Willis Chipman discussed Mr. Lafreviere's paper in a most interesting and instructive manner. Whe he started practice as a consulting engineer in Ontario, there was not a sewage disposal nor a water purification plant in Canada. He had seen the various systems introduced—some by promotors who lacked good faith, and these systems have passed away or are passing—and believes there is great progress yet to be made in sewage disposal.

Tendencies to Nationalize

Maintenance is the key to success in sanitary structures just as it is in roads, said Mr. Chipman, but here the engineer suffers from the machinations of the professional politician who always prefers to mortgage the future than to raise the present tax rate. Many structures needing only repair and maintenance have been abandoned unnecessarily.

Mr. Chipman called attention to the fact that there is not one engineer on the Ontario board of health. He says it largely rests with the engineers themselves to decide when they will take matters into their own hands and improve these conditions.

Mr. Chipman also called attention, practically without comment, to the very great increase in tendency to nationalize everything. First the canals, then the steam railways, now the radial railways in Ontario, and the water supply systems to a certain extent, and he thought that the public is looking to the engineers for guidance in these matters.

There have been many encroachments on the status of the engineer, said Mr. Chipman, and the engineers should support the movement for legislation and get some recognition from the provinces. They should also persuade the schools and universities to give the engineers better training in English so that they can express their ideas in as clear a manner as can other professional men.

Wise Administration of Power Regulations Necessary

Prof. Peter Gillespie drew attention to a resolution adopted two years ago urging that the institute secure the appointment of engineers to the boards of health.

J. B. Challies, director of water power for Canada, in discussing Mr. Lefebore's paper, said that water power development is largely a matter of administration of the power regulations; that capital is timid and must not be frightened away from Canada by restrictions that are unduly onerous. He particularly called attention to a remark made by Prof. Scott in replying to a toast at the banquet,—namely, that the demand for central electric power is doubling every five years. If that demand be projected into the future, and if it continues at the same rate of increase, the task ahead of Canadian hydro-electric engineers is no mean one. Mr. Challies stated that the unit cost of the Quebec Streams Commission's work compares very favorably with other similar work.

C. H. Keefer, consulting engineer, Ottawa, voiced an appreciation of the Public Utilities Commission as an enormous asset to the province of Quebec.

Closing Business of Convention

The last business or technical session of the convention was held Thursday afternoon, when the following papers were read: "The Policy of the Air Board of Canada," by Lt.-Col. O. M. Biggar; "The Pulp and Paper Industry," by F. van Bruyssel; and "Quebec's Forests," by G. C. Piché, chief of the Forest Service, Department of Lands and Forests, Quebec.

The convention closed Thursday evening with a smoker and concert in the Rose Room, Windsor Hotel, with several hundred in attendance. There were no speeches but an excellent program of vaudeville entertainment by Wilkie Bard, the English Comedian, and numerous other performers from local theatres. Toward the end of the evening several of the leading players from the Chu Chin Chow company joined the party and added to the entertainment. The "hit" of the evening was the recitation of two of Dr. Drummond's poems by Chas. Godwin. Like all previous sessions of the convention, it was unanimously agreed that the smoker was the best ever held by the Engineering Institute of Canada.

FLOW IN UNIFORM CHANNELS WHEN THE WATER-SURFACE IS NOT PARALLEL TO THE INVERT*

By Prof. Alex. H. Jameson, M.Inst. C.E.

In ordinary cases of flow in open channels of uniform section, the water surface is parallel to the invert, and it is to such "uniform flow" that the ordinary formulæ apply whether of the Chezy form, $v=C(mi)^{½}$, or in the much more satisfactory and modern form, $v=cm^x i^y$. For convenience, call the uniform depth of the water for a given discharge at a given gradient the "normal depth" for that discharge at that gradient in the given channel. If, however, the depth of the water is increased above the normal—e.g., by passing over a weir which can only pass the given discharge by raising the water surface there, the water surface can be no longer parallel to the invert, but forms a "backwater curve" for a long distance back before the water regains its normal depth. Similarly, if there is a sudden drop in the bed or the water passes over a weir which does not require to pass the given discharge, a head equal to the difference between normal level and weir level, the water surface forms a "drop-down curve" from the normal water level at a long distance back to the level necessitated by the weir or drop (which latter is similar in effect to a weir). In such cases the depth, water area, velocity and hydraulic mean depth vary along the channel, consequently so does the gradient of the water surface. In addition the "velocity head" $(v^2/2g)$ is constantly decreasing (or increasing) and the water surface must fall less (or more) steeply to provide for this change in the kinetic energy of the water. A third case of "non-uniform" flow occurs when the invert of the channel is level or rises against the flow. Here the water surface must fall, and as the depth decreases it must fall, as before, in a curved profile.

This subject is treated at considerable length in Gibson's and in Merriman's "Hydraulics," but only for the case of a very broad and shallow channel of rectangular section (such as some rivers and canals), which is very different from the conduits used by water engineers. This has been done to employ a section in which the hydraulic mean depth equals the depth of the channel at every point, as this alone gives a purely mathematical solution. Even then the solution is one of considerable difficulty, and to simplify it tables of the "backwater" and "drop-down" functions for various values of (depth/normal depth) have to be used. In addition, the Chezy formula is used to simplify the mathematics, but without varying the "constant" with the varying hydraulic mean depth, which, of course, is essential to obtain at all accurate results.

In the appendix the author shows that if what he calls the "flow-function," $\phi=dl/dh=[l-(v^2b/ag)]/[i-i^1]$ is plotted as a curve for various depths, h, of the water in the channel, where v is the velocity for that depth—i.e. (discharge/area), b=breadth of the water surface, a=water area at that depth, $g=32.2$ as usual, i=the gradient of invert and i^1=the calculated gradient of the channel to discharge the given quantity of water at a uniform depth h, then the *area* of this curve between any two depths h_1 and h_2= the *length* 1_1-1_2, in which the *depth* increases or decreases from h_1 to h_2. This function is not difficult to calculate once the *water areas*, and hence the velocities and hydraulic mean depths, have been found at a sufficient number of depths, while i^1 can be found by an "alignment diagram" from the hydraulic mean depths and velocities, or from charts giving gradients, hydraulic mean depths and velocities.

As shown in the appendix, $1/\phi=dh/dl=[i-i^1]/[l-(v^2b/ag)]$=rate of change of depth with length along the channel. When h="normal depth," $i^1=i$, the rate of change of depth is zero, and the depth remains constant. This is, of course, as it should be. When $(v^2b/ag)=1$—i.e., when $v=(ag/b)^{½}[=(gh)^{½}$ in a rectangular conduit), the denominator becomes zero, and the rate of change becomes *infinite*—

*From paper read before the Institution of Water Engineers.