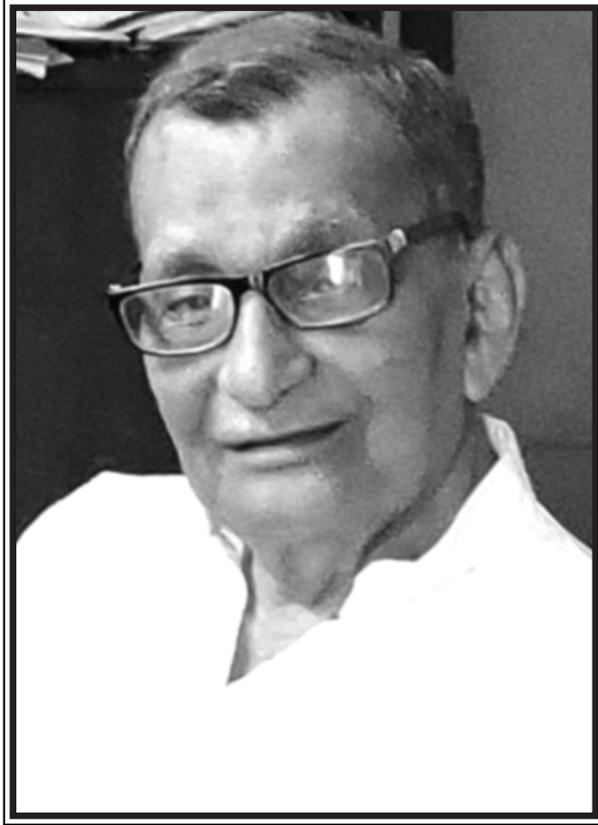


ARUN KUMAR SHARMA
(31 December 1924 - 06 July 2017)



Amma

ARUN KUMAR SHARMA **(1924 - 2017)**

Elected Fellow 1970

ARUN KUMAR SHARMA, an internationally acclaimed cytogeneticist and cytotaxonomist, passed away on July 6th, 2017, in Kolkata. He was living at the Ramakrishna Mission Institute of Culture, Golpark, since 2014 after his wife Archana Sharma's demise in 2008. His passing is a great loss to the scientific community in India especially because he was a great visionary. An excellent geneticist, he made seminal contributions and worked tirelessly to improve plant science teaching and research in the country. He was truly an ideal GURU who inspired many and made lasting contributions to science, cytogenetics in particular. Yet, most of all he will be remembered for his utter simplicity and humility despite his extraordinary scholarship and contributions.

Since 1943, till his demise, he had been associated with the Department of Botany, University of Calcutta first as a post graduate student, then a part time researcher and teacher, Assistant Lecturer, Lecturer, Reader, Professor, Sir Rashbehari Ghosh Professor, Head of the Department of Botany, INSA Golden Jubilee Professor and the founder Programme Coordinator of UGC-CAS in Cell and Chromosome Research, Department of Botany, CU.

FAMILY BACKGROUND AND EARLY EDUCATION

Arun Kumar Sharma was born on the December 31st, 1924 in the then Calcutta to Charu Chandra and Shovamoyee Sharma. They were part of a joint family who lived in a road called Madhab Lane off Lansdowne Road in Bhowanipore, an old and large locality of South Calcutta. Charu Chandra was the eldest of four brothers and two sisters, whereas Shovamoyee was a young housewife. The parental original home of the Sharmas was at Nirolegram under Ketugram Thana of Burdwan district. Arun was the only son of his parents growing up in a large joint family with cousin brothers and sisters.

Charu Chandra was a practitioner of Ayurvedic medicine and had his own clinics both in South and North Calcutta. The lineage could be traced back to Charu Chandra Sharma's maternal family - Charuchandra's maternal uncle (mama) was Pandit Mahamahopadhaya Kaviraj Gananath Sen and the family learnt Kaviraji from him.

Losing his father at the tender age of 8 years was a huge setback for Arun and the family went into acute financial distress as a result. Young Arun was thereafter brought up by his mother at his maternal grandparents' house at Rupnarayan Nandan Lane located in a different part of the same locality of Bhowanipore. From his very childhood, frugality became the essence of his life as it was difficult for the family to make two ends meet. Often when in dire straits, the adolescent Arun had to literally run to his maternal uncle to borrow a few annas (the lower denomination currency in the pre-decimal days) to see through the day. The frugality and the value of money which he thus learnt the hard way never deserted him for the rest of his life even as he strode the world of science like a colossus until the end of his life.

His early schooling was at Mitra Institution, Bhowanipur (1933-1939), a school in the neighbourhood where he lived, which was renowned for the quality of education imparted. Academics came to him naturally from his schooldays but along with that came humility and a genial nature which have been the hallmark of the man as we have known him all his life. Not for a day did his exalted status in academia come in the way of humaneness, of which he was a shining example.

Arun (Bubla) never really got the company of his father but he must have been hugely influenced by his father being a practitioner of Ayurveda and his consequent knowledge of plants. He was also close to Ayurvedacharya Gananath Sen, who is regarded as a pathfinder in the field of medicinal plants. Plants thus became the first love of his life. Arun frequently visited residence of Gananath Sen at Kalpataru building, Maniktala (North Calcutta) to meet him. He was very close to Gananath Sen's grandson, Dhruba (Dr. Dhruba Sen). Dhruba's mother often invited Arun's mother to Kalpataru, so that young Arun and Dhruba could spend their formative years together.

