Squaring both sides—

$$h_1^3 = \overline{\cdot 52567})^2$$
$$h_1 = \overline{\cdot 52567})^{\frac{2}{3}}$$
$$\log.\ \cdot 52567 = \bar{1}\cdot 7207132 \times \tfrac{2}{3}$$
$$\cdot 65 = \bar{1}\cdot 8138088$$
$$\text{Hence, } x = \cdot 68 - \cdot 65 = \cdot 03 \text{ feet}$$
$$= \cdot 36 \text{ inches.}$$

This is the depression in the water surface of the tank necessary to maintain equilibrium between influx and efflux.

When the sills of the notches are at different elevations, the problem becomes more complicated, involving a cubic equation for the value of x. While the roots of the equation could be calculated by "Taylor's Theorem," it has not been deemed necessary for purposes of this illustration to pursue it any further.

In the above illustrations, it will be observed that the discharge of the smaller notch or orifice is 1 : 15 of the capacity of the larger. This ratio has been assumed as that of the Chicago drainage channel to that of Lake Huron-Michigan by its natural outlet, the St. Clair River.

LEVELS OF THE GREAT LAKES.

The plane of reference of the water level curves of Lake Erie, adopted by the Lake Survey, is the supposed high water of 1838. It is 575·2 feet above mean tide in New York Harbour. With this plane of reference as zero, mean level of surface of the lake from 1860 to 1875 is —2·34 feet. This latter, which is 572·86 feet above mean tide, New York, is the zero of the United States gauge at Buffalo Harbour. The mean monthly level of Lake Erie for the month of November, 1895, at Cleveland, Ohio, has been —4·41 feet, equivalent to —2·07 feet on the Buffalo gauge.

For the discharge measurements of the Niagara River, taken in December, 1891, and in April and May, 1892, (see annual report of the Chief of Engineers, U. S. Army, for 1893, p. 4364 *et sequitur*), the relation of the Buffalo gauge to the local gauge at the discharge cross-section is expressed by the following equation :—

Local gauge height $= 2\cdot 087 + 0\cdot 624\, x - 0\cdot 046\, x^2 +$ &c., in which $x =$ height of Buffalo gauge in feet, — + indicating above zero, and — below.

$$-2\cdot 07 \text{ feet Buffalo gauge} = 2\cdot 087 + 0\cdot 624 \times (-2\cdot 07) - 0\cdot 046 \times \overline{-2\cdot 07})^2 + \&c.$$
$$= 2\cdot 087 - 1\cdot 292 - 0\ 197 = 0\cdot 598$$

The discharge given on the smooth curve of discharge for 0·6 feet on local gauge is 190,000 cubic feet per second.

Assuming that 85 per cent of this efflux passed through the St. Clair River at the foot of Lake Huron, gives 190,000 × ·85 = 161·500 cubic feet per second, the discharge for Lake Huron. At a corresponding stage of Lake Michigan, the Chicago drainage channel will discharge, as shown above (p. 13) 12,500 cubic feet per second.

Assuming like conditions as in our tank illustrations, that is to say, a rectangular outlet at Port Huron, 2,000 feet in width.

1st. What would be the depth (mean) to dischaoge 161,500 cubic feet per second?

By Rankine's formula above—

$$D = 8\cdot 025c \times \tfrac{2}{3}\, b\, h_1^{\frac{3}{2}}$$
$$= 5\cdot 35 \times \cdot 5 \times 2000\, h_1^{\frac{3}{2}}$$
$$= 5350\, h_1^{\frac{3}{2}}$$
$$h_1^{\frac{3}{2}} = \frac{D}{5350} = \frac{161500}{5350} = 30\cdot 2$$

Hence, squaring both sides,

$$h_1^3 = \overline{30\cdot 2})^2 \text{; and } h_1 = 30\cdot 2^{\frac{2}{3}}$$
$$\log.\ 30\cdot 2 = 1\cdot 4800069 \times \tfrac{2}{3} = 0\cdot 9866713,$$

and the natural number corresponding to this log. is 9·6978 feet, or 9·7 feet nearly.