by

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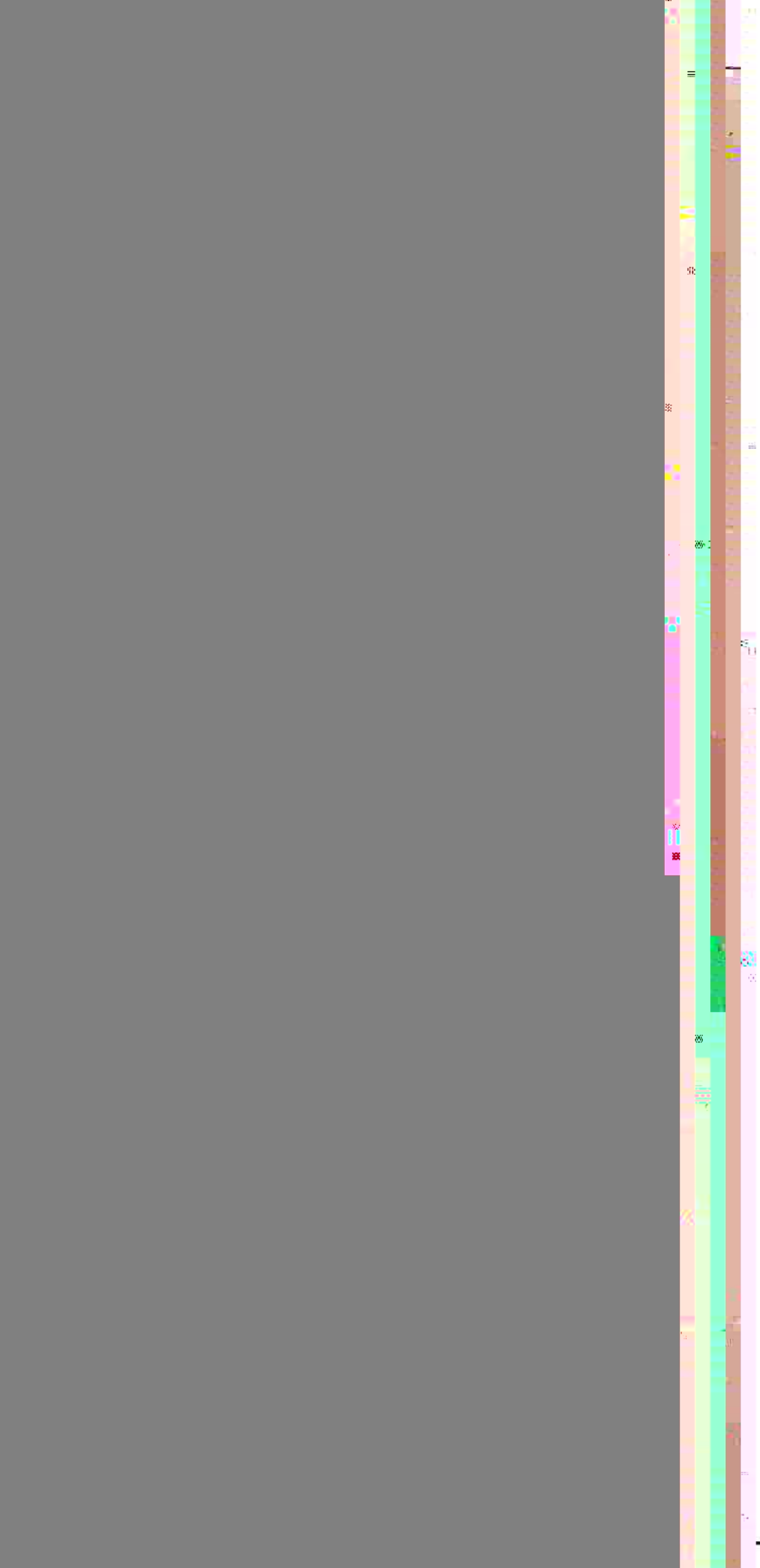


LIST OF FIGURES (cont'd)

$$\frac{d[\,V(t)\,]}{dt} = y' = LV_s - Ly \ , \tag{3.1a}$$

$$V_s L e^{Lt} = y' e^{Lt} + L e^{Lt} y \ . \tag{3.2}$$

$$d[\,ye^{Lt}\,] = y'dt \cdot e^{Lt} + Le^{Lt}dt \cdot y \ ;$$

Or,

(3.3)

Then, substituting equation (3.3) into equation (3.2):

$$V_s L e^{Lt} = \frac{d[ye^{Lt}]}{dt} \ ,$$

$$V_s L e^{Lt} dt = d[ye^{L} \tag{3.4}$$

$$V(t)e^{Lt} = V_s(e^{Lt} - 1) + V_o \quad , \tag{3.5}$$

But

$$y = V(t) \ ;$$

$$V(t)e^{Lt} = V_s(e^{Lt} - 1) + V_o \ ,$$

$$V(t) = V_s(1 - e^{-Lt}) + V_o e^{-Lt} \ ,$$

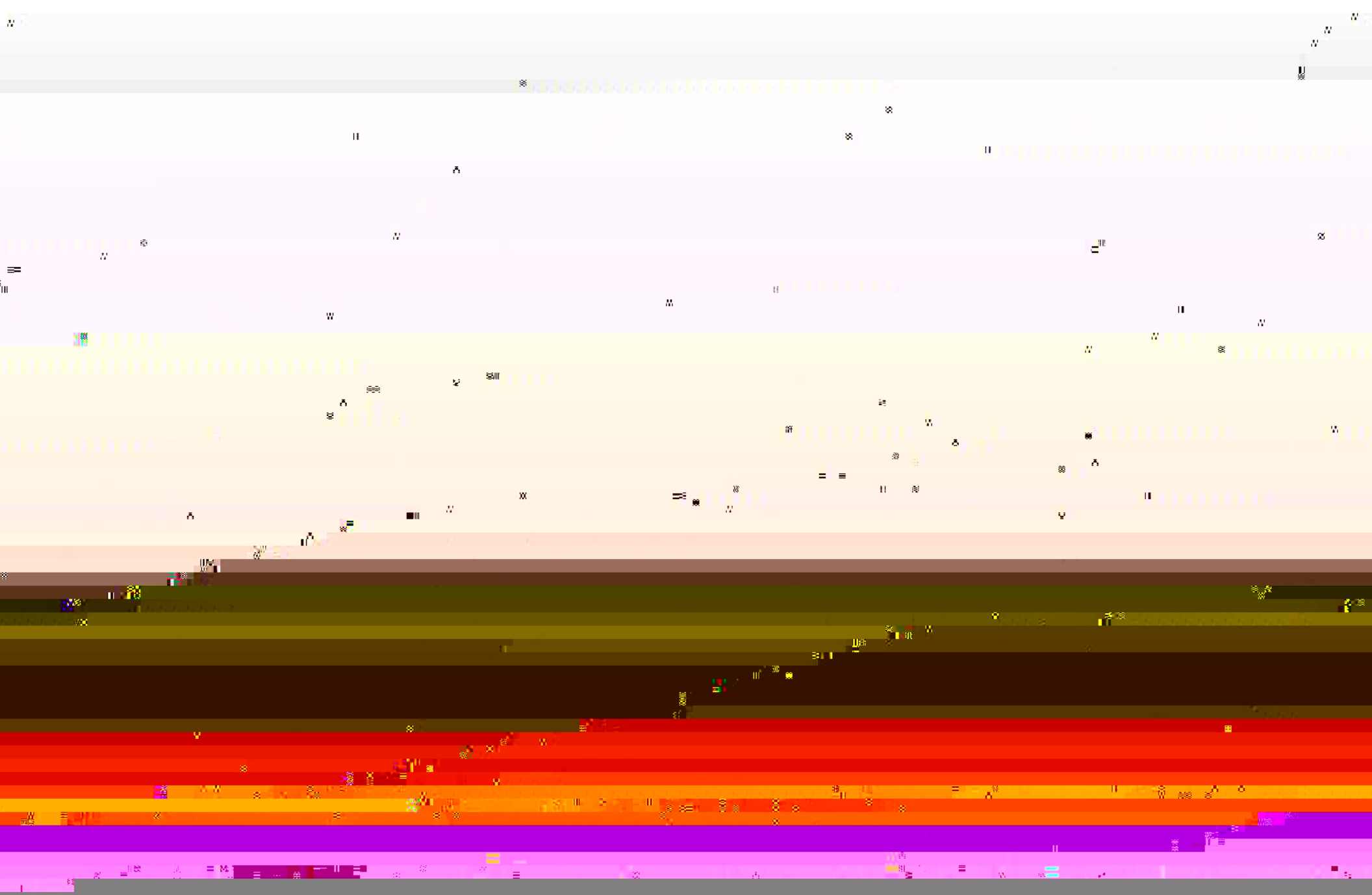
$$V(t) = V_s - V_s e^{-Lt} + V_o e^{-Lt} \ ,$$

$$V(t) = V_s - (V_s - V_o)e^{-Lt} \ . \tag{3.6}$$

$$V_c = V_s - V_o \ ,$$

then equation (3.6) becomes

$$V(t) = V_s - V_c e^{-Lt} \ . \tag{3.7}$$



In a sucrose solution, mitochondria assume a nearly spherical shape (Pauly, et al., 1960); hence, the surface area and volume are functions of the time-dependent radius, r:

(3.13a)

Finally,

$$\frac{dr}{dt} = \frac{3k}{4\pi r^3} - \frac{kM_o}{V_o M_i} \quad . \tag{3.16}$$

Making use of the volume formula again and the definition of concentration (see equation 3.8):

$$\frac{dr}{dt} = \frac{k}{\bar{V}} - K_2 \quad . \tag{3.18}$$

$$= 0; \text{ hence,}$$

(3.19)

or, simply,

$$Veq = \frac{M_i}{C_o} \quad . \tag{3.20}$$

$$\frac{dr}{dt} = \frac{k}{V} - \frac{k}{Veq} \quad ,$$

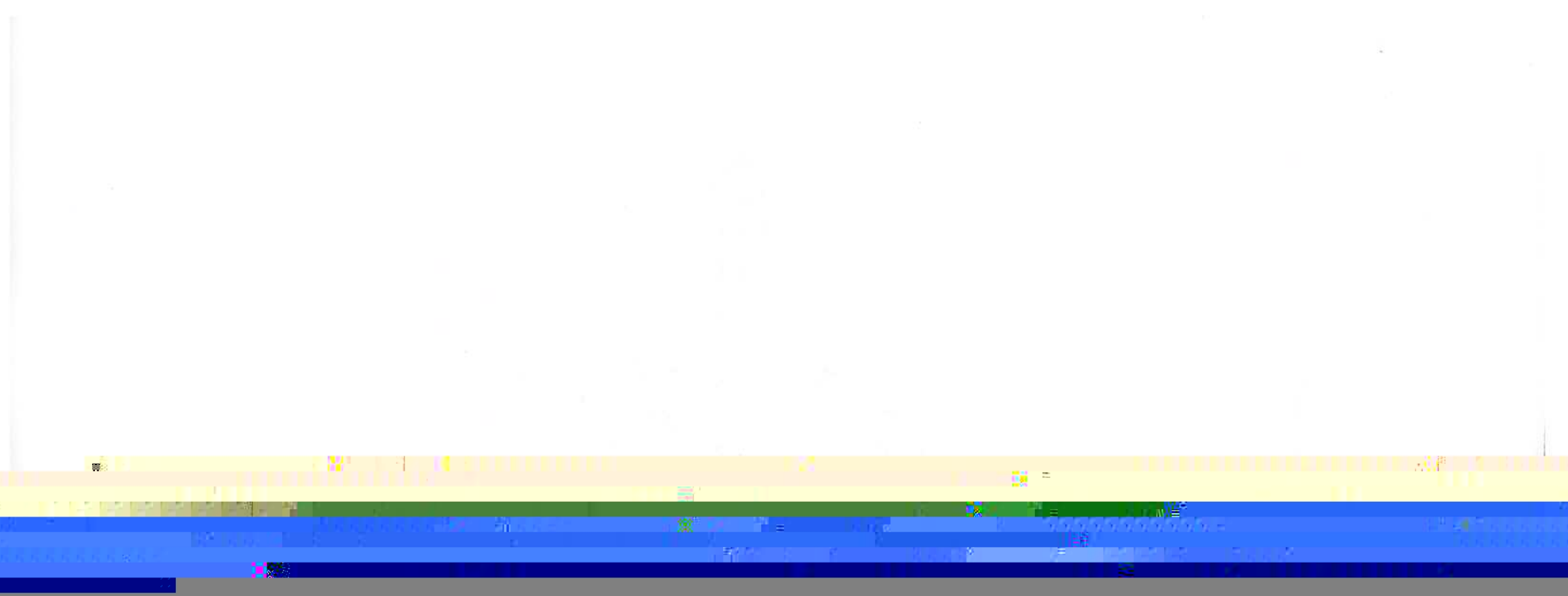
or,

$$\frac{dr}{dt} = k \left(\frac{1}{V} - \frac{1}{Veq}\right) \tag{3.21}$$

$$\frac{dr}{dt} = \frac{a}{r^3} - b \quad , \tag{3.22}$$

in which $a = 3k/4\pi$ and $b = k/Veq$. After determination of a common denominator, and rearrangement,

$$\frac{dr}{dt} = \frac{a - br^3}{r^3}$$



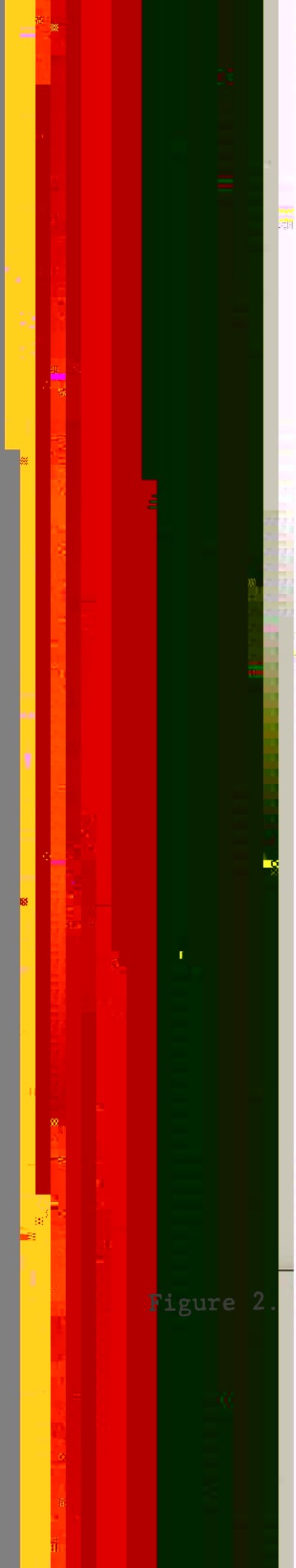


Figure 2. Spherical Mitochondrion

(3.38)

With unit path length and arbitrary units of r such that p = 1, the following model for the time dependent transmittance is obtained from equation (3.38):

$$T(t) = e^{-\sum_{i=1}^{N} P_i r_i^{-2}} . \qquad (3.39)$$

Equivalently, in terms of volume,

$$T(t) = e^{-\sum_{i=1}^{N} P_i V_i^{-2/3}} . \qquad (3.39a)$$

Time

in which the radii, r_1 and r_2, and abundances, P_1 and P_2, are defined for intact and damaged mitochondria, respectively.

Using the rela

a, and radius, given b

$$a \propto 1/r^2 \tag{4.2}$$

and substituting into equation (4.1) gives

$$T(t) = e^{-(P_1 a_1 + P_2 a_2)} , \tag{4.3}$$

$$- \ln[T(t)] = P_1 a_1 + P_2 a_2 \tag{4.4}$$

For the special case of a control, in which none of the mitochondria are damaged, $P_2 = \emptyset$, and at the same time, t,

$$- \ln[T(t)_c] = P_T a_1 \tag{4.5}$$

Substitution of equation (4.6) into equation (4.4) yields:

$$- \ln[T(t)] = - P_1 \ln[T(t)_c] + P_2 a_2 \qquad (4.7)$$

(4.8)

(4.8a)

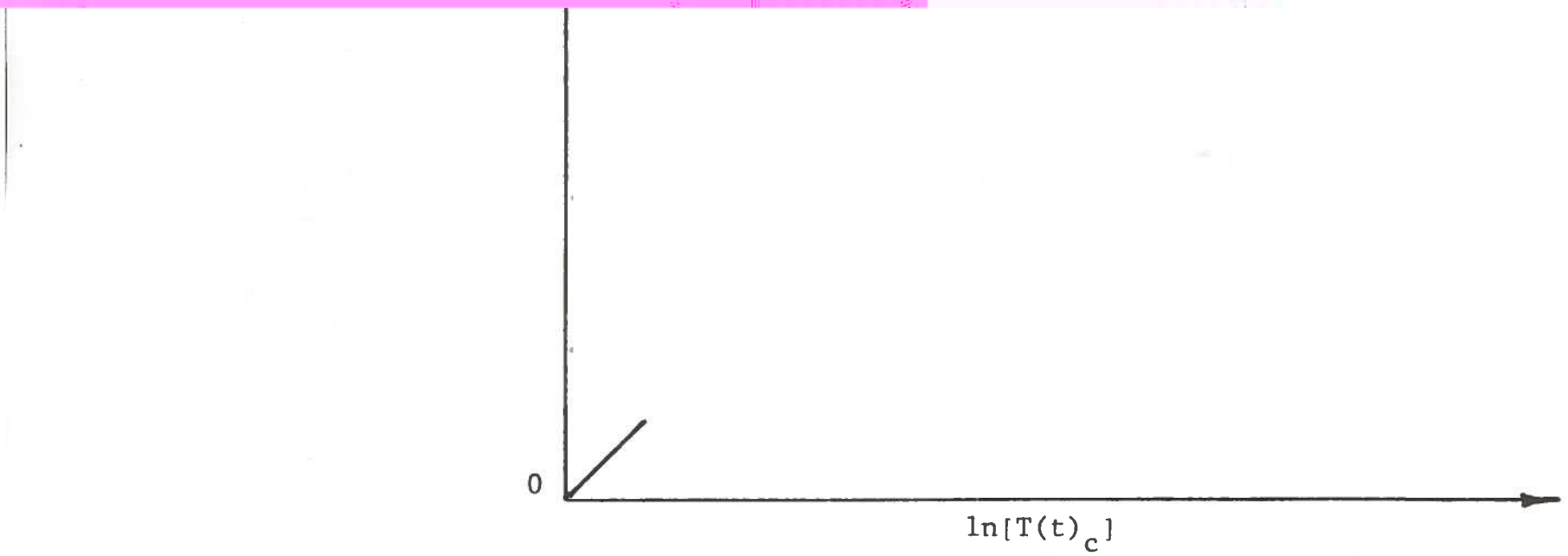


Figure 4. Graphical Determination of Surviving Fraction

$$T(t) = e^{-P(V^{-2/3})} \quad , \qquad (4.10)$$

By taking natural logarithms;

