core, state the materials used and mode of construction.

Ques. 2. Give the following dimensions of the centre core: bottom width at original surface, top width, depth of base below original surface, width of base at bottom, height over all.

Ques. 3. Does the water in your opinion percolate through the inner portion of the embankment to the centre core?

Ques. 4. Speaking generally, do you think the additional security gained by a concrete or masonry core justifies the extra expense?

The replies received to the above queries were so conflicting that it was impossible to harmonize the opinions expressed. If a classification were attempted it would be something like the following:

(1) Those who consider a masonry core wall essential.

(2) Those who consider any kind of a core wall an element of weakness and a useless expenditure of money.

(3) Those who would insert a masonry core wall as an additional safeguard in all important structures, the failure of which might endanger life or property.

(4) Those who would be guided entirely by the quality of the materials and the conditions connected with each case.

The chief advantages of a masonry core wall are:

(1) It prevents animals from burrowing holes through the embankment.

(2) It may prevent percolation.

The chief disadvantages are:

(1) The additional cost.

(2) The unequal settling of unlike materials of different density and weight.

(3) The liability of the earth in the upper part of the embankment becoming saturated and increasing the pressure on the wall much beyond the designed limit.

(4) The tendency of the wall to crack on account of the expansion and contraction due to changes of temperature, presence of water back of the wall, or on account of the unequal settling.

It has always seemed to the writer that the advantages to be gained from a masonry core wall are in no measure commensurate to the disadvantages arising from its use. A 12-inch brick wall laid in cement mortar will prevent the burrowing of animals as effectively as a concrete wall six feet in thickness. Besides, it is doubtful if there is an animal in existence which will burrow, for the sake of the pleasure to be derived from the exercise, through a well made gravel puddle. In the Western States cement concrete costs per cubic yard in place from $6 to $7, while earth suitable for earthen dams can be conveyed in wheel scrapers, puddled and rolled, for from 12 to 20 cents per cubic yard. A yard of concrete is thus equivalent to nearly 45 yards of puddled earth. The most pronounced advocate of concrete core walls will hardly dare maintain that the relative utility of equal volumes of a concrete wall and the adjacent earthen embankment is as 45 to 1.

In considering the safety of earth dams with masonry or concrete heart walls, the late James B. Francis assumed that the full hydrostatic head would be exerted against the wall, and that as the wall alone was wholly inadequate to sustain this pressure, the earth on the down stream side had to be made of sufficient weight to resist the total pressure.

Desmond Fitzgerald, in describing the high earth dams recently constructed under his supervision for the Boston Water Works, lays down a similar assumption. One embankment is 65 feet high, has an inner slope of 2 to 1, and an outer slope of 2 to 1 and 2½ to 1, a berm 6 feet wide on each side, and a concrete core wall 10 feet thick at the base and 2 feet at the top. "In considering," he says, "the stability of this kind of an embankment, we must assume that the full head of the reservoir is carried to the core wall."

The writer fails to see the benefits to be gained by this process of reasoning based on such an assumption. In the first place, hydraulic engineers are nearly unanimous in the opinion that the inner part of the embankment should be the most impervious, and that if it cannot be homogeneous in structure, the materials should be so placed that the imperviousness of the inner part should change gradually to the porosity of the outer. In following this practice it would be impossible in all well executed structures for the full head, or any head of water, to be exerted against a centre wall.

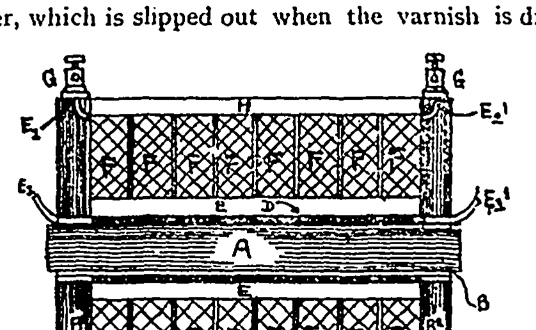
If the intention is to place all the impervious material near the centre and next to the core wall, the design is one of the worst that can be conceived. In such an embankment there is a porous mass of earth next to the water, through which the latter can readily seep or percolate, then a heart wall encased in clay puddle much too weak to sustain the hydrostatic pressure, and back of this a second porous mass of earth too weak in itself to retain the impounded water. This method of retaining water reminds the writer of the city engineer of a Western city who built a stand pipe of brick, and, to be doubly safe, lined its exterior with thin sheet-iron plates. When the water was first turned in it never rose to the full head, but burst the brick and afterwards the thin sheet-iron. In impounding water one must depend wholly upon one particular class of material to sustain the pressure and prevent seepage and percolation.

AN INDUCTION COIL.

J. B. HALL, E.E.

The construction of an induction coil to give a 4 inch spark, to be used for producing X rays with vacuum tubes.

The core A is composed of No. 22 B. & S. gauge iron wire in pieces 10 inches long, the tube B being filled with them. The tube B is made of paper, stuck together with shellac varnish, formed on a round rod 1 inch diameter, which is slipped out when the varnish is dry.



Scale in inches 1 2 3

FIG. 1. INDUCTION COIL IN SECTION.

The end blocks C are of vulcanite or red fibre and are $\frac{3}{4}$ inch thick by 7 inches square, drilled to permit the terminals of the primary ($E1$ & $E1^1$) and secondary ($E2$ & $E2^1$) coils to pass out, also drilled and tapped to receive screws to hold the coil to base. The primary coil D is composed of 64 wires of No. 14 B. & S. gauge double cotton-covered copper wire, with terminals, taped or enclosed in a rubber tube, emitting from the end blocks ($B1$ & $B2$) and connected to binding posts. Upon completion of the primary coil, it is well wrapped with paper until cover E is $\frac{3}{4}$ inch thick, shellacking the layers to cause them to stick together. When the shellac is dry, the secondary coils are to be slipped over. The secondary coils F are composed of No. 31 double cotton-covered, B. and S. gauge copper wire. They are wound on a former (Fig. 2), the former first having a strip of presser unsized cardboard wound on it to act as a stiffener or base for the coils. The coils F are

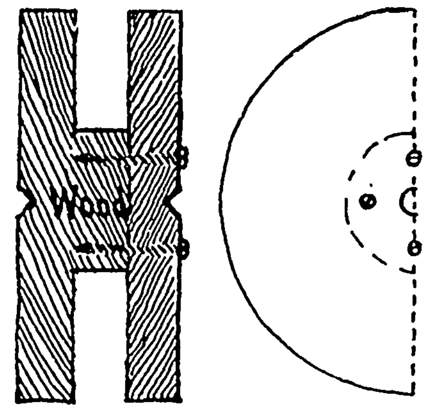
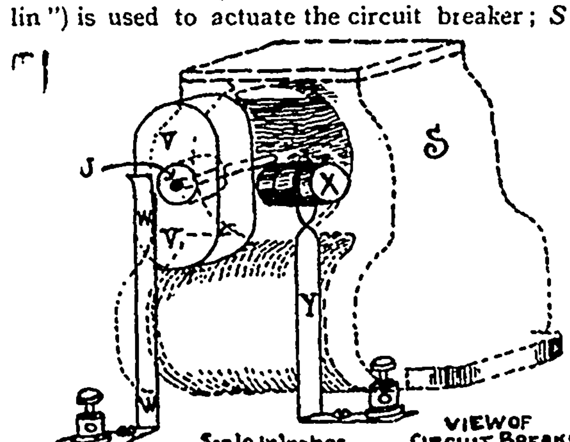


FIG. 2.
FORM FOR SECONDARY COIL.
Scale in inches
1 2 3

eight in number, and each when completed is removed from the former with the cardboard attached, and taped with two thicknesses of best quality adhesive tape. They are then slipped on the coil over tube E, care being taken that they are all turned in the same direction, the end of No. 1 joining the beginning of No. 2. (It is better to mark the terminals so that no mistake will happen.) Lead the terminals $E2$ and $E2^1$ (enclosed in rubber tubes) out, as shown, to the binding posts, GG^1, from whence connection may be made to the vacuum tube. Complete the coil by wrapping it with varnished paper to $\frac{3}{8}$-inch thick, H, sticking it with shellac, after which it may be screwed to its base I, and the connections made to circuit breaker. The circuit breaker is a novel one. Owing to the large current and voltage being used, the ordinary make and break contact is unworkable, so the following method is substituted. A toy electric motor (such as a "Franklin") is used to actuate the circuit breaker; S is the



Scale in inches.
FIG. 3.
VIEW OF CIRCUIT BREAKER.

motor on whose shaft is fastened a fibre washer U, on which fibre washer is fastened a carbon block, elliptic shape, V, of carbon $\frac{1}{2}$-inch thick, against the side of which continually presses a contact of spring brass, W, $\frac{1}{2}$ inch wide by $\frac{1}{32}$ thick, on which is a binding post. The edge of the elliptical carbon is in contact twice, apart of each revolution, with a piece of $\frac{1}{2}$ inch electric light carbon, X, held by a spring clip on a spring contact, Y, to which is screwed a binding post. The circuit is broken with the usual spark and heating, but the carbon is easily replaced and answers all the requirements that platinum fulfils in the same place, besides being much cheaper. The motor is run by taking off the current from one storage battery of the number used to excite the primary coil.

The efficiency of the coil is increased by placing in shunt with the secondary circuit a condenser composed of 16 pieces ordinary 10-inch by 12-inch window glass, "double strength." Eight sheets of tinfoil, 8 inches by 12 inches, are pasted on seven sheets of glass, allowing one inch as margin on three sides; on the fourth (long) side the tinfoil projects over the edge of the glass; assemble the sheets of glass together, first a blank sheet, then one with foil on, leaving the projecting edge lapping over on the right-hand side, then another blank sheet, then one with foil on with the projecting edge lapping over on the left-hand side; continue to build the pile, and when complete there will be four sheets of foil projecting on the right side and three on the left. Solder those on each side together and wires to them, keeping the wires and foil always more than six inches away from each other outside of the condenser; mount the condenser in a box made of red fibre so as to keep the plates from being disturbed; make the box oil proof and fill it with rosin oil (this last can be dispensed with where moisture is not prevalent.) The condenser is to be placed in shunt between the terminals of the coil.

Cells of storage battery having a capacity of 50 volts and 10 amperes, or current direct from a lighting circuit through 5 to 6½ ohms resistance, should be used to excite the coil; the circuit breaker motor invariably using a single storage cell to operate it. With the above mentioned current the secondary circuit with condenser in circuit will spark five inches through air, its power being sufficient to excite vacuum tubes for radiography.

Instead of a coil for producing high potentials a "static" machine such as a "Toepeler-Holtz" glass disc, or a "Jacobi" tube machine, may be used; the only objection to a "static" machine being the liability of its losing its charge from condensed moisture on its standards.

Vacuum (X-ray) tubes are produced and sold very cheaply by the various incandescent lamp manufacturing companies.

The above described arrangement provides a cheap but efficient induction coil which will stand ordinary usage.

ALUMINUM.

SOME OF ITS CHARACTERISTICS.

When acted on by attrition with sand or hard clay rock containing silica, aluminum corrodes. An interesting proof of that is to draw lines upon glass with a piece of the metal, using a heavy, steady pressure; the result of which is to leave a groove in the glass which may be seen and felt. When melted in an atmosphere of steam or "carbonic acid" gas, the metal decomposes those compounds and forms oxide; a thin film of fluor-spar, or even common salt, will act as a protection. Eventually "black lead" crucibles are attacked by the metal, and when used for a considerable length of time become honey-combed, dissolving the clay and leaving the black lead intact. Aluminum is attacked superficially by salt or sea water; but the corrosion is probably due to a small percentage of sodium, which is deposited from the electrolyte simultaneously with aluminum. Newly fractured aluminum has a grain hardly distinguishable from the best steel except by its color.

The metal is not readily attacked by vegetable acids, and therefore is eminently suitable for culinary purposes. When in use for a time it assumes a light gray blue color, which is hardly pleasing to the eye, and therefore spoons, forks, etc., made of the metal are not very desirable.

It is well nigh impossible to plate other metals on aluminum. The writer, who is a practical plater, attempted to copper, gild and silverplate some small articles, but met with dire failure. All sorts of baths, with greater or less voltage, acted the same. The nearest satisfactory result was obtained with copper, using a cyanide bath, with a potential of 7 volts. The copper was deposited in an even, adherent film, but after a few minutes it began to scale off, and finally, in less than two days, the copper had all disappeared, leaving the surface of the aluminum in its natural state. The other metals would not adhere. Aluminum cannot be used to plate other metals with, in a satisfactory manner, even as an alloy, although a Philadelphia concern claimed and published a description of what they considered a workable process, but the proportion of aluminum to tin in the alloy was ½ to 99½.

As a conductor of electricity, aluminum is less valuable than copper, area being considered, but weight for weight, aluminum is twice as good as copper.

At present there is only one workable process for the production of aluminum, it being the reduction of alumina (oxide) dissolved in a fused bath composed of calcic, sodic, and aluminic fluorides by electrolysis. The oxide may be reduced directly by electricity, but unfortunately it rises to the surface of the fused oxide and volatilizes. The action of the bath of fused salts is to serve as an intermediary substance, which is decomposed by the current and the more electropositive metals. Calcium and sodium deposit aluminum, in turn combining with the fluorine, and the freed fluorine combines with the metal in the alumina, replacing the oxygen, which combines with the carbon of the anode, forming carbonic oxide which escapes into the air. The flux or solvent bath is practically constant, only requiring renewal in several weeks operation. Calcic carbide* is formed as a secondary product which deposits on the bottom of the reduction pots, and eventually, by its resistance, increases the working volts until the bath must be renewed. The removal of the aluminum by a duct from the bottom of the pot is rendered impracticable by the formation of the calcic carbide, and carbon ladles are provided which are dipped down through the fused bath, and remove the metal in a more or less crude way. Owing to the decomposition of the bath and the presence of silica in the carbon anodes (caused by grinding the coke used in their making with buhr stones), the metal seldom is over 98.5 per cent. pure, the impurities being carbon *(as carbide of aluminum, and graphite), sodium, silica* and occasionally iron. Chemically-pure metal can only be obtained by enormous expenses, and then not always when desired.

The horse-power consumed was given some years ago by Capt. A. E. Hunt, pres. of the Pittsburg Reduction Co., at the enormous expenditure of 22 E. h.-p. per hour. No doubt by this time that figure has been cut in two, but even then it is 33 per cent. greater than the theoretical; for the voltage required is 4.32, and current is 1,394 (roughly) ampere hours, and the watt-hours expended is 6022.08 against 16412 watt-hours in 22 E. h.-p. hours. Until a process of direct reduction is found aluminum can hardly expect to rank

*Calcic carbide is the compound used in making acetylene.

with copper, iron and zinc, as a common metal, and since the discovery of the fused bath process, no progress has been made, although a great many men have struggled with the problem.

Clay is popularly supposed to be the great source of supply for making the metal cheaply, but its undesirable qualities cause it to be kept in the background, while cryolite ($Al_2\ Na_6\ F_{12}$) from Iceland and bauxite ($Al_2\ O_3$, H_2O) from France, Ireland and the Southern States, can be obtained so cheaply. Clay is hard to treat to remove the silica, lime, and especially iron, and as the fattest clays (kaolin) contain no more than 20 per cent. of metal, as compared with bauxite at 50 per cent., no comparison as to cheapness exists.

To Chas. M. Hall, inventor of the fused bath process, now vice-president of the Pittsburg Reduction Co., which operates his process at Niagara, is due the honor of being the one who, at least in America, has brought the price down and quality up, so as to render it commercially useful. M. Heroult, of France, invented the same process at the same time, and developed it at Menhausen, Switzerland, where several thousand horse-power is in operation. The British Aluminum Co. is using the same process at the falls of the Foyer in Scotland. It has been in operation but two months, but even now is making money. J. B.

SMOKE PREVENTION FROM A MECHANICAL STANDPOINT.*

BY PROF. C. H. BENJAMIN.

Quite a number of experiments were made several years ago on very black, dense smoke. It was all collected, and the amount of solid matter was determined by weight. It was found to be in all one-third of one per cent, or 1-300 of the weight of coal burned at that time. Probably one-half of this solid matter was carbon, showing that the amount of coal which is actually wasted in soot is 1-600 part of the coal. This shows that there is no economy in burning smoke, as far as the manufacturer is concerned. It is his neighbor that would profit by the change.

In preventing smoke the principal requirements seem to be:—

1. That the coal shall be evenly heated.

2. That there shall be a free supply of hot air raised to the temperature of combustion.

3. That the volatile matters distilled from the coal shall pass through gases of such temperature that they shall be burned, so it shall be impossible for these gases which distill from the coal to escape by the chimney, or to become cooled after once having been ignited.

The great mistake that many manufacturers have made in trying to invent a smoke-preventing device by the introduction of air about the fuel or at the bridge wall, is that they have not made their air hot enough. The introduction of cold air is a disadvantage rather than an advantage, as far as preventing smoke is concerned. It will produce smoke where none existed before. There are a number of stokers on the market which, under ordinary conditions, with uniform firing by a careful fireman, will operate to prevent smoke successfully and with good economy. These different types of stokers all have a common principle, that of maintaining the thickness of the fire uniform, and of supplying the air either by means of steam jets or otherwise at a high temperature above the coal, and insuring that all the volatile matter should pass through a hot place on the way to the chimney.

One of the more common forms of stokers consists of the inclined grates, all the gases being obliged to pass over the incandescent coal before escaping into the chimney, and the clinkers being deposited on the bottom.

Another type has a cooking plate at the upper end, and one inclined grate running lengthwise of the boiler. Both have shaking grates.

Still another device consists of a traveling grate with an endless chain over two pulleys and a coking course at the front end, the gas passing over the incandescent coal on the way to the boiler.

There is an underfed stoker, where the coal is placed in the ash pit and forced up through the grate, this being the same as our ordinary baseburner, only the other side up.

One other type is the so-called down draft furnace, which is not a mechanical stoker, in one sense of the word, but consists of a water grate connected to the bottom of the boiler by risers, at the rear usually having a drum at the connecting point and a supplementary grate underneath on which the half-burnt coal is dropped and the combustion completed. Most of the air is obliged to pass over the grate down through the fuel, a small amount of air being admitted underneath. The principle of all these is the same, that of supplying air at a high temperature and forcing the volatile matter to pass over incandescent fuel.

I presume there are other varieties that will work under ordinary circumstances with good results, and give good economy. The steam jet is applicable to all these, and is used in many of them as a means of introducing air at a high pressure.

The great difficulty with all mechanical stokers is the fact that in many establishments there are many sudden demands for steam pressure, and there is a possibility of its being necessary to double the amount of steam used inside of fifteen minutes or half an hour. Many stokers are not adapted to that kind of treatment. This is one reason why they have failed of adoption. A stoker cannot respond so readily to a sudden demand for more steam. I will say, without prejudicing any of the other stokers, that the down-draft furnace is the most successful stoker for all such emergencies. It involves the use of hand firing, the coal being fed to the grate the same as to any grate. It allows the same treatment as the ordinary open grate, and the fireman has the same liberty that he would have on any grate. In a paper read by two experts, of St. Louis, last year, it was stated that in their opinion this form of grate was best adapted to cases where there were sudden demands for large amounts of steam, and great fluctuation of the pressure and consumption of steam. They said that this form of grate had done a great deal to diminish the amount of smoke made in St. Louis, where they are more unfavorably situated than we because they do not get as good coal.

I will mention what seems to me to be the requirements of a good smoke preventing device:

In the first place, variable feed. It is necessary that it should be possible to vary the feed of the stoker quickly and conveniently. In the second place it is necessary that the spacing of the grate bars should be variable; that the air spaces between the bars may be varied, and the coarseness and fineness of the grate may be quickly adapted to the particular kind of coal used. Third, it is necessary that the grate bars should

* A paper read before the Civil Engineers' Club of Cleveland.

be of the automatic shaking type, so as to prevent the formation of clinkers and facilitate the dropping of the ash. Some form of air control is quite important. Almost any form of stoker or grate under hard service needs a high chimney. The great difficulty in many of our establishments is that the chimney is not high enough and the draught not powerful enough. There should be a margin, and the fireman should have the means of controlling it. If there is not enough draught, the fireman cannot do anything; if there is too much he can easily reduce it. It is impossible to get good results with a small grate. A grate which is large enough under ordinary conditions is not large enough under sudden emergencies. In order that a stoker may commend itself to a purchaser, it should be easily accessible for cleaning and repairing, and it should be so located that it can be taken out and replaced without tearing out the whole front of the boiler. This is one of the serious objections to several forms of stokers which otherwise are very desirable. Where the feed water is pure, the water grate is a success, and where the feed water is impure, the water grate is not a success. Among the requirements in smoke prevention no item is of such importance as good firing. A good fireman can, with an ordinary grate, give good economy, and to a large extent prevent the formation of the smoke, if the boiler is not forced beyond its capacity. A good fireman is just as necessary with any form of stoker that has ever been used. The reason why so many chimneys smoke, is partly because there is not enough fireman, and also because there is not enough boiler.

It has been claimed by opponents to mechanical stokers, or to any form of furnace which is intended to prevent the formation of smoke, that it is impossible to realize the full duty of a boiler when equipped with such a device. I know from my own experience that that is not true. I have made experiments with one form of stoker, and continued them for several years. I found it entirely feasible to double the rated capacity of the ordinary return tubular boiler without the formation of smoke. Of course, when the fire is being cleaned, there is a little smoke. But during ordinary combustion there is no smoke except the blue smoke, which is due to impurities. It is possible to double the ordinary rating of the boiler without smoke, with an ordinary mechanical stoker, and to expect more than this is unreasonable. With hand firing you cannot go beyond this without making smoke, and without limiting the life of the boiler. It has been found by repeated experiments that such attempts are made at the expense of the boiler.

Summing up, then, I will say the principal requirements for the prevention of smoke are the adoption of a device which shall best be adapted to the particular situation; second, a chimney of suitable size and height; third, a boiler, which is at least half as big as it ought to be; and last but not least, a fireman who is worth more than $1.50 a day.

M'GILL ADVANCES.

Some new appointments have been made in the Faculty of Applied Science, at McGill University, which will add not a little to the strength and efficiency of the scientific section of the University. They are those of Stewart Henbest Capper, as McDonald Professor of Architecture: John Bonsall Porter, Ph.D., as McDonald Professor of Mining and Metallurgy; Herbert W. Umney, as Assistant Professor of Civil Engineering, and Henry F. Armstrong, as Assistant Professor of Descriptive Geometry and Freehand Drawing.

STEWART HENBEST CAPPER.

