

## Review article

## Govindjee's 90th birthday – Congratulations from friends and colleagues

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## ABSTRACT

On the occasion of the 90th birthday of Govindjee, Professor Emeritus of Plant Biology, Biochemistry, and Biophysics, the University of Illinois at Urbana-Champaign (UIUC), over 100 celebrants have sent felicitations and messages to thank him for mentoring, nurturing, and building the community of photosynthesis researchers belonging to four generations; and in making the scientific knowledge accessible to students and young researchers via his monumental writings and editorial contributions. Govindjee joined UIUC in September of 1956 to study as a graduate student in the laboratory of Robert Emerson. In 1961, he joined UIUC as an Assistant Professor and retired as a full professor in 1999. He is well-known for pioneering work in oxygenic photosynthesis, leading to the current Z-scheme, and for his breakthrough advances concerning light harvesting, primary charge separation, the role of bicarbonate on the two-electron gate of photosystem II, water oxidation, non-photochemical quenching, and the use of biophysical techniques, such as prompt fluorescence, delayed fluorescence, thermoluminescence, and nuclear magnetic resonance. Today, despite his retirement, Govindjee continues to explore several important questions in the field of photosynthesis and documents the history of science. This tribute, in turn, attempts to capture scientific collaborations, as well as scholarly and personal contributions made by Govindjee to the lives of hundreds of scholars and students worldwide.

## 1. Introduction

Ninety years ago, there were no lasers, color TVs, laptop computers, iPhones, passenger jet airliners, or moon landings; and in the life sciences, genetic material was not discovered, the green revolution and the sequencing of the genes & genome were not in the sights. However, of life's energy transformations, the concept of the photosynthetic unit [1] was born in the same year as Govindjee (Fig. 1), while photosynthesis was still a 'black box', as the specific structures and mechanisms involved were not yet discovered [2].

The details of Govindjee's family, his early education and influences, and his life journey with Rajni Govindjee have been described previously [3–5]. Here we briefly describe his journey from Allahabad, India,

to the University of Illinois at Urbana-Champaign (UIUC). Govindjee and Rajni met in Allahabad; both obtained their B.Sc. in Chemistry, Botany, and Zoology (respectively in 1952, & 1953) and M.Sc. in Botany (respectively in 1954 & 1955) from the University of Allahabad. Just after his M.Sc., Govindjee worked with the late Professor Shri Ranjan (1889–1969) and began his research in Plant Physiology. After finishing his M.Sc., Govindjee joined as a Lecturer in the same Botany department. He soon became very interested in the well-known "Red Drop Effect" [6], and as a Fulbright scholar, he started his doctorate at UIUC with Robert Emerson (1903–1959) in 1956. A year later, Rajni Varma also started as a graduate student in Emerson's laboratory, and the two were married on October 24, 1957, on Govindjee's 25th birthday. However, due to the unfortunate death of Emerson in a plane accident, they

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Fig. 1. Govindjee, October 2022.

Source: College of Liberal Arts & Sciences, UIUC. Photo by Della Penna.

finished their doctoral studies under the supervision of Eugene Rabinowitch (1901–1973), a prominent scientist in Physical Chemistry and close collaborator of Emerson [7].

As graduate students, both Govindjee and Rajni worked on the “Emerson Enhancement Effect” [8], which was crucial for the introduction of the concept of two-light reactions and two photosystems working in series in oxygenic photosynthesis, which is at the base of the iconic Z-scheme. In his thesis, Govindjee showed for the first time that a short wavelength absorbing form of chlorophyll *a* (Chl *a* 670) is in the same system as Chl *b* in the green alga *Chlorella*, and fucoxanthol (carotenoid) in the diatom *Navicula minima* [9]. And Rajni, using benzoquinone Hill reaction of whole algal cells, showed that the Emerson Enhancement Effect was not in respiration [10]. Govindjee remained at UIUC; he served as Assistant Professor of Botany (1961–1965); Associate Professor of Botany and Biophysics (1966–1969); Professor of Biophysics and Plant Biology (1969–1999); and Professor Emeritus of Plant Biology, Biochemistry, and Biophysics (2000 onwards). During his long academic career, Govindjee advanced the understanding of photosynthesis. His personal and scientific achievements are summarized in Fig. 2 (for a complete list of publications, talks, honors, and awards see <https://www.life.illinois.edu/govindjee>). However, for the readers and students who encounter his name for the first time, we mention ten of his most important contributions: (i) existence and details of the two light reactions and two photosystems, photosystem I (PSI) and photosystem II (PSII) in several algae [9]; (ii) the first measurement of Chl fluorescence spectra from room temperature down to very low temperatures, minus 269° C [11]; (iii) explanation, using reactions in both PSII and PSI, for the dip (D) and the peak (P) in the Chl *a* fluorescence transient [12]; (iv) the unique role of bicarbonate on oxygen evolution and the two-electron gate of PSII [13–15]; (v) first measurement of the primary charge separation rate in PSI [16] and PSII

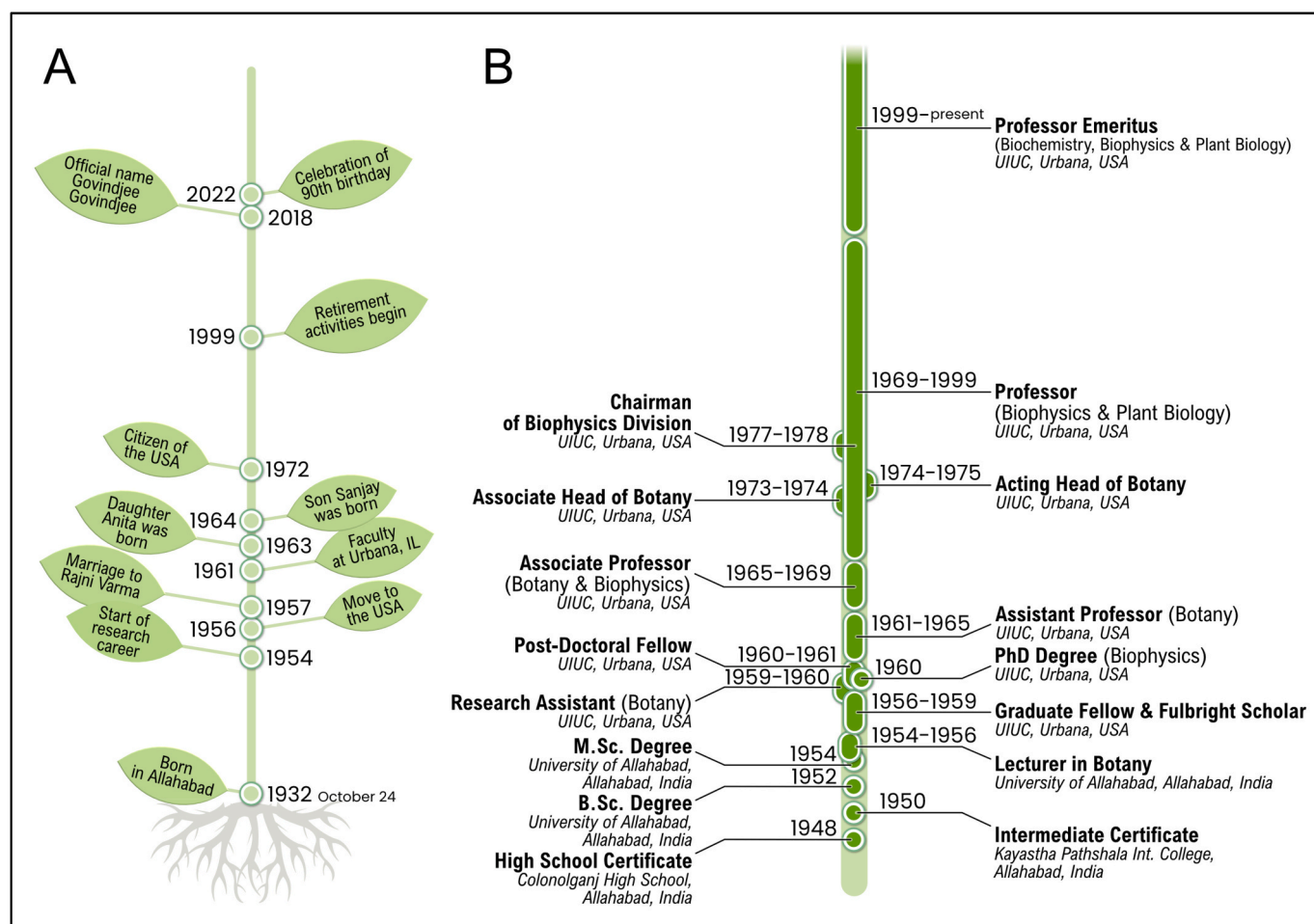


Fig. 2. An illustration by Dmitry Shevela depicting timeline infographics on Govindjee's personal milestones (A) and academic degrees and positions (B).



[17]; (vi) charge accumulation during oxygen evolution in photosynthesis, and the role of Mn, Cl, and bicarbonate ions [18]; (vii) discoveries on the mechanism of nonphotochemical quenching of Chl *a* fluorescence [19]; (viii) modeling Chl *a* fluorescence transient [20,21]; (ix) new ways to improve photosynthesis [22,23]; and after retirement (x) research, teaching, science outreach, and editorial activities. During this period, he dedicated his life to documenting the history of science and the personal contributions of plant scientists for posterity. A detailed account of Govindjee's contributions after 2000 has recently been published [4]. Indeed, here, we propose that the “Emerson Enhancement effect” be known hereafter as the “Emerson-Govindjees’ Enhancement Effect” in recognition of the key scientific contributions of both Govindjee and Rajni Govindjee. Fig. 3.

## 2. Reminiscences and greetings

In the history of science, this highly significant figure, Govindjee, had pushed the field forward to the extent that, when his 90th birthday became known by colleagues, collaborators, friends (including Nobel laureates, distinguished professors, post-docs, graduate students, college staff, corporate officers, and leaders), and family, they sent felicitations, congratulations, and heartfelt thanks for the marvelous memories and reminiscences of their various collaborations with Govindjee. Indeed, just two years prior, there were more than five dozen greetings for his 88th birthday [24]. We have provided the full, unedited versions of every message in a single file to Govindjee. We must say that Govindjee is deeply touched by the gracious felicitations and birthday wishes.

Here, we provide the full, unedited versions of most of the messages, with minor edits, although a few very long messages were shortened due to the page limit for this publication. We also did our best to cite and list the appropriate references; however, a few that are not yet published, and those lacking details, were excluded. Further, it was not easy for us to arrange these messages using any particular scheme (i.e., alphabetical or date received). Nonetheless, we have grouped all for accessibility and readability: sometimes those from the same institutions are grouped together, and at other times the longer texts are interspersed with shorter ones, and in other places, the notes of younger researchers and students, who were inspired by Govindjee, are kept together. We were not able to accommodate all the wonderful photographs in the main text of this article, but most are included in Supplementary File 1. We hope that both the scientists and general readers will enjoy this article. We begin the messages with that of Sir John Walker.

**John Walker**, Nobel Laureate in Chemistry, 1997; Professor, MRC Mitochondrial Biology Unit, University of Cambridge, UK

Congratulations on reaching four score years and ten, now for the century. Over many years now, I have greatly enjoyed our encounters and your written articles. Like countless others, I have benefitted greatly from your encyclopedic knowledge of Photosynthesis and the history of the field. I hope that you are well and that the MRI scans you mention in your excellent tribute to Paul Lauterbur were for routine purposes. I enjoyed reading the article [25] very much and seeing the photographs with old friends and colleagues (you and Tony Crofts). All good wishes for your 90th Birthday.



**Fig. 3.** Govindjee with colleagues and friends. (A) Brandi Eide, Govindjee, and Gary Moore (Left to right) in East Boston at Jeffries Point in August 2014, (source: G. Moore). (B) S.K. Guru and Govindjee, 2015 (source: S.K. Guru). (C) Govindjee at his office door (669 Morrill Hall, UIUC) with Mike McBride (photo credit: A. Nonomura). (D) Govindjee and Jos T. Puthur, in 1998 (source: J. Puthur).

**Anthony “Tony” Leggett**, Nobel Laureate in Physics, 2003; Knighted, Order of the British Empire (KBE) “for services to physics” by Queen Elizabeth II, 2005; John D. and Catherine T. MacArthur Chair; Emeritus of Physics, UIUC, Urbana, USA

Heartiest congratulations on your 90th birthday. I have no doubt that you will make it safe and well to 100!

**Rudolph A. Marcus**, 1992 Nobel Laureate Chemistry, John G. Kirkwood and Arthur A. Noyes Professor of Chemistry, California Institute of Technology, CA, USA

Many thanks for your welcome emails. I enjoyed reading about Paul Lauterbur, whom I never actually met. We have been working on interpreting sum frequency generation experiments on a water surface, stimulated by their ability to detect dangling OH bonds at a water surface. It certainly would be nice to chat together sometime. All good wishes and regards.

