

Obituary



David Hall (1935–1999)

David Hall, Professor of Biology, King's College London, died of cancer on 22 August 1999, after 35 years of a distinguished career devoted to teaching, research and International Scientific co-operation for the sustainable development of the Earth. David was an ardent believer in the potential of 'photosynthesis as a clean energy resource', ever advocating the role of plants (biomass) in the present and the future formulation of Energy and Environment policies for the developed and developing parts of the world. His premature death at the age of 63 is a great loss not only to the photosynthesis community but also to many worldwide networks of specialists on biomass, agriculture, renewable energy, climate change, and biodiversity.

David Oakley Hall was born on 14 November 1935 in East London, South Africa. After graduating cum laude in Agriculture from the University of Natal in 1957, he went to the University of California at Los Angeles (UCLA), and obtained an MS degree in Horticulture in 1959. In UCLA he learned the basics of chloroplast isolation, genetics and biogenesis from Sam Wildman. He proceeded to the University of California (UC) at Berkeley, and enrolled in the PhD program in Daniel Arnon's Plant Physiology Department. At that time, the UC laboratory of Arnon (and also of Melvin Calvin–Andy Benson) was in the forefront of photosynthesis research and attracted many young plant physiologists from all over the world.

According to Bob Whatley, who was a prominent member of that group, "David's energy, enthusiasm and determination earned him the rare privilege of participating in the weekly discussions held by Arnon and his postdoctoral researchers". David was fortunate to cultivate the friendship of Bob, Achim Trebst, Manuel Losada, Harry Tsujimoto and Akira Mitsui during his graduate studies. Part of his thesis work was concerned with the role of photosynthetic phosphorylation coupled to electron transport to nicotinamide adenine dinucleotide phosphate, NADP (or NAD) in plants and photosynthetic bacteria (Arnon et al. 1961).

After graduation from Berkeley in 1963, David worked for a year as a postdoctoral fellow with Albert Lehninger at the John Hopkins School of Medicine in Baltimore. Although David was investigating oxidative phosphorylation in *Neurospora crassa* mitochondria (Hall and Greenawalt 1967) in Lehninger's laboratory, he had ample opportunities to associate with the Photosynthesis Research fraternity – the likes of André Jagendorf, Richard McCarty, Joe Neumann, and Geoff Hind, an association he continued to cherish the rest of his life.

In 1964, at the invitation of Professor Whatley, David joined King's College in London as a lecturer in Plant Sciences but was soon promoted to Reader in Biology. The focus of research in the Department was on photosynthetic electron transport and ATP

synthesis and the structure–function of ferredoxins (a legacy from Arnon’s laboratory). In 1969, I joined the team which included Bob Whatley, Mike Evans, Dick Cammack, Alison Telfer, Philip John, John Palmer and Stuart Reeves; Peter Heathcote joined the group later. By a combination of biochemical and spectroscopic techniques, we were able to show that the active center of plant ferredoxins contained in the oxidized state two high spin Fe^{3+} atoms antiferromagnetically coupled; upon reduction of the ferredoxin by a single electron, one of the iron atoms became high spin Fe^{2+} (Rao et al. 1971); the antiferromagnetic coupling was reported earlier by: J. F. Gibson, D. O. Hall, J. H. M. Thornley and F.R. Whatley. There was a debate about the number of ATP molecules synthesized during photophosphorylation and much effort was expended in determining the ATP/2e and ADP/0 ratios, although the issue was not resolved at that time (Reeves and Hall 1973). The production of superoxide radicals by electron transport in chloroplasts was demonstrated by John Allen, a new PhD student (Allen and Hall 1973). In 1974, David was appointed as a Professor in Biology. From the mid-1970s the basic photosynthesis research field was enlarged to studies on oxygen metabolism (Christine Foyer), photorespiration (Tony Moore), characterization of Photosystem (PS) I and PS II (C.P. Dos Santos, J. Masojidek), and photoinhibition (P.K. Sharma).

The ‘fuel oil crisis’ in the early 1970s prompted David to diversify his interests to the application of photosynthesis towards the production of non-fossil-based fuels and the development of ‘clean’ energy technologies. He was selected by the European Economic Community (EEC) as Project Leader and Co-ordinator of Photochemical and Photobiological Research within the Community with the objective of developing natural and ‘biomimetic’ photosynthetic systems for the production of energy resources such as electricity, and hydrogen. This enabled him to visit numerous photosynthesis laboratories in Europe to renew his acquaintance with photobiologists and to familiarize himself with the work of photochemists such as George Porter and Michael Graetzel, and also Jim Bolton with whom he worked out photoconversion efficiencies (Bolton and Hall 1991).

