

M. V. George (1928–2019)

Manapurathu Verghese George (MVG), an eminent organic chemist and a great teacher, who had contributed significantly to the growth of photochemistry research in India, passed away peacefully on 9 December 2019 at the age of 91 in Thiruvananthapuram. MVG was born on 3 October 1928 to M. O. Verghese and Saramma Verghese of Manapurathu family in Ashtamudi, one of the most beautiful backwater areas of Kerala. Early in his life, his parents moved to Kollam, to run a successful water transport business, and it was here that MVG, second of five children grew up and had his early schooling. After completing his pre-university education from Union Christian College, Alwaye in 1945, he moved on to study at the Madras Christian College, University of Madras from where he obtained his Bachelor's degree in chemistry. He then went on to receive his Master's (1951) and Ph D (1954) degrees from Agra University (later renamed as the Dr B. R. Ambedkar University). His doctoral research was on some aspects of Perkin and Knoevenagel condensation reactions which he carried out under the supervision of P. I. Ittyerah.

As was common in his time, he travelled by ship to Canada to work as a post-doctoral researcher with George F. Wright at the University of Toronto. Subsequently, he went on to conduct post-doctoral research with many other renowned organic chemists of that time, including Henry Gilman at Iowa State University, Melvin S. Newman at the Ohio State University, Sir Derek Barton at the Imperial College of Science and Technology, London, and Rolf Huisgen at the University of München. The experience of working with these leading organic chemists and exposure to various research topics including physical organic chemistry, electron transfer reactions and photochemistry helped MVG to develop his own unique style of working on his return to India. He returned to India in April 1963 and was appointed as a Faculty member at the Department of Chemistry, IIT Kanpur. Here he worked together with scientists like C. N. R. Rao, P. T. Narasimhan and others to establish one of the best departments of chemistry in India. This department produced outstanding chemists of the country over the years and continues to be

one of the leading centres in India for research and teaching in chemistry.

Areas of research which he had initiated early on at IIT-Kanpur and in which he had sustained his interest throughout his research career, were the study of electron transfer reactions and photochemistry¹. His early studies on electron transfer reactions were related to generation of radical anions and dianions of unsaturated organic substrates in polar aprotic solvents with alkali metals. The reactive intermediates formed in these reactions were utilized for the synthesis of a variety of silicon and germanium



based heterocycles². Jointly with Rao, he had also examined the electronic spectra of a large number of radical ions and related species, generated from aromatic hydrocarbons, heterocycles, ketyls as well as azo, nitro and nitroso compounds³.

He subsequently moved on to study functional group transformations of a variety of organic substrates, including oxidation of organic compounds employing non-stoichiometric oxides such as manganese dioxide and nickel peroxide, photo-oxygenation of heterocycles and nucleophilic additions to acetylenic esters and ketones. Most of these reactions were observed to proceed through free-radical intermediates resulting in the formation of interesting coupling products. His group also utilized chemistry of acetylenic esters to develop novel methods of synthesizing known and novel heterocycles. They also investigated the detailed stereochemistry of addition of different nucleophiles to acetylenic esters

such as dimethyl acetylenedicarboxylate, and were able to successfully use many of these adducts for constructing highly useful heterocycles.

MVG was one of the early pioneers in the study of organic phototransformations in India. He and his colleagues were able to develop a simple photochemical procedure for the decarboxylation of secondary and tertiary carboxylic acids through the photodecarbonylation of the corresponding acyl xanthates. The transient intermediates formed in many of these photoreactions were also characterized by them. Of the large number of phototransformations studied by MVG, of particular interest to him was the photochemistry of sydnone, a class of mesoionic compounds named after Sydney in Australia where they were initially prepared and studied. His group carried out detailed photochemical studies on this class of compounds. As a typical example it could be shown that the photochemistry of N,C-diphenylsydnone in benzene gave 2,4,5-triphenyl-1,2,3-triazole as the major product via a process that involved the formation of 1,2-bisphenylazostilbene as a precursor. They could also show that bis-phenylazostilbene could be converted nearly quantitatively to the triazole derivative, on treatment with carbon disulphide. Careful isolation of the products formed also indicated the presence of phenylisothiocyanate and elemental sulphur, suggesting that the reaction proceeded through decomposition of an intermediate pentadienyl type cycloadduct. They could demonstrate that such reactions could be extended to a wide variety of triene systems⁴.

His group subsequently moved on to study 1,2-dicarbonyl systems, including multichromophoric substrates, most significant of this being his studies on multichromophoric dibenzobarrelenes containing both 1,2-dibenzoyl and barrene chromophores. They were able to elucidate their complex photochemical reaction pathways combining product analysis and study of transient intermediates using nanosecond and picosecond laser flash photolysis techniques.