S. H. Capper, M.A., who has been appointed to the recently endowed McDonald Chair of Architecture, was educated at the Royal High School of Edinburgh, and in his final year was Dux of the school. In 1875 he entered the University of Edinburgh, passed through the complete Arts Course, and in 1880 graduated as Master of Arts with first-class honors in classical literature, obtaining the Pitt Club Scholarship in Classics. From 1879 to 1884, Mr. Capper resided in Portugal and Spain, as a member of the household of Sir Robert Morier, G.C.B., G.C.M.G., and spent much time in studying the architecture of these countries. In 1884 he became a student of the Ecole des Beaux Arts, and entered the studio of Monsieur J. L. Pascal, architect, member of the Institute of France. He also travelled for study in France and Italy, and in 1887 entered upon the work of practical architecture in Edinburgh. During the last ten years Professor Capper has carried out numerous works, among which may be mentioned: Whitewich Orphanage, Glasgow; University Hall Buildings, Edinburgh; New Laboratories for the Royal College of Physicians, Edinburgh; Model Workmen's Dwellings, Blainhoyle, Perthshire, etc., etc. Mr. Capper is an associate of the Royal Institute of British Architects. In 1891 he was appointed a University extension lecturer in connection with Edinburgh University, and in 1895 he was authorized by the University Court and Senatus Academicus to give a special course of lectures upon architecture. In 1896 he was elected an additional examiner in Archæology and Art for the M.A. degree. He has given numerous courses of lectures upon historical and technical architecture, has a thorough knowledge of French, sufficient, indeed, to lecture in that language, is well acquainted with German and Spanish, and has also a knowledge of Italian. He possesses tact, courtesy and high mindedness; he is both by temperament and habit an educationalist, and has the art of attracting the respect and affection of his students by the firmness and moral strength of his character as well as by his winning address. It need only be added that Mr. Capper's testimonials are of the very highest character, and are from such distinguished authorities as Professor Baldwin Brown, Sir Nathaniel Barnaby, Monsieur J. L. Pascal, Professar Carey Foster, Senor Don Manuel B. Scissio, Ph.D., and many others.

JOHN BONSALL PORTER, PH.D.

Dr. Porter belongs to an old Massachusetts family, and by his education and experience is eminently qualified for the work connected with the McDonald Chair of Mining and Metallurgy. After a very thorough preliminary training, he took the mining and metallurgic course in the School of Mines, of Columbia University, New York. After graduating, he spent two years in the field study of the economic geology, and mining and metallurgical possibilities of certain of the Southern States. For his investigations during this period he received from Columbia the degree of Doctor of Philosophy in 1884. Dr. Porter was then requested to establish a department of mining and metallurgy in the University of Cincinnati. His work was most successful, and he gradually built up a practical laboratorv for milling and metallurgical investigations. After an experience of four years in the University, he entered upon the active practice of his profession, and for the next two years was engaged in the expert examination of mining properties, and in carrying out metallurgical tests. During the last seven years he has been engaged in general engineering, his time having been occupied in field work in copper and lead, in hydraulic mining, in the mining and milling of gold, and in work on iron, steel and coal. In his several positions he has frequently had control of from 800 to 1,500 or more employees. Dr. Porter's testimonials speak of him in the very highest terms, and all agree in the opinion that he is a man of unusual ability as an organizer and as an inspirer of enthusiasm in others, that he possesses a natural talent for arrangement and classification, which extends not only to material things, but to ideas and mental concepts. He is a man of wide reading and diversified tastes, is singularly lucid in explanation, and successful in imparting information.

HERBERT W. UMNEY.

H. W. Umney, the newly-appointed assistant Professor of Civil Engineering, is an associate member of the Institution of Civil Engineers (Eng.), and of the Institution of Mechanical Engineers (Eng.). After spending six years in the Dulwich College, he studied for three years at the City of London College, under Professor Adams, M. Inst. C. E., obtaining a first-class honor certificate at the City of Guilds of London Institute examination in engineering, as well as a science and art honors certificate in machine construction, etc. Subsequently he took the complete engineering course at the Yorkshire College of Victoria University, and secured the first place in the examinations, obtaining the prizes and a special certificate of honor. Mr. Umney's qualifications as an hydraulic engineer may be estimated from the fact that for three years he was articled with R. Waygood & Co. (hydraulic engineers), of London, Eng., passing through the different shops and the drawing office. He was also in the employment of Middleton & Co., hydraulic engineers, and was afterwards made assistant general manager of offices and works to the Pickerings of Stockton-on-Tees, where he had complete control of the hydraulic department. At the time of his appointment to the vacant post in McGill University, he was engaged with Stothert & Pitt, manufacturers of high-class harbor and dock machinery. Mr. Umney is an able speaker, has given several courses of lectures as lecturer on engineering to the Yorkshire County Council, and is the author of several original papers.

HENRY F. ARMSTRONG.

Mr. Armstrong, after serving an apprenticeship to the teaching profession, obtained a Queen's scholarship, and entered the South Wales Training College, where he remained for two years and was then placed in the first division. For the following two and a half years he was second master in a large Higher Grade School in Leeds, and his work, especially in drawing, was most successful. As a result, he obtained from the Education Department what is known as the "Experience Parchment." Mr. Armstrong then spent three years in the Art Training Schools, South Kensington, where, as an art master, he was elected to the training class out of a large number of candidates from different parts of Great Britain. He was appointed a teacher of art work and a lecturer in geometry and perspective in the Leeds School of Art, and was then engaged by Professor Cusack as a lecturer in his college in the city of London, where he had charge of geometry, perspective, freehand drawing, modelling and shading. Mr. Armstrong is the author of a text book on solid geometry and orthographical projection, which has been very warmly received by the teaching profession of Great Britain, and has already been adopted in most of the colleges and other institutions in which this subject is being taught. Mr. Armstrong's natural genius for art and aptitude for teaching will greatly strengthen the drawing department of the university.

THE RAPID EVOLUTION OF ENGINEERING.*

The essential characteristic of the engineer is the scientific habit of observation, deduction, and experiment. Exercised *per se* in the natural world, the resultant would be discovery, pure and simple; combined with the conception of adaptation to human needs, it becomes creative. The engineer may not necessarily be an investigator, but he must be quick to understand the investigator's work, and interpret it in terms of useful application and practical service.

Mr. Clarke, in a brief summary, suggests the many highly-specialized branches into which the profession is now divided. Apart from military engineering, he distinguishes "structural, mechanical, electrical, metal lurgical, hydraulic, mining, agricultural, chemical, sanitary, municipal, highway, and railway engineering. These classes are again sub-divided; as hydraulic engineering into canal, harbor, water-supply, power, storage, and irrigation engineering; or railway engineering into bridge, foundation, track, signaling, locomotive, and car engineering." All these he would include under the one general head of civil engineering, abandoning the restricted and at the same time indefinite sense in which this term is generally understood, and returning to the primary sense which it bore when the entire profession had but two departments—"Military" and "Civil." This almost overwhelming catalogue suggests the rapid expansion and specialization which has taken place under the influence of modern tendencies, and the radical change involved to older members, as well as to those just entering the work. We have been passing through an era of extraordinarily rapid change, no doubt often bearing hard upon those whose lack of equipment or of adaptiveness prevents them from continuously adjusting themselves to a rapidly-changing environment.

Like many other lines, engineering is becoming "commercialized" as well as specialized. Much of the work which formerly sought the individual now goes to large construction companies; but the increased facilities and economies attending the new method lead to more and larger undertakings. And the net result is a demand for still higher skill and more workers. Railroad construction may diminish, but railway operation absorbs even more engineering talent for its maintenance of way, its shops, its signals, and its superintendence. The final settlement of boundaries takes away the occupation of the once important surveyor, but the growing municipality requires a score for its public works and private buildings.

And the end is not yet—nay, this is but the beginning. The tendency of the future will be steadily toward a broader and more diversified extension of the work of the engineer. The profession has better openings now than it ever had before, but he who builds his career within its lines must lay his foundations broad

* Extracts from President Thomas Curtis Clarke's address before the annual convention of the American Society of Civil Engineers, at San Francisco, on June 30th.

and deep, so that there may be room to erect safely upon them a structure which may require unexpected modification in the building. There is much short sighted criticism of engineering schools for amplifying their courses with studies of which the impatient "special student" does not see the value in relation to his chosen branch of work, simply because, as a rule, neither he nor the critics who join with him have had experience to teach them how inextricably the applied sciences are interwoven, and how many things ought to be somewhat familiar even to the close specialist. The engineer, above all, must realize the definition of a gentleman (Lord Chesterfield's was it not?) and know "something of everything, and everything about something."

POWDERED COAL AS FUEL.*

Weight is not the proper standard for the purchase of coal and the price paid for fuel should correspond to "the quantity of heat it contains." The quantity of heat developed in its combustion is a more exact statement. But, as this cannot be determined for coal or any other fuel, except by an experiment for each sample, supposed or proved to be a fair sample of the coal purchased, and as the amount of heat developed must depend upon more or less complete combustion, the suggestion seems to be impracticable in the coal trade. It is also suggested that a sliding scale should be adopted for the amount of dirt contained in coal, which varies in different samples from five to fifteen per cent. of the entire weight. This dirt produces useless and harmful clinkers, which costs time and labor to remove. But, when Mr. Donkin says "it is not tons of coal, but so much heat," that boiler-owners want when they buy coal, he puts an old truth into new and forcible expression.

Powdered coal, in combining with oxygen in the act of combustion, will generate more heat than can be obtained from it in any other way, except by first converting the coal into gas, and the pulverization of coal at the cost of one shilling per ton (alleged to be the average cost) is considerably less than that of making a ton of coal gas. The reason why more heat may be obtained from powdered than from lump coal is that, with suitable appliances, a more perfect and rapid combustion can be effected. Twenty years ago or more the extensive experiments of the American engineers, Whelpley and Storer, proved this to be the case. But these experimenters were ahead of the times, and they failed to make a practical commercial success of the system.

At the present time five systems of burning powdered coal are working in Germany. The forced blast is used with some, as it was used by Whelpley and Storer. Others employ a natural draft only, with means for continuously supplying the powdered coal to the furnace for maintaining continuous combustion. Of the latter class is the Wegener system, which sifts the powder into a current of air entering by natural draft, quite uniformly, the sieve through which the fuel passes being aided in its delivery by a tapper which beats against the sieve to which the coal is supplied. This tapper is operated by an air turbine working in the duct which supplies the air, the air current being set up by heated gases passing out through a chimney stack in the ordinary way. The arrangement could scarcely be more simple. The powdered coal falls into the ascending current of air, and, thus thoroughly mixed with the supporter of combustion, passes with it into the furnace, becoming almost instantly ignited and burning with intense heat.

The sieve employed is of wire gauze, sixty meshes to the inch—and the particles of coal are reduced, before use as fuel, to a fineness of $\frac{1}{100}$ to $\frac{1}{1000}$ inch.

The proper method of disposing of the ashes remaining after the combustion, is an important part of this subject. The dirt fuses into slag under the high temperature produced; but, in a current of air strong enough to carry along coal particles of $\frac{1}{100}$ inch fineness—the particles of the ashes resulting being much smaller and lighter—we should expect, without some special means of separating them from the spent gases, that they would all be carried up and out of the chimney, thus substituting a new nuisance for the old smoke nuisance, the abatement of which is sometimes claimed as a point much favoring the use of powdered coal as a fuel for steam generation.

* An abstract of a paper read before the Federated Institution of Mining Engineers, by Bryan Donkin.

THE POWER OF THE FUTURE.

BY THOS. FROOD.

Assuming that water-power, transformed into electric energy, wind-power, and steam or gas, will furnish all the energy required during this generation, our task becomes rather adaptive than inventive in trying to outline future progress in mechanics. Efficient means of storing and transporting energy are the pressing need of the hour. Imagine the effect on the mechanical world if *a barrel of power* (say 10 h p. for 50 hours) were as cheap and portable as a barrel of flour! In the form of battery charges, or improved storage cells, this is even now upon the horizon; and the genius who makes it commercially profitable to ship *portable power* for use on private motors (or other wheels), will have advanced humanity by two enormous paces. First, it will lessen the wear of physical energy, and thereby increase comfort and prolong life; and, secondly, it will tend to prevent overcrowding at manufacturing centres by enabling mechanics to do a great deal of work at home which can now be done only at the source of power. The manufacturing city would then be extended over a township, with a railway along each street, supplying material and collecting finished work; and the artisan would labor in his own cottage, with his family around him and his garden before the shop window, instead of in the fifth story of a dusty factory, with only a smoky sky and rusty roofs to meet the eye. The factory and the ironclad are two of the monstrosities of our civilization which "have got to go" ere our race reaches its zenith. That such a change would promote comfort, longevity, and national prosperity, as well as stimulate ambition, foster higher manhood, and lessen vice, need hardly be argued. That it will be encouraged by the large manufacturer and capitalist is very doubtful, but the guilds of the artisan of the middle ages developed a skill and manhood in the members which was the bulwark of freedom then, and would be a very welcome addition to our present social condition. Intelligent co-operation is always preferable to servile unthinking labor; and as a traveller on a cycle sees more of the landscape, exercises more skill, and controls his risks more than the railway passenger, so the man who runs and rules his own machinery will have more pride in the product than one who is almost automatic in a huge factory, and who expects that any carelessness on his part will not be personally cognizable in the finished product. A perfect co-operation and unity of interest in what relates to the whole community, with a clear recognition of the faithful performance of his part by each individual and due compensation for the work he does thoroughly, is the acme of social life.

ARTIFICIAL REFRIGERATION.*

BY JNO. FOX.

For some time I have looked forward to the preparation of a short paper on cold storage and refrigeration. I will dwell principally on that system of refrigeration which is now under my charge at the O'Keefe Brewing Company's, namely, the Delevergne, or direct expansion system.

The substance used in this system is anhydrous ammonia. We are told that ammonia is a combination of nitrogen and hydrogen, expressed by the formula NH_3, which means that an atom of nitrogen (representing 14 parts by weight) is combined with three atoms of hydrogen (representing 3 parts by weight) at ordinary temperatures; the ammonia, or anhydrous ammonia, as it is called in its natural condition, is a gas or vapor; at a temperature of 30° F. it becomes a liquid, at the ordinary pressure of the atmosphere; and at higher temperatures also, if higher pressures are employed. The anhydrous ammonia dissolves in water in different proportions, forming what is called ammonia water, ammonia liquid, aqua ammonia, etc. At a temperature of 900° F. ammonia is decomposed into its constituents, nitrogen and hydrogen, the latter being a combustible gas. It appears that partial decomposition takes place also at lower temperatures, but probably not to the extent frequently supposed.

Ammonia is not combustible at the ordinary temperatures, and a flame is extinguished if plunged into the gas, but if ammonia be mixed with oxygen the mixed gas may be ignited, and it burns with a pale yellow flame; such mixtures may be termed explosive in a certain sense. If a flame sufficiently hot is applied to a jet of ammonia, it (or rather the hydrogen of the same) burns as long as the flame is applied, furnishing the heat required for the decomposition of the ammonia. Ammonia is not explosive, but when stored in drums and there is not sufficient space left for it to expand, when subject to a higher temperature, the drums will burst, as has often happened in hot seasons. The ammonia vapors are highly suffocating, and for that reason persons employed in rooms charged with ammonia gas must protect their respiration properly.

In the direct expansion system the liquid ammonia is directly conducted to the place where heat shall be absorbed, or we might say into the rooms to be cooled, and is here allowed to expand in a system of pipes called refrigerators or expansion coils, so that heat is absorbed directly by the ammonia gas. The gas is then drawn back to the machine or compressors, where it is again compressed and discharged into pressure tank, and from there on to condensers, where it is again liquedized.

The liquefaction is accomplished by cold water trickling over the condenser, or, we might call it condensing coils, thereby cooling the ammonia; it then passes on to the separating tank, and if any oil should get carried over, it is caught here. The ammonia then goes on through expansion valves into cold storage rooms, where the heat of the room is absorbed, thereby cooling or lowering the temperature, completing its work thus to repeat its circulation over and over again.

Now let us see what we have to consider in the shape of mechanical work performed. As you know, the equivalent of a ton of ice is 284000 heat units, or the amount of heat that would be necessary to convert a ton of ice 32° Far. into a ton of water at 32° Far. Conversely it is the amount of heat that must be extracted from a ton of water at 32° Far. in order to convert it into a ton of ice at 32° Far. Let us take, for instance, a fifty ton plant; the latent heat of one lb. of ice is one hundred and forty-two heat units; multiplying this by two thousand gives us the number of heat units in one ton. Now as we are considering a fifty-ton plant this will be 14,200,000 heat units in 24 hours of time, or, in other words, a 50-ton plant in 24 hours will absorb this number of heat units. (It might be stated here that in speaking of a plant of so many tons' capacity it is always understood to mean for a period of 24 hours.) The temperature of expanding ammonia would have to be about 10° lower than the temperature of cold storage room, which we will take as 35° Far. Consequently by using the latent heat of vaporization at that temperature, which is 35° Far.—10° Far. = 25, we find it to be 540.03, which is refrigerating effect of 1 lb. of ammonia when the temperature of refrigeration is 25°, and that of condenser 70°. Specific heat of the ammonia being 1. The number of pounds of ammonia required per hour, therefore, in a fifty-ton plant is represented by the following equation:—14,200,000 heat units in 24 hours, ÷ 60 x [540.03 heat units per one lb. of ammonia—(70°—25°)] x 24 = roughly, 20 lbs. per hour. The volume of 1 lb. of ammonia vapor at 25° Far. is equal to 5.26 cubic feet; consequently, compressor capacity per minute will have to be 105.20 cubic feet. Now, if we add to this 20 per cent., which is a fair allowance for losses by radiation, etc., we require an actual compressor capacity of 126.20 cubic feet per minute.

We will see how the plant of the O'Keefe Brewing Company compares with the theoretical calculation just made; the compressor cylinders are 11 x 22, which is equal to about 1¼ cubic feet capacity of each cylinder. Now the engine makes 40 revolutions per minute, and each is double acting, diameter 11 x 11 = 121 x 7854 = 95.0334 x 22 ÷ 1728 = 1.2099. Consequently at each revolution of crank shaft each compressor discharges its contents twice, which gives us a total discharge of about 192 cubic feet per minute. Now we will deduct 20 per cent. for clearance losses, etc., and we get 154 cubic feet, or about 27 feet more than required by our theoretical calculation, which would be the amount allowed to come and go on, which is close enough for all practical purposes.

In piping cold storage rooms, from what information I can gather, it is usual to allow about one square foot of pipe surface for every 3,000 heat units to be absorbed; this is equal to about 1.6 running feet of two-inch pipe. Now, for a 50-ton plant, according to this rule, we will require a sufficient amount to absorb 14,200,000 heat units in 24 hours, which in round numbers would be 7,573.3 running feet of pipe.

The condenser is a system of pipes or coils into which the ammonia, after being compressed in compressors, is forced, and where it is cooled by water trickling over the pipes. These are called atmospheric or surface

* A paper read before the Convention of the C.A.S.E.

condensers. The ammonia, in passing through the condenser, yields to the water the heat which it has acquired in doing refrigerating duty by its evaporation, and the heat it has acquired during compression (superheating being prevented by a liberal supply of oil), in the plant under discussion. The mechanical work done during compression being converted into its equivalent of heat, this amount of heat is also equal to the latent heat of volatilization of the ammonia, at the temperature of the condenser. The efficiency of the condenser determines in a great measure the economical working of the machine, and for this reason it is good policy to have as much condenser surface as practical considerations will permit, it is said for average conditions (incoming water 65°, outgoing 85°), it will take about 20 square feet of surface per ton of refrigeration, or, in other words, for 50 tons it will take 1,600 running feet of 2-inch pipe.

Where cooling water is very scarce, and especially where atmospherical conditions, dryness of air, etc., are favorable, the cooling water may be used again by subjecting the spent water to an artificial cooling process, by running it over large surfaces exposed to the air in a fine spray.

A device of this kind is described as being a chimney-like structure, built of boards, having a height of 25 feet, the other dimensions being 8 x 8 feet. Inside this structure are placed a number of partitions of thin boards, spaced four inches apart, extending to within one foot of the bottom of the structure. But the lower halves of these partitions are placed at right angles to those in the upper portion, this arrangement giving better results than unbroken partitions. The water to be cooled enters the structure at the top, where, by the use of galvanized iron overflow gutter, it is spread evenly over the partitions and walls, and flows downward in thin sheets. At the base of the structure air is introduced in such quantities that the upward current has a velocity of about 20 feet per second. The air meeting the downward flow of water, absorbs the heat by contact, and also by vaporizing about two per cent. of the water, reducing its temperature during the passage 20° F. The chief expense to be considered in the process of re-cooling condenser water is the lifting of the water to the top of the structure.

The oil used for lubricating the compressor differs from ordinary lubricating oil in that it must not congeal at low temperature, and must be free from vegetable or animal oils. For this reason, only mineral oils can be used, and of these only such as will stand a low temperature without freezing, such as the best paraffine oils.

FAILURE to receive THE CANADIAN ENGINEER on the part of our subscribers is always the occasion of much regret to the publishers, as we are aware that much of the value of a publication depends upon the regularity of its receipt. An occasional or intermittent visitor is little thought of either by the subscribers or the proprietors. We would be glad if any subscriber who does not receive his paper before the fifteenth of each month, would kindly notify us of the fact and enquiry will at once be made as to the cause of the delay.

WE have lately received a number of orders for complete sets of THE CANADIAN ENGINEER from our initial number, for reference purposes in public and private libraries, amongst others, the Smithsonian Institute, for example. We find it quite impossible to comply with these requests because we have not a single copy of our issue of May, 1893. Subscribers who have copies which they do not wish to preserve would greatly oblige the publishers by forwarding them to the Toronto office. We will pay one dollar, or two years' subscription, per copy of May, 1893, for a limited number.

ASBESTOS.

The use of asbestos in manufacturing is increasing, and new uses are being almost daily found for it—uses for which a satisfactory substitute might be hard to find. The following abstract from an article on this subject which we find in an exchange may prove interesting, if read in connection with the description of the Danville Asbestos and Slate Co.'s works, which appeared in the July number of THE CANADIAN ENGINEER:—

"In itself, asbestos is a physical paradox, a mineralogical vegetable, both fibrous and crystalline, elastic yet brittle, a floating stone, but as capable of being carded, spun and woven as flax, cotton or silk. It is apparently a connecting link between the vegetable and the mineral kingdom, possessing some of the characteristics of both. In appearance it is light, buoyant and feathery as thistledown, yet, in its crude state, it is dense and heavy as the solid rock in which it is found. Apparently as perishable as grass, it is yet older than any order of animal or vegetable life on earth. The dissolving influences of time seem to have no effect upon it. The action of unnumbered centuries, by which the hardest rocks known to geologists are worn away, has left no perceptible imprint on the asbestos found imbedded in them. While much of its bulk is of the roughest and most gritty materials known, it is really as smooth to the touch as soap or oil. Seemingly as combustible as tow, the fiercest heat cannot consume it, and no known combination of acids will destructively affect the appearance and strength of its fibre, even after days of exposure to its action. It is, in fact, practically indestructible. Its incombustible nature renders it a complete protection from flames; but beyond this most valuable quality, its industrial value is greatly augmented by its non-conduction of heat and electricity, as well as by its important property of practical insolubility in acids.

