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GUEST EDITORIAL

Celebrating Govindjee's 50 years in photosynthesis research and his 75th birthday

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Introduction

This volume of *Photosynthesis Research* is the first of a two-part Special Issue to recognize Govindjee's many achievements and contributions to the field of photosynthesis. His scientific career has spanned over 50 years and has been characterized by continuous scientific publications and dedication for communicating about photosynthesis to many different audiences including professional scientists, graduate and undergraduate students and the general public. It is difficult to imagine the photosynthesis community without Govindjee. I am fortunate to have been one of his 25 graduate students and I am delighted to have edited this volume. Here, we take the opportunity to celebrate his lifetime achievements on behalf of the photosynthesis community at large.

Govindjee received his PhD in biophysics from the University of Illinois at Urbana-Champaign in 1960 and thereafter served on the faculty until he became Professor Emeritus in 1999. In recognition of "Gov's" achievements and acknowledging his love of teaching and education, the Rebeiz Foundation for Basic Research presented him, on June 16, 2007, its first Lifetime Achievement Award that reads: "*For his scientific achievements, original research in the field of photosynthesis, promotion of photosynthesis research in books and at international conferences and his continuing efforts to document the history of photosynthetic research, as an editor par excellence*." Further, the Department of Plant Biology of the University of Illinois administers an Annual Govindjee and Rajni Govindjee Award for Excellence in Biological Sciences. The text on Govindjee, written by the Head of the Department of Plant Biology, Evan DeLucia, reads as follows:

> Govindjee is Professor Emeritus of Biochemistry, Biophysics and Plant Biology at the University of Illinois. He studied with the founding fathers of photosynthesis research and Govindjee now stands among the discipline's luminaries. From his seminal research on the mechanisms of Photosystem II and chlorophyll fluorescence by plants to his recent unique work on the history of photosynthesis research, Govindjee's scientific reach and impact are considerable. He once was introduced with the opening assertion, "We depend upon photosynthesis and photosynthesis depends upon Govindjee."

In Part A of the Govindjee Special Issue, more than 90 international scientists, from 15 countries, honor Govindjee (see Fig. 1) with 21 research papers on the biochemistry, biophysics and molecular biology of cyanobacteria, algae and plants, all of interest to Govindjee.

I present below selected aspects of his personal and academic life including the story of his use of one name only that often frustrates publishers, indexers and even authors.

Govindjee: family and name

Govindjee, who uses one name only, grew up in Allahabad (India). He was born on October 24, 1932 to (Mrs) Savitri Devi Asthana and (Mr) Vishveshwar Prasad Asthana. His father was first a college teacher, served as the General Secretary of the U.P. (United Provinces) Teachers Association, and then as the representative of the Oxford

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Fig. 1 A 2006 photograph of Govindjee, Professor Emeritus of Biochemistry, Biophysics and Plant Biology at the University of Illinois at Urbana-Champaign, since August 1, 1999. He also serves as the Series Editor of *Advances in Photosynthesis and Respiration* and the Historical Corner Editor of this journal, *Photosynthesis Research*. Photograph provided by Wolfgang Lubitz

University Press in Northern India. He was fluent in English, Hindi and Urdu. After his father's death in 1943, Govindjee's older brother Krishnaji was responsible for bringing him up, and served as his role model. (Krishnaji passed away in August 1997.) Govindjee's second brother Gopal Ji lives in Gurgaon (India) with his wife Nirmala. Govindjee's sister, Malati lives in Bhagalpur (India) with her husband Radha Krishna Sahay. (Photographs and details of Govindjee's family in India appear in an informal family book: "Amma and Babuji: Our Life at Allahabad", edited by Govindjee, 2007.)

The family name, Asthana, was dropped by Govindjee's father in a response to the "Arya Samaj Movement" that was against the "Caste System," and believed in the ideals of the Vedic times. Govindjee came to Urbana, Illinois, USA, in 1956, with his name written on his Indian passport as "Govind Jee." He was not happy to be called "Mr. G. Jee", and, thus, began to use "Govindjee" as his one and only name. This has caused problems in citations, and in many formal settings. He has been referred to by many names: N.F.N. Govindjee (where N.F.N. stands for No First Name); I. Govindjee (where I stands for Illini); Mister Govindjee; and once A.V.P. Govindjee (where A. stands for Allahabad, and V.P. are the initials of his father). Quite often, his name has appeared with the initials of his doctoral students: the longest being J.C.M. Govindjee, Jr (where J.C.M. stood for John Clingman Munday).