$$\ln[T(t)] = -P(V^{-2/3}) \quad ;$$

and inverting;

$$\frac{P}{-\ln[T(t)]} = V^{2/3} \quad ,$$

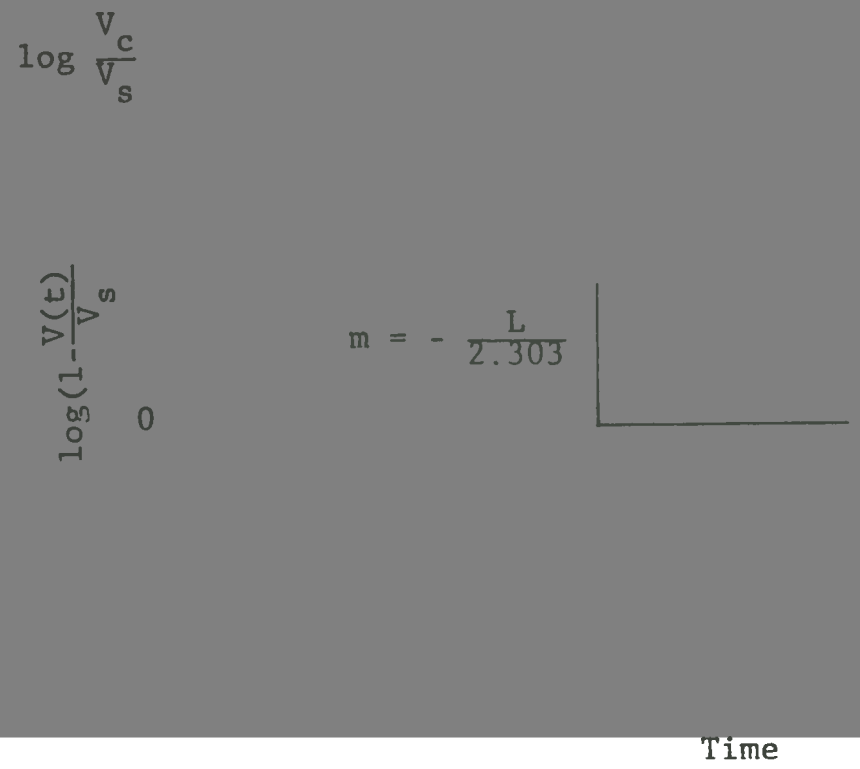
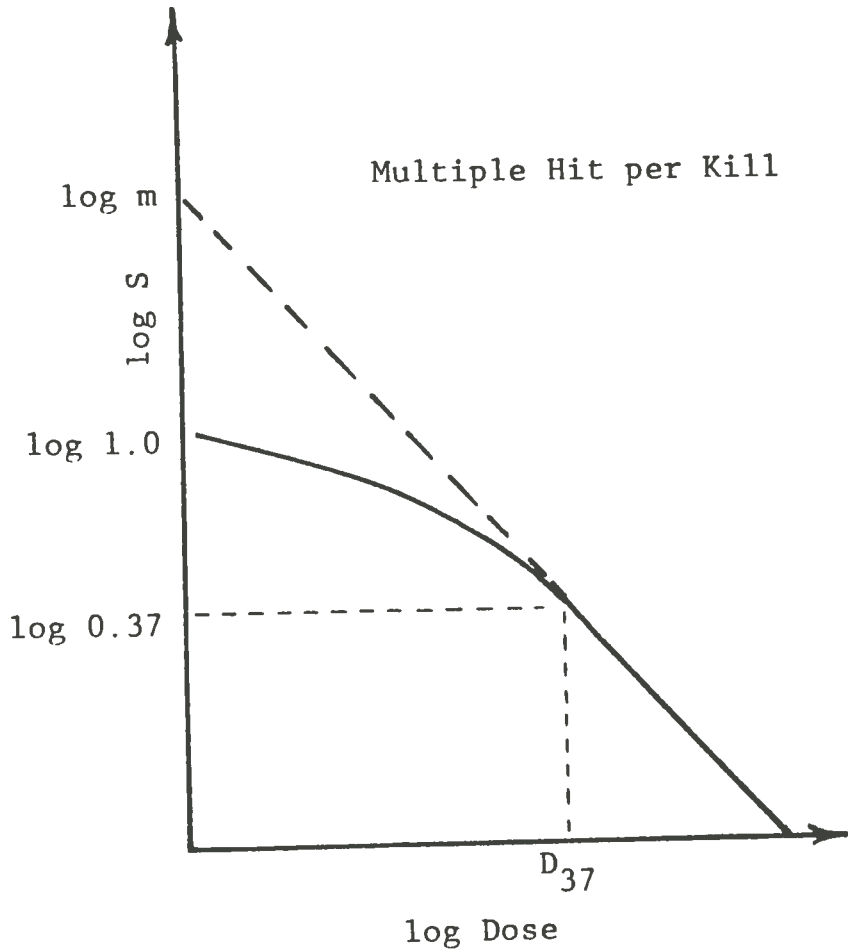
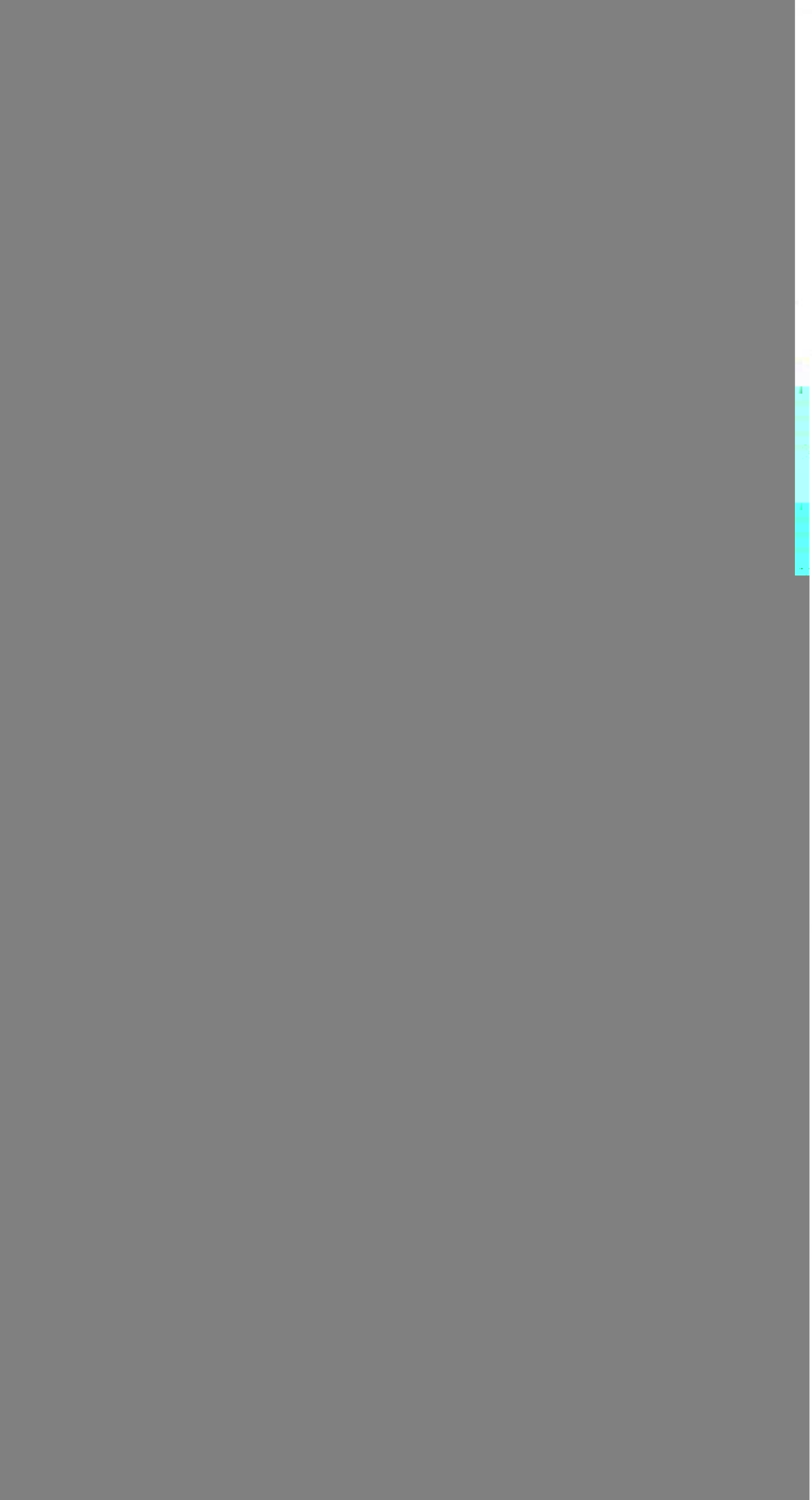


Figure 5.