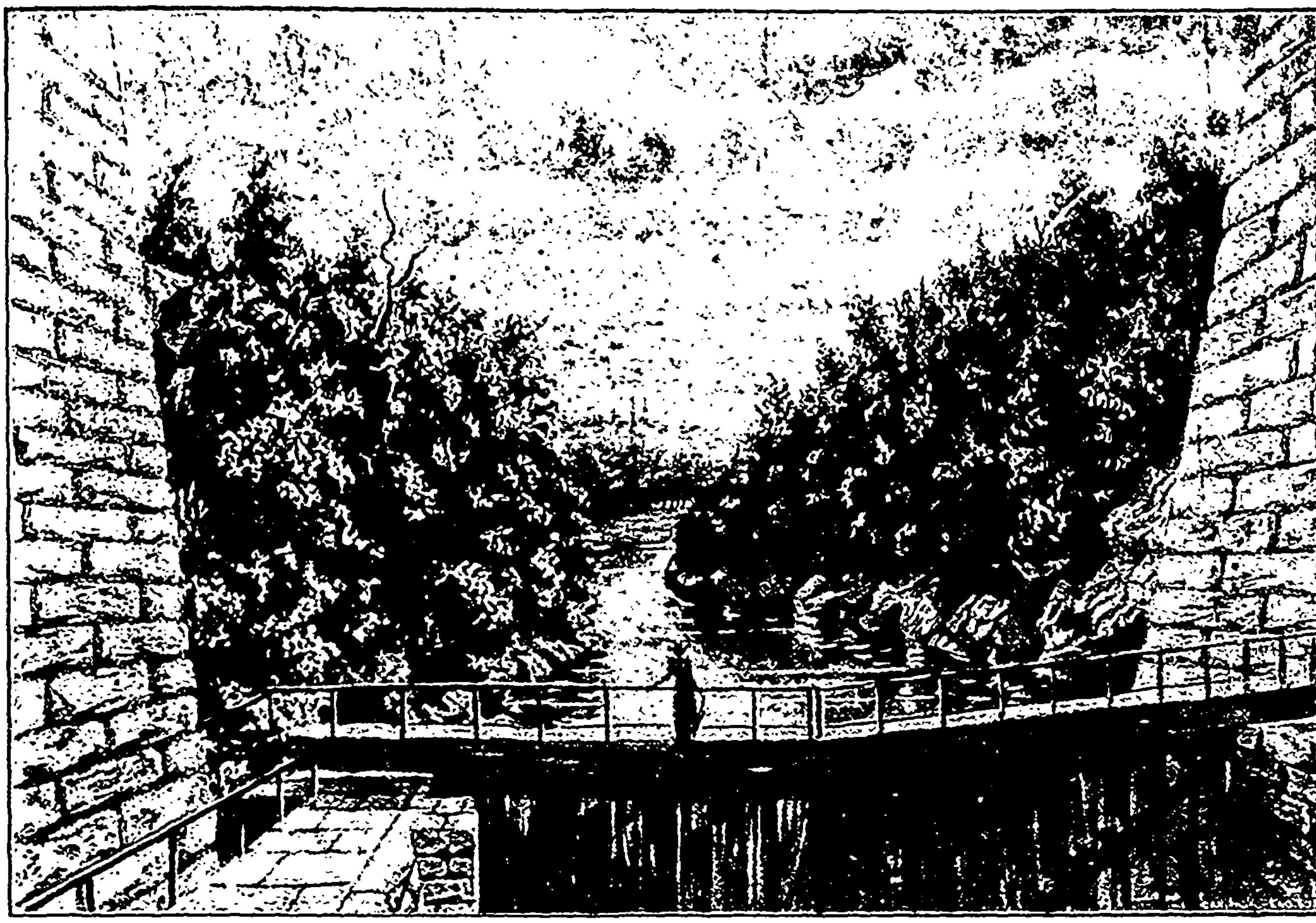
"As a matter of fact, Canada contains the great asbestos region of the world, in the sense that while its mines are practically unlimited in productive capacity, the product is of a quality which fully meets the requirements of the newest and most exacting of the innumerable uses that are daily being found for it.

"One of the largest branches of asbestos manufacture is that of sectional cylinders for pipe coverings for retaining the heat of steam and other pipes, felt protective coverings for boilers, frost-proof protections for gas or water pipes, and cement felting, which can be laid on with a trowel, for the covering of steam pipes, boilers or stills. In some of these cases, where it is only necessary to retain the heat, the asbestos is mixed with other substances; but where the protection must be fireproof as well, only asbestos is used. The utility of such covering is well illustrated in the heating system of railway cars. The main pipe from which the individual cars draw their respective supplies is protected by this material.

"To the electrical engineer, asbestos is absolutely indispensable. Many parts of electrical devices, and machinery, and wires through which the electric current passes become heated, and were it not for the electrical insulation and heat-resisting qualities which asbestos possesses, the apparatus would be completely destroyed, particularly in the case known to electricians as 'short-circuiting.' For such purposes it has been found advisable to combine asbestos with rubber and other gums, and this combination is now used generally for not only electrical, but also steam and mechanical purposes."

THE sinking of the engine shaft on the Josie, Rossland, B.C., is being steadily continued, and shows five feet of high grade ore in the bottom. A contract has been let for a 100-foot crosscut tunnel to tap this shaft at a depth of 120 feet.

THE directors of the Annapolis Manufacturing Co., Lequille, N.S., are: Robie Uniacke, president of the Halifax Banking Co., president, Thomas Ritchie, vice-president of the Merchants Bank of Halifax; Charles Archibald, director of the People's Bank of Halifax; James E. Roy, of the Halifax Piano and Organ Co., vice-president, and Fred H. Oxley, of Bauld, Gibson & Co., merchant. James Pennington was appointed the secretary-treasurer of the company.



KINGSTON MILLS

SEVENTH ANNUAL CONVENTION OF THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ACCORDING to the resolution of last year, this convention was held in the council chamber of the City Hall at Kingston, on the 18th, 19th and 20th ult. On the evening previous to the opening, Mr. Donnelly, president of the Kingston branch, and Jno. Taudvin, its acting secretary, devoted themselves to the reception of visitors and delegates, and thus aroused the expectation of a splendid welcome, which was realized each successive day.

Tuesday, August 18th.—An early visit to the council chamber disclosed various preparations for serious business. The semi-circular tables were strewn with copies of the chief technical papers devoted to the various branches of engineering, and some advertising matter and circulars, which afterwards obtained a place in the discussions, and on the secretary's table were great piles of the admirable souvenir published by the local branch, programmes and badges. This badge was said by the local papers to be one of the handsomest seen in Kingston for a long while, and it certainly became a passport to many unpremeditated entertainments during the few odd moments left by the executive for innocent mischief.

At 10 o'clock badge wearers were seen approaching the council chamber from various directions, and soon after from the neighborhood of the British American came a posse of decorated engineers, including president, past-presidents, deputies and delegates, which swelled the attendance at the council chamber to 40. At 10.45 Pres. W. G. Blackgrove took the chair, with Vice-Pres. James Devlin on his right. Mayor Elliott, accompanied by Aldermen Skinner, Walkem, Robinson and Carson, then entered and were introduced by the president. In his address of welcome the mayor expressed the pleasure the city felt in entertaining the society at its seventh convention, and hoped that their impressions of the Limestone City might be pleasant ones. He pointed out the advantages which the city enjoyed as an educational centre, and as being the scene of many of the most stirring incidents of Canada's earlier history.

The president then said, in reply, it was equally pleasant for him to thank his worship for the kind and hearty welcome. The reception was thoroughly appreciated by the delegates. By their programme pleasure is combined with work, and he was sure one and all would depart to their homes feeling that it was good to be in Kingston (providing they did not change their clothes for a term of years) He extended to the mayor and council a cordial invitation to visit the convention at any time. The convention's objects were purely educational, the members believing it never too late to learn. The mayor then introduced the aldermen, who severally supported him in his welcome to the C.A.S.E., and the municipal party retired.

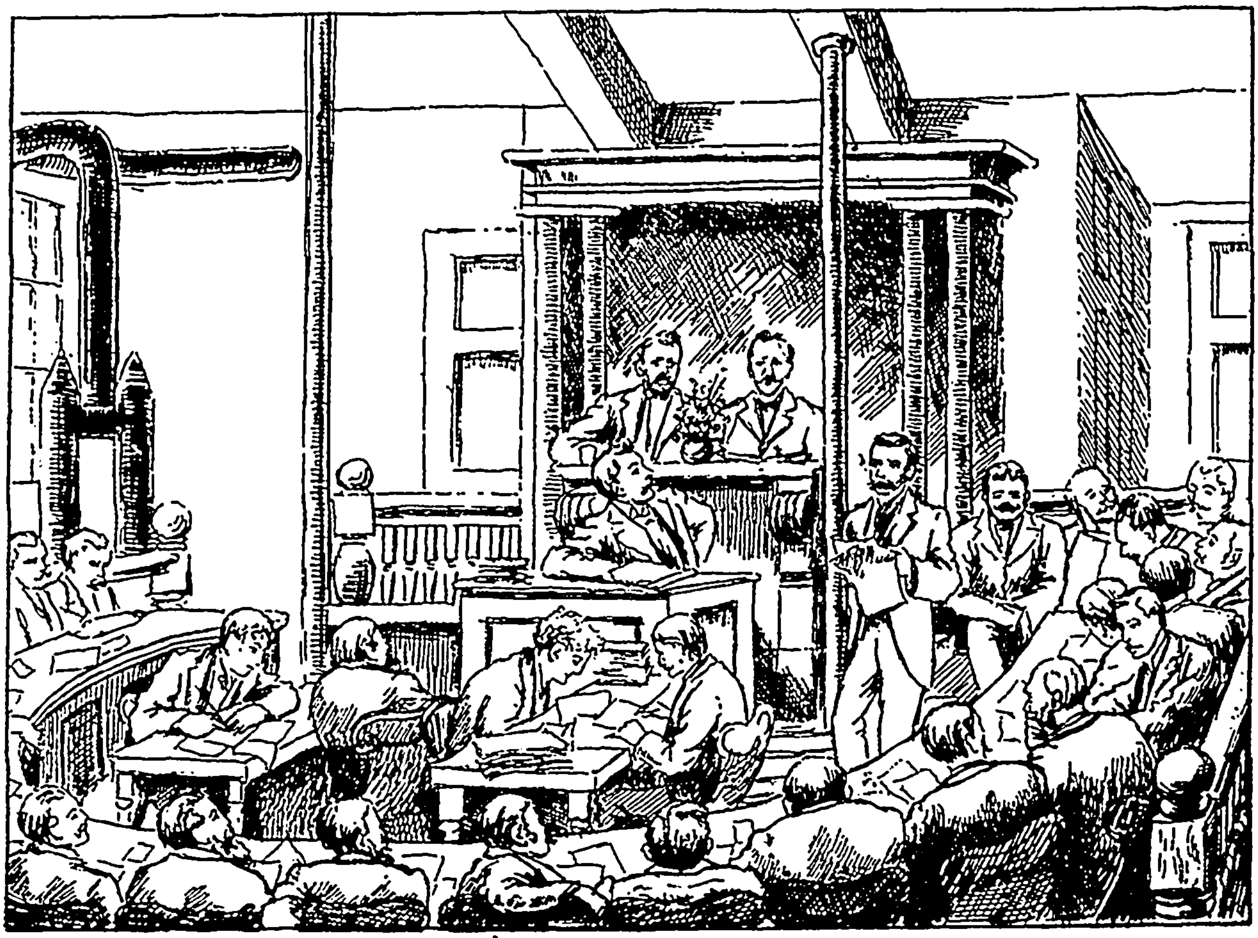
Mr E J Phillip, the secretary, then called the roll. The delegates present were · Toronto—A. E. Edkins, Jno. Fox, W. Selby, J. Huggett, R Pink, J Bain, Wm. Kay (representing the Robb-Armstrong Engine Co., of Amherst), C. Moseley, A. M. Wickens, W. G. Blackgrove. Montreal—J. J. York, B. A. York, John Murphy, Wm. Ware, O. E. Granberg. Hamilton—R. Pettigrew, W. Norris. Ottawa—F. G. Johnson, F. Robert, F. J. Merrill. Brantford—J. Jordan. Wiarton—F. J. Cody. Brockville—W. F. Chapman, J. McCaw. The Kingston members present were—Pres. S. Donnelly, Sec. Jno. Taudvin, Treas Chas Selby, D Reeves, Jno. McDonald, Chas. Asselstine, Thos. Burns, Fred. Simmonds. Visitors—Frank. Robert, Ottawa, No. 7; Wm. McKay, Toronto, No. 1; F. J. Greene, Montreal, No. 1 President Blackgrove now rose to address the Convention as follows:—

THE PRESIDENT'S ADDRESS.

Officers and brethren, for the seventh time we have been permitted to meet to discuss matters that may tend to advance the interests of our order. It is gratifying to see so many familiar faces before me. Among the representatives I feel as though I am in good company, and can rely on one and all to help carry on the work during this our annual convention.

While there are many familiar faces here, there is one which we shall never see here again on earth. I refer to our late esteemed brother, Duncan Robertson. I am sure we regret his death exceedingly. We have lost a faithful officer, a true friend and a thorough Christian. He was a man of great integrity, on whom we could rely for straightforwardness, whose counsel was always cheerfully given.

To those members who are here for the first time a word may not be out of place. I want you to join heartily in the work that is to be



Council Chambers, City Hall, During the Reading of the Mayor's Address.

done, have your say on every question that may come up for discussion, and you will return to your homes thoroughly convinced there is some good being done at our yearly meetings

There is a considerable amount of business to be done, quite as much as in former years, and as our time is limited, I request that your deliberations will be short and to the point. The most important question will be the changing of the name of this association, and I sincerely hope the brothers will weigh their thoughts before expressing their views on the matter. The next question will be that of holding the convention every two years. There will also be the compulsory issuing of certificates of membership and other interesting topics, of which you will receive due notice.

I am pleased to inform you, though the increase in the number of new associations has not been as we would have liked, we have had the pleasure of re-organizing Stratford No. 3. There is also an application received from an association in Waterloo. The district deputies' reports may interest you more than I am able to do. I also wish to call your attention to the programme that is laid before you. I think that every member will bear me out in saying it is the finest we have ever had. From the correspondence I have had with Messrs Taudvin and Devlin, I am perfectly satisfied that the members of Kingston No. 10 are a whole-souled and hard-working lot of men. Nothing has been left undone in the way of making this meeting both successful and entertaining to the delegates during their stay in the city of Kingston.

Before closing I want to ask a favor from you, and that is, you will act with decorum and give your best attention to the business we have to perform. I also need your assistance in carrying on the work of this convention, as many hands make light work I must not forget to thank you for the honor conferred upon me in placing me in the highest position attainable in the Canadian Association of Stationary Engineers. It has been my object during the past year, and will be on this important occasion, to further advance the welfare of our association. In conclusion I wish to thank the officers most heartily for the valuable assistance rendered to the Chair during the past year.

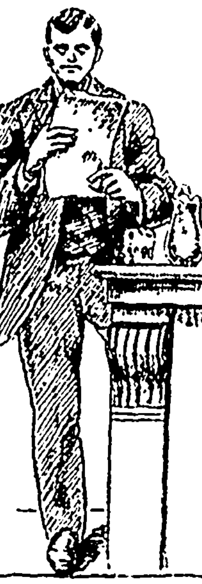
Secretary E. J. Philip then read the minutes of the previous meeting at Ottawa. The adoption of these was moved by J. J. York, of Montreal, seconded by W. F. Chapman, of Brockville. Carried.

Vice-President Devlin wished to know what had been done by the International Correspondence School of Steam Engineering in favor of the C.A.S.E. Mr. Philip replied that the only concession he had obtained was that a member of the C.A.S.E. would be allowed to take up one subject at a quotation for that subject alone, which was not generally permitted, but a scholarship would cost them as much as an outsider. H. S. Robinson, a representative of the School, was present and explained the situation, stating that the C.A.S.E. could obtain the same privileges as the International Association This institution teaches trades and professions by correspondence, and has now over twenty-eight different courses of study,

Vice-President Devlin wished to Know ——

covering all the engineering trades and professions represented by students in nearly every country on the globe, and with a total enrolment of over 13,000 men. A committee on the good of the order and education, consisting of Messrs. Devlin, of Kingston, Wickens, of Toronto, and J. J. York, of Montreal, was appointed to confer with H. S Robinson.

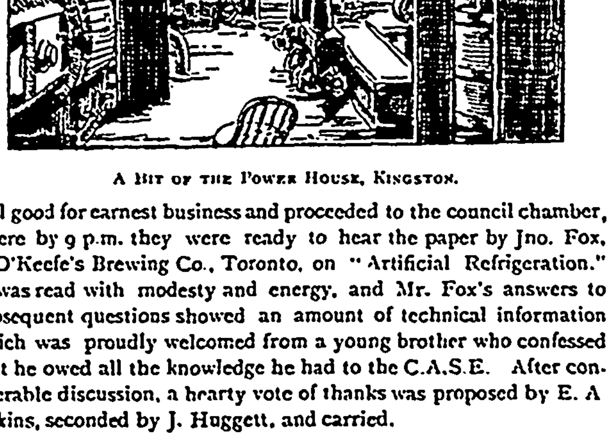
The question of insurance rates was next raised. The secretary stated that most societies offered no reduction beyond the commission usually paid to an agent. One society had, however, offered a slight inducement. Some astute proposals were then made by members who had previously effected personal insurance business, but the matter was referred to a future occasion.



JOHN FOX READS HIS PAPER.

The meeting then proceeded to the election of committees, which resulted thus: Committee on Credentials, O. E. Granberg, Montreal; J Huggett, Toronto; W. F. Chapman, Brockville. Committee on Constitution and By-laws, J. J. York, Montreal; A. W. Wickens, Toronto; W Norris, Hamilton. Committee on Mileage R. Pettigrew, Hamilton; C. Moseley, Toronto, J. Murphy, Montreal; J F. Cody, Wiarton; J. F. Merrill, Ottawa. The Committee on Good of the Order and Education has already been mentioned. Auditors, Messrs. Johnston, Selby and Bain With the announcement that Mrs. D. Reeves, of 281 Montreal St., extended through the convention an invitation to the ladies of the engineers to call upon her, the first business meeting broke up.

At 2 o'clock the engineers and their friends collected on the wharf, where a steamer was moored ready to take them on a trip down the American channel among the Thousand Islands. The sky was threatening but beautiful; some little rain did fall, but altogether insufficient to check the ardent pursuit of pleasure upon which every member of the convention was bent. The three hundred and fifty passengers settled into numerous little groups, which were ever exchanging until everybody knew nearly everybody. Much hilarity was caused by a Highland piper, who was subjected to innumerable practical jokes. On the return journey an excellent supper was served, at which conversation flowed freely and laughter prevailed. Towards the end of the trip the moon rose and added its charm to a most enjoyable voyage. The boat arrived rather late for the evening meeting, but the engineers were



A BIT OF THE POWER HOUSE, KINGSTON.

still good for earnest business and proceeded to the council chamber, where by 9 p.m. they were ready to hear the paper by Jno. Fox, of O'Keefe's Brewing Co., Toronto, on "Artificial Refrigeration." It was read with modesty and energy, and Mr. Fox's answers to subsequent questions showed an amount of technical information which was proudly welcomed from a young brother who confessed that he owed all the knowledge he had to the C.A.S.E. After considerable discussion, a hearty vote of thanks was proposed by E. A Edkins, seconded by J. Huggett, and carried.

J M. Campbell was down on the programme for a paper on "Electrical Appliances," but he did not appear. The convention was still anxious for more knowledge, and Messrs. Wickens Edkins, Granberg and McKay were specially called upon for impromptu lectures, but each declined owing either to the fatigue from pleasure seeking in the afternoon or the modesty that belongs to superior attainments.

The meeting then adjourned for a visit to the plant of the Light, Heat and Power Co., where the mechanism was explained by Bro. Simmons and the engineer on duty.

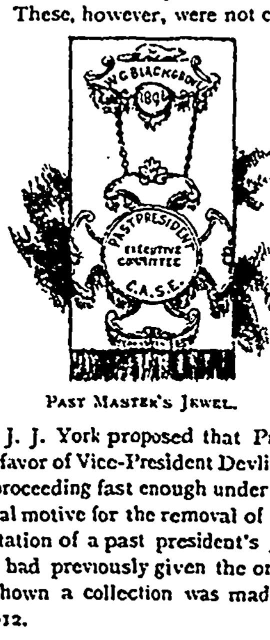
Wednesday, August 19th.—The convention met at ten o'clock, with President Blackgrove in the chair. After the roll-call Secretary Philip presented his report: The receipts for the year were $607.22; expenses, $505.65. In regard to insurance the secretary said: "We have applied to two or three companies, but they have not given us a special rate, except that they are willing to allow us the rate allowed to agents." He referred to the Information Bureau question, and suggested that members could send in whatever questions they had to the secretary, who would send copies to each branch association, the answers from these to be adjudged by the secretary or the supreme association. The Berlin branch had been very anxious about this matter, and it was a scheme which would be of the greatest value to subordinate associations.

Treasurer Pettigrew was then called upon. He said that the association had felt the depression of trade in common with most organizations, but it had felt more seriously the want of enthusiasm in some of its members. There are some who join the association only for the immediate benefit to themselves, regardless of the advantage which their membership could and ought to be to other engineers, and then drop out, leaving themselves in debt of honor to the association. The association gives all the assistance in its power to individuals, but hopes for a return of devotion to the general objects of the organization. He proceeded to deal with the finances of the association, and reported a balance in hand of $101.15.

The adoption of the report was moved by J. J. York, seconded by Jno. Murphy, and carried.

The report of the Committee on Constitution and By-laws was presented by J. J. York Several alterations were proposed and hotly discussed by A. M. Wickens, E. J. Philip, Edkins, Norris, and Granberg. One alteration in Art. VII., sec. 2, was carried, however. In future it will read "All associations shall pay with each semi-annual report, in July and December in each year, 35 cents per member reported in good standing on the books, and no association shall receive a password until the secretary receive their report and per capita tax, and every member reported shall have a free membership card."

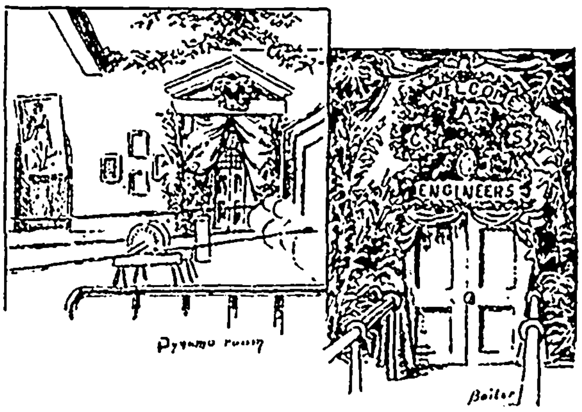
Proposals were made during this debate that each association be allowed to send only one delegate, who should have power to cast the full number of votes of his local association. It was objected that this would reduce the attendance at conventions, and Secretary Philip considered that the advantages to each member were to be measured in some degree by the members in attendance. Another proposal was to have bi-annual conventions, the interest of the local association to be sustained by a three-monthly circular. The objections to this were many. Vice-President Devlin was so enthusiastic as to offer a guarantee for the expenses of next year's convention, founded on an eminently workable plan in the production of a souvenir. These, however, were not carried.



PAST MASTER'S JEWEL.

At this point J. J. York proposed that President Blackgrove vacate the chair in favor of Vice-President Devlin, on the excuse that business was not proceeding fast enough under the guidance of the president. The real motive for the removal of the president was to discuss the presentation of a past president's jewel to Mr Blackgrove. J. J. York had previously given the order, and while the jewel was being shown a collection was made to defray the cost, which was about $12.

At 2.30 p.m., the members met for a visit to the Penitentiary and Rockwood Asylum. Vice-president Devlin is the chief engineer at the penitentiary, and undet his escort the convention saw through the various departments where are carried on the manufacture of binder twine for the outside market, tailoring and bootmaking for the prison, stone cutting and carpentering for internal alteration and construction; the foundry, the kitchen, dining hall and cells were also visited Mr. Devlin had his engine-room quite elaborately decorated with palms and flags, and thus produced an air of gaiety in a place which, notwithstanding the eminently humane treatment of its unfortunate inmates, must ever wear an aspect of gloomy severity.



