



P. Chaturvedi



PHANINDRA CHANDRA DUTTA

(1912–1983)

Elected Fellow 1971

EARLY LIFE AND EDUCATION

PHANINDRA CHANDRA DUTTA was born on January 31, 1912 in Agartala, Tripura, as the fifth of nine children, six sons and three daughters, to Sri Naba Chandra Dutta and Smt Rajalakshmi Dutta. The father had served as an Office Superintendent with Government of Tripura. The family originally hailed from East Bengal (now Bangladesh) and had large landed property. But fluctuations of fortunes forced them to seek their chances elsewhere and they migrated to Agartala and settled there. Sri Naba Chandra Dutta and his wife continued to live there till death and some of the surviving brothers of Professor Dutta still live in the family home at Agartala. The parents held very modern views and even in those days when it was not a common practice to send daughters to school, they provided all sons and daughters with education in equal measure. The children proved to be extremely good at school and particularly Phanindra Chandra was very brilliant. He had his schooling from Umakanta Academy at Agartala and always stood first in the class. He passed his matriculation examination in 1929 securing a scholarship and subsequently the ISc examination from Rajshahi (now in Bangladesh) College in 1931. But he had to forfeit his scholarship on account of the political upheaval then sweeping Bengal. He left Bengal and passed the BSc examination from Cotton College, Gauhati, securing first position and receiving the R K Barat Gold Medal for mathematics. After obtaining the MSc degree from the University College of Science, Calcutta in the thesis group, he was offered the Sir R B Ghosh research fellowship in 1935 to work under Professor P C Mitter, the then Palit Professor of Chemistry. At that time there was no provision for the DSc degree on the basis of joint work and D Phil/Ph D degree was not introduced in the University of Calcutta till 1948. The prevalent system was joint work for two years and independent work for the remaining one year. In the absence of any provision for financial assistance after the third year, he had to depend entirely on private tuition for mere subsistence in Calcutta. He was awarded the Nagarjuna Prize and gold medal for independent research for the year 1938 and admitted to the DSc degree of Calcutta University in 1940 on the strength of a thesis—"Synthesis of Alicyclic Compounds", adjudicated by Professor W N Haworth, FRS, NL, Professor I M Heilbron, FRS and Professor S Smiles, FRS. The Sir P C Ray fellowship was offered to him in 1941 and later he was awarded the J M Dasgupta Memorial Gold Medal of the Indian Chemical Society. He was appointed Honorary Lecturer



Chemistry in Calcutta University in the very next year. In 1944, he was awarded the Premchand Roychand Studentship and the Mokat gold medal of Calcutta University. In the same year, ICI introduced research fellowships in India and he was its first recipient in Chemistry. In 1947, Dr Dutta proceeded abroad on a Rash Behary Ghosh travelling fellowship to work under Professor Paul Karrer, a Nobel Laureate, at the University of Zurich on anti-vitamin activities of vitamin E with incorporation of sulphur atoms. A year later he switched over to ETH laboratories of Professor Ruzicka, another Nobel Laureate, to work on sesquiterpenes, a subject which became his life-long interest. In 1949, Dr Dutta was offered a post-doctoral fellowship at Harvard University under Professor Gilbert Stork to work on the synthesis of 11-ketoperhydrophenanthrenes related to cortisone. Four years later, in March 1953 he returned to India and joined the Department of Organic Chemistry, Indian Association for the Cultivation of Science, Calcutta, as Reader and Head of the Department.