At NIIST, jointly with K. George Thomas, MVG had demonstrated one of the early approaches for stabilizing photoinduced electron transfer products by

M. V. George: A teacher and mentor *par excellence*

Two of us share some fond memories of Prof. George as a teacher and mentor from his early years at IIT Kanpur. One of us, Ila H. (nee Bhatnagar) was a Ph D student (1964–68) under his supervision and the other, S. Sivaram (SS) was a Master's student (1965–67) and had the privilege of doing his Master's dissertation under his supervision. In particular, he infused in me the love of chemistry by inviting me (SS) in 1965, a nineteen years old, into his laboratory without a project or an assignment!

George was an enigmatic personality, extremely kind and generous and at the same time a strict disciplinarian with exacting professional standards which his students found difficult to live up to. Through his personal example he taught his students to strive for perfection and to pursue it diligently. As students most were terrorized by his persona but everyone realized the value of his lessons as they progressed in their professional life.

As a teacher he was impeccable. It was an amazing experience to listen to him, writing every structure/word on the blackboard in his inimitable hand writing in a meticulous and systematic way and clarifying every concept in organic chemistry with lucidity. Every atom with a lone pair had the flat *umlaut* (unlike the two dots which most of us were used to), attesting to his training in the German School of Organic Chemistry and every transformation had the beautiful arrows. His elucidation of structure and mechanisms in organic chemistry and teaching us the 'science behind the arrows' led one of us (SS) to choose physical organic chemistry as a topic for Ph D.

His penchant for house-keeping and cleanliness in the laboratory is legendary. No sample could be left on the table unlabelled; no dirty reaction flask be set aside for cleaning the next day and no lab bench could be left uncleaned at the end of the day's work. He had the habit of coming to the lab on his bicycle in the wee hours of the morning, when the lab was empty, to check every lab bench! One morning, one of his students found a few milligrams of a precious compound that he had isolated after weeks of chromatography missing from his table, only to realize that George during his nocturnal visit had thrown it away, since it was unlabelled. The next morning, when George arrived in the lab, the student was literally in tears. A harsh lesson, nevertheless, one which left a deep impression on all of us.

Writing a thesis or a paper with him was an experience which none of his students can forget. Every paper was written in pencil with an eraser and a pencil-sharpener in hand. In the days before computers this was the only way we could modify the text before it was finally typed. His table had a large container with scores of pencils, every-one of them with razor sharp leads. He would normally use one pencil for just about two sheets of paper! Manuscripts and thesis went through endless drafts and corrections. For him every comma and full-stop mattered; every *t* had to be crossed and every *i* should be dotted. Most of us learnt the art of writing from him. My (SS) Master's dissertation, comprising less than fifty pages possibly went through a dozen drafts. One can imagine the ordeal of his students to get a Ph D dissertation through his gaze!

In spite of his stern exterior, he was a kind and generous soul, accessible, friendly and concerned about the well-being of his students. He was extremely popular with the undergraduate B Tech students. As a ritual, many of his undergraduate students would gather at his home in the campus every Saturday for an evening of conversation, great music and wonderful food. I was privileged to be a part of this group. Incidentally, his Ph D students were not invited! He had bought from Germany a Grundig Stereophonic Music system. In 1966, this was a novelty for most of us who had never seen or heard anything but an Edison HMV Gramophone! To hear a symphony or any of the pop stars of those years (Beatles, Ray Charles, Bob Dylan, Aretha Franklin, The Ventures, Credence Clearwater Revival, etc.) on this system was an aural treat.

He infused in us the love for research in Organic Chemistry. As a mentor he showed us the way when many of us were not sure what to do with our careers. As a teacher, he took genuine pride in his students' progression and stayed engaged with them for many years. By example, he taught us to be humble, upright and disciplined. He stayed scrupulously away from the politics of science. He shunned glamour and power associated with administrative roles and stayed a true teacher till his last days. He built departments and institutions which excelled because he nurtured it. He instilled in us the desire to pursue perfection and to live the credo that we must pay attention to details because small things do matter in science. He lived a full life, in dignity and decorum.



M. V. George receiving the Bhatnagar Prize

H. Ila (nee Ila Bhatnagar), e-mail: hila@jncasr.ac.in
S. Sivaram, e-mail: s.sivaram@iiserpune.ac.in

studying fullerene based systems. They synthesized several mono-, bis- and tris-fullerene (C₆₀) based donor-acceptor systems which could spontaneously self-assemble to form larger clusters. The photophysical and electron transfer properties of the monomeric and clustered forms of these systems were studied using ultra-fast spectroscopic methods. These studies showed that the electron transfer products decayed rapidly in their monomeric form, while they survived for several microseconds in the clustered environment. The remarkable stability of the charge separated products in clusters was attributed to hopping of electrons between the fullerene moieties⁵.

