

Thorner J P. Chlorophyll-proteins: light-harvesting and reaction center components of plants. *Annu. Rev. Plant Physiol* 26:127-58, 1975.
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The isolation, composition, and biogenesis of plant chlorophyll-proteins was reviewed. The article proved to be instrumental in establishing that proteins, rather than lipids, organized the photosynthetic pigments into specific complexes in the chloroplast membrane [The SCI® indicates that this paper has been cited in over 400 publications since 1975.]

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The chlorophyll molecules in the chloroplast membrane are precisely arranged so that they can perform their light-harvesting and photochemical functions efficiently. Whether lipids or proteins in the membranes provided this organization was much debated in the 1960s and early 1970s. Many photosynthesis researchers favored lipids for this purpose.

While I was working at Twyford Laboratories in London in the mid-1960s, I had observed that chloroplast membranes solubilized by a surfactant could be resolved into several green protein bands by polyacrylamide gel electrophoresis. Since each band had a slightly different color and their protein and pigment compositions differed, I was convinced that proteins were involved in organizing at least most of the chlorophyll. It was difficult to persuade other photosynthesis researchers of this. Many of these researchers thought that the green bands were more likely to be spurious associations of chlorophyll with colorless proteins formed during membrane solubilization. Furthermore, the lack of a reproducible purification scheme for these hydrophobic components, and the fact that their

pigment composition often varied from preparation to preparation, fueled skepticism about their authenticity and also made it difficult to relate the components described by one laboratory to those studied in another.

Thus, an invitation in 1974 from *Annual Reviews* to write about chlorophyll-proteins seemed to be a good opportunity to clarify what had become a very baffling subject for many people. I had moved from England via Brookhaven National Laboratory to UCLA by this time. I spent much of my 1974 summer assimilating a rather large and rapidly expanding body of relevant literature that had appeared in spite of the difficulties of working with chlorophyll-proteins. Randy Alberte, who was a postdoctoral student with me at the time, helped me enormously in assembling the article. I wrote what I hope was a clear, comprehensive synopsis that included an explanation of how different laboratories could isolate disparate preparations of the same chlorophyll-protein, a disconcerting point to many individuals.

The review convinced many skeptics that proteins were responsible for the organization of chlorophyll *in vivo*. Apparently, one particularly persuasive point was my demonstration of the relationship between several publications on mutant plants lacking one of the putative chlorophyll-proteins to what had already been published on chlorophyll-proteins. I had planned to review chlorophyll-proteins of both plants and bacteria; however, time ran out and the equivalent story for the bacterial complexes did not appear until later.¹

The review has been much cited by those needing a general reference to: (a) chlorophyll's association with protein in plants, (b) chlorophyll-proteins accounting for the bulk of the chloroplast membrane's protein, or (c) the early work on the P700-chlorophyll *a*-protein and the light-harvesting chlorophyll *a/b*-protein.^{1,2} and others have updated the topic of the review during the last decade. Now there is so much information available about chlorophyll-proteins that it requires a monograph be written to be comprehensive.

- 1 Thorner J P, Trosper T L & Strouse C E. Bacteriochlorophyll *in vivo* relationship of spectral forms to specific membrane components (Clayton R K & Sistrom W R, eds.) *The photosynthetic bacteria* New York Plenum, 1978 p 133-60
- 2 Thorner J P. Biochemical characterization and structure of pigment-proteins of photosynthetic organisms (Staehelein L A & Arntzen C J, eds.) *Photosynthesis III photosynthetic membranes* Berlin Springer-Verlag To be published, 1986