Using equation (4.13), it is possible to compare the average volume of a given sample at a given time with the average volume of a control (intact) sample at the same time, provided there are the same number of particles in each sample.

$$\frac{Q(t)}{Q(t)_c} = \frac{V}{V_c} \alpha S \qquad (4.16)$$


Multiple Hit per Kill
log m
log S
log 1.0
log 0.37
D_{37}
log Dose



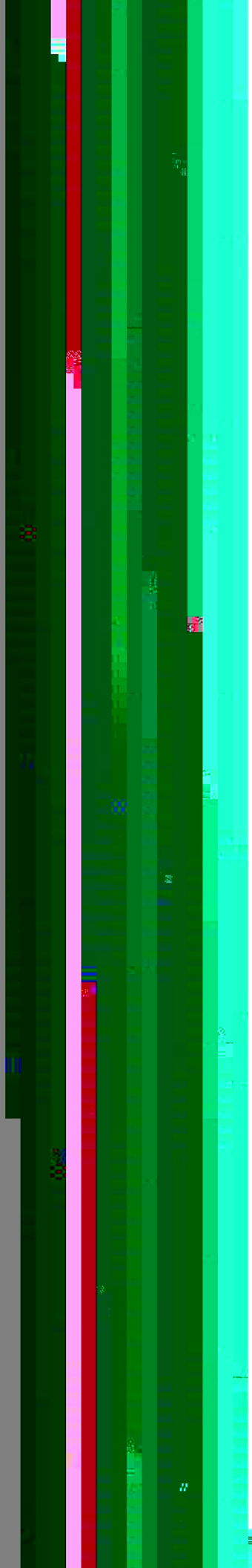
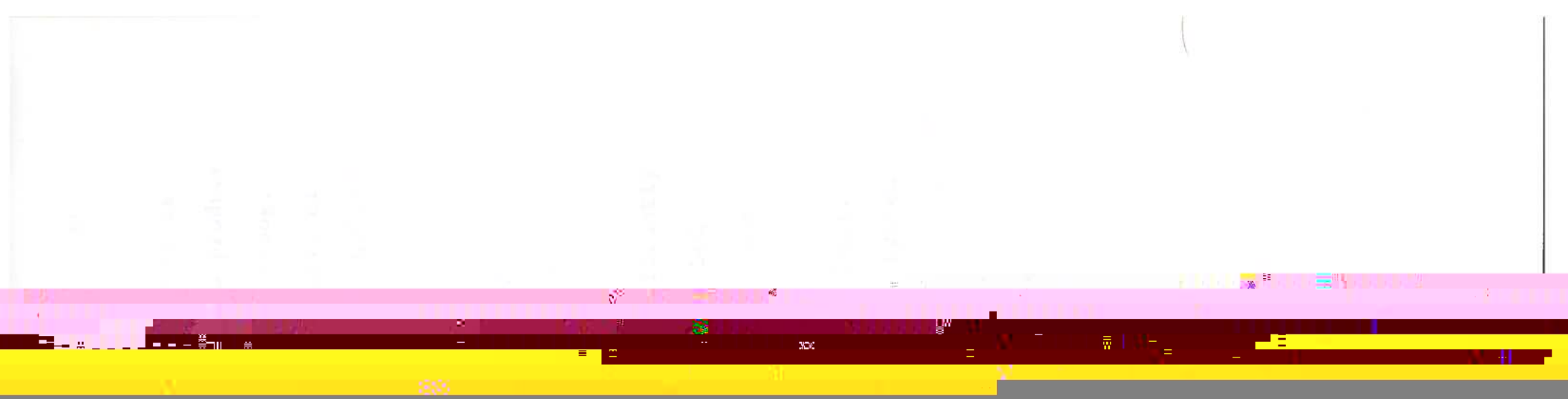
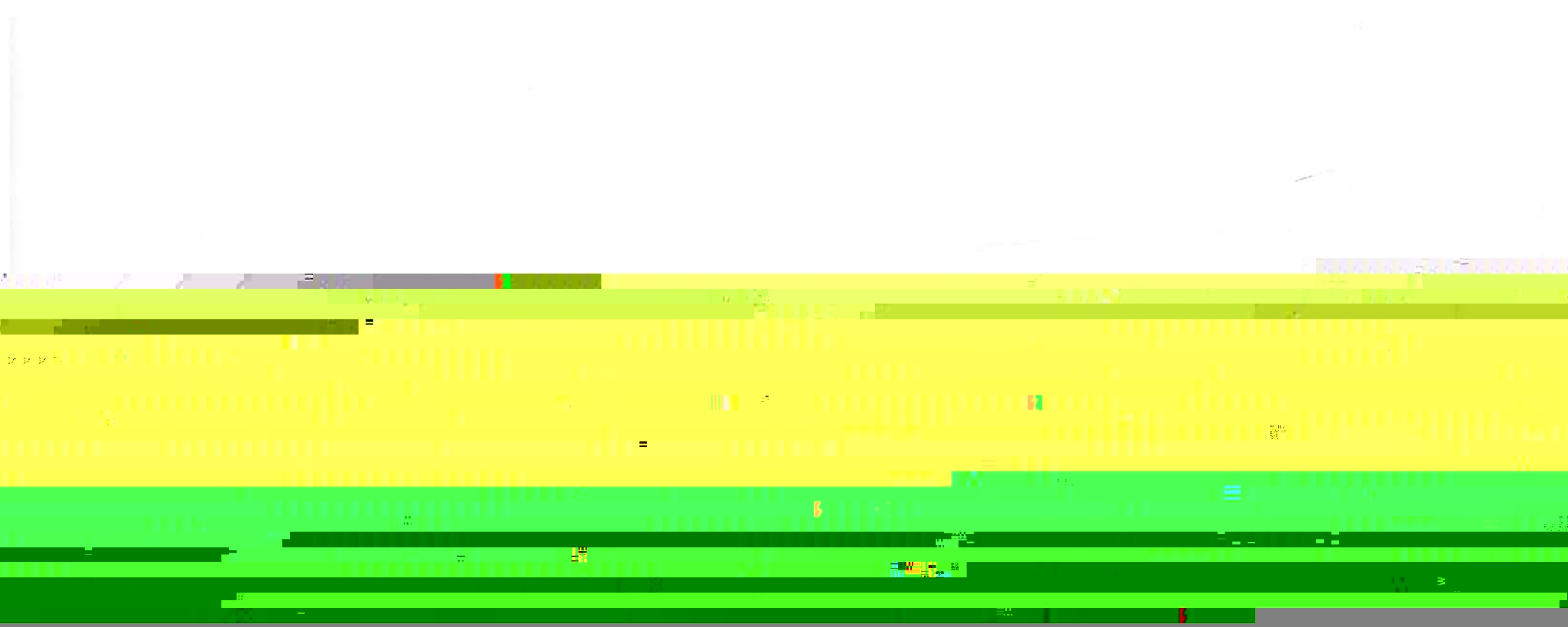