**John Whitmarsh**, Member, USDA/ARS Photosynthesis Research Unit, UIUC; Professor and Director, Center for Biophysics & Computational Biology, UIUC, USA

Govindjee and I have been friends for 50 years, during which time he has published a ton of papers, given thousands of lectures, mentored a brigade of students and postdocs, and, not surprisingly for those of us who know him, is still charging ahead with enthusiasm, humor, and his unforgettable smile. His contributions to photosynthesis research are extraordinary in their breadth and diversity. Long before it became the standard model, he recognized the need for collaborative, multidisciplinary research. It is fair to say that Govindjee is as well known for his editing and book chapters as he is for his research. Google photosynthesis to see the huge contribution he has made in presenting photosynthesis to everyone, from researchers to high school students. He brings the same dedication and energy to teaching and mentoring that he does to research. Talk to any of his former students you find that his support continues throughout their careers. I recall him teaching a large class in which he brought some students up on the stage, asking them to become molecules and follow his stage directions to demonstrate biochemical pathways. It was hilarious - he was able to make them laugh while they were learning. It is truly my pleasure to wish my dear friend a joyful 90th birthday.

**Charles J. Arntzen**, Member, National Academy of Sciences; Recipient, ASPB Dennis Robert Hoagland Award, 1994; President, ASPB, 1985–86; Director, MSU/DOE Plant Research Laboratory, 1980–84; Emeritus Professor, Founding Director, Bidesign Institute for Immunotherapy, Vaccines, and Virotherapy, Arizona State University, USA

On the occasion of Govindjee’s 90th birthday, let me add to the chorus of congratulations. I have known Gov since I joined the UIUC faculty in the Department of Botany in 1970 when he was already an established faculty member and researcher. What is amazing to me is that more than 50 years later, he is still active in science and is an author or co-author on publications. He has astonishing energy and an enduring commitment to photosynthesis and the history of early developments in this field. When I joined the UIUC, I was assigned a laboratory adjacent to that of Govindjee. His space housed a historical treasure house of equipment used in the days when the light reactions of photosynthesis focused on measurements of quantum efficiency and processes of light capture. This included some of the devices used by Robert Emerson back in the days when the university was first becoming known as a ‘*Mecca for Photosynthesis Research*’. It probably seems prehistoric to current-day students in the field to think of a time when there was a hot debate about the existence of one vs. two light reactions or when we were trying to accept that formation of adenosine triphosphate in chloroplasts could be related to the movement of hydrogen ions across thylakoid membranes. But -

it was a marvelous time to be a part of this highly active UIUC community as many new faculty members were added to encompass photosynthesis from nanosecond spectroscopy to ecological studies of crops, and more breakthrough concepts were discovered. Throughout this time, Gov was always a Grand Old Man of our university photosynthesis community (even when he was still a young scientist!). And parties at his home, with Rajni sharing the hosting, were always fun, with lots of inspiring science thrown in. My own career veered away from the study of chloroplasts and light harvesting systems after I moved from Illinois to subsequent locations. I became more deeply involved in biotechnology and its use in protein engineering in plants, with a focus in the last 20 + years of my career on production of pharmaceutically active proteins (especially subunit vaccines) in plants. But throughout this time, I’ve stayed in contact with Gov and have indirectly watched with delight as UIUC has remained a powerhouse in photosynthetic research. I thank Gov for keeping me as a friend and frequently updating me with new publications and general news of the field. I look forward to having this continue for another decade and beyond!

**Diana Yates**, Life Sciences Editor, News Bureau, Public Affairs, UIUC, USA

Happy 90th, Govindjee! I am so lucky and proud to know you, and I wish you the very best. See my interview at: <https://news.illinois.edu/view/6367/801235>

**Stephen R. Downie and Deborah Katz-Downie**, College of Liberal Arts and Sciences, UIUC, USA

Congratulations on your 90th birthday! You are truly an inspiration to us all. We appreciated your congeniality in Plant Biology over the years, the publications and other works you’ve provided us, and the wonderful conversations we’ve shared with you and Rajni. Here’s to another 90!

**William L. Ogren**, Member, National Academy of Sciences; Recipient, ASPB Charles F. Kettering Award for Excellence in Photosynthesis Research, 1986; Recipient, Alexander von Humboldt Foundation Award, 1990; President, ASPB, 1990–91; Inductee, ARS Science Hall of Fame, 1997; Formerly Director, USDA/ARS Photosynthesis Research Unit, Department of Agronomy, UIUC, USA

I send my best wishes to you on the occasion of your 90th birthday. Congratulations, and may many more follow. It has been my great pleasure and delight to have worked with you in the past and to have known you for more than 57 years now since you showed me around the Botany Department during my job interview there. Time surely does fly by! As always.

**Satish K. Nair**, Gregorio Weber Chair and Head, Department of Biochemistry; Director, Center for Biophysics & Quantitative Biology; Co-Director, Macromolecular CryoEM and MicroED Facility, UIUC, USA

Happy birthday and many happy returns on the day. I miss the old times of catching up with you at the coffee shop or after a Biophysics seminar to talk about science, students, and other matters. My best to you and Rajni on this occasion.

**Barbara A. Zilinskas**, Professor Emerita, Department of Plant Biology, Rutgers University, USA

First and foremost, I wish my dear Govindjee a very Happy 90th Birthday. You have been blessed with an amazingly rich life: your intense love of science, most especially photosynthesis; your passion for discovery and unraveling complex puzzles through creative thought and experimentation; your vivacious dissemination of new knowledge in the classroom, at countless invited presentations around the globe, and all-importantly, in your prolific editorial activities, most notably 1) in your role in spearheading and then guiding Photosynthesis Research toward its recognition as a first-rate

journal, and 2) as founding editor of the long-lived series '*Advances in Photosynthesis and Respiration*'. Equally precious riches in your life are those special people that love you and supported you throughout your professional life. First, of course, is your beloved spouse, Rajni, who shared the same Ph.D. mentors with you [26]; at one time, a lab partner, she soon became a life partner and soulmate. Such great fortune to have two caring children, Anita and Sanjay, who have certainly made you proud with their own accomplishments and their gifts of three grandchildren for Rajni and you!

I was fortunate to join UIUC in 1969 as a NASA fellow to pursue my Ph.D. on algal photosynthesis in Govindjee's laboratory. I admit that I was initially intimidated by Govindjee, but senior graduate students in the lab were very kind and supportive. The era that I spent at the UIUC (1969–1974) was memorable with regard to the wonderful comradery of Govindjee's graduate students at that time. Govindjee's unbridled enthusiasm for photosynthesis was infectious and spilled over to his research students. Govindjee and Rajni were family in loco to many other graduate students who were warmly welcomed into your home not only for our famous weekly Monday night lab meetings but also for many dinners and (sometimes infamous) parties. I, for one, am forever indebted for feeling that I had a home when far away from my own home for the first time in my life. Other riches that came your way are the many true and lasting friendships you have made with hundreds of collaborators from around the world. Your unbridled enthusiasm for sharing your encyclopedic knowledge of photosynthesis with others and your willingness to mentor fledgling students have also blessed you with "photosynthesis converts" that revere you. Govindjee and I stayed connected after I completed my Ph.D. He has for many years been intent on preserving the history of photosynthesis, including pivotal discoveries, key luminaries, scientists who have not been adequately credited for seminal discoveries, and others with whom Govindjee collaborated or mentored. Many of these articles were published in the "Historical Corner" of *Photosynthesis Research*. Presently, Govindjee is very busily writing and/or recruiting others to co-author such tributes. He tracks down former students, collaborators, and family members to correctly document the subject's research and to obtain photos and personal reminiscences. I've had the pleasure of occasionally editing these tributes. In closing, I'm sending you my congratulations, Govindjee, on this milestone birthday on a life well-lived. May you continue to be richly blessed.

**Paul Jursinic**, Medical Physicist, Radiation and Surgical Specialties, West Michigan Cancer Center, USA

I worked twice in Govindjee's laboratory, from 1969 to 1970 and 1973–1977. First, I came to explore doing research in photosynthesis. I had read an article Govindjee wrote in the *Scientific American* journal about algae photosynthesis and found it very interesting. Since I had studied engineering physics at the UIUC, a visit to Govindjee seemed a reasonable idea. Unannounced, I walked into his laboratory and found him and explained my interest in doing graduate work. He warmly received me and gave me an impromptu tour of the laboratory. We really had an immediate liking for each other. I was struck by his enthusiasm for his work and his openness to me as a stranger. He made some recommendations for me to consider if I wanted to pursue this research area. This led to completing my master's degree in biophysics. I wanted to continue to complete work for a doctorate, but the Vietnam war and my being drafted resulted in my spending three years in the US Navy submarine service. At the end of my Naval service, I wrote Govindjee about continuing my research work. And so began the second period of my work with Govindjee. He gave me a warm welcome upon my return to UIUC. I remember the research group meetings that took place at his home on Monday evenings. He had a chalkboard in his den, and everyone discussed their work and the progress or lack thereof for the week.

Rajni and Govindjee welcomed us into their house. My writing was poorly developed, and many drafts of papers came back to me with more red corrections than unchanged black text. I did improve, and Govindjee insisted on the best! He never berated me but always looked to improve the research and writing and move forward. I feel fortunate to have worked with Govindjee and to be encouraged to do better and eventually earn a doctorate degree under his guidance at a great university. My professional life branched into years of research and clinical work as a medical physicist. The years of research work with Govindjee were a gift that has allowed me to have a rewarding professional life that has helped other people and has given me the pleasure of doing work that I found joyful. Happy Birthday, Govindjee.

**Rita Khanna**, International Technology Transfer Management, Inc., Bethesda, Maryland, USA

Congratulations on your 90th birthday! It is a time to cherish all the special memories and past achievements, live to the fullest in the present, and look forward to many more exciting adventures in the future. You have been blessed with your companionship with Rajni and the happiness that you have been able to share with Anita and Sanjay and their families. Your contribution and distinguished career in the field of photosynthesis have been truly legendary – you are regarded as one of the pioneers in the field. I am sure the field has and will continue to benefit from your deep and seminal knowledge. I feel privileged to have had the opportunity to do my graduate studies under your guidance. I am ever so grateful to you and Rajni for providing me a home away from home when I first came to Urbana in 1974, and I cherish the warmth and friendship that you continue to extend to my family and me. Wishing you good health and many more years of fun with photosynthesis.

**Robert S. Knox**, Department of Physics and Astronomy, University of Rochester, USA

I first met the dynamo named Govindjee at a 1972 summer school in Fiesole. As a physicist, I have been unable to follow the details of his biochemical work in photosynthesis, but it is clearly prodigious and valuable. His biographical articles about photosynthesis researchers that include many photographs are very well done and may be unique among the fields of science. Future historians will value them highly.

**Tinus Pulles**, Department of Biophysics, Huygens Laboratory, The Netherlands

In the mid-1970s, Hans van Gorkom and I worked together with Govindjee at the Biophysics group of Lou Duijsens (Duysens) and Jan Amesz on the role of bicarbonate in the electron transport surrounding photosystem II [15]. For me, this was a very special experience for several reasons: first of all, the difficulty in arranging a car for Govindjee in the Netherlands. Our bureaucratic system was not able to issue the necessary registration for a car to be owned by a person with no first name. Finally, this was solved by entering Govindjee in both the name boxes in the forms. A solution that has been used in other instances, also, I guess. The experiments were performed on an apparatus that enabled both changes in absorbance and in fluorescence intensity in automatically replaced dark-adapted chloroplast samples. While this young Govindjee was smoking a cigar (Figure S1A), I was clicking the buttons and ensuring the experiment was running well. It was the same apparatus, shown in Figure S1B, that I used to show absorbance changes due to the charge-accumulating species, both at the donor and acceptor sides of System 2. The frequent discussions over coffee and lunch breaks were an important part of my training as a scientist. Although I left photosynthesis research soon after finalizing my Ph.D. thesis, I have always remembered my work together with Govindjee as great fun



with interesting results. I wish Govindjee all the best and hope that he will be with us in good health for at least ten more years!