PROFESSIONAL CAREER

Dr Dutta took up the post of Reader in the Indian Association for the Cultivation of Science in 1953 and was assigned by the then Director, Professor M N Saha, FRS, the stupendous task of organizing the stripling Organic Chemistry Department. He went about this job with his characteristic missionary zeal and during his undisputed reign of 24 years, organized and uplifted the status of the Department of Organic Chemistry from a scarcely noticed entity to one of international repute. Dr Dutta became the first Professor of the Department in 1955 just before the untimely demise of Professor M N Saha. He went to UK in 1959 on receipt of a Royal Society Bursary and a Nuffield Foundation fellowship and spent four months as a visiting scientist in Imperial College of Science, London and Dyson Perrins Laboratory, Oxford to work on the structure of cascarillins. In 1962, he attended the second international symposium under International Union of Pure and Applied Chemistry (IUPAC) at Prague. He was nominated as one of the chairmen of the session on synthesis in the third symposium held at Kyoto in 1964 and travelled extensively in Japan. Same year in June, he delivered one of the invited talks in an international symposium on synthesis held at Ecole Polytechnique, Paris, and in November, proceeded to Harvard University to work with Professor R B Woodward on the revision of the structure of magnamycin. In 1966, he attended the fourth IUPAC symposium held at Stockholm. He was invited to be the chairman of one of the sessions on synthesis at the sixth symposium held in London in 1968 and in 1970 went to Russia to preside over one of the sessions in the seventh symposium at Riga and travelled in Poland and Hungary on invitations from the Polish and Hungarian Academies of Sciences for delivering lectures in different places. In 1971, he was elected a Fellow of the Indian National Science Academy (FNA) and elected to its Council in 1975.

In 1973, Professor Dutta again went to the USSR as a member of the Indian delegation to the third Indo-Soviet symposium held at Tashkent and visited Moscow and other places. In 1974, he was elected chairman at the IX IUPAC symposium



in Ottawa, Canada and visited a few places in Canada and USA to deliver lectures. He spent two months as a visiting scholar in the chemistry department of Columbia University, USA in 1975 and two weeks as a visiting scientist at the State University of New York at Buffalo, USA. He represented the Indian National Science Academy at the first session of the Bangladesh Science Conference in March 1976. The following May, he spent seven weeks at Ecole Polytechnique, Paris, as a visiting Professor and in West Germany to give a lecture in Heidelberg University and two weeks as a guest of the British Council, visiting a few universities in England and Scotland for scientific discussions.

Professor Dutta had travelled extensively in the USA, Europe and Japan to give lectures and seminars on researches carried out in the department of organic chemistry. These acquaintances had helped him a lot to organize the laboratories in the Association and to fill up his 'beggar's bowl' with gift of chemicals, exhaustive experimental data on his compounds and other essential help through discussions and exchange of ideas from almost all parts of the world.

In India, he was connected with many research organizations and universities and served on various committees as expert and adviser. His association with the Central Drugs Research Institute, Lucknow as a member of the Executive Council for six years since 1967 had been particularly rewarding. With the advent of sophisticated instruments like NMR, Mass spectrometer, GLC, X-rays and computer, organic synthetic research has assumed a new dimension transforming itself from an empirical art to an exact science. With these advanced technologies, monitoring the progress of researches by micro-analysis became a less-resorted exercise although it has remained a final and confirmatory check on all new compounds before these are announced. The consequences were rather disappointing as it became pretty difficult to publish the research results from this laboratory in well-known chemical Journals. Through the courtesy of CDRI, Lucknow, instrumental facilities of that laboratory were freely accessible not only to the Association but to many other research workers of that region. The desperate situation prevailing at that time can be gauged from the fact that most of the results incorporated in the PhD theses from 1962 to 1967 could only be published from 1971 onwards. The situation, however, improved with the installation of an NMR and analytical GLC in 1974, replacement of UV in 1975 and IR in 1976, purchased in 1949 and 1957 respectively. Professor Dutta had also been responsible, through his connections and personal influences, in securing research grants from outside sources, like the chemical research committee of the CSIR, and NIH (USA) for a scheme in collaboration with Professor Alex Nickon of Johns Hopkins University. His personal influences also brought forth substantial funds from East India Pharmaceutical Works Limited, Calcutta, for meeting expenses incurred in connection with lectures organized in the Department by foreign and bright young Indian organic chemists.

Professor Dutta formally retired from his services in January 1977; but continued as Emeritus Scientist and in keeping with his phenomenal devotion to science, took up a very important project for conversion of quinine to quinidine sponsored by the Government of West Bengal.