Figure 8. Co^{60} Irradiator Facility





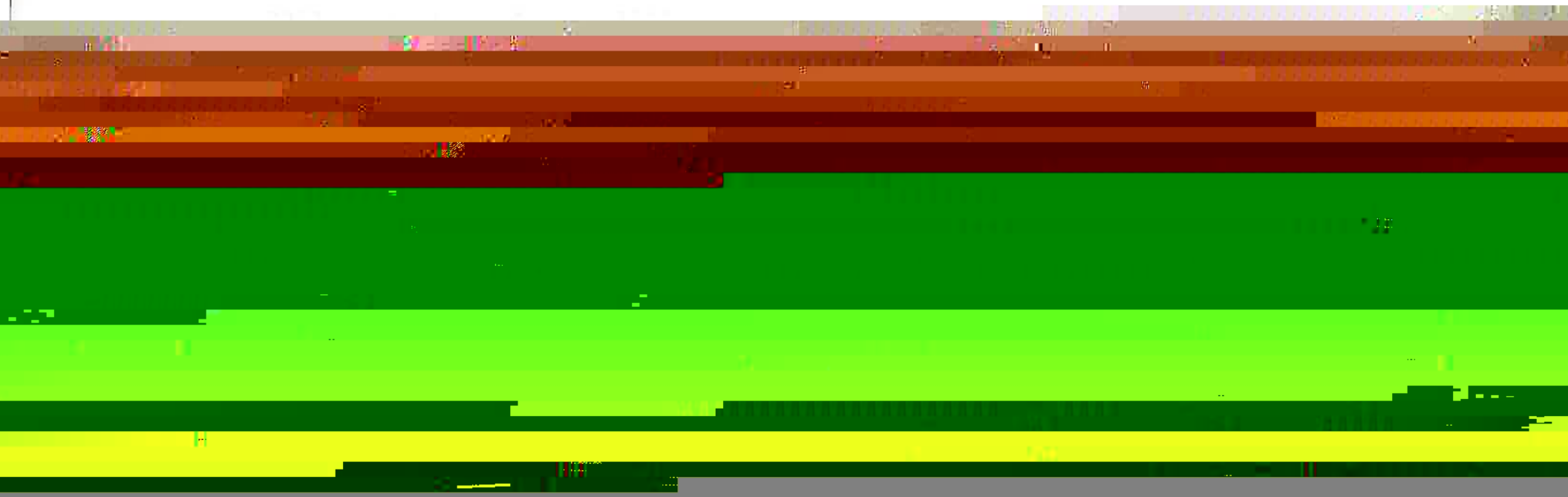


TABLE 4. continued)

Figure 11. Swelling Rate Constant Determinations for Samples C1 and C2.

Swelling Rate Constant Determination for Samples S1-S3.

Figure 13. Swelling Rate Constant Determinations for Samples S4-S6.


0.001
0
5
10
Time (min)

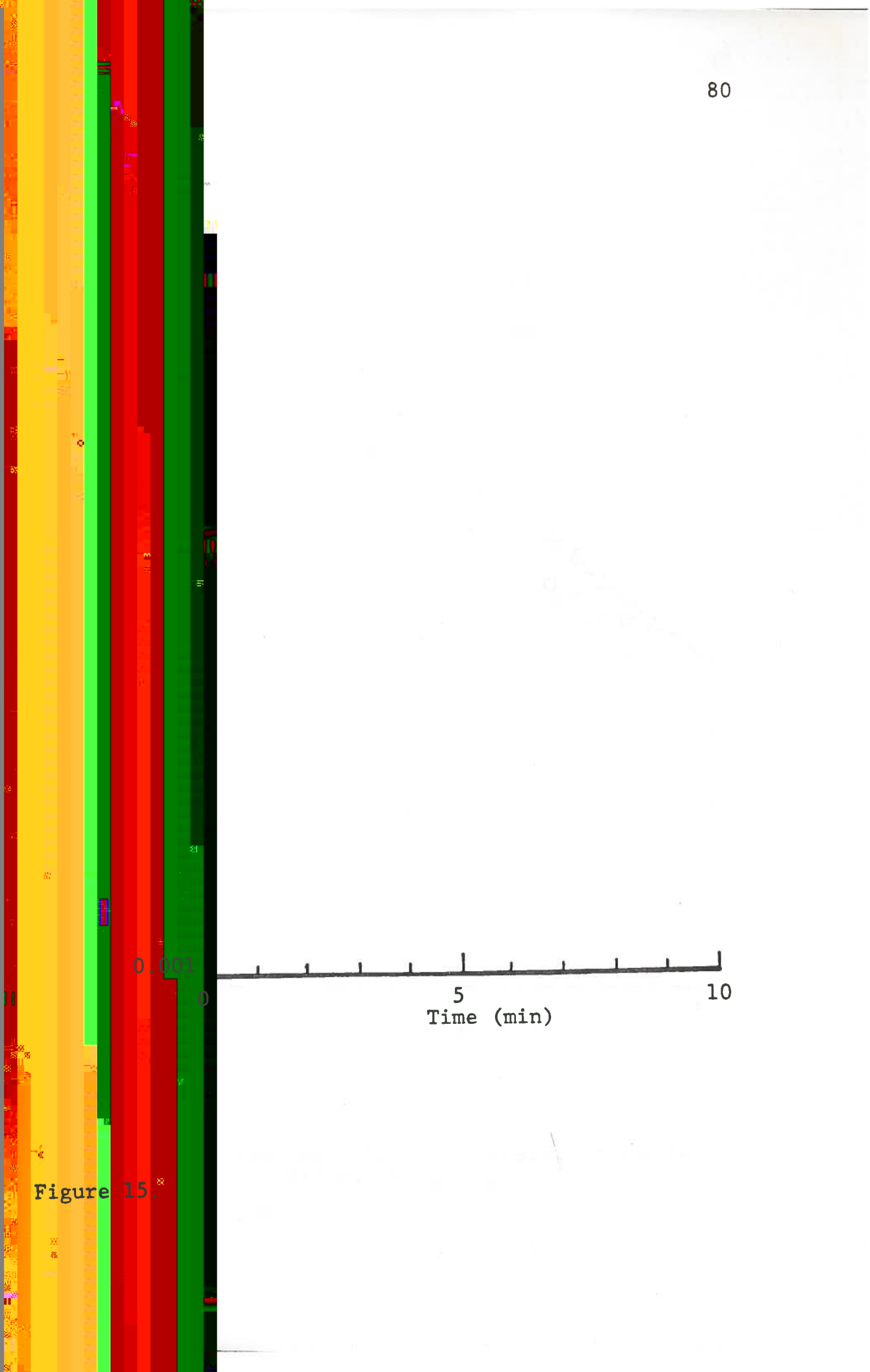


Figure 15.

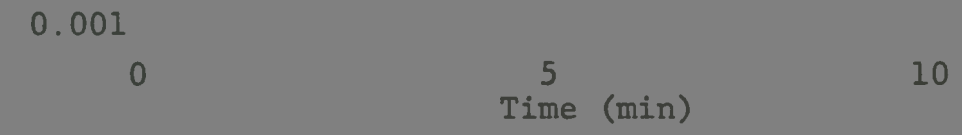


Figure 16.

TABLE 5. (continued)

