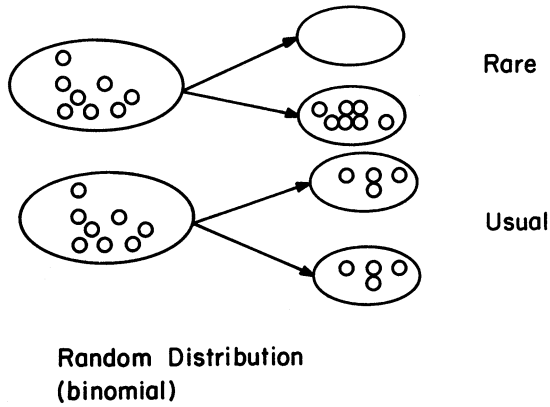

Figure 14.4. Segregational instability results when a dividing cell donates all its plasmids to one progeny and none to the other.

Example 14.1.

What fraction of the cells undergoing division will generate a plasmid-free cell if:

a. All cells have 40 plasmids at division?

b. All cells have enough plasmid DNA for 40 copies, but one-half of the plasmid DNA is in the form of dimers and one-fifth in the form of tetramers?

c. Half of the cells have 10 copies of the plasmid and half have 70 copies (the average copy number is 40 as in case a)?

Solution

a. If we assume a random distribution at division, the probability of forming a plasmid-free cell is

$$P = 2^{(1-Z)} \tag{14.1}$$

where Z is the number of plasmid replicative units. For $Z = 40$, $P = 1.8 \times 10^{-12}$ plasmid-free cells per division.

b. If the total amount of plasmid DNA is equivalent to 40 single copies, we can determine the plasmid distribution from

$$M + D + T = 40 \text{ monomer plasmid equivalents} \tag{14.2a}$$

$$D = \frac{1}{2}(40) = 20 \text{ monomer plasmid equivalents} \tag{14.2b}$$

$$T = \frac{1}{5}(40) = 8 \text{ monomer plasmid equivalents} \tag{14.2c}$$

which implies that

$$M = 40 - 20 - 8 = 12 \text{ monomer plasmid equivalents} \tag{14.3}$$

The number of copies of replicative units is then

$$M + D/2 + T/4 = \text{total replicative units} \tag{14.4a}$$

$$12 + 10 + 2 = 24 \text{ total replicative units} \tag{14.4b}$$

since a dimer consists of two monomer equivalents and a tetramer of four monomer equivalents.