where D is the diffusivity (cm^2/sec) of the drug in the ointment. After differentiation for time, an expression for the instantaneous rate of release is obtained.

$$\frac{dM_t}{dt} = \frac{1}{2}\sqrt{\frac{D\,(2Q - C_s)\,C_s}{t}} \qquad [2]$$

When $Q >> C_s$, the amount of drug released into a sink bears the following relationship to time:

$$M_t = \sqrt{2\,Q\,D\,C_s t} \qquad [3]$$

and the rate becomes

$$\frac{dM_t}{dt} = \sqrt{\frac{Q\,D\,C_s}{2t}} \qquad [4]$$

Equation 3 predicts that a plot of the amount of drug released (per unit area) versus the square root of time should be linear, whereas Eq. 4 predicts that the rate of drug release is proportional to the reciprocal of the square root of time.

Higuchi also deduced a relationship characterizing the release of drug from an ointment with its drug totally in solution ("solution ointment"), also from a planar surface directly into a diffusional sink (6). This equation is a solution to Fick's second law, and can be found in several standard texts concerning diffusion processes (7,8). As in the previous case, uptake into a sink is assumed, with diffusion to the releasing interface being the rate-limiting step in the overall process. The following mathematical description of the process was presented:

$$M_t = h\,C_0\left\{1 - \frac{8}{\pi^2}\sum_{m=o}^{\infty}\frac{\left[\exp\left[-\frac{D\,(2m+1)^2\pi^2 t}{4h^2}\right]\right]}{(2m+1)^2}\right\} \qquad [5]$$

In this expression, h is the thickness of the ointment phase and C_0 is the initial drug concentration in the ointment. The following simplified equation closely describes diffusion for the first 30% of release (9):

$$M_t = 2C_0\sqrt{\frac{D\,t}{\pi}} \qquad [6]$$