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MISSING

The Canadian Engineer

A Weekly Paper for Civil Engineers and Contractors

Walkerville Underground Sewage-Pumping Plant

Circular, Two-Story, Reinforced Concrete Structure, Approximately 23 ft. Diameter and 20 ft. High, Built Entirely Below Ground Level Excepting Housing for Stairway—Lower Compartment, Containing Pumps, Encircled by Suction Well and Force Main

By CHARLES W. TARR

Deputy Chief Engineer, Morris Knowles, Ltd., Windsor, Ont.

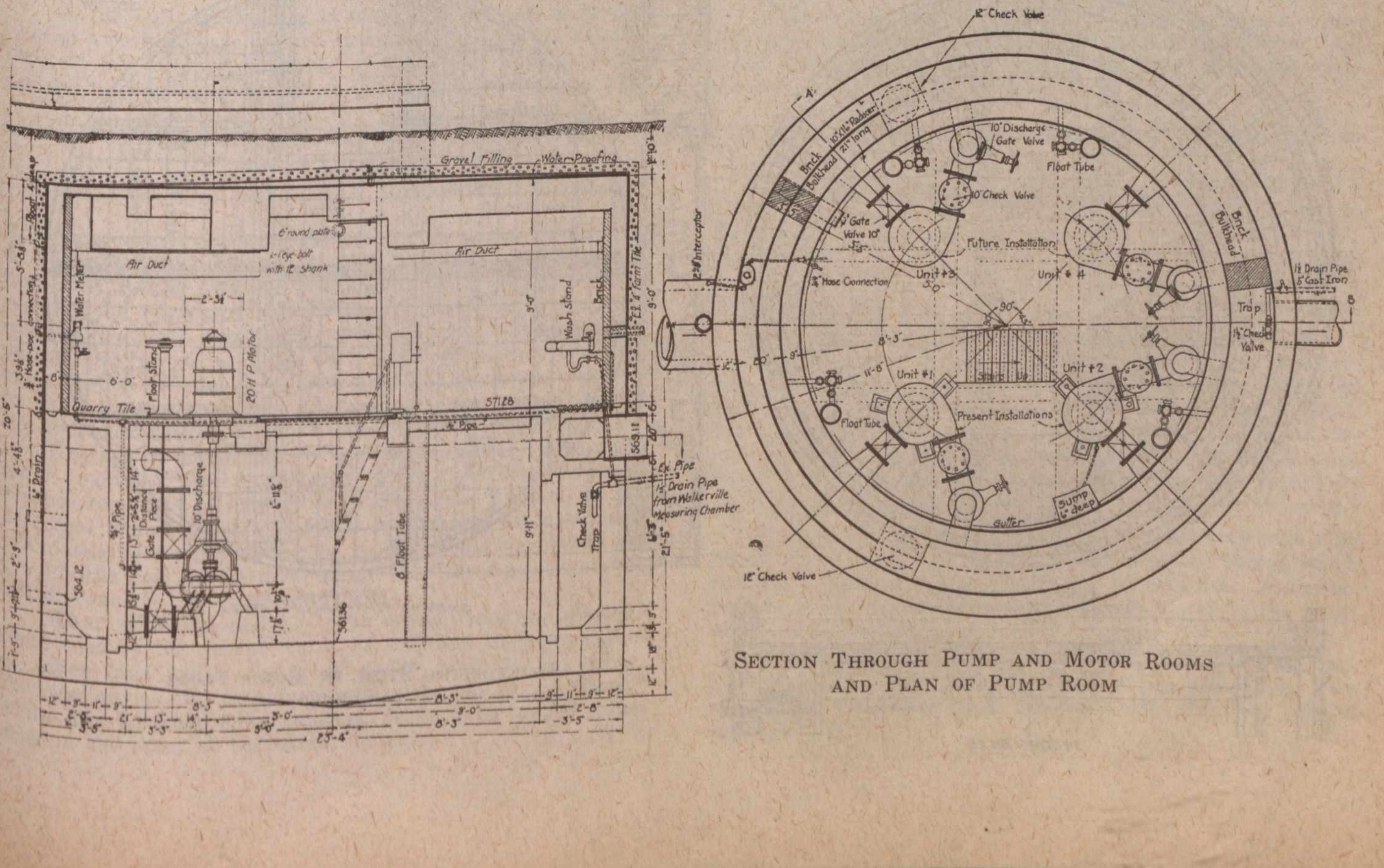
THE sewage pumping station referred to in this article is located in Walkerville, Ont., and is part of a general scheme of the Essex Border Utilities Commission to provide sewerage and sewage disposal for the Essex Border District. This district includes an area about 2 miles wide by 10 miles long, bordering on the Detroit River, and includes Windsor, Walkerville, Ford City, Sandwich, Ojibway and portions of the townships of Sandwich West and Sandwich East.

The commission now has under construction 2½ miles of intercepting sewer to serve the south end of the district, and in June last completed 2½ miles of sewer which will serve the east end, the latter sewer being known as the east interceptor.

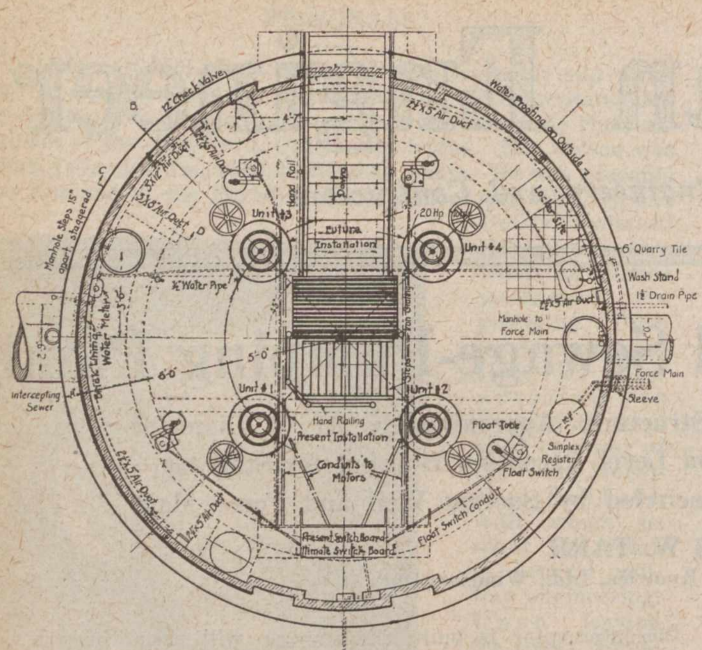
The Walkerville pumping station is necessary to complete and put into operation the east interceptor. Owing to the level topography along the Detroit river, the depth to which it would have been necessary to carry the interceptor to secure a proper gradient, would have been prohibitive, so provision has been made to raise the sewage at an intermediate point, from which it will again flow by gravity to the disposal site. Until such time as the central section of the interceptor is built, the sewage will pass through a temporary outlet into the Detroit river below the water works intakes.

The pumping station is a circular, two-story, reinforced concrete structure, 23 ft. 4 ins. in diameter and 20 ft. 5 ins. high, all built below ground with the exception of the superstructure which houses a stairway leading to the floors below, somewhat on the style of a subway entrance. The upper compartment contains the electric motors, while the lower compartment contains the vertical pumps and is entirely encircled by an annular suction well, above which is the force main. The circular design for the station was chosen, after a careful study of all the factors, because it gave a very efficient and compact arrangement for the pumping units, and allowed a very considerable saving of reinforcing steel and concrete.

The pumping equipment will consist of four units, two of which will be installed at present. The other two will be added when required. Each unit consists of a 20-h.p. vertical motor and a 2,000-gal. vertical centrifugal sewage pump. The units will be automatic in operation, and the motors will



SECTION THROUGH PUMP AND MOTOR ROOMS AND PLAN OF PUMP ROOM



Plan of Motor Room

be started and stopped by a float-operated switch attached to a copper float in an 8-in. wrought-iron float tube, and actuated by the rise and fall of sewage in the suction well. For the present population served by the station, one pump will be sufficient and the other will be used as a spare and later to assist during peak load when additional units are installed. For the ultimate conditions, when the district tributary is more densely populated, four pumps will be required, one of which will be a spare.

The lower compartment, containing the pumps, is encircled by two compartments, from one of which the pumps draw their suction, discharging into the other, which is connected by a force main to the gravity sewer at a higher level.

The upper compartment, or motor room, will eventually contain four vertical motors, four float switches, the switchboard, wash-stand, lockers for supplies, etc., and a venturi meter register. The sewage will be measured by a venturi tube situated in a chamber on the force main about 50 ft. from the pumping station, the pressure pipes being led back to the register in the motor room.

Power

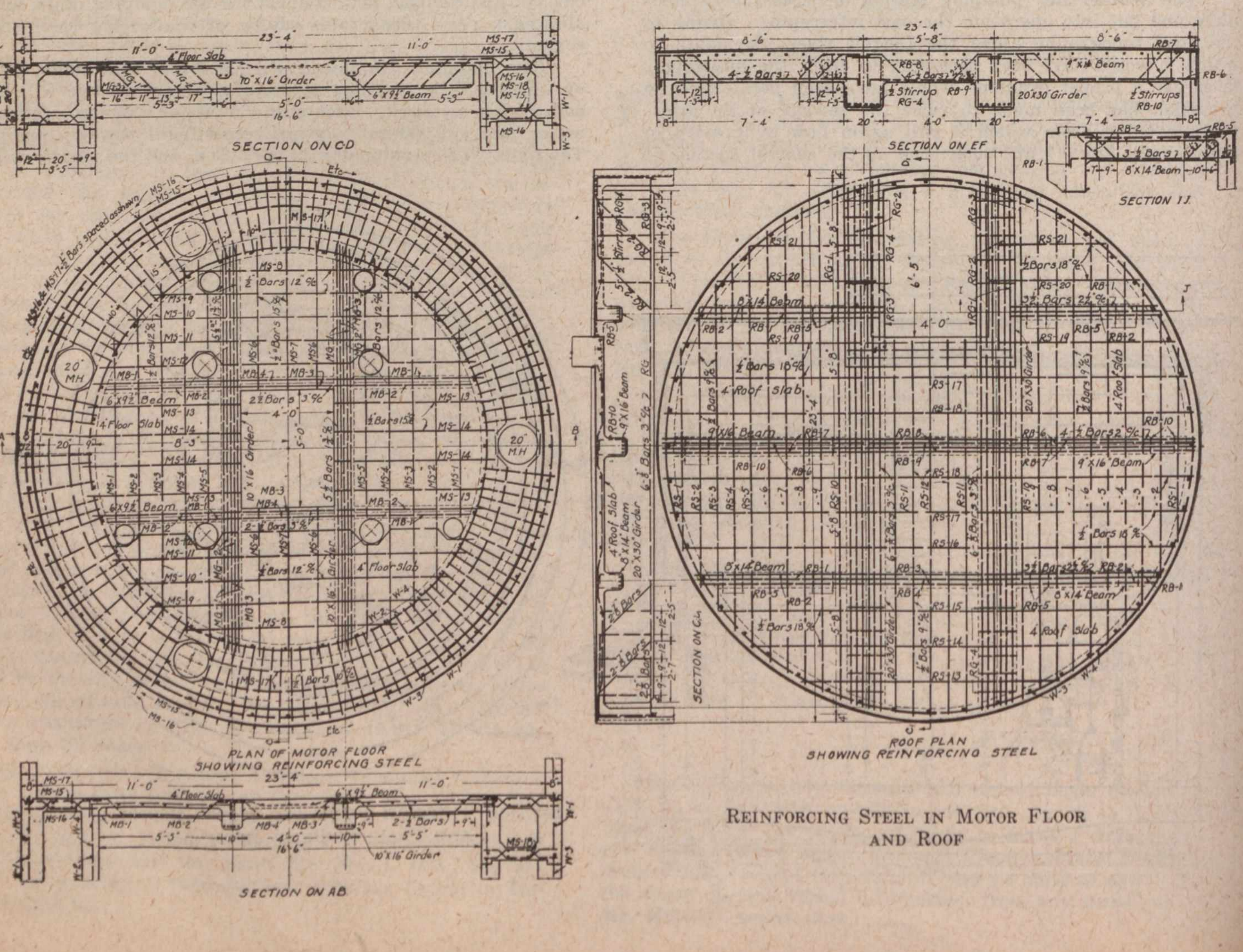
"Hydro" current will be used, and to provide for interruptions in current flow, 12-in. check valves are placed between the suction and discharge chambers, so that should the sewage rise to a sufficient height in the suction well, it would flow through the check valves and on into the force main with the minimum damage, if any, by flooding the interceptor and overflowing into the river.

Interior Finish

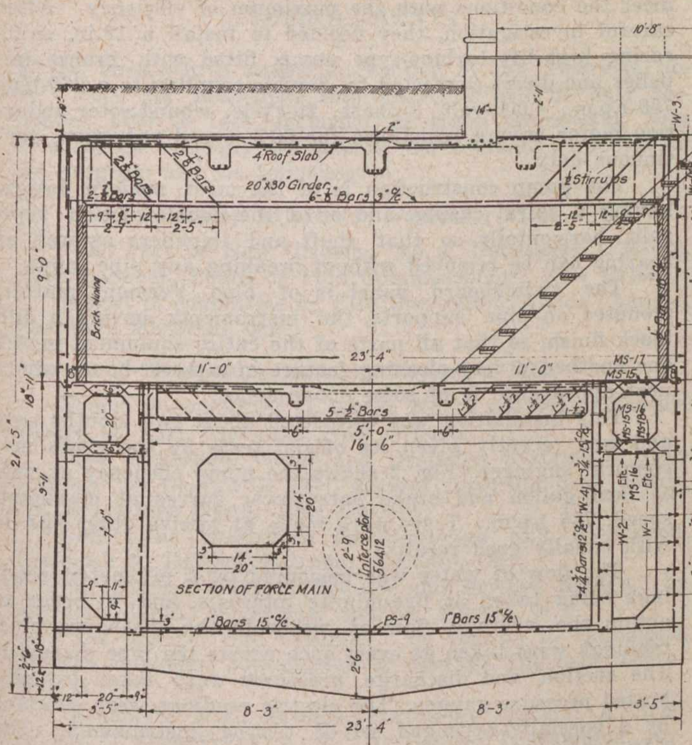
The motor room will be lined with a light-colored brick and will have a red quarry-tile floor. The ceiling and girders will be painted with a cream color cement paint. The pump-room will be painted a similar color, but will be a light stone color from the floor to a height of 3 ft. 6 ins.

