USHA RANJAN GHATAK

(26 February 1931 – 18 June 2005)

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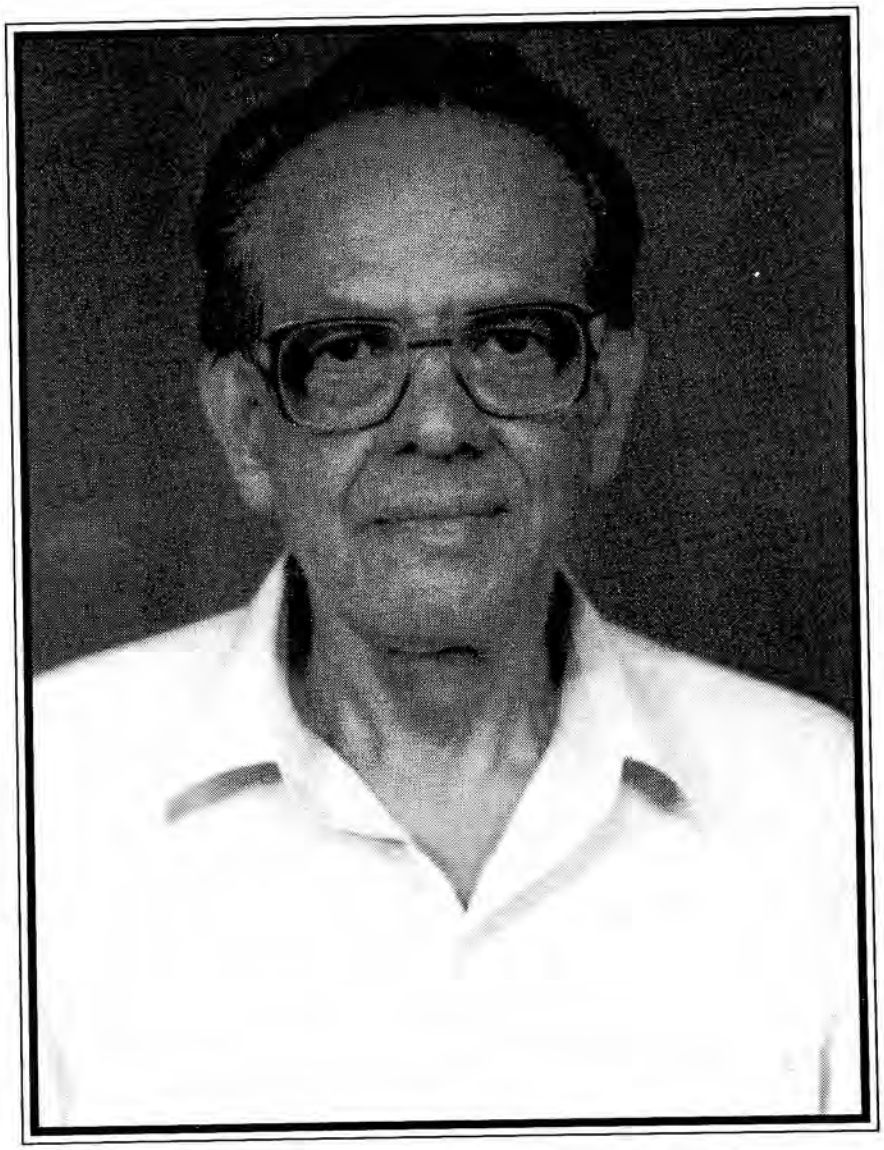

Meghnatak

USHA RANJAN GHATAK

(1931 - 2005)

Elected Fellow 1980

USHA RANJAN GHATAK was an Organic Chemist of high repute nationally and internationally with an enormous appetite for chemistry. He pursued all of his professional responsibilities with outstanding dedication and overall brilliance.

FAMILY BACKGROUND AND EARLY EDUCATION

Usha Ranjan Ghatak was born on February 26, 1931 in Brahmanbaria, a small subdivisional town (now in Bangladesh), as the fourth of the six sons and one daughter to Sri Hem Ranjan Ghatak and Smt Soudamini Devi (nee Roy). The family originally hailed from the village of Nasankar in Bikrampur District (now in Bangladesh) and most of the members were deeply involved in the freedom movements of India. His father was an Administrative Officer in a Zamindari estate with the headquarter at Brahmanbaria.

