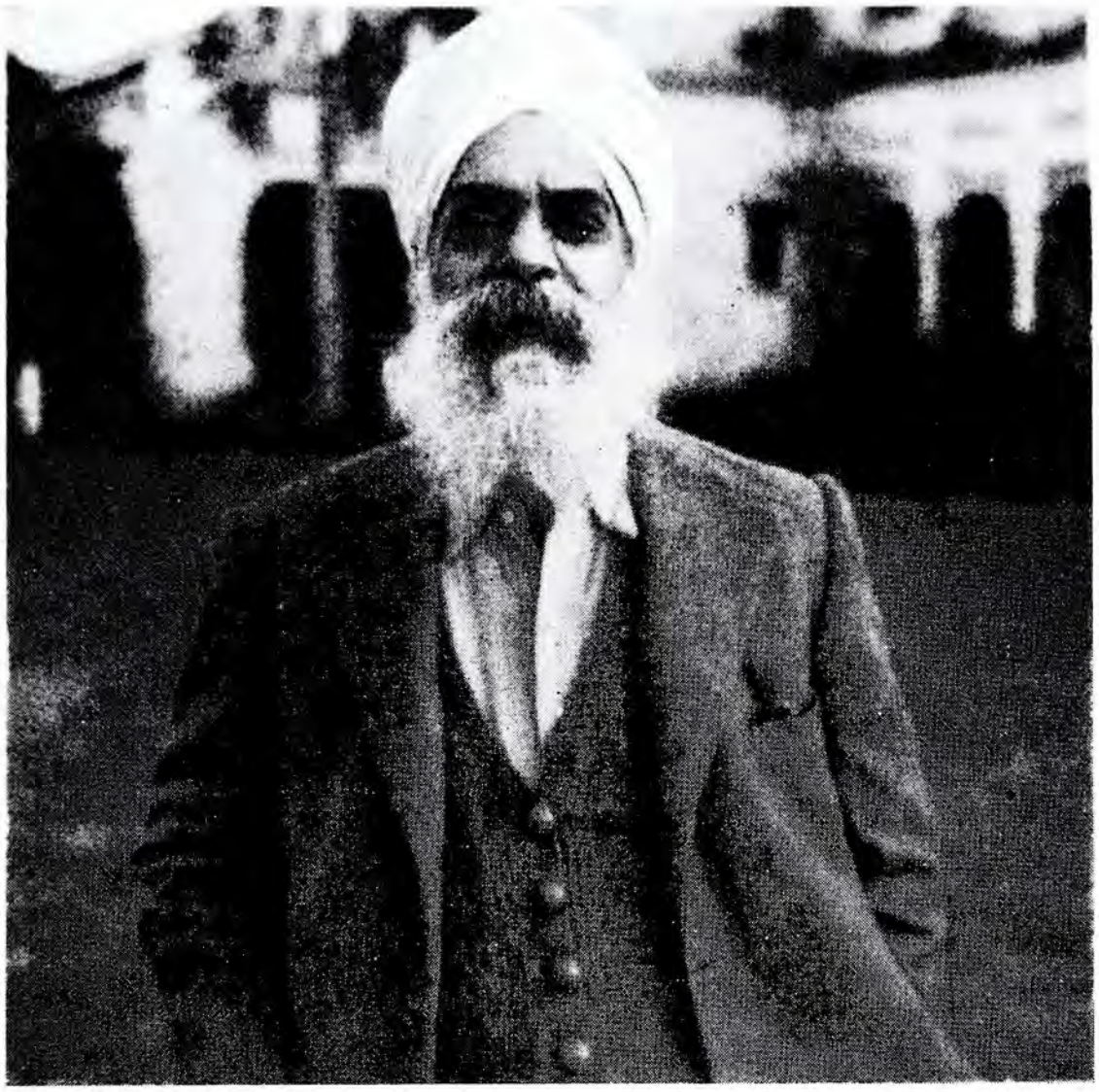

Bikram Kanwar Singh

BAWA KARTAR SINGH

1886-1960

Foundation Fellow 1935

BAWA KARTAR SINGH was born on April 17, 1886 in the Amritsar District of the Punjab, and died on June 15, 1960.

Bawa Jiwan Singh, his father, was a member of the Indian Medical Service. Bawa Kartar Singh joined the D.A.V. School, Lahore, but could not continue there long since his father was transferred to Burma. He continued his early education in Collegiate School, Rangoon, and passed the Entrance Examination of the Calcutta University in 1903. In 1904 he proceeded to England and joined Downing College, Cambridge. After obtaining his Tripos in Natural Science from there in 1906, he continued his studies in London and Cambridge till 1910. On returning to India in the same year he joined the Dacca Government College as Professor of Chemistry. Dr. E. R. Watson, an enthusiastic research worker, was the head of the chemistry department then. Bawa Kartar Singh was very much influenced by Dr. Watson. No less was the influence of Sir P. C. Ray with whom he came in contact at this time. An enthusiastic research worker himself, Bawa Kartar Singh could not escape being inspired by the work of Sir P. C. Ray.

