

Marine Botany

Photorespiration in Marine Plants. N. E. TOLBERT and C. B. OSMOND, Eds. CSIRO, Melbourne, and University Park Press, Baltimore, 1976. viii, 140 pp., illus. \$19.50. Also published as *Australian Journal of Plant Physiology*, vol. 3.

This book is composed of papers that result from studies of photosynthesis and photorespiration in marine algae and sea grasses that were conducted on board the R.V. *Alpha Helix* during a 1973 expedition to the Great Barrier Reef of Australia. The book includes a checklist of benthic marine plants found in the vicinity of Lizard Island, discussions of the ultrastructure of sea weeds and sea grasses, and analyses of $\delta^{13}\text{C}$ values and of the enzyme systems operating in the C_3 and C_4 pathways of photosynthetic CO_2 fixation in free-living as well as symbiotic organisms.

A wide range of photosynthetic organisms, from cyanophytes to anthophytes, was investigated. The general conclusion reached—and the overall thesis of the book—is that the C_4 pathway characteristic of plants with little or no photorespiration does not play an important role in the marine environment, most of the observed photosynthetic CO_2 fixation being effected through the C_3 pathway and ribulose diphosphate carboxylase. This thesis is maintained even in light of the demonstration of reasonably high concentrations of reduced nicotinamide adenine dinucleotide malate dehydrogenase with high substrate affinity in several organisms. The possibility that this enzyme might be located within the mitochondria appeared so great, in light of the high sensitivity of photosynthesis to oxygen in most of the organisms studied, that the investigators could not conclude that it was located within the chloroplasts. The possibility that there might be combined C_3 and C_4 activities in the plants studied was not considered.

The way some data have been interpreted in this book raises several interesting questions. First, one might wonder how useful the technique of stable isotope fractionation is in studies of systems in which there is diffusion of gases across air-water and water-organism interfaces. The assumptions made in the interpretation of the observed $\delta^{13}\text{C}$ values were based on past observations of land plants, but the complexity of the $\text{CO}_2\text{-HCO}_3^-$ equilibrium in the marine environment renders such assumptions suspect. Second, studies of the endosymbiotic dinoflagellate *Symbiodinium* (= *Gymnodinium*) *microadriaticum* were interpreted as constituting a demonstra-

tion of a C_3 pathway in the organism. On the positive side, this conclusion is supported by the observed O_2 inhibition of CO_2 fixation and by the organisms' production and release of glycolate. Nonetheless, zooxanthellae have never been reported to photosynthetically produce serine and glycine, amino acids characteristic of photorespiring plants. In addition, the photosynthetic apparatus of zooxanthellae from different hosts became saturated at different light intensities, but the possibility that these differences were the result of differences in the genetic makeup or physiological adaptability of these algae was not considered.

For those interested in productivity in tropical marine environments as well as in the physiology of photosynthesis, this volume should be interesting reading.

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