Usha Ranjan Ghatak grew up in a completely rural old atmosphere and locality and had his entire school education in the Annada HE School from where he passed the matriculation examination in 1947, the year of the independence and the division of Bengal. Under the uncertain political conditions, his parents sent him to nearby Agartala, Tripura, where he got his intermediate college education in the newly created MBB College, affiliated to the University of Calcutta, and passed the ISc examination in 1949 with a good academic record. Soon afterwards, with most of his family members, he migrated to Calcutta and since then this city became his new hometown. In 1951 he passed the B.Sc. examination from Asutosh College with Honours in Chemistry. He passed his M.Sc. examination in Pure Chemistry in 1953 from the University College of Science, Calcutta University, in the first class, having stood first in order of merit and secured the Calcutta University Gold Medal and Motilal Mullick Medal. In spite of serious financial problems arising out of the sudden migration of the family to Calcutta, he received considerable encouragement from his parents and elder brothers to pursue higher education. It deserves to be mentioned that he had to earn most of his educational expenses and maintenances since his college days in Calcutta through private tuition. Immediately after passing the MSc examination he was offered a much-needed job as a Lecturer in Asutosh College. But under the influence of Ajit Kumar Mukherjee, a teacher in his BSc Class, in February 1954 he joined the research group led by Dr PC Dutta, the then Head of

the Department of Organic Chemistry at Indian Association for the Cultivation of Science (IACS), Calcutta. At this time researches in the organic chemistry department were concerned with synthetic chemistry on polycyclic aromatic and terpenoid compounds under the leadership of Professor PC Dutta. Ghatak was assigned to work on stereocontrolled synthesis of resin acids, a problem of contemporary interest. This work with Professor PC Dutta marked the beginning of introducing the concept of stereocontrol in the synthesis of complex natural products with multiple asymmetric centres. Based upon this and other related works, he was awarded the PhD degree of the University of Calcutta in the year 1957.

PROFESSIONAL CAREER

Ghatak continued his research on the synthesis of resin acids as a Research Associate at IACS. After the tenure of the Research Associateship was over he left for USA in December 1959 for postdoctoral work. He spent one year with Professor GR Pettit at University of Maine, Orno. Then he moved to University of California, Berkley where he worked with Dr Henry Rapaport, one of the celebrated organic chemists at that time. After that he spent two years with Dr Kovacs at St. John's University, New York. During these four years of stay in USA he worked in a wide field of organic chemistry from carcinoidal compounds to alkaloids to peptide chemistry and biochemistry. He returned to Calcutta in November, 1963 and joined IACS as a member of the faculty in the Department of Organic Chemistry. Subsequently, he accepted an invitation from St. John's University, USA as a visiting scientist for the period 1968-1969. Although he had training in wide areas of chemistry, he decided to continue working in the area of stereocontrolled synthesis of natural products which was then at its infancy. All through his career, he practiced synthesis of complex carbocyclic natural products, the most fascinating area in organic chemistry. His contribution in organic chemistry is marked by a deep understanding of the conformational, steric and mechanistic factors which control bond formation in organic synthesis and was focussed on new reactions that form such bonds in novel ways. He unraveled the way how the highly unstable carbenoid species can be successfully utilised in carbon-carbon bond formation.

During the early years of his professional career, the organic chemistry department of IACS did not have the proper instrumental facility. He realised that it was going to be difficult to maintain a high level of research without adequate equipment facility. With his initiative, the department was able to procure a 60 MHz NMR spectrometer, an inevitable part of organic chemistry research, in the year 1974. This was in fact the first NMR spectrometer installed in Eastern India. The sophisticated equipment constraints that dwarfed his scientific efforts in his formative years remained so etched in his mind that in subsequent years when he took charge of the Department of Organic Chemistry in 1977, he ensured that the

sophisticated equipment facilities set up at IACS through his own research grant, were made accessible to any researcher who needed them. Many researchers from Institutions in West Bengal and also outside benefited from this consideration. This characteristic concern for the less privileged in his profession endeared him to all that he was affectionately called by all his juniors and even some seniors as 'Ushada' (elder brother Usha). His experience and wisdom were utilised by many funding agencies like DST, CSIR etc. and he also served for many years as a Member of the DST Project Advisory Committee. Professor Ghatak utilised this opportunity to ensure that promising young researchers received due funding support.