**Fred (W. S.) Chow**, Emeritus Professor, Division of Plant Sciences, Research School of Biology, The Australian National University, Canberra, Australia

I first had the pleasure of meeting Govindjee in person at a conference in Yangzhou, China, in 1984. Also attending the conference were Bacon Ke, who was near retirement, and Eric Lam (see Figure S1C). The conference organizers were Yun-Kang Shen (well-known for his work on photophosphorylation), and Hung-Chang Yin (Ph.D., Caltech, 1937). After the conference, we visited the labs at the Shanghai Institute of Plant Physiology, from where one of the research students (Chun-He Xu) went on to study for a Ph.D. at Govindjee's laboratory and also we traveled together by train to Beijing to visit the photosynthesis labs at the Institute of Botany, the Chinese Academy of Sciences. Since 1984, we have been in contact. On one occasion, when Govindjee's daughter and granddaughter came to visit Canberra, I also had the pleasure of meeting them. In 1994, Tom Wydrzynski, Murray Badger, and I (myself still at the CSIRO Division of Plant Industry then) organized a conference on Chlorophyll Fluorescence: Origins, Measurements, Interpretations, and Applications, at The Australian National University (ANU). Prior to the conference, Govindjee gave a lecture course on the biophysics of photosynthesis, bringing with him the lab coat that he inherited from Robert Emerson. When Govindjee was about to officially retire, ca. 1999, he took a research trip around the world, stopping at various labs for collaboration. He spent about a month at the Photobioenergetics Group, Research School of Biological Sciences, ANU, which I had joined in 1996. On arrival, he gathered a group of us to study the greening of intermittent-light-grown bean plants on exposure to continuous light. Chloroplasts in leaves of intermittent light were found to contain abundant xanthophyll cycle pigments and the *psbS* gene product, presumably providing adequately for photoprotection in continuous light as soon as chlorophyll *a/b*-protein complexes were synthesized. The results suggested that greening is accompanied by adjustments in the contents of photosynthetic components that improve the quantum efficiency of photosynthesis [27]. I observed Govindjee's enormous capacity for work in photosynthesis. His contributions to photosynthesis research, including documenting its history, are of great significance. His dedication to photosynthesis is a life-long effort, which is much appreciated and will be remembered by us. Wishing Govindjee a very Happy 90th Birthday, a special milestone, and Good Health. Looking forward to the next milestone in his most remarkable innings

**Autar K. Mattoo**, AAAS Fellow; Supergrade Scientist, Sustainable Agricultural Systems Laboratory, United States Department of Agriculture, Beltsville Agricultural Research Center, Maryland, USA

It is a great honor for me to pen down a few lines here on the occasion of the 90th birthday celebration of dear Govindjee, a great doyen of research in biology, photosynthesis in particular. His name was familiar, but it was only after I had moved into the arena of photosynthesis, Photosystem II in particular, that I became more acquainted with and had the pleasure of meeting The Govindjee. As has been stated again and again by his admirers, Govindjee is a unique person, deep in science, a wonderful colleague, a teacher, and a great human being with a bewitching smile. In 1981, our work showing that the rapidly metabolized 32,000-Dalton polypeptide of the chloroplast is the 'proteinaceous shield' regulating Photosystem II electron transport and mediating diuron herbicide sensitivity [28] generated a lot of discussions. Soon after, Govindjee engaged us in discussions about PS II. In particular, the manuscript entitled "A search for subpicosecond absorption components in PSII reaction center" [29] generated more discussions. Soon after, he invited the Marvin Edelman and Mattoo team to submit reviews, including those

on Photosynthesis: Photoreactions to Crop Productivity and Photoregulation and Photoprotection of the PSII reaction center heterodimer.

Govindjee has a new addition to his name Govindjee! Govindjee Govindjee reminds me of a rhythmic song that could go on and on forever, like Govinda, the Krishna! In that light, I wish Govindjee's health to remain excellent, as also his powerful bewitching smile. We are fortunate to celebrate with him his 90th birthday! May he continue to charm us with his multi-million-dollar smile, with continued interest in Photosynthesis, and his voracious writing skills. It was amazing for me to note that he has published 100 papers in the last six years, with more coming! A scientist so much devoted to his profession, even after retirement, is God-sent and we wish him to receive in abundance more of the love and good health. As Charlie Arntzen stated, Govindjee has remained a powerhouse in his research areas, and we wish him to continue in that light and may he continue to have good health, abundance of love, and long life! Thank you, Govindjee!

**P. V. "Raj" Sane**, Former Director, National Botanical Research Institute, Lucknow, India

Many Happy returns of the day, Professor Govindjee, 'A walking encyclopedia of photosynthesis'. Hearty congratulations on your 90th birthday. On this day, I recollect our several meetings and discussions. Prof. Rod Park told me about you at the 1969 International Botanical Congress in Seattle. I had just begun my work in Berkeley. I was thrilled as I was meeting an Indian whose work on photosynthesis I had read. After that, we had a good time during the Stressa Photosynthesis Congress and a follow-up meeting in Germany. But the best time we had together was in Mumbai when you spent three months of your sabbatical working in our Bhabha Atomic Research Centre laboratory. It was such an exciting time, not only for me, but also for other members of my group, T. S. Desai and V. G. Tatak. During those three months I learned so much from you. Thereafter, of course, we had several meetings in Lucknow and at conferences. I had heard several presentations you made at different places with interesting personal references to historical perspectives. Each one was so very enjoyable. I am lucky to have a friend like you who is not only so very knowledgeable, but also a great human being who values friendship. The most impressive aspect for me has been your frank opinions and comments, not mincing words. I wish you many more years of good health, happiness, and productive time. Happy Birthday, dear Gov; enjoy the birthday evening with your family and friends.

**Dave Turpin**, President Emeritus, University of Alberta; President Emeritus, University of Victoria, Canada

As a young academic, I was very honored that a scholar of your stature reached out to me and asked to come and work together on an important topic in photosynthesis. I also remember that you were the first person to whom I sent an email. You had just set up email in your lab at UIUC, and you wanted to know if we were doing it at Queen's. I reached out to Computing Services, and by the end of the day we had sent the first emails and received a reply! When was that, 1989?? I also remember running many, many formate "blanks" through the mass-spectrometer so we could accurately control for residual CO<sub>2</sub> contamination in the reagents. Do you remember how pleased we were when the kinetics of bicarbonate release from the thylakoids (as manifested by increasing CO<sub>2</sub>) were so different from the kinetics of CO<sub>2</sub> appearance from the controls? That was the observation that convinced me that there was something to this Photosystem II - bicarbonate binding you were talking about. Yes, Govindjee, a lot of great memories indeed! So, my friend, congratulations on your very special birthday milestone. I do hope to be so lucky one day. Thank you also for your very kind words. I have been extremely fortunate to

have had the leadership opportunities I have had, and I am very grateful for the wonderful people I have met along the way, such as shown in the Supplementary File (Figure S2). Govindjee, you are a fine example of that. I will always feel honored that our paths crossed. Thank you for reaching out, thank you for your many contributions to the study of photosynthesis, and thank you for your friendship and support. All the very best on your special birthday.

**Neera Bhalla Sarin**, Former Dean and Professor, School of Life Sciences, Jawaharlal Nehru University, New Delhi, India

My acquaintance with Govindjee has been for almost half-a-century. While wishing him on his 90th birthday, I have vivid memories of my first interaction with him. The year was 1973, and we—the first batch M.Phil. students in the School of Life Sciences at Jawaharlal Nehru University (JNU), India—were headed to Madurai to attend an international conference on membrane biology. For us, among the other charms of attending this conference was the prospect of meeting Govindjee, whose seminal work on photosynthesis was by then already a part of textbooks. We also had heard first-hand accounts of him from our teachers, the late Prasanna Mohanty and G. S. Singhal. In our eagerness to meet Govindjee, whom we had never seen (remember, those were the pre-internet and pre-social media days), we mistook P.M Bhargava for him. We did find Govindjee the following day and enjoyed our discussions with him. Ever since those days, I have been in regular contact with Govindjee. Govindjee's stay at JNU during his India visits has benefitted our students and faculty members for several decades (see Figure S3). His lectures on photosynthesis, embellished with anecdotes from his personal narratives of Robert Emerson, Eugene Rabinowitch, and scientists from around the world, are exemplary. I recall an international conference at New Delhi wherein each speaker was allotted only 10 min. It was mesmerizing for the audience to watch Govindjee deftly deliver an encyclopedic talk—a tour de force—on “splitting of water” in the allotted time. A translation of *The Music of Sunlight* by Wilbert Veit in the vernacular presented to me by Govindjee has been a coveted possession adorning my bookshelf. I and my former students, Aslam and Deepak, collaborated with Govindjee while he was a Jawaharlal Nehru Institute of Advanced Study Fellow in 2008 to study the abiotic stress response of alpha-tocopherol enriched transgenic *Brassica* [30]. It is seldom that one finds attributes of a good teacher and communicator, an excellent researcher, an able administrator and negotiator, a valued and globally respected collaborator, and an amiable personality amalgamated in a single person. On the occasion of his 90th birthday, I wish Govindjee many more healthy, happy, and fruitful years.

**M. Aslam Yusuf**, Pangaea Academic Communications Pvt. Ltd., Lucknow, India; and **Deepak Kumar**, Department of Botany, Institute of Science, Banaras Hindu University, India

We had known Govindjee through our textbooks at school for his contributions to photosynthesis research. During our doctoral studies at JNU, we were fortunate to have met and interacted with Govindjee several times. His insights and scientific inputs were instrumental in the publication of one of our research papers with him [30]. We wish Govindjee a very happy 90th birthday and hope that he keeps smiling and inspiring for years to come.

**Manoj Joshi**, Science and Technology Lead, Reliance R&D, Bangalore, India

Dear Prof Govindjee, I learned about this great occasion. I would like to congratulate you and wish you a long healthy life ahead. I am indebted for this opportunity to revisit with you those exciting yet nervous times, trying to make sense of the observations during my Ph.D. research in the 1990s. I worked with Salil Bose and the late P. Mohanty in JNU, on thylakoid membranes from pea plants grown in

the presence of herbicide (SANDOZ 9785). SAN9785 is similar to DCMU in the mode of action, only milder. The idea was to see how thylakoid structure-function would modulate in plants grown with partially inhibited PSII electron transport. I had the good fortune to be in a lab where your legacy prevailed. I realize now how profoundly fortunate a situation I was in – your prior work had illuminated the field, and I could get hold of the ground to identify research questions for myself. I also realize most of the research methodologies I used in my investigation (thermoluminescence, fluorescence, and oximetry) were adapted and perfected by you and described in lucid detail in innumerable research papers and books. I could access them in any of the libraries I happened to be in. In 1992, I was in JJS Van Rensen's lab in Wageningen. You visited us there, and I had an elaborate discussion with you about the possibilities data was indicated. It boosted my confidence, and in the coming years, I published my key finding that chronic in situ reduced PSII electron transport leads to an increase in the unit size and number of PSII units [31]. To arrive at this conclusion, I did pass through struggle to reconcile with the data. I was overzealous with number or size binary. You inspired me to broaden my vision and visualize facets encompassing both.

**N. Raghuram**, Professor, GGS Indraprastha University, New Delhi, India

I have known Govindjee for over 30 years. My earliest experiences were as a doctoral student and postdoc (1989–1995) at JNU. His seminars were awe-inspiring, and his informal interactions enthused us and infused positive energy. I was quite fascinated with his readiness to help the faculty and research scholars who sought his ideas, comments, and edits on their projects or manuscripts. I am sure everyone who ever dealt with him benefitted from his unfailing attention to detail and razor-sharp skills in editing. In 2005, I interacted with him again in my capacity as a university faculty and as an editor of the journal, *Physiology and Molecular Biology of Plants*. Prasanna Mohanty helped us to bring Govindjee to the editorial board of our journal, on which he served for many years. He gave us some excellent suggestions on how an aspiring international journal of Indian origin should publish world-class research and showcase the contributions of Indian plant biologists. We salute Govindjee for his great contributions on his 90th birthday and wish him a long and contented lives full of health and happiness!

**Barnali Padhi**, Jawaharlal Nehru University, New Delhi, India

Govindjee and Photosynthesis have been synonymous for me since I ventured into this field as a Ph.D. student at Prof. Baishnab Tripathy's lab at JNU, New Delhi. I had the good fortune of working closely with Govindjee and attending his classes on the subject in February 2016. The ease with which Govindjee explains the fundamental concepts and applications of photosynthesis has always left me in awe. His explanation of the Z-Scheme using various props and trying to virtually show the class how electrons move between the photosystems has ensured many students like me memorize the entire pathway [32]. I consider myself lucky to have conducted experiments with him for comparing chlorophyll fluorescence measurements using HandyPEA and Fluoropen [33]. Govindjee is a mentor every student wishes for, someone who understands you and corrects you, all the while encouraging you to become the best version of yourself. I wish him a healthy life ahead and look forward to meeting him again!

**Rajagopal Subramanyam**, Professor, Department of Plant Sciences, University of Hyderabad, India

I have known Govindjee since I started my research career in Prasanna Mohanty's laboratory at JNU. I enjoyed the scientific discussion with Govindjee at several international meetings, and his suggestions helped me over the years. Similarly, our students also had a chance to interact with him several times during his visits to the University of Hyderabad (see Figures S4, S5, and S6) and got an

opportunity to collaborate on research work that showed the slow PSMT fluorescence transient in *C. reinhardtii* is due to the superimposition of two phenomena: 1) qE dependent non-photochemical quenching of the excited state of Chl; and 2) state transitions [34]. I wish Govindjee a long, happy, and healthy life. Also, I wish Govindjee a happy 90th birthday.

**Swati Tiwari**, Professor, School of Biotechnology, Jawaharlal Nehru University, India

I met Govindjee and Rajni Govindjee first time in 2013 at JNU after my Ph.D. thesis advisor, Prasanna Mohanty, had passed away. Govindjee, in turn, was the Ph.D. thesis advisor of Prasanna Mohanty! I was a bit nervous about meeting him as I knew about his stature in scientific circles. Govindjee asked whether I would help him with the tribute to Prasanna, and I readily agreed. This tribute was published in Photosynthesis Research [35]. Govindjee was also the driving force to initiate 'The Prasanna Mohanty fund for young scientists,' to be awarded by the International Society of Photosynthesis Research. I am fortunate to have had a chance to interact with him almost every year from 2013 to 2020 (see Figure. S7). I learned many lessons from him: his positivity, professional commitment, helping and caring nature, down-to-earth behavior, friendliness, generosity, and above all, willingness to listen. Govindjee also delivered lectures on photosynthesis several times at JNU. Students flocked to him from various schools in JNU. With his guidance, JNU students presented a Z-Scheme drama in 2015. His ability to form a personal bond with students is amazing. I also treasure several signed books he gifted me, and our school library benefitted from donations of his books on photosynthesis. Hidden behind that gentle and soft demeanor is a steely resolve and determination to focus on what needs to be done. I got a glimpse of that during one of his visits to India when he managed to travel to deliver a lecture in another city after receiving the news about his elder brother's death. I have great admiration for Govindjee for documenting the life stories of plant scientists. Recently, with Govindjee, I co-authored a tribute to my uncle, the late Krishna Kumar Tewari [36]. I will forever cherish my daily meeting with Govindjees at JNU during the Covid-19 lockdown in 2020. Govindjees were the only people left in the guest house, and they had to wait for quite some time before they could fly back to the USA. Govindjee and Rajni Govindjee are the two best human beings I have met in my life. I wish Govindjee a very happy and healthy 90th birthday! You are my hero.