Early in 1962, during David’s tenure at Berkeley, Arnon, together with A. Paneque and A. Mitsui, had demonstrated that illuminated spinach chloroplasts in the presence of dichlorodimethyl urea, DCMU (an inhibitor of PSII reaction), cysteine (an electron donor), methylviologen (an electron carrier) and *Chromatium*

hydrogenase produced H_2 gas and ATP via cyclic photophosphorylation. The new EEC initiative gave an opportunity to develop the chloroplast–hydrogenase system for H_2 production. One group in the laboratory (L. Rosa, M.W.W. Adams, P.E. Gisby, J.L. Senna and M.J. Llama) was concerned with the isolation and characterization of hydrogenases from various phototrophs and coupling them to isolated chloroplasts, algal cells or cyanobacteria for the photoproduction of H_2 . Although these coupled systems evolved H_2 for days, the efficiency was too low to encourage further development (Hall et al. 1980). Subsequently, the photoproduction of H_2 was studied with nitrogen-fixing cyanobacteria in helical photobioreactors both in the laboratory and outdoors. This research, in collaboration with the Institute of Photosynthesis, Pushchino, Russia (I.N. Gogotov, A.A. Tsygankov, V. Borodin and A. Fedorov) and supported by the Research Institute of Innovative Technology for the Earth (RITE), Japan, was coming to fruition when David died rather suddenly (Tsygankov et al. 1999).

For many years David was the Chairman of the School of Biological Sciences Academic Committee at King’s College. Apart from teaching cell biology and energy technology courses and supervising research, David was engaged in a number of international scientific activities. He was a founding member of the International Photosynthesis Committee and an office bearer of the International Photobiology Association. He was a co-organizer of the 4th International Congress on Photosynthesis at Reading, UK, in 1977. He, with M. Archer and J. Page, founded the UK section of the International Solar Energy Society and served as its Chairman and Treasurer. From 1977 to 1994, David was the co-ordinator of a research project and of a training course on ‘Bioproductivity and Photosynthesis in a Changing Environment’ sponsored by the United Nations Environment Program (UNEP). These courses he conducted together with his PhD student, Jonathan Scurlock, in various developing countries generating a network of young researchers with skill in measurement and analysis of photosynthetic productivity under field conditions.

In the 1990s, David got more and more involved in energy and environmental issues. He became a firm believer in the potential of biomass in solving world energy problems (Hall 1997). His laboratory research was focused on the application of microalgae in the production of fuels, biofertilizers, nutraceuticals and bioremediation (Hall et al. 1995). He was a member of the Biomass Users Network (BUN), Scientific

Committee on Problems of the Environment (SCOPE) and a lead author of the Intergovernmental Panel on Climate Change (IPCC) Working Group. His office in King's College (London) houses one of the best resource centers for biomass literature in Europe. He was the recipient of numerous awards for his work on photosynthesis, biomass and global climate change: for example, the UK Solar Energy Society Award (1998), and the Linneborn Prize for Achievements in Biomass Development (1998).

In between his busy schedule, David also took two sabbaticals to extend his knowledge, the first with Jean Le Gall and co-workers at the University of Marseilles (Bacteriology) and the second at Princeton, New Jersey, with Bob Williams (Energy and Environment).

He was a prolific writer and authored 12 books and more than 400 articles. I had the privilege in 1972 to coauthor one of these books written as an introduction to Photosynthesis; the 6th edition of this book was released just a few weeks before David died (Hall and Rao 1999). He was the founding editor of Biomass as well as Biomass and Bioenergy and served on the editorial committee of many other journals.

I have been with David for 30 years. His office door was always open to visitors (and there were many) and students. Even when he was travelling frequently to different continents he found time to advise his students and to monitor their progress. David always encouraged and supported his students to present research data at the meetings of the UK Scientific Societies and also, in particular, at the International Photosynthesis Congresses which he regarded as an ideal forum for young scientists to listen to the experts and to seek future employment. He supervised 20 PhDs at King's College London, and was an external adviser to many across the world. He was a benevolent person and contributed regularly to various charities and individuals. A generous donation by him and his brother Michael, who is a Professor in UCLA, helped his Alma Mater Kearsney College, Botha's Hill, South Africa, to build and equip a Biology Hall last year for teaching high school students. He was an enthusiastic rugby and cricket player; and

enjoyed frequenting London theatres with family and colleagues. All who met him remember his charming smile, warm heartedness and dedication to scientific research. David Hall's contributions to photosynthesis, bioenergy and environment will be remembered and appreciated in the next millennium.

David is survived by his wife, Peta, and daughters Elena and Claire.

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