SCIENTIFIC CONTRIBUTIONS

Professor Dutta had been a pioneer in initiating in this country, investigations into the challenging field of organic synthesis, particularly in the design of ways to negotiate the problems inherent in the synthesis of multi-asymmetric centred complex natural products. The main feature to be highlighted is the introduction of the concept of stereospecificity, developed in Harvard in late forties and early fifties for the synthesis of multi-asymmetric centred polycyclic compounds. Drawing on the abundant experience he gained while at Harvard, Professor Dutta initiated one of the most outstanding series of synthetic investigations on terpenoids. His contributions have to be viewed against the back-drop of inadequate equipment facilities and chemicals. A measure of his sustained dedication and scrupulousness can be gauged from the fact that the structures and stereochemistry he established with 'bare hands' at that time are valid till today. Professor Dutta's contributions span the whole spectrum of terpeneoid chemistry and in the following pages an attempt is made to highlight the more important of these.

Sesquiterpenoids

The chemistry of sesquiterpenes, which represents under the enveloping mantle of fifteen carbon atoms, more than hundred skeletal types, had become his life long interest. He started the process of organizing the researches in the organic chemistry laboratories of the Indian Association for the Cultivation of Science with synthetic studies towards the sesquiterpene lactone, santonin, an important anthelmintic agent. One of the earliest achievements in this regard had been the stereo-controlled total synthesis of two diastereoisomers of dihydrosantonin, the synthetic precursor of this lactone. In the ensuing years he shifted emphasis to sesquiterpenes containing cycloheptane ring systems and the study on the stereo-chemical aspects of these conformationally mobile systems. Notable success in this area represents, the synthesis of a diastereoisomer of cyclocolorone, a degradation product and model compounds related to xanthatin a few bicyclic lactones related to psilostachyns and important bicyclic intermediates to pseudoguaianolides. He utilized the concept of formation of bridged rings to control stereochemistry for a total synthesis of racemic clovane and advanced intermediates towards isoclovane and pseudoclovane-B, two important artifacts arising from caryophyllene. In the late sixties he also initiated synthetic studies on the newly discovered sesquiterpenes, which culminated in synthesis of racemic sesquicaran-2-one and a key intermediate towards bakkenolide-A and fukinone.

Diterpenoids

During Professor Dutta's period and even afterwards the greatest emphasis had been given to this area and particularly towards stereo-controlled synthesis of diterpene resin acids. He started synthetic studies and made very significant contributions long before a few others entered this field abroad in the early sixties. The first phase of the investigation in this direction was devoted to transformation of a carbon



group to a *gem*-carboxy methyl functionality with such stereocontrol that a single tricyclic ketone would lead to two diastereoisomeric acids at C-4 with respect to the C-10 angular methyl group, having stereochemistry related to dehydroabiatic acid and podocarpic acid. Two methods were successfully worked out and one of them led to the first stereo-controlled total synthesis of (\pm)-5-epidesisopropyl dehydroabiatic acid.

The next phase involving studies on stereochemical course in cyclialkylations ultimately led to synthesis of racemic desoxypodocarpic acid and 5-*epi*-desoxypodocarpic acid. With a subsequent stereo-controlled synthesis of desisopropyldehydroabiatic acid, the synthesis of all the four possible racemates was completed, with established stereochemistry. These studies helped to unravel the stereochemical uncertainties present in some of the racemates of the tricyclic acid known upto that time, besides providing a better understanding of stereoselectivities of a few reactions of general utility.

These studies were further extended and culminated in the stereo-controlled synthesis of three diastereomers of dehydroabiatic acid. The optically active form of one of them, 4-*epi* dehydroabiatic acid, designated as callitrisic acid, was later isolated from natural sources.

In a further series of studies a novel A-B-C ring route was developed for stereo-controlled synthesis of the C-5 epimeric pair of desisopropyldehydroabiatic acid. During this time Professor Dutta and his collaborators made a remarkable discovery in the diterpene field relating to conversion of the *cis* A/B-ring junction to *trans* series of ring-C aromatic tricyclic resin acid derivatives under mild dehydrogenation conditions with palladium-on-charcoal. They also completed a total synthesis of a biogenetically significant ring-C aromatic tricyclic diterpene, nimbiol.