One of us, **Ashwani Pareek**, Executive Director, National Agri-Food Biotechnology Institute, Mohali, India; and Professor, Jawaharlal Nehru University, India

I wish Govindjee a very happy 90th birthday. "Aap jiyo hazaro saal. saal ke din ho pachas hazaar." Our relationship has become more personal than intellectual thanks to him, who is an amazing person. His favorite term is "passion," and for a good reason—we all think of him as the embodiment of that quality. We value his ability to inspire us, listen to what we have to say, and bring out the best in us. I'm sure I'll create a separate article someday in the future to summarize what I learned from him. We still treasure the memories of our delightful and instructive journey to Salt Lake (Sambhar) (a photo is in Figure S8), which resulted in the distinctive method of conducting joint research. We had a productive and fun time on the protracted bus ride to Jaipur, thanks to Govindjee's old memories (and stories) of PSI and PSII measurements. I am happy to see that he is continuing his research with numerous international collaborators, and I ask the Almighty to grant him many more years of good health so that he can continue to enchant us with his million-dollar smile. I am confident that I am only one of the many people who were meant to find you.

**Sneha Sudha Komath**, SERB-POWER Fellow (2021), Professor, School of Life Sciences, Jawaharlal Nehru University, India

It is such a lovely occasion! Sending you 90th birthday greetings and hoping that you find joy in everything you do. I enjoyed very much working on the lectin review [37].

**Meena Barupal**, Assistant Professor, Department of Botany, Jai Narain Vyas University, India

From the western part of India, Jaisalmer, I am sending love and best wishes to Govindjee on the coming happy 90th birthday. Govindjee is also well known as Mr. Photosynthesis. Besides his larger-than-life journey in plant science, he is a very generous, gentle person who always wants to connect younger fellows to the journey of photosynthesis. I was researching about Fay Bendall, and sent an email to Govindjee to enquire about Bendall's contribution to the field of photosynthesis. He responded right away and gave me details about Fay Bendall and asked me about my plans. You can imagine how a student feels getting a reply from such an eminent scientist like Govindjee for the first time. He is equally supportive of many young students and researchers. Rajni Ji—without showing my respect to her, I could not complete my feelings. She is a brilliant scientist herself [26]. My dream is to meet and get blessings from both of them. Thanks for everything, Govindjee.

**Nandita, Anand, Gaurav, and Seema Chandra**, New Delhi, India

As I look back to my growing years and on my interaction with Govindjee (relationship: Phuphaji - paternal Uncle) and Rajni Govindjee (relationship: Bua-paternal Aunt), I share, along with my family, some of my plentiful memories and beautiful life with them. Govindjee and my father, the late Pradip Chandra, were classmates since 5th Standard that continued until their college. They had been close friends and frequent visitors with the family while they were residing in Allahabad. He has very fond and vivid memories and often carried on exchanges with my father during their interactions. Rajni is the younger sister of my father; he addressed her as 'Rajjo', and they shared a very strong bond since their childhood. My late Mother, Anuradha Chandra, also spent quality time with Govindjees while they always visited us in Bhopal, Kolkatta, and Delhi. Thus, our family has a very special relationship with Govindjee. In the last few years, the ties have been growing ever stronger, especially after they had spent approximately 3-months of every year regularly visiting our home in India. We had streams of professors who came to visit Govindjee during their stay in our home. Both Govindjee and Rajni have rich expertise in their field, and on various occasions, I had opportunities to attend their lectures. Even at this prime age, I have never seen them shying away from their knowledge, and for that, I am filled with joy because with such enormous achievements and high accolades that they have received over time, I still have not seen any change in their humility, integrity, positive and uplifting attitudes, and in their care for all whom they have touched. They radiate with an elegant simplicity that defines them. It is lovely to do a small synopsis of our experiences with them as a family. I would like to wish Great Life and Good Health to this lovely couple.

**Shimmi Chandra and Family**, Chicago, Illinois, USA

It is so wonderful to read about you & we feel so proud to be part of your life. We are lucky to get the chance to know a world-famous personality like you. We are proud of you, Govindjee.

**Hans Henrich Hock**, Professor Emeritus, Department of Linguistics, UTUC, USA

Professor, H. H. Hock composed two ślokas for Govindjee's 90th birthday in the classical language Sanskrit (see Figure S9) that were previously cited in [4].

**Elizabeth A. Ainsworth**, Research Leader, USDA ARS Global Change and Photosynthesis Research Unit, USA

Happy 90th Birthday Govindjee!



**Robert R. Alfano**, Distinguished Professor of Science and Engineering at The City College of the City University of New York, USA

Happy Govindjee 90th birthday. U are a kid. Thanks for helping me to understand the primary basis of Photosynthesis in the 1970s. I used this knowledge 52 years later, in 2021, to explain the quantum nature in PS1 and PS2 using the temporal behavior from exciting spinach with 100fs pulse and measuring the fluorescence. Happy and healthy birthday!

**William H. Armstrong**, Associate Professor (retired), Department of Chemistry, Boston College, USA

Although I have been interested in Photosystem II since 1984, and have attended a number of photosynthesis conferences, I don't think I have ever met Govindjee in person. I have, however, gotten to know him over the course of a couple of years in relation to a paper we published together last year. I first innocently emailed him on May 29, 2019, to ask him if he knew of an English translation of several of Otto Warburg's papers from the 1940s. Characteristically, I received a reply within a few hours. Little did I know that this first interaction would expand into a project that would extend over a couple of years and result in the publication of a historical article [38]. We were fortunate to be able to recruit Holger Dau, Boris Ivanov, and Dmitry Shevela as co-authors. While everyone had a job to do, the paper never would have come off if it had not been for Govindjee's involvement. Whenever progress slowed for one reason or another, Govindjee was there to take the reins and supply motivation and encouragement. He was nothing if not intense, enthusiastic, rigorous, thorough, exacting, and persistent. He has the energetic intellect and drive of someone one-third his age. I was pleased to learn that he is one of the few who will not hesitate to pick up the phone and call about whatever is on his mind. I recall many enjoyable conversations that occurred while I was on walks or driving to the store or what have you. As someone who is endeavoring to continue research into Photosystem II after formal retirement, I find Govindjee to be a great inspiration. I wish Govindjee a very Happy Birthday and look forward to our future interactions for years to come.

**Reema Bagga**, Production Coordinator, International Journal of Life Sciences, New Delhi, India

Greetings! Many congratulations on your 90th birthday in 2022

**Christina Banks**, formerly a visitor at *Laboratoire de Photosynthèse*, Gif-sur-Yvette, France.

I met Govindjee and Rajni more than 50 years ago -when they were on 'sabbatical' in France, doing research at the Laboratoire de Photosynthèse in Gif-sur-Yvette. During that period, I did 'babysitting' for their two wonderful children, Anita and Sanjay, and I enjoyed it much as I got to know quite well this family of four. I also vividly remember their trips to Germany, especially when Govindjee visited my family in the 1970s. Cleaning out old boxes of photos, letters, and papers brought back many good memories of my time with the Govindjees. Note that even after a half-a-century, we continue to remain in regular touch. Time does not stand still. My best wishes to Govindjee for his upcoming 90th birthday and to Rajni for her 88th!

**Christoph Benning**, Distinguished Professor, Michigan State University, USA

The MSU-DOE Plant Research Laboratory (PRL; <https://prl.natsci.msu.edu>), founded in 1965, has a long record of excellence in the plant sciences. The DOE grant, in part supporting the 12 PRL faculty members, focuses on "Photosynthetic Energy Capture, Conversion, and Storage: From Fundamental Mechanisms to Modular Engineering". Anton Lang was the founding director of the PRL, and we

annually honor his memory with an invited lecture by a prominent plant scientist. Hence, Prof. Govindjee was invited in 2022 to give the Anton Lang Memorial Lecture (<https://prl.natsci.msu.edu/news-events/news/2022-anton-lang-memorial-award-winners-announced>). During his long and distinguished career, Govindjee witnessed and contributed to milestone discoveries of the fundamental mechanistic principles of photosynthesis. As such, he focused his presentation on his mentor Robert Emerson and gave an inspiring lecture that covered important historical events and scientific facts. Moreover, due to his sunny nature and his talent as a narrator, his audience was enticed to reflect on the joy of scientific discovery and its human dimension. I like to thank Govindjee and wish him, on behalf of all of us at the PRL, a happy 90th birthday and many more years of inspiring the next generations of plant scientists.

**Josh Vermaas**, Assistant Professor, Michigan State University, USA

I would certainly like to congratulate Govindjee on the occasion of this 90th birthday. While I am nearly certain that I ran into Govindjee in my youth at photosynthesis conferences my father brought me to, I first ran into Govindjee as I was starting my time as a graduate student in Urbana around 2010. He was gracious enough to host me for a week as I was getting my own living arrangements sorted out, and he made me feel right at home amongst the corn-fields! During my time as a graduate student, Govindjee was an active presence on campus, frequently attending talks and seminars. On one occasion, he brought in Z-Scheme posters for all the biophysics graduate students. His excitement and engagement in photosynthesis research really impressed upon me, and as a result, I have kept my poster since then. The poster now hangs on my office wall now that I am a faculty member at Michigan State. More recently, Govindjee was invited to Michigan State as part of the Anton Lang lecture series to provide historical context for modern photosynthesis research.

**Berkley Walker**, Assistant Professor, Michigan State University, USA

Happy Birthday Govindjee. You first reached out to me after I posted a poem about you on my "poem-a-day" blog when I was a graduate student. I had just learned about your work in my photosynthesis course, and I was fascinated by your mononymic status. You joined the ranks of other famous mononyms like Madonna, Cher, and Plato. Through your warm correspondence, I learned how friendly and stimulating the photosynthesis field was. I first met you in person at the Beijing photosynthesis conference, where you handed out signed Z-Scheme posters like you were the headliner at a rock concert. This correspondence continued when I did a postdoc at UIUC, where you actively participated in seminars despite having "retired" many years before. My appreciation for photosynthesis continues due to your infectious excitement and curiosity. Now I am a faculty member at another institution; your signed Z-Scheme poster hangs on the lab wall for my students to reference. I know that my experience is not unique. While you do not likely have another 9-decades on this earth physically, your presence will echo through all those that you have touched for generations to come. Cheers!

**Carl J. Bernacchi**, Research Plant Physiologist, Global Change and Photosynthesis Research Unit, USDA-ARS Professor of Crop Sciences and Plant Biology, UIUC, USA

Dear Govindjee, I wish you the happiest of birthdays as you turn 90. From my days as a graduate student to my present position within the department, it has always been a joy to talk with you and to experience the excitement you bring to classes, departmental functions, and all other activities. I wish you a happy and healthy 90th birthday, and I look forward to seeing you around campus again soon.

**Gábor Bernát**, Senior research fellow, Aquatic Botany, and Microbial Ecology Research Group, Balaton Limnological Research Institute, Hungary

Naturally, I wish Govindjee a very happy birthday. I met him for the first time in 2007, in Bochum, Germany, in the laboratory of Matthias Rögner and later, in 2014, in the Czech Republic in the laboratory of Ondrej Prasil. On both occasions, we worked together, which I enjoyed pretty much. Later, I visited him in 2016 in Urbana, which was also my greatest pleasure.

**Karl Y. Biel**, Professor in Plant Physiology and Biochemistry of the Russian Academy of Sciences; Institute of Basic Biological Problems, Moscow Region, Russia; and President, Biosphere Systems International Foundation, Tucson, Arizona, USA

From the Institute of Basic Biological Problems of the Russian Academy of Sciences, my colleagues and I sincerely join in this celebration on the occasion of your 90th birthday by scientists, students, friends, and relatives from around the world. I am proud that I have been so fortunate to take part in joint publications—including Govindjee's Educational Poster series—with you. I must say that we admire your broad scientific outlook, vital energy, incredible professionalism in theoretical and experimental work, and innovations, and these great virtues have never diminished in you—you are truly an inspiration for all time. We are enlightened by your internationally recognized contributions to science, including advances in biology, teaching, editorial activities, and the history of science for the benefit of all Mankind, the significance of which cannot be overestimated! We wish you good health, creative success, and all the joys of life for many years ahead to come! With respect and gratitude.

