Professor Bawa Kartar Singh: A pioneer in stereochemistry in India

H. S. Virk

When the British annexed Punjab in 1849, there was no degree college to teach European science in Punjab. Teaching of science started during the late 1870s when Government College, Lahore was established which became the nucleus of the Punjab University. In the beginning of 20th century, Punjab University, Lahore could boast of better educational facilities in science than Delhi, the future capital of India and its Chemistry department became a nucleus of research activity with stalwarts like Ruchi Ram Sahni, Bawa Kartar Singh and S. S. Bhatnagar on its faculty.

Bawa Kartar Singh was born on 17 April 1886 at Verowal, district Amritsar of the Punjab. He passed the entrance examination of the Calcutta University in 1903, standing seventh in the order of merit. He proceeded to England in 1904 for higher studies at the Downing College of the Cambridge University where he distinguished himself as a Prizeman of the College in 1905 and obtained Tripos in Natural Sciences in 1906. He continued his post-graduate studies in the University of Cambridge and London. He was awarded Sc.D. degree by the Dublin University in 1921 for his researches in stereochemistry. Cambridge University also awarded him a Sc.D. degree in 1941 for his outstanding research work.

He returned to India and joined as Professor of Chemistry at the Govt College, Dacca in 1910. Here he came in contact with E. R. Watson, the reputed dye chemist of India and was also inspired by the work of P. C. Ray, the doyen of Indian chemists. He left Dacca College in 1918 to join the Govt College, Lahore, as Head of the Department of Chemistry. He created an atmosphere of active research in his department by his ardent zeal and perseverance. In 1921, he was appointed in the Indian Education Service (I.E.S.) and was posted at the Govt College, Patna (now Patna University). Soon he was transferred to the Ravenshaw College, Cuttack where he worked as Head of the Department of Chemistry till 1936. In spite of the meagre facilities for research in the college, he carried on his researches and published a good number of papers in scientific journals of repute in India and abroad.

During 1925–26, Bawa went to England and France on study leave and worked in the Universities of Cambridge, St. Andrews, and Paris. Then, he attracted the attention of the scientific world to his brilliant research on the stereochemistry of camphor compounds. In 1936, he returned to Patna and joined as Head of the Chemistry department in Science College (under Patna University) and as the Chemical Adviser to the Govt of Bihar. After his retirement from Govt service in 1940, he joined as the Professor and Head of the Department of Chemistry

at Allahabad University. In 1946, he was appointed an Emeritus Professor by the same University. After partition of India, he shifted to Varanasi and worked in BHU from 1948 to 1960 in an honorary capacity. He suffered an attack of paralysis at the age of 74 and breathed his last on 16 June 1960 at Chandigarh.

Scientific achievements

B. K. Singh was a pioneer in the field of stereochemistry in India. He prepared several compounds containing an asymmetric nitrogen atom and brought out the relation between optical activity and chemical constitution of compounds. While studying the valency of two directly linked nitrogen atoms, he worked out a new method for the preparation of tertiary amines. Later, he found out several additive compounds of thiocarbamide with azonium iodide and also studied the optical rotatory power of substituted quaternary azonium compounds in solution.

The international scientific community was attracted to Bawa's brilliant research on stereochemistry of camphor compounds. He started this work by studying the position isomerism and optical activity in naphthylimino camphors and derivatives of phenylimino camphors. It was followed by the study of the effect of position isomerism and conjugation on the optical activity among aryl derivatives of amino and bisimino camphors. He next took up the study of the structure and kinetics of mutarotation of stereoisomeric oxymethylene camphors and studied the rotatory dispersion of camphor carboxylic acids and borneols. It was noticed that the rotatory power in polar and non-polar solvents was markedly different and it is a function of the dielectric constant. He wanted to establish some rule by which the optical rotation of an organic substance could be calculated once its constitution was known or vice-versa but he did not succeed.

Bawa was deeply interested in the nature of optically active forms. He studied several physical properties of the dextro and laevo forms with a view to experimentally examining the validity of Pasteur's principle of molecular dissymmetry. Raman spectra of the dextro and laevo borneol did not reveal anything which was in contradiction to Pasteur's views. He found that physical properties such as density, viscosity, refractivity and even magnetic susceptibility did not show any differences beyond experimental error.

He focused his research on the nature of racemic modification. Active isomers exhibit varying degree of stability and by suitable treatment, most of them, can ultimately be converted into inactive racemic modification which contains 50% of the dextro and 50% of the laevo form. Bawa and his students developed a biochemical method to distinguish between a racemic mixture and a racemic compound. He studied the relation between chemical constitution and ultraviolet absorption spectra of optically active and racemic compounds. He also studied the

correlation of the absorption maxima and characteristic wavelength.

Bawa Kartar Singh published more than 150 research papers in journals like *Nature*, *Journal of the Chemical Society (England)*, *Journal of Indian Chemical Society*, *Proc. Indian Academy of Sciences*, *Proc. Lahore Phil. Society* and *Journal Scientific and Industrial Research of CSIR*. He delivered popular science lectures on stereochemistry, Walden inversion and the doctrine of symmetry in chemistry at the meetings of the Lahore Philosophical Society and the Indian Science Congress Association. He co-authored a book *Optical Activity and Chemical Constitution* with O. N. Perti.

I recall an interesting episode from the life of Bawa Kartar Singh. He had no research facility when he joined as Head of the Chemistry department in Ravenshaw College, Cuttack. It so happened that Mahanth of Emar Math, Puri came to visit Ravenshaw College and Bawa took him to his laboratory. He told the Mahanth that he could not complete his experiments as he did not have a polarimeter. The Mahanth of Puri was so impressed by the spiritual aura of his personality that he donated an amount which enabled him to buy a polarimeter for his laboratory.

Bawa is considered as father of stereochemistry in India. He was a dedicated teacher and researcher. I gather from his family sources that he was one of the members of an enquiry committee constituted by the British Govt of India to probe some fictitious charges against C. V. Raman. Bawa was an admirer and a friend of Raman. Naturally, he gave his opinion in favour of Raman. A photograph of Bawa with Raman in Bangalore on this occasion is a prize possession of the Bawa family.

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