Ventilation

A system of ventilation will be installed, capable of supplying 500 cu. ft. of air per minute, or a complete change of air in ten minutes. The fan with motor is placed near the roof, from which air ducts are carried to the floor of the motor and pump rooms. The air exhausted by the fan will be expelled through a flue and opening in the side of the superstructure, and fresh air will enter through the stairway



Reinforcing Steel in Motor Floor and Roof



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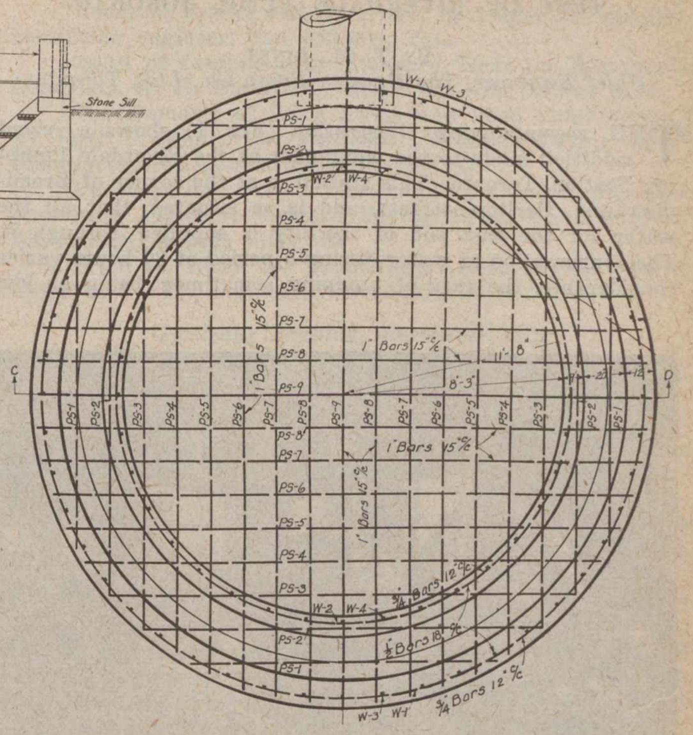

SECTION AND PLAN SHOWING REINFORCING STEEL IN PUMP FLOOR

to take its place. This principle of ventilation, by exhausting the air from near the floor, was decided upon because gasoline vapors and other heavier-than-air gases, if encountered, would settle to the floor and require removal.

Waterproofing

The exterior of the pumping station, down to the level of the motor room floor, will be waterproofed with alternate layers of wool felt and coal tar applied hot. Over this, a 6-in. layer of gravel will be placed to drain the ground water from the top and the upper side walls of the station.

Superstructure

As the pumping station is located in a small park containing a bathing beach which is very popular in the summer time, it was deemed desirable to have the superstructure present a pleasing appearance. It will, therefore, be built of gray brick, with cut-stone trimmings, and will be covered with a copper-frame, wire-glass skylight.

Contractors and Personnel

The equipment was furnished by Darling Bros., Ltd., Toronto, and consists of Canadian General Electric motors, Sundh self-starters, Yoemans pumps and Yoemans float switches.

The pumping station is being constructed by the R. Wescott Co., Ltd., contractors, of Windsor, Ont., who are doing the excavation and concrete work at actual cost plus 15%, and the installation of pumping units and other equipment at a bid price. The total estimated cost, including two pumping units and engineering and contingencies, is $18,900.

The station was designed by Willard R. Rhoads under the direction of the writer, the firm of Morris Knowles, Ltd., being the engineers for the Essex Border Utilities Commission.

"BORE FOR POWER!" SAYS SIR CHAS. PARSONS

In an address recently delivered in London, Eng., Hon. Sir Chas. A. Parsons, inventor of the Parsons turbine, said that "failing new and unexpected discoveries in science, such as the harnessing of the latent molecular and atomic energy in matter, the great position of England cannot be maintained for an indefinite period. At some time or other, more or less remote, the population will gradually migrate to those countries where the natural sources of energy are the most abundant."

England is using up its coal more rapidly than most other countries, and Sir Charles states that long before it reaches the point of exhaustion, it may pay England to import coal from countries where it is workable at lower cost. Ultimately water-power will be more rapidly developed, although the cost of harnessing all the water-power of the world would be about £8,000,000,000.

What shall England do to be saved from the disaster threatened by the exhaustion of its coal and the competition of other lands with plenty of cheap power? Sir Chas. Parsons' advice may be summed up in the one word: "Bore." There may be cheap power waiting, ready to be tapped, down deep in the crust of the earth, he says.

He recalled that some years ago he suggested boring a shaft 12 miles deep, or about 10 times deeper than any in existence. At that time the cost was estimated at £5,000,000, and the time that would be required at 85 years! Since then, he added, experiments have been made, showing that in limestone a depth of 15 miles is probably practicable, and in granite a depth of 30 miles might be reached.

"Little is at present known of the earth's interior," said Sir Charles. "When we consider that the estimated cost of sinking a shaft to a depth of 12 miles at present-day prices is not much more than the cost of one day of the war to Great Britain alone, the expense seems trivial compared with the possible knowledge that might be gained by an investigation into this unexplored region of the earth."

In Italy, at Lardarello, he said, bore holes have been sunk which discharge large volumes of high-pressure steam, which is used to generate about 10,000 h.p. by turbines. A similar project is on foot near Naples to supply power to the great works in that district.

Without promising that a 12-mile bore hole in England would yield ready-made steam-power, Sir Chas. Parsons urged that "the whole subject merits the most careful consideration."

TEST OF RIVERDALE PUMP, TORONTO

By T. M. Jones
Chief Engineer, The Bawden Pump Co., Ltd., Toronto

THE accompanying illustration (Fig. 1) shows a recent addition made to the equipment at the Riverdale Pumping Station, Toronto. This station is at the corner of Broadview and Carlton streets, and is so situated that all the water for the east end of the city is supplied through it. The consumption of water during a period of 24 hours varies considerably, the rate of pumping sometimes being as low

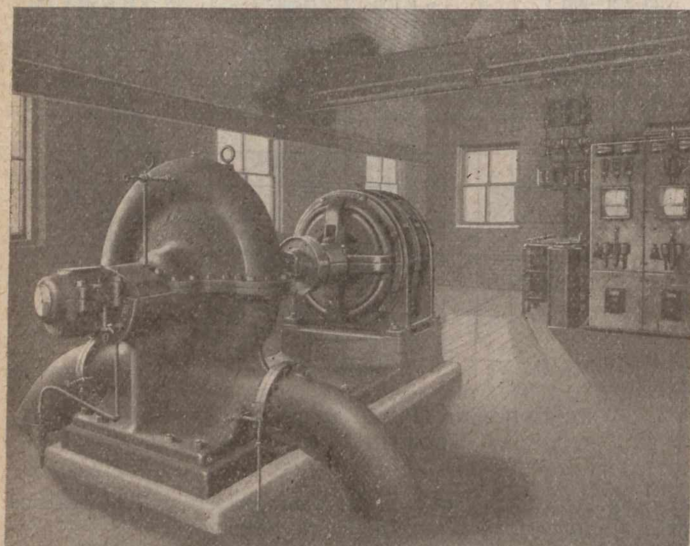

Fig. 1—Riverdale Pumping Unit, Toronto

as two million gallons per day and at other times as high as five million per day, and, as one pump is called upon to take care of the supply, the city engineer had to select a pump having characteristics that would give high efficiency at a wide range of pumpage.

Besides high efficiency, other considerations were taken into account. Due to the fact that this station is situated

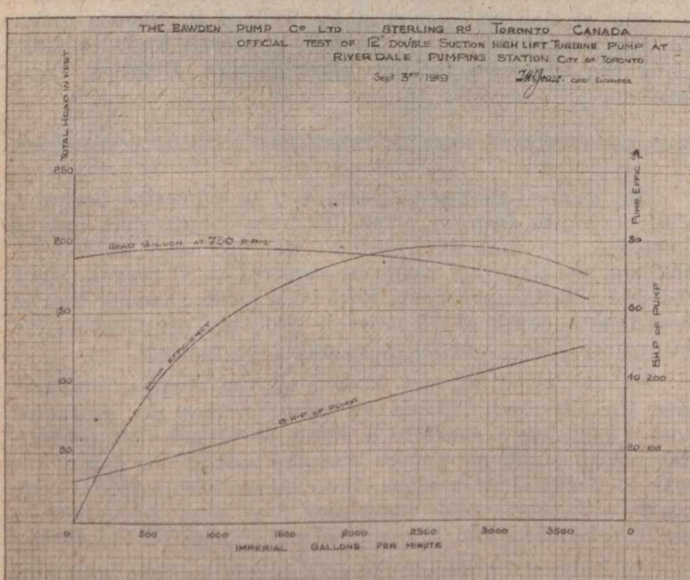

Fig. 2—Efficiency, B.H.P. and Head-Gallon Curves

in a residential section, it was essential that the pumping equipment should operate with a minimum of noise. In view of the above local conditions and the variable pumpage required, both as to capacity and head, it was necessary for the contractors, the Bawden Pump Co., Ltd., Toronto, to design a special pump having characteristics that would meet the conditions with the maximum of efficiency. After careful investigation, they decided to install a 12-in. split-casing high-lift turbine-type pump, fitted with bronze impeller and direct-connected by flexible coupling to a 260-h.p., 750-r.p.m., 4,000-volt, 3-phase, 25-cycle, wound-rotor induction motor having resistance for 50% speed reduction, continuous duty.

The pump construction is of the most modern design, having a spiral casing, and is of the double-suction type, split horizontally so that shaft and impellers as well as bearing can be removed without breaking any pipe joints.

The switchboard panel is of blue Vermont marble, mounted on pipe supports, the instruments having a dull black finish, so that all parts of the entire equipment match one another, a very pleasing feature in a power-house where neat appearance is of some consequence.

This installation was completed about two months ago, and was recently given its official tests by the city's mechanical engineer. Fig. 2 shows the pump efficiency as well as head-gallon and brake horsepower curves at maximum speed, 735 r.p.m. Tests were made at twelve other speeds with equally good results.

The flow of water was measured by a pitometer, readings being taken at five-minute intervals, and in order to obtain the average flow of water in the discharge pipe, readings were taken at every inch across the pipe diameter. The suction and discharge pressures were taken by calibrated pressure gauges. The electric readings were obtained by a specially arranged set of testing instruments. The latter were also used to check the instruments supplied with the switchboard.

FLUSHING AND CLEANING WATER MAINS*

By William Molis
Superintendent Muscatine (Iowa) Water Works

NO matter how good the water is, what the source of supply, or how good the filters operate, you will find some accumulation of some sort in water mains—mud or a trace of iron or some algia forms—depending altogether on the source of supply—whether it is a deep-seated well, a shallow well or a large or small river. While the accumulation may not be large, and not detrimental to the health or purity of the water, it still exists, and the flushing of the mains will readily remove it.

One way of doing this is to gate off a main on both sides, say for half a mile, or a few blocks at one flushing, starting at some high point in the system, either by opening hydrants or a flush gate. If no flush gate is available, then start at the high point and open hydrants down the line until you get to the end. This procedure must be followed in the cross-sections, the same as in the main lines.

This flushing process is mostly done at night, when it will inconvenience the least number of people. In the outlying districts we usually flush mains in the daytime. One must have a good force of men on the job to be ready to answer a fire alarm and to open the gates quickly.

Flushing a 16-in. or larger main is not an easy task. A goodly number of hydrants must be opened to do the work right. If there are steamer connections on the hydrants, by opening these one gets a good flow and it is easier on the pavements.

We have two flush gates in our system, one a 6-in. and the other an 8-in. opening, which open into a large sewer or creek. I would not advise emptying into a sewer that is too small; all kinds of trouble will result from overflowing into cellars.

If there should be too much deposit to wash out at one time, there will surely be some trouble with the meters, which would then have to be cleaned out after the flushing.

*Paper read before the Iowa Section of the American Water Works Association, Mason City, Iowa, October 23rd, 1919.

THE AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS

THE twenty-fifth annual convention of the American Society for Municipal Improvements will be held November 11th to 14th, inclusive, at Hotel Grunewald, New Orleans, La. Among the papers and committee reports on the program are the following:—

Tuesday Afternoon, November 11th

"The Port of New Orleans," by J. Devereaux O'Reilly, chief engineer, Board of Port Commissioners, New Orleans.

Report of committee on Fire Prevention, Alcide Chausse, chairman, Montreal, Que.

Wednesday Morning, November 12th

Report of committee on Water Works and Water Supply, George G. Earl, chairman, New Orleans.

"The Sewerage, Water and Drainage Systems of New Orleans," by George G. Earl, general superintendent, sewerage and water board, New Orleans.

Report of committee on Sewerage and Sanitation, Frederick A. Dallyn, chairman, Toronto, Ont.

"Economic Values in Sewage and Sewage Sludge," by Raymond Wells, consulting chemist, Homer, N.Y.

"The Modern Grit Chamber," by George B. Gascoigne, sanitary engineer, sub-division of Sewage Disposal, Cleveland, O.

"Brooklyn, N.Y., Sewage Treatment Station: A Brief Review of Five Years' Work," by George T. Hammon, surgeon (Reserve) U.S. Public Health Service, Brooklyn, N.Y.

"Garbage Disposal and Economic Recovery of Valuable Constituents of Municipal Waste," by Samuel A. Greeley, Pearse & Greeley, consulting engineers, Chicago, Ill.

