of sounding. Denote these successive mean velocities by v_1, v_2, v_3, ... v_{n-1}. Fig. 34 shows a vertical section of the river at a place of measurement. Then the vertical lines N_1O_1, N_2O_2, ... $N_{n-1}O_{n-1}$ indicate the lines of sounding, and the dotted lines M_1P_1, M_2P_2, ... $M_{n-2}O_{n-2}$ bisect the distances between them. The

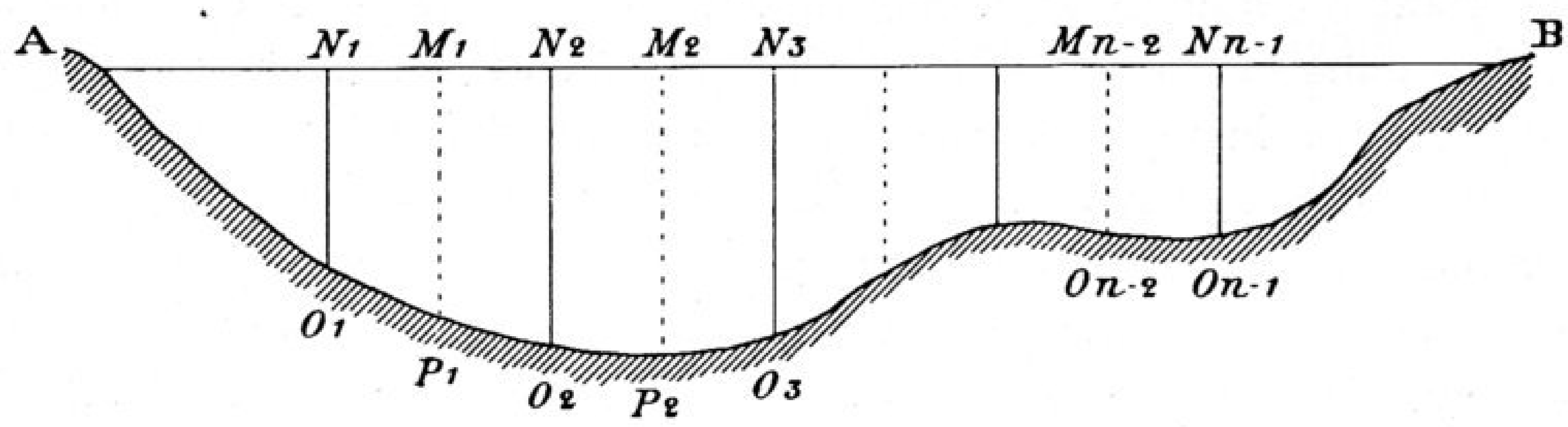

Fig. 34.

most accurate way to ascertain the volume of the water flowing past the section in the unit of time is to measure with the planimeter the areas of the figures AM_1P_1, $M_1M_2P_2P_1$, ... and to muliply the successive areas by their corresponding mean velocities and take the sum of the products. Thus, if we denote the areas by a_1, a_2, a_3, ... a_{n-1}, then the volume Q which passes the section in the unit of time is

$$Q = a_1v_1 + a_2v_2 + \ldots\ldots + a_{n-1}v_{n-1} = \Sigma av \quad \ldots\ldots\ldots (1)$$

The mean depth is

$$d_m = \frac{A}{b} \quad \ldots\ldots\ldots\ldots\ldots (2)$$

where
$$A = a_1 + a_2 + \ldots\ldots + a_n = \Sigma a \quad \ldots\ldots\ldots\ldots (3)$$

A denoting the area of the total section of the river.

The mean velocity of the entire river is

$$V_m = \frac{\Sigma av}{\Sigma a} = \frac{Q}{A} \quad \ldots\ldots\ldots\ldots\ldots (4)$$

As a check upon this, Q may be calculated from the formula

$$Q = bd_mV_m \quad \ldots\ldots\ldots\ldots\ldots (5)$$

II.

The following simplified method may also be employed, without any material error, more especially as the contours of the river-bottom between the vertical soundings are not known.

In fig. 35 we bisect each of the n divisions AN_1, N_1N_2, ... $N_{n-1}B$, and from the points of bisection Q_1, Q_2, ... Q_n let drop the perpendiculars Q_1R_1, $Q_2R_2S_2$, ... Q_nR_n; then through the lower ends O_1, O_2, ... O_{n-1} of the lines of sounding draw the horizontal lines R_1R_2, S_2R_3, ... $S_{n-1}R_n$. Then the area of the figure bounded by the broken line $Q_1R_1R_2S_2R_3S_3$ .... $S_{n-1}R_nQ_n$ and the straight line Q_1Q_n is approximately equal to the area of the vertical section of the river; and the difference diminishes without limit, as the number of points N_1, N_2, ... N_{n-1}