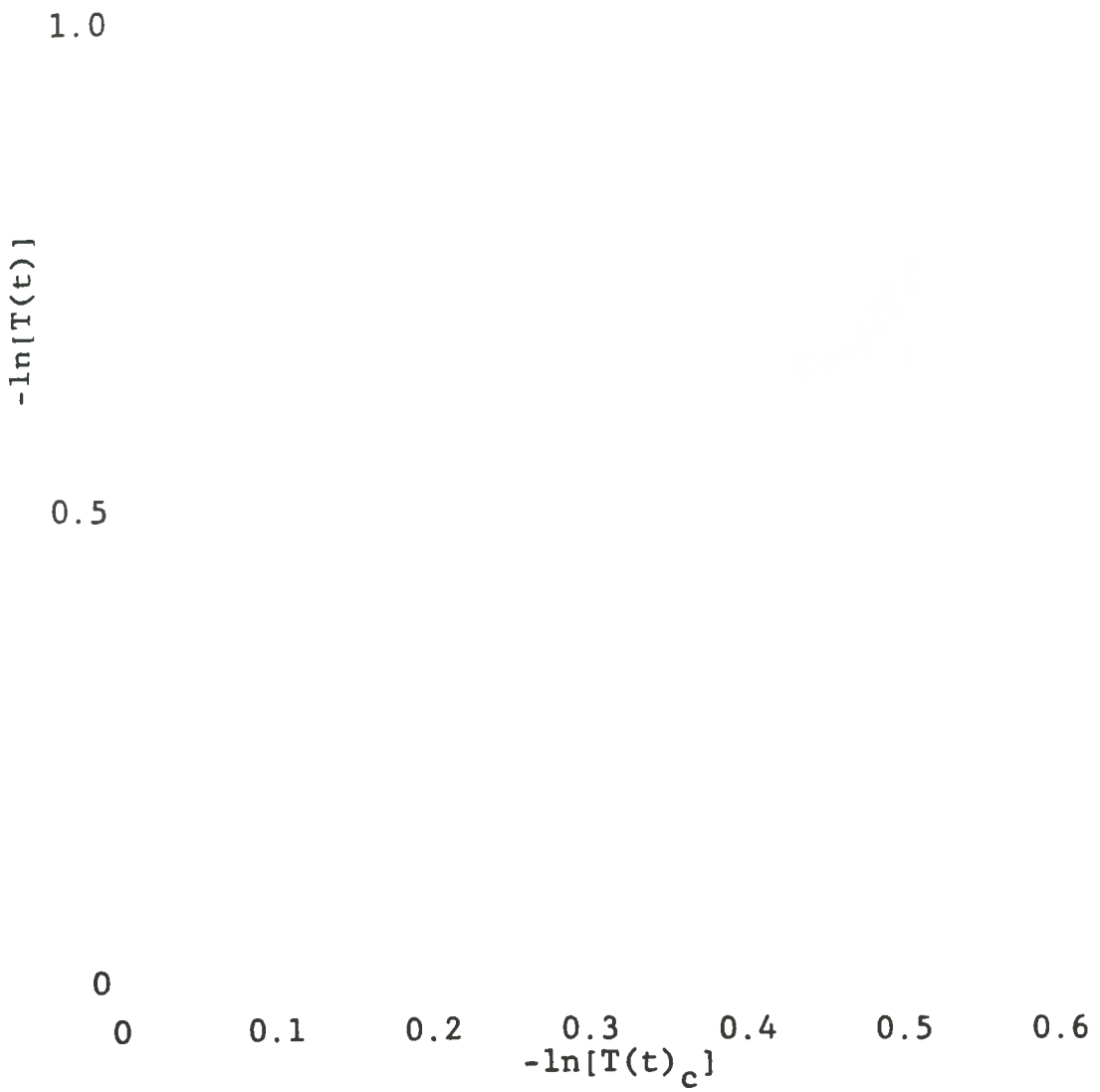


Figure 17. Direct Determination of S

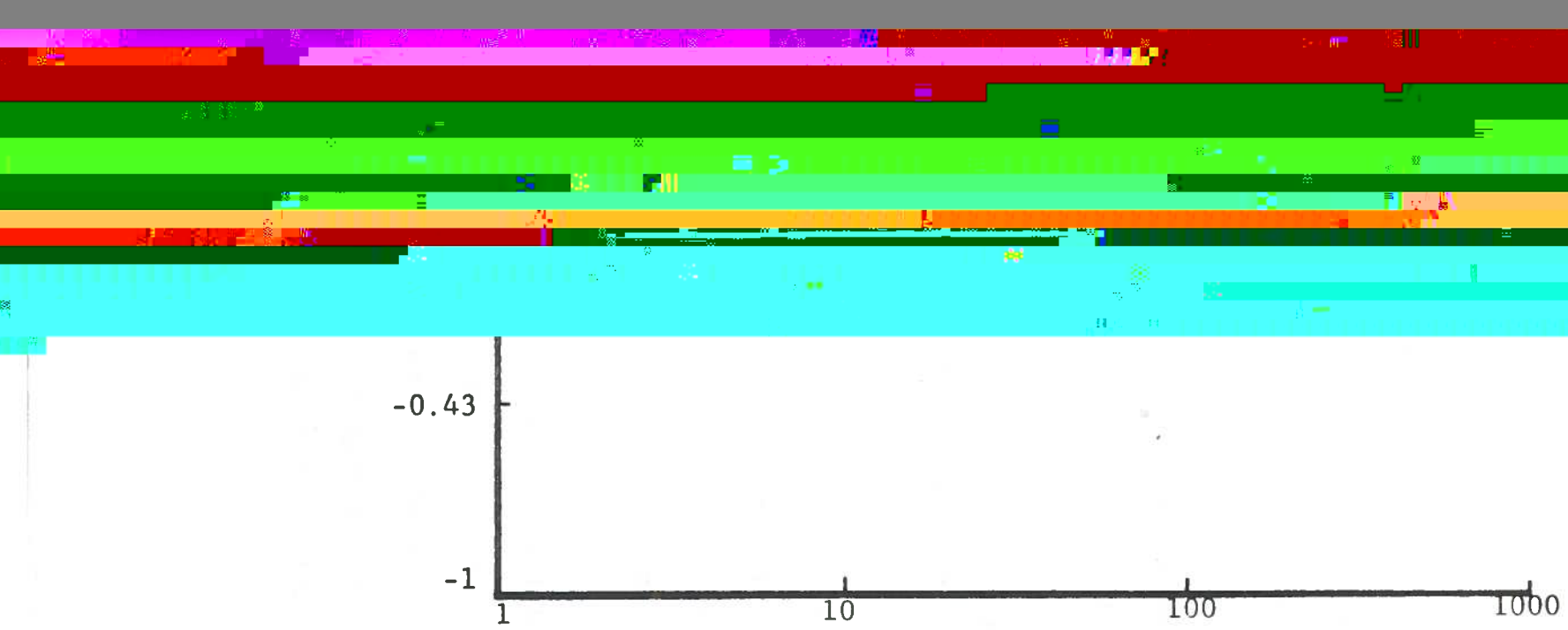


Figure 18. Dose Response of Parameters from Table 5.

