SOLUTION TO PROBLEM NO. 117

By similar triangles, $\frac{b}{9} = \frac{d}{R}$ and $\frac{t}{9} = \frac{d}{L}$

$b = 9d / R$ and $t = 9d / L$

$9d / R + 9d / L = d$

$1 / R + 1 / L = 1 / 9$

$L^2 = 20^2 - d^2 = 400 - d^2$, so that $d^2 = 400 - L^2$

$R^2 = 30^2 - d^2 = 900 - d^2 = 900 - 400 + L^2 = 500 + L^2$

$1 / \sqrt{(500 + L^2)} + 1/ L - 1/9 = 0$ (1)

There is no direct solution, so iteration is necessary:

For L = 5, (1) yields 0.0933

For L = 10, (1) yields 0.0297 (The trend is towards zero)

For L = 15, (1) yields –0.0073 (Too far)

Linear interpolation between 10 and 15 gives L=14.0135, then (1) is –0.00186

Returning to L = 13, (1) yields 0.0045

Interpolation between 13 and 14.0135 gives L= 13.7163 and (1) is 0.00008

$d^2 = 400 - L^2 = 400 - 13.7163^2 = 211.863$, d = 14.556'

Note: Equation (1) can be expanded into a fourth degree equation with one unknown and solved explicitly, but the algebra is tedious and complicated.