In the area of polycyclic diterpenoids, important tetracyclic intermediate related to cafestol, with proper stereochemistry was realized. Successful syntheses of tetracyclic bridge ring compounds related to the complex diterpenoids phyllocladene, kaurene and hibaene were also completed.

The complex pentacyclic diterpene alkaloids of the garrya and atisine group posed a great synthetic challenge and a number of leading groups were involved in developing synthetic methods towards these. Professor Dutta, very early, recognized the importance of a key tricyclic diacid, a degradation product obtained during the structural studies, as the proper 'junction' point for further elaboration and developed a stereocontrolled route to this diacid. Eventually this did serve as the intermediate in the total synthesis of these alkaloids by other workers. During this time, his collaborators also developed a stereocontrolled route to this diacid through a remarkable angular alkylation procedure involving ketocarbenoid insertion.

Sesterterpenes

The chemistry of sesterterpenes, comprising a net work of 25-carbon atoms and



constituting the 'missing link' between di- and triterpenes did not fully emerge until the sixties when compounds containing this unit began to be isolated. Remarkably it was found that they exhibit many skeletal variations, some of them not so far encountered in the terpenoid field. This made a synthesis of these more challenging and at the same time more complex. Professor Dutta had been one of the earliest workers to enter this field with synthetic recipes and published the first paper with an approach to the perhydrophenanthrene ring system of cheilanthatriol involving synthesis of a tricarbocyclic intermediate with stereocontrol at each of the five chiral centres. Another notable achievement in this area had been the realization of a synthetic intermediate comprising a linear array of five-eight-five ring system related to the ophiobolin group of sesterterpenes.

As is evident from the achievements he had been able to realize, Professor Dutta displayed a remarkable versatility in successfully venturing into diversified fields. This had been at a time when hard work and tenacity were the only answer to long-standing problems and long before the advent of sophisticated equipments made short work of structural assignments. His success story is a measure of his dedication and long hours, that by no means came easy, and which helped him build up a great tradition, which is being upheld to this day. And it had been such dedication that prompted Professor Sir Ewart Jones to write him on his retirement, "I send congratulations on the achievement of 24 years of unremitting toil and on having 'stayed the course'. Congratulations too on your excellent work in the terpene series and for having inspired and trained so many very able collaborators. You can leave it happy in the knowledge that you and your colleagues have made valuable contributions and that you have kept the flag of research flying under far from easy conditions".

PERSONAL LIFE AND QUALITIES

Apart from being a very able researcher and research guide, Professor Dutta was a great humanist. All those who came in contact with him were deeply touched by his frankness, informality and sensitivity to the feelings of others. He ungrudgingly extended his helping hand in all possible ways to any one who approached him in need. Reportedly a good portion of his salary used to be taken away for financial assistance to those in need. A particular incident will illustrate his philanthropic attitude. One day while he was taking his usual stroll in the corridors of the department, a smart young man came upto him and touched his feet. Professor Dutta himself did not immediately recognize him until the facts were unfolded by the youth. Long ago, as a small forlorn boy, he had approached Professor Dutta for a job. At that time even though there was provision for a 'bearer' in the department, Professor Dutta could not wrangle it for the boy since he did not command much influence. So all he could do was to get him some minor job as a gate keeper with a friend of his, and arranged to get him admitted in a night school and also helped him financially through his undergraduate course. Then the boy had left Calcutta, established himself as a good accountant and