Report of committee on Street Cleaning, Refuse Disposal and Snow Removal, George H. Norton, chairman, Buffalo, N.Y

Wednesday Evening, November 12th

"Methods of Sewage Disposal Used by the Emergency Fleet Corporation," by Clark P. Collins, senior assistant engineer, Engineering Branch of Housing Department, U.S. Shipping Board, Emergency Fleet Corporation, Philadelphia, Pa.

"The Water Supply and Sanitation of Base Section No. 1 (St. Nazaire, France)," by John B. Hawley, consulting engineer, Fort Worth, Tex.

"Army Camp Utilities," by W. L. Benham, Johnson & Benham, consulting engineers, Kansas City, Mo.

"Water Supply and Sewerage Systems of Camps Meade and McClellan," by Morris Knowles and John M. Rice, chief engineer and division engineer, Morris Knowles, Inc., consulting engineers, Pittsburg, Pa.

"The Acid Process of Sewage Treatment," by Edgar S. Dorr, engineer, Sewer Service Boston, Mass.

"The Psychological Influences of Public Improvements on the Minds of the People," by P. A. McCarthy, Lufkin, Tex.

"The Proposed National Department of Public Works," by W. B. Gregory, consulting engineer, Tulane University, New Orleans, La.

"Fairness in Specifications," by Alexander Potter, consulting engineer, New York.

Thursday Morning, November 13th

Report of committee on Street Paving, Sidewalks and Street Design, W. A. Howell, chairman, Newark, N.J.

"Proper Sands and Aggregates for Cement Concrete Roads," by Duff A. Abrams, professor-in-charge of Structural Materials Research Laboratory, Lewis Institute, Chicago, Ill.

"Recent Developments in Concrete Highway Construction," by A. N. Johnson, consulting highway engineer, Portland Cement Association, Chicago, Ill.

"Mineral Aggregates for Bituminous Pavements," by Wallace L. Caldwell, director of Department of Roads an Pavements, Pittsburg Testing Laboratory, Birmingham, Ala.

"Some New Discoveries in Bituminous Pavement Construction," by A. E. Schutte, consulting chemist, Warren Bros. Co., Boston, Mass.

"Roads in France and America," by Edgar A. Kingsley, consulting engineer, San Antonio, Tex.

Report of Committee on Standard Tests for Bituminous Materials, A. H. Blanchard, chairman, Ann Arbor, Mich.

"The Economy of Brick Street and Road Construction," by Will P. Blair, vice-president, National Paving Brick Manufacturers' Association, Cleveland, O.

"Vertical Fibre Brick Pavements," by Clark R. Mandigo, consulting engineer, Western Paving Brick Manufacturers' Association, Kansas City, Mo.

"Brick vs. Block for Permanent Street Paving," by S. Cameron Corson, engineer, Norristown, Pa.

Thursday Evening, November 13th

Report of committee on Street Lighting, C. W. Koiner, chairman, Pasadena, Cal.

"Illuminations, Ancient and Modern, with Special Reference to Decorative Street Lighting," by W. D'A. Ryan, director of General Electric Illuminating Engineering Laboratory, Schenectady, N.Y.

"Public Ownership of Utilities in Springfield," by Willis J. Spaulding, commissioner of Public Property, Springfield, Ill.

Reports of committees on Standard Specifications: Sheet Asphalt Pavement, Francis P. Smith, chairman, New York; Bituminous Macadam, Bituminous Concrete and Asphalt Black Pavements, Morris R. Sherrerd, chairman, Newark, N.J.; Broken Stone and Gravel Roads, With or Without Bituminous Surface Treatment, Arthur H. Blanchard, chairman, Ann Arbor, Mich.; Brick Pavements, E. H. Christ, chairman, Grand Rapids, Mich.; Cement Concrete Pavements, William A. Hansell, Jr., chairman, Atlanta, Ga.; Stone Block Pavements, H. H. Smith, chairman, Brooklyn, N.Y.; Wood Block Pavements, E. R. Dutton, chairman, Minneapolis, Minn.; Sidewalks and Curbs, Sylverius Sammelman, chairman, St. Louis, Mo.; Sewers, Alexander Potter, chairman, New York City; Foundations for Pavements, special committee, F. P. Smith, acting chairman.

Friday Morning, November 14th

Report of committee on Traffic and Transportation, on Uniform Traffic Laws and Classification of Highways, R. Keith Compton, chairman, Baltimore, Md.

"A National Highway System and Its Relation to Traffic and Transportation," by S. M. Williams, chairman, Highways Industries Association, and Federal Highway Council, Washington, D.C.

"Highway Traffic," by Frederic A. Reimer, county engineer, Newark, N.J.

Report of committee on City Planning, Nelson P. Lewis, chairman, New York.

Regional and Civic Planning as the Basis for Municipal Improvements," by Thomas Adams, housing and town planning adviser, Commission of Conservation, Ottawa, Ont.

"Lowland Farms Development, Youngstown, O.," by Morris Knowles, John M. Rice and E. O. Rose, Pittsburg, Pa.

"Architectural Design and Construction in St. Louis Parks," by Nelson Cunliff, commissioner of Parks and Recreation, St. Louis, Mo.

"The phenomenal development of highway transportation in the United States has created a demand for men having knowledge of and trained in a new technical field, which may be designated Highway Transport Engineering. Fundamentally, this branch of engineering deals with the science, art, economics and business of highway transportation of passengers and commodities. During the past decade, the United States has witnessed a rapid growth in the utilization of the motor vehicle as indicated by a registration of 125,000 motor vehicles in 1908 and 6,146,617 in 1918. While in 1908, a motor truck was rarely seen on American highways, in 1918 not less than 600,000 were in use in the United States, motor trucks constituting from ten to twenty per cent. of the registered motor vehicles in the several states."—A. H. Blanchard, Professor of Highway Engineering, University of Michigan, Ann Arbor, Mich.

THE UTILIZATION OF SEWAGE SLUDGE*

By John D. Watson
Birmingham, Eng.

Real progress in the treatment of sewage sludge was made in Birmingham when it was first realized that (a) sewage was inoffensive to the sense of smell until putrefactive changes began, and (b) that foul-smelling sludge ceased to offend the olfactory nerves when putrefactive changes had run their course.

To bury sludge as it leaves the sedimentation tanks is to take the most efficient method of retaining the foul odor which characterized it when it left the tank. Sludge was unearthed at Saltley recently after 30 years, which proved that burial *per se*, even if the sludge is deposited near the surface of the ground, where nitrifying organisms are most active, is not sufficient to free it from objectionable smell.

With the idea of carrying on the functions of oxidizing the liquid of sewage and the septicization of sludge simultaneously, Dr. Imhoff patented about 1904, and in German fashion boomed, a two-story tank, which had the Travis hydrolytic tank for its prototype. The lower chamber of this tank is for fermentation, and the upper one for sedimentation. The Birmingham plan provides two separate shallow tanks, one placed alongside the other, to do the same work.

In comparing the two, it is claimed for the Birmingham method that the cost of construction is less; it is better under control; the results obtained under normal conditions equally good, and under abnormal conditions—such as obtain in time of rainfall—much better. Operating costs of the Birmingham method are greater than by the Imhoff method, but the latter is distinctly inferior when large quantities of antiseptic substances like gas tar, arrive unheralded at the outfall works. It is desirable to isolate highly antiseptic matter instead of automatically distributing it over the whole surface of the fermentation chamber, or lower story of the Imhoff tank, where it tends to inhibit the action of the anaërobic organisms upon which the success of the process depends.

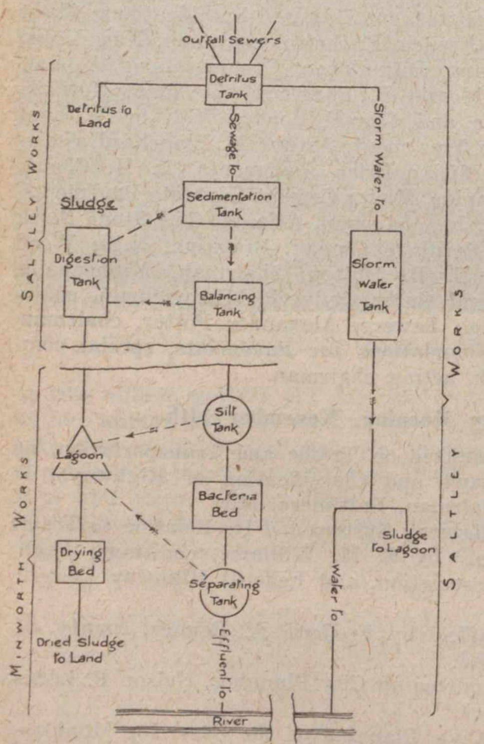

Fig. 1—Diagram Illustrating Method of Purifying Birmingham Sewage

There are no doubt advantages and disadvantages based upon physical and topographical circumstances pertaining to both methods which an engineer must appraise in determining the design most suited to individual cases, but the author maintains that the shallow flat tank has more to commend it than the other, and in this view he is supported by the Drainage Board's consulting chemist, F. R. O'Shaughnessy, whose knowledge of this process is unsurpassed.

A marked feature of the Birmingham installation is the temporary character of the sludge digestion tanks, many of which are formed by a combination of excavation and embankment; the material employed to make the latter is composed chiefly of engine ashes laid on the soft material from the excavation. No lining of flag-stones or inside coating of any kind is given to these improvised tanks, the sludge itself having been sufficient to seal all the interstices of the ash embankments. These tanks or lagoons are sufficient to effect the main objects in view, but they do not admit of the advantages of quick and thorough emptying and refilling associated with well-built vertical-sided tanks. Still, when cheapness of construction is essential, as, for instance, when one is experimenting, this form of construction has much to commend it; indeed, if the Birmingham installation had had to be designed with the view of obtaining Local Government Board sanction to a loan, the probability is that it would never have been built, and the gigantic experiment which is about to be described would never have been made.

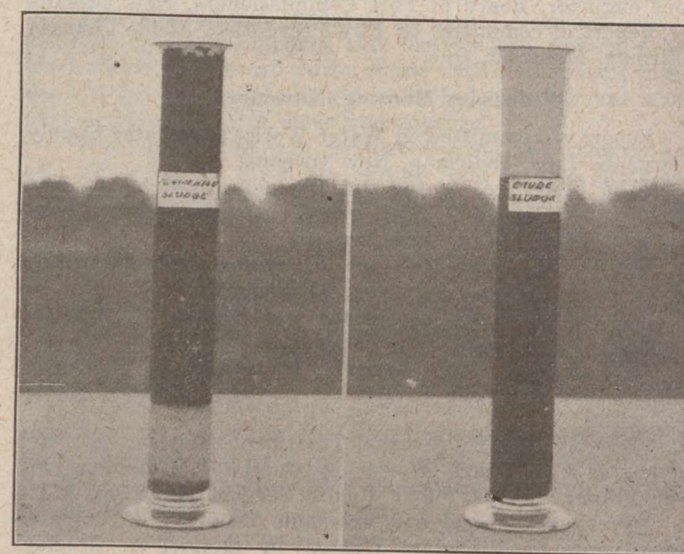

Fig. 2—Fermented Sludge Fig. 3—Crude Sludge

After the inflowing sewage from a population of about 750,000 persons passes through the detritus pit, from which the heavy solids are dredged by an electrically operated dredger, it flows through five sedimentation tanks working in parallel and subsequently through what is called a balancing tank. (See Fig. 1.) Each of the former has a capacity of slightly more than 1,000,000 gals., and the latter 7,000,000 gals., together 12,500,000 gals., or about half the dry-weather flow coming to this, the main outfall of the Drainage Board's Main Sewerage District. Each of the 5,000,000-gal. sedimentation tanks is cleaned every week, and the balancing tank, which is run in series with them, less frequently.

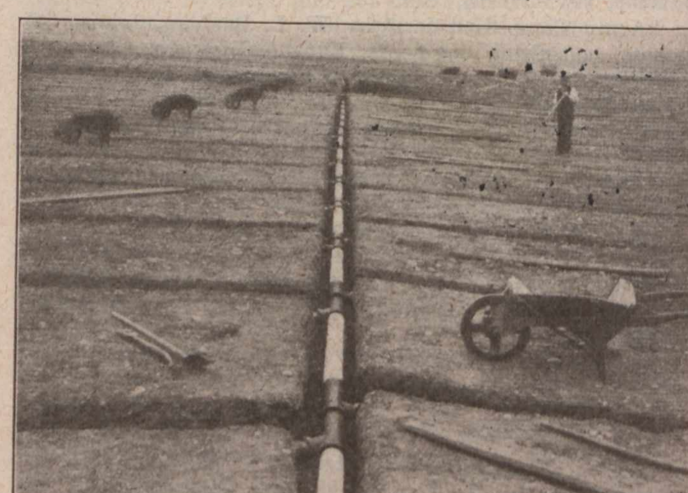

Fig. 4—Drying Beds, Showing Method of Draining

*Paper presented at the 46th annual meeting of the Institution of Municipal and County Engineers of Great Britain.

The crude sludge—92.5% water—arrested in the Saltley sedimentation tanks alone amounted to 1,523,000 cu. yds. during the past four years, or an average of 380,750 cu. yds. per annum, the whole of which was transferred to 39 sludge digestion tanks or lagoons possessing a total capacity equal to 28,250,000 gals.

The total *dry solid matter* removed from all tanks at Saltley, etc., Outfalls, including Minworth Tanks, in the four years 1915-18, amounted to 110,000 tons, or 75 tons per diem, all of which was transferred to the sludge digestion lagoons.

The density of the sludge removed chiefly depends on the frequency of the cleaning operation. During 1915 these tanks were emptied once in two or three weeks, when the average water content of the sludge was 87%, whereas the weekly cleaning during the four years under consideration yielded sludge with a water content of about 92.5%.