DECORATION IN ENGINEER'S DEPARTMENT, KINGSTON PENITENTIARY.

About 8 p.m. everyone wearing the red badge repaired to Lake Ontario Park. This is a spot of great natural beauty, unadulterated by any attempt at artificial improvement; and, as the cars (which were placed at the disposal of the convention) landed their loads of engineers and friends on the moonlit sward, all trace of fatigue was removed by a fresh breeze from the little bay, the sense of Arcadian freedom asserted itself, and even the fathers of the convention rollicked like boys.

Thursday, August 20th.—Word had been passed round on the previous evening that so much business remained to be done that the convention would meet at 9 o'clock and sit till the programme was completed, but the doses of free oxygen at the park on the previous evening probably induced a heavier sleep than usual, and the gathering together this morning was somewhat tardy. Each member sauntered in, as it were, still rubbing his eyes, and was greeted with cheers or sympathetic enquiries for reasons known only to his immediate companions. During the desultory talk it transpired that the "Scranton man" had become a hero. He had donated $5 to the C.A.S.E. on behalf of the Correspondence School of Engineering at Scranton. At 9.30 the roll was called and discovered two absentees, who presented themselves soon afterwards. A referred report on the subject of By-laws was presented, but has been already dealt with.

The report on education was then called for. J. J. York recommended "That this convention adopt the system of education as proposed by the International Correspondence School of Steam Engineering at Scranton, Pa.; that every delegate be asked to strongly advocate this school to his association: that the Executive Secretary be instructed to at once communicate with all associations and enclose them copies of contracts and a full description of this system of education, together with the special terms offered to members of the C.A.S.E., and that he should push the matter with vigor while a large percentage of the members are enrolled. We also recommend that this convention tender a hearty vote of thanks to H. S. Robinson, the representative of the Scranton school, for the painstaking way in which he has explained this subject to the committee." Signed, J. J. York and A. M. Wickens. This proposal was immediately adopted.

It was then moved by A. E. Edkins that a committee be appointed to co-operate with the board of examiners of the Ontario Association of Engineers, with a view to securing Dominion legislation to provide for the compulsory qualification of stationary engineers. This was seconded by Secretary Philip, spoken to by Messrs. Wickens, Philip, Granberg, J. J. York and Devlin, and carried. The committee for this purpose would be appointed by the new executive. An addition was moved by A. M. Wickens and seconded by W. Morris, that subordinate associations appoint a member to work in conjunction with the aforesaid committee. Carried.

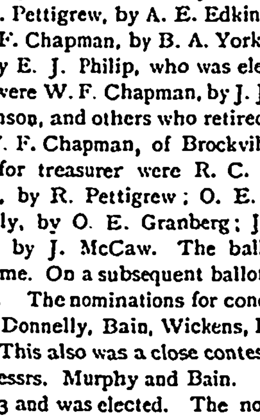
Vice-President Devlin then moved that "the executive council take up the matter of raising revenue to defray the expenses of the annual convention by issuing an annual souvenir; arrangements to be made with the executive secretary to do whatever work is necessary in connection therewith, and that the secretary be paid for such service the sum of 10 per cent. on net revenue, the expenses of entertainment to be such as agreed by the executive after corresponding with the branch where the convention is held." This was seconded by local President Donnelly and carried.

The report of the Mileage Committee was presented by R. Pettigrew. There were fifteen representatives who had travelled 2,429 miles, and three days' board for each to be paid. The amount would be $211.35. The adoption of this was moved A. E. Edkins, seconded by Jno. Fox. Carried.

It was then proposed by J. J. York that the souvenir take the form of an informative handbook, including an engineers' directory and advertising medium. He proceeded to criticise various well-known handbooks, and gave exhaustive explanation of the way in which the proposed one could be made useful and profitable to all concerned. This was seconded by O. E. Granberg, and carried.

The report of the auditors was then presented and adopted in the usual form. W. Norris, of Hamilton, then proposed "That the executive secretary report to subordinate associations every three months showing the standing of the order." This was seconded by O. E. Granberg, spoken to by Messrs. Pettigrew, Devlin, Taudvin, Murphy, and carried. At the instance of secretary Philip, the question of buying stationery of the central organization was discussed. The Montreal Association, it appears, has the right of buying and printing on the spot, but it was asked to consider the question of buying in future from the association.

The convention then proceeded to the election of officers for the ensuing year. Messrs. Edkins and Tandvin were appointed scrutineers. Messrs. Selby and Edkins nominated for president, vice-president Devlin, who was elected by acclamation. The nominations for vice-president were E. J. Philip, nominated by A. M. Wickens; R. C. Pettigrew, by A. E. Edkins; O. E. Granberg, by J. J York; W. F. Chapman, by B. A. York. Out of 21 ballots, 13 were secured by E. J. Philip, who was elected. The nominations for secretary were W. F. Chapman, by J. J. York; O. E. Granberg, by F. G. Johnson, and others who retired. Of 22 ballots, 15 were secured by W. F. Chapman, of Brockville, who was elected. The nominations for treasurer were R. C. Pettigrew, by E. J. Philip; J. J. York, by R. Pettigrew; O. E. Granberg, by A. E. Edkins; S. Donnelly, by O. E. Granberg; J. Huggett, by Jno. Fox; B A York, by J. McCaw. The ballot did not show a majority for any name. On a subsequent ballot R. C. Pettigrew was elected by 11 votes. The nominations for conductor were Messrs. Huggett, Murphy, Donnelly, Bain, Wickens, B. A. York, Moseley, Jordan, Johnson. This also was a close contest and the process of elimination left Messrs. Murphy and Bain. Of 22 ballots Mr. Murphy secured 13 and was elected. The nominations for doorkeeper were Messrs. Huggett, Fox, Jordan, Merrill, Norris, Johnson, McKay. Of these, Messrs. Jordan and Merrill secured 11 each. Finally, out of 24 ballots F. J. Merrill secured 13 and was elected.



E. J. PHILIP, VICE-PRESIDENT.

The installation of the new officers was the next business. Past-President York nominated A. E. Edkins, grand secretary, and called upon him to read out the names of the officers: President, J. Devlin, Kingston; vice-president, E. J. Philip, Toronto; secretary, W. F. Chapman, Brockville; treasurer, R. C. Pettigrew, Hamilton; doorkeeper, Merrill, Ottawa; conductor, J. Murphy Montreal.

The conductor then brings up the president elect, who, raising his right hand, repeats after the acting president a manly promise to do all in his power to advance the proper interests of the association. The other officers go through the same form, except that the undertaking is appropriately altered according to the duties incumbent upon them.

The past-president, W G Blackgrove, was then called for. Addressing him, the acting-president said it was his pleasure to confer upon him still further honors Evidences of the earnest manner in which the office of president has been filled during the past year were plentiful. In appreciation of the past-president's labors and as an insignia of his rank, the acting-president pinned on W. G. Blackgrove the past-president's badge In acknowledging the honor, Past-President Blackgrove thanked the members for their hearty support in the past, and said that his best wish for the new president was that he might receive the same assistance in the duties of his office.

The president elect, James Devlin, then tendered his sincere thanks for the honor conferred upon him, and promised, to the utmost of his power, to increase the membership and improve the finances of the association.

Jas. Devlin, President.

[President James Devlin is a native of Kingston. He was trained in the works of the Canadian Locomotive and Engine Co. In 1873 he was appointed engineer of the Government water works, which were afterwards taken over by the city. In 1875 he became chief engineer for the St. Vincent de Paul Penitentiary, in Quebec Province, and, in 1885, for the Penitentiary at Kingston—a position which he still holds. The fact that he is on the Board of Examiners of the Ontario Association of Stationary Engineers, and the initiative ability which he once or twice displayed during the deliberations of the Convention show him to be well fitted for the post of president at a time when strenuous efforts are to be made to secure Government acknowledgment of the grade of Stationary Engineer.]

Vice-President E. J. Philip also thanked the Convention and promised to second the president in every effort for the good of the C.A.S.E.

R. C. Pettigrew, Treas. C. A. S. E.

The other officers followed in rotation, all giving evidence of enthusiasm for the association, and a will to do their several duties to the utmost of their power. Conductor Murphy intimated that he was not anxious for muscular exertion in the performance of his duties, but—and he sat down, glancing around the chamber with a look that showed a reserve of determination likely to add telling effect to the use of his silver staff, should it ever be called into requisition.

J. J. York then moved a vote of thanks to H. S. Robinson, of the Correspondence School (the "Scranton Man," as he was generally called). He had taken a room close to the council chamber, where he displayed drawings and explained the system of teaching to any engineer who cared to investigate, and had in every way given satisfaction to the convention. This was seconded by J. Murphy and carried.

W. Selby then proposed a vote of thanks to B. W. Folger, the proprietor of the electric car system, for the use of the cars during the convention. This was seconded by A. M. Wickens and carried. Mr. Wickens proposed a vote of thanks to the mayor and council, seconded by W. Selby, and carried. A. E. Edkins then proposed that a message of condolence be sent to the widow and children of the late treasurer, Duncan Robertson, of Hamilton. This was seconded by F G. Johnson, and carried. A vote of thanks to the officials at the penitentiary, including J. Devlin, was proposed by A. E. Edkins, put by A. M. Wickens, and carried, to which President Devlin briefly replied. J. J. York proposed a vote of thanks to Kingston No. 10 Entertainment Committee. This was seconded by W. Weir, and carried with musical honors.

Conductor Murphy.

O. E. Granberg.

J. J. York proposed that the doorkeeper of the City Hall be tendered $5 for his services, seconded by R. Pettigrew. Conductor Murphy then brought in Doorkeeper Lanigan. He entered unconscious of a crime, and wondering what was to be meted out to him. His glance gained somewhat in pointed intelligence on the receipt of the $5 bill, and he retired with a better lined pocket and his honor uncompromised.

The next place of meeting was then discussed. A. E. Edkins proposed Brockville and was seconded by Past-President Blackgrove. R. Pettigrew proposed Hamilton and was seconded by W. Norris. The voting showed a majority of three in favor of Brockville, which town was announced as the next place of meeting. O. E. Granberg was then appointed district deputy for Quebec and F. J. Cody for Ontario. President Devlin then extended an invitation to the ladies of the convention to his residence during the dinner in the evening. This ended the last, longest and most fruitful business meeting of the convention.

A. M. Wickens.

A. E. Edkins.

At 3 p.m. the members again gathered at the council chamber for a drive to Kingston Mills, Fort Henry and the Tete du Pont Barracks. Once more the engineers were happy to greet the ladies, for their light-colored dresses and parasols and their reposeful demeanor were highly suggestive of the cool relaxation for which the tedium of the previous business meeting had prepared everyone. In a few minutes the whole procession of over a dozen carriages was wending its way to the mills. Spirits were high and tales for which a technical journal has no space were told and capped, except where the ladies discanted more calmly upon the beauties which surrounded them (referring of course to the landscape, not the engineers). The afternoon was warm and the road dusty, and on arrival at the cool sward of Kingston Mills, sundry inviting viands were discovered and thoroughly appreciated. Some of the party, invited by the cool grass, disposed themselves at full length upon it, and those who did not were speedily placed in that position by one of the many forces known to engineers. After about an hour's stay the party proceeded to the fort and barracks. The fort itself was interesting chiefly as a relic of the past and as a standing evidence that no hostile occupation of Canada is expected for some months to come. But in the fort was found a well developed, though for the time, unfortunate goat. Last year in addressing the Kingston branch, J. Devlin said: "We do not subject our new members to the trying ordeal of riding the goat" (see souvenir), but in the fort they did it voluntarily and Past-President Blackgrove—the most solemn visaged of all the dignitaries—was seen astride the goat as an example to all junior members. Indeed so much attention did the animal receive that he began to know the badge and disputed the ground with every engineer who approached him. And yet, perhaps, having been so honored, he objected to favor any less a person than a past-president. Anyhow, after Mr. Blackgrove left him he was dangerous. From the fort the party returned home, having enjoyed themselves most thoroughly.

The convention was brought to a close by a banquet at the British American Hotel. It was tendered by Kingston No. 10, and was the last item in the admirable programme arranged by that branch. S. Donnelly, president of the local branch, occupied the chair. On his right were the mayor and aldermen Skinner, Ryan and Tait. On the left were the newly-elected president Devlin, retiring president W. G. Blackgrove and A. M. Wickens, of Toronto. There were present as visitors Geo. Anderson, manager of the Royal Oil Co., Toronto, and Mr. Birch, of McKelvey & Birch, of Kingston. After an excellent repast the chairman proceeded with the toast list. The toast of The Queen was honored in the usual manner, all singing the National Anthem.

Kingston had a certain institution on the hill which doubtless kept the aldermen in awe. The Association of Stationary Engineers must succeed, for it was founded on the rock of knowledge. No qualified engineer regarded a boiler explosion as an accident. As the work of the association progressed, and knowledge took the place of incompetence, the handling of steam engines would become absolutely safe Engineers must keep abreast of their business. In no other line of activity were so many improvements being made.

J. J. York, of Montreal, in the course of his speech, made and emphasized the fact that employers need to be educated. This association benefited employers quite as much as it did the engineers—a fact which should be more fully recognized. When it was, men would be paid in proportion to their skill and ability to save their employers' money.

O. E. Granberg made an excellent little speech, in which he explained his absence from the party which visited the Penitentiary, as he could not bear to look upon men whom even justice had deprived of liberty when he was so fully enjoying his own.

FUN OF THE FAIR.

Mr Nixon, of the *Electrical News*, was called upon and sang "My Dad's the Engineer" The City of Kingston was the next toast, and the mayor, on rising, was received with musical honors. It was, he said, the universal opinion of the people of Kingston that the Stationary Engineers were "a jolly good crowd." He was glad to know that the principal features of the city had been duly viewed and appreciated. It was a matter of regret that the City Council was not more largely represented, this being the vacation season. The city authorities were always glad to extend a hearty welcome to strangers. Differences of opinion might arise at the council board, but on festive occasions like the present, and in particular whenever any of the City Fathers joined the ranks of the Benedicts, all differences were forgotten in the general rejoicing. He hoped the delegates had accomplished the purposes which had brought them together, and that they would carry away a favorable and kindly recollection of the old Limestone City.

Aldermen Skinner, Ryan and Tait followed. Mr. Grant, of Toronto, was called upon and sang "The Little Tow Head." The next toast was "The C.A.S.E., its aims and objects," coupled with the names of A. M. Wickens, of Toronto, and J. J. York, of Montreal, O. E. Granberg, of Montreal, and W. Norris, of Hamilton.

In reply, Mr. Wickens referred to the hearty welcome the association had received in Kingston. If Kingston had an honest city council, as much could not be said of Toronto. But then He hoped the association would receive the public sympathy it deserved in the attempt it was about to make to secure a Dominion law requiring stationary engineers to hold certificates of proficiency. Why not, if steamboat engineers, druggists, etc., were obliged to hold them? Wm. Norris, of Hamilton, said that as a young man he felt deeply indebted to the association for the assistance it had given him in the acquirement of a technical education. The duties of a stationary engineer were continually growing in number and complexity. He, too, thought employers needed a little education on this point. Past-President Blackgrove was called upon and sang "When the Sun was Low," and responded to an encore.

The next toast was "Our Manufacturing and Industrial Establishments and Mechanical Education," coupled with the names of H. S. Robinson, of the Correspondence School, and Geo. Anderson, of the Royal Oil Co. Mr. Robinson in reply emphasized the importance of thorough mechanical knowledge. Mr. Anderson congratulated the engineers on the fact that so many had brought their wives and some their children. This was evidence at least of pure intention and domestic felicity. Among other things, he said that the plant of the Imperial Oil Company, which he represented, occupied 65 acres at Petrolea. Canada, he thought, had thus far been laying the foundation of prosperity by providing herself with great public works. This process was about completed, and the time had come for a judicious immigration policy and the extension of our export trade. We could send abroad much more than we are doing of furniture, wood pulp and dairy products.

Mr. Cochrane was then called and sang "The Wedding March" and responded to an encore.

The next toast was "Kindred Associations," coupled with the names of Messrs. Blackgrove, Edkins and Bain. Mr Blackgrove, in responding, said he always liked to visit Kingston, but the present visit would be to him the most memorable of all. "The brothers of Kingston are the real stuff. They did everything they could to make our trip enjoyable. Certainly they could have done nothing more"

A. E. Edkins, of Toronto, explained the history of the Ontario Association, to correct an impression that it was antagonistic to the Canadian Association. It was formed in order to exercise certain powers granted by the Ontario Government. It held examinations and granted certificates of qualification, but the holding of such certificates was not compulsory. He hoped the effort of the Canadian Association to secure a Dominion law making it compulsory, would be successful. For the encouragement of others he would say that his experience confirmed the belief that thorough competency in the case of any engineer would sooner or later be fairly recognized and rewarded. Alderman Skinner then favored the company with "The Boys of Our Old Brigade," the chorus of which was heartily taken up by the company. The "Executive Council" was then toasted, and replies were made by President Devlin, Vice-President Philip, Treasurer Pettigrew, and Secretary Chapman.

Mr. Robert, of Ottawa, was called and sang two inimitable songs. The refrain of one of them, "It's all right but it's upward," haunted some of the party in their dreams. The mayor then rose and proposed "The Press." In doing so, he said he would most heartily do all he could to assist the association in securing the legislation which they sought. Mr. Shanks, editor of the Kingston *News*, made an interesting reply. Mr. Stevenson responded for the *Whig*, Mr. Nixon for the *Electric News*, and Mr. H Spurrier for THE CANADIAN ENGINEER. After two more songs by Messrs. Murphy and Grant, the toast of "The Ladies" was proposed and responded to appreciatively by O. E. Granberg and B. A. York. Alderman Tait, certainly the wit of the council, was called upon for a story, and Mr. Cochrane for another song, which was encored. Alderman Skinner then proposed the "Kingston Branch." Brief replies were made by local President Donnelly and Pres.-elect Devlin. After another song by W. G. Blackgrove and the toast of "Our Host," the members joined hands and lustily sang "Auld Lang Syne." At 2.20 a.m. the dining hall was clear and the convention over.

As each item in the programme was reached one heard renewed praises of the hearty and generous reception accorded to the convention by the Kingston Branch, and this, combined with the beauty of the city in the magnificent weather which the convention each day enjoyed, made all the members reluctant to leave. They lingered on Friday, and on Saturday morning some were repining that their duties demanded their departure in an hour or two.

This convention has not been so full of instruction as some, partly owing to the absence of J. M. Campbell, but it is likely to have a very important effect on the policy of the association. There is an evident intention to whip up lethargic members and arouse an enthusiastic spirit and a sense of the responsibility in each member to every other member. The energetic efforts to secure Dominion legislation which are to be made will immensely increase the fitness of each engineer for his important duties, sanction the association as a highly responsible body, and put a proper stamp on the personal pride which each engineer should feel in his scientific and manly calling.

OIL TUBE DRILLS.

In our advertising pages will be found a cut which shows the style of oil tube drills which are manufactured by the Cleveland Twist Drill Co., Cleveland, Ohio. The leading feature of this new tool is a provision for the fact in boring deep holes it is necessary that lubrication of the cutting and bearing surfaces shall be satisfactory, inasmuch as the close packing of the chips will not admit of proper lubrication by gravitation when holes are deep, and it is necessary to provide other means for forcing the oil down into the cutting lips. Grooves are cut on each land part just deep enough to admit of enclosing a small brass tube, which is soldered in place, making a smooth surface as ordinarily provided for in twist drills. The tubes terminate at the lower ends in openings discharging the oil directly at the cutting edges of the drill. The upper ends of the tubes project from the shank of the drill, and through these the oil is inserted. With a high speed and heavy feed, drills heat at the point, as it is impossible to force in a lubricant, and it was to overcome this objectionable feature that these tube drills were placed on the market. There may be several ways of conveying the oil through the tubes. That which the makers find the most successful is as follows: The tubes are cut flush with the shank end, then a collet placed on the shank which fits the turret. An oil pipe is connected with the centre of the turret, and carried down to a chamber connected with the butt end of the drill. A flexible steel pipe conveys the oil from the pump to the turret. The oil is forced through on to the point with considerable force, and assists in sending the chips up the flutes, and at the same time keeps the cutting lips perfectly cool. Collets are made for various sized drills, and as the outside diameters of the collets fit the turret, a drill can be changed in a few seconds. The manufacturers have already furnished many of these tools to turret lathe and bicycle manufacturers, and they are giving excellent satisfaction.

THE CORROSSIVE ACTION OF PURE WATERS.

It is not generally known that pure, soft water will corrode boilers, and so may be undesirable to use. It would seem that the purer the water, and the more free consequently it is from scale-making matter, and from salt, soluble magnesia compounds, and other substances known to cause corrosion, the better it would be for boiler purposes, and up to a certain point this is true; but it has been found by experience (and experiment shows the same thing) that waters carrying a certain small proportion of solid matter, and perhaps making a little scale, are better for boiler use than those that would be extolled as the finest drinking waters.

There is hardly such a thing as absolutely pure water in nature. Water, being almost a universal solvent, takes up more or less of every substance with which it comes in contact. Even rain is charged with soot, dust, acids and ammonia from the atmosphere, so that only in remote regions of scanty population does rain approach the purity of distilled water. Pure water itself has very little solvent power for iron, and a fixed amount soon takes up all the iron it can hold. Indeed, on bright surfaces pure water exerts hardly any action at all; and yet there are cases in which a bad corrosive action can occur from apparently pure water, as, for example, when condensed water is delivered back to the boiler so near the shell as to first mingle freely with the water in the boiler. The feed, in this particular case, will not only dissolve away all scale near the point of discharge, but will also eventually badly corrode the boiler itself. We shall not attempt to decide whether the particular phase of corrosive action here mentioned is due entirely to the purity of the distilled feed, or whether it arises from other causes; but will merely repeat that the waters that are available for use in boilers are never absolutely pure. The purest surface waters always contain some foreign matter—a little organic matter from swamps, perhaps, or some leaf-mould from the woods, or mountain moss. At considerable distances from the sea, our ponds may contain more or less salt and saline matter brought inland by fog or wind, and even water from melted snow, on frozen ground, contains much air and other gases All of these substances are corrosive under certain circumstances, and sometimes remarkably so. That corrosion from these dissolved matters is not more general is due to the fact that ordinarily our supplies do not approach to a state of purity (using the word "purity" in its exact sense, without reference to contamination by sewage or other similar matter), but contain more or less scale-forming matter and some alkali Even trap rocks and granite yield some soda and potash to water, so that the tendency of the organic matter and decomposable saline constituents to acid decomposition is continually corrected; and in our best waters, from pure sources carrying some organic matter a varnish-like coating, consisting of compounds of low iron oxides with organic matter, soon covers the iron surfaces, and protects them very perfectly, sometimes for many years.

It is difficult to represent, in an engraving, a typical case of corrosion from too pure a water, because the affected plate usually does not show any very sharp contrast of light and shade; but a pitted tube will show what may be expected under certain circumstances. This tube was not protected by the varnish-like coating that we have referred to, and the water therefore came in direct contact with the iron. The action was most rapid when the boiler stood idle for a time. It showed itself, first, in the formation of thin blisters of rust. The blisters are easily removed, and the surface of the metal underneath is then found to be of a reddish black color. It may be that no change, other than this discoloration, will be visible when the blister is removed, but by picking at the spot, with the point of a knife, it will be found that a considerable quantity of oxide may be removed before the bright metal is exposed, leaving pits of various sizes.