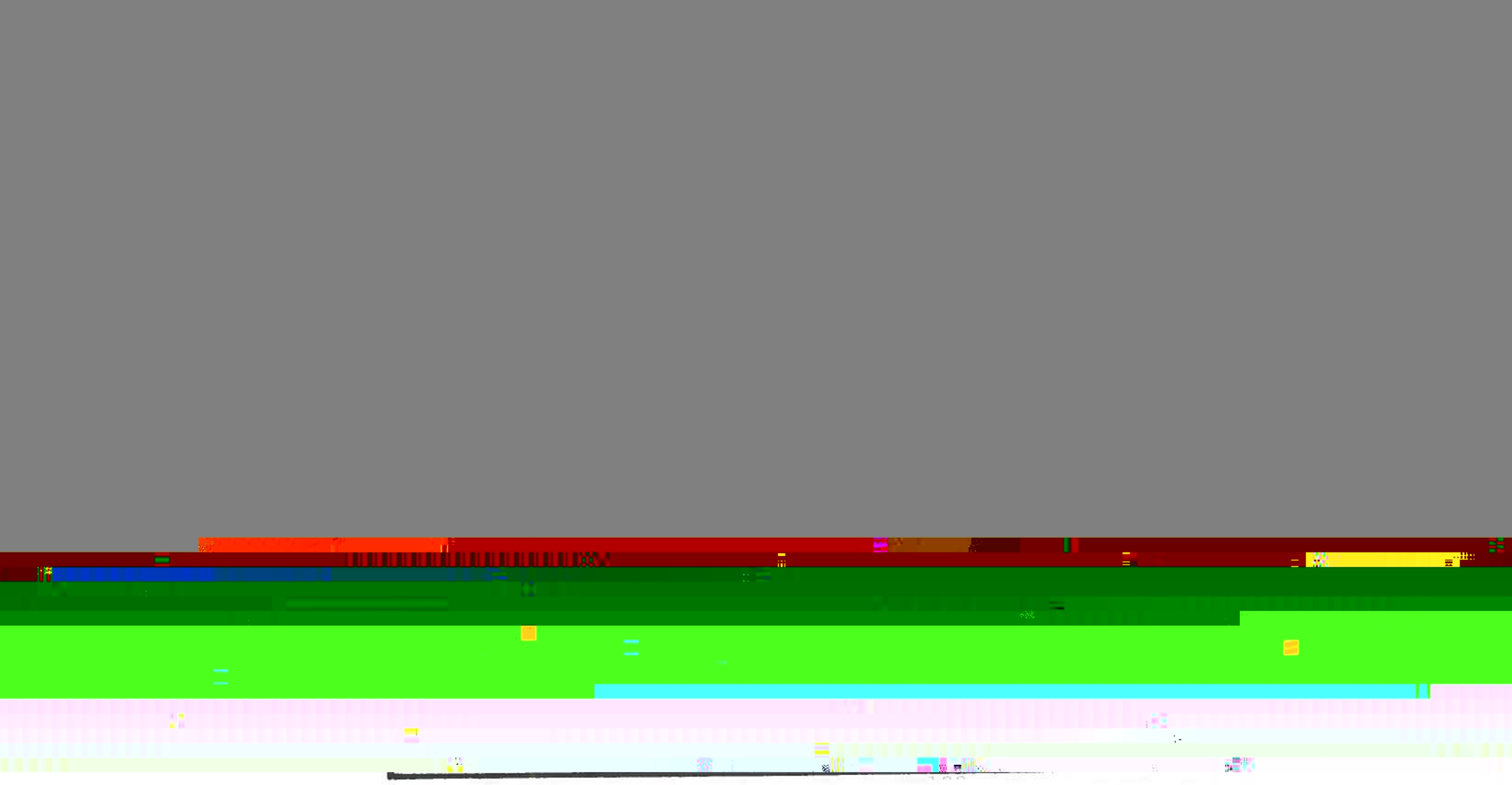


Figure 19. Survival Curve Based on Q/Q_c

Figure 20. Log/Probit Dose-Effect Curve

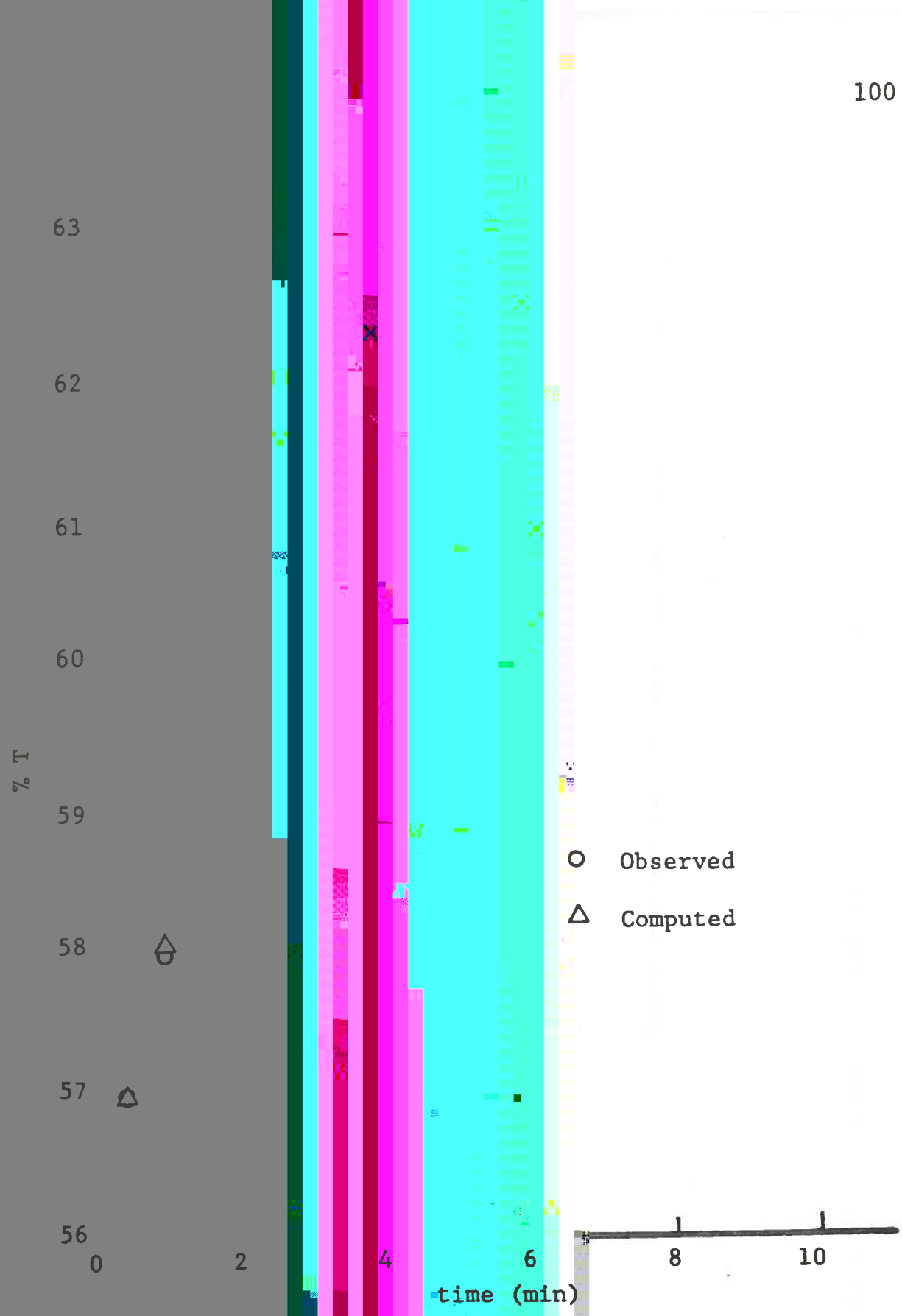


Figure 21. A Typical Swelling Curve Sample C-2

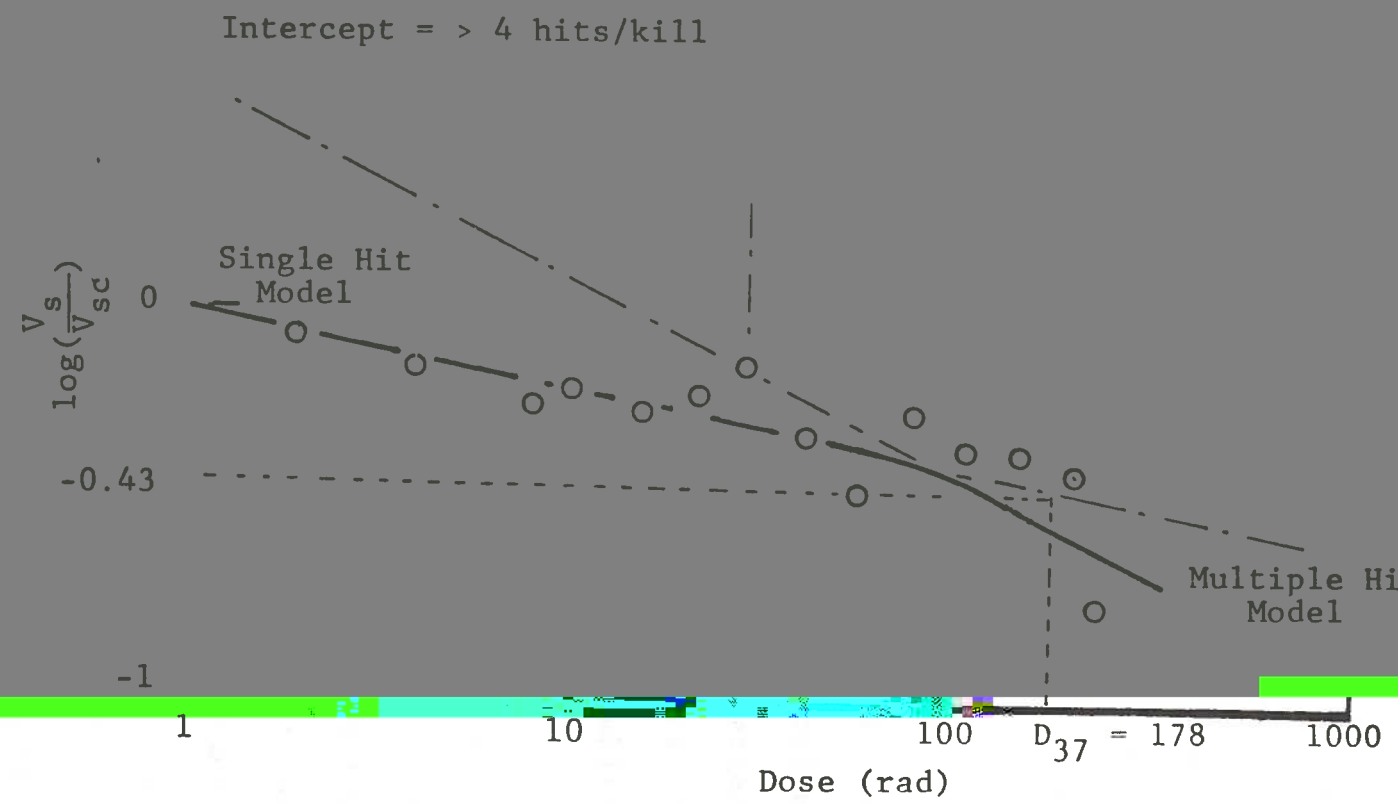