Theoretically, the more frequent the emptying operations the better, but economy suggests a curtailment of the operation when temperatures are low. When temperatures are high, there should be frequent cleaning, and the strictest avoidance of obstructions in the sewers should be encouraged if objectionable odor is to be reduced to a minimum. This becomes even more imperative as the area of a drainage district increases.

It has been shown that with care the putrefaction of the liquid can be prevented, but the successful digestion of the sludge has proved to be a more difficult problem; still, with accumulated experience and the expansion of the tank area, the operations at Birmingham have been conducted with greater ease, economy and success as time went on.

The digestion tanks used at first consisted of an existing installation of 20 tanks, 16 of them with an aggregate capacity of 4,539,500 gals., and 4 of them with an aggregate capacity of 2,723,680 gals., all so thoroughly well built and equipped with emptying arrangements that they are easily the best of the installation of 39 tanks.

For the first two years the digestion operations were conducted in two stages in this installation of 20 tanks. The 16 tanks were used for primary digestion and the 4 larger ones for the secondary digestion. Two stages were adopted, as it was found in the very early days that vigorous fermenta-

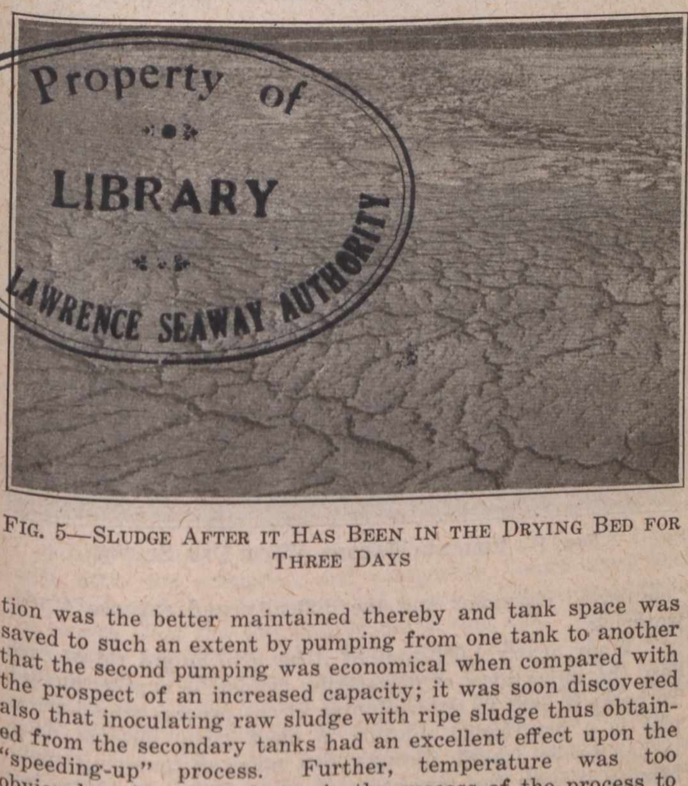

FIG. 5—SLUDGE AFTER IT HAS BEEN IN THE DRYING BED FOR THREE DAYS

tion was the better maintained thereby and tank space was saved to such an extent by pumping from one tank to another that the second pumping was economical when compared with the prospect of an increased capacity; it was soon discovered also that inoculating raw sludge with ripe sludge thus obtained from the secondary tanks had an excellent effect upon the "speeding-up" process. Further, temperature was too obviously a beneficial factor in the success of the process to be ignored.

The following mode of operation was adopted at the beginning of 1912 and has been continued ever since:—

In cold weather the sludge is transferred from the particular sedimentation tank whose turn it is to be cleaned out, into the selected digestion tanks (generally five or six in number) by the main set of pumps; simultaneously some of the ripest of the available sludge is pumped by a small pump into the same delivery main in the proportion of 1 to 4, thus inoculating at the earliest possible moment the fresh sludge with the fermentative organisms; in addition, steam from one of the Lancashire boilers is injected into the delivery main to produce temperature conditions most favorable to fermentation.

In moderately warm weather steam injection is abandoned, and during the heat of summer neither inoculation nor steam injection are resorted to. The biological factor governing the digestion process must necessarily be somewhat complicated, and it is only by the most careful observation of the conditions which bring about the right balance of living organisms that success can be achieved.

FIG. 6—SLUDGE AFTER IT HAS BEEN IN THE DRYING BED FOR THIRTEEN DAYS

The following tables of analyses supplied by Mr. O'Shaughnessy indicate two different sets of conditions, Table A where the fermenting mass was very offensive, and Table B where the vigorous fermenting mass was quite inoffensive:—

TABLE A.

		Total counts. Organisms per cc.
Gelatin-Peptone-Bouillon at 20°C.	Mean	24,000
Agar-Peptone-Bouillon at 37°C.	"	130,000,000
Coli group		7,000
Proteus group (including *Enteritidis sporogenes*)		100,000
Denitrifiers		500
Fat-splitting organisms		10,000
Cellulose		100,000

TABLE B.

	Total counts. Aërobic per cc.	Anaërobic per cc.
G.P.B. at 20°C.	52,000,000	15,700,000
A.P.B. at 37°C.	5,000,000	3,000,000
Coli group	60,000	
Proteus group	100,000 at least	
Denitrifiers	100,000 "	
Fat-splitting organisms	100,000 "	
Cellulose organisms	50,000	

Having obtained the right bacterial balance, so to speak, the aim of the management is to maintain it. What looks like an inexhaustible volume of sludge which constantly varies in character (about 1,000 tons per day) is drawn to a locality literally surrounded with dwelling-houses, factories, etc., and formerly gave rise to loud and serious complaints. Now, this large mass of foul material is treated on the same site without any offence whatever.

Variation in the character of sludge is only to be looked for in a great manufacturing district where there are no restrictions on the discharge of trade waste into sewers; but these are sometimes very serious in their consequences, as when large discharges of tarry products from coal, water, or producer gas-plants suddenly appear.

The saving factor in the situation is the system of separate sedimentation and separate sludge-digestion tanks, so that whether it is a sudden increase of volume due to rainfall or an overpowering mixture of antiseptics, the large number of sludge tanks in all states of fermentation renders the scheme at once elastic and manageable. The capacity of the whole of the sludge-digestion apparatus is equal to 165,000 cu. yds., or 28,000,000 gals., which, with the present demand, means a time retention of between four and five months.

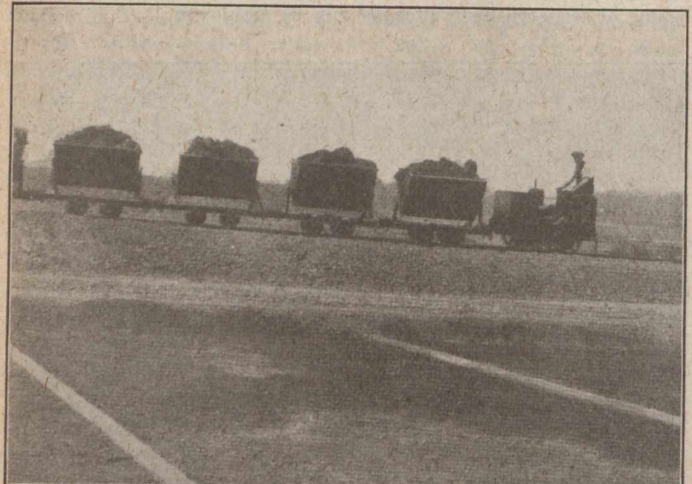

FIG. 7—FIVE TIP WAGONS DRAWN BY ELECTRIC BATTERY LOCOMOTIVE

The average analysis of the sludge for the four years 1915-18 is as follows:—

Water	92.5	%
Dry solid matter	7.5	%
Specific gravity of wet sludge (estimated)	1.0256	%
Specific gravity dry solid matter	1.50	%

The average analysis of the dry solid matter is as follows:—

Matter volatile at red heat	58.5	%
Matter non-volatile	41.5	%
Total nitrogen	2.71	%

The fatty matter in the crude sludge varies greatly, the actual limits for the figures in the analyses made being from 16.86% to 31%, with an average of 22%. These figures represent a total ether extract, but it is probable that about 2% of this ether extract is resinous matter, and the real fatty matter will be represented by an average figure of about 20%.

Those who see the Birmingham works for the first time are struck by the great distance (about five miles) which separates the sedimentation tanks from the bacteria and sludge-drying beds. In contemplating this it should be remembered that the Saltley section of the Board's works was built more than 60 years ago.

The author is responsible for selecting Minworth as the site of the main works, and the reasons were:—

1. The advisability of obtaining as isolated a site as possible where it would be practicable to have the whole of the works some day.

2. The belief which obtained 20 years ago that a 24-hr. period of septic action was beneficial, and that utilizing the capacity of the existing 8-ft. conduit (6,000,000 gals.) would obviate the need for increasing the tank capacity at Saltley.

3. The fact that the disparity between the falling gradient of the conduit, 2 ft. per mile, and the river, 7½ ft. per mile, provided an available head of 29 ft. with which to spray the sewage over the bacteria beds and eject the sludge from the silt tanks.

Minworth was also selected as the best site for completing the fermentation process of sludge treatment and laying out the drying beds. This involved pumping from Saltley, a distance of five miles—a task which looked more formidable than it turned out to be, the sludge in its fermented state having been found to be more mobile than was expected, a condition due probably to the innumerable air-bubbles between particles acting upon it as so many ball-bearings. This is illustrated to some extent by the photograph of the glass cylinder (Fig. 2), which shows fermented sludge, after a short settlement, held up by the air-globules *above* the clear water. Fig. 3 shows the crude unfermented sludge in a similar glass cylinder with the liquid above the solids.

The improvised lagoons at Minworth, which form part of the installation of 39 tanks, were formed by surplus spoil from the bacteria bed site and dry sludge from the drying bed area, and they perform at least three functions:—

(a) They give time for the completion of the fermentation process.

(b) They permit, with almost no detriment to the installation, the admission of humus from the bacteria beds, flushings from tanks and flushings from distributing pipes.

(c) They act as decanters of supernatant water.

The first is of course the primary purpose of the lagoon.

Imhoff found that he required his fermentation chambers to be large enough to contain from three to six months' storage of sludge. The author finds that the average requirement for the past four years has been equal to a storage of four months.

It has been proved abundantly that sludge dries more readily when the digestive process has been carried to exhaustion before it is pumped to the drying area; hence the economy of ample tankage.

The second is a most important function. The so-called "humus" excreted from a bacteria bed, like the sludge discharged from an activated sludge plant, is a valuable fertilizer, but so far has not been utilized because of its "emulsive" character and the difficulty and expense of dewatering.

FIG. 8—FILLING WAGONS WITH DRY SLUDGE

When nearly 1,000 tons of it have to be got rid of each day, the importance of dewatering cannot be over-estimated. To pump it back to the beginning of the process (the detritus pit) is a practicable solution in most cases, but not when it has to be forced through five miles of pumping main. Mixing it with the sewage as it entered the silt tanks just before spraying it over the bacteria beds was tried, but was found impracticable owing to the fibrous growths which were introduced into the distributors. Allotting a lagoon to itself with the view of trying to separate solids from liquids

(Continued on page 427)

RECONSTRUCTION AND CIVIC DEVELOPMENT*

What We Have Learned from the War and What We Can Take from Europe—"Co-operation" the Slogan for the Reconstruction Period

By C. H. Mitchell, C.B., C.M.G., D.S.O.
Dean of the Faculty of Applied Science and Engineering, University of Toronto

We have learned a great deal by the war. We have learned a great deal in adjusting our ideas so that on coming back home we may reapply them in Canada. We who are engaged in construction, whether material or educative or moral, are confronted with many problems, and what our soldiers have learned in Europe can readily be applied here, to the best advantage, to the new conditions under which we now find ourselves.

For those of us who are engaged in construction and in art, civic development, town planning, architecture, etc., what more do we want in the way of inspiration than some of the things that all of us saw, for instance, in that sacred city of Ypres, with its wonderful architecture, its features of what old-world planning meant 400 years ago, and, by contrast, what it may mean now: the beautiful architecture of the Cloth Hall and St. Martin's Cathedral, and the old walls and the moat, the wonderful old gates, the Menin Gate and the Lille Gate. All these things must have an influence on those who have come back.

Impressions from Italy

In the same way, in my own experience, I cannot help feeling that my year and some months in Italy were full of memories which will influence my life and views for many years to come. When we first went to Italy, now almost two years ago, we were confronted with many problems in which civic development and town planning had a very material part. The little city of Mantua, which you all know from Shakespeare if in no other way, had, to me at any rate, a particular interest because of the extraordinary arterial traffic arrangements in narrow, crowded streets, with arcades along them, and in which the traffic conditions were very serious.

No one would ever have thought of them as being serious if we had not tried to march one division after another toward the front, through those narrow streets. I shall never forget the day when the First British Division marched through Mantua, going toward the front, November 19th, two years ago, when the enthusiasm of the Italians knew no bounds. Brigade after brigade of infantry and artillery and transport marched through that little old city, with its narrow streets resounding with the clank of wheels, and the whole populace out on the streets or wherever they could get—on the verandas or on the galleries or in the windows—shouting, cheering, singing, waving everything from handkerchiefs to table cloths, and throwing flowers and fruit to the soldiers continuously for hours at a time. It was a wonderfully inspiring thing, and that same spirit followed the British all through that campaign to the end, and when we came out of Italy the Italians were the same firm friends of the British that they had always been.

An Axiom and an Example

And Venice! I well remember standing in Venice a year ago, after the armistice, and comparing Venice then with the Venice of 12 years ago, when I saw it before, and trying to realize what the war had meant to that city. Venice was not close enough to the front, even after the terrible catastrophe of Caporetto, to be shelled, although a few shells were dropped near it; but it was close enough to the front to be almost continuously bombed by the Austrian airmen.

It is surprising how many bombs can be dropped into a city without doing much damage, and it is surprising how little damage of a serious character really was done. You will all be glad to know that the damage to Venice was comparatively small.