New boilers, new tubes, and new work generally, that has not acquired this protective coating, are apt to suffer when first put into service with a very soft, pure water, such as follows the melting of the snow in the spring, or the copious fall rains which fill our streams and reservoirs; and the singular phenomenon is sometimes presented of new tubes or new boilers giving out, so that they have to be replaced even more than once, while old ones, worked under the same conditions, remain serviceable.

This past spring has been an unusual one in New England in this respect. Two remarkably dry years in succession had exhausted our reservoirs, reduced the flow from our springs and streams, and lowered the ground water to an unusual extent. A considerable fall of snow that covered the ground during the last of the winter was rapidly melted off by heavy rains, re-filling the depleted streams and reservoirs with the softest water possible—the solid matter present in solution being, in some cases, even lower than one part to 100,000. Such water, when used in a boiler unprotected by scale or iron oxide skin, would be very certain to cause corrosion.

The corrosive power of pure water on new or unscaled boilers was well illustrated in the city of Glasgow, when a new water supply was introduced from Loch Katrine, one of the purest waters in the world which is available for city consumption. (The facts are given in Rowan's little handbook on "Boiler Incrustation and Corrosion.") The former supply had been poor and calcareous, and old boilers were much coated with lime scale. To the dismay of the users, those who had put in new boilers or new tubes found them rapidly corroding, while the old scaled and coated boilers remained as before; and those who had removed every possible trace of old incrustation from their old boilers, by mechanical or chemical means, "in order to get the full benefit of the pure water," were also badly troubled by corrosion; and even the old boilers, as the scale was gradually removed by unvaringly soft, pure water from the lake, were more or less corroded when no means were taken to prevent it. It was found, in this case, that introducing a little lime from time to time—enough to give the boilers a slight calcareous coating—usually prevented the corrosive action of the water, and in the course of time the lime, organic matter, and iron oxide skin formed a protecting, oxidized surface that prevented further corrosion.

Water similar to that of Loch Katrine,—soft and pure in quality without alkalinity, containing some vegetable organic matter, and with the natural proportion of acid and gases common to a fully oxidized water,—is what in the non-lime bearing sections of our country is met with at certain seasons of the year in our streams, ponds and reservoirs, after the melting of snow or heavy rains. Except in certain limited sections, however, this condition fortunately does not long persist, for in dryer times the water soon takes up its normal proportions of lime and alkali, and reaches the point where some scale may form in a boiler.

It will be inferred from what has been said that the most perfect boiler water is one which makes a slight deposit in the dryer seasons, and has this deposit largely dissolved off by the soft water of spring and fall, so that the balance of efficient working, without much scale and without serious corrosion, is practically kept. Fortunately, many of our Eastern boiler waters fulfil these conditions. It will not do, however, to rely entirely upon nature to keep the balance in even the best boiler waters; for the condition of the water will vary from season to season, and even the smallest amount of solid matter, whether soluble or not, will accumulate, in time, to a dangerous extent, if not blown or cleaned out.—*The Locomotive.*

BEATTY GOLD DREDGING AND MINING COMPANY.

Application is made for Dominion incorporation of the Beatty Gold Dredging and Mining Co., with the following gentlemen composing the same: McSloy Bros., St. Catharines; H. C. Symmes, Banker R Paine and Charles F. Morse, of Niagara Falls South, A B. Denison, of Niagara Falls, N.Y.; Hugh McCulloch (of Goldie & McCulloch), Galt; Senator Ferguson, Toronto, and Beatty & Sons, of Welland. The capital stock is $50,000, which is all subscribed. The claim is three miles in length of bed and bar on the Fraser river, and is located just below North Bend, 129 miles from Vancouver. The location was made after personal investigation of the claims, and lies in the centre of a gold-bearing section. Gold is being taken out by hand on all sides in paying quantities. It is correctly argued that if thousands find remunerative results from hand work, the dredges will take big money out of the river bed and bars. The stockholders have awarded Beatty & Sons, Welland, the contract for supplying a gold-dredging plant to cost about $20,000, which they are now building with all possible speed. Dredge hull, scows, grizzlies, sluice boxes, etc., will be built on Fraser river. The plant will be of the most modern style, supplied with Beatty's latest improvements. All will be ready for business about October 1st, when active operations will be begun under the superintendence of L. R. Symmes. One great advantage lies in the fact that the company's claim is within half a mile of the C.P.R., and it will not prove very costly to place the machinery at its destination.

THE POETSCH FREEZING PROCESS FOR SHAFT-SINKING AT VICQ, BELGIUM.

In its "Abstracts of Papers" the American Institution of Civil Engineers publishes an interesting account of a recent application of the Poetsch freezing process to the sinking of a shaft through nearly 300 feet of water-bearing ground. The Anzin Mining Co. proposed to open a new mine at Vicq, in the valley of the Scheldt. The ground overlying the coal deposit was of a loose and water-bearing nature, and in sinking neighboring pits the outlay had amounted to $1,100 per yard of depth, and a long time was required for completion.

A preliminary boring, made in 1892, gave the following sections of material to be penetrated:

	Ft.
Fine sand and alluvial gravel	22.14
Compact argillaceous sandstone	13.12
Chalk, loose and incoherent	65.44
Chalk, compact	138.74
Chalk, marl, with flints	59.04
Blue marls	82.00
Plastic clay	190.24
Green sand	44.75
Coal measures marked at	615.49

These measures were all water-bearing down to 298½ ft. below the surface, when a secure foundation for tubbing could be found in the blue marl under the flinty chalk. Flowing springs were found at two levels; one in the sandstone, of 2,700 gallons per hour, and one in the loose upper chalk; the latter being under pressure, rising 2¼ ft. above the surface and flowing.

To provide the feed and condensed water for the freezing plant, an estimated demand of 3,500 gallons per hour, a well was sunk at a distance of 820 ft from the site of the shaft. This well, though only 6¼ ft. in diameter and 39 ft deep, cost $2,000; the last 15 ft. being bored while the upper part was secured by an iron cylinder with a cutting edge.

Two pits of unequal size were to be sunk; one, 12 feet in diameter, was intended for the pumping, ventilating and passenger hoists, and the other, 16.4 feet in diameter, was to be fitted with eight tubs capable of raising 300,000 tons of coal per annum. The first thing done was to bore 36 holes for the reception of the circulating pipes; 20 of these were arranged around the larger pit in a circle 21 3 feet in diameter, and 16 around the smaller pit in a circle 16.73 feet in diameter. They were all of the same depth, or 298½ feet, and the two pits were 121 feet apart. All springs encountered were trapped to prevent a circulation of water through the ground.

The freezing circuits, the most important element of the plant, were made of steel pipes, arranged in series; one, 1.17 inches in diameter and 0.156 inches thick, being placed concentrically inside another, 4½ inches in diameter and 0.273 inches thick. Each series was connected by a goose-neck to its own ring-main, and the freezing fluid was passed down the inner pipe and returned through the outer one back to the refrigerator. Extreme care was taken in making and testing these tubes. The ring-mains were 7.8 inches in diameter; and the cold fluid moved at a speed of 4 inches per second in the small tubes and 4.43 feet per second in the larger pipes. The calculations by the engineer called for the abstraction of 110,000,000 calories from the ground about the larger pit, and 90,000,000 from about the smaller one, or, allowing 25 per cent. for losses, about 250,000,000 calories as the total heat to be removed. The time required to freeze the ground was estimated at 1,000 hours, or about 40 days.

The Linde freezing machinery was used. The calcium chloride solution in circulation measured 16,380 gallons and contained 25 tons of the dry salt, costing $30 per ton, and the density of the solution was 1.25. The progress of the freezing operation was watched by sinking a series of thermometers 6¾ feet deep and about 3 feet 3 inches outside the ring of freezing tubes.

The freezing machine was started with one compressor on May 28, 1894, the ground temperature then being 11.65°C., and the cold developed being represented by 285,000 h. u. per hour. The next day the temperature had fallen to —47°C. in the refrigerator and to —1° in the return pipe; a second cylinder was then started, which reduced the temperature of the solution to —7°, and to —4° on the third day, when the third compressor was started. In ten days more —10 6° was obtained in the cold solution, and then the whole four compressors were worked from June 12 to July 1, when the temperature was —15° C. in the supply pipes, and the freezing of No. 2 pit was complete. Until July 17, only two compressors were now used, and on this date the initial freezing operation was considered finished, and the ice walls were maintained by working three compressors until September 2 and two until December 1, when the machine was stopped during the day, and on Sundays and holidays On December 28 its use was discontinued, after working seven months, with 76½ hours stoppage in that time. The thermal equivalents of the work done in this period are shown in the following table:—

	Calories.	
	Pit No. 2.	Pit No. 1.
Heat absorbed in:		
Formation of ice	43,040,000	70,075,200
Cooling ground, outside circuits	16,825,615	28,285,845
Cooling ground, inside circuits.	14,473,982	22,917,860
Cooling work utilized	74,339,597	121,278,905
Surface losses................	25,574,640	32,793,936
	99,914,237	154,072,841
Work done by engines:		
May 28 to July 2	100,379,694	....
May 28 to July 16............	....	161,354,901

Sinking was commenced in the smaller pit on July 2, and in the larger on July 16, the grounds then being frozen in a ring 4 feet thick, extending 18 inches outward from the freezing centre and 30 inches inward in one case and 22 inches and 40 inches in the second case. By keeping the source of cold entirely outside the ground to be excavated, a large part of this ground was loose and the shovel could be used. Hard ground was wedged down, no explosives being employed. The chalk strata contained vertical fissures, and here the maximum rate of sinking was 6½ to 8 feet per day; but in the flinty strata below this the rate fell to 12 to 20 inches per day. At this point the temperature in the pit was —12° C., the lowest reached. In this flint stratum the diameter of the unfrozen part was only 5.4 feet in the large pit, and the small pit was entirely frozen. As showing the difficulties encountered, as many as 3,000 picks and wedges were blunted in one day in Pit No. 1. The blue marls at the foot of the shaft were entirely unfrozen, no ice being found at a greater depth than 34 inches below the bottom of the freezing circuits in either pit. The actual time consumed in sinking the two pits through the 298 feet of frozen ground was from July 2 to October 5 for the small pit, and from July 16 to October 16 for the larger pit, including 9 days of stoppage for building the first ring of tubbing. This tubbing was of cast-iron rings, built up of segments and backed on 8 inches of concrete, the latter mixed with water containing 10% of calcium chloride to prevent freezing.

The total cost of sinking was about $142,000, or about $183 per foot. A summary of items is given as follows in meters and francs:—

	Per cent. of total.	Total francs.	Per meter francs.
Patentee's royalty	4.6	32,760	139.20
Temporary plant and buildings.	2.7	19,582	83.25
Boring for freezing tubes	10.4	73,673	313.10
Freezing plant	35.0	248,765	1,057.20
Measuring apparatus	0.3	1,898	8.10
Freezing........	4.7	33,030	140.40
Sinking and tubbing	40.5	287,454	1,221.65
Carriage	0.6	4,562	19.40
Tools	0.7	5,257	22.35
Sundries......................	0.4	2,865	12.15
Total	100 0	709,850	3,016 80

In this statement the whole cost of the plant is charged to this single use; its subsequent employment in future sinking would be worth 1,000 francs per meter, leaving the work done here to cost about 2,000 francs per meter. The items especially chargeable to the freezing operations amounted to about 660 francs per meter, or, say, $40.24 per foot. About 20 per cent. of the cooling effect was lost at the surface owing to the distance of the machines from the work; the engines used being intended to eventually drive air-compressors in working the mine. The authors of the paper, MM. Saclier and Waymel, also think that each pit should have had its separate freezing plant, so as to be enabled to get to work as soon as an ice wall of sufficient thickness had formed over the surface. They could then have excavated in softer ground and advanced more rapidly. Especial stress is laid upon the necessity for absolutely vertical borings for the freezing pipes; and the maximum distance between holes should not be more than 4 feet to depths of 328 feet, and for greater depths it would be well not to exceed 3.28 feet. The original of this paper is to be published later in full, with 14 plates, by the Institution of Civil Engineers.

NEW IDEAS.

LARGE ROLLED STEEL PLATE.

There was recently rolled at the works of the Stockton Malleable Iron Co., at Stockton-on-Tees, England, a steel plate weighing 12,320 lbs., being 76 feet 3 inches long, 5 feet wide, 3/8 inch thick, after being sheared.

POLISHING BRASS.

To remove greasy discolorations from brass, use benzine—or potash solution; the latter will also take paint off, whether desired or not, wherever it happens to drop.

COST OF EVAPORATION OF WATER.

This will vary somewhat with cost of coal and the skill of the fireman. The range is from 10 cents to 16 cents per 1,000 lbs. of water evaporated.

CONCENTRATION OF POWER PRODUCTION.

The tendency of the present day seems to be toward the abolition of small independent steam power plants, and, instead of this, large steam and water power plants produce and distribute electric power direct to the consumer. This is lessening very much the number of engines required for stationary service, and is taking advantage also of the greater efficiency of large, carefully-run engines, boilers or turbines.

BALL BEARINGS.

Recent tests made at Fitchburg, Mass., show

(1) That friction on ball bearings increased little, if any, with *increase* of pressure.

(2) That friction increased less than in proportion of the square root of the speed. The actual co-efficients of friction varied from .0025 to .005. In comparing ball bearings with babbitt bearings, it was found that under 200 lbs. per square inch pressure and 800 revolutions per minute, babbitt bearings 2½ inches diameter, lubricated with 20 drops of oil per minute and having ½ inch lateral play, heated badly. Under the same pressure ball bearings were run at 2,600 revolutions per minute without signs of heating.

RAILWAYS OF INDIA.

The administration report upon the railways of India is a very interesting document There are 19,677 miles in operation, of which 14,721 miles are owned by the Government and the remainder by native states or private companies. The dividends on the total investment are 5¾ per cent.—which is very surprising when it is considered that there are many military frontier roads which do not pay expenses.

The reason for these large dividends is that working expenses are only 46 per cent. of gross receipts—as compared with 68 per cent. in Canada. It is probable that low wages is the largest item of difference, also less climatic difficulties, and heavier traffic on lines running through densely populated districts. Our own railways would increase very rapidly could dividends such as those of India be assured. As it is, the net earnings only represent about 1¾ per cent. on the gross capital invested.

MICROSCOPIC FLAWS IN STEEL.

To those interested in the use or manufacture of steel, the articles contributed to *Engineering* lately by Thomas Andrews, F.R.S., are very interesting. He gives tables showing the number and diameters of micro-flaws in square inch sections of Siemens and Bessemer steel axles, etc., traces their cause to the presence of sulphur, and gives a list of serious accidents which have occurred owing to fractures of such axles while in use. The most striking sentence in the article is:—"A fracture once commencing at one of these micro-flaws (started probably by some sudden shock or vibration, or owing to deterioration by fatigue in the metal), runs straight through a steel forging on the line of least resistance in a similar manner to the fracture of glass or ice."

INCREASED ECONOMY IN RAILROAD OPERATION.

The continued hard times for the railways is forcing on them every possible economy. Two particular features noticed lately are (1) Weighing or recording the cargoes on each freight car so as to load each engine to its full capacity. The old method of loading by so many cars was apt to make light trains—as many cars are only partially loaded. (2) Increased length of runs—one run recorded lately as being established as a fixture is 192 miles from Jersey City to Susquehanna, Pa. The loss of fuel and time while engines are being "groomed" and then steamed up again, will thus be largely decreased

PLATING ON WOOD

Plating on wood is described at length by the *Electrical World* as a new process, but it has been practiced for quite a number of years. The procedure is to first varnish the article to be plated, then carefully coat the surface with plumbago so that it is covered evenly, and brush the surplus off. The article is suspended by copper wires, and is plated in the usual way, first giving a ground coating in the alkaline copper bath and then plating with whatever other metal is desired. Leaves, flowers, and small animals may be treated by the same method

INDUCTOR MOTOR

Information has been received, but not in a detailed way, of the application of an inductor (alternating) motor to operate a direct-belted hoist in Somerville, Ont

POPULARITY OF ELECTRIC MOTORS.

At the Carnegie Steel Works, at Pittsburg, there are in use more than 200 electric motors ranging from 5 to 100 h.p. capacity, and aggregating about 3,000 h p.—*American Electrician.*

OBITUARY.

Sir William R Grove, whose name is borne by a very famous battery, died August 2nd, 1896. He was a contemporary of Faraday, Sturgeon and other pioneers His efforts in the electrical field were numerous and crowned with success. He was a F.R.S. and was knighted in 1872, since then he has been a judge of the High Court.

TROLLEYS IN THE UNITED STATES

In the U S there is now being operated 12,133 miles of trolley road with 34,971 cars, which is a wonderful illustration of the growth of the electric business during the past 7 years Horse cars have 11 219 miles, but with only 5,385 cars; cable roads are in the rear with 5,099 miles and 4,871 cars. The debt (bonded) of the street railways is $590,5 6,391 or $40,800 per mile of track, and the total capital liabilities are $1,375 410,162, or $95,000 per mile of track

CANADIAN WATER-POWER

Owners and users of water-power in Canada are requested to send information, public or confidential, to THE CANADIAN ENGINEER, as to the cost per h p. year for their power, the data to include cost for maintenance and repairs.

HORSE-POWER.

An English engineer has reported the results of some dynamo metric experiments on the pull of horses. In one case a powerful draught horse (Percheron breed) exerted 5.44 h.p. over 138 feet, and it is concluded that an ordinary street-car horse may exert 3.75 h.p at the moment of starting a car. A French experiment is quoted where the horses were called upon during one or two minutes to make an effort equivalent to 5.2 h p., but which exertion it was found is liable to seriously strain a horse.

ELECTRIC STEERING APPARATUS.

Electric motors have been substituted for steam engines in operating the steering gear of the United States war vessels, as also they have displaced steam in operating windlasses, hoists, etc

ELECTRIC RIVETING

Electricity is operating riveters in boiler and bridge shops where formerly steam, air or hydraulic power did the work, the electric riveters are lighter and dispense with a boy who is used to manage the flexible pipe when the machine is being moved around.

THE FLUID IN THE TAILOR SHOP.

Tailors' "gooses" or smoothing irons are now heated by the alternating current, in this way. The interior of the goose is wound with copper wire insulated with asbestos, which induces eddy currents in the solid iron of the "goose," thus heating the iron to the proper temperature.

CURATIVE ELECTRICITY.

M. D'Arsonval, of Paris, has published a report of the use of currents of high frequency in treatment of diseases such as lack of nutrition, obesity, sugary diabetes, gout, rheumatism, etc. He was successful in many cases The currents used varied from 350 to 450 milliamperes, and, though so very strong, were not felt by the patients. Some have attributed this phenomenon to the fact that high frequency currents do not penetrate a conductor, but he proved that that hypothesis was erroneous, as bad conductors like the body conduct like electrolytes, *i.e.*, throughout the whole section.

CORUNDUM.

German manufacturers convert emery ($Al^2 O^3$) with a trace of water and iron, into corundum, which is practically pure alumina, by the electric furnace.

"X" RAY EFFECTS.

From continued exposure to the "X" rays deleterious effects show themselves. The skin dries and peels off, hands swell, finger-nails stop growing, eyes bloodshot and sight becomes dimmed. Protection is obtained by a mask and gloves covered with tin-foil.

REQUIREMENTS OF THE UNITED STATES NAVY IN ELECTRICAL APPARATUS.

The authorities of the United States Navy require their dynamos to generate 4 watts for every pound weight of the machine, which equals 186½ pounds to every horse-power; that the ultimate temperature of the machines is but 50° Fahr. above the room temperature, and that the insulation tests show a resistance of 500,000 ohms between any two circuits, or between the ground and any circuit.

ARTIFICIAL GRAPHITE.

Several parties have been working to produce graphite (plumbago) by directly heating carbon by the electric arc. This has been done several years ago, and it is well known among those manufacturing carbon that a certain temperature, not necessarily produced by the electric arc, will change the form from amorphous carbon to graphite. Graphite is seemingly more friable than the artificially produced carbons, and possesses a specific gravity of 3.87 as compared with that of ordinary carbon, 2.63. It has a gloss, and generally contains from 2 to 5 per cent. of iron. Artificial graphite possesses no fibre, but has all the other qualities that the native articles have.

CAPITAL AND LABOR.

Editor CANADIAN ENGINEER:

The very candid and exhaustive article of G. P. Clapp, on this subject, excited my warmest sympathy, and I expected, in the August No, to find some other continue the subject, but was disappointed. The writer very truly says that ignorance is the main impediment in a fair adjustment of the labor question. The toiler probably does not know, and grossly exaggerates, the value of his labor in the world's markets; while the capitalist equally overestimates the share he has in the development of manufactures. The plea for equity, "that we are all members of the same great human family, and every division and class of honest labor is necessary for all conditions of society,' is true and fundamental—all great reforms must have this basis, and practically enforce it. All wealth is accumulated or hoarded labor. The laborer who hoards (or saves) a part of his work, becomes a capitalist to that extent; he who hoards enough to permanently employ all the labor of his family to advantage, is independent in the best sense of the term. Farmers most frequently attain this independence by working long hours, by self-denial in living and enjoyments, and by being able to employ more family labor than the citizen. But his family are apt to long for the luxuries, amusements, and shorter hours of the city, and hence the stream from the farm which so constantly fills the city with redundant labor, and makes competition so keen.

An eight-hour law in the city would only increase the rush—and, in the country, on present terms it would be impossible. The farmer must toil from sunrise to sunset in spring and autumn, if he would meet the expense of the long winter, and have wherewith to keep up with falling markets and a growing family. Equally futile would it be for the lumberman to compete with the American market or the spring flood, with men working only eight hours—16 to 20 hours is frequent with river drivers. Till the conditions of toil are equal in town and country; till the men who toil also own the capital which is to employ them; till the son of the workman has the same education as the son of the banker and lawyer, and till the men who labor have confidence in each other as professional men have, will these evils continue. Universal compulsory education we have—representation in some proportion to our numbers we lack—while the professions and bankers make our laws and settle our status in society.