Govindjee met Rajni Varma in 1953, when they were M.Sc. students at Allahabad University; she was a year junior to him. They were married on October 24, 1957 at Urbana, Illinois when both were PhD students of Robert Emerson. The Govindjees have two children: (1) Anita: she is a software engineer for IBM, and she is married to Morten Christiansen, who is a Professor of Psychology at Cornell University, Ithaca, NY; they have one daughter, Sunita. (2) Sanjay: he is a Professor of Mechanics at the Swiss Federal Institute (also known as ETH); he is married to Marilyn Hubbs; they have two sons: Arjun and Rajiv.

Education and academic positions held

Govindjee was educated in Colonelganj High School (1943–1948), then Kayastha Pathshala (K.P.) Intermediate College (1948–1950), and finally Allahabad University (1950–1954), all at Allahabad, India. Several great teachers in Biology and in Chemistry influenced Govindjee's academic life. Two of his college teachers (Jalpa Prasad and M.L. Gaur) were responsible for igniting his interest in both Chemistry and Biology as they would loan him their personal books on the subject.

Govindjee received his B.Sc. (Chemistry, Botany and Zoology, in the first division) and M.Sc. (Botany, also in the first division, and first position) from the University of Allahabad, in 1952 and 1954, respectively. He specialized in Plant Physiology under Shri Ranjan (a former student of Felix Frost Blackman); Govindjee served as a Lecturer in Botany at Allahabad University from 1954 to 1956. He came to the University of Illinois at Urbana-Champaign (UIUC), Illinois, USA in 1956, as a Fulbright scholar and a UIUC Graduate Fellow, to work for his PhD in Physico-Chemical Biology under Robert Emerson. After Emerson's untimely death in a plane crash in February, 1959, he worked with Eugene Rabinowitch, and obtained his PhD in Biophysics from UIUC, in 1960, with a thesis on the "*Action Spectra of the Emerson Enhancement Effect in Algae*". From 1960 to 1961, Govindjee served as a United States Public Health (USPH) Postdoctoral Fellow. Govindjee has also mentioned that he considers the time he spent discussing photosynthesis research with Bessel Kok, C. Stacy French, Louis N.M. Duysens, and William Arnold, during his visits to their laboratories, as extremely valuable in his training as a biophysicist. From 1961 to 1965, he was an Assistant Professor of Botany; from 1965 to 1969 an Associate Professor of Biophysics and Botany; and from 1969 to 1999 a Professor of Biophysics and Plant Biology, all at UIUC. During 1998–1999, he also served as a Professor of Biochemistry. On August 1, 1999, he became Professor Emeritus of Biochemistry, Biophysics, and Plant Biology at UIUC. His teaching and research career was celebrated in October, 1999, through a symposium at UIUC, organized by John C. Whitmarsh, where Gerry Babcock and Bob Blankenship were the major speakers.

Research contributions in photosynthesis

Govindjee has focused mainly on the function of Photosystem II (PS II—the water-plastoquinone oxido-reductase), throughout his research career, in collaboration with literarily almost a 100 scientists around the world. Among his research accomplishments, he pioneered the first picosecond measurements on Photosystem I primary photochemistry in 1978 at Urbana, and then on PS II primary photochemistry in 1989 with Michael Wasielewski at Argonne National laboratory. He also established the unique role of bicarbonate on the acceptor side of PS II, particularly in protonation events involving the Q_B binding region and provided the first comprehensive theory of thermoluminescence in algae and plants. Govindjee also exploited both delayed and prompt fluorescence (particularly lifetimes) and used them for the understanding of electron transport and for photoprotection against excess light.

Govindjee is also known for his expertise on fluorescence spectroscopy and for his research on excitation energy transfer in photosynthetic systems. His early research, with several collaborators, included the discovery of a short-wavelength form of chlorophyll (Chl) *a* functioning in the Chl *b*-containing system, now called PS II; as well as the two-light effects in Chl *a* fluorescence and in NADP (nicotinamide dinucleotide phosphate) reduction in chloroplasts (Emerson Enhancement). Further, he showed the existence of different spectral fluorescing forms of Chl *a* and demonstrated the temperature dependence of excitation energy transfer down to 4 K (in agreement with Förster theory). Govindjee also exploited basic relationships between Chl *a* fluorescence and photosynthetic reactions; and he was the first to use Fluorescence Lifetime Imaging Microscopy of Chl *a* fluorescence in understanding photoprotection against excess light.