migrated to USA and was in-charge of the overseas section of a multi-national organisation and on a trip to the Far East, had broken journey to pay his respects to Professor Dutta, but for whom he would not have made it in life. Instances such as this are too numerous. Where ever he went, he displayed such generosity and many were drawn to him on this account. Professor R B Woodward, the legendary figure in the domain of organic chemistry, with whom Professor Dutta worked at Harvard, had this to say in his message at the time of Professor Dutta's retirement, "It gives me great pleasure to have this opportunity to express my appreciation of the outstanding scientific, intellectual and human qualities of Professor Dutta, whose friendship I have valued for many years. May I express my warm hope that he will enjoy the many further happy years to which his contributions to science and the kindness he has always extended to his colleagues and friends have entitled him". Professor Gilbert Stork, with whom Professor Dutta was associated for four years at Harvard during his formative years, recalled, "Dear P C, I wish I could be with your friends and colleagues who are celebrating your very important contributions to the field of organic synthesis. Certainly, you became one of the most innovative masters of chemical architecture. This, obviously, contributes to the pleasure I have in recalling our association at Harvard (many years ago, though it still seems recent). But it is more particularly your personal qualities which combined an enthusiasm for chemistry, which many younger men could well have envied, with remarkable intellectual honesty, as well as your great sensitivity to the feelings of your friends and colleagues that have made the memory of our friendship over the years one I particularly value".

Professor Dutta also utilized his many contacts abroad to obtain scientific data on his sample and scarce chemicals. He used to refer to himself as the chemist with a 'begging bowl' for chemicals. Probably it was this which prompted his close friend Professor Alex Nickon of Johns Hopkins University, USA to comment, "but it was only during our close association in 1970-74 on your NIH grant that I truly appreciated the difficulties under which much of your research had been carried out, as well as your unflinching devotion to your students, to your institution, and to your profession. Before your department had spectrometers, you had to send (and even take), samples all over the world. And rumour has it that your smuggling techniques for scarce chemicals are the envy of professionals in the business".

Professor Dutta established a leading school in organic synthesis in this country and fortyfive students obtained the PhD degree under his guidance and another twenty were associated with him professionally. All of them have successfully established themselves in academy and industry. Some of the more illustrious names in the academic field are Professor U R Ghatak, a synthetic organic chemist and one of his very early collaborators, and who incidently succeeded him on his retirement as Head of the Department, Professor S A Narang of National Research Council, Canada, who subsequently shifted to biochemistry and carved out a niche for himself, Professor J R Mahajan of University of Brazil, Dr S L Mukherjee, Vice-President, INFAR (formerly Organon) India Limited, and Dr P K Ramachandran, Director, Defence Research and Development Establishment, Gwalior.



He married Smt Chhabi Sengupta in 1943, who established herself as a leading microanalyst, having trained in Switzerland, and subsequently organized the microanalytical laboratories of the Indian Association for the Cultivation of Science. They have only one child, a son, Sudhin, who has also shown the same brilliance of mind and aptitude for science. He completed his PhD in chemistry from Harvard University and is at present with Exxon Corporation, USA.

Professor Dutta led a very unostentatious life. His needs were few and he shunned luxury, but never forced his spartan habits on others. Besides looking into the various administrative problems as Head of the Department, he also found time to work with his own hands and prepare starting materials for his students. This was a habit he continued right upto his retirement and his associates very much miss the familiar figure, down to his vests in summertime, carrying out laborious bulk distillations and other experiments. He used to be one of the earliest to come to the laboratory and one of the last to leave, many times after well past 8 pm. Such dedication served as a source of inspiration to all his associates.

After his formal retirement, true to his incessantly active habits, he took up a project for chemical transformation of quinine to quinidine sponsored by the Government of West Bengal and was involved with this till his death. Even though he completed the task successfully he did not live to see the setting up of a pilot plant on his process.

After his son left abroad, his wife also soon joined him. But Professor Dutta steadfastly refused to leave his country and during his last years was looked after by his spinster sister Smt Leena Dutta, who is a Government Marriage Registrar. Smt Dutta, along with another sister Smt Binapani Deb, who is a teacher in Victoria Institute, Calcutta, had been actively involved in the freedom struggle and also suffered imprisonment. These services have been recognised by Government of India and they are worthy recipients of the Freedom fighter's pension. The high noon over, the strains of the years took their toll and Professor Dutta was rendered weak, and yearned for filial company which eluded him. He grew progressively pensive and weak and was bed-ridden briefly till the end came on June 13, 1983. Many of the present staff of the Department of Organic Chemistry, Indian Association for the Cultivation of Science, who were his associates and continue on his great tradition, bear living monument to his dedication and contributions.

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R V VENKATESWARAN
U R GHATAK



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