Arun (Bubla) studied in Ashutosh College (1939-1941), located near his house in Bhowanipore, unable to afford to study in Presidency College those days. As he recalled "I couldn't have spent money on bus fares every day to College Street and so chose to get admitted to a college close to my residence". He secured B.Sc. (1943) and M.Sc. (1945, First Class First) degrees in Botany from University of Calcutta.

The most outstanding trait in Bubla was the unflinching love which he had for his mother who had given her all to bring him up single-handedly from the age of 8. Such was his devotion to his mother that he would never go to sleep at night till she came in late after finishing all her domestic chores. Even at the fag end of his own life, not a day passed without him recalling her sacrifices and wishing that she were with him. He treasured her photograph throughout journey of his life. For all those who were near him during his last days, his recollections of his mother were indeed touching moments.

Arun married Archana Mookerjea. The invitation card of the event is in Bengali preserved and kindly shared by his cousin. It records that the event took place on 24th Baisakh, 1362 (Bengali year) at 7.30 pm at 81 Lansdowne Road, Kolkata. The invitation was sent by Arun's uncle, Sri Subodh Chandra Sharma. Archana Mookerjea had initially joined as Research Scholar under guidance of Professor P.C. Sarbadhikari, the then Sir Rashbehari Ghosh Professor in Botany at the University of Calcutta. After marriage, the couple shifted with his mother to a 2-room rented apartment at Ballygunge Place. The familiar feature of Professors A.K. Sharma and Archana Sharma reaching Ballygunge Science College in a Rickshaw every day reflected their simplicity despite their prestigious status. Although the couple had no children of their own, Archana was very close to her sister Dr. Geeta Talukder, in bringing up the latter's daughter Babi (Dr. Kana Talukder, IFS). A relative recalls Arun would often come back from Science College at Ballygunge Circular Road and would be seen by neighbours going around Ballygunge Place carrying little Babi on his shoulder, the child enjoying the ride!

A cousin who used to remain in touch recalls Professor Sharma was held in utmost regard by the family for being a bright star who shone through his achievements. From time to time to time, their hearts would be gladdened by the news of their dear Bubla being honoured with prestigious awards such as the Shanti Swarup Bhatnagar Award and recognitions such as the General Presidentship of the Science Congress. It was sheer joy for the elders and the younger members alike to see his name in the press the following day. The zenith of his success, which the family celebrated, was the conferring of the Padma Bhushan on him. The thought that a family member would actually go to the imposing Rashtrapati Bhavan to receive the award from the first citizen of the nation was a matter of immense joy. When the book 'Chromosome Techniques' jointly authored by the couple was published abroad, the family members looked at the immaculately hard bound copy in awe. But Professor Arun Kumar Sharma's highly elevated academic status never overshadowed his affable nature and he always remained very close to the extended family, feet firmly rooted to the ground. He had time for everybody and a solution or at least a suggestion for any problem posed to him. The secret of this was his immense patience and almost Gautama Buddha-like coolness. The philosopher in him always seemed to suggest: "come good or bad, accept truth as it unfolds in your life".

And the child in him was filled with joy by watching the children around him. Every day on his way to work he would keenly notice the antics of children on their way to school, playfully nudging each other or quarrelling over trivia and derive immense joy out of the sight. Nothing better can describe the happiness on his face when he observed children than the following lines from the Nobel-acceptance speech of Rabindranath Tagore: "The vigour and the joy of the children, their chats and songs filled the air with a spirit of delight, which I drank in every day. And in

the evening during the sunset hour, I often used to sit alone watching the trees of the shadowing avenue and I could hear distinctly the voices of the children coming up in the air, and it seemed to me that these shouts and songs and glad voices were like those trees which come out from the heart of the earth like fountains of life towards the bosom of the infinite sky".

Freedom was the most cherished value in Professor Sharma's life and he never believed in tying down anyone. Anybody who had gone to his unostentatious flat in Meghamallar Apartments near Golpark in Kolkata would remember that an integral part of the family besides his mother and wife Archana, was Lal Singh, the parrot who was kept uncaged and unbound and flew around the house as if enjoying every moment of his independence. He used to greet the master back from work every evening and engage in conversation which only the two of them could understand. Such was their love for each other that the bird, which flew out one day probably in search of freedom, actually found its way back "home" into the safe arms of his master after a few days.

Arun's uncle's son Bimal Kumar Sharma maintained his relationship with Arun for over four decades. Bimal (a Surveyor at GIC) had very informal relations with Arun, visiting his "Jethima" (Arun's mother) during Durga Puja at their Madhab Lane residence. In Bimal's words, "Bublada was very polite and down to earth always". When his wife Archana expired, on 14th January, 2008 around 9.15 p.m. Arun called Bimal and asked him to come over the next morning. Though Bimal pleaded that he could come over immediately, Arun would not agree. He spent the night alone yet disciplined in his grief, having lost his wife with whom he had spent 53 years of blissful life.