With regard to the war generally, we have been in the business of destruction, and now we are confronted with the business of reconstruction, and with that goes all the development that we have learned from Europe. But the situation and the conditions in which we have to apply this, determine the progress that we can make. That is another axiom, of course, which is ever before those engaged in civic development and town planning. But of those things, what are we going to select? Along what lines are we going to develop? I cannot refrain from quoting a thing written by Kipling,

> "When 'Omer smote his bloomin' lyre
> "He'd 'eard men sing by land and sea,
> "And what he thought he might require
> "He went and took, the same as me."

Now it is for us to go and take, and what we can take and apply in Canada are the things with which we are most vitally concerned to-day.

What Can We Take?

What can we take? The science and the art of town planning—I am speaking now in the broadest sense, and it is not confined to town planning but applies to civic development, and national development if you like—is based on three principal things. The first is the collection and the investigation of information and data. After all, I suppose that is the same kind of job as I had in the war, which was the collection of information, only it was about the enemy. I feel strangely familiar with those expressions. Next after that comes the analysis of that information; and after all, I suppose that is a bit of intelligence work too. And thirdly, the conclusions we make from that analysis, and their application. Those are the things with which we are now concerned.

In general, there are two large branches into which these resolve. One is the branch of education, the informing of the public as well as ourselves, and the improvement of our minds, with regard to the science and the art of civic development, based upon all those things which we have brought from Europe and of which we have read. Then comes, arising from that, the application: The legislation, which, through the means of good government, we are able to bring about, by that means forming a stimulus by which to raise the standards of life.

Roads and Transportation

Let us see what, of these things which we have been able to learn from the war, we may apply in this country. Take, for instance, the question of roads and streets. I do not want to be too specific, but those of us who have been "over there" realize what good roads and streets, the proper kinds of streets for definite purposes, mean. Those of us who were driven along the great pavé roads of northern France, realized then, and we realize more now, when we have come back to this country, what Napoleon meant when he said that roads won wars. I do not suppose there has ever been a finer example of that axiom than in this war, for I am sure, as you must have heard dozens and dozens of times, that the war could not have been fought in Flanders were it not for the good pavé roads that Napoleon's engineers built 100 years ago. Not that we anticipate ever having a war in this country, but we are engaged in a war of peace, a war of industry and a war of many other things, by contrast, which require good roads. Now let us start out to get good roads and good streets built for the purpose.

Another phase is transportation as apart from the material road itself. When I got back to Canada, landed at Montreal and a few days later arrived at Toronto, I was struck with the tremendous change that had come about in our civic situation by the very general use of the motor car. We thought, over in France, and in Italy, too, that we had nearly all the motor cars of every kind and vintage that could be scraped together into one place. When we got back to England, on leave or after the war was finished, we dis-

*Excerpts from a luncheon address before the Canadian Club of Ottawa, Ont., during the joint conference held October 18th-19th by the Town Planning Institute of Canada and the American City Planning Institute.

covered, as we thought, that probably most of the cars came from there, because there were comparatively few in England. But when we got back to Canada and saw them parked for miles on the streets of Montreal and Toronto, we realized that, after all, all the motor cars in the world had not been sent to the war; and we realized also what it means to introduce a new form of transportation that is going to revolutionize the whole business of civics.

Aeroplane Photography

A means of study which the war has developed, and which perhaps we who are engaged in civics and in other lines of work can naturally use to good advantage now, is aeroplane photography. I saw hundreds of photographs of towns in France and Belgium, and in Italy, too, not only on our own side—we took very few, of course, on our own side—but also on the side occupied by the enemy, and I could not but realize what a great advantage it is to have the means of getting an aeroplane photograph of a place in order to pick out the essential, outstanding features. It seems to me that if I were a gentleman engaged in town planning, I would want to own an aeroplane in order to take photographs before and after, and in order to make studies of how to replan and how to work out schemes.

You probably remember the use to which aeroplane photography was put recently in connection with excavations in Persia, and which someone out there discovered, I suppose, by accident. Some persons who were looking for the ruins of a lost city were able by an aeroplane photograph, taken high up, to discern underneath the sands, by some difference of color or shading, or some features about the sands, the outlines of the city for which they were seeking,—by the same method by which an aeroplane or a balloon can always see a submarine deep down in the water. It is a most curious application of aeroplane photography, but I am sure of this, that many other things will be found about this device which can be applied to much of our work in the future.

One of the first requisites in our reconstruction is education. Not only in the science and art of town planning and civic development, but in many other things, our country requires education: that publicity which comes through the press and otherwise; that real, genuine, basic information which comes through the school children themselves in the public schools, and which, as many of you know, is being applied with such great success in Chicago; and the education in connection with our universities.

Four Hundred Freshmen

The Faculty of Applied Science at the University of Toronto now has many more students than in the greatest year before the war. There are over 800 students, of whom 400 are freshmen. As announced yesterday, we are hoping to put on a course, and some work in design, etc., in connection with civics and town planning, and that, we hope, will be something towards education for the country in connection with this work.

In Canada, and in fact all over this continent, we have come now to the industrial age, and with industry, as we see it now, and as we saw it during the war, the great essential is to produce. To produce more we must introduce methods and means whereby the people can live more comfortably and earn their money more easily, and go back and forth to and from their work more readily, particularly as industries are developing far out from the crowded portions of the cities. And at the same time, we must realize that our duty is to do something by which the earnings can be more equitably distributed for the convenience of everyone. That I do not wish to discuss further except to say that we should realize that the industrial situation is closely bound up with general civic development and the broad subject of city and town planning.

If we look at the great successes of industry and science, not only during the war, but for centuries before, we find that they are the evolution of many minds, the evolution of many years, the evolution of many processes and experiments, some of which have been great failures, others of which have been successful in the sequence by which they have come. To them we look for examples by which we can apply our future methods of civic development and our future methods of civic planning. I am speaking now not only of the actual planning, but of the economic side and of government as well.

The methods by which this can ultimately be brought about will be identical with the methods by which the evolution of anything in history has been achieved, such as the steam engine, or such as, in the war, the tank. A few weeks ago an effort was made to determine who invented the tank. Well, of course, no one man invented it. Eleven claimants came forward to the Inventions Board to say that they had invented it, and the next day, not after a long period of investigation, it was discovered, and announced by Winston Churchill, that no one man invented it; that to the whole eleven belonged the glory of the achievement. And the same thing is going to apply in civic development and civic planning of all kinds. Everybody is in it and everybody is doing it, and the thing is to have it go hand in glove with all the other development and reconstruction work in which we in this country are embarked.

The Scientist Comes First

And in that development the scientist must be the first man to do his part—to do the part which will bring about the analysis and the investigation of all these things, and the first trials which are made; and after that, so far as town planning is concerned, the aesthetic side, the artistic side, comes into consideration. But do not let us try, as I fear we in Toronto for a long time tried, to have the artist the first on the ground, and then to consider the practical or the scientific side in the second place. It should be the other way round.

With regard to legislation, just a word. That is the other element with which we have to deal, and which, I am sure, everyone is thinking about a great deal at the present time. The duty of those responsible for legislation is primarily to raise the standards of human life. I think everybody will agree to that. And whatever we do for reconstruction, that must be the thing in front of us, clearly defined all the time; to make the country a better place in which to live and work; to make the lot of those who work, happier and more contented—because you cannot get really good work out of discontented people, and with discontented people you cannot get health and ease. Lloyd George once said: "You cannot make an A1 nation out of a C3 lot of people." That applies just as much now, when we are at peace, as it did when we were at war. Now we have come to the period when legislation is required; more legislation; not too much of it. I am afraid we have too much of it now in some respects.

Another thing which Lloyd George said:—"Society and the nation at large, at the present time, is in the molten state, and in that molten state you can impress or stamp anything on it that you will, so long as it is reasonable." Now is the time to put the stamp on it, and let us do so in civic development.

Education, Legislation and Co-operation

Following on these two, education on the one hand, legislation on the other, comes the other thing, co-operation. Co-operation won the war, and we cannot say it too loudly in this country at the present time. Those of us who were at the front know what co-operation meant among the various arms of the service. Those of the infantry know what it meant to have co-operation from the artillery, shooting over them, carrying them, with its barrage in front of them, up to the enemy's position. Infantry and artillery both know what it meant to have the co-operation of the engineers, who were preparing in various ways to help them across. They all realized what it meant to have the co-operation of the men in the air, who were observing for them, directing operations so far as information was concerned, and performing all the work which men in the air could do. And behind it all there was the co-operation of all the various organizations and the staffs all the way back to the army staff, 20 miles behind the line. That was co-operation, and it all fitted into one plan; and the more we worked at it, the more we tried, the more we developed it and the better the co-operation, the better we succeeded and the more we won.

Now we have come back to the wars of peace, and co-operation is the watchword. We must have co-operation from everybody in the scheme of the country, from the top down, from inside and out, from all classes of people—everybody trying to help everybody else; and in no place can we apply it more advantageously and more successfully than in this very large problem of civic development. I am sure that in the construction period that we are entering on now, with the public mind not settled on these things, the leaders of all civic improvement and civic development must take their position to lead and to impress and to engage in that co-operation all classes of people.

People say right away, if we start talking about large programs—and I am afraid that very large programs are talked of—that money is the first requirement. Well, money may be; but there are many things that can be done even without a large amount of money, and it is for those of us engaged in this work to think out what we can do, for the present at any rate, until such time as money is forthcoming to do it, and therein to adjust our views to the requirements of the country for the future. But again it is co-operation.

In the same way, policies of all kinds are advanced—good and bad, reasonable and unreasonable—policies which are nebulous and policies which are perhaps too specific; but all of these require careful thought and discussion and education and publicity, and the co-operation of everybody, from the top down, in order that we may determine what policy to follow. And in the end, everything from the group to the community, and the regional area, and the nation, and all things which involve housing, transportation, public utilities, education, etc.—all of these things fit together, so that in a large way the word "co-operation" spells success. The great motto, after the war and for the period of reconstruction, is "co-operation."

PRESSURES IN PENSTOCKS CAUSED BY THE GRADUAL CLOSING OF TURBINE GATES*

By J. T. Noble Anderson

On several occasions, the writer has investigated this question, or a cognate phenomenon, with pumps—centrifugal and others—through long pipes. In one case, there were two pipes with a common penstock—each of wood, 3 ft. in diameter, and 2,300 ft. long. In every case, he has been greatly impressed by the extreme complexity of the subject.

With the help of Prof. Joukovsky's theory and some "rule-of-thumb" guesses, gained from a general experience, these pipe lines and the values concerned can now be calculated to as close an economic margin as most other engineering problems. At the same time, the result of experience shows so many baffling discrepancies, that the experimental results, which Mr. Gibson hopes to obtain "in the not too distant future," will be waited for eagerly.

The care he has taken to collect and co-ordinate the formulas, is an earnest that he may be relied on to record fairly and fully not only his results, but all the extraneous facts and happenings which may, however, remotely, bear on the many irregularities between actual records and what the formulas anticipate. In particular, it might help if two slightly disturbing factors were recorded in each test, that is: (1) The temperature of the water; and (2) the proportion of free air present in the water.

The second factor will probably be quite immaterial, but, in a case where the substance pumped through a centrifugal was sewage with a specific gravity of 64 lbs. per cu. ft., the author found that the gases contained had a very disturbing influence.

In some recent investigations, the writer used a steam indicator with springs specially chosen for the anticipated pressure. Some indication of Mr. Gibson's apparatus will no doubt be given.

*Discussion (presented to the American Society of Civil Engineers) of Norman R. Gibson's paper (see September 4th and 11th issues of *The Canadian Engineer*).

LOT AND BLOCK UNITS FOR HOMES OF MODERATE PRICE*

By Arthur Coleman Comey
City Planner, Cambridge, Mass.

It is to be assumed that in the normal case a proper layout of main streets and disposition of public grounds will permit the minor streets to be so arranged as to produce the optimum in block lengths and widths, the latter closely affecting lot depths. Lot widths on the other hand are not controlled to any large degree by other elements in the plan and may, of course, readily be changed at any subsequent time prior to development or actual sales without materially modifying its general relations.

Factors Controlling Width

The factors controlling the width of interior lots are, on the one hand, adequate width for the dwelling itself, light and air in its yards and (to a less degree) passage for automobiles; on the other, the cost of utilities in the street, which rise rapidly as lot widths are increased and practically require the minimum adequate width to be the standard, if not the maximum as well, except as topography and other elements in the plan fix certain points and permit somewhat larger lots without increased expense. A house nearly square is the most economical, so that, except where under the spur of high land values lots have been plotted too narrow, the two room deep house is the usual type.

For detached houses, 7 or 8 ft. is the minimum side yard width to assure sufficient light and air at the first story, as well as safety from fire. One side yard should be at least 10 ft. wide to provide space to drive an automobile. The square house is probably the widest that should normally be provided for. The 6-room house may be as small as 22 ft. square, the 7 and 8-room types running up to 26 or 27 ft. The proper standard minimum lot width for detached houses is 40 to 44 ft. Unless 40 ft. can be obtained, semi-detached or row houses should be planned.

For semi-detached houses, 10 ft. is none too wide a side yard for light and air as well as for the passage of automobiles. Such houses need not be over 23 ft. wide and are frequently not over 20 ft. The proper standard minimum lot width for semi-detached houses is 30 to 33 ft. In sections with moderate rentals it is proper to mix detached and semi-detached houses according to any scheme of grouping the city planner and architect may work out. Each pair of semi-detached houses requires 1½ lots of a size suitable for detached houses. In cases, therefore, where it is desirable to plat lots in advance of building, the 40-ft. width, or better, 44 ft., may be used as a standard minimum.

Mingling of Types Undesirable

Three reasons prevent the advantageous mingling of row houses with the other two types: An alley is usually required behind the row house, a considerable expense, which constitutes an unnecessary burden if incurred behind houses with side yards and therefore not dependent on alleys; the larger building units are apt to be out of scale with the other types; and in most cases the type of occupancy is different. The row of three houses placed at intersecting streets may be used with semi-detached and detached houses by adding to the rear yard of the middle house an extension 10 to 20 ft. wide, reaching the side street across the rear of the corner lot. The unit of three will require about two lots of the size for detached houses, and therefore fits into a scheme of 40 to 44-ft. lots.

