CC/NUMBER 41
OCTOBER 12, 1981

This Week's Citation Classic

Walker D A. Photosynthetic induction phenomena and the light activation of ribulose diphosphate carboxylase. *New Phytol.* **72**:209-35, 1973. [Department of Botany, University of Sheffield, Sheffield, England]

Photosynthetic induction was reviewed in its relation to the autocatalytic function of the Benson-Calvin cycle. In addition, the affinity of ribulose bisphosphate carboxylase for CO_2 was discussed and the possibility that the enzyme might be activated by light driven Mg^{+} $^{+}$ movement was considered. [The *SCI*® indicates that this paper has been cited over 95 times since 1973.]

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July 30, 1981

"When, in 1973, I wrote what I believed to be a specialist review, I had no idea that I might be addressing the many rather than the few. Of course, a paper cited is not necessarily a paper read, and I may have unwittingly helped this particular contribution to fame, or notoriety, by citing it in my own subsequent publications. Any residual interest must, I believe, have focussed on ribulose diphosphate carboxylase (as it was then called) rather than on induction, an even more esoteric subject.

"The carboxylase was an enigma. The evidence in favour of its central role in photosynthetic carbon assimilation was compelling, and yet the characterisation of the purified enzyme put the affinity for CO_2 far too high to be acceptable with an apparent $Km(CO_2)$ equivalent to six percent in the gas phase. This was discussed and attention drawn to the early work of Pon[1] (who demonstrated that the affinity of the enzyme could be increased by preincubation with Mg^{2+} and CO_2). It was concluded, in view of contemporary work on similar lines, that the enigma might already be resolved. Indeed definitive experiments, which were soon to follow,[2] made it clear that the carboxylase is readily inactivated and that, on reactivation, the affinity once again equal to its role *in vivo.*

Ironically, the light activation of the carboxylase, a theme which was developed both by hypothesis and experiment in this review, remains in doubt and has nowhere been questioned more strongly than in my my own labo--ratory at Sheffield, where the feasibility of such a notion was first demonstrated. Thus, it had been shown that in a reconstituted chloroplast system, CO_2 fixation could be initiated either by increasing the Mg concentration (by a reasonable 4 mM) or by raising the CO_2 concentration.

At present, the extent of the light-generated movement of free Mg into the stroma is still a matter for debate in its relation to enzyme activation (see, e.g., Portis[3]), but if it does play a part in creating a favourable environment, the emphasis would probably be placed on the requirement of the bisphosphates for Mg++ rather than on the carboxylase. Certainly in many circumstances, the carboxylase shows little tendency to dark inactivation whereas FBPase seemingly trims its catalytic activity to every nuance in the light-controlled reduction status.[4]

"Inevitably, my pleasure in having written a popular paper is tempered by the fact that it is a review, rather than an original contribution, which has been so well received. It does, however, strengthen my conviction that pause for reflection, between experiments, is not necessarily a bad thing."

1. **Pon N G.** *Studies on the carboxydismutase system and related materials.* PhD thesis. Berkeley, CA: University of California, 1961. 34 p.
2. **Lorimer G H, Badger M R & Andrews T J.** The activation of ribulose-1, 5-bisphosphate carboxylase by carbon dioxide and magnesium ions: equilibria, kinetics, a suggested mechanism and physiological implications. *Biochemistry* **15**:529-36, 1976.
3. **Portis A R.** Evidence of a low stromal Mg^{2+}concentration in intact chloroplasts in the dark. *Plant Physiol.* **67**:985-9, 1981.
4. **Leegood R C & Walker D A.** Modulation of fructose bisphosphatase activity in intact chloroplasts. *FEBS Lett.* **116**:21-4, 1980.