No commentary on the man Arun Kumar Sharma would be complete without a mention of his deep-rooted faith in the Almighty. An ardent but quiet devotee of Shri Ramakrishna Paramahansa and Ma Sarada, every conversation would end with him reminding the other person that the Almighty is omnipresent and will take care of the smallest of our needs and we should not stray from our path. This is the essence of "sharanagati" where one surrenders completely at His feet. His practising of science did not end in mere research; it went much beyond in search of the Ultimate Truth.

PROFESSIONAL CAREER

After his post-graduation in 1945 from University of Calcutta, Arun joined the Botanical Survey of India. He was selected by the Public Service Commission Examination at that time and was among the five botanists selected for the development of the Herbarium and Garden of the Royal Botanical Garden (BSI) at Shibpur, Howrah, Kolkata. During his short tenure at BSI, he had to undertake extensive field work in taxonomy all over India. In spite of his work load at BSI, he

continued to be attached to the laboratory of his mentor Professor P.N. Bhaduri, a renowned cytogeneticist, in the Department of Botany, University of Calcutta, working through evenings till late in the night. Although he loved and enjoyed his work at BSI, he soon realized it would not be possible to pursue his research career if he continued with his job. Professor P.N. Bhaduri, Professor P.C. Sarbadhikari and other teachers of the Botany Department at that time were highly impressed by his passion and dedication for chromosome research and Arun was inducted as a temporary teacher in 1947. He joined the Department of Botany as Assistant Lecturer in 1948. Beginning his postgraduate research project under his mentor Professor Bhaduri instilled in him a passion for plant cytogenetics. Professor Bhaduri soon left the Department of Botany to join Indian Agricultural Research Institute (IARI), New Delhi and young Lecturer Sri A.K. Sharma was in charge of the cytogenetics laboratory of the Department of Botany. He continued teaching and research for completion of his thesis and was awarded Doctorate in Science (D.Sc.), of the University of Calcutta in 1955. In between, he served as a Lecturer (since 1952) in the Department of Botany, CU.

To get a picture of the academic ambience of the Botany department in the 1940's, I shall refer to the "Time table for the postgraduate classes in Botany to be effective from 5th September 1949" signed by S.N. Mitra, the then Secretary, of CU dated 02.09.1949, neatly preserved by Professor A.K. Sharma under a thick glass sheet of his writing table in his room in the Department of Botany. I sought his permission to photocopy the Time Table which is now displayed in the office room of the Head of the Department of Botany. Classes in Botany were taught by some very eminent botanists. In the classes scheduled for 5th Year postgraduate students, Professor J. Sen taught palaeobotany and gymnosperms, and Professor Sarbadhikari taught cytology. Practicals on "microtechnique" were taken jointly by Professor Sarbadhikari and Sri A.K. Sharma, who also taught bryophytes on Saturdays to 5th year students. The curriculum in the sixth year has five special papers. The special paper on cytogenetics was taught jointly by Professor Sarbadhikari and Sri A.K. Sharma. The class load during that period for the young Lecturer was obviously heavy. Despite that, his research output during that period reflected his tenacity, intellectual ability and utter dedication. An excellent teacher, he taught for decades several disciplines of Botany including classical and molecular genetics. Since I joined the Department as a postgraduate student in 1973, I noticed, inspite of his very busy schedule in the Department and other engagements at the National level, he rarely missed any of his scheduled classes. He was unable to conduct practical classes at that time, but took keen interest in formulating a detail curriculum in cytogenetics and ensured that other members of the faculty looked after the students' requirements with great care.

As a Reader in Botany (since 1962), he was guiding the research of Ph.D. and D.Sc. students-altogether 20 students were admitted to Ph.D. and D.Sc. degrees

under Dr. A.K. Sharma and 30 scholars were working under his guidance in 1966. During these early years of his career, he and his associates had already published around 200 original articles in National and International Journals. He authored a standard text cum reference book, "Chromosome Techniques- Theory and Practice (460 pages) published by Butterworths (London) in 1965, jointly with Dr. Archana Sharma. He was the founder and chief editor of 'The Nucleus'-an International Journal of Cytology and allied topics at the young age of 34, (inaugurated in Montreal, 1958, during International Congress of Genetics) in which the editorial board was composed of outstanding scientists from all over the world during that period.

His students who were appointed later as members of the faculty, recall the days in 1960s, when Dr. A.K. Sharma was one of the youngest members among eminent scientists teaching during those days in the Department. He used to share a table in his room with Dr. Archana Sharma. The room was equipped with microscopes on all sides whereas the centre table was filled with theses, books, reprints, journals, documents and students' practical note books. Over dozens of senior and junior research scholars, part time teachers from colleges, used to work all the day through. They stayed long hours in the evening, and for the Sharmas, the laboratory was their home and research scholars were nurtured like children. The present building at 35, Ballygunge Circular Road was soon ready and Dr. Archana Sharma took the responsibility of shifting the entire Cytogenetics laboratory to its new room in the Western Wing on the 2nd Floor of the Department. The Sharmas shared the laboratory till 1979, when the Eastern Wing was constructed with the financial support of the UGC (University Grants Commission). All the junior and senior scholars under all faculty members shared the laboratories, and everybody was supposed to know each other's work. It was the largest "cytogenetics family" of research scholars, part time teachers, teacher-fellows, faculty members who met each Friday for the weekly Seminar. Numerous visitors and dignitaries from abroad and all over India visited the small cytogenetics laboratory of Professor Sharma from 1960s to late 1970s, till he had his own room in the Department and separate laboratories.