**Pankaj Jaiswal**, Professor, Department of Botany and Plant Pathology, Oregon State University, USA

I teach Plant Physiology and Development. Every time I teach Photosynthesis, Govindjee's legendary work in the area of photobiology comes to the fore. It gives me an opportunity to engage my students in discussing the impact of photobiology on the stress response, ecophysiology, development, and crop yield. I had a chance to meet with Govindjee in JNU, Delhi, in 2013, and it is always a pleasure interacting with him over the phone and getting inspired. My laboratory focuses on the study of abiotic stress response in plants at physiological, molecular, and genome scales [39–41], develops Ontologies for plant biology (<https://planteome.org>), maintains plant genomics (<https://www.gramene.org>) and pathway knowledge bases (<https://plantreactome.gramene.org>) for plant researchers (including those pursuing photosynthesis research) [42,43]. Extending my best wishes to Prof. Govindjee for his good health and a very happy 90th Birthday.

**Joy E. Block**, Ph.D. Candidate, U.S. History Program, University of Wisconsin - Madison, USA

In 2016, Govindjee answered my open request for research interviewees. As a Ph.D. student in U.S. immigration history, I was searching for individuals who migrated to the U.S. from South Asia during the 1950s and '60s. I knew nothing about Govindjee at the time, simply excited to find someone who could tell me stories about his experiences in the U.S. during the mid-20th century. However, recording his personal history also opened me to the history of photosynthesis research and gave me the blessing of adoption into Govindjee's vast network of students and colleagues. His guidance and collaboration taught me the ropes of academic publication. "*Life of Govindjee, known as Mister Photosynthesis*," [3], captures a bit of the fascinating life Govindjee has lived, the struggles he has overcome, and the successes he has achieved. Govindjee, thank you for your commitment to unearthing, recording, and sharing biographies and

historical artifacts related to the fields of Plant Biology, Biophysics, and Biochemistry. Your indomitable energy in doing so is a model for everyone in preserving the memory of where we came from and where we have been. Moreover, thank you for your lifelong drive to teach and collaborate in research and producing knowledge. I have been immensely privileged to be included in that legacy, despite working in a non-science field. What an honor for me to say that "Govindjee taught me everything I know about photosynthesis"! Even as you aided me in my research as a historian, you were enlightening me with foundational scientific understanding. Thank you for investing in my development as an academic and researcher as well. May your legacy as a scientist, teacher, and researcher never fade. And may History itself be kind to you, as you have honored and valued it so well. Happy 90th birthday, Professor Emeritus Govindjee!

**Keith Boardman**, Fellow of the Australian Academy of Science; Fellow of the Royal Society of London; Fellow of the Australian Academy of Technological Sciences and Engineering; Honorary DSc, University of Newcastle; Officer of the Order of Australia

It is my pleasure and honor to send salutations and best wishes to Govindjee for his 90th birthday. There is universal international recognition of Govindjee's outstanding contributions to photosynthesis over more than six decades; his pioneering research on the photochemistry of photosystem II including the role of bicarbonate and the development of fluorescence techniques, his dissemination of knowledge of photosynthesis through individual reviews and as editor of books and review series, and his more recent promotion of the history of photosynthesis and the contributions of individual scientists. I have known Govindjee from the early international meetings of photosynthesis research, and I have particular memories of the second congress in Italy and our travel together to Germany for a post-congress meeting on chloroplast fragments. It was easy to have a conversation with Govindjee. He is always so friendly.

**Regina and Hans L. Bohnert**, Plant Biology/Crop Sciences Departments, UIUC, USA

Congratulations on your 90<sup>th</sup> birthday! Hans and I fondly remember your and Rajni's wonderful hospitality and hope you'll celebrate this special day in good health and pleasant company. Best wishes for many more happy and healthy birthdays.

**John Boyer**, Division of Plant Science and Technology, University of Missouri, USA

I am sending Govindjee, "Happy 90th Birthday"; long ago, I worked with him on some special projects. All best wishes.

**Donald A. Bryant**, Ernest C. Pollard Professor of Biotechnology and Professor of Biochemistry and Molecular Biology, The Pennsylvania State University, USA

Hi Gov, Happy 90th! Nearly a century of contributions to photosynthesis is quite an accomplishment! Keep up the good work. I sometimes think about the pain you caused me by convincing me to edit Volume 1 of *Advances in Photosynthesis and Respiration—The Molecular Biology of Cyanobacteria*. It was a tough slog, to be sure, but then I know it has served students well for almost 30 years now. I am quite proud of it and hope you are as well. All the best and many returns.

**Susan Carlson**, Director, Division of Food Ingredients, Office of Food Additive Safety, Center for Food Safety and Applied Nutrition, U.S. Food and Drug Administration, College Park, MD, USA

Happy Birthday, Govindjee! Best wishes on this very special occasion! I am honored to have been one of your recent collaborators. Your career is absolutely amazing for your sustained contributions to the field of photosynthesis, science education, and, more recently,

the history of science. I'd also like to thank you for inviting me to participate in the article honoring my major professor, Robert (Bob) Togasaki [44]. I will always remember what you told me, "Every scientist deserves to be remembered."

**Darlene Kelly Cederstrand** (wife of the late Carl N. Cederstrand, Govindjee's Ph.D. student)

*Happy Birthday, Dear Govindjee*

**William J. Coleman**, Distinguished Scientist, NovoNutrients-Oakbio, Inc., CA, USA

I would like to wish Govindjee the warmest greetings and congratulations for his 90th birthday. I received my Ph.D. in Biology with Govindjee at UIUC in 1987. We worked together on studying the structure and mechanism of the oxygen-evolving complex of photosystem II.

**Christa Critchley**, Emeritus Professor, The University of Queensland, Australia

My dear Gov, it is wonderful to see that you have made it this far and that you are still working. I have great memories of the year I spent in your lab in Urbana 40 years ago. They include such diverse things as doing chloride NMR with Ion Baianu; having the opportunity to go to a concert at the Krannert given by Isaac Stern; and, in a country (still) not known for the quality of its coffee, finding a decent café on campus. I send you my very best wishes for the day and hope that there will be more to come.

**Henry Daniell**, W. D. Miller Professor & Director of Translational Research, Vice Chair, Department of Basic and Translational Sciences, Editor in Chief, Plant Biotechnology Journal; School of Dental Medicine, University of Pennsylvania, USA

I met Prof. Govindjee when I was a graduate student almost 45 years ago, and he was my doctoral thesis examiner. He inspired me to pursue research in chloroplasts in relation to understanding photosynthesis. After graduation, when I was a postdoctoral fellow at UIUC, we discussed several projects on photosynthetic electron transport. We keep in touch regularly and remarkably discuss scientific projects during weekends!! We also quite often discuss the challenges of foreign-born plant biologists in American academia and our roles in helping the next generation. I followed in his footsteps in editing books/journals. Govindjee is my role model in serving as the Editor-in-Chief of the Plant Biotechnology Journal. I express my gratitude for his support throughout my career, especially in encouraging advances in chloroplast genetic engineering to make high-value proteins for enhancing human health and nutrition. I wish Prof. Govindjee many more decades of happy and healthy life!!

**Mrinmoyee Das**, Jadavpur University, Kolkata, West Bengal, India

I want to give my best wishes to Govindjee on the occasion of his 90th birthday. Two years back, I wrote my personal reminiscences about Dr. Govindjee. Since then, he has not stopped running in different countries of the World giving lectures and publishing papers as well as books on his favorite subject, 'Photosynthesis', in spite of his own disturbing health and that of his family. I pray for his good health and long life.

**Yaroslav de Kouchkovsky**, Former Research Director at the French National Center for Scientific Research, CNRS campus at Gif-sur-Yvette, France

My dear Govindjee, you have had a wonderfully rich life, and I congratulate you. We have known each other for so many decades! Unlike you, who are always hyper-productive in photosynthesis, I no longer participate in its advancement, even though I am still very

interested in it (as you know, I have opened up to other scientific fields and activities). This does not prevent us from communicating, and chatting with you on the phone is always a pleasure. So, stay as you are and enjoy life. Best wishes from an "old brother" to his "young brother" (it's a joke between us) for this great birthday!

**Denise Devotta**, Environmental Scientist at DHI Group, Los Angeles, California, USA

Wishing you a very happy and blessed 90th birthday!! Congratulations on using those 90 years to inspire, encourage and care for all those around you, including me. I am certain there are still adventures for you on the horizon! Hope you have a wonderful day.

**Charles Dismukes**, Waksman Institute of Microbiology; Department of Chemistry & Chemical Biology, Rutgers University, USA

We have recently dedicated the following manuscript to Govindjee, with great admiration, on the occasion of his 90th birthday: Cyclic electron flow around photosystem II in silico: How it works and functions *in vivo*, by Apostolos Zournas<sup>1,2</sup>, Kyle Mani<sup>1</sup>, and G. Charles Dismukes<sup>1,3</sup> \*

<sup>1</sup>Waksman Institute of Microbiology, <sup>2</sup>Dept. of Chemical and Biological Engineering, <sup>3</sup>Dept. of Chemistry & Chemical Biology; \*Corresponding author: G. Charles Dismukes; ORCID for G. Charles Dismukes: 0000-0003-0155-0541 (submitted; not yet published)

**Sailaja V. Elchuri**, Associate Professor, Department of Nanotechnology, Vision Research Foundation, Sankara Nethralaya, Chennai, India

My admiration for Govindjee began when I was a graduate student in the Plant Science Department at the University of Hyderabad. My mentor, Vallabhaneni Sita Ramadas (fondly called VSR), worked as Lecturer at Allahabad University when Govindjee was a Master's student there. He would say that there was a spark in Govindjee and knew that his intellect and thrust for research would kindle and motivate thousands of students towards the path of research in the field of photosynthesis. Govindjee was an inspiration to do research work in the field of photosynthesis, and I considered him as my guiding force to pursue my work. I pursued my research on light regulation in C<sub>4</sub> metabolism as my graduation thesis and worked on the phenomena of heliotropism and the photosynthetic performance of both C<sub>3</sub> and C<sub>4</sub> plants. With Govindjee, I have co-authored a tribute on VSR [45]. Now, I work for a premiere eye hospital that investigates restoring vision and gives the gift of sight to people. My research focused on trying to reduce the side effects associated with chemotherapy in retinoblastoma patients (<5 years) and restore vision by identifying novel therapeutic targets and drugs. Govindjee's work has inspired me. Happy 90th birthday to Govindjee! I wish him to live 100 fruitful years. My wish list is to see him personally.

**Fatma Elshintinawy**, Professor of Plant Physiology, Tanta University, Tanta, Egypt

It is a great honor to say, "Happy birthday to you Govindjee"

Wishing you all happiness in the incoming years."

**Charlene Forest**, City University of New York - Brooklyn College, New York, USA

Happy Birthday, Govindjee

**Christine Foyer**, School of Biosciences, University of Birmingham, UK

It is my pleasure to wish Govindjee a very Happy Birthday. Ninety exceptional years.

**Elisabeth "Beth" Gantt**, Emerita and Distinguished University Professor, Department of Cell Biology and Molecular Genetics, University of Maryland, USA



Sending you warm birthday wishes for your 90th birthday. It has been a pleasure to have known you for many years. I have always appreciated your true friendship over all this time and was thankful for your information on topics of photosynthesis and the depth of the knowledge of people in this area of research. You have been the best and most complete historian of the field. Please add my personal thanks for these accomplishments, and wishing you many more positive years.

**Adam Gilmore**, Product Manager, Fluorescence Division, HORIBA Instruments Inc., USA; and **Xiao-Ping Li**, Research Professor, Rutgers University, USA

We wish you, Gov, the Happiest of 90th Birthdays! We hope to see you and Rajni again soon and wish for the best of luck with your research and documentary activities!

**Ya (David) Guo**, Professor, School of Internet-of-Things, Jiangnan University, Wuxi, China

Govindjee: Best Mentor, Best Friend, and Best Student. When I was a mechanical engineering Ph.D. grad student in the Department of Bioengineering at the University of Missouri, I had many questions about photosynthesis that really frustrated me. One day, I wrote an email to Govindjee. I was very nervous when I hit the "Send" button and received his response in a very short time. He provided elaborate answers to each of my questions and encouraged me by using the background of his son, an engineering professor. The content of his first email to me was way more than technical because he also gave me big encouragement. I know that he has some health problems recently, but he continues to help me and many others, as he has done in the past. It is hard to imagine how energetic, diligent, patient, unselfish, and appealing a person can be, and yet, he is the combination of all these traits. I feel very lucky to know him. To me, Govindjee is not only a big name but also the best mentor and my best friend. I met Govindjee in person around ten years after we began our many frequent discussions via email. During our communications, I realized that he is also the best student. He shared a lot of interesting stories and impressive academic contributions of his advisors with my students. He remembered everything very clearly and showed great respect to his own advisors, although 50 years had passed since his student life. In summary, Govindjee is the best role model for scientists.

**Oliver Holub**, Senior Scientist, ZEISS Research Microscopy Solutions, Germany

I wish you all the best for your 90th birthday. Your teachings in the field of photosynthesis are inspirations to many people. One is forgetting so many things in life, but a meeting with a great scientist sticks to the memory and can be a motivation for the whole life. I think that many people, who had the chance to meet you, had such an experience. Please keep moving on to inspire the world.

