

Method 'a' (page 84, bottom paragraph):

The maintenance respiration rate of organs that are not growing or transporting substances can be determined directly from CO₂ evolution rates, assuming the absence of idling respiration. Care should be taken in preparing the samples since cutting or slicing can affect the internal structure and the metabolic rate considerably (Eberhardt, 1960; MacDonald, 1968). Some measurements obtained in this way (method a) are presented in Table 3; their values are always very low.

Methods 'b', 'c', and 'd' (page 85, 2nd, 3rd, and 4th paragraphs):

One method of determining the rate of sugar consumption for maintenance processes is to extrapolate the relation between growth rate (increase in structural dry weight) or rate of export of assimilates and respiration rate to zero (cf. Penning de Vries, 1974), assuming that the rate of maintenance processes is independent of transport and biosynthesis processes. To avoid changes in the system to be maintained, the measurements must not be taken over long time intervals. There is no easy way to obtain a range of growth rates within one day without changing the conditions for maintenance processes also. (Although the CO₂-assimilation rate of leaves can be changed instantaneously, the growth rate responds slowly due to the buffering capacity of the pool of reserve carbohydrates.) Some data obtained by this method (b) are given in Table 3. The considerable variation in the data suggests that the method is not accurate. This extrapolation method has been used also to determine the maintenance requirement of animals (Kleiber, 1961) and of growing bacteria. Since growth and maintenance processes are not independent in bacteria the 'maintenance rate' obtained in this way is only valid for growing bacteria (cf. Pirt, 1965). In higher plants this complication is absent, since at all growth rates most plant cells are mature and do not increase in structural dry weight (total dry weight minus reserve substances); only seedlings may be an exception.

Another method of determining maintenance respiration (c) involves measurement of the rate of CO₂ production of attached organs under conditions where growth and translocation are absent, but maintenance is unaffected. Mature leaves after 6–24 h in darkness are used in most cases. Values obtained by this method are somewhat larger than those obtained by (b), but a few very low values have been found as well (Table 3). This method is inaccurate because it is difficult to establish whether all processes except maintenance have stopped.

The fourth method (d) of determining maintenance respiration involves measurement of the rate of respiration or the rate of dry weight decrease of full-grown, detached organs. If these are not exhausted of carbohydrates the respiration rate does not change much during the first few days (James, 1953). In well-designed experiments, wound respiration contributes little to the total CO₂-evolution. Thus rates observed with leaves of well-illuminated plants for the first day after detachment probably approximate to normal rates. Examples of such rates are presented in Table 3, and are similar to those obtained by other methods; the high values for primary bean leaves (80 and 55) probably reflect some remaining biosynthetic activity. The very high rates reported by James (up to 150) must be erroneous since not enough carbohydrates were present to sustain such high rates for the 7 days, as was reported.