Construction of Pipe-flow Diagram.—Since equations (1) and (2) for flow in pipes are of the same form as the general equations (12) and (13), the rules given above may be applied. For the purpose of construction the variables must be taken in groups of three, the units and positions of the scales of any two being assumed or previously calculated, and those of the third determined therefrom. In Plate 1 the standard length selected is 1 in.

Group $i\ h\ l$: Select logarithmic units and positions of h- and l- scales; $N_h = -.75$, $N_l = -1.5$, $B_{hl} = 2$. Required, the unit and position of the i-scale. To make equation (1) comparable with (8), write—

$$i = h\ l_{-1}$$

whence $a = 1$, $b = -1$; then the logarithmic unit of the i-scale is given by—

$$\text{(I.)}\quad \frac{1}{N_i} = \frac{1}{-.75} + \frac{-1}{-1.5} = -\frac{4}{3} + \frac{2}{3} = -\frac{2}{3}$$

whence $N_i = -1.5$, the negative sign denoting that the scale must increase downwards. For the distance from the i-axis—

$$\text{(II.)}\quad B_{ih} = \frac{-1.5}{-1.5} \times -1 \times 2 = -2$$

the negative sign denoting that the i-axis lies away from the l-axis.

(III.) If h and l are in feet, and i is to be in feet per 1,000, the i-scale must be placed on its axis in such a position that an index line passing through $h = 1$ and $l = 1{,}000$ cuts, the i-scale at $i = 1$.

It will be noticed that in order to make a scale read in other units it is necessary merely to move it bodily up or down its axis; thus, on the l-axis, the two logarithmic scales of feet and miles are sub-divided in exactly the same way, but differ only as to their position. The logarithmic unit is affected only by the power of the variables.

Group $q\ d\ i$: The i-scale has been fully determined; select logarithmic unit and position of q-scale; $N_q = +1.5$, $N_i = -1.5$, $B_{qi} = 6$. Required, the unit and position of the d-scale. To make equation (1) comparable with (8) write—

$$d = q^{\frac{m}{n}} - i^{\frac{1}{-n}}$$

whence $a = .384$, $b = -.197$; then the logarithmic unit of the d-scale is given by—

$$\text{(I.)}\quad \frac{1}{N_d} = \frac{.384}{1.5} + \frac{-.197}{-1.5}$$

whence $N_d = +2.58$, the positive sign denoting that the scale must increase upwards. For the distance from the q-axis—

$$\text{(II.)}\quad B_{qd} = \frac{2.58}{-1.5} \times -.197 \times 6 = +2.03$$

the positive sign denoting that the d-axis lies towards the i-axis.

(III.) From equation (1) it may be calculated that when $i = 1$ ft. per 1,000 and $d = 12$ in., then $q = .65$ million gallons per twenty-four hours. The scale on the d-axis must be so placed that these three values when plotted on their respective scales lie on a straight line.

Group $q\ p\ h$: The q- and h-scales have been already fully determined; $N_q = +1.5$, $N_h = -.75$, $B_{qh} = 8$. Required, the unit and position of the p-scale. To make equation (2) comparable with (8) write—

$$p = q\ h^{\frac{1}{-m}}$$

whence $a = +1$, $b = -.512$; then the logarithmic unit of the p-scale is given by—

$$\text{(I.)}\quad \frac{1}{N_p} = \frac{1}{1.5} + \frac{-.512}{-.75}$$

whence $N_p = +.74$, the positive sign denoting that the scale must increase upwards. For the distance from the q-axis—

$$\text{(II.)}\quad B_{qp} = \frac{.74}{-.75} \times -.512 \times 8 = 4.05$$

the positive sign denoting that the p-axis lies towards the h-axis.

(III.) Since the unit adopted for carrying power corresponds to a pipe discharging at the rate of 1 cu. ft. per second under a total loss of head of 1 ft., the scale on the p-axis must be so placed that the three points representing these values lie in a straight line.

For the calculation of the s-scale, since $s = \frac{1}{p^m}$ equation (2) must be written in the form—

$$s = q^{-m}h$$

whence $a = -1.95$, $b = +1$; then the logarithmic unit is given by—

$$\text{(I.)}\quad \frac{1}{N_s} = \frac{-1.95}{1.5} + \frac{1}{-.75}$$

whence $N_s = -.38$, the negative sign denoting that the scale must increase downwards. For the distance from the q-axis—

$$\text{(II.)}\quad B_{qs} = \frac{-.38}{-.75} \times +1 \times 8 = 4.05$$

i.e., the axis for the s-scale is in the same position as the axis for the p-scale.

(III.) The position of the s-scale on its axis is determined by the fact that s and p must equal unity at the same point.

This completes the calculations for the diagram; it may, however, be pointed out that the p-axis and its scales might equally well have been determined from group $d\ p\ l$, a procedure which would have led to exactly the same results and might be carried out as a check on the construction.

The sub-division of the scales may be ascertained from tables of logarithms; but a sufficiently accurate method is to transfer the scale from a slide rule to a sheet of paper and join the sub-divisions to a point, as shown in Fig. 5 (Plate 2). Any logarithmic scale can then be obtained from the intersections on a straight line drawn parallel to the original scale E F, and at such a distance therefrom that the length $e\ f$ is equal to the known logarithmic unit.

SHORTAGE OF LABOR ON THE COAST.

(Staff Correspondence.)

Vancouver, September 4th.

Manufacturing industries are beginning to feel the lack of labor. The need of men is felt by all, but the Empire's war is the first consideration. The manager of a lumber mill in Vancouver told *The Canadian Engineer* that unless more men were available they would have to consider the question of closing down of at least part of their operations. The output of logs is being curtailed, and notwithstanding the unprecedented output in June of 120,023,869, and it is expected that July's figures will approximate this, prices of logs have stiffened. Demand is better, too. Shingle manufacturers are affected to a greater degree, and one or two of the large producers have already shut down. Shingle bolts are higher in price than they ever were, and scarce. It is possible that after the salmon fishing season is over a number of Japs will be in the woods getting out bolts.

Shipbuilding plants are affected. At Ocean Falls, where a pulp and paper industry is being started, many men could be taken on, and some have been secured in Seattle. The Empire Pulp and Paper Company has taken over the idle pulp plant at Swanson Bay with the idea of resuming operations, and men will be needed there also.