

## DESIGN OF NEW AND RELIEF SEWERS.

IN several previous issues (August 27th and September 3rd) of *The Canadian Engineer* articles appeared dealing with special phases of the new sewerage plan for the City of Cincinnati. The sewerage investigations formed the subject of a very complete report recently issued. Another portion of it that contains an abundance of information for sewerage and municipal engineers is based on that portion of the work in connection with the design of new and relief sewers, which is chosen as the subject of this article. This work was under the direction of Mr. F. J. Van Hook, from whose report we present the following:

A critical study of the existing sewerage system of Cincinnati was made with a view to recommending such improvements as would provide relief in districts subject to flooding in times of storm, and such new sewers as may be required for districts not provided with sewerage

larly and continuously used in Cincinnati for the determination of the amount of storm drainage for which sewers and drains should provide, a review was made of the more commonly accepted methods and formulæ to ascertain if any one of these was applicable to local conditions.

Table I.—Rates of Precipitation Which Fix Lower Limit of Excessive Precipitation in Storms Since 1904.

Period (minutes).	Rate (inches).	Period (minutes).	Rate (inches).
5	0.25	40	0.60
10	0.30	45	0.65
15	0.35	50	0.70
20	0.40	60	0.75
25	0.45	80	0.80
30	0.50	100	0.90
35	0.55	120	1.00

Most of the run-off formulæ are based on conditions existing in the particular city or locality for which they

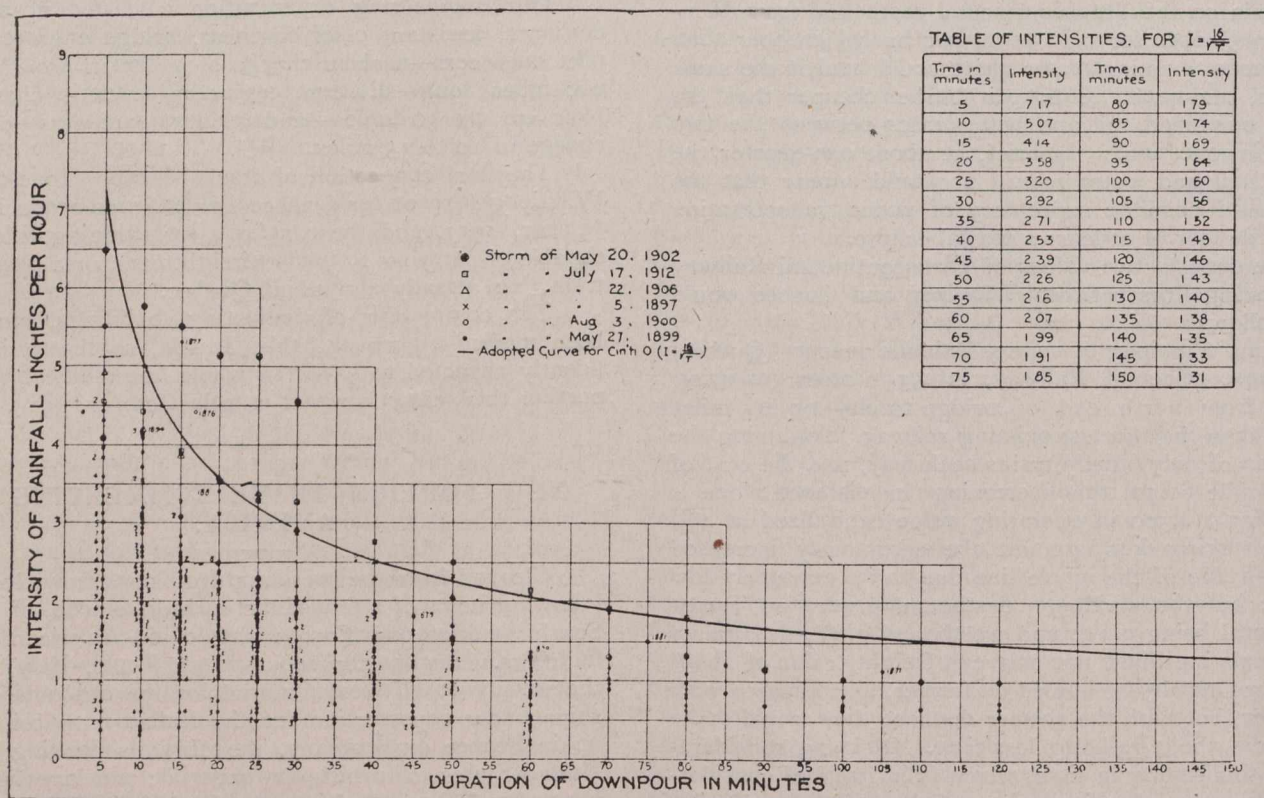


Fig. 1.—Relation Between Intensity and Duration of Rainfall, Cincinnati, 1871 to 1912.

facilities. In the design for the new sewers recommended the combined system of sewerage was employed. Since the quantity of house sewage is relatively very small, as compared with the storm water-flow, it is evident that the problem presented is one of storm sewer design.

**Rainfall and Run-Off.**—Before taking up the detailed studies for sewerage improvements, analyses were made of the several factors controlling the determination of the amount of surface drainage for which provision should be made in the design of storm sewers. The factors considered are as follows: (1) Intensity of rate of rainfall. (2) Relation between rainfall and run-off, or the proportion of rainfall which immediately reaches the sewers. (3) Extent and shape of the area to be drained. (4) Surface slopes.

Many attempts have been made to establish relations between these factors and to express them in formulæ. As there appeared to be no method which had been regu-

were derived and it is, therefore, evident that these should not be used excepting under similar conditions. Also, some formulæ are made dependent upon an adopted maximum rate of rainfall which is kept constant. On the other hand, the use of the so-called "rational" method of analysis through the introduction of the element of time permits of a varying rate of rainfall immediately dependent upon the area, shape and slope of the territory to be drained.

Also, on account of the unusual topographic features prevailing in Cincinnati, producing numerous small drainage areas with comparatively steep surface slopes in the outlying districts and flat slopes in the older portions of the city, it is important that the proper rainfall intensity and run-off for short periods of time should be accurately determined.

In view of these facts, it was concluded to adopt the "rational" method in determining the amount of storm