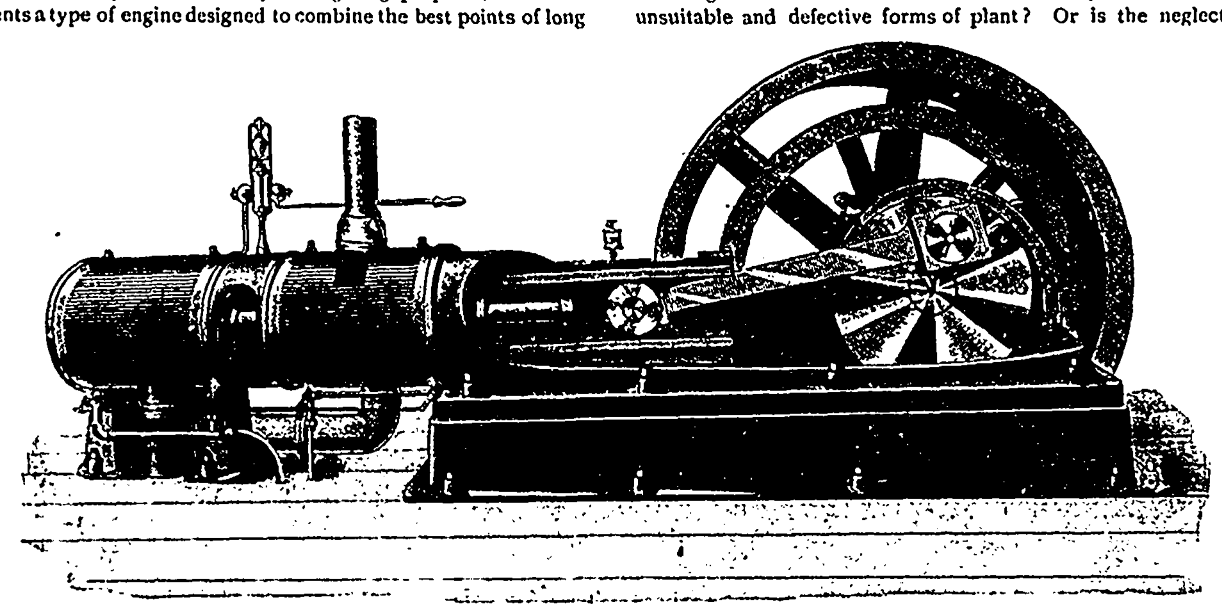
We never can have overproduction of the necessaries and comforts of life, if we only distribute them fairly; with 95 per cent. of Canada's resources yet dormant, there is no sense in curtailing hours of labor. Rather take all round pins out of square holes, get every man to work where he can to public advantage, limit non-toilers to same pay as honest laborers, cease manufacturing whiskey and millionaires, and beggary will also become extinct.

THOMAS FROOD.

SIDE CRANK ENGINES.

Those who have observed the trend of steam engine designing during the past few years may have noticed that there is a tendency toward a short, compact, heavy built frame with strong, simple parts suited to the severe and incessant work imposed upon power plants by street railways and other heavy work. Corliss and other types of long stroke engines have been shortened and strengthened in order to meet these conditions and to occupy less room, and there is also a tendency to increase the speed to suit direct driven dynamos and give better regulation. In fact there seems a tendency for the advocates of high and low speed to meet half way in a type of engine which will embody the best points of each. As an example of what is being done in this way, we 'e an illustration of a tandem compound engine, built by the Robb Engineering Co., of Amherst, Nova Scotia. The cut is from one of four engines of 300 h.p. each, recently installed for the Halifax Electric Tramway Co. for railway and lighting purposes, and it represents a type of engine designed to combine the best points of long and short stroke engines. The design of frame and general proportion of parts is similar to recent types of long and medium stroke engines designed for railway work. The shaft bearings, crank and crosshead pins, are much larger than usual, to insure cool running under stress of overloading or irregular work. The guides are cylindrical, allowing the crosshead free alignment. The disc crank contains sufficient metal to permit the crank pin and shaft to be forced in under heavy hydraulic pressure, and is balanced. The main journal has quarter boxes with adjustment at top and sides. The governor, which is of the "Sweet" or "Straight Line" pattern, used in all engines made by this company, is of the simplest and directly connected to the valves. The high pressure cylinder is placed next to the frame, the low pressure in rear, and so arranged that the cylinder head and pistons may be removed without disturbing the cylinders, valves or other parts. The valves are of the "Porter" type, consisting of a flat plate balanced by a pressure plate, which have proved so successful in the "Porter-Allen," "Straight Line" and other engines, their greatest merit being simplicity and freedom from wear. Both high and low pressure valves are attached to the governor in such a way as to divide the load exactly between the high and low pressure cylinders. This system, the makers claim, is new and peculiar to the Robb engines, and is found to give better economy and variable loads, such as are found in railway work.

The manufacturers are now building a full line of these engines, in simple, tandem and cross compounds up to 700 h.p., having a medium length of stroke, speed from 150 to 200 revolutions per minute, and as the parts are massive, and bearings unusually large, parts simple and strong, they are splendidly adapted for direct connection to electric generators or for other variable work.



THE Hamilton, Beamsville and Grimsby Railway Company, which operates nineteen miles of trolleys between the above-named places, is the first company in Canada to use arcs as head lights on cars. Most of the track is through the open country, and as they run at a high rate of speed, it is necessary to see a long distance ahead, and this is obtained by this method. The arc is operated in series with a resistance and is rather wasteful, as most of the volts, from 400 to 450 out of 500 (the line voltage) are wasted in the resistance. However, they are giving great satisfaction.

THE IMPORTANT FUTURE OF PRODUCER-GAS.*

BY A. HUMBOLDT SEXTON.

That producer-gas has failed to take the position in the world of manufactures which those familiar with its advantages think that it deserves can hardly be denied. It is universally used for firing open-hearth steel furnaces, and in a few other operations where high temperatures are required it has to some extent come into use; but in the majority of our manufactures it is very little used, and for steam-raising and similar purposes its value has hardly been recognized. Yet for many purposes—probably for most—it has very decided advantages over solid fuel, both as regards convenience and economy. That the importance of these advantages has not been fully realized is evident, and for this there must be some good reason. Is it that the manifest advantages of gaseous fuel are accompanied by less obvious disadvantages, which to ordinary fuel-users more than counterbalance them? And, if so, are these disadvantages inherent in the fuel itself, or are they due to the use of unsuitable and defective forms of plant? Or is the neglect due merely to innate conservatism which makes most people loth to change the methods of work to which they have been accustomed?

That there are certain disadvantages attending the use of gaseous fuel may be admitted, but they are so few and unimportant that they cannot weigh against the many advantages; the writer feels, therefore, that the small progress which has been made in the use of gaseous fuel has been very largely due to the unsuitability of much of the plant that has been employed—for, unfortunately, very few of the gas-producers at present in use allow anything like a full realization of the convenience and economy of gas-firing.

On studying the various patents which have been taken out for gas-producers, one is at first appalled by their number; but this feeling is soon replaced by one of wonder at the extraordinary lack of originality shown by the patentees, and at the evident ignorance of most of them of the principles on which gas-production is based. Most inventors seem to content themselves with merely modifying or improving (?) in details forms already in use, while but few go back to first principles, study the nature of the various operations, and consider how best these may be applied to the case in hand. Too often also the attempt is made to make a producer which will give gas suitable for all purposes rather than for one special purpose, regardless of the fact that what is best for one purpose may be worst for another, and that it is impossible to design any form of plant which will be equally good under all conditions.

That a plant may be successful, it is, above all, essential that it should be economical in working. The first cost is of little moment since it is incurred once for all; but the cost of up-keep and repairs must be low, and the less labor required the better. The gas produced must be as rich as possible in combustible constituents, it must be suitable for the purposes for which it is required, and the expenditure of energy in the conversion of the solid fuel into gas must be kept at the lowest possible point. This can be done only by minimizing all sources of heat loss.

The theory of the manufacture of producer-gas is very simple, but a brief consideration of it may be useful. The simplest possible form of producer is undoubtedly the early Siemens type, which for a long time was largely used, and which even now is not quite extinct. It consisted of a rectangular chamber of fire-brick

* Published in the *Engineering Magazine*.

provided at the bottom with fire-bars, and at the top with a tube for carrying off the gas and a hopper for charging the fuel. The grate was open to the air, and the draught was produced by a chimney.

Assume such a producer at work, using coke or charcoal as fuel, and no steam being used. The air entering would burn the carbon to carbon monoxide and carbon dioxide, and the latter, if the producer were working perfectly, would be decomposed by the hot charcoal, forming carbon monoxide, so that the escaping gas would consist only of carbon monoxide and nitrogen, and would contain 34.7 per cent. of the former. Such a gas would have a very low calorific power, and its production would be extremely wasteful, as about one-third of the heat which the solid fuel was capable of giving would be evolved in the producer, and thus lost for all practical purposes There is considerable misapprehension as to the nature of this loss of heat in the production of producer gas It is often spoken of as if it were heat absorbed or rendered latent, as is the case when water is boiled into steam. It is, however, quite different; heat is not absorbed, but evolved; only, it is evolved in the producer, where it is not wanted, instead of in the furnace, where it is wanted. Therefore it cannot be used to advantage.

In order to secure economical production, the gas must be enriched, and at the same time the evolution of heat in the producer must be reduced to the lowest point. Both these objects are secured by the use of steam. When steam comes in contact with hot carbon, it is decomposed, and yields equal volumes of carbon monoxide and hydrogen. The amount of carbon monoxide produced is the same as if the carbon were burned by air, but, instead of being mixed with about twice its bulk of inert and incombustible nitrogen, it is mixed with its own volume of combustible, strongly-heating hydrogen; if it were possible to use all steam and no air, the gas would be what is commonly called water-gas. The decomposition of the steam, however, absorbs a very large quantity of heat, and, therefore, if too much be blown in, the action would stop, or, at any rate, be seriously modified. The heat is absorbed in producing these combustible gases, which, by burning in the furnace, give out the heat again, thus serving as carriers of heat from the producer, where it is not required, to the furnace.

The amount of steam that can be used is limited, for, owing to the absorption of heat, if too much be blown in, the action will not go on satisfactorily If too much steam be used without abundance of air, the cooling will be so great as to stop the action altogether; if sufficient air be supplied at the same time, the cooling will be less complete, but a large quantity of carbon dioxide will be formed, and much steam will pass through undecomposed, thus carrying away a large quantity of heat. By the judicious use of steam the loss of heat in the producer may be reduced to about fifteen per cent. of the heating power of the fuel.

The gas may be further enriched by the use of coal, instead of charcoal or coke, as assumed above The coal is thus distilled, and the products of distillation mix with the producer-gas, the amount of added gas varying from a trace with anthracites up to nearly ten per cent. with very bituminous coals.

The sources of loss of heat in gas-production are due:

(1) To undue evolution of heat in the producer by formation of carbon dioxide:

(2) To loss of heat from the producer itself—

(a) Carried away by the gases,

(b) Lost by radiation,

(c) Carried out in the ashes,

(d) Used in distilling the coal.

As it is necessary to keep up the temperature of the producer to the point at which combustion can take place, the greater the amount of heat lost, the smaller is the quantity of steam which can be used. It is obvious that the losses can never be reduced to nothing, if they could, once the producer was started, the heating power of the gas would be equal to that of the solid fuel from which it was produced. This is impossible, and so the heating power of the gas is always less than that of the solid fuel by an amount which will be greater, the greater the loss of heat in the producer. When carbon monoxide is being produced, the evolution of heat in the producer, as remarked, is about one-third of that which the solid carbon would give; but, immediately carbon dioxide is produced, the loss becomes very much larger, being, of course, evolution in the wrong place. Not only does it do this, but it impoverishes the gas, robs it of its chief combustible constituent, and increases the quantity of inert nitrogen. Carbon dioxide occupies the same volume as a quantity of carbon monoxide containing the same amount of carbon; but, as it contains twice the amount of oxygen, its production adds twice the amount of nitrogen to the gas. As already remarked, if in a producer fed with charcoal, all the carbon were burned to carbon monoxide, the producer-gas would contain:

Carbon monoxide	34.7
Nitrogen	65.3
	100.0

If, however, one-third of the carbon were burned to carbon dioxide, the composition would be:

Carbon monoxide	19
Carbon dioxide	9.5
Nitrogen	71.5
	100.0

This amount of carbon dioxide is frequently present in producer-gas Under these circumstances the heat evolved in the producer, and therefore lost, would be about fifty per cent. of that which the solid carbon could give, if completely burned.

It is obvious, therefore, that in gas production it is of the very utmost importance to prevent the formation of carbon dioxide, and no producer can be efficient which allows more than a trace of this to be produced.

The amount of heat carried away by the hot gas leaving the producer is very large, and, without an exceptionally high temperature, may reach ten per cent. of the heat which the fuel can evolve, or one-third of that given off in the producer when no steam is used; if steam is escaping with the gas, the amount may be very much more The heat carried away is in most cases lost, as the gases cool before entering the furnace, and, if regenerators are used, nothing is gained by sending in the gas hot. Obviously, therefore, the gas should be cooled to the lowest possible temperature before it leaves the producer, and this can best be done by passing the gas through a thick layer of fuel, to which it can give up its heat.

The loss of heat by radiation is also large; the larger the radiating surface in proportion to the heat evolved, the greater will be the loss.

The loss by the fall of hot ashes is small, but in bar-bottom producers there may be considerable loss by the fall of unconsumed fuel through the bars.

The heat absorbed by distillation of the coal is small, and may be neglected in the comparison between solid and gaseous fuels, because, even when coal is burned on a grate, the gas distils out before it burns. The gas-producers at present in use fall into two chief groups—those used with a natural draught, and those used with a blast.

(1) Producers worked by natural draught. Of these, the first Siemens producer may be taken as a type. The draught was obtained by passing the gas through a long overhead cooling tube. The cold gas in the vertical portion farthest from the producer, being heavier than the hot gas in the portion near the producer, acted as a siphon, and produced a current. The grate-bars were open to the air, so but little steam could be used. The gas, therefore, was poor; and, as the layer of fuel was thin, often contained a considerable quantity of carbon-dioxide. This type of producer has now been almost completely abandoned. It was not efficient, and the fuel consumption was only about fifteen pounds per square foot of grate area per hour.

(2) Producers worked by draught. Of these there are three distinct types.

(a) Bar-bottom producers. In these the fuel rests on fire bars beneath which the air is blown. They vary much in form, but differ from the class already described in the fact that the hearth is closed. They are usually of small size, and the consumption of fuel is small. This type of producer has been almost entirely abandoned in Great Britain, except for small installations, as it is much less efficient than other types For small plants producers of this form are handy, as they are easily managed. (b) Solid-bottom producers. In these there are no grate-bars, but the ashes rest on the solid bottom of the producer, and the air and steam are blown into the centre of the mass. These are the most popular producers in Great Britain, the best known form being the Wilson A much greater pressure of steam can be used with this class of producer, and a more rapid combustion can, therefore, be obtained, many producers burning as much as forty pounds of fuel per square foot of bottom per hour They can be made of considerable height, and, owing to the high temperature that can be obtained, the gas contains very little carbon dioxide. They may be built separate or in block, the latter being usually the most economical.

One objection to most solid-bottom producers is the necessity for stopping periodically for the removal of the ashes. This difficulty has been overcome in the Wilson Automatic, Taylor revolving bottom, and some other producers.

(c) Water-bottom producers. These are solid-bottom producers in which the ashes are received in a vessel of water, the sides of the producer being carried down into the water far enough to form a water seal, and prevent the escape of gas, and to allow the withdrawal of the ashes below. The lower portion of the producer is usually made conical, and may be solid, or in the form of a hanging grate. The air and steam may be blown into the centre of the fuel by means of a steam pipe, but usually they are supplied to a space between the annular grate and the casing, so that they pass up through the hot ashes. These producers are efficient, and are rapidly coming into use. The heat of the ashes is utilized in evaporating the water and they are easily cleaned. The best known producer of this type is the Dawson.

All the producers described are usually made low, being rarely more than twelve to sixteen feet in height. The gases, therefore, leave at a high temperature, and very frequently contain carbon dioxide in considerable quantity. The only way in which the heat carried off by the gases can be saved is, as already remarked, that of making the column of fuel higher, and the only way to prevent the formation of carbon dioxide is to increase the zone in which the temperature is high enough to ensure its decomposition by the hot carbon.

When these changes have been made, the producer will approach very near to a blast furnace in type.

The blast furnace is, in many respects, an ideal gas-producer. The gas from an ordinary iron-smelting blast-furnace contains a large quantity of carbon dioxide produced by the reduction of the iron oxide; but even then it compares favorably with some producer-gases, and can be used for all purposes for which gaseous fuel is required, including steel-making in open-hearth furnaces and driving gas engines. If there were no reducing reactions to take place, the gas would contain no carbon dioxide. In ordinary producers the ashes are drawn out solid; in a blast-furnace producer they are melted and tapped out. The fluxing of the ashes might necessitate the addition of a small quantity of limestone, but the carbon dioxide from it would probably be decomposed at the temperature at which it was separated. Wish a blast furnace the fuel consumption, and, therefore, the gas-production, is very much larger than in ordinary producers. A blast furnace of moderate size will consume two hundred pounds of coal per square foot of bottom per hour, reducing the sources of loss to a minimum.

The writer is convinced that it is in the direction of approach to the blast-furnace type of producer that we must look for future developments in gas-production; and, curiously enough, this would be reverting to one of the very earliest forms—that of Ebelman.*

Coal is now almost always used in gas-producers, and, when it is subjected to destructive distillation, a large quantity of tarry matter is produced, which has sometimes proved troublesome; therefore, many attempts have been made to destroy or remove it.

When open producers were used with an overhead cooling tube, much of the tar was condensed in this; but now that this has been abandoned, much of the tar is carried forward with the gas.

In the Wilson and some other producers the gas distilled from the coal is made to pass through the incandescent fuel, and the tarry matter is thus broken up into permanent gases and solid carbon. If the tar is to be removed, it seems more rational to condense it, and thus recover it and any ammonia that may be present.

Whether the tar should be removed or left depends upon the conditions under which the gas is to be used. There can be no doubt that the removal of the tarry matter reduces the heating power of the gas, but by how much it is quite impossible to say, as the amount of tar which deposits and the amount which is carried forward by the gas are uncertain. Probably the reduction of heating power may be taken as being about ten per cent., though some workers have placed it as high as twenty per cent., or even more.

When the gases are passed through brick-lined or underground flues, so that they do not cool, there is still a deposition of tarry matter, which has to be burned out each week end; but the bulk of the tar is, no doubt, carried forward into the regenerators; there it is to a large extent decomposed with the deposition of solid carbon, which will be burned when the gases are reversed.

When used in regenerators, therefore, probably the tarry matter adds but little to the heating power of the gas, and may be safely removed and utilized in other ways. When the gas is to be used for boiler-firing and similar purposes without regenerators, the removal of the tar is, no doubt, very disadvantageous. If the producers are so placed that the flues are short, there will be very little condensation, and the tarry matter will be carried forward, adding to the heating power of the gas, and at the same time—what is of far more importance for this purpose—adding to the luminosity, and, therefore, to the radiative power, of the flame. It is difficult to conceive a more inefficient way of securing steam than the use of tar-free gas burning with a non-luminous flame under ordinary boilers.

For such purposes as reverberatory furnace and boiler-firing, where a radiative flame is required, it seems best to send the hot tar-laden gas direct to the furnace, and use an air regenerator for heating the air.

For use in gas engines, the gas must be free from tar and dust, and should, therefore, be well washed.

Among recent suggestions for the use of gaseous fuel, the furnace and producer of F. Siemens deserves notice. In this system the air only is heated by passage through a regenerator. The products of combustion are divided. One-half is sent through the regenerator, the other half being sent, together with some air, into the producer. The carbon dioxide in the products of combustion is reduced to carbon monoxide, and the gases pass to the furnace at a very high temperature. These furnaces are being somewhat extensively used for reheating and similar purposes.

The writer thinks it would probably be more satisfactory if four regenerators were used as usual, the air being heated in one, and steam and air for the producer being heated in the other. In that way gas could be economically supplied at a very high temperature direct from the producer to the furnace.

Another method of making producer-gas has recently come to the front, and promises to be largely used in the future. The method was invented and patented some years ago by Dr. L. Mond, and has been recently taken up by J. H. Darby. The gas obtained by this process is very different from ordinary producer-gas, and may, for convenience, be called Mond gas.

The object of Mr. Mond was to obtain the largest possible quantity of ammonia, and in this he was eminently successful. Mr. Darby now obtains a gas of good quality, which has been successfully used for steel-melting and other purposes. The principle of the process is simply to blow in the largest possible quantity of steam, and so to produce a large amount of free hydrogen, under the influence of which, probably in the nascent condition, a large quantity of the nitrogen of the fuel is evolved as ammonia. The gas-producer is of the water-bottom type, with a conical grate through which the air and steam are blown. The amount of steam supplied is about two and one-half tons for each ton of coal consumed, and necessarily a large proportion of this passes through undecomposed. The gas leaves the producer at about 500°C., and is passed through cooling tubes, where a good deal of the water is condensed; then through an agitator, where it is mixed with cold water; then up a lead-lined tower, where it meets a descending rain of sulphuric acid; then up another tower, where it is washed with cold water; and then to the furnaces, or engines, where it is to be used. The yield of gas from a common slack containing eleven per cent. of ash is about one hundred thousand cubic feet per ton, and its average composition by volume is:—

Carbon dioxide	17.1
" monoxide	11.0
Olefines	.4
Methane	1.8
Hydrogen	27.2
Nitrogen	42.5
	100.0
Total combustible gas	40.4

The amount of ammonium sulphate recovered is about ninety pounds for each ton of coal consumed, the coal containing about 1.5 per cent. of nitrogen. Mond gas has been successfully used for various purposes, among others for driving gas engines, for which its freedom from dust and tar, and its high calorific power, render it specially suitable. While the first cost of the plant is high, the large amount of ammonium sulphate recovered makes it a profitable method of gas-making.

The writer believes that there is a great future before gaseous fuel, and that, ere long, it will to a large extent supersede solid fuel for many purposes with great advantage, both as to economy and efficiency, and that with this development the gas engine will to a large extent take the place of the steam engine as a source of energy.

The Highlands Scenic Railway Company, Kirkwood, Mo., has introduced a novel feature on its lines. It consists of a buffet trolley car which is said to be the only one in operation in the United States. This car is used for trolley parties, surprise parties, card parties, etc.

* Mr. Ormiston, of Glasgow published a pamphlet a few years ago, calling attention to the blast furnace as a gas-producer.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the values in sterling money of the metal imports into Canada from Great Britain for July, 1895 and 1896, and the seven months to July, 1895 and 1896:

	Month of July.		Seven m'ths end'g July.	
	1895	1896.	1895.	1896
Hardware and cutlery	£4.199	£4,032	£28,664	£36,143
Pig iron	5,186	2,416	13,823	12,282
Bar, etc	1,286	1,068	7 529	9,509
Railroad	21,678	40,614	52,985	88,089
Hoops, sheets, etc.... ...	6,934	8,968	24,150	25 110
Galvanized sheets	4,461	7,625	35,144	30,979
Tin plates	13,588	9,681	73,097	77,235
Cast, wrought, etc., iron ..	5 781	3,522	27,897	29,625
Old (for re-manufacture) ..	3,145	2,496	4,732	11,422
Steel	6,357	10,778	32,763	55,185
Lead	3,014	950	12,344	8,506
Tin, unwrought	2,787	1,796	13 809	9,510
Cement	4,111	1,642	13,738	16,115

MANUFACTURE, USE AND ABUSE OF DYNAMITE.*

Under the most favorable conditions the manufacture of dynamite is a hazardous business, safety being entirely dependent upon the purity of materials used and the skill and care of the workmen employed. Although the first plant was established in United States only a little over 20 years ago, the art has to-day reached that point of perfection, brought feats of engineering within the range of possibility and exerted an influence upon modern civilization, which entitles it to take rank with the application of steam power.

The aim of the various powder companies is to supply a product which can be transported and handled with safety, which will give uniform results in blasting, keep in good condition when properly stored, and, as far as possible, neutralize all poisonous fumes when exploded. The explosives used almost universally throughout Colorado are compounds having nitro glycerine for a base, commonly called by the miner "30 per cent. powder" or "60 per cent. powder," according to percentage of nitro-glycerine in the mixture.

The strength of the American nitro powder is not, as is generally supposed, wholly dependent for force upon the amount of nitro-glycerine present in the mixture. The compound is composed of various elements which in manufacture not only absorb the desired amount of nitro-glycerine, but are in themselves an explosive. In blasting, the exploder or cap, which is charged with fulminate of mercury, explodes the nitro-glycerine and the nitro-glycerine in turn the remainder of the mixture. A line of experiments, conducted by experts, shows that the force exerted by this combination exceeds that of the sum of the three exploded separately.