For the monumental work on plant cytogenetics, Professor Sharma along with research scholars would go to different regions of Eastern Himalayas for the collection of plant materials. The research scholars who later became members of the faculty still remember the warmth and the positive vibes of the association with their teacher. For others getting a glimpse of the awesome personalities at close quarters was an event to cherish. The Sharmas also enjoyed the tours as much as their students.

One of his student who later joined the CAS as member of the faculty, Professor Satyesh Chandra Roy, recalls his experiences of field excursions with his teacher in

different regions of Eastern Himalayas including Sandakphu (~12,800 ft.) and Phalut (~11,400 ft.) for the collection of medicinal plants under the US PL 480 Research Project (1965-1970). Professor Sharma and his team developed a new method of pretreatment of root-tips collected in the field for the analysis of karyotypes of these important and rare plants (as these plants were difficult to grow in Calcutta). He never used any woolen cap even in the early morning in Sandakphu (4 °C with cold winds) to watch sunrise and snow peaks which was very difficult for others in the team. Professor Sharma along with Professor Archana Sharma and some members of his team could trek at high altitudes for five days at a stretch with untiring energy starting from Batasia to Palmajua, Rimbik, Ramam, Phalut and Sandakphu for the collection and processing of important collected materials. His students during that period fondly remember how he enjoyed with all the team members playing light games in the evening. One such adventurous excursion, Professor Roy remembers, was to the Western Himalayas up to the altitude of 15,000 feet (Hemkund) on foot through glacier of about 1 km with a lot of experience with his supervisor.

Although he was incredibly active at the national level, Professor Sharma took great interest in the curriculum, teaching and as well as research guidance in the Department of Botany. He served as Professor, Head of the Department and Sir Rashbehari Ghosh Professor in Botany (1969-1988), as INSA Golden Jubilee Research Professor (1985-1990), simultaneously as the Programme Coordinator of CAS in Cell and Chromosome Research from 1972 till his retirement from university service in 1990, continuing his association with the Department of Botany as an honorary professor till the last day.

After taking charge of the department as Head in 1969 (up to 1980), he brought significant academic changes in the curriculum through the University. Under his leadership, the 5-Semester, 2-year postgraduate course was introduced in Botany by University of Calcutta in 1971, and the Department was recognized by UGC under Special Assistance Programme in Botany in 1972. During this period, presenting (December 27, 1976) the report to advisory committee members Professor V.L. Chopra (Director, IARI, New Delhi), Professor H.Y. Mohan Ram (Delhi University) and Dr. D. Shankaranarayan, (Joint Secretary, UGC), Professor A.K. Sharma highlighted the involvement of his group on multipronged approach to chromosome studies involving metabolism, differentiation, evolution, mutagenicity and the improvement of yield and quality of valuable species, refinements in methodology as well as cytological and biochemical analysis of genetic variability/polymorphism. Dr. Shankaranarayan appreciated the activities towards the modernization of teaching courses and examination system on which the Department had taken a lead in the University.

Opening of the Tissue Culture Unit: During this period, Dr. G.C. Mitra, who had earlier served at the University of Delhi and then moved on to National

Botanical Research Institute (NBRI), Lucknow had retired and came to settle in Calcutta. Professor Sharma requested him to establish a plant tissue culture unit under the Special Assistance Programme of UGC in the Department of Botany as he knew he needed an expert in the area of plant tissue culture which was beginning to be recognized an important thrust area of research in plant science laboratories all over the country in the 1980s. Dr. G.C. Mitra then joined the Department as ICAR Emeritus Scientist. Thus the foundation of the plant tissue culture unit was laid in the garden of the Department of Botany. It was formally opened by the then Vice-Chancellor of Calcutta University Professor S.K. Mukherjee on 27th December 1976. Dr. G.C. Mitra continued his own research on excised root culture of *Atropa belladonna* in this laboratory, helping research scholars working in the tissue culture laboratory for over a decade after his retirement.

Having attended many international meetings early in his career, Professor Sharma wanted research scholars working with him to gain the valuable learning experience of attending and organizing scientific meetings. It was by no means an easy task. In 1968, he organized an International Seminar on "Chromosome- its structure and function", jointly with Dr. Archana Sharma and Dr. Amiya Kumar Sarkar at the Vivekananda Hall of RK Mission Institute of Culture, Kolkata. Many eminent scientists from all over India and abroad dealing with higher organisms were invited as speakers in the event. The Proceedings of this seminar were published in a supplementary Volume (1968) of the journal *The Nucleus*.