The row house attains practically its full economy with 5, 6 or 7 in a group. Above 9 the inordinate length of the row becomes unpleasant architecturally, and at the same time increases fire risk and steadily decreases ventilation in the block. Such relatively short groups obviously require special lotting. The lot widths for interior houses are controlled absolutely by the design of the house. To secure

*Paper read October 19th in Ottawa, Ont., at the joint meeting of the Town Planning Institute of Canada and the American City Planning Institute.

adequate light and air, row houses should not be more than two rooms deep. The usual plan is one large room across the front and one or two smaller rooms at the back. The proper width for such a house is 18 or 20 ft. The end houses of rows may be put on lots 27 to 30 ft. wide, so that two such end houses of adjacent groups require three of the lots designed for interior houses.

It is difficult to make a lotting scheme which will serve for both row houses and for semi-detached and detached houses. In cases where row houses are anticipated, lotting should accompany the plan for grouping the dwellings instead of preceding it.

Expense is in Frontage

While it is generally recognized that 50 ft. is sufficient distance for light and air between the fronts of small houses, and while this same distance is also a sufficient minimum between backs, in practise such shallow lots as these dimensions produce are seldom found necessary owing to the fact that added lot depth does not correspondingly increase the cost of most utilities. It is frontage that is expensive, and rear land must be considered to remain close to the acreage cost of raw land. This is a particularly important factor where topographical conditions or irregular boundaries would involve considerable extra length of streets to produce but few more lots of standard depth, the alternative of fewer and deeper lots with much less street construction being much cheaper and involving only a slight loss in gross selling value.

On all except the main thoroughfares, the needs of traffic are not sufficient to affect the distance between the fronts of houses. In detached house neighborhoods, experience indicates that 20-ft. front yards are not excessive. For semi-detached houses, 15 ft. is found suitable. For row houses, 10 to 15 ft. may usually be provided. A variation in set back not exceeding 5 ft. usually adds to the attractiveness of the street. Unnecessary depth runs up the cost of service lines from the utilities that are placed in the street. If the street line were placed at the building line, as in Washington, D.C., the utility lines might be run close to the houses, thereby saving considerable expenditure necessary under any of the present methods.

Houses of moderate price normally range from 18 to 32 ft. in depth, the vast majority being from 20 to 30 ft. deep, though certain designs for narrow semi-detached houses may require 34 to 35 ft. In the depth of rear yards even more variation occurs, both because their use varies and because it frequently proves to add so little to the cost to make them ample. For detached houses, an ample garden space for a person working elsewhere during the day is 40 by 50 ft. If not so used, this is still not too large for children's play.

On streets of ordinary width, lots for detached houses should normally be planned 90 to 110 ft. deep; for semi-detached houses, 80 to 100 ft,; and for row houses, 70 to 90 ft., including to the centre of alleys where introduced.

Where extreme land values do not preclude, a scheme of lots based on a standard minimum of 40 to 44 ft. by 90 to 100 ft. is proper. In extreme cases, where row houses are certain to come, lots as small as 16 to 18 ft. by 70 ft. may be necessary, but intermediate widths so common in most of our cities are not easily adapted to modern housing standards.

Corners are Special Problems

The best size for corner lots in cases where practically all the houses are to face one set of roughly parallel streets may be fixed as ranging from the same width to 5 ft. wider than corresponding interior lots, and approximately the same depth.

With houses fronting on all streets, to secure the maximum salable frontage and the least interruption to the architectural motive along each street and around the corner, the corner lot is best made approximately square. It should be equal in area to the corresponding interior lots. A somewhat large square corner lot may be cut diagonally in two, and a pair of semi-detached houses set across it, though this expedient is not always pleasant. It is not apt to be a good plan to attempt to crowd houses at a street intersection and still give sufficient square feet of rear yard space by violent skewing or irregularity in lot boundaries. Acute interior lot corners should be particularly avoided. Lot lines should usually be run back at least 40 ft. to a point not less than 5 ft. behind the house, approximately at right angles to the street.

Block widths are normally twice lot depths, though many irregular blocks are bound to be platted, especially in layouts on rough or peculiarly shaped land, to economize in construction cost and in land used for streets.

Block lengths are controlled by the needs of traffic, both vehicular and pedestrian, and by factors of safety. Experience shows that in residential areas, blocks 600 to 700 ft. long cause little dissatisfaction. Shorter blocks are wasteful of land in cross streets. Blocks longer than 800 ft. are found to cause undue detours in going from one side to the other. This is more noticeable in the case of foot traffic than the modern automobile. Inasmuch as adequate footways require but one-sixth the space of cross streets, and even less proportionate construction cost, their use midway across blocks of lengths up to 1,200 ft. is permissible, particularly in districts with steep slopes, making connecting streets expensive. In areas designed with deep courts and blind streets only partially cutting up the blocks, if each such court and street has a path leading from it across the block, most of its disadvantages will disappear, though it will still be less easily policed or protected in case of fire than regular blocks.

While variations to the ordinary block and lot system which do not easily conform to rule have hitherto seldom been laid out, the increased attractiveness attending their use in a reasonable number of instances demands that the opportunity be not closed by rigid standards. As they are apt to be integral parts of the group designs for the actual houses, their layout cannot be determined until the building program is adopted. Where interesting variations are not anticipated, the minimum standard of blocks, 180 to 200 ft. by 600 to 800 ft., with lots 40 to 44 ft. wide, is more apt than any other to be adapted to the future needs of a neighborhood.

THE NEW MUNICIPAL STANDARD

VERY illuminating is the story of two Ohio cities told by the State Department of Health. These cities are Wellsville and Ironton, with the unenviable distinction of having as many cases of typhoid fever in five months as two score of larger cities of the state had in the same period. Speaking exactly, these cities had 51 cases, while 80 remaining cities had 180 cases during the same period. Reduced to averages, while Ironton and Wellsville had an average of 25 cases each in five months, other cities had an average of three each. Ironton is now taking steps to remedy its defective water supply and citizens of Wellsville are waking up to past dereliction. Consumption of untreated Ohio river water is not consistent with municipal health. When both cities have completed their works they will soon lose the sorry reputation which they have gained in this vital health respect. Looking at the matter in its broader phases there is an interesting field for study opened here. Let comparisons be made among remaining cities of the state. The success of local municipal government may be told with greater accuracy in death and morbidity statistics than in any other form. If the state makes these comparisons, local communities may wince under the sting of the lashing that comes to them. But there should be no complaint in the revelations: rather obligation for demonstration of the manner in which the unfavorable showing can be converted into a favorable one.—Cincinnati Enquirer.

The Town Planning Conference for Southwestern Ontario will be held at the Royal Connaught Hotel, Hamilton, Thursday, November 27th, and Friday, November 28th. This change in time was necessary due to the Victory Loan.

THE UTILIZATION OF SEWAGE SLUDGE

(*Continued from page 422*)

by mechanical action alone was not a success, and of all the various proportions of humus and ripe sludge mixtures made with the view of encouraging separation, the best result was obtained where the smallest quantity of the former was mixed with the largest proportion of the latter. This is understandable when one remembers that the "humus" contains 5% to 6% of nitrogen and the oxidized sewage effluent conveying it has in its composition a sufficient quantity of nitrates to arrest putrefactive tendencies. How long this humus emulsion will remain a jelly it is difficult to say, but there are samples on the works which still retain that jelly-like character after exposure to the atmosphere for six years.

The third is not the least important function of this lagoon. Water rises to the surface when fermentation is exhausted and frequently when it is quiescent, when it may be decanted direct to the filter-bed. When one remembers that by reducing a 90% to an 80% sludge, one gets rid of one-half its water-content, the importance of decanting as much liquid as possible is evident. It has also been proved that additional advantage is gained by providing deep lagoons, thus supporting A. J. Martin's theory that the deeper the tank, the denser the sludge obtained; at the same time the benefits in this respect must be measured by the degree of emulsification obtaining.

Drying Beds

The rotted sludge or residuum of the fermentation process is pumped direct to the drying-beds which are in the immediate vicinity. They consist of plots of engine ashes 150 ft. square and have a total area of 54 acres. All the plots are under-drained with 4-in. agricultural tile-pipes in herring-bone fashion (see Fig. 4) toward a main leader which conveys the drainage to a well, whence it is pumped with water decanted from the lagoons to a percolation filter made for the purpose.

Each drying-bed is formed by earthen banks about 2 ft. high. The area is provided with a system of permanent 2-ft. gauge tramways—laid to suit loco haulage, both steam and electric battery locos (see Fig. 7)—and provided with conveniently placed turnouts and crossings to allow temporary rails to be laid through the beds for the collection of dried sludge.

The time required for drying varies with the weather, but in dry weather it quickly cracks and admits air. Fig. 5 shows the appearance of the sludge three days, and Fig. 6 thirteen days, after it has been deposited. When it has become sufficiently dry to be lifted in lumps (see Fig. 8) it should be conveyed to the tip, as it is troublesome to the workmen when it gets into the dry-as-dust state; indeed, eye protectors have had to be provided in such cases. The embankments which are being formed of the dry sludge are about 15 ft. in height. When the lumps are tipped over the embankments, the drying is completed, and the estimations for calorific value dried at 212°F. give an average of 4,500 B.T.U., or something similar to the calorific value of ordinary house and shop refuse as burnt on a destructor.

Process Complete in Itself

It should be clearly understood that this process of sludge treatment is put forward as a complete process in itself, just as the Imhoff tank process was put forward by the German engineer, but without in this case any suggestion that the effluent from the sedimentation tank could be discharged into a stream. It effectually converts an exceedingly offensive colloidal mass of sewage into a dry substance, which might be kept in one's office for years without giving off more odor than would garden soil in similar circumstances. This conversion is accomplished without nuisance at any stage, and judging by pre-war costs the expense is similar to that incurred by London and Manchester. In a report which the author submitted to the Drainage Board in June, 1914, comparative costs were given as follows:—

	Pence per ton.
London	5.6
Birmingham	5.7
Manchester	6.9

The figures for cost given by the Royal Commission on Sewage Disposal are as follows:—

	Pence per ton (90% water).
Sea disposal	4.1 to 6.9
Trenching in soil	4.0 to 7.0
Pressing (for large towns)	7.7 to 12.6
Pressing and burning	18,0

Comparing sludge digestion at Birmingham with these figures, and assuming a wet sludge containing 90% water, it is approximately 5 pence per ton.

Cost figures are bound to vary, and in comparing sludge costs care should be taken to see that the percentage of water in the sludges coincides. Another statement showed the cost to be 6.3 pence per ton of sludge (86.6% water) made up as follows:—

Statement of Cost

1. Cost of tankage, digestion and pumping to drying beds:—

	£	s.	d.
Wages	1,622	10	0
Coal	710	5	0
Stores, etc.	90	9	0
Repairs, etc.	22	10	0
Water charges	75	5	0
	£2,520	19	0

The volume of sludge dealt with was 260,000 cu. yds. Approximate cost per cu. yd. of wet sludge, 2.25 pence.

2. Cost of drying sludge, lifting and carrying to tip:—

28,816 cu. yd. of dry sludge	£990 17 7
Cost of cu. yd. of dry sludge	8.3 pence
Cost of cu. yd. of wet sludge	2.5 pence

By adding (1) and (2), wet sludge 86.6% water = 4.7 pence per cu. yd., or 6.3 pence per ton.

That the scheme as illustrated at Birmingham is as perfect as it might be made, the writer does not claim. It has been an experiment, and has been extended from time to time always as an experiment. The great tanks and lagoons, with a total capacity of 28,000,000 gals., have been built in a temporary manner out of revenue as necessity has arisen, and the design or lay-out—apart from the biological side—if design it may be called, is obviously an improvization to meet current requirements and to obtain knowledge, rather than a consistent ideal based on some well-tested prototype. Indeed our calculations were so far out of truth originally that at one time we hoped that by an intensive fermentation at Saltley, the 20 brick-built tanks, which have a capacity of only 7,000,000 gals., would suffice for treatment of all the sludge arriving there.

Success Depends Upon Nitrogen

The adoption of the scheme which has been described was due to the impossibility of septicizing sewage and sludge together without nuisance. It has accomplished what it essayed to do, thanks chiefly to the consistent work of our chemist and superintendent of works, but its final success is dependent upon the profitable utilization of the nitrogen, which up till now has been lost sight of in the predominating desire to get rid of sludge with a minimum of nuisance.

With the object of recovering from the dry sludge nitrogen and other products of distillation, a boat-load of it has been sent to the Saltley Gas Works each week for some time. Absolutely trustworthy results will not be available until more producers are installed there, but the gas works engineer, Mr. Chaney, says that he is willing to give 3s. 6d. per ton for it delivered in boat at the Saltley Gas Works.

The fact that they are possessed of a plant capable of treating sludge for a moderate sum does not satisfy the Drainage Board that they have done all that they might to utilize the nitrogen and grease found in it to the best advantage. Some boards might say that they have done all that is required of them by controlling effectually an enormous potential nuisance, such as is represented by arresting from 300,000 to 400,000 tons of sludge and converting it into a non-smelling dry substance (which under no circumstances can be reconverted into malodorous sludge) without establishing a huge municipal trading concern for the recovery of waste products, but the Drainage Board realize the possibility of doing more than they have done, and further that it is their duty to do more if that is possible, and with that in view they entered into a contract with the Anglo-Continental Fertilizers Syndicate, Ltd., just before the war began, by which that company agreed to treat about one-fifth of the Birmingham slude with the view of recovering from it both fats and fertilizers, but chiefly fertilizers. The outbreak of war upset the project for the time being, the Treasury absolutely forbidding the expenditure of money on work of this kind, with the immediate result of encouraging the gas works experiments, which have turned out as well, and now that the war is over the company's plans are to be put into the hands of builders whose initial work is essential before the company can begin to fulfil their agreement.