**Harvey J. M. Hou**, Professor of Forensic Science, Alabama State University, USA

As an active member of the photosynthesis community, I have studied the structure and function of photosynthesis, especially the thermodynamics of electron transfer in photosynthesis and catalytic mechanisms of artificial photosynthesis, with David Mauzerall, Parag Chitnis [46], Jacques Breton, Ting-Yun Kuang, John Golbeck, and Gary Brudvig for 29 years. In 2012, it was a great honor for me to work with Govindjee to edit the Research Topic for Frontiers in Plant Sciences [47]. Being the world's leading expert in book editing, Gov has provided specific and timely advice throughout the whole

process. The fruitful collaboration led us to initiate another book entitled "Photosynthesis: Structures, Mechanisms, and Applications," in collaboration with Mahdi Najafpour, Gary Moore, and Suleyman Allakhverdiev that was published by Springer in 2017. In the three years of the Springer book project, Gov was continuously supportive and inspiring and wrote a superb and insightful "Foreword" for the book. Currently, we are pleased to work together with Gov again on the Research Topic for Frontiers in Plant Sciences, "Current Challenges in Photosynthesis: From Natural to Artificial," Volume II (scheduled to appear by the end of 2022). The advice and guidance of Gov during the completion of these book projects have become remarkable long-lasting knowledge, and he is a precious resource for me. I deeply appreciate Gov for everything and wish him a very happy 90th birthday!

**Irada Huseynova**, Academician, Vice President of The Azerbaijan National Academy of Sciences; Director General of the Institute of Molecular Biology & Biotechnologies, Baku, Azerbaijan

On behalf of the Institute of Molecular Biology & Biotechnologies, Azerbaijan National Academy of Sciences, and all Azerbaijani scientists who are involved in photosynthesis research, I take countless pleasure in congratulating you on your auspicious 90th birth anniversary. We studied photosynthesis based on your Z-Scheme and your books, and we are continuing to study your research. Over the path of your career, your research has covered many aspects of photosynthesis, particularly the primary events of the process. You have also made noteworthy studies in chlorophyll fluorescence and thermoluminescence research. You pioneered the first picosecond measurements on Photosystem I and II. Since you developed a method of measuring the lifetime of chlorophyll fluorescence, scientists have been better able to understand the relationship between chlorophyll fluorescence and photoprotection because the lifetime measurements are independent of chlorophyll concentration. You have never stopped amazing us with the uppermost level of perfectionism that you have put into your investigations, and we are grateful to you for all your incredible years of science. I have known you personally since you visited Azerbaijan to participate in the International Conferences on "Photosynthesis Research for Sustainability" in 2011 and 2013 (both were held in Baku). You have created many fond memories, lifelong friends, and a solid education in Azerbaijan, too. On this very special occasion, I wish we celebrate together your Jubilee of 100 years. I hope that you continue to change the lives of others with your positivity, love, and beautiful spirit. I wish you all good health for the times to come.

**Yorinao Inoue**, formerly Director, Photosynthesis Project, RIKEN, Saitama, Japan

Govindjee-san! Congratulations for your 90th birthday. We all know you've done quite enough. We had fun working together on the thermoluminescence of plants. Please work harder and enjoy life even more.

**Anjana Jajoo**, Professor, and Dean, Devi Ahilya University, Indore, India

I want to take this opportunity to acknowledge your hard work and ever-lasting zeal to work. You deserve everything best today and always. Your wealth of experience has impacted us positively in so many ways for which we are grateful to you. While some people grow more stubborn and become grumpier with age, you just become wiser and more optimistic! You are still more strong and more cheerful as compared to many youngsters. You have been able to maintain your prestige, cheerfulness, vivacity, and intelligence

successfully. We all are happy and proud to be associated with you! You spread liveliness and positivity in people around you. A very happy 90th Birthday from Anjana, a student who was inspired by you in a very early stage of her career.

**Nicholas E. Korres**, Associate Professor, Agronomy & Weed Science, Dept. of Agriculture, University of Ioannina, Kostakii, Greece

I had the privilege to meet and work with my dear friend Professor Govindjee while I was working as a research scientist for the USDA in Urbana, Illinois, during 2019–2021. I was amazed by the sharpness of his mind, his enthusiasm, passion, and fascination with photosynthesis, his simplicity, his effectiveness in discussing and conveying various complex and sometimes difficult-to-conceive ideas, and above all, his kindness and humility. He is a great scientist and a great philosopher. I would like to wish him a Happy 90th Birthday and many joyful and constructive moments in the years ahead. Thank you, Professor Govindjee, for being a good friend and a great mentor to me.

**Alexander Krasnovsky, Jr.**, Professor of Biophysics, Principal Research Scientist, Federal Center of Biotechnology, Russian Academy of Science, Russian Federation

Please accept my warmest greetings in connection with the approaching fantastic date of your 90th birthday. I appreciate very much the respect you showed to my father and the publications you issued in his favor. Collaboration with you when you edited my writings was always useful, productive, and enjoyable. Maybe, it is especially important that you picked up a relay of Eugene Rabinowitch and managed to bring it up to nowadays. I mean not only brilliant manuals on photosynthesis and history sketches, but also, I mean the relay of mutual respect between scientists of different countries, honest mutual citation (which is the basis of the fundamental science!), and friendly relations. I do not see anybody in this world who could change your position on this, even in the event that you should have ever decided to leave science. So, stay with us forever!!

**Johannes Kromdijk**, Fellow of Pembroke College, Department of Plant Sciences, University of Cambridge, UK

Dear Govindjee, happy birthday on your 90th! It seems like such a long time ago since we could go for a coffee in Urbana, and even since the last time we spoke on Zoom! I hope that you can move more freely again now that most countries have lifted lockdown rules and you can enjoy some company of your friends and family on the day. All the best, Wanne.

**Agü Laisk**, Professor Emeritus, Institute of Technology, Faculty of Science and Technology, University of Tartu, Estonia

I thought that I am getting old at 84, but I envy your energy at 90! But I wish you good health and strength; you are the true figurehead of photosynthesis research.

**Tony Larkum**, University of Technology Sydney, Australia

Govindjee has been a firm friend for as long as I can remember. He has always made my attendance at conferences a brighter experience, but as I dig deeper into the literature, I am amazed at the contributions he has made! Sincere and honored congratulations on your 90th birthday!

**Elise Lauterbur**, NSF Postdoctoral Fellow, Department of Ecology and Evolutionary Biology, University of Arizona, USA

Happy Birthday, Govindjee. It has been a great pleasure working with you, and writing about my father Paul Lauterbur [25], and I wish you a happy day and an auspicious year.

**Dušan Lazár**, Department of Biophysics, Palacký University, Olomouc, Czech Republic

When I was a PhD student, some 25 years ago, I knew the name, Govindjee, only from his scientific papers. When I submitted my first manuscripts, I suggested Govindjee as a reviewer and later, I learned that in some cases he really was the reviewer. When doing so, he always tried to help a beginner. He corrected my European English and he supported ideas and concepts of my mostly theoretical papers, including one [48] on in silico prediction of the existence of variable chlorophyll fluorescence of Photosystem I, as experimentally confirmed last year [49]. Later, I was asked by Alexandrina Stirbet and Govindjee to join their team in writing some reviews. Now, if I remember well, I have met Govindjee only twice in person, and yet, my experience with him and our cooperation has been ever fruitful. Indeed, I congratulate Govindjee on his 90th birthday and wish him all the best.

**Christine M. Lewis**, Biodesign Institute Center for Applied Structural Discovery, Arizona State University, USA

It was my first Gordon Research conference when I met Govindjee. He requested an overview of my poster and took delight in each step as I described them. Also, Govindjee provided tidbits of context about who, where, and how this or that took place in history—and how certain parts of the electron chain were discovered—providing a comprehensive picture of the Z-Scheme. As the days at the conference progressed, I ran into Govindjee over and over, and I often found him sitting with Julian Eaton-Rye conspiring to “get the word out” to outline bicarbonate’s role in PSII. I was surprised to find out that I had received an award and was asked to present my work before the whole conference. Govindjee congratulated and complimented me on how much he loved my presentation slides and asked to use them in his future presentations (and said he would cite me too)—to which I consented. He then gave me a signed poster and book. Later, I related my encounters to my advisor, Petra Fromme. She smiled and told me to cherish those items because Govindjee is often called “the father of photosynthesis.” Govindjee wrote me an email right after the conference, and we have corresponded ever since. Before my first publication, I sent him a copy to check the Z-Scheme, and he enthusiastically approved it. I am grateful to call Govindjee both a friend and a colleague. I will forever appreciate his openness to share and invite a newbie into his discipline without reservation or judgment, only with appreciation for what new things can be contributed to science. Happy birthday, Govindjee, you have led a remarkable life, and you have left a positive mark on so many.

**Hartmut Karl Lichtenthaler**, Botanical Institute II, Molecular Biology and Biochemistry of Plants, Karlsruhe Institute of Technology, Germany

My dear friend Govindjee, this fall, you are celebrating a very special day, your 90th anniversary. Happy birthday! My hearty congratulations to you for this event. Only very few people do reach this high age. And you reach it mentally, fully fit, and still full of scientific ideas. Wonderful, marvelous! Continue this way, my dear friend. I wish you many happy returns! You are like an older brother to me, and I am following in your steps. Fifty-nine years ago, in August 1963, we first met at an ASPP meeting in Amherst, Massachusetts. Since then, we have communicated, exchanged ideas, and soon became friends. It has been a pleasure knowing and meeting you over these six decades. I summarized our friendly cooperation in the article ‘*My contact and cooperation with Govindjee over the last five decades: Chlorophyll fluorescence and Rebeiz Foundation*’ [50]. I hope and wish our life, cooperation and friendship may continue for various more years. Good luck, good health, and all the best to you, my friend.

**Mahir Mamedov**, Head of Laboratory, Belozersky Institute of Physical-Chemical Biology, Moscow State University, Russia

My dear Govindjee, it is a great honor for me to congratulate you on your 90th birthday— this is only the middle. I met you many times in many different places on our green globe. I am proud to know you. You have so much passion, so much determination and so much individuality. I love everything about you. You are one of the greatest men the Oxygenic world ever created. I was lucky to publish a minireview with you on the fastest reactions in photosynthesis [51]. Also, I am very hopeful about the future. I have a dream that I will soon see you again. My thanks also go to the people who love you. I love and miss you so much.

**Sabeeha Merchant**, Professor, Department of Molecular and Cell Biology, University of California, Berkeley, USA

Amazing how you write all this. Thanks for sending me the Tributes you have been writing. Congratulations on your 90th!

**Amarendra Narayan Misra**, Distinguished Professor, Centurion University of Technology & Management, Bhubaneswar, India

Respected Govindjee, You have attained the distinction of a NON-AGENERIAN scientific leader, who encouraged and led generations in the field of photosynthesis. Yours is a journey of academic and research achievements and excellence. My interest in photosynthesis was ignited by reading your book on photosynthesis by Rabinowitch and Govindjee (1969) during my college days. I am fortunate to be associated with you and mentored by you. Your encouragement has been an asset and strength for my research endeavor. I wish you to lead more generations in the field of Photosynthesis worldwide. Pray God for your good health and more productive years to come. My personal regards to you and Madam Rajni Govindjee.

**Paula Mulo**, Professor, Department of Life Technologies, Molecular Plant Biology, University of Turku, Turku, Finland

Happy Birthday, Govindjee! Best wishes and hugs from Turku, Finland!

**Mahdi Najafpour**, Institute for Advanced Studies in Basic Sciences, Zanjan, Iran

In a book from Govindjee's series (Advances in Photosynthesis and Respiration; see Ort and Yocum, 1996), for the first time, I learned about the role of Mn in the biological water-oxidizing complex. After that, water oxidation and artificial photosynthesis were not the same for me anymore, and I was looking at them from a fundamentally different and much broader perspective. Govindjee and I wrote some papers on water oxidation and artificial photosynthesis together [52]. Also, we published papers on artificial photosynthesis, chemical processes that would bio-mimic the natural paths of photosynthesis toward storing energy and even producing valuable products; and all of that could benefit humanity greatly in the near future. In 2019, I met Govindjee at the 10th International Photosynthesis and Hydrogen Energy Research for Sustainability meeting, held in honor of Kimiyuki Satoh (Japan), Tingyun Kuang (China), Cesare Marchetti (Italy) and Anthony Larkum (Australia). I admire him for his compassion, enthusiasm, vigor, and knowledge of photosynthesis and, above all, its history. For me, Govindjee is the symbol of photosynthesis. Happy 90th birthday to the great Govindjee on 24 October 2022; I wish him good health and long and prosperous life.

**Gary F. Moore**, Associate Editor, Photosynthesis Research; Associate Professor, School of Molecular Sciences, Biodesign Institute Center for Applied Structural Discovery, Center for Bioenergy and Photosynthesis; Honors Faculty, Barrett Honors College, Julie Ann Wrigley Global Institute of Sustainability Scholar; Arizona State University, USA; and **Brandi L. Eide**, Senior Director of Horticulture & Facilities, Deputy CEO, San Diego Botanic Garden, CA the, USA

We wish you all the best in celebrating your birthday. It has been a pleasure interacting with you over the years. Our travels together have been adventurous and enjoyable. We are grateful for you being part of our lives (see Fig. 4A). Sincerely, Gary Moore and Brandi Eide.