Along with teaching and research activities, AKS periodically organized regular workshops, International and National Seminars and Colloquia, on several aspects of chromosome research for the benefit of teachers and researchers. For example (i) a regional conference on teaching of Life Sciences (1972) sponsored by the University Grants Commission (UGC); (ii) Summer Institute on "Chromosome methodology" (1973) sponsored by the UGC; (iii) National Symposium on "Effects of physical and chemical agents on chromosomes" sponsored by INSA and UGC (1974) and (iv) International Symposium on "Chromosomes in Evolution" sponsored by the UGC (1976). During the two vacations each year, Professor Sharma organized short term training courses on chromosome research for the teachers from various universities and colleges of the country.

Professor Sharma tirelessly continued his efforts for developing links with well-established laboratories abroad with the Department of Botany in his University, having visited some of the premier Institutes in Plant Sciences in Europe. The Indo-British University Collaboration programme proposed by him was accepted by the British Council and UGC between the Special Assistance Centre of Chromosome Research, Department of Botany, CU with the Department of Plant Biology and Microbiology, Queen Mary College, University of London and Department of Botany, University of Nottingham on Chromosome research in relation to

differentiation, variability and reproduction in eukaryotes (1978). Linkages were established through exchange of scientists from India and overseas Universities. Initially, Drs. Sumitra Sen, Probir Chatterjee visited Queen Mary College to learn techniques to set up Ultra-structural and Cell biological laboratories in the Department while Dr. Satyesh Chandra Roy visited Nottingham University to learn techniques in Protoplast culture to set up a laboratory in the Centre on "Protoplast Culture". Other faculty members (students of Professor Sharma) who joined the Centre, also visited several laboratories in UK and Europe, and established laboratories in thrust area of research in the Centre. Professor Sharma successfully obtained sanctions through Colombo Plan Assistance for procuring items of sophisticated equipment such as Electron microscope with ultra-microtome, spectrophotometer and ultra-centrifuge, to enhance infrastructural facilities of the Department during 1980s.

Eminent visitors to the centre included Professors J.B.S. Haldane, P.C. Koller (UK), T. Dobzhansky, S. Patau, Hans Ris (USA), A. Muntzing and Lima de Faria (Sweden), C. Barigozzi (Italy), C. Pavan (Brazil), W. Gottschalk (Germany), V.H. Heywood, E.C. Cocking, E.A. Bevan (UK), Robert Haynes (Canada), Ralph Singleton (USA), H. Kihara and Hu Han (China), Keith Jones (Kew, UK), C.G. Vosa (Oxford, UK) to name a few.

In 1980, UGC upgraded the Special Assistance Programme to the level of Centre of Advanced Study (CAS) and recognizing the high quality research carried out by the "Cytogenetics laboratory" with the thrust area of research as "Cell and Chromosome Research". By the time Professor A.K. Sharma retired from University of Calcutta, the CAS Phase II had been completed (March 1990). He took great interest in all the activities of the Centre, advising the successive Programme coordinators even after retirement from University service. As the Programme Coordinator of CAS in 1990, Professor Sharma concluded achievements of his group and associates in the advisory committee meeting, "During last eighteen years (1972-1990), the research scholars and teachers at this Center showed excellence in carrying out research on various aspects of the approved thrust area. Presently excellent laboratory facilities for conducting research on a wide variety of plants in diverse areas such as reproduction, differentiation and evolution are available. Newer techniques have been adopted for better chromosome analysis and for estimating C-values in diverse species through Feulgen-DNA cytophotometry. Different groups have dealt with research on environmental mutagenesis and genetic polymorphism in human system, cytogenetic studies on fuelwood species as well as some algal systems, reflecting the wide interdisciplinary approach adopted by researchers engaged in this Centre".

Professor Sharma actively participated first as the founder Coordinator of the CAS till 1990 and later as an invitee in all the meetings of Advisory Committee of

CAS in the Department of Botany, CU till his demise. He was extremely happy that the CAS in Cell and Chromosome Research he had founded in 1980s continued to receive UGC support for over three decades and became one of the oldest CAS in Botany in the country. The Department is currently under UGC-CAS Phase VII programme in Botany.

Having spent over three decades in the Department of Botany since 1973, in various capacities, I had close interactions with him. I realized that although he had attained and could have attained many more distinctions, could have taken any job abroad or moved to any other Institution in India, his first love was the chair in his room in the Botany Department of his own University. The CAS in Cell and Chromosome Research which he founded was his child, nurtured and grown over four decades. Being "Programme Coordinator" of the CAS was a very serious affair in his presence and I graduated under him, learning research cum administration, for two terms. Till the last day, he would enquire about the activities of the CAS and its future development. He was an invaluable academic advisor, and a constant source of excellent advice to all who knew him. His relationship with colleagues, the supporting staff including laboratory technicians, clerical staff, gardeners, and attendants was those of father figure and guardian. He was kind, always looked after their needs, including job opportunities over decades. He was a true Acharya. His blessings and advice for all those whom he mentored (including me) have given us strength not only to carry out our duties but has given us courage to face difficulties. His optimism was highly infectious. We feel grateful that he was a fountain head of inspiration.

SCIENTIFIC CONTRIBUTIONS

Professor A.K. Sharma's field of work and major research areas are plant cytogenetics and cytochemistry. He is distinguished for his outstanding contributions on different facets of chromosome research and had built one of the largest and most active centres for cytogenetical research in the world during 1970s. He had such a large number of research scholars who worked for Ph.D. under him since 1955, the exact count is not easy to state. His biodata (dated January 1, 2009) which came to my possession states 115 scholars had been admitted to Ph.D. and D.Sc. degrees under his supervision since 1955. He was remarkably productive and has published over 500 research publications in International and National Scientific Journals. He has written and edited large number of books during his active life.