Professor Ghatak was instrumental in further expanding the department with a chosen band of new faculty members and procuring state-of-the-art equipment. His sustained efforts brought further glory to the Department. Subsequently, he was also called upon to shoulder the responsibilities of the Association as the Director at a very crucial time from May 1989 to January 1993, which he carried out admirably. He continued as the Professor of Organic Chemistry till the date of his retirement in January 1996. But he never retired from science. He continued his research as INSA Emeritus Scientist at the Indian Institute of Chemical Biology, Calcutta, until he breathed his last on June 18, 2005.

Professor Ghatak married Anindita Mukherjee, daughter of a renowned physician of South Calcutta in 1964. They had only one child, a son, Anjan. He also pursued organic chemistry as a career and after completing a doctorate degree proceeded to US for advanced training. There the budding young organic chemist died all of a sudden under tragic circumstances leaving the parents shell-shocked for life. The son's death took its heavy toll on Professor Ghatak's cheerful mental frame and he progressively withdrew into gloom. The unendurable tragedy finally laid siege on his own life and within a year of this personal loss Usha Ranjan passed away on the morning of June 18, 2005 following a massive heart attack. His death thus brought the curtain down on the enviable clan of chemists who were more passionately devoted to unraveling the mysteries of organic chemistry than yearning for personal fulfillments in its practice. He was also an engaging conversationalist, and could indulge in long monologues on topics as varied as chemistry, politics, human behaviour. Despite his high achievements, he practiced a spartan life style and was easily accessible to anyone who needed his wise counsel. The many students whom he so ably trained and are now occupying important positions in the academy and industry bear living testimony to his devotion to the pursuit of excellence in science.

RESEARCH CONTRIBUTIONS

Ghatak has made substantial contributions to methods for stereochemically controlled organic synthesis, particularly in the fields of polycarbocyclic

diterpenoids and bridged-ring compounds related to bio-active natural products. His work is marked by a deep understanding of the conformational, steric and mechanistic factors which control bond formations in organic synthesis, and has focused on new reactions that form such bonds in novel ways. His major research contributions can be classified in the following two categories.

1. *Stereocontrolled Synthesis of Bio-Active Diterpenoids and Related Compounds*

At the early stage of his research career, Ghatak and his co-workers achieved total synthesis of some resin acids of profound contemporary interest such as podocarpic acid, desisopropyl dehydroabietic acid and 5-*epi*-deoxypodocarpic acid. These studies clarified the stereochemical uncertainties that existed in the literature and paved the way for entry into other related compounds. He also demonstrated that the stereochemical outcome at the ring-juncture in acid-catalysed cyclialkylations of 2-(2-aryl ethyl)-3,3-dimethyl-1-methylene cyclohexane is greatly influenced by the electronic nature of the substituents on the aromatic ring. Employing this concept Ghatak and his coworkers achieved stereocontrolled synthesis of the diterpenes nimbidiol, sugiol, sempervirol and xanthopherol.

Synthesis of the plant hormones, gibberellins possessing a bridged-tetracyclic carbon skeleton, was a challenging problem from structural and stereochemical points. Ghatak developed a novel general protocol for the construction of the bridged rings present in them based upon intramolecular copper-catalysed carbenoid addition to double bond by thermal photochemical decomposition of γ,δ-unsaturated diazomethyl ketones followed by regioselective acid-induced reductive cleavage of the cyclopropyl ketone. Another crucial problem associated with the synthesis of gibberellin was stereocontrolled introduction of the angular substituents. Ghatak developed a remarkably simple solution that involved a regioselective intramolecular α-oxo-carbenoid insertion across the relatively inert benzylic C-H bond through copper-catalysed carbenoid decomposition of diazomethyl ketone. This was a major breakthrough in carbenoid insertion reaction into an unactivated C-H bond. Subsequently Ghatak and his group developed a much simpler solution involving acid catalysed cyclisation of β,γ-unsaturated ketones to form cyclobutanone followed by a novel rearrangment. The tetracyclic compound obtained as above was the key synthon for the synthesis of atisine, veatchine and gibberellin A_{15} by Nagata and his co-workers.