Govindjee's graduate students and research scientists visiting his laboratory

Graduate students

Govindjee had more than 25 graduate students in Biochemistry, Biophysics, Cell Biology, Plant Physiology, Plant Biology, and Molecular Biology, working in his laboratory. They include (alphabetically): Maarib Bazzaz, Glenn Bedell, Daniel Blubaugh, Jiancheng Cao, Carl Cederstrand (jointly with Eugene Rabinowitch), Fred Cho, Roger Chylla (with John Whitmarsh), William Coleman, Raymond Chollet (with Bill Ogren), Julian Eaton-Rye, Fatima El-Shintinawy, James Fenton, Oliver Holub (jointly with Bob Clegg), Paul Jursinic, Rita Khanna, Anna Krey, Ted Mar, Prasanna Mohanty, John C. Munday, Jr., George Papageorgiou, Robin A. Roffey (with Richard Sayre), Ralph Schooley, Hyunsuk Shim (jointly with Peter Debrunner), Carmela Shimony, Paul Spilotro, Alan Stemler, David van der Meulen, Wim F.J. Vermaas (jointly with Jack van Rensen), Quin Jun Wang (with John Whitmarsh), Thomas Wydrzynski, Jin Xiong, Chunhe Xu, Louisa Yang, Xinguang Zhu (with Steve Long), and Barbara Zilinskas.

Research scientists

Ion Baianu, Patrick Breen, Jean-Marie Briantais, Christa Critchley, Mrinmoyee Das, Don DeVault, Ralphreed Gasanov, Ashish Ghosh, Adam Gilmore, Elizabeth Gross, Ron Hutchison, T. Kambara, Ashok Kumar, Shmuel Malkin, Ismael Moya, Teruo Ogawa, Subhash Padhye, Barbara Prezlin, G. Sarojini, Richard Sayre, Manfredo Seufferheld, Vladimir Shinkarev, Gauri Singhal, Beazy Sweeney, Karel Vacek, Jack van Rensen and Hasan Younis were among the many research scientists or professors, from around the world, who have worked with him in his Urbana laboratory.

Govindjee's collaborative spirit

Govindjee's collaborative spirit is remarkable. Just on one campus, the UIUC campus, he has collaborated with more than a dozen laboratories; these include (alphabetically) the laboratories of: Charles Arntzen; John Boyer; Robert Clegg; Anthony Crofts; Peter Debrunner; R. Docampo; Enrico Gratton; Herbert Gutowsky; D.N. Hendrickson; Kenneth Kaufmann; Steven Long; William Ogren; Donald Ort; Archie Portis; Tino Rebeiz; Paul Schmidt; Shankar Subramaniam; John Whitmarsh; and Colin Wraight.

A count of the number of his coauthors on his 400+ publications reveals an astonishingly large number of approximately 400 around the world. A complete list of Govindjee's publications and recent publications are available at http://www.life.uiuc.edu/govindjee/publications.html and http://www.life.uiuc.edu/govindjee/recent_papers.html, respectively.

Govindjee's teaching spirit

Govindjee has always been rated as an outstanding and exceptional teacher at all levels from an undergraduate class of more than 700 students to a graduate class of 6 students. His personal involvement and stories make his lectures enjoyable. At UIUC, he has taught the following topics: Introduction to Plant Physiology; Advanced Plant Physiology; Organismic Biology; Introduction to Biophysics; Photosynthesis: Biochemistry, Biophysics and

Molecular Biology; Honors Biology; and Fluorescence Spectroscopy, among others.

Books, journals and membership in societies

Books and journals

Govindjee coauthored, with Eugene Rabinowitch, "Photosynthesis" (John Wiley, 1969); this book has had a world-wide impact on thousands of students, especially during the 1970s and 1980s. Marcel Babin, of France, wrote, on June 4, 2007 "The Rabinowitch and Govindjee book remains for me the best ever introduction book about photosynthesis. There is certainly still a demand for a new edition...the pitch of [this]- book was, and is still, unique." Fortunately, this book is available free at: http://www.life.uiuc.edu/govindjee/photosynBook.html

Govindjee has edited other unique books of high impact: "Bioenergetics of Photosynthesis" (Academic Press, 1975); and "Photosynthesis" (in 2 volumes, Academic Press, 1982, Russian translation, 1987). His co-edited, but equally important, books include: "Light Emission by Plants and Bacteria" (Academic Press, 1986); "Chlorophyll a Fluorescence: A Signature of Photosynthesis" (Kluwer/Springer, 2004); and "Discoveries in Photosynthesis" (Springer, 2006), among several other books. He has also edited special issues of journals honoring, e.g., some of the pioneers of the biophysics of photosynthesis: Eugene Rabinowitch (*Biophysical Journal*, 1972), Warren Butler (*Photosynthesis Research*, 1986), Bessel Kok (*Photosynthesis Research*, 1993), and William Arnold (*Photosynthesis Research*, 1996).

Membership

Govindjee is an Emeritus member of the American Society of Plant Biology (formerly Physiology), American Society for Photobiology, Biophysical Society of America, Sigma Xi, and the International Society of Photosynthesis Research.