The American dynamite of to-day is not an accident, but is the result of a long line of careful experiments, conducted by eminent chemists, and demonstrated by practical tests. These tests, aided by great advances in the art of manufacturing, have demonstrated that the products can be handled with greater impunity than many other things common to transportation by common carriers They have also demonstrated that the safety of the compound is dependent upon purity of materials used and care in mixing. During the past few years competition among various powder companies has been so keen and bitter that gradually but steadily the cost of dynamite to the consumer has been reduced. It is a dangerous contest, and a rivalry in which, sooner or later, if continued, safety will be sacrificed. To be more explicit upon this point—skilled labor commands a certain price, likewise chemically pure nitro-glycerine, the two being the most expensive parts in the compound of dynamite, combined the product is a safe mixture. Unskilled labor and impure nitro glycerine can be had for less money, but the product of this combination is a mixture subject to decomposition. Decomposition in such a compound is practically explosion. Decomposition may not set in for some time, and the great danger of the competition in the manufacture and sale of dynamite, is that of forcing some of the competitors to use impure or cheaper materials and labor, in order to meet a lower price, and take chances upon decomposition not commencing before the stock thus manufactured is disposed of. This danger point may not as yet have been reached. The older powder companies have much invested and a reputation to maintain, the newer companies have much invested and a reputation to make From the standpoint of safety, however, the bottom price is very little below the market price of to-day

Powder should be stored in a dry, cool and well-ventilated magazine built for that purpose. A brick or stone magazine is preferable to a frame, both on account of being affected less by sudden changes in temperature, and freed from any danger of bullets from careless marksmen. When built of wood the frame, or studding, should be covered inside and out with boards and so set that the air can circulate all around, and the inner boards be but little affected by the heat of the hot sun.

Caps should not be stored with powder.

Regarding the age of powder—when powder has had proper care in manufacture and storage, decomposition will not set in. If there is no decomposition there is no chemical change, and under these circumstances powder 10 years old or older is just as good and safe to handle as powder 10 days old.

One of the main sources of accident is from thawing powder, and the only safe plan is the use of heat from hot water. The powder should be placed in a water-tight vessel and the vessel set in hot water, or a regular powder-warmer should be made These vessels can be obtained from any of the mechanical firms or from the powder companies, at nominal cost. Do not place powder under or on a stove, or in the oven. Do not lay on boiler wall or on back plate of a boiler. Do not heat around a blacksmith forge, or over a burning candle. Do not lay on hot sand, or, in short, do not thaw powder with dry heat. Do not consider these precautions unnecessary, or reason that because you have done so many times there is no danger. An explosion is usually fatal, and numberless escapes in no manner reduce the explosive force.

Powder freezes at from 40° to 44° F., explodes, when confined, at from 320° to 360° F. From a quick application of dry heat powder is liable to explode at 120° F. A stick of powder heated to 120° F. can be held in the hand with little inconvenience, and this degree of heat is soon reached when placed under or about a stove.

That frozen dynamite is liable to explode from heat quickly applied has been demonstrated many times, and to ignorance, non-appreciation or carelessness of this fact, most accidents are due. If you have heated powder about a stove for years without harm, consider yourself fortunate and stop it. If the warning of those who make the powder has no effect, let the accidents constantly occurring from this cause convince you. If you cannot procure a powder-warmer, take a 5-lb. lard bucket, fill it with powder, and set in warm water. If you have no warm water, put some sharp rocks in the bottom of a larger vessel to keep smaller vessel off the bottom, surround the inner vessel with water and set two lighted "snuffs" about an inch long under the big can, throw an ore sack over the whole, and in a short time the powder is in good condition for use and no risk has been incurred. With slow heat thus applied, dynamite may be heated to temperature of boiling water with safety. Do not use frozen powder to load a hole. It is unfit for use. If it explodes at all, it will do poor work. If it does not seemingly burn or explode, it may be smouldering or decomposing, and the dropping in of a spoon, a drill, or the stroke of a pick or hammer, may be sufficient to explode what is left.

Constant care in preparing charge and loading will avoid "missed holes." Next to warming powder with quick, dry heat, "picking out a shot" is the cause of the most fatal accidents. If a hole "misses," do not be in a hurry to return, and especially if the hole was tamped close. A small, sharp rock may be tamped into a piece of fuse, so that the fire will not pass that point for hours; this is often mistaken for a "missed hole." The hole is picked out, this particular rock removed and an explosion follows. To fully demonstrate this, put some V-shaped clamps on a piece of fuse and see how long it will take to burn by certain points. Long after the fuse is supposed to be out, loosen the clamps and see how quickly it will "spit" at other end Some holes do miss fire and have to be picked out. In these great care should be exercised to clean down not nearer than 5 inches from cap, then reload with another charge, and, instead of using a small piece of powder, use plenty. A heavy charge on top may destroy the effectiveness of the lower charge, but it will explode it and get rid of a bad job. If the "collar" of the hole is simply blown off and the lower charge has not broken to bottom of hole, do not drop in a drill or spoon to see "how much hole is left," leave it alone as long as possible The lower powder may have frozen and all may not have been consumed

Caps are charged with fulminate of mercury, one of the most violent explosives and one of the most unstable chemically, and may explode from the slightest jar or least amount of friction. The caps at all times should be stored well away from the powder and at no time in or round a miner's pocket.

Powder should under no circumstances be stored underground. Poor ventilation with damp air will produce decomposition, and

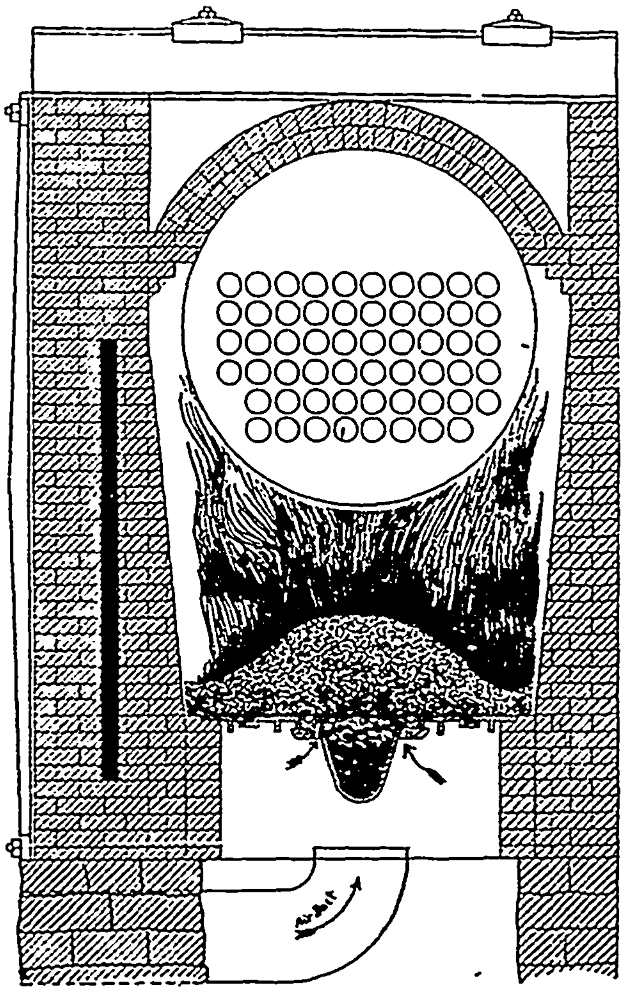
*Abstract of a paper by H. A. Lee, Commissioner of Mines of the State of Colorado.

decomposition explosion There is practically no danger in transporting powder in cases, and especially when frozen Even well-thawed powder will not explode from any of the jars occasioned by a wagon haul or pack train. A case dropped several hundred feet upon rock might explode, but separate sticks would simply break out of the wrapper and no explosion follow

Powder will burn in the open air and not explode, providing the gases generated in the adjoining powder from the heat of combustion have room to escape. For example, place two boxes of powder side by side, open one and ignite, leave the other box closed. The burning box will not explode, but the heat from it will explode the closed box.

DESCRIPTION OF THE IMPROVED JONES UNDER-FEED MECHANICAL STOKER.

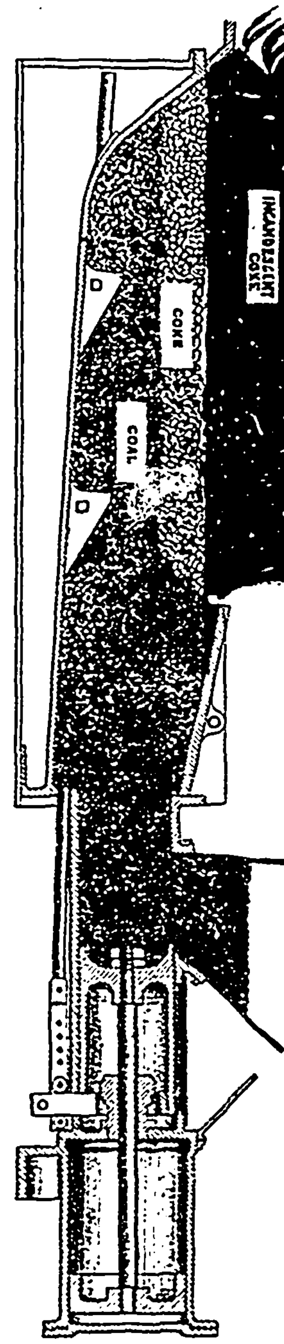
Within the past twelve months a new device in connection with furnace-firing has been brought to the attention of Canadian manufacturers; this is the Improved Jones Under-feed Mechanical Stoker. We have seen this apparatus at Taylor Bros.' Paper Mills, Toronto, where it is now in successful operation



CROSS SECTION, SHOWING FURNACE IN OPERATION.

The stoker consists of a steam ram, or cylinder, with hopper for holding coal outside of furnace proper, and a retort or fuel magazine inside the furnace. Into this retort fuel is forced by means of the ram. Not grate-bars, but dead plates are used, and all air supplied for combustion is forced by means of a blower through tuyere blocks placed on each side of the retort. The ash-pit is used for an air chamber. A small auxiliary ram is placed at lowest point in bottom of retort, at a point where the fire never reaches, as all of air supply comes in at grate line. By means of the rams, coal is forced with even distribution underneath the fire, each charge of fuel raising the preceding charge upwards until it is forced into the fire. As the green coal lies directly underneath the burning mass of fuel above, it becomes coked and the gases are liberated Above this coking fuel and below the burning mass the air is admitted through the tuyeres, mixing with the gases given off. The mixture of gas and air passes upwards through the burning coke and is consumed, thus giving, the makers claim, the benefit of all the combustible matter in the fuel. It may be said that this stoker works on the principle of a Bunsen burner, which gives one of the hottest, most economical flames known to science.

By the use of this stoker, only gases and coke come in contact with the fire, consequently no smoke, clean tubes, no ash. The refuse from firing passes off through the stack in the form of non-combustible gases, and the minerals, sand, etc., contained in coal, falling down the mound of burning fuel and upon the dead plates at points *x*, as shown in cut *B*. The fire in ordinary cases needs to be cleaned but once a day, and does not take five minutes a day for each furnace, it is said. At all other times the doors should be kept closed. All that is required of the fireman is simply to keep coal in the hoppers and handle the lever as the furnace requires stoking.



Stoker in Operation

LONGITUDINAL SECTION

GREEN COAL COKE AND FIRE

The stoker appears to us to be a model of simplicity and durability. Among the many advantages claimed for this device we enumerate a few as follows: First—Economy in the use of fuel brought about by liberating all the gases from the fresh fuel under the burning fuel, and by causing all the gas from the same, thoroughly mixed with air, to pass through a body of burning coke at a high temperature, thereby consuming all the heat producing elements, and also by avoiding the waste of small particles of unconsumed fuel that unavoidably pass through an ordinary grate bar. Second—A furnace adapted to the use of any kind of fuel, especially screenings or other fine fuel. Third—A smokeless stack. Fourth—Simplicity of construction. Fifth—A furnace at all times under complete control of the operator. Sixth—A furnace that can be operated by any practical fireman. Seventh—Durability Repairs cost no more than when ordinary grates are used, and oftentimes less. Eighth—A furnace without any mechanical movement subject to the action of the fire. Ninth—A furnace in which the proper quantity of air can always be diffused through the burning coal to produce perfect combustion. Tenth—A furnace that can be applied to any boiler. Eleventh—Great range of steaming power, it being possible to increase steam pressure almost instantly. Twelfth—Clean tubes, there being no smoke Thirteenth—Ease and rapidity in cleaning fires. The retort keeping itself clean, there is little else to clean. Fourteenth—Ability to put the coal where it is needed, when it is needed.

An exhibit of this stoker is to be made at the Industrial Exhibition, Toronto, and we trust our readers will investigate this apparatus for themselves.

Below is published a test copied from the original record sheets of the Calumet & Hecla Mining Co., Calumet, Mich. Three hundred h.p. boilers fired by two improved Jones under-feed mechanical stokers, March 25th to 30th, 1895:

Date.	Time.	Lbs. Coal.	Lbs. Water.	Ash.	Feed. Water.	Steam Pressure.
March. 25,	Night 7 p.m to 7 a.m.	15,500	142,800	343	111.8	119 4
" 26,	Day 7 a.m. to 7 p.m.	14,500	135,600	757	108.7	118 8
" 26,	Night	16,000	148,800	371	106.9	118 9
" 27,	Day.	15,000	141,600	812	101.5	117 7
" 27,	Night	14,750	134,400	649	105.	118 2
" 28,	Day	13,500	128,400	1225	106.2	116 9
" 28,	Night	14,250	132,000	328	108.1	116 3
" 29,	Day	14,500	142,800	1062	104.2	119 1
" 29,	Night	15,000	134,400	358	104.7	117 2
" 30,	Day to 4 p.m.	11,250	108,000	767	102.3	118
" 30,	Night 4 p.m. to midnight	10,000	107,603	1224	100 2	118 5
	Totals	154,250	1,456,403	7896	1159 6	1299.
	Average				105.4	118 1

Evaporation lbs. water per lb coal at observed temperature 9.5
" " " from and at 212 .... 10 98
" " combustible at temp. 9 95
" " " from and at 212 .... 11.39

Duration of test, 125 continuous hours.
Lbs. coal per hour, 1,234.
Stokers fired by inexperienced operators one-half of time.

Industrial Notes.

An office building is being built by the Hamilton Smelting Works.

The Montreal Park & Island Railway is building a bridge over the Back River.

The Rathbun Co., Deseronto, Ont., are shipping charcoal to the Radnor Forges, Quebec.

Shaver & McDonald are about to erect a saw mill near the O.A. & P.S. station at Eganville, Ont.

The waterworks in the town of Sandon, B.C., have been completed. The fire protection is reported excellent.

The Guelph Heading and Stave mill has been purchased by Mr. George McAllister, sawmiller, of Bloomingdale, Ont.

The Montreal and Ottawa gas companies have reduced the price of gas for heating and cooking purposes from $1.25 to $1.00 per 1,000 feet.

The promoters of the project of developing water power by damming the Humber River near Toronto, say that they are going to proceed with the work at once.

Wm. Mitchell is erecting some new machinery in the Rathbun Company's cement works at Napanee Mills, Ont. The demand for the products of these works is constantly increasing.

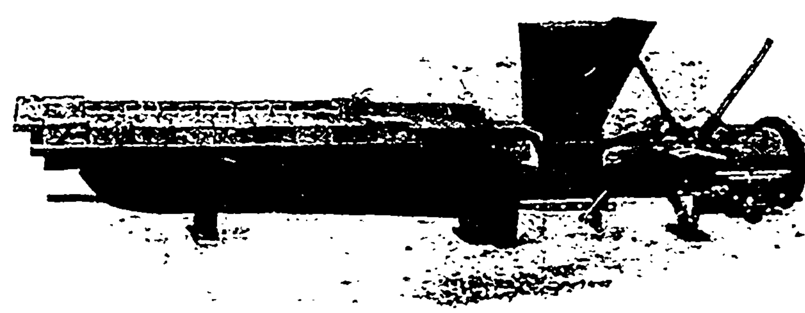
The stonework for the new York street bridge, Toronto, is completed. The ironwork, which is being made by the Central Bridge Co., of Peterboro', will be proceeded with without delay.

The proposal to bonus a smelting furnace at Bancroft, Ont., is being generally endorsed by the people of that district. The furnace would employ 75 men and the working of the mine 1,000 more.

Heidleman & Trachsell, proprietors of the flax mill at Shakespeare, Ont., have secured a boiler belonging to the Stratford Bridge and Iron Works, and will use it in place of the one that exploded recently.

The Rat Portage Lumber Company, Ltd., is incorporated with capital stock of $500,000. The company consists of D. C. Cameron Walter Ross, Wm. R. Dick, Hugh W. Kennedy and Matthew Brown, Rat Portage, and J. A. McRae, of Niagara Falls, Ont.

Engineer Millican, of the Manitoba Public Works Department, has gone to make surveys for various public works there. Before returning he will also visit the municipality of Carman, where he will make levels and report on drainage for that district.



It is claimed that this furnace will burn any kind of bituminous coal or lignite, slack or screenings, and will fully utilize all heat, giving elements contained therein; and that, whether good coal or refuse slack or screenings are used, this device when properly operated insures a substantially smokeless stack. Also that the device will increase the capacity and efficiency of boilers, and by its use even the non-fluctuating heat saves wear and tear of the boilers, thereby adding to their durability. The use of this device require no change in boilers proper, the only change being in the furnace. This is so small a change that installation can be made without experiencing trouble from loss of time.

The Hamilton and Dundas "dummy" road will be converted into a trolley line: Messrs. MacKenzie and McCullough, president and electrical engineer of the Toronto Railway Company, having charge of the alteration. Dundas will bonus the road for $15,000, for making the track strong enough to bear railway freight cars from the junction of the Toronto, Hamilton and Buffalo road to the last-named city

The Dodge Wood Split Pulley Company are calling attention to the removal of their Toronto offices and stock rooms to 74 York street, where they will continue to carry a full stock of their celebrated wood split pulleys, friction clutches, etc., etc.

The boiler in George Taylor's boiler shop at the corner of Inkerman and Malakoff streets, St. Thomas, Ont., exploded, August 22nd. Mr. Taylor and Thomas Harris were standing beside the boiler and were thrown violently to the rear of the building. The boiler, which was at the west end of the building, turned completely over and landed out on the road in Inkerman street. The top and side of the building were torn away, and boards, dust, etc., were sent flying in all directions.

The Canadian Cut Nail Association will be maintained, notwithstanding the report that the Portland Rolling Mills and the Montreal Rolling Mills had retired from the association. It has been decided, at a meeting held in Montreal recently, to make a reduction of five cents per keg in the price of cut nails. P. Howland, of Toronto, was elected president; J. C. Robertson, of St. John, N.B., vice-president, and D. Jenks, of Toronto, secretary-treasurer. The association will meet again in Montreal in October.

KING & SON, Levis, Que., are adding a box factory to their shoe factory.

EXCAVATIONS are now being made for the new waterworks system in Deseronto, Ont.

THE dock at the smelting works, Hamilton, Ont., has been completed and filled with slag.

SEWELL & PEARSON, planing mill, North Bay, Ont., are putting in some new machinery.

THE Manitoba Government engineers have located sites for bridges over the Pembina and Souris rivers.

THOS. SHAW, Pembroke street, Victoria, B.C., has applied for water supply for his foundry to the city council.

THE Collins Bay Rafting Co.'s plant for laying the steel intake pipe in the lake at Toronto is now in operation.

HUNTSVILLE, ONT., has passed a by-law in favor of putting in a waterworks system and an electric lighting plant.

PROMINENT citizens of Kingston, Ont., are trying to raise capital to build an elevator of a million bushels capacity.

WORK is now being pushed on the sewage interception plant in Hamilton. An effort will be made to have the works in operation by Jan. 1st, 1897.

THE time for receiving tenders for the London and Port Stanley Railway freight shed, round house, etc., is extended. A. O. Graydon, chief engineer.

HUNTER BROS., of Kincardine, have been awarded the contract for the erection of a steel bridge over the Yokasippi River at Cargill, for the sum of $1,775.

THE Robb Engineering Co. of Amherst, N.S., has received an order for four compound engines and seven boilers for the Montreal Park and Island Railway.

THE city of Windsor Gas Company has asked the courts to continue the injunction restraining the town of Walkerville, Ont., from interfering with the former corporation's plan to supply the latter place with gas.

THE Department of Railways and Canals has awarded the contract for the substructure of a bridge over the Trent Valley canal, at Auburn, near Peterboro', to Larkin & Co., of St. Catharines. The work will cost from $20,000 to $25,000.

A FIFTEEN-INCH valve between the raceway and the hydraulic pump-house at the waterworks, at London, Ont., has been placed in position, and it will now be possible to pump river water into the city mains in case of a shortage of spring water.

THE boiler of A. W. Billingham's saw mill at the north forks of Old Man's River, 40 miles from McLeod, N.W.T., exploded, August 12th, killing three men named Smith, May and Edsall, and injuring another. The mill was completely wrecked.

A LARGE furnace has recently been sent by rail to Whitbourne for Prof. Shalstrom, to be used for drying peat. This peat-drying, charcoal-making industry is likely to become a very fine one in this colony in the near future.—*Twillingate, N.F., Sun.*

ALL the preferential stock recently issued by the Norway Iron and Steel Co. has been taken up, says the Guelph *Mercury*, and the resumption of operations at the Guelph rolling mills now solely depends on the rapidity with which some repairs and alterations can be effected.

MELDRUM & MCDOUGALL, builders, Winnipeg, have closed a contract with R. P. Roblin for the erection of three elevators at Gretna, Austin and Deloraine, Man. This firm has also contracted to build three elevators for Dyell & Co., of Souris, and are building a number for the Northern Elevator Company.

UNITED STATES CONSUL J. B. TANEY writes to his Government from Belfast, Ireland, that the Canadians are introducing household and office furniture in all parts of the United Kingdom. One agent of an Ontario firm, within a week, took orders for about $5,000 worth of furniture in Belfast, and in Dublin for about $10,000 worth.

THE Annapolis *Spectator* says that Lamont Glass Company, of New Glasgow, N.S., manufacturers of glass chimneys, fruit jars, bottles, etc., have doubled their work during the past two years, and now employ 70 hands, with a pay roll of $500 a week. They contemplate going into the manufacture of electric light bulbs and shades.

JAS. KING'S flour mills at Sarnia are being rapidly rebuilt. The bolting machinery of the mill will be on a new principle, according to designs recently patented by the Ellis Mill Building Company, of Milwaukee. The Stratford Mill Building Company have secured the Canadian right for the invention, and will build the first set of machinery under the patent for Mr. King.

NEW machinery is to be placed in Jordan's saw mill at Pleasant Point, N.B., it is said.

A. WATTS & CO., Brantford, Ont., have bought the Perley flour mills at Burford, Ont., and are making extensive alterations and improvements.

W. P. MCNEIL, of New Glasgow, N.S., has received the contract for building an iron bridge, 61 feet in length, in Wilmot, Kings County, N.S.

EFFORTS are being made to secure aid from the Department of Public Works towards building a bridge across the Gatineau river near Maniwaki, Que.

THE suit of Jane McPhee against the Gurney-Tilden Co., Hamilton, for $3,000 damages for injuries received by her late husband, resulting in his death, has been dismissed without costs.