He left Dacca college in 1918 to join Government College, Lahore, as the Head of Department of Chemistry. He continued his research there, but before long he joined the Indian Educational Service in 1921 and was posted as Professor of Chemistry at the Patna College. After a few months he was transferred to the Ravenshaw College, Cuttack, which had only B. Sc. courses at that time. It goes to the credit of Bawa Kartar Singh to start research work there within a short time. He was in need of an accurate Polarimeter for his research work. It so happened that the Mahanth of Emar Math, one of the leading Mahanths of Puri, visited Revenshaw College. Bawa Kartar Singh took him for a round in the laboratory and showed him his experiments which, he told, could be completed only with the help of a Polarimeter. Mahanth of Emar Math donated an amount which enabled him to buy a Polarimeter. He took full advantage of the Polarimeter and published a large number of papers with his co-workers.

In 1936 he came to the Science College, Patna, as Head of the Chemistry Department. He was concurrently working as a Chemical Adviser to the Government of Bihar. The College had no facilities for his work on Optical Rotation, but Mr. Singh was very keen to carry on his research. He persuaded the Director of Public Instruction to lend him the apparatus at Cuttack for his use at Patna. In 1940, he was appointed as Professor of Chemistry at the

Allahabad University. He could have stayed at Patna till 1942 but he retired in 1940 to join the Allahabad University as Professor. On retirement from Allahabad in 1946, he was appointed as Emeritus Professor in the University. Dr. Singh went to settle in Lahore and carry on research in the Punjab University (of the unpartitioned India). He was appointed Honorary Professor of Chemistry and an Associate Director of the Punjab Institute of Chemistry. Meanwhile, India was partitioned. Dr. Singh had to leave Lahore with a very sad heart. He moved to Banaras Hindu University in 1948 which offered him facilities for research. He worked in an honorary capacity at the Banaras Hindu University till March, 1960. He shifted to Chandigarh in 1960 with the idea to carry on research in the new laboratories at Chandigarh.

Distinction and Honours

A devotion like his was bound to have its rewards. The first appreciation of Kartar Singh's researches came when he was elected as President of the Chemistry Section of the Indian Science Congress in 1920. Soon after, he was awarded the Sc.D. Degree of the Dublin University on the basis of his published work. He was awarded Sc.D. of Cambridge in 1941 on the basis of his contributions to the advancement of science.

He was Founder Fellow of the Indian Chemical Society. He was a Member of its Council for a number of years. He was Honorary Editor of the Journal of the Indian Chemical Society for some years. He served the Society as its Vice-President and President. He was the Vice-President of the Indian Academy of Sciences from 1934 to 1938 and Vice-President of the National Institute of Sciences of India for two terms. He was Foreign Secretary of the National Academy of Sciences during 1944-1946.

Contribution to Science

Bawa Kartar Singh's research was mostly in the field of stereo-chemistry. He prepared and resolved several substituted azonium compounds containing an asymmetric nitrogen atom. 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. The optical rotatory power of substituted quaternary azonium compounds in solution was studied by him.

Through a series of papers, he brought out the relation between optical activity and chemical constitution of different types of compounds. The optically active compounds studied by him were derivatives of the natural dextro, camphor and laevo camphor. He started this work by studying 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 optical activity among aryl derivatives of amino and bisimino camphors. This work was later extended

by studying several derivatives of imino, amino and bisimino camphors. He studied the rotatory dispersion of (+) camphor-benzylimide, benzy (+) camphoramic acid and their derivatives. The work was also extended later by studying several derivatives of (+)-camphorimide and (+)-camphoramic acid. He next took up the study of the structure and kinetics of mutarotation of stereoisomeric oxymethylene camphors. It was found by him that though oxymethylene camphor undergoes mutarotation due to change of form, the amino derivatives of oxymethylene camphor do not exhibit this change. He condensed several amines with optically active oxymethylene camphor and studied the rotatory power of these compounds. He studied the rotatory dispersion of camphor carboxylic acids, camphors and borneols. Using active camphor β-sulphonyl group, he prepared and studied the rotatory power of several of its aryl derivatives. He studied the kinetics of conversion of +Camphor β-Sulphonamide to +Camphor β-Sulphonanhydramide and found it to be monomolecular. In all these studies, he repeatedly emphasised that comparison of rotatory power should be made only under similar conditions of temperature, concentration, solvent and between compounds having similar dispersion. All the compounds examined by him were solids and their rotatory power was studied in acqueous and/or non-acqueous solvents. Frequently it was noticed that the higher the dielectric constant of the solvent, the lower was the rotatory power observed in it, but, sometimes, converse of this was also noticed. In general, the rotatory power in polar and non-polar solvents was found to be markedly different. In these studies, he found that substituent group has an effect on rotatory power, but he could not find any definite relationship between substituent group and the change produced in rotatory power. He was keen on finding out some rule by which the optical rotation of an organic substance could be calculated once its constitution was known. Obviously, if the rule could have been worked out, constitution also could have been found out to some extent by measurement of optical rotation. He did not succeed in finding out the exact laws governing optical rotation but he could accumulate a vast mass of data which will help those who work on elucidating the laws governing Optical Rotation.