Honors

Govindjee's honors include: Fellow of the American Association of Advancement of Science (1976); Distinguished Lecturer of the School of Life Sciences, UIUC (1978); Fellow and Life Member of the National Academy of Sciences, India (elected 1979), President of the American Society of Photobiology (1980–1981); Fulbright Senior Lecturer (1996–1997); Honorary President of the 2004 International Photosynthesis Congress (Montreal, Canada) and the first recipient of the Lifetime Achievement Award of the Rebeiz Foundation for Basic Biology (2006).

Current interests

Govindjee's scientific interests, now, include Fluorescence Lifetime Imaging Microscopy and regulation of excitation energy and electron transfer(s) in cyanobacteria and algae. In addition, his current focus is on the history of photosynthesis research, in photosynthesis education, and in the possible existence of extraterrestrial life. He is not only the founding Series Editor of the *Advances in Photosynthesis and Respiration* series (Kluwer/Springer) and continues to serve in that capacity, but also the founding editor of the "Historical Corner" of *Photosynthesis Research*.

Concluding remarks

Govindjee has been a pioneer in the area of photosynthesis research, with a primary focus on the function of the oxygen-evolving PS II in chloroplasts, especially through the use of Chl *a* fluorescence. His early discoveries, with his collaborators, revealed the two-light effect in Chl *a* fluorescence, established the participation of Chl *a* in both the light reactions (Photosystems I and II), and showed the effect of the two-light reactions and two pigment systems in the reduction of NADP in chloroplasts, providing a fundamental background to the current Z-scheme of the "Light Reactions" of photosynthesis.

Govindjee has also been an immensely effective and energetic advocate for photosynthesis research and has dedicated his entire life to educating students and researchers throughout the world. He has served the photosynthesis community uniquely and with great dedication as Editor-in-chief of *Photosynthesis Research*, where he increased by fourfold the number of pages published per year from <400 to 1,600. His advocacy and educational outreach have included numerous lectures around the world, delivered at international workshops, international conferences, in renowned Universities, and in remote Colleges, as well as three outstanding Scientific American articles (1965, 1974 and 1990), and more than 15 seminal reviews. He has also co-authored and edited many books, serving a remarkable 12-year period as Series Editor of *Advances in Photosynthesis and Respiration*; this series has already resulted in 25 volumes of inestimable value to the photosynthesis community.

In recent years, Govindjee has followed his passion for a unique project on the history of photosynthesis research for

the benefit of present and future students of Plant Biology, Biochemistry and Biophysics. For almost 20 years, he has documented the progress of research in photosynthesis, through interviews, obituaries, tributes, personal perspectives, and news of scientists around the world. Much of this has been presented through his innovative "Historical Corner" section in *Photosynthesis Research*. These publications, accompanied by photographs of key people and places, are unique contributions to the history of science, and photosynthesis, in particular.

Govindjee cherishes very much the following quote from Satish Chandra Maheshwari about Volume 20 in the *Advances in Photosynthesis and Respiration* series:

> Discoveries in Photosynthesis is easily among the most outstanding and valuable books published in the biological sciences in the last 100 years. Insofar as the plant sciences are concerned, it may indeed be in the rank of a classic because it not only deals with one of the most remarkable processes sustaining life on our planet, but also because of its unique authoritative style where the greatest investigators of photosynthesis describe, in their own words the discoveries they have made or those made by their close colleagues, many of whom have passed away... However, even for an edited volume and despite part publications earlier, the collective work represents a gigantic effort comprising as it does more than 1300 pages, with as many as 132 authors from 19 countries contributing 111 chapters, including much new material. The book is richly illustrated with nearly 800 photographs (many of them informal, adding greatly to the charm of the book)... I do not know of any comparable effort in the plant sciences or even the broader area of biology.

In summary, Govindjee has made unique and important contributions to research and science education, through his love and dedication for the field of photosynthesis. He is a passionate scientist whose dedication to service and education, as well as research, has enriched the photosynthesis community and everyone who has come into contact with him.

Fig. 2 A 2006 photograph of Govindjee in front of the Natural History Building, University of Illinois, where the concept of the two light reactions and two pigment systems, in oxygenic photosynthesis, arose during 1956–1960, and the plaque honoring his two Professors: Robert Emerson (1903–1959) and Eugene I. Rabinowitch [born as Evgenii Isaakovich Rabinovich] (1898–1973)]. Left to right: Rajni Govindjee (1961 PhD, under Eugene Rabinowitch, and Govindjee's life partner), Govindjee (1960 PhD, also under Rabinowitch), and Rita Khanna (1980 PhD, under Govindjee). Photograph provided by Rajni Govindjee

I end this dedication with a 2006 photograph (see Fig. 2) of Govindjee with his wife Rajni Govindjee, together with one of his past graduate students, Rita Khanna and the plaque that he helped design honoring two of his (and Rajni's) professors: Robert Emerson (September, 1956–February, 1959) and Eugene Rabinowitch (March, 1959–September, 1960).

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