Fertilizer Company's Scheme

The scheme put forward by the company is one which the author hopes to deal with in a subsequent communication, but briefly it is as follows: The sludge is warmed to a temperature of about 90°F., when a small amount of yeast (from 0.5% to 1%) is added, and the mixture allowed to remain in suitable tanks for a period of 24 hours, provision being made to keep the mixture at the optimum temperature of 90°F. As the result certain important changes take place in the character of the sludge, the particles coagulating into a compact mass which separates from the water and rises to the surface, being buoyed up by the gases evolved from the ferment. The water is run off through perforated pipes, which, whilst allowing the liquid to pass, holds back the thick sludge, and enables the separation of the water from the sludge to be effected easily and quickly, and with a minimum of labor.

Some changes other than physical are brought about by the process, and the colloids are affected to some extent, with the result that the sludge is improved for subsequent treatment.

Fermentation reduces the sludge from, say 90% water content—which is the average of ordinary sludges—to 80%, equal to the reduction of one-half the water content, thus reducing the cost of treatment. The operation being a static one the cost of working is small.

The heat used for warming the sludge is obtained from the drying process, and may be either furnace gases, or hot air and vapor from the dryers, which would be otherwise wasted.

Product Reduced to Powder

The further treatment of the sludge depends to some extent on local conditions. Moisture may be got rid of by treatment in dryers heated by means of hot air, by direct heat, or in steam-jacketed drying-pans. It can also be reduced to about 50% by an intermediate process of pressing in ordinary sludge presses, and the cake, after being broken into small pieces, finally dried to a moisture content of from 10% to 15%.

The product is reduced to a fine powder for easy application to the land; it is then in a suitable condition for further treatment if grease is present in sufficient quantity to justify its recovery.

This process is too complicated to be disposed of in a few sentences, and the writer proposes to give a detailed account of it when the works are erected and in full operation.

In the end of 1918 a committee appointed by the Institution of Municipal and County Engineers impressed upon the government the need for investigating the whole question of recovering from sewage sludge products which are worth salving. One of the government departments (the National Salvage Council) had already made preliminary inquiries at the Bradford and Huddersfield sewage works, which convinced them that grease was being recovered profitably at both of those works, and the reply of that department was both prompt and sympathetic; later, the Board of Agriculture and the Local Government Board took cognizance of the institution's demands, and in consequence a committee was formed consisting of one representative of each of the following—viz., the Local Government Board, the Board of Agriculture, the National Salvage Council, the Institution of Municipal and County Engineers, and two experts on the salvage of grease from sewage sludge—the one an engineer and the other a chemist.

This committee, formed under the ægis of the government, has just issued their report, from which the writer makes the following extracts, with the cognizance and approval of the Assistant Director of the National Salvage Council, who acted as chairman of the committee:—

"We recommend that inquiry should be instituted in other towns* as to the grease content of local sludges, as we are of opinion that where a sludge after acidification contains 15% of grease calculated on a perfect dry basis, it is profitable to recover the grease, provided the selling price is not less than £15 per ton and 100 tons of wet sludge are available for treatment daily. In these figures no note is taken of the value of the dried degreased sludge; but this is saleable, and provided the nitrogen content is 2% or more, has a market value of 10s. to 30s. per ton.

"We are satisfied that there is a shortage of organic fertilizers in the country, and that it is likely to continue.

Nitrogen Lost by Delay

"It may be taken that the amount of wet sludge produced annually in England and Wales is roughly about 250 tons per thousand of the population drained. Assuming the population drained to treatment works to be 24,000,000, the average quantity of wet sludge produced annually is about 6,000,000 tons, equal to 600,000 tons dry matter (based on 90% moisture in wet sludge), of which quantity we estimate from the data before us that not more than 12½% is utilized for fertilizing purposes.

"We are of opinion that although the sludge, as at present disposed of by local authorities after air-drying or pressing, does not contain sufficient nitrogen to enable it to compete with artificial fertilizers in manurial value, there is sufficient nitrogen in the fresh sludge, as it is removed from the tanks, to give it a definite fertilizing value. We are further of opinion that considerable quantities of nitrogen are lost by delay in disposal, in some instances as much as 50% or more of the original quantity in the sludge, and that the nitrogen so lost is the most valuable from the point of view of the possible fertilizing value of sewage sludge.

"We consider that before any attempt is made to impress upon local authorities the advisability of utilizing sewage sludge as a fertilizer, efforts should be made to increase the manurial value of sludge by some method of treatment designed to fix more of the original nitrogen in the sludge. If this could be done, it would probably add a value of 10s. per ton for each additional per cent. of nitrogen retained in the sludge for use as a fertilizer. In this connection it has to be borne in mind that at the present time many local authorities are not only unable to sell the sludge, but in some instances are called upon to pay for its removal from the works even after it has been pressed into cake.

Activated Sludge More Valuable

"We recommend that controlled experiments be carried out on a suitable scale at selected disposal works in order to ascertain the best method of dealing with sludge so as to retain as much as possible of the original nitrogen and produce a fertilizer or fertilizer base.

"We have not specifically inquired into the results to be obtained from sewage treated by the activated process, but as a result of visits made by the committee to the Manchester

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*Reference had been made to towns engaged in the woolen industries.

and Sheffield Sewage Disposal Works, where the activation by aëration and activation by agitation processes respectively are under investigation, it would appear that the residual sludge from such processes contains a higher percentage of nitrogen, and consequently as a fertilizer would be of greater value than sludge produced in the ordinary way. Experiments have been commenced to ascertain its fertilizing value, but further investigation is necessary to find out the best method of dewatering and drying.

"We are strongly of opinion that the time has arrived when a government committee should be appointed to follow the recent developments in the treatment of sewage and the recovery and utilization of by-products, with a view to collecting information for the guidance of local authorities and for the benefit of agriculturists."

This document from which the writer has taken extracts shows that the committee were under no illusion about the difficulties which must be overcome if substantial progress is to be made. Underlying the report there is a conviction that it is a matter of great importance that both fertilizers and fat should be recovered, that manure for which arable and pasture lands are yearning should not be thrown away. There is no suggestion that local authorities should spend a shilling to recover elevenpence, but it is implied that some local authorities have unwittingly allowed valuable substances to go to waste by failing to erect suitable plant for their recovery.

The need for creating this attitude of mind has been reinforced by the war. It has been proved that the efficient cultivation of the soil, which is impossible without manure, is quite as essential for the Defence of the Realm as the building of ships, and so, too, it may prove that the conservation of nitrogenous matter which now goes to waste is a national necessity.

COST OF CONSTRUCTING SEWERS AND WATER MAINS IN MONTREAL SOUTH, QUE.

DURING 1918, about 22,230 ft. of 6-in., 8-in. and 10-in. water main, and 25,300 ft. of 24-in., 12-in. and 9-in. sewer were constructed for the town of Montreal South, Que. The work was done by contract, and the following figures are the actual cost to the contractor. The contractor, by the way, made no profit.

The sewer work covered the construction of mains in 17 streets. The material in which the trenching was done consisted of hard pan at the surface, a layer of shale, a bed of trap rock 3 to 5 ft. thick at 5 to 8 ft. from the surface, and shale below the trap rock. The rock excavation was paid for at the rate of $4 per cubic yard over the other material. The rates of pay for labor were as follows:—

	Per hour, cents.
Common labor	35
Pipe layers	37½
Drillers	40
Blacksmith	40
Foreman	45
Single horse and driver	40
Double team	70

The units costs on four jobs were as follows:—

Materials:—	Job No. 1. 24-in. sewer, per lin. ft. of sewer.	Job No. 2. 12-in. sewer, per lin. ft. of sewer.	Job No. 3. 12-in. sewer, per lin. ft. of sewer.	Job No. 4. 9-in. sewer, per lin. ft. of sewer.
Pipe	$1.800	$0.590*	$0.580*	$0.370*
Cement and oakum for joints	.160	.052	.052	.040
Manholes†	.270	.290	.246	.218
Coal and oil	.015	.012	.012	.009
Total material	$2.245	$0.944	$0.890	$0.627
Labor:—				
Cartage	$0.065	$0.050	$0.050	$0.027
Excavation and pipe laying	1.755	1.940	1.850	1.590
Rock extra	1.947	2.082	1.265	1.006
Back filling	.717	.624	.605	.515
Total labor	$4.484	$4.696	$3.770	$3.138
Grand total, material and labor	$6.729	$5.640	$4.660	$3.765

*Pipe and branches. †Brick with concrete bottom and cast-iron cover, cost $70 each.

Job No. 1 consisted of 1,780 ft. of 24-in. vitrified pipe sanitary sewer with 7 manholes. The average cut was 9½ ft. in hard pan, shale and trap rock. The total excavation was 2,350 cu. yds. with 867 cu. yds. of rock extra.

Job No. 2 consisted of 2,970 ft. of sanitary sewer, 107 6-in. branches, and 12 manholes. The average depth was 10 ft. in hard pan, shale and trap rock, with the latter close to the surface in places and varying 3 to 5 ft. in thickness between shoals. The total excavation was 3,260 cu. yds. with 1,550 cu. yds. of rock extra.

Job No. 3 consisted of 11,650 ft. of 12-in. sanitary sewer laid in five streets, 296 6-in. branches, and 41 manholes. The average cut was 8½ ft. in hard pan, shale and trap rock.

Job No. 4 covers 8 to 10 ft. of 9-in. sanitary sewer on nine streets with 284 6-in. Y-branches, and 27 manholes. The average cut was 8 ft. in hard pan, shale and rock.

Owing to the direction of veins in the rock, practically the whole of the work was done by hand, except the heavy fill on backfilling, which was done by steam tractor shovel.

The water main construction involved the laying of 3,560 ft. 10-in., 7,070 ft. of 8-in., and 11,600 ft. of 6-in. Class C cast-iron pipe. All the materials except the valves were imported from the United States. Cast-iron pipe and fittings cost $46.00 per ton (2,000 lb.) on car Philadelphia. Freight and duty brought the cost to $77.00 per ton on car 2 miles from line of work. The rates of pay were as follows:—

	Per hour, cents.
Common labor	30
Pipe layers	35
Foreman	40
Single horse and driver	40
Double team	70

The following figures represent materials and laying pipe and not excavation, as the work was done under separate contract during the laying of sewers. The sewer contract providing for the backfilling over the sewer pipe to the depth of 1 ft. to allow the water main to be laid, the sewer contractor completing the backfilling.

Materials:—	10-in. main, per lin. ft. of main.	8-in. main, per lin. ft. of main.	6-in. main, per lin. ft. of main.
Pipe	$2.747	$2.040	$1.387
Gate valves and boxes[1]	.109	.111	.060
Hydrants[1]	.109	.119	.128
Leadite[2] and coal oil for heater	.080	.067	.051
Total materials	$3.045	$2.337	$1.626
Labor:—			
Cartage from cars to line of work[3]	$0.035	$0.025	$0.017
Grading trench, pipe laying, packing pipe in trench, testing	.437	.378	.279
Total labor	$0.472	$0.403	$0.296
Grand total labor and material	$3.517	$2.740	$1.922

[1]6 10-in. double gate valves and boxes at $65 each, and 6 6-in. balance valve hydrants (6 ft. fill) at $65 each, with 10-in. main; 19 8-in. double gate valves and boxes at $41.50 each, and 13 6-in. balance valve hydrants at $65, with 8-in. main; 22 6-in. double gate valves and boxes at $31.50 each. and 22 6-in. balance valve hydrants at $65, with 6-in. mains.

[2]Leadite at 20 cents per lb.

[3]Cartage at $1 per ton.

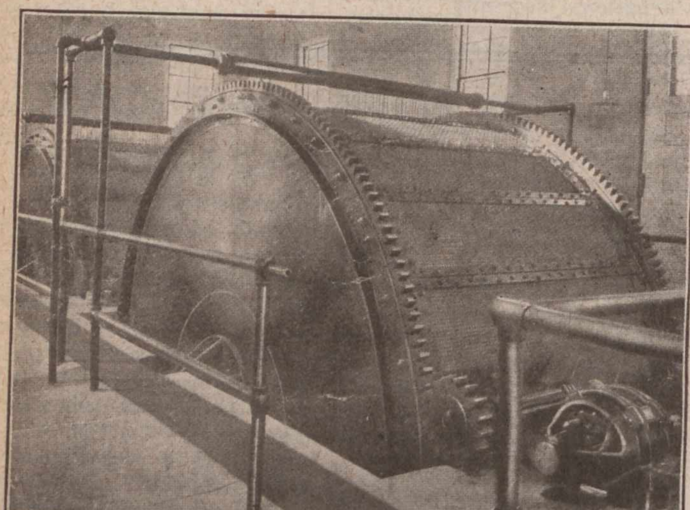
The above information was written by Ernest Drinkwater, consulting engineer, Montreal, for "Engineering and Contracting," Chicago, to whom *The Canadian Engineer* is indebted for same.

ROTARY WATER SCREENS

By L. N. Thompson
Department Engineer, St. Paul, Minn.

MOTOR-driven rotary screens are now being used very successfully by the city water department, St. Paul, Minn., for removing vegetation and solid particles from the drinking water. Prior to November, 1917, when the present system was put into operation, stationary screens were used which were cleaned with difficulty and required constant care, and were not very satisfactory. The rotary screens require practically no attention and have operated continuously since their installation.

The screens, as will be seen by the accompanying illustration, are cylindrical in shape, approximately 7 ft. long



Rotary Water Screens at St. Paul

and 14 ft. in diameter, with framework of structural steel, and have the appearance of large drums. One end is sealed tight by steel plates, the other end being left open for the entrance of water into the drum. The sides of the drum are covered with 24 sections 80-mesh Monel metal screens, which are also reinforced by ¾-in. mesh No. 8 copper wire.