The Beginning: 1946-1947

Arun Kumar Sharma started his research career under the guidance of distinguished cytogeneticist Professor Dr. P.N. Bhaduri. He was then a postgraduate student working for his M.Sc. dissertation and continued later as part time lecturer in the Department of Botany. His first publication with his mentor was on "Cytogenetics of

Datura fastuosa L." in the Department of Botany, Calcutta University. Professor S.P. Agharkar was the Head of the Department during that time and he has been acknowledged in this paper. In this study, Bhaduri and Sharma (1946) showed that the formation of a ring of four and multivalent formation in *Datura* may be due to duplication of chromosomes by irregular pre-meiotic mitosis without assuming previous translocations. Following Dr. Bhaduri's suggestions, a detailed cytological investigation of incompatibility between the two garden plants *Cosmos bipinnatus* Cav. and *C. sulphureus* Cav. (family Compositae) was also carried out by him in 1947. From this study, he reported that in both cases (*C. bipinnatus* and *C. sulphureus*) the original basic chromosome number was 5, and the secondarily balanced polyploid nature of the species had been explained on the basis of amphidiploidy. Cytological evidences put forward in this paper (Sharma, 1947) had also shown that the incompatibility between the two species can be correlated with the physical differences present in the chromosome complement of the two species.

D.Sc. Thesis: 1955

The outstanding and novel contributions in his thesis began with training under his teacher-mentor Professor Bhaduri. However, Professor Bhaduri left the Department of Botany, CU to join Indian Agricultural Research Institute, New Delhi in 1947 and young Arun continued to work independently. Arun was his favourite student and Professor Bhaduri was fully confident about Arun's promise. Among the students who did Ph.D. under Professor Bhaduri, Sumitra Sen (later a member of the faculty in the CAS, Dept. of Botany, CU) recalls that whenever she had any doubt on chromosome analysis, she was sent from Presidency College (where Professor Bhaduri later joined in 1958) to Ballygunge Science College, Department of Botany, for the slides to be checked by Dr. A.K. Sharma.

The thesis submitted for the degree of Doctor of Science (D.Sc.) in Botany under University of Calcutta in August'1955 by Sri A.K. Sharma (AKS) as a Lecturer in Botany, entitled "Chromosome structure and constitution of meristematic and adult nuclei of sexually and vegetatively reproducing plants", consisted of 50 published papers, in journals of high repute such as *Nature*, *Chromosoma*, *Genetica*, *Stain Technology* and *Caryologia*.

Major areas of research in the thesis include:

New techniques for study of plant chromosomes: Part of his thesis included a series of published papers dealing with clarification of chemical nature of plant chromosomes through techniques specially evolved for the purpose (Sharma, 1950). The importance of trichloroacetic acid (TCA) as an agent for the removal of nucleic acids from their combination in nucleoprotein was known by that time. AKS tried to find out whether any differential activity of the euchromatin and heterochromatin with fuchsin sulphurous acid appears after treatment with TCA using root-tips of

Allium cepa L. and *Hordeum vulgare* L. His results demonstrated the importance of TCA in the feulgen reaction, as well as the reactivity of TCA and N-hydrochloric acid with the nucleic acids and his research was published in Nature (Sharma, 1951).

AKS and Dipti Bhattacharjee (who was then teaching in Bethune College, Kolkata), continued this study in different plant materials on the effect of TCA on both chromosomes and nucleoli. The results from this study, published in Nature (1952), revealed that hot TCA in low concentration brings about an increase in the intensity of staining with acidic dyes and complete disintegration of the nucleolar protein.

A.K. Sharma with Archana Mookerjea and Chitra Ghosh (1953) developed a method for demonstration of alkaline phosphatase activity in plants during mitosis and meiosis and discussed on the validity of the technique for the *in situ* localization of phosphate in various monocotyledonous plants.

In another part of his thesis, AKS included publications dealing with fixation of plant chromosome that have been worked out in connection with a varied group of plants investigated (Sharma, 1956). Use of oxyquinoline, heterocyclic bases, veratrine, galic acid, coumarin, aesculin, phenols, hormones, *p*-dichlorobenzene etc. were recommended, some especially for plants with high chromosome numbers. After a series of trials in different plant materials, he recommended that good permanent smear preparation with fully clarified chromosome structure could be obtained if the materials, before smearing, were fixed in appropriate concentration of oxyquinoline at suitable temperature and optimized the schedule of the method for permanent mounts of chromosomes after squashing (Sharma and Bhattacharya, 1952).