HOLGATE FIELDING CO., of Toronto, has been incorporated, capital $20,000 in $100 shares. The incorporators are: W. T. Costigan, W. Sclater, J. H. S Carr, Montreal; F. H. Holgate, W. J. Fielding, J. D. Stephenson, Toronto. The object is to manufacture and deal in chemical and other products.

THE Royal City Mills, New Westminster, B.C., sawed recently two beautiful sticks of timber. These sticks are each 70 feet long, and square 36 inches. One tree was over 160 feet long, and, in addition to the 70-foot timber, it produced three logs of 22, 24 and 32 feet in length respectively.—*The Chilliwack Progress.*

THE Galt, Ont., waterworks department has let a tender to the Goldie & McCulloch Co. for a compound steam pumping engine capable of pumping 1,000,000 imperial gallons per 24 hours. The new artesian well is a "gusher." Drilling has been stopped at the depth of 190 feet, and there is a flow of between 350,000 and 400,000 gallons per 24 hours.

A COMPANY have applied for incorporation to take over the business of the Canadian Pacific Railway Company's cement works at Vancouver, and also the Saanich Lime Company's location on Tod Inlet, B.C., and to carry on business as manufacturers of Portland cement, lime, etc. The corporate name will be the Pacific Coast Portland Cement Company; the capital $500,000 in $5 shares. The incorporators are: J. C. Ferguson, C. W. Robson, H. J. Warsap and T. R. Hardman. Vancouver is named as the chief place of business.

SOME time ago the Montreal Bridge Company invited designs of a bridge to be built from Montreal across to the south shore, offering a prize of $1,000 and a second of $500. Walter Shanley, the well-known engineer, was appointed to decide as to the merits of the several plans, and no less than twenty-four were sent in to the office of the company, of which Henry Hogan is the president. Seven designs came from Europe, one from India, sixteen from the United States, yet strange to say none came from Canada. The award has now been made, and the first prize goes to E. S. Shaw, C.E., of Boston, while A. L. Bowman, C.E., of Roanoke, Vt., gets the second.

THE town of Carleton Place, Ont., is desirous of possessing new manufacturing enterprises, in view of the fact that its large saw mills may not have timber to cut much longer, and the fine water-power would then not be fully employed. F. I. Johnson, manager of the Iver-Johnson arms and cycle works, Fitchburg, Mass., has been seeking to establish a manufactory there. It is proposed that a stock company be organized with a capital stock of $100,000, to be made up as follows: $5,000 cash bonus from the town of Carleton Place, $15,000 subscribed stock from the town, $30,000 subscribed by citizens, $25,000 by the Gillies Co., and $25,000 by the Iver-Johnson Co. The present works of the Gillies Company would be turned over to the new concern, and the Johnson Company would put in their share in plant and such stock as would not be manufactured in the town. The council and citizens are considering the scheme.

A NUMBER of new companies are seeking incorporation in Ontario. Among them is the Paxton-Tate Co., with a capital stock of $99,000. The object is to take over the machinery manufacturing business of the Paxton-Tate Co., Port Perry. The first directors are Hon. John Dryden, Geo. Wm. Dryden and Wm. McGill.——Another foundry concern seeking incorporation is the Wortman & Ward Manufacturing Company. The object of incorporation is to acquire the business carried on in London by the firm above named. W. H. Wortman, T. E. Pound, and A. B. McKay are to be the first directors of the company.——A new venture is "The Owen Sound Sugar Manufacturing Company (Limited)." Its object is to manufacture sugar and other products from beets, with a capital of $150,000. Michael Robinson, James Henderson, Thomas Cairns, William Donaldson Forrest and Wesley Owens are to be the first directors of the company.

C. W. Thompson will manufacture paper at Napanee Mills, Ont

The Robb Engineering Co., Amherst, N.S., is running night and day.

The Berlin, Ont, Gas Co is building a gas holder of large capacity

John Hartnett has the contract for the Deseronto, Ont., water works.

The Edmonton, N W.T., Milling Co is building a large flour mill at that town.

The Lake of the Woods Milling Company is to erect a new elevator at Neepawa, Man.

Wm. Lewis & Sons, St. John, N.B., have a contract for iron work on wharf extension in that city.

Collingwood, Ont., will try to induce Jas Hay & Co., of Woodstock, Ont., to locate in that town.

The tenders for the pumps and machinery for the Petrolia, Ont., water works has been let for $14,287.

G A Troop & Co., St John, N B., are placing the machinery in their new vinegar factory and pickling works

The McLaughlin Carriage Company, Oshawa, Ont, are preparing to build a wing to their already large factory

The rebuilding of the Ontario Wheel Co's works at Gananoque, Ont., is being carried on by J. D. Warwick, of Brockville, Ont.

The Winnipeg city council is having estimates made looking towards the purchase of the waterworks system by the municipality.

The Georgetown, Ont., paper mills are running day and night, and in order to increase the capacity some $7,000 is being expended in new machinery.

J. C. Dumaresq, the Halifax architect, has prepared plans for Geo. Wright, who will build a block of stores and residences in Halifax, to cost $125,000.

Springhill, N.S., has made a survey of its possible water supply, and as 363,000 gallons are obtainable, the waterworks system will probably be constructed at once.

A. C. Miller & Co., of Picton, Ont., have established a canning and evaporating factory in Harrowsmith. A free site and exemption from taxation have been secured.

William Lyons, the Windsor, Ont., contractor, has secured the contract for the laying of the intake pipe for the Goderich, Ont., waterworks, the figures being $5,000.

The Portland Rolling Mills Co is installing in its new horseshoe factory and nail works a 90 horse-power engine, and boiler and iron stack from the works of E. Leonard & Sons.

A joint-stock company will be formed in Deseronto, Ont., to build a flour mill in place of the one recently burned, as the Rathbun Co. does not wish to rebuild its mill at present.

Beaver Flint Glass Co. has been incorporated, capital $20,000 in $100 shares The incorporators are R W Louden, J D Wright, J. G Gibson, J. Berry, and Jennie G. Louden, of Toronto

F. L. Waters, of the Waterous Engine Co., St. Paul, and C. H. Waters, of the Brantford branch, have been in Merritton, Ont., recently, placing machinery in T. L. Willson's calcium carbide works.

The amount of business which is being done by the machinery manufacturers of Sherbrooke, Que., is evidenced by the fact that the G.T R. has erected a new steel derrick in the freight yard for the unloading of heavy machinery.

The North American Paper and Lumber Co., Ltd., will receive a Nova Scotia charter to manufacture wood pulp and paper, etc Chief place of business, Halifax, N.S.; capital, $100,000. Provisional directors—H. S. McKay, G Schenck, R R. McLeod, N P. Leahy and W. H. Covert.

The Queenston and Grimsby stone road committee has awarded the contracts for the building of a new iron bridge over the Forty Mile Creek in Grimsby to the Stratford Bridge Co., of Stratford, for the iron work, and W. F. Gibson, of Beamsville, Ont, for the masonry work.

The Lozier Manufacturing Company, Toronto Junction, Ont., is applying for incorporation with a capital of $500,000 to manufacture bicycles, type-writers and motor vehicles. The provisional directors are H. A. Lozier, of Cleveland, E. R. Thomas, R. E. Van Dyke, C. C. Going, and A. H. Royce, of Toronto.

Hiram Walker denies that he is going to establish a refinery at Walkerville, Ont.

Lawrencetown, N.S., has decided to build, own and operate a waterworks system.

Bowmanville, Ont., Cycle Wood Rim Co. has been incorporated, capital $95,000, in $100 shares.

The Burrill-Johnson Iron Co., of Yarmouth, N.S., will make the engines and boiler for the new steamer to be built at Shelburne, N.S., for the Insular S. S. Co., of Westport.

H. G. Burke, of Hamilton, Ont., asks Gravenhurst for tax exemption for a box factory he purposes to establish in that town.

The Canadian High Commissioner in England has called the attention of the Dominion Government to the complaints which have reached England from Canada respecting an organization called the International Patentees' Agency, which has been advertising extensively in Canada, to procure patents in Europe for Canadian inventors on payment in advance of certain sums of money. The association had its headquarters in Victoria Chambers, Chancery-lane, and from information obtained in Scotland Yard it appears to be a first-class swindle agency. It consists of one man, who previous to turning his attention to Canada, operated successfully in the United States until the Government of that country took the matter up and caused a warning to be published for American inventors. Sir Donald Smith advises that a similar warning be conveyed to Canadians who may be interested in patents.

The Architectural and Arts and Crafts' Exhibition, under the auspices of the Province of Quebec Association of Architects, will be held in the galleries of the Art Association, Phillips Square, Montreal, commencing on Thursday, October 8. The exhibition will consist of architectural drawings, a loan collection of antiques and modern industrial art in its application to architecture. The architectural section will consist of pen and ink and color perspectives, drawings of original designs and sketches in ink or color of old work. The industrial art section will consist of stone and wood carvings and sculpture, original architectural models, artistic iron and metal work, ornamental and figure glass work, and original cartoons for the same, original designs for wall paper, artistic bookbinding, colored designs for interior decoration, figure mosaics in glass, marble or tile; architectural ceramic work, textile fabrics applicable to interior decorations, and many other exhibits.

Electric Flashes.

Winchester, Ont., is thinking of putting in an electric lighting plant.

A Toronto-Hamilton trolley line is among the possibilities of the near future.

Negotiations are pending for the sale of the St. Thomas street railway to a Cleveland company

The town of Toronto Junction shuts off its street lights at 12 o'clock, and thus effects a considerable saving.

The assets of the Holmes Electric Protection Company, Montreal, were sold at auction recently for $4,700.

The new radial line from Hamilton to Ancaster has been granted a free right of way through the latter municipality.

The contract for grading and track-laying of the H., G. and B. extension was awarded to Carpenter & Larson, of Grimsby.

The company which has just completed a water system for the town of Sandon, B.C., proposes to install an electric lighting plant at an early date.

The Hull Electric Co. has ordered a parlor car from the Canadian General Electric Co to meet the demand for such a service on part of excursion parties from Ottawa.

The Niagara Falls Light and Power Co. recently started up the second of the 2,000 light single-phase generators purchased from the Canadian General Electric Co.

The starting up of the Hull Electric Co's new system between Hull and Aylmer on July 1st was a marked success, both in point of the patronage which it has secured and in the operation of the electric plant.

The time for beginning the construction of the Perth and Lanark electric railway has been extended one year by the Perth town council, provided satisfactory guarantees of good faith are given on behalf of the company.

W. A. Johnson, of Dresden, has ordered a 500-light single phase alternating plant from the Canadian General Electric Co.

Mrs. P. Gougeon and Mrs. O. Riviere are each suing the Montreal Street Railway for $5,000 damages for injuries.

The result of the vote on the by-law for electric light and waterworks was 18 in favor of the by-law in Listowel, Ont.

The Canadian General Electric Co. is installing a 500-light incandescent plant in the Winnipeg, Man., General Hospital.

The Vancouver Consolidated Railway Co. has ordered a 150 K. W. "Monocyclic" Generator from the Canadian General Electric Co.

The Niagara Falls Power Co. have contracted for additions to their premises and plant to cost $3,000,000, for the purpose of furnishing power to Buffalo.

Granby, Que., is out looking for electric street lights. It is proposed that Adamsville, East Farnham and Farnham Centre should join in the enterprise.

The Rathbun Company machine shops, at Deseronto, Ont., shipped two car loads of street car trucks to the Canadian General Electric Company at Peterboro recently.

The line from Champlain street along Dalhousie street is the section of the Quebec Street Railway which will first be constructed. The rails are now on their way to Canada.

Hooper & Starr, who are constructing the Cornwall Street Railway, owing to the increasing traffic, have ordered additional G. E. 800 motors from the Canadian General Electric Co.

Ross and Mackenzie, who were to take over the street railway system of Birmingham, England, will not undertake the work at present, as the contract must first be approved by the English Government.

Peterboro, Ont., council will pay $57.50 per annum for electric lights on a two years' contract. At the end of that time the corporation expects to have power of its own from the Trent Valley canal.

Ahearn & Soper, Ottawa, have bought one of the best water powers at Fitzroy Harbor on the Ottawa river. This is about 30 miles above Ottawa city, within 3 miles of the O.A. & P.S. Railway, and is one of the finest powers on the continent.

The Berlin and Waterloo Electric Street Railway Co. has placed an order for two closed motor-car bodies with the Canadian General Electric Co. These cars will be of the company's standard vestibule type, somewhat modified to meet the views of the president of the road, E. Carl Breithaupt, and are intended to be models both in design and construction.

A. J. Reynolds, J. Quinn, M. Guerin, G. G. Foster and J. A. C. Madore will apply for incorporation under the name of the Reynolds Self-Loading Car Co., with a capital stock of $200,000. The object of the proposed corporation is to work the rights granted by patent to A. J. Reynolds for the use of his electric street sweeping car, of which an illustrated description appeared in the June number of The Canadian Engineer.

The Chateauguay and Northern Railway Co. is proceeding rapidly with the equipment of its road, which is really a branch of the Montreal Island Belt Line system. The contract for the entire electrical equipment and for the car bodies has been awarded to the Canadian General Electric Co. This will consist initially of one 200 K.W. multipolar railway generator, and two open and four closed cars equipped with C.G.E. 800 motors and type "K" controllers. The road is expected to be ready for operation not later than September 15th.

The Montreal Cotton Co. is installing an electrical power apparatus in its mill at Valleyfield. Louis Simpson, the manager of the company, after examining the operation of similar plants in the cotton mills in the United States, has placed an order with the Canadian General Electric Co. for a 600 h.p. three-phase generator, and for 350 h.p. capacity in induction motors. Some of the latter will be of the inverted type attached to the ceiling and directly coupled to the line shafts which they are to run.

A powerful electric plant is being installed by the Imperial Government at Fort Clarence, on the Dartmouth shore of the Halifax harbor. The building in which the electric plant will be located, will be situated on the south side of the fort and will be built into an excavation dug for the purpose. The building will be entirely concealed beneath the mound and protected by earth and masonry. The object of the installation of the plant is to obtain a revolving searchlight. The light will be of great power and will control the entrances by the eastern passage and Drake's passage, and also all the western entrances north of York Redoubt.

Rhodes, Curry & Co., Amherst, N.S., are turning out some vestibuled cars for the Moncton, N.B., Street Railway, the same as those supplied to the Halifax Street Railway.

The Gravenhurst Electric Light Co. has made a proposition to the town council to pump water for the proposed waterworks at a rate per thousand gallons, or at a lump sum per annum.

The corner stone of the main dam and power-house of the Lachine Rapids Hydraulic and Land Co. will be laid on September 12th, and quite a ceremony will take place on the occasion.

A by-law has been passed to authorize the Huron and Ontario Railway Company to construct, equip and maintain a line of railway through the various streets within the limits of the corporation of Meaford, Ont.

The corporation of Newmarket has ordered a 35-light "Wood" arc machine from the Canadian General Electric Co., and a 60 K. W. alternator from the Royal Electric Co. The contract in each case was awarded to the lowest tenderer.

The promoters of the Lanark-Perth Electric Railway explain their failure to push construction by the fact that a special charter is required by the Ontario Government for electric roads running more than 1½ miles outside municipality.

The London, Ont., Street Railway Co. are gainers to the extent of from $12,000 to $15,000 by the recent decision of the Privy Council of England allowing the Toronto Street Railway Co. a remission of the duties paid on imported steel rails.

The manager of the Pare & Pare Telephone Company has concluded the purchase of the Richelieu Telephone Company. This line runs from St Remi to St. Guillaume, Que., and connecting lines, making 262 miles of trunk lines with 47 towns and villages connected together.

The Amherstburg Electric Light, Heat and Power Company (Ltd.) applies for incorporation, capital, $20,000. The applicants are. W. H. McEvoy, Amherstburg; F. C. Armstrong, Toronto, J. J. Ashworth, Toronto; Mary A. McEvoy, Amherstburg; Mary A. Kane, Amherstburg.

The Canadian Engineer received an invitation to be present at the eighteenth annual clam dinner, tendered to the electrical fraternity by Eugene F. Phillips, president of the American Electrical Works, of Providence, R.I., which was given at the Ponham Club, on Saturday, August 22nd.

The Park & Island Railway, Montreal, is making rapid progress with its line to Lachine. Large gangs of men are at work between Cote St. Paul and Rockfield laying the track, which runs on the south side of the Grand Trunk track. It looks as if the line might reach Lachine and be running by October 1.

At the annual meeting of the Canadian Electric Light Company, Montreal, the following gentlemen were re-elected directors: R. McLennan, president; Adolphe Davis, vice-president; Henry Hogan, Robert Bickerdike, John D. McLennan, Cleveland, O.; C. C. Claggett and F. S. McLennan, secretary-treasurer.

The Quebec electric light company having made arrangements with the Harbor Commissioners for the laying of a cable opposite the city between the north and south shores, has written to the Levis Town Council to notify it that it is ready to supply electricity to the town, and would prefer to sell it direct at a given price per meter, to the corporation, which in turn should supply the ratepayers.

Personal.

CITY ENGINEER GRAYDON, of London, Ont., has been seriously ill with asthma lately

W. COLTER, of the Wabash Railway, is to be made district superintendent of the G T.R. at Brockville, Ont.

H. NOAD, who was accused of stealing $5,500 from the C.P R. when assistant-paymaster, has been released in New York.

THE engineer of the R.C Y.C launch "Hiawatha" had his right arm crushed in some machinery at Toronto Island recently.

RICHARD MITCHELL, engineer at the railway pumping station at Cayuga, Ont, was found dead in his engine room Aug. 3rd.

JAMES BROWNLEE, of the Grand Trunk repair shops in Stratford, Ont, was crushed to death by a locomotive tender falling upon him

W BURKE, formerly employed in the Ontario Wheel Works, Gananoque, Ont, is now foreman of the St Catharines Wheel Works, St Catharines, Ont.

DAVID MORICE has been appointed Grand Trunk superintendent at the Toronto terminus, with full charge of the yards and transportation in Little York and Parkdale.

W. McDOUGAL, JR., of Hamilton, Ont, has been appointed engineer of the Kootenai Navigation Company's steamers. During the summer he was on the S.S. "City of Collingwood."

THE bursting of an emery wheel in the Pontiac and Pacific Junction Railway repair shops, at Aylmer, Que., nearly killed Wm. Pothier Pothier was removed to the hospital at Ottawa.

CHAS. H. WRIGHT, B.Sc, son of A. A. Wright, of Renfrew, Ont., has been appointed superintendent of construction of the Chateauguay and Northern Railway. Twelve miles will be built this year, it is said; twenty next.

THE Grand Trunk Railway system has made these appointments: Wm. McNab, assistant engineer in charge of the engineering and drawing office at Montreal; Robert Armour, assistant engineer, eastern division, office at Montreal.

ALEX. POTTER, of New York, consulting engineer, a graduate of Lehigh University, an associate member of the American Society of Civil Engineers, and an associate member of the Canadian Society of Civil Engineers, son of J. S Potter, Kingston, Ont., was married recently to Florence H. Dangerfield, a practising attorney in New York city. Miss Dangerfield was the second woman admitted to the New York bar.

THE St John *Sun* says that the D. A. Ry. Co.'s steamship "Prince Rupert" has a new staff of engineers and firemen as a result of a recent strike. A Clyde man, Wm. Colquohoun, is the first engineer.

FOREMAN McLEOD and a workman named Ryan were instantly killed, and another workman, St. Pierre, was fearfully injured, by a dynamite explosion on the O. A. & P. S. Railway, August 3rd.

As the Grand Trunk will let its mason work by tender hereafter, the office of inspector of masonry, which has for a number of years been held by James Grant, of Belleville, Ont, has been abolished Sept. 1st

JOHN MERRIN, the oldest engine driver of the G.T.R, was recently presented by his fellow employees at Belleville with an address and a gold-headed ebony cane. Mr. Merrin entered upon his railroad career in 1848.

CHAS. E. BRITTON, of Gananoque, Ont., has been appointed Superintendent of the Rideau Canal system, made vacant by the death of Mr. Page. Mr. Britton is a man of ability, and for many years has been one of Gananoque's leading manufacturers.

FRANK H. DOTY, a member of the Doty Engine Works Co., of Toronto, a well-known contractor, was killed at Hanlan's Point, Toronto, early in August. While superintending the working of a dredge, he was struck by a flying lever on the forehead, and was instantly killed.

J. J. ASHWORTH, formerly connected with the agency department of the Canadian General Electric Co., has retired from their staff to engage in independent construction and engineering work. Mr Ashworth, on the occasion of his severing his connection with the company, was made the recipient of a handsomely engraved locket presented by the members of the Toronto staff of the company.

FRANK J. WATSON, who has been connected with the Grand Trunk Railway in Montreal for a number of years, has been appointed chief clerk of the staff in Hamilton. His departure from Montreal was made pleasant by the gathering at the Board of Trade of his many friends, who presented him with a handsome mahogany bookcase and gold locket set with diamonds.

JOHN W. PLUMMER, late manager of the Granite Mountain and Delamar mines, died on August 20th, in London, England. Mr. Plummer was an Algoma man, having been assistant manager of the Bruce mines in the sixties, and afterwards at Silver and Jarvis Islands, near Port Arthur, for a great many years. His later mining experience had been wholly in the Western States, where he amassed a large fortune. Mr. Plummer was married in 1872, to Miss McIntyre, a daughter of Governor McIntyre, of Fort William, Ont.

SOLDERING GLASS.

An item has recently appeared in a number of foreign technical publications announcing the fact of a discovery which may prove to be of industrial importance. Two different alloys, melting at not too high temperatures, have been found strongly adherent to glass surfaces. One of these is composed of ninety-five parts tin and five parts zinc, and melts at 200° C. Another, composed of ninety parts tin and ten parts aluminum, melts at 300° C., and is said to adhere to glass with great force. It is further stated that, with either of these alloys soldering glass is as easy as soldering metals. If the glass be heated to the melting-point of the solder, with the usual precautions for preventing its cracking, a small bar of the alloy may be passed over the edges it is desired to join, and the edges, pressed together till they are cooled, will be firmly united. A wand of paper may be used to distribute the melted alloy evenly along the surfaces to be joined. Also an ordinary soldering iron may be used, as in soldering metals to metals. It is alleged that their alloys have a fine metallic lustre, which, under ordinary conditions, is well retained. This being the case, it would seem that such alloys might possibly be made substitutes for the amalgam of tin and mercury used in the manufacture of looking-glasses.

THE SEVENTH ANNUAL CONVENTION OF THE CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

1. James Devlin.
2. E. J. Philip.
3. W. F. Chapman.
4. R. C. Pettigrew.
5. John Murphy.
6. F. J. Merrill.
7. W. G. Blackgrove.
8. A. F. Edkins.
9. J. J. York.
10. A. M. Wickens.
11. S. Donnelly.
12. Jno. Taudvin.
13. O. E. Granberg.
14. B. A. York.
15. Frank Robert.
16. J. F. Cody.
17. C. J. Jordan.
18. Jno. Fox.
19. James Huggett.
21. Jno. McDonald.
22. G. W. Grant.
23. W. Norris.
24. H. S. Robinson.
26. —— Potter.
29. —— McKay.
30. Chas. Moseley.
31. F. G. Johnson.
34. —— McCoy.
35. Jas. McKay.
37. D. Reeves.
38. J. G. Bain.
39. F. Simmonds.