without increased head and when you consider that the system of sewers forms a net work you will see that this head cannot be obtained, as the sewage will make its escape through other connections, and the sedimentation goes on till the pipe is completely choked. This may be seen again and again in Queen street sewer and other sewers throughout the city.

Fig. VII.

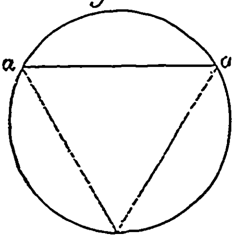


Fig. VIII

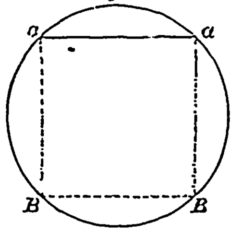
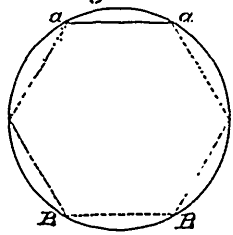


Fig. IX.



A formula for calculating the coefficient of friction in pipes running partly full is as follows :—Coef. of F $= \frac{\text{F. Sur.}}{\text{V. of Sew.}}$; regarding the coef. as unity when the pipe is running full or half full, as you will thus see, the whole F. Sur. ÷ whole vol. = 1. or ½ F. Sur. ÷ ½ vol = 1.

Fig. VII. shows the circle divided into two segments by the side of an inscribed equilateral triangle, figures VIII. and IX. are similarly divided by the side of an inscribed square and hexagon respectively. In Fig. VII., consider the sewer filled to the line *a. a.*, the frictional surface would be represented by $\frac{2}{3}$, while the Vol. of Sew. $= \frac{4}{5}$. Then by applying the formula $\frac{2\cdot3}{4\cdot5} = \cdot833$, = Coef. of F. While the small Seg. would give $\frac{1\cdot3}{1\cdot5} = 1\cdot6 =$ Coef. of F. The latter being double of the former.

Similarly, if Fig. VIII. were filled to the line *a. a.*, the F. Sur. would be $\frac{3}{4}$, while the Vol. of Sew. would be $\frac{10}{11}$; then by applying the formula we get $\frac{3\cdot4}{10\cdot11} = \cdot825$, = Coef. F. While the smaller Seg. shown by *b. b.* would be $\frac{1\cdot4}{1\cdot11} = 2\cdot75 =$ Coef. of F. The latter more than three times the former.

Fig. IX. gives a more marked contrast still. In the large Seg. cut off by *a. a.* the F. Sur. is represented by $\frac{5}{6}$ while the Vol. of Sew. is $\frac{17}{18}$, then $\frac{5\cdot6}{17\cdot18} = \cdot882$, = Coef. of F. While the small Seg. cut off by *b. b.* would give a result of $\frac{1\cdot6}{1\cdot18} = 3.00$. Coef of F., nearly four times as great as in the larger segment. You will observe that figures VII. VIII. and IX. give Coef. respectively, of ·833. ·825 and ·882, thus Fig. VIII. having the lowest Coef. would give the best maximum of velocity. And thus we obtain the paradoxical result that a pipe flowing partly full will have a better Coef. of discharge than when flowing full.