For chromosome analysis in monocotyledons, he used coumarin for high resolution of primary constriction in *Haemanthus kalbreyeri* Baker ($2n=18$), *Crinum amoenum* Ker Gawl. ex Roxb. ($2n=22$ and 18 in different cells). Even with limited microscopic facilities (magnification 800-900X) available with him, the black and white photographs taken by AKS were excellent with clear chromosome morphology (Sharma and Bal, 1953). The action of different prefixing agents on plants with high chromosome number was attempted and *p*-dichlorobenzene was recommended for chromosomes scattering in *Dieffenbachia* spp., *Eleusine* spp. and *Ocimum* spp. (Sharma and Mookerjea, 1955). He also studied effects of chemicals (alloxan, phenols and few purine derivatives) on chromosomes and suggested that chemicals used for pretreatment may also cause chromosome fragmentation both in monocotyledonous and dicotyledonous plants (Sharma and Roy, 1955).

The study of chromosomes of palms has always been considered as a very difficult task and there was lack of data on the vast number of genera of Palmae. He undertook the cytology of tropical palms, using the alkaloid aesculin obtained

excellent results and the new technique for Palms was published in Nature (Sharma and Sarkar, 1955). In fact the word 'difficulty' in chromosome preparation from plant specimens almost became outmoded in his vocabulary because of his intense resolution and astute vision.

Chromosome behaviour in relation to origin of species: The second part of his D.Sc. thesis comprises 18 published papers establishing the inconstancy in chromosome number in the somatic tissue of vegetatively reproducing plants and this feature had been demonstrated to play a distinct role in the origin of new species. While dealing with somatic chromosomes of *Caladium bicolor* var. *verschaffeltii* (Lem.) Engl., a commonly cultivated horticultural Indian aroid, he noted an interesting peculiarity in the chromosome behaviour of vegetative tissue. In addition to normal cells with 14 pairs of chromosomes with a constant karyotype, cells differing from the normal ones in chromosome structure and/number in the same root tip were observed. Meiosis was abnormal and seed setting was not detected (Sharma and Das, 1954). The investigation was then extended to other varieties of *Caladium bicolor* and in all cases, such abnormal nuclei were found to occur in large numbers, along with normal ones, in somatic cells. The gross similarities in the karyotypes of the individual varieties and also the fact that an abnormal type of chromosome in one species was found to become a normal type in another, led them to conclude that these features might have a profound role in speciation, being not necessarily dependent on sexual reproduction (Sharma and Das, 1954). These authors believed that if such abnormal nuclei might be considered to be present in the growing region of the daughter corm as well, and the later might give rise to individuals, different from the parental type. Thus a new concept of speciation was proposed based on studies on the chromosome behavior of large number of vegetatively propagating plants belonging to families Amaryllidaceae, Liliaceae, Aroideae and Dioscoreaceae including the ornamental ones, especially those with obligate vegetative propagation (Sharma and Ghosh, 1954; Sharma and Bal, 1954; Sharma and Bhattacharya, 1954; Sharma and De, 1955; Sharma, 1956; Sharma and Sharma, 1956).

AKS also extended this study to families of angiosperms whose members propagated principally through sexual means and observed the regular behavior of chromosomes with no significant irregularity in the somatic tissue, supporting that evolution in these groups of plants was principally effected by structural and genetic changes operating through sexual means of reproduction. Based on the cytological considerations, Sharma and Ghosh (1954) suggested that evolution within the family Umbelliferae took place along different lines, initiated by structural changes of chromosomes. He also extended his work on chromosome analysis and behavior in *Scirpus*, *Fimbristylis*, *Cyperus* (Cyperaceae), *Eleusine*, *Setaria*, *Pennisetum* (Poaceae).

On the basis of the cytogenetic analysis of different dioecious members of the family Menispermaceae (*Tiliacora*, *Tinospora*, *Stephania* and *Cocculus*), AKS commented that “though all the species are characteristically dioecious, bearing male and female flowers in different plants, no evidence of the presence of sex chromosomes could be detected. In such plants it seems likely that sex is determined by certain special genes located in some of the autosomes” (Sharma and Bhattacharya, 1955).

The problem of the nature of adult nuclei and induction of divisions in them: During late 1940s, when the “endopolyploidy concept” in differentiated cells was being proposed, AKS was interested to find out the principle underlying the endopolyploidy of differentiated cells in plants and their division through various agents. Sharma and Sen (1954) induced divisions in differentiated cells of *Allium cepa* L. and demonstrated endopolyploidy in permanent cells following nucleic acid treatments. The polyploid nature of the adult nuclei was further demonstrated following treatments with a number of nutrient substances, vitamins and a number of hormones etc. (Sharma and Mookerjea, 1955).

I am tempted to quote the preface of his D.Sc. thesis, which is self-explanatory, and reflection of the personality of the budding scientist. AKS wrote “*Lastly, I would consider my work to be a success if my efforts in the face of difficulties, which often appeared to be unsurmountable in the execution of this varied scheme of work, get appreciation from my revered colleagues. It had been my utmost endeavour to investigate and present my findings as accurately as possible. If, even inspite of my utmost and sincere efforts, any shortcomings are noted, I hope that these would kindly be viewed in a proper perspective of the situation, affording but limited facilities for this type of work. In any case, I have been fortunate enough to have a sincere group of students, working under me, whose collaboration in the development of my ideas, I am glad to acknowledge with deep gratitude. Some of my papers have therefore been published jointly with them, as would be evident from the list of papers submitted at the beginning of the thesis.*”

The major findings of Arun Kumar Sharma:

The main contributions of Professor Sharma and his group cover different facets of chromosome research, including

- (i) Innovation of methods for the study of physical and chemical nature of chromosomes and identification of chromosome segments. Several new schedules have been worked out enabling analysis of chromosomes from any organ.
- (ii) Analysis of chromosomes of different group of plants and their role in evolution. In addition to conventional techniques, C-banding techniques were optimized in several species to understand evolutionary significance of the heterochromatin. The systematic status of different genera of both

monocotyledonous and dicotyledonous species have been assessed and their evolutionary pathway clearly delineated.