The entire drum rotates about a hollow cast-iron shaft, or axle, 8 ins. inside diameter. By using two sets of roller bearings, very little power is required to operate them. A concrete wall, which is built at the open end of the drum, with an opening approximately the same radius as the drum, prevents the escape of water around the screens. Rubber belting is used between the concrete and metal frame to seal the joint.

Operation of the Screens

The unscreened water enters the open end of the drum and passes through the screens, leaving the dirt on the inside face. On the inside of the drum, near the top, extending the entire width, is a 4 by 6 ft. iron wash-water trough. Directly above the trough, on the outside of the screen, is a 4-in. pipe, the under side of which has a row of small holes, from which high-pressure streams wash through the screens and into the wash-water trough below. As the screens revolve past the trough, they are thus continually cleaned. The wash water is carried away through the hollow shaft, a very small amount of water being required to clean the screen thoroughly each revolution.

Drums Driven Independently

Either drum is driven independently of the other by a 7½-h.p. electric motor. A driving gear is connected at either end of the drum and any tortion is taken up by a differential. A speed regulator and two changes of speed in the gears give any desired rate of revolution and cleaning.

Two screens have been installed and provision made for a third. During the past year approximately 17,000,000 gallons passed the screens daily, which is far from their maximum capacity.

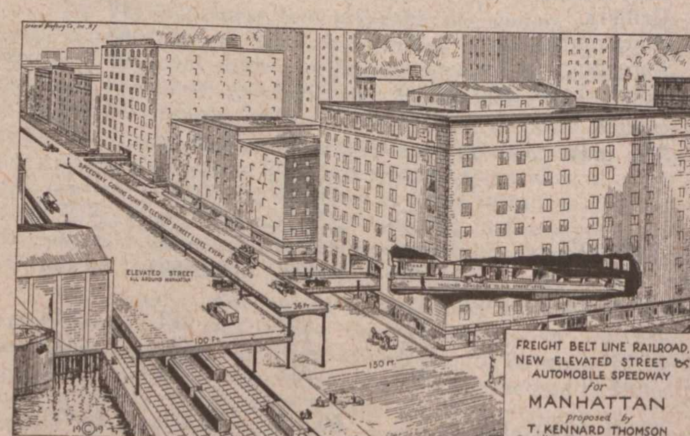
The screen chamber was built so that either or both screens can be shut off from service, and water passed around them without being screened. The screens were built by the St. Paul Foundry Co., and were designed under the direction of G. O. House, general superintendent, and W. N. Jones, engineer. The screen chamber was designed and constructed by J. W. Kelsey and L. N. Thompson, department engineers. All work was done by force account.—From "Fire and Water Engineering."

CANADIAN ENGINEER PROPOSES BIG RAILWAY SCHEME FOR NEW YORK CITY

DR. T. KENNARD THOMSON, a well-known engineering graduate of the University of Toronto, who has been in private engineering practice in New York City for many years, has designed a proposed belt line railroad to encircle Manhattan Island. The railroad is intended for freight service only. Above it, as shown in the accompanying sketch, is to be an elevated street 100 ft. wide, with a separate speedway 36 ft. wide. The speedway comes down to the level of the elevated street at every 20 blocks. Spaced only a few blocks apart, there are to be a number of inclined concourses from the elevated street to the old or lower street level. The elevated street and speedway, like the railroad, are to encircle the entire island.

Dr. Thomson declares that capitalists who are associated with him in the scheme are willing to build the railroad, streets and concourses entirely at their own expense, and donate the streets and concourses to the city without remuneration, provided that they are given a free franchise for the railroad.

The estimated cost of the whole scheme is about two hundred million dollars, but Dr. Thomson states that there are two hundred business men in New York who will finance it if the franchise is granted. When the scheme was sub-



Proposed Railway and Elevated Street, New York

mitted last month to the city's Board of Estimate and Apportionment, it was referred to the Committee on Franchises. Whether the franchise will be granted or not is a matter of considerable doubt; nevertheless the many Canadian engineers who know Dr. Thomson will, no doubt, be much interested in his ingenious scheme.

The American Association of Engineers received 902 applications for membership between October 1st and October 23rd, and the qualifications committee approved the admission of about 700 members.

The annual meeting of the American Road Builders' Association will be held November 7th at the Automobile Club of America, New York City. There will be two sessions for the purpose of receiving seven committee reports and annual reports of officers, electing new officers, etc.

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PRINCIPAL CONTENTS

CHICAGO DRAINAGE CANAL DIVERSION

AGAIN comes the plea, often repeated, for permission to increase the diversion of water for the Chicago Drainage Canal. This time Francis C. Shenehon, Dean of the College of Engineering, University of Minnesota, who was at one time District Engineer of the U.S. Great Lakes Survey, is its special advocate. He proposes that the effects of the diversion be compensated for by remedial works on the Great Lakes, these works to be financed by the Chicago Drainage Canal Commission.

The history of the canal is too well known to warrant repetition. It suffices to say that to-day the commissioners in charge of the drainage district, in defiance of all governmental authority, are diverting approximately 10,000 cubic feet per second, while the permit issued by the U.S. Secretary of War, in whom is vested jurisdiction over, and discretionary powers appertaining to, the navigable waters of the United States, gives them the right to divert not more than 4,167 cubic feet per second.

Canada has protested many times against this extraordinary state of affairs, but to no avail. As a matter of fact, the Canadian authorities were not even consulted when the original permit was granted. Many are the arguments against increased diversion and in favor of limiting the canal to the original permit of 4,167 cubic feet per second. Despite Canadian protests, the United States government has taken no adequate steps to enforce its orders and to prevent this wanton breach of constituted authority.

Mr. Shenehon now presents this scheme of remedial works which, if accepted, would allow the drainage commissioners to perpetuate their illegal diversion, and which would afford an easy method for the United States government to step out of its difficult position of being unable, even with the authority and prestige of its Supreme Court, to enforce its rightful prerogatives.

But this proposition is not acceptable to Canada; although remedial works on the lakes may partially compensate for the injuries to navigation, they cannot compensate for the power that will be lost to both countries as a result of the diversion. It is generally conceded by those who have been in intimate touch with the original scheme, that the development and sale of the power now obtained on the Drainage Canal under a 40-ft. head, is the great incentive to the diversion of additional water. The sale of this power is in the hands of the commissioners, and it finds a ready market in the drainage district.

This water, if carried along in its proper course through the Niagara and St. Lawrence rivers, could be used at the several points of development under a total head of fully 500 ft., which means approximately 500,000 h.p. Canada's share of this 500,000 h.p. will be permanently lost if the Chicago diversion is legalized by the acceptance of "compensation" for damages to navigation.

BRITISH OPTICAL FIRMS BUSY

ONE result of the war in England has been an enormous development of the optical manufacturing firms, states A. J. Ames, managing director of E. R. Watts & Son Canada Limited, who recently returned to this country after a four months' visit to his firm's English factory.

"As an instance of this development," says Mr. Ames, "I might mention that within a fortnight of my sailing for Canada, our London house had received orders for the following important geodetic instruments:—

"Twenty 12-in. micrometer transit theodolites reading to one second; fifteen 8-in. micrometer transit theodolites reading to two seconds; and one hundred and fifteen 6-in. micrometer transit theodolites reading to ten seconds.

"This does not take into consideration large orders for ordinary surveying and scientific instruments, nor does it reckon with the very large number of instruments connected with the various war departments in Britain, contracts for which are still being concluded.

"In pre-war time one seldom heard of an order for 12-in. micrometer theodolites for more than two at a time, and very often only one of these most important and precise instruments was ordered."

With labor conditions as they are in England, one wonders where all the business is coming from to keep the large optical firms so busy. However, everyone who has visited Great Britain since the war agrees that a wonderful change has taken place in the "old country," and that hereafter they are going to be more "up and doing" than ever. When British competition strikes its stride, Canadian and United States firms may have to hustle for their fair share of Canada's business.

NOVA SCOTIA POWER COMMISSION

UNDER the Power Commission Act passed at the last session of the Nova Scotia Legislature, a power commission for that province was recently appointed and is undertaking definite investigations with a view to an early development of certain water powers adjacent to the city of Halifax. The members of the commission are Hon. E. H. Armstrong, commissioner of Public Works and Mines (chairman), R. H. MacKay, of New Glasgow, and F. C. Whitman, of Annapolis. K. H. Smith, hydraulic engineer of the Dominion Water Power Branch, who for some time past has been in charge of hydrometric work and water power investigations in the maritime provinces and at the same time has acted as engineer to the Nova Scotia and New Brunswick authorities concerning water power matters, has been appointed chief engineer and acting secretary of the commission. It is expected that Mr. Smith will be able to continue in his present capacity with the Water Power Branch.

PERSONALS

J. C. REILLY, who was recently appointed acting general secretary of the Association of Canadian Building and Construction Industries, was born September 10th, 1881, in Toronto. He received his primary education at the Clinton St., Manning and Ryerson public schools, Toronto, and after two years in a law office and seven years with R. G. Dun & Co., he entered McGill University to study arts and theology. Mr. Reilly graduated from McGill in 1910, and became assistant at the St. James' Methodist Church, Montreal. Two years later he resigned in order to pursue further theological studies at the Harvard Divinity School, Boston. During the war he was overseas with the Y.M.C.A., returning in July this year. Mr. Reilly seems to have liked building construction as well as theology, as he was employed in various capacities by building contractors and architects during the summer vacations throughout his college courses. He was timekeeper, foreman, etc., on various large construction jobs in Montreal, including the McGill Engineering building. He has decided not to return to the ministry at present, and it is expected that his appointment as permanent secretary of the Association of Canadian Building and Construction Industries will be confirmed at the next annual conference of the association, which will be held the week of January 26th, 1920, in Ottawa.

J. A. DUCHASTEL, city engineer of Outremont, Que., and past president of the Canadian Good Roads Association, has been nominated as one of the vice-presidents of the American Road Builders' Association.

A. W. SWAN, assistant advertising manager, Canadian Ingersoll-Rand Co., Ltd., Sherbrooke, Que., has resigned in order to accept an appointment as assistant secretary of the Engineering Institute of Canada, with headquarters at Montreal.

DR. ERNST STEINER, a member of the Swiss political and trade mission to the United States, is in Canada for the purpose of investigating our hydro-electric developments. Dr. Steiner has visited Niagara Falls twice and expects to go to Montreal and Winnipeg. He is a graduate of the polytechnic school at Zurich and is in private practice as a civil engineer. In an interview with *The Canadian Engineer*, Dr. Steiner stated that the Queenston-Chippawa development will be the greatest in the world at the time of its completion.

OBITUARY

J. E. SIROIS, president of the Corporation of Quebec Land Surveyors, died recently at his home in St. Anne de la Pocatière, Que., aged 61.

The firm of C. H. & P. H. Mitchell, Toronto, has been consulted by the Nova Scotia Power Commission with a view to definite action at an early date.

Letter to the Editor

RULES FOR DRAFTING PRACTICE

Sir,—In reading the rules for drafting practice, by H. N. Savage, published in your issue of October 16th, I note that the dimensions of the drawings are somewhat similar to those originated by L. L. and P. N. Nunn for the Ontario Power Co. during the construction of the No. 2 pipe line. Each size is designated by a letter and the dimensions are multiples of letter size, as follows:—

Letter.	Out to Out.	Inside Border Line.
L	8½ by 11 ins.	8 by 10½ ins.
M	11 by 17 ins.	10¼ by 16¼ ins.
A	17 by 22 ins.	16 by 21 ins.
B	22 by 34 ins.	21 by 33 ins.
C	34 by 44 ins.	32½ by 42½ ins.
D	34 by (44+) ins.	32½ by [(44+)—¾] ins.

GERALD HAMILTON.

Niagara Falls, Ont., October 21st, 1919.

CORRECTION

IN the report of the meeting held by the Toronto branch of the Engineering Institute of Canada for the adoption of a schedule of salaries, qualifications, etc., for engineers, the following paragraph appeared on page 397 of last week's issue of *The Canadian Engineer*:—

"After Mr. Clark had read the schedule in regard to railway work, Mr. Harkness inquired regarding the present rate of pay received by railway brakemen, and was informed by Mr. Clark that it amounts to between $300 and $330 per month."

Mr. Clark calls attention to the fact that the rate of pay mentioned by him is that received by railway freight conductors. Mr. Harkness had inquired regarding brakemen, but Mr. Clark's reply did not refer to brakemen's wages.

Pion & Grothe, contractors, have asked the city of Montreal to arbitrate their claims with regard to the construction of the Lasalle bridge, and have instructed F. C. Laberge to act for them. The city council recently decided to settle the claims in accordance with the Act passed by the provincial legislature.

Following is a partial list of Canadian patents recently issued through the agency of Ridout & Maybee, Toronto: Edward B. Killen, vehicle spring suspensions; Fred L. Rapson, lifting jacks and the like for use on motor, road and other vehicles; Woodington & Young, abrasive wheel; J. Stone & Co., Ltd., valves for fluid pressure systems adapted for operating bulkhead and like doors; Farm & Dairy Machinery Co., pneumatic valve actuating devices.

A public meeting of the North Atlantic Division of the National Highway Traffic Association will be held at the Automobile Club of America, 247 West 54th St., New York City, at 8 p.m., November 7th. The program includes the following: Progress report of committee on "Sign Posting for Detours and Through Routes in Municipalities," by Elmer Thompson (chairman), secretary, Automobile Club of America; "Present Status of Impact Tests on Roadway Surfaces," by A. T. Goldbeck, testing engineer, United States Bureau of Public Roads; "Motor Vehicle Traffic which Requires the Use of Cement-Concrete Foundations," by W. G. Thompson, state highway engineer of New Jersey; "Relation of the Motor Truck to the Railroad," by C. W. Reid, manager, Transportation Bureau, Federal Highway Council. Dinner will be served in the grill room of the club at 6.30 p.m. The public is invited to attend both the dinner and the meeting. Dinner reservations should be addressed to Elmer Thompson, 247 West 54th St., New York City.