Figure 22. Computer-Derived Swollen Volume Parameter Versus Dose

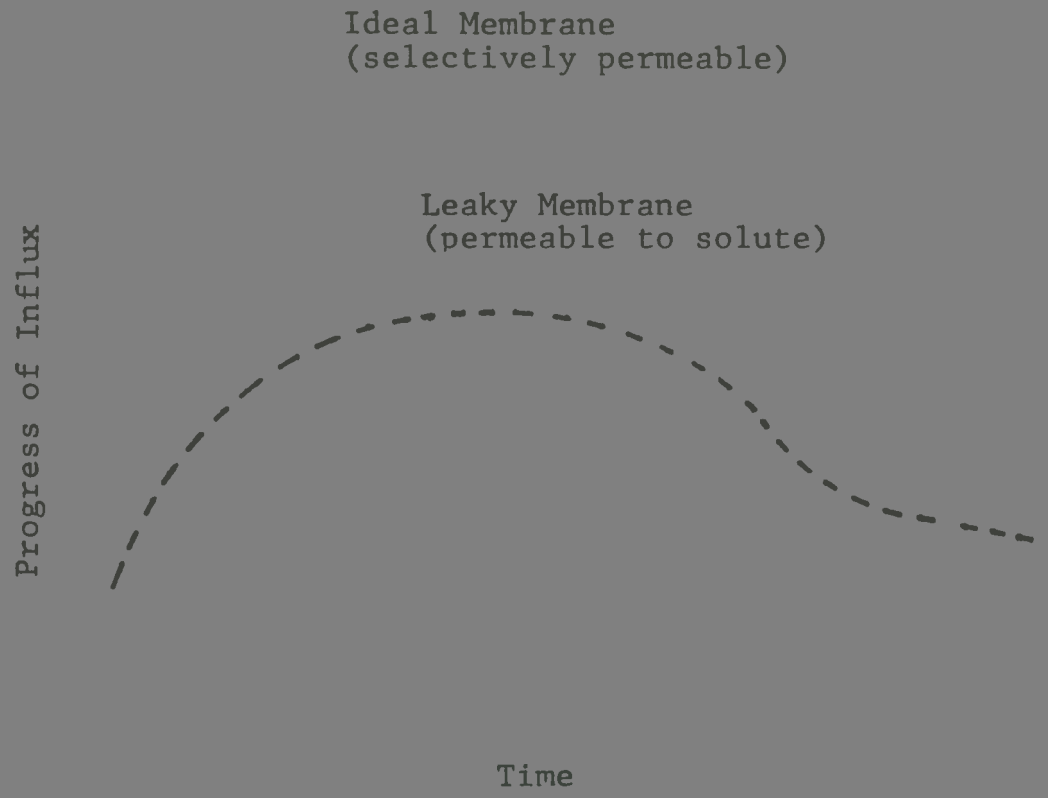
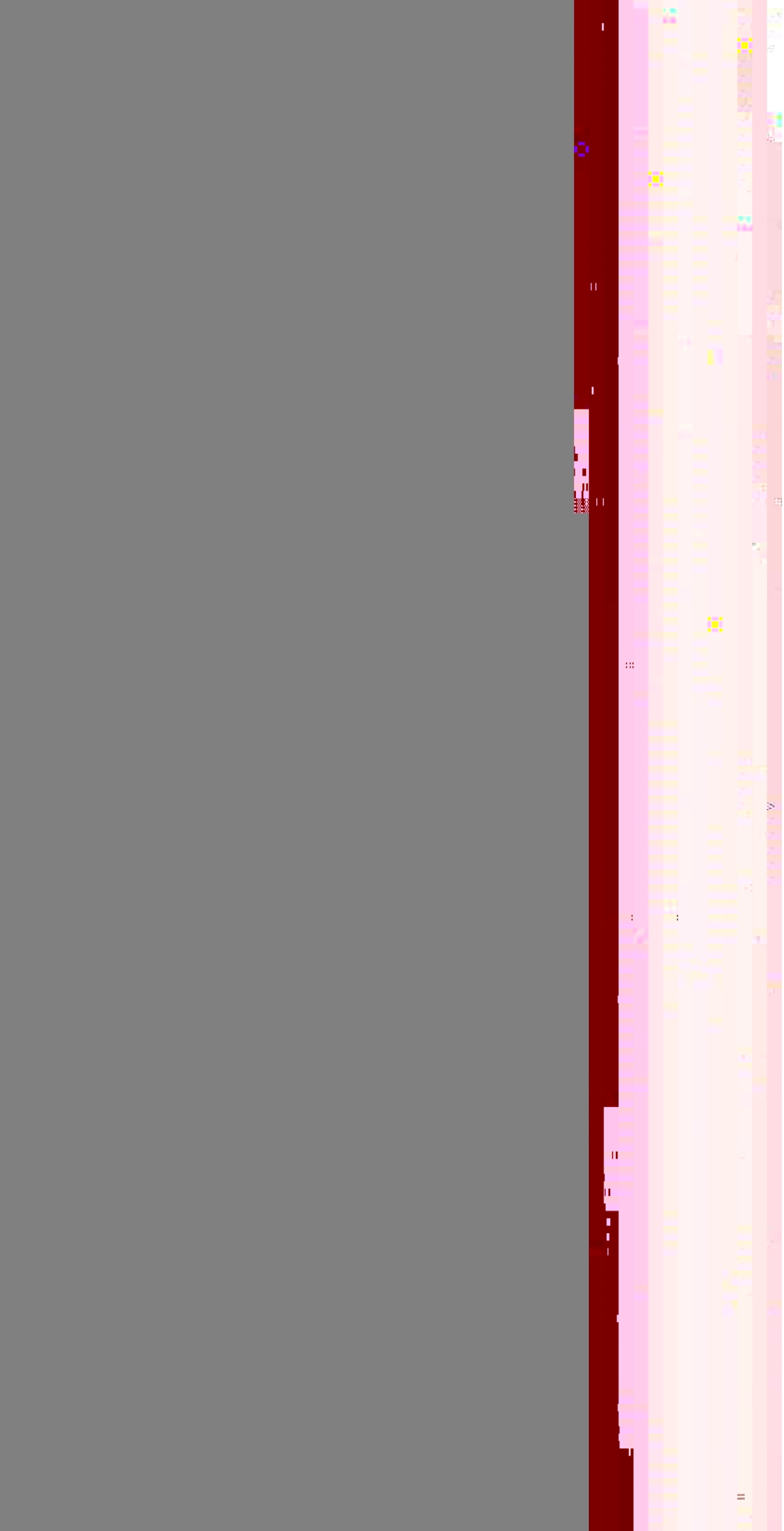
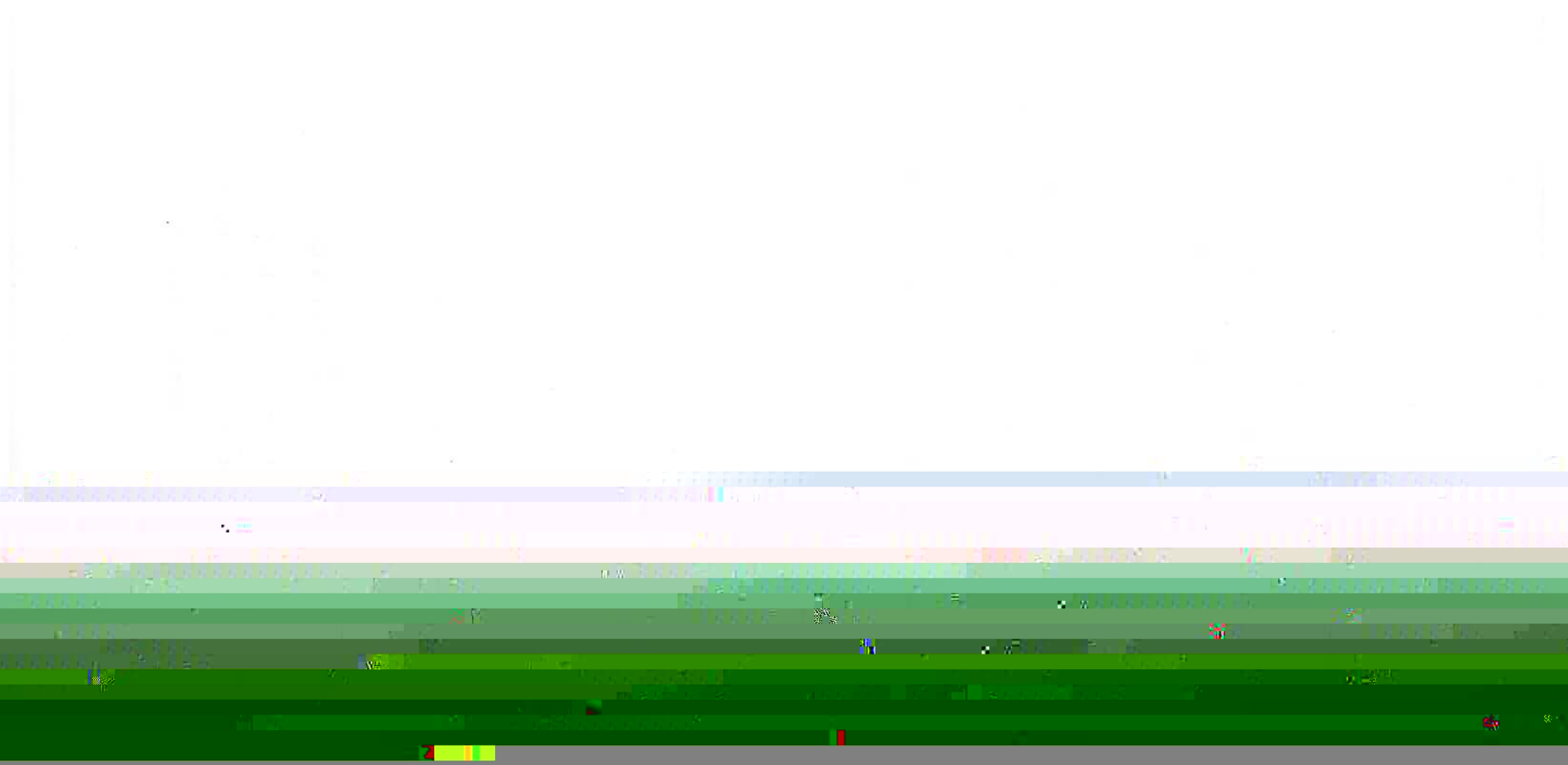
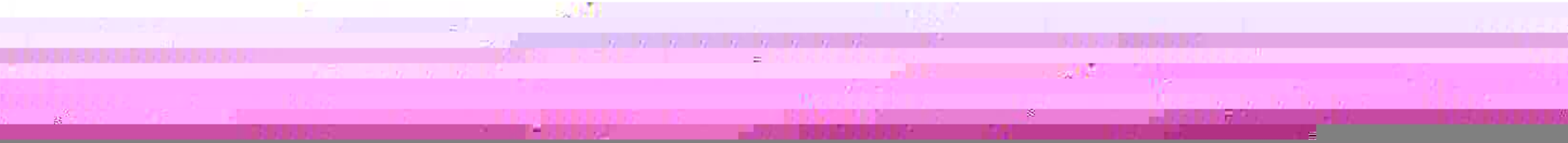


Figure 23. Time Course of a







APPENDICES