He was deeply interested in the nature of optically active forms. According to Pasteur's principle of molecular dissymmetry, the dextro and laevo forms must possess the same energy and should, therefore, exhibit the same scalar properties and the same magnitude of vectorial properties. On the basis of Wave Mechanics (Temple, *Trans. Farad. Soc.*, 26, 278) he suggested that the dextro and laevo forms of a compound differ in energy and rotatory power. Bawa Kartar Singh and his students studied several physical properties of the dextro and laevo forms with a view to experimentally examine the validity of Pasteur's principle of Molecular Dissymmetry and clear the doubt which had been expressed by Temple on the basis of wave mechanics. He and his students found that the physical properties such as density, viscosity and refractivity of enantiomorphic forms of isonitrosocamphors (stable and unstable forms), camphor, camphoric acid, camphoric anhydride, cam-

phorquinone and sodium camphorate did not show any differences beyond experimental error. Raman Spectra of the dextro and laevo borneol did not reveal anything which was in contradiction to Pasteur's views. The magnetic susceptibility measurements of dextro and laevo forms of camphor, borneol and camphorquinone did not show any difference. Similar results were found in the case of camphoric acid, camphoric anhydride and camphor β-sulphonic acid and a number of other compounds. In the case of physical properties of enantiomorphs, he found that slight differences in physical property wherever noticed, were well within the limits of experimental error or else were due to slight impurity.

The nature of racemic modification also attracted his attention. 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 (+) form and 50% of the (−) form. This inactive racemic modification may exist in three forms in the solid state, namely, a mixture, a compound or a solid solution (psuedo racemic mixed crystals) of the active forms. The problem of distinguishing these three forms was first discussed systematically by Roozeboom from the standpoint of phase rule. Roozeboom discussed theoretically two methods to distinguish the three types of racemic modification, viz., the freezing-point method and solubility method. Bawa Kartar Singh and co-workers used both these methods in studying several cases of racemic modifications. They studied the melting point composition curve of racemic and active modifications of a number of compounds. In all cases, they found that the racemic modification is a true compound at the temperature of fusion and is fairly stable in most cases. On the basis of different physiological action of optically active isomers and racemic forms, Bawa Kartar Singh and his students developed a biochemical method to distinguish between a racemic mixture and a racemic compound.

In 1957, Bawa Kartar Singh took up studies on the relation between chemical constitution and ultraviolet absorption spectra of optically active and racemic compounds. He studied the correlation of absorption maxima and 'characteristic' wavelengths. He found that direct absorption measurements give more than one absorption maximum for each compound. The 'characteristic' wavelength is almost identical with one of these absorption bands.

His research activities were not solely confined to stereochemical and related problems. He studied condensation products of deoxybenzoin with aromatic aldehydes, determination of sucrose by double viscosity method and carried out chemical examination of the fruit and kernel of Palmyra Palm. While at Allahabad University during 1940-'46, he devoted himself also to the study of seed fats and oils, the composition of fatty-acids and glyceride structure in fixed oils. In these studies, he was very much interested in the component fatty-acids and glyceride structure of the oils. He discussed optical activity and structural patterns of the glycerides in natural fats and oils.

Major portions of his research career was directed at optical activity in organic compounds and related topics. He talked about them whenever he

had an opportunity. In 1920 he addressed the Lahore Philosophical Society on "Walden Inversion" and the same year, his Presidential Address to the Chemistry Section of the Indian Science Congress dealt with *Recent Advances in Stereochemistry*. During 1925-1926, he visited Paris and utilised his time there in studying the rotatory dispersion of nicotine. His Presidential Address to the Indian Chemical Society in 1931 dealt with *The Early Development of Stereochemistry and Pasture's Law* and in 1933, he spoke on *Science of Optics in the Service of Chemistry*. He contributed two articles to the Acharya Sir P. C. Ray Commemoration Volume—*Report on the Progress of Stereochemistry in India* and *The Doctrine of Symmetry in Chemistry and its Significance in Molecular Configuration*.

He had over hundred and fifty published papers to his credit. His devotion to research was very uncommon. He also published a book entitled "Optical Activity and Chemical Constitution" under joint authorship with O. N. Perti.

Social Virtues, Ideas and Outlook

He married Shrimati Kunti Singh who is an accomplished lady. Though he lived till 1960, his health became bad right from thirties. Mrs. Singh looked after him with rare care and devotion. To his long and useful life, Mrs. Singh had a great contribution. He was a very affectionate father to his three children—one son and two daughters.

He hailed from a highly religious family. The third Guru of the Sikhs was one of his ancestors. He himself was a devout Sikh. He studied *Granth Saheb* every day. He was very liberal in his outlook. Though a staunch Sikh, he had respect for other religions and never said a word against any religion. He was very social. He enjoyed the company of friends and mixed with all classes of people. The country lost one of its devoted scientists in his death.

Acknowledgement

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BALBHADRA PRASAD

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