**Sudhir Kumar Guru**, Professor & Head, Department of Plant Physiology, Pantnagar University, India

It means a great deal when we stand up for an occasion to join hundreds of distinguished scientists, colleagues, students, and friends across the globe to wish Govindjee a happy 90th birthday in October this year! I first met Govindjee while a Ph.D. student at the Indian Agricultural Research Institute, New Delhi. I was fascinated to see Govindjee in person, one who had been described in detail in a box essay in the famous Plant Physiology textbook by Salisbury and Ross. I requested an autograph on that page in the book. Our second meeting occurred in 2015 in New Delhi (see Fig. 4B). There, during his lecture, Govindjee put on the white apron of Prof. Emerson; that was an extraordinary moment in my life. I express my sincere gratitude to Prof. Govindjee for sending me the signed copies of the Z-Scheme poster and for personal gifts. Thank you, Govindjee, for all these treasures. You have enriched my life. Praying the Almighty to always take special care of you. The world of scientists, teachers, and students needs more of you, always. With the warmest personal regards, best wishes, and gratitude, I wish you a very happy birthday!

**Michael S. McBride**, President, BRANDT iHammer, Powell, USA

In the course of commercial developments, various industries have been in consultation with Govindjee for his keen understanding of the flow of energy into the complexities of photosynthesis. Indeed, our parent company, Brandt Inc., is headquartered in Springfield, IL, and their agricultural relations with the University of Illinois have enjoyed a history of over 65 years of innovation in the field. The plant scientists as well as crop and turf specialists at BRANDT iHammer regard Govindjee, a gentleman of integrity and great scientist, with the highest honor, and that is why I treasure my autographed copies of Govindjee's Educational Poster Series. When we first met, he jumped right away into the Z-Scheme, explaining the fundamentals of life's transformation of light energy into chemical energy. He brilliantly gave me photosynthesis in a way that I could grasp. As we moved along the hallway outside of his office, he further explained the diagrams on the walls and the photographs hanging on his door (see Fig. 4C). Not only is Govindjee the greatest educator I have met in my life, he is the finest scholar in the field of photosynthesis. My own discussions with an always energetic Govindjee will continue because he very capably rises to the challenges of contributing to the transfer of science to agriculture. As the products of the carbon reactions of photosynthesis are sugars, we look forward to a sweet future with Govindjee as he remains on the cutting edge of science. Happy 90th Birthday, Govindjee!

**Jos T. Puthur**, Professor and Head, Department of Botany, University of Calicut, India

It is a moment of joy and happiness to join others in wishing a happy 90th Birthday to our dear Professor Govindjee. Although your age is increasing, your heart remains very young, and I was fortunate to experience the sweetness of your young heart whenever we met. I remember that our first meeting was at the International Photosynthesis Congress held in Budapest in 1998 (Fig. 4D) and the last was when you visited India in 2020, just before the start of the pandemic. I remember the tough days you had to undergo while you were held up in New Delhi. But your young mind and the vigor as well with the support of Rajni ma'am, you kept going until you flew back to the US. You were kind enough to agree to join online for the Conference we are planning in October 2022, which will also be held to honor you





**Fig. 4.** Govindjee's many interactions with photosynthesis researchers. A: A photo of the 2019 Gordon Research Conference on Photosynthesis Research, including from left to right: Maria A. Dominguez-Martin, Han Bao, Govindjee, Juliana Artier, and Divya K. Matta. B: Govindjee, with scientists in Russia, June 2019, including (left to right) Valeria Dmitrieva, Elena Tyutereva, Govindjee, Alexandr Shitov, Olga Voitsekhovskaja, Ksenia Chebotareva, and Kamilla Rabadanova (source: A. Shitov; photo by Anastasia Maksimova). C: Robert (Bob) Blankenship, Govindjee, and Nancy Kiang, at Bob's retirement symposium in 2019 in St. Louis (source: N. Kiang). D: Rajni Govindjee, Sushila Narsimhan, and Govindjee, in New Delhi, India, 2020 (source: S. Narsimhan).

and your contributions to photosynthesis research. Let the Almighty provide you and Rajni ma'am with good health and more years ahead.

**Christopher James Gisriel**, Postdoctoral Associate, Department of Chemistry, Yale University, USA

I first met Govindjee at the 2017 Gordon Research Conference on Photosynthesis Research, one of the defining social gatherings of my academic career. As a graduate student at the time, I was struck by Govindjee's passion and excitement for the photosynthesis research community. He floated from group to group, introducing himself to many newcomers to the field and including them in conversations with people he had known for years. Govindjee paid special attention to young researchers, including me, whom he sees as the legacy for older generations. In fact, see Fig. 5A, showing Govindjee with students in 2019. It would have been easy for Govindjee to forget that we had ever met, but he continues to contact me as years have passed, sharing updates on his life and asking about mine. I think I am not alone in the attention Govindjee has provided to young researchers. This exemplifies Govindjee's persistence in enhancing the climate of the photosynthesis research community, whether by honoring contributors, reporting on important contributions or by a casual phone call. Happy birthday, Gov!

**Divya Kaur Matta**, Assistant Professor, Department of Chemistry, Brock University, Canada

I remember meeting Govindjee with my PI, Marilyn Gunner (CCNY), at the Gordon Research Conference in 2019. I am shown at the far right in Fig. 5A. We discussed some intriguing questions, particularly about the role of bicarbonate near the quinone site during the photosynthesis process. I also remember how passionately he distributed the poster for the Z-Scheme diagram of photosynthesis

during the poster session. Govindjee is always an active participant, whether during meet-up talks, coffee breaks, or presentation talks, which is remarkable. Even after the conference, Govindjee is still in contact sending his recent publications, which is excellent motivation for me. I wish a very happy birthday to Govindjee.

**Alexandr V. Shitov**, Senior Researcher, Federal Research Center, Pushchino Scientific Center for Biological Research of The Russian Academy of Sciences, Institute of Basic Biological Problems, Russian Academy of Sciences, Moscow, Russia

Dear and respected Govindjee Govindjee, on the day of Your 90th birthday, I would like to wish You to keep the same passion and the same energy in Your work, which, I think, is Your whole Life! I also wish you to have less troubles related to Your health and the health of Your close relatives! I wish there were fewer events that could distract You from Your life's work - from the study of Photosynthesis! I would also like to wish that in Your life, there were more reasons for sunshine and less for sorrow! What more could I wish You on Your 90th anniversary? Your life was rich not only in scientific discoveries, but also in successes in the educational field, including the education of the followers of Your ideas, many of which have reached significant heights in science and education. I would like to wish to You that Your students continue to please their teacher with new achievements and successes! Let me remind you of your photograph together with us (see Fig. 5B)

**Nancy Y. Kiang**, NASA Goddard Institute for Space Studies, New York, USA

Govindjee was my first contact with the wonderful world of photosynthesis back in 2003 when I emailed him to inquire about chlorophyll absorbance spectra. I was in my first year as a postdoc in Earth System Science at NASA, looking at satellite observations of

vegetation at the global scale, and I was struck by correlations between features of solar spectral irradiance at the surface and the reflectance signature of vegetation, the vegetation “red edge”. I had never delved into the molecular level, and Govindjee answered me right back with his characteristic erudite conveying of the literature history, good people to contact, and many more details to expand upon. That contact blossomed into collaborations that included the cover figure for the *Advances in Photosynthesis and Respiration* volume, “*Chlorophyll a Fluorescence: A Signature of Photosynthesis*” edited by Papageorgiou & Govindjee [53], two landmark papers on photosynthetic pigments as potential biosignatures of life on other planets [54], and a cover article for *Scientific American* [55]. This work set my reputation at NASA and in the field of Astrobiology. But the most important thing I learned from Govindjee was about collegiality in science (see Fig. 5C), how to lead a good life, and how leaders set the example for others. The loving, supportive nature of the photosynthesis community, as nurtured by Govindjee, is ever my inspiration, and I feel blessed to have had him as a role model. Dear Govindjee, thank you – wishing you a very Happy 90th Birthday, and many more tireless, enthusiastic years of transmitting your joy to others.

**Sushila Narsimhan**, Professor of Japanese Studies (Retired), University of Delhi, India

My association with Govindjee and his wife Rajni started via emails in 2019, and it gradually evolved into a lasting friendship. Having grown up in a family dominated by botanists (my father, Panchanan Maheshwari, an eminent Embryologist), I had the fortune of meeting and interacting with many plant scientists. A prime reason for Govindjee to connect with me was spurred by the need to derive information about the family for his article on my deceased brother, Satish Maheshwari – a plant molecular biologist. Our meetings in New Delhi in February 2020 (Fig. 5D) gave me insights into both Rajni Ji and Govindjee’s persona, attitudes toward life, and career. They were staying in the JNU Guest House during the sudden lockdown due to Covid-19. I found Govindjees full of ebullience as they greeted me with great warmth. Govindjee and Rajni were cool and uncomplaining. Govindjee said, “*Life is a continuous succession of problems which never end. The defining moments in our lives are not about problems, it’s how we tackle them. Indeed, we are not alone. Best is to take precautions, manage with whatever is available, and be happy.*” This speaks of his power of resilience, positivity, and a high level of adaptability. To lighten the mood, he suggested going out in the open air. The morning drizzle had made the weather perfect for a stroll along the undulating ridges of the JNU campus. The message was clear: ‘*Connect with nature, enjoy the cool breeze, the melodious cooing of cuckoos, and honks of the peacocks; and be cheerful, even in adversity.*’ Dear Govindjee, during this long span of nine decades, you have accumulated so many who admire and love you. The 90th birthday is a landmark in one’s life, and in Japanese culture, it is called ‘*Sotsuju*’. May God bless you with many more healthy and happy years to hit a century.

**C. Jerry Nelson**, Professor Emeritus, Department of Plant Science and Technology, University of Missouri, USA

You are a prolific scholar and benevolent person who remembers and honors the scientists who pioneered and also supports those younger ones who are eagerly developing their insight and skills to carry the science forward. A great legacy.

**Shabnam Nisha**, Department of Biophysics, Centre of the Region Haná for Biotechnological and Agricultural Research, Faculty of Science, Palacký University, Czech Republic

I wish Govindjee a very happy 90th birthday. I first met Govindjee in 2013. It has been a pleasure to have known and to have worked with him. Apart from being a great researcher and teacher, he is an

amazing human. I will be forever grateful to him for the experiences that he shared with me and the advice that he gave to me for my professional as well as personal life. He is truly a gem of a person, and I wish him all the happiness in the world.

**Dominick “Dom” J. Paolillo, Jr.**, Emeritus Faculty, School of Integrative Plant Science Plant Biology Section, Cornell University, USA

Happy 90th birthday. And keep up the good work!

**Raghubir “Raj” Prasad**, Emeritus Scientist and Professor, Forestry, Victoria, Canada

It gives me great pleasure to felicitate and congratulate Govindjee on his 90th birthday. I have known him since 1954 (68 yrs. ago) when I was a student in my MSc at Allahabad University, India, and where he taught a laboratory course in Plant Physiology. He was a very good teacher, knowledgeable, enthusiastic, and inspiring to all the students. Then I met him, his wife Rajni, and their daughter Anita, after our PhDs (his at UIUC; and mine at Oxford University, Oxford, UK) in the mid-1960s. Since then, we have visited each other many times, both in Canada and in the USA, including when his son Sanjay (now an Engineering Faculty at the University of California at Berkeley) was married in California. My late wife Shashi, a scholar of Indian Religions and languages, knew the families of both Rajni and Govindjee from their days in Allahabad —thus, we have this special ‘Allahabad’ connection. Our three children have met and had a great time with the Govindjees; they have been very impressed by his writings on Photosynthesis, since they read about his work in Biology Textbooks in their High Schools. My own professional interest has been in applied Plant Physiology related to Pest Management. However, after his retirement, Govindjee began to spend much time remembering and honoring those who are not with us anymore. Here, our paths crossed again, and I joined him in remembering several scientists- many who came from India. Here, I enjoyed his enthusiasm, editorial comments, dexterity, and knowledge. We all know that he has been a prolific, productive, and internationally reputed authority in Photosynthesis. His ‘Recent Publications’ page on his website clearly proves to us that age is not a factor in his scientific work and productivity. On behalf of all his many friends at Allahabad (then and now), I wish him a healthy, happy, and productive life beyond 90 years!

**Peter Raven**, President Emeritus, Missouri Botanical Garden, USA

Deepest congratulations on reaching such a significant milestone and heartfelt thanks on behalf of the international botanical community on all you have contributed to our knowledge and understanding over the years!

**P. Pardha Saradhi**, Professor, Department of Environmental Studies, University of Delhi, India

Dear Govindjee, Many, many happy returns for your 90th Birthday. You have always been an inspiration to me and many of my students. I believe that the divine force created you to spread the knowledge of light reactions of photosynthesis to the scientific world. God Bless you with the strength to continue to serve the scientific world, particularly the fraternity of photosynthesis researchers.

