

### Notation 9-3

General features of even-aged stand development as depicted by the production function in figure 9-5.

To portray even-aged stand development (fig. 9-5), time (or stand age) serves as the measure of input and stand volume or basal area as the output. The curve portrays how volume or basal area increases as a stand matures (Matthews 1935; Davis and Johnson 1987; Leuschner 1990). The marginal change (called the *periodic annual increment*, or *p.a.i.*) represents the stand-wide balance between *accretion* ( $A$ ), *mortality* ( $M$ ), and *ingrowth* ( $I$ ), as represented by the basic model (after Gilbert 1954; Beers 1962; Marquis and Beers 1969):

$$p = A + I - M$$

Foresters call this net change the *production*. They compute the p.a.i. (net change during a specific period) (after Leuschner 1990) by:

$$\text{p.a.i.} = (Y_a + Y_{a+n})/n$$

where  $Y$  = production per year during the period of interest  
 $a$  = the initial measurement date or age  
 $n$  = the number of years between successive measurements

Or foresters can divide the standing crop volume at any time of interest by stand age to determine the *mean annual increment* (*m.a.i.*). This represents the average annual amount produced by stands held to some specified age, as such:

$$\text{m.a.i.} = Y_a/a$$

Note that m.a.i. reaches a peak level at the point where it also equals p.a.i., or where the long-term average production equals that realized during a shorter-term measurement period.

For the general case depicted in fig. 9-5, the total volume increases to a peak level at an age called *physiological maturity*. Then mortality ( $M$ ) equals growth ( $M = A + I$ ), and for a short period of years, p.a.i. equals zero. Thereafter, mortality exceeds increment ( $M > I + A$ ), and the total standing volume declines. Note also that during early stages of stand development, p.a.i. rises rapidly and then begins to decrease steadily. After a period of years, p.a.i. equals m.a.i. This delineates the maximum level of m.a.i., often called the *culmination of mean annual increment*.