- (iii) Establishment of a new concept about speciation in plants: The concept involves that in asexually reproducing species, the somatic tissue represents a chromosome mosaic in which the normal complement occurs in highest frequency. The altered complements enter into the propagation of daughter shoots and new genotypes originate without involving the complicated act of fertilization.
- (iv) Chemical basis of chromosomal control of differentiation: Methods have been devised for the analysis of the chromosomes in differentiated (or adult) nuclei. The induction of cell rejuvenescence could be attained by fully utilizing different plant growth hormones and herbicides. The polytenic state in the differentiated nuclei was established to be due to deficiency of sugar moiety of nucleic acid. Polyteny has been shown to be a method adopted by chromosomes for the supply of fresh strands of DNA for uninterrupted transcription without involving cell division. According to this theory, in the mature organ the differentiation as such remains a continuous process despite the limited transcribing capacity of DNA molecule.
- (v) Analysis of principles underlying the effect of physical and chemical agents on chromosomes with their utilization both *in vivo* and *in vitro*: One of the important findings is the demonstration of water alone as the pretreatment and mutagenic agent under certain specific conditions.
- (vi) The concept of chromosome dynamism: An analysis of chemical nature of chromosomes in differentiated organs of plants through *in situ* estimation of DNA and protein as well as extraction and analysis has revealed that the chemical nature of chromosomes maintaining the basic DNA content, may vary from organ to organ, involving specially amplification of DNA and difference in ratios of basic and non-basic proteins. The above studies on chromosome structure and behavior have revealed that increase in complexity in chromosome structure has been associated with the evolution of genetically controlled flexibility of their behavior. The theory of chromosome dynamism thus explains the mechanism through which chromosomes exert control over phasic differentiation as well as reproduction and evolution. The role of repeat DNA sequences in stress conditions in plants, their positive control on generation time, mitotic cycle and other factors has been demonstrated by him and his associates in several genera. It has been further shown that highly homogeneous repeat are involved in the control of stability, whereas lesser repeats are responsible for generating variability at the intraspecific level in legumes.

- (vii) Chromosome research in relation to plant tissue culture: Plant cell and tissue culture techniques has been utilized by his group extensively in different species including medicinal plants. Such studies have shown that chromosome behavior and *in vitro* response can be utilized as a measure of genetic diversity. Methods have been devised for rapid propagation and enhancement of secondary metabolites in several species.

Magnitude of Contributions in Plant Cytogenetics and Cytotaxonomy in 50 years (1948-1998):

Professor A.K. Sharma has given a reorientation to angiosperm taxonomy on the basis of cytogenetical data collected from investigations on different families. He and his associates worked on large number of plants and a vast diversity of plant groups which included monocotyledons, dicotyledons, gymnosperms, pteridophytes as well as algae. Using techniques standardized in his laboratory, he guided students to explore both plants with minute chromosomes and with large chromosomes. His "thumb" pressure (in chromosome preparations by conventional squash/smear technique) was very unique and taught personally to students in M.Sc. classes in early career as well as to research scholars.

A total of 3725 species/subspecies/populations/varieties/cultivars under 796 genera from 120 families have been explored for chromosome number, karyotype analysis, cytotaxonomy and phylogeny by him and his associates during the period 1948-1998. Among these, the cytogenetics of dicotyledons constituted the major component of theses under his guidance encompassing cytotaxonomy of ~96 families, 481 genera and 1419 species. Within the monocotyledons, cytogenetical analysis was carried out in ~17 families, 295 genera and 789 species. Among the Angiosperms, most of the work was on Leguminosae, Euphorbiaceae, Ranunculaceae, Apiaceae, Solanaceae, Amaryllidaceae, Liliaceae, Orchidaceae and Poaceae.

Additionally, a number of species belonging both to dicotyledonous and monocotyledonous families (Sharma and Bhattacharya, 1960; Sharma and Dey, 1960) studied in the cytogenetics laboratory were shown to contain accessory chromosomes. In connection with a plant collection tour in the Eastern Himalayas, during the summer of 1960, a species of *Allium*, *A. stracheyi* Baker ($2n=14$) was collected by him. Both diploids and polyploids were found to occur, the diploids containing B-chromosomes varying from 2-10 in number. Interestingly, polyploids were conspicuous by absence of B-chromosomes (Sharma and Ayenger, 1961). He hypothesized that the B-chromosomes in diploids possibly help the individual to compete with polyploids by enlarging the adaptive capacity.

Majority of gymnosperms are gigantic, woody in nature and it is difficult to procure reproductive and meristematic cells for cytogenetical analysis. Professor Sharma with his student