As mentioned above, towards the latter part of his research career, MVG had developed strong interest in studying photogenerated transients for which he developed strong links with R. W. Fessenden, P. K. Das and P. V. Kamat of the Radiation Laboratory (Rad Lab), University of Notre Dame, USA. This association with the Rad Lab continued even after his superannuation from IIT Kanpur. It was in 1985 in Rad-Lab as a post-doctoral fellow that I first met MVG who was then there on a one-year visiting scientist assignment. All members of the Rad Lab, both scientific and non-scientific, had great respect for him, and it was also a fascinating sight for me to see senior MVG in his starched Lab coat at the Rad Lab, heading toward the cellar with his trolley containing his usual collection of sharpened pencils, neatly stacked glassware, and meticulously maintained workbook to conduct transient spectroscopic studies with the same excitement and enthusiasm of a fresh young Ph D scholar.

In 1988, MVG superannuated from IIT Kanpur and joined as a CSIR-Professor Emeritus at the Regional Research Laboratory-Trivandrum (later renamed as the National Institute for Interdisciplinary Science and Technology). Here he established the Photochemistry Research Unit initially with A. Ajayaghosh, D. Ramaiah, K. George Thomas, M. Muneer and myself as scientists. The unit was later renamed as the Photosciences and Photonics Section under the Chemical Sciences & Technology Division of RRL-T and continued to remain as an active centre for research in photosciences. His presence at RRL-T attracted several

leading chemists and photochemists to visit and support the growth of the photochemistry group. His presence also helped in the overall growth of the stature of the National Institute for Interdisciplinary Science and Technology and is one of the leading centres for chemistry, and materials research.

MVG has published over 200 articles in peer-reviewed journals and guided a number of doctoral and post-doctoral scholars. In recognition of his contributions to science, he was elected as Fellow of the Indian Academy of Sciences in 1973, Indian National Science Academy in 1975 and The World Academy of Sciences in 1993. The Council of Scientific and Industrial Research awarded him the prestigious Shanti Swarup Bhatnagar Prize, in 1973. He was also the recipient of the C. V. Raman Award in 1985, the Professor T. R. Seshadri 70th Birthday Commemoration Medal of the Indian National Science Academy in 1990, TWAS Prize in 1992 and the Lifetime Achievement Gold Medal of the Chemical Research Society of India in 2001.

During the early stages of establishing the Photochemistry Research Unit at RRL-T, he helped to create a vibrant work culture, encouraging weekly seminars, meetings and major national and international conferences to discuss the latest developments in photochemistry. MVG remained a lifelong learner and his intense interest and curiosity about life and in learning of new things in science, of cultures, was highly infectious and his close interaction with scientists and student of the Unit ensured that many of them imbibed the same qualities.

One of MVG's greatest passion was to identify talented youngsters and encourage them in the field of science. It was this passion that led him to establish the Foundation for Capacity Building in Sciences (FCBS). Along with C. N. R. Rao, MVG established FCBS an autonomous, non-profit organization, devoted to strengthen and further the cause of science education and research in India in 2000. Through its annual meetings, seminars and workshops organized in various parts of Kerala targeting science students and teachers, FCBS has had a significant role in promoting a number of bright students of Kerala to pursue a career in science. He has also played a

pivotal role in establishing the Indian Institute of Science Education and Research (IISER) at Thiruvananthapuram in 2008.

MVG continued to attend his office at NIIST till nearly two weeks before his passing away, where he continued to play the role of a mentor for a new generation of scientists and students. He will be remembered as a great scientist, expert organic chemist and photochemist, a great teacher and excellent scientific administrator. But one of his most important contributions was to compassionately listen to and encourage research students and scientists around him to be the best they could be. At IIT-Kanpur he had been a father figure for many of the B Tech students he had taught. His commitment to them can be recognized by the fact that many of them, who are presently highly successful professionals working at some of the leading institutes around the world, used to regularly visit him in Thiruvananthapuram to acknowledge the role he had played in shaping their professional and personal lives.

MVG leaves behind a great legacy, one that will surely be kept alive by the many people whose lives he has touched. The scientific community of India will remain forever grateful for his varied contributions to science and humanity.

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SURESH DAS

*IISER, Thiruvananthapuram,
School of Chemistry,
Maruthamala PO, Vithura,
Thiruvananthapuram 695 551, India
e-mail: sureshdas55@gmail.com*