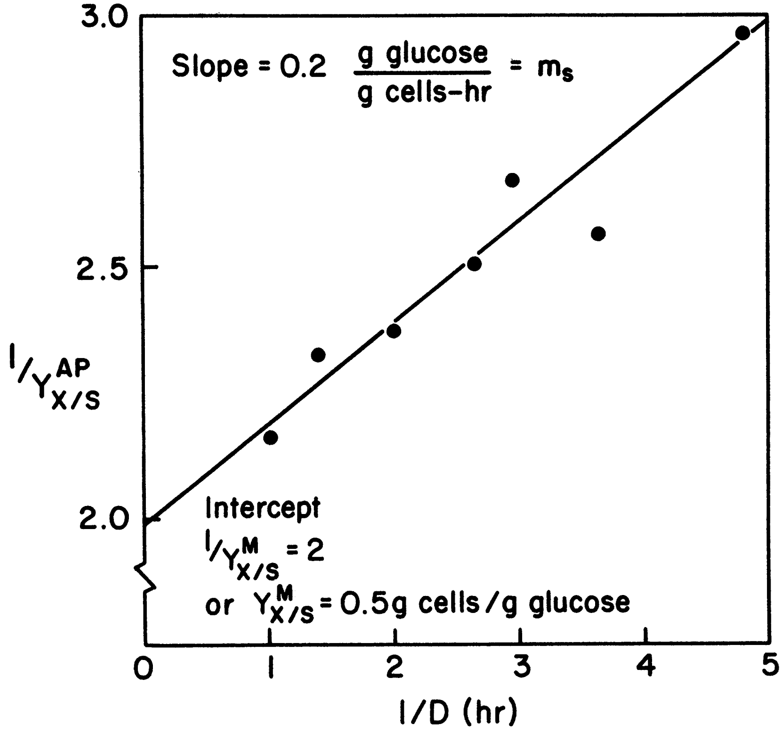

Figure 6.19. Graphical approach to estimating $Y^M_{X/S}$ and m_s for chemostat data for *E. coli* growing on glucose as the limiting nutrient.

model, we must view this conversion as instantaneous. Otherwise, a perceptible period of substrate uptake, prior to conversion to product, would cause a change in the amount of X. This is unlike maintenance, since the period between substrate uptake and use for maintenance functions may be long, so we allow S to become incorporated into X and X is then degraded when needed; the following equations assume instantaneous conversion of substrate to extracellular product, with the cell acting as a catalyst. The balance on product formation is

$$DP = q_P X \tag{6.80}$$

where q_P is described by eqs. 6.16, 6.17, or 6.18. For nongrowth-associated product formation, q_P is a constant (β), while for growth-associated products it is a function of μ_g. For substrate balance, eq. 6.69 becomes

$$D(S_0 - S) = \frac{1}{Y^M_{X/S}}(D + k_d)X + \frac{1}{Y_{P/S}} q_P X \tag{6.81}$$

The biomass balance is unchanged from the case with endogenous metabolism and yields