Bond reorganisation of strained ring systems was the most fascinating aspect in Ghatak's approach to structurally complex natural products. A biogenetic type rearrangment of a bicyclo[2.2.2]octane moiety was the key step in his approach to the diterpenes, stemodin, stemarin and aphidicolin, the tumor-inhibiting fungal metabolite. Other diterpenes synthesised by him and his group include cytotoxic benzocycloheptenes deoxofavelin and faveline. 9a-Carbamorphinan, a bridged-ring

hydrocarbon synthesised by Ghatak and his group was the first synthetic compound that turned out to be a powerful insect attractant.

2. New Synthetic Methodologies and Reaction Mechanisms

A large number of synthetic methodologies for the carbon-carbon bond formations and reorganisations have been developed by Ghatak and his co-workers. Some important functional group transformations include photo-induced rearrangement of diazoketones, transition metal catalysed degradation of aromatic rings for utilising this moiety as a latent functionality and a novel synthesis of α,β-unsaturated aldehydes by 1,3-carbonyl transposition through 1-carbon homologation. Very recently regio- and stereospecific 6-*endo*-aryl radical cyclisations leading to simple convergent general method of synthesis for some linear polycarbocyclic systems have been developed. Important mechanistic informations concerning the effects of neighbouring carboxyl group in chemical and catalytic reductions have been gainfully employed in stereocontrolled generation of several chiral centres in a single step.

HONOURS AND AWARDS

Professor Ghatak's contributions have been recognised by a number of awards: He was a recipient of the Gold Medal of the Chemical Research Society of India (2003), SS Bhatnagar award in Chemistry (1974), Gold Medal and ML Mallick Medal of the University of Calcutta (1953). He was a Fellow of the Indian National Science Academy (FNA) (1980) and Fellow of the Indian Academy of Sciences (FASc). He has traveled extensively and attended many international conferences. He visited USSR as a member of Indian Delegation at the Vth Indo-Soviet Symposium on chemistry of natural products (1978), Japan under INSA-JSPS exchange scientists programme (1981), France and delivered lectures in several Institutes as an invited scientist (1982), visited UK to deliver invited lectures in several top universities and participated in discussions as Senior INSA-Royal Society Exchange Visitor (1986), and Federal Republic of Germany to deliver invited lectures (1986). He was the Chairman of the Research Council and Technical Advisory Board of CSIR, member of the Project Advisory Committee of DST, associate member of the Chemical Society of London, Associate Editor of the *Journal of the Indian Chemical Society*, member of the Editorial Board of the *Proceedings of the Indian Academy of Sciences* (1980-83 and 1986-1992). He has delivered a number of prestigious lectures: First Maitreyi Memorial Lecture at the National Symposium in Organic Chemistry, University of Calcutta, March 1985; Professor NV Subba Rao Memorial Lecture on February, 1986 at Osmania University, Hyderabad; Dr RC Shah Memorial Endowment Lecture on March, 1986 at the University of Bombay, Bombay; TR Seshadri Memorial Lecture for 1987 at the Delhi University, Delhi; Plenary Lecture at the 8th Indo-Soviet Symposium on the Chemistry of Natural Products held at RRL,

Hyderabad, December 8-12, 1986; Acharya PC Ray Memorial Lecture for 1985, under the auspices of the Indian Chemical Society at Kolhapur, Maharashtra, November 23, 1987; Mukarram Hussain Khundkar Memorial Lecture 1988 on January 15, 1989 at the University of Dhaka (Bangladesh); First Professor PC Mukherjee Memorial Lecture at the 5th National Symposium on Recent Advances in Organic Chemistry, held at Kalyani University, March 28-29, 1989; Sectional Lecture at the 17th International Symposium on the Chemistry of Natural Products (IUPAC) held at New Delhi, February 4-9, 1990; Baba Kartar Singh Memorial Lecture on March, 1990 at the Punjab University, Chandigarh; Professor S Swaminathan 60th Birthday Commemoration Lecture – 1994 on October 5, at the INSA premises, New Delhi and KS Krishnan Memorial Lecture for 1995 at the Indian Association for the Cultivation of Science are a few to be mentioned.

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