**Hugo Scheer**, Department of Biologie 1-Botanik, Ludwig-Maximilians-Universität, Germany

Happy Birthday to you. Ageless, well, almost ageless center of photosynthesis: researcher, editor of books and journals and inspiring coach of numerous young scientists, now, well esteemed. You initiated the obituaries in PSRES and thereby helped remembering fellow researchers as scientists and human beings. I am glad

that this is not another obituary, but rather addressed at a friend still going strong. Stay well, enjoy life, and avoid health troubles.

**Ananya Sen**, Science Writer, Carl R. Woese Institute for Genomic Biology, University of Illinois at Urbana-Champaign, USA

Happy birthday, Govindjee! I hope you have a fantastic year. See what I wrote on you: <<https://mcb.illinois.edu/news/2019-02-19/govindjee-pioneer-photosynthesis>>

**Chandra Senan**, Literati Publishing, India

At the outset, I would like to wish you a memorable and equally ecstatic 90th birthday and many more to come. I first got in touch with you in 2012 when I was writing a book entitled, '*Oxygen: the story of a primal fluid of vital importance to all life forms on the planet and our intimate relationship with this extraordinary gas*'. In a chapter captioned, 'More about photosynthesis & oxygen evolution', I wrote about some of your pioneering research done with Rabinowitch. I contacted you by email, and you kindly provided me with a photograph of the two of you, which I gladly incorporated into the book. I wish you a wonderful day, and remember, the more birthdays you have, the longer you live with every conceivable good wish.

**Shackira AM**, Department of Botany, Sir Syed College, Kannur, India

Respected Govindjee, I wish a photon-full happy birthday to you. Let your birthday shower with light. I am sure that the way you see the light is different. Of course, due to your influence, I am also trying to see the leaves as the leaves see the light. Many, Many Happy Returns of the day.

**Thomas D. Sharkey**, University Distinguished Professor, Department of Biochemistry & Molecular Biology, Michigan State University, USA

Greetings to Govindjee on the occasion of his 90th birthday. Govindjee has played such an immense role in the photosynthesis community, it is hard to overstate his contributions. I want to highlight two aspects. First, he is a tireless editor responsible for almost 50 volumes of *Progress in Photosynthesis Research* (with additions of respiration and bioenergy considerations along the way). Many who have been editors in this series know of Govindjee's attention to detail and amazing editorial skills. Photosynthesis is a very broad field and no one person can be conversant in more than a subset of issues. But in his editorial roles, Govindjee respected and encouraged people in all aspects of photosynthesis, he was as inclusive as anyone could be. The second area I want to highlight is Govindjee's work celebrating the lives of many of the major figures in photosynthesis research. He has written many articles discussing the life of this or that leading figure in photosynthesis research, often pulling in one or another person to help broaden the essay. In addition to his own work, Govindjee encouraged and cajoled many of us to write about a person we might know about. This has produced an absolutely invaluable documentation of the lives of those who crafted our understanding of photosynthesis. Govindjee's obvious respect for the people who shaped our understanding of photosynthesis is an inspiration.

**Jian-Ren Shen**, Professor, Research Institute for Interdisciplinary Science, Department of Biology, Okayama University, Japan

Congratulations on the occasion of your 90th birthday! It is amazing that you are still so active and influential in the field of photosynthesis research. I always enjoy the conversations and discussions with you when I meet you at various conferences, and I have received numerous important suggestions from you regarding our work on the structural and functional studies of Photosystem II. I look forward to seeing you and listening to your talks regarding science, as well as your jokes. You are truly a giant in the field of photosynthesis research, and I believe you will continue to be for the younger generation of photosynthesis researchers.

**Ulrich Siggel**, Former member, in the groups of H.T. Witt and B. Rumberg, Max-Volmer-Institut of the Technische Universität Berlin, Germany

It is a matter of the heart for me to send my congratulations on Govindjee's 90th birthday. For me, Govindjee is now the grand old man of photosynthesis. I have met him many times, often at the congresses of photosynthesis research and at symposia, such as that on the Greek island of Spetsai, in 1977. I got to know him as an engaged scientist, a pleasant and cheerful companion, and a great historian. He has been in Berlin several times, also in 1997, on behalf of the feast colloquium at the 60th birthday of Gernot Renger, which I missed, being in Japan. In June 1976, I had the pleasure of cooperating with him. With the late Gernot Renger and Rita Khanna, we measured the effect of bicarbonate on the absorbance changes of plastoquinone. But we also had fun together at the summer party of the Max-Volmer Institut, and at the eve-of-the wedding party of Günter and Christa Döring. After the fall of the Berlin wall, Govindjee also visited Humboldt University in former East Berlin. I remember a historical lecture, after which we sat in Bertold Brecht's cellar nearby. Finally, I had the honor to write a commemoration on the late Gernot Renger [56], with Govindjee as Historical Corner Editor. So happy birthday to you, dear Gov, and as much health as possible!

**Jan Snel**, Wageningen, The Netherlands

Yes, it was fun during the satellite meeting, 'The Use of Chlorophyll Fluorescence and other Non-Invasive Spectroscopic Techniques in Plant Stress Physiology', at Doorwerth, near Wageningen, The Netherlands, August 13–16, 1989 (see Figure S10). Govindjee, it has been a privilege working with you, and I wish you all the best in the years to come.

**Christopher Somerville**, Professor Emeritus, Department of Plant and Microbial Biology, University of California, Berkeley, USA

Happy 90th birthday! It was fun seeing you at the Rubisco symposium in August. Best wishes.

**Alan J. Stemler**, Professor Emeritus, College of Biological Sciences, University of California, Davis, USA

...On your coming 90th, my wish is that your longevity rivals that of Paul Castelfranco!

**K. Sowjanya Sree**, Department of Environmental Science, Central University of Kerala, India

Over the several decades, contributing significantly to our understanding of photosynthesis, Govindjee has been an inspiration to younger researchers like myself. I am fascinated with his writings, recollecting and remembering the works of other researchers. I wish Govindjee a very happy and healthy 90th birthday and all good wishes for the years to come.

**Jinglu Tan**, Director, Division of Food, Nutrition, & Exercise Sciences; Professor of Biomedical, Biological & Chemical Engineering; University of Missouri, USA

I got to know Govindjee through Ya Guo. While I have never met him in person, we have interacted electronically and coauthored publications [57]. I have been utterly impressed by Govindjee's energy and dedication to science. He is a great role model for all of us in the research community. Happy Birthday, Govindjee!

**David L. VanderMeulen**, Quality Control Vanguard Labs, Glasgow, USA

I am so pleased to extend our very best wishes on the occasion of Govindjee's 90th birthday! I am grateful for all the fond memories of many hours shared in his laboratory and the profitable learning experiences. I admire and appreciate his tireless commitment to not only decades of continued learning, collaboration, and publishing,



but also keeping all past students informed and included in what's been happening in both your life and that of others. Your gift of camaraderie and team building has no doubt benefited and helped advance the cause of life science research. After 16 years of post-doctoral biophysics and biochemistry research, I eventually diverted to a quality control laboratory path in the pharmaceutical industry. I am grateful for the solid scientific, collaborative, and humane foundation received from Professor Govindjee. May God bless you now and in the coming days and years in a special way!

**Jack van Rensen**, Department of Plant Physiology, Wageningen University & Research, The Netherlands

In 1971, I obtained my Ph.D. under the supervision of E.C. Wassink. My research addressed the mode of action of Photosystem II-inhibiting herbicides like DCMU and atrazine. In 1977, I had the opportunity to join Govindjee's laboratory at UIUC for my sabbatical. Govindjee's group was involved in very interesting research on bicarbonate's role in PSII. The site of the bicarbonate effect was very much related to the site of action of "my" herbicides. This sabbatical was a turning point in my career. I remember Tom Wydrzynski, Daniel Wong, and Rita Khanna working on their Ph.D. thesis. Later, I returned two times to UIUC, and Govindjee also visited me in Wageningen. I have co-authored eight papers with him spanning a period of about 20 years. I retired in 2006, but I kept on working until 2012. In that year, I concluded my career as a co-author together with Julian Eaton-Rye and Iain McConnell of Chapter 20 on bicarbonate in Volume 34 of the Series, *Advances in Photosynthesis and Respiration*, of which Govindjee was the (founding) series editor. I wish Govindjee all the best and a very fine 90th birthday on October 24, together with your wife, Rajni.

**Wim Vredenberg**, Bennekom/Wageningen, The Netherlands

I send you herewith my warmest congratulations on your 90th birthday. I wish you both the best conditions for well-feeling, happiness, and health in the coming years. You are a highly esteemed colleague, and we have discussed over the years many interesting subjects associated with chlorophyll fluorescence in bacteria, algae, and plants since we met in 1965, as young Ph.D. students from Urbana and Leiden, during the Second Western-Europe Conference on Photosynthesis, in Woudschoten, the Netherlands. This conference, organized by Jan Thomas, Joop Goedheer, Lou Duysens, Evert Wassink, and Jan Wessels, has been followed by a large number of photosynthesis congresses of the international organization. I have great remembrance of the exchanges of thoughts and ideas that we have had during these meetings and many other occasions where we have met during mutual visits. God bless you!

**Jindong Zhao**, Faculty, School of Advanced Agricultural Sciences, Peking University, China

Happy birthday! I would like to say that I am so fortunate to hear your lectures and read your books and papers. You have such outstanding achievements in your research, contributed so much to the plant physiology field, and inspired so many around the world. Thank you, Thank you very much! Happy birthday!

**Fred Zwicky**, Director of Photography, Public Affairs, UIUC, USA

Govindjee, it was an honor and so much fun to spend that time with you. I hope the images help others celebrate your amazing work and perhaps bring additional joy for your 90th. I'm thinking you can do a birthday celebration for the entire year. You have earned it.

One of us, **Lars Olof Björn**, Member of the Royal Swedish Academy of Sciences; Professor Emeritus, Lund University, Sweden,

Happy 90th Birthday Govindjee! I think that we have met only once face to face, long ago, but I have admired you for as long as I can

remember. I am proud to have written some publications and a book together with you.

One of us, **Dmitry Shevela**, Senior Research Engineer, Department of Chemistry, Umeå University, Sweden

Dear Govindjee, my very best congratulations to you on the occasion of your 90th birthday! Thank you so much for sharing your tremendous research experience with me for more than 15 years! I wish you strong health and many years of scientific activity! I am very much looking forward to our future joint work on publications and to our inspiring professional and personal discussions!

One of us, **Sushma Naithani**, Associate Professor (Sr. Research), Oregon State University, Corvallis, USA; and the Editor-in-chief, *Current Plant Biology*

During the early stage of my career, I studied photosynthesis and organelle biogenesis in cyanobacteria, yeast, and higher plants [46, 58,59]. Currently, I am pursuing research in plant molecular biology, genomics, bioinformatics, biocuration, and plant pathway modeling [60–63]. I first came to know about Govindjee and Rajni Govindjee by reading a review article on photosynthesis [64]. In 1995, I first met Govindjee and Rajni Govindjee in P.V. (Raj) Sane's laboratory at National Botanical Research Institute, Lucknow, where I was a Ph.D. student. In the fall of 1998, while I was a postdoc in Parag Chitnis's laboratory (Iowa State University, Ames, Iowa), we (Chitnis group members) drove to Turkey Run State Park, Indiana, to attend the 'Midwest Photosynthesis conference' with a detour to UIUC in the hope of meeting Govindjee; however, he was away. I met Govindjee again in JNU in 2013 in Ashwani Pareek's laboratory. From 2017 onwards, I had regular conversations with Govindjee via phone and emails. I have collaborated with him on writing three tributes [36,65,66] and one research article on lectins [37]. I also interacted with Govindjee as an Editor-in-chief of the *Current Plant Biology* a few times. More recently, I conducted a detailed zoom interview of Govindjee on the history of photosynthesis research and on his close collaborators. Through these various interactions, I have come to know Govindjee as a wonderful human being with deeply ingrained democratic and humanitarian values and ethics, and as a sincere science historian, besides being a great scientist. I am greatly inspired by his attention to details, continued aspiration, focus, and ability to work hard—and in spite of problems with his own health and Rajni's (after she suffered a stroke in 2021). Especially the past two years of the Covid-19 pandemic posed many challenges; nonetheless, I always found inspiration and greater motivation after talking to Govindjee. I know many others who found a source of strength and energy from Mr. Photosynthesis! It is a special pleasure to join the global community of photosynthesis researchers and many eminent plant biologists to congratulate Govindjee on his 90th birthday. It is also the 65th marriage anniversary of Govindjee and Rajni, and soon it will be Rajni's 88th birthday on 29th November 2022. Thus, I congratulate and wish both of them good health and happiness!

Overall, we see Govindjee through the eyes of four generations and learn more about his style, grace, humanity, and scholarship through these personal messages. We hope that this tribute will serve as an informal instruction to many of us and especially the younger and future generations, that *science is an international enterprise* and that we can build our professional network, receive encouragement, enjoy camaraderie, and in turn, inspire and support others.

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## Authors Contributions

All authors helped to gather messages and contributed to the writing and editing of this article. Fig. 2 was drawn by DS.

## Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## Data availability

No data was used for the research described in the article.

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We thank all the contributors for their messages and the community of plant biologists for their comradery, which makes science fun.

## Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at <https://doi.org/10.1016/j.cpb.2022.100263>.

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