These three equations:

$$F = \frac{29}{\sin \alpha} = 2\,N\,g = \frac{9.4}{\sin \alpha} \quad \text{or} \quad 9.4\,N$$

$$S = .29\ F$$

and $$L = F - s \quad (5)$$

will solve all the simpler problems of single throw turnout, but in the double and treble throw something more is wanted. It was cases like figs. 4 and 5 which set the writer thinking on the following lines.

Returning to fig. 3 again, the offset at the end of a 100 feet chord of a 1° curve is 0.87 ft., and increases proportionally to the degree of curvature. Hence for a curve of D° it will be .87 D and as above for any other distance (within moderate limits) from the point of curvature, it will be for N feet

$$.87\ D \times \left(\frac{n}{100}\right)^2$$

The total deflection at the end of this distance will be $\frac{Dn}{100}$

Then for fig. 3 we have $\frac{F^2}{100} \times .87\ D = g \quad (a)$

and $\frac{F}{100} \times D = \alpha \quad (b)$

Simplifying (a) and (b) $F^2D = \frac{10000\,g}{.87}$ and $F\,D = 100\,\alpha$

$$F^2D = 100\ \alpha\ F$$

therefore $100\ \alpha\ F = \frac{10000\,g}{.87}$

$$F = \frac{100\ g}{.87\ \alpha} = 115\ \frac{g}{\alpha} \quad (6).$$

Substituting in (b) $\frac{100\ g}{.87\ \alpha} \times \frac{D}{100} = \alpha \quad D = .87\ \frac{\alpha^2}{g} \quad (7).$

Substituting for—α and g—the same values as before, 1 in 10 or 5°.75—and for g—4.7 ft., we get:

$$F = 94 \text{ ft. as before}$$
$$D = 6°.12 \text{ or } 6°\ 07'$$
and $$S = 27 \text{ ft.}$$
$$L = 67 \text{ ft.}$$

Comparing with Trautwine's tables, we find for a 26 ft. slide rail, a lead of 72.7 or F = 99.7.

and R = 877 or D = 6° 30′

We have therefore saved 6 ft. of lead or 12 ft. of steel, and got a slightly easier curve on it.

Lower down in the same table we will find that with a 16 ft. slide rail, we will have a lead of 67.8 and a curvature of 6° 15′ practically the same as above, but with an angle at the heel of 1° 30′ which is rather abrupt for high speeds and certainly not as desirable as a continuous curve.

Let us now take up fig. 4, a three throw switch with two 1 in 10 frogs, on the main line. We wish to determine the longitudinal position of the third frog. We have given the curvature D = 6°.12 the offset for which for 100 ft. or 0 = .87 D = 5.3 ft. (from the tables).

Since the third frog is evidently in the centre of the gauge, we have the total offset = ½ g or 2.35. hence the equation

$$\left(\frac{F_1}{100}\right)^2 \times 5.3 = 2.35$$

$$F_1^2 = 4434$$
$$F_1 = 66.6$$
$$L_1 = 40 \text{ (nearly)}$$

This last problem can of course be readily solved by a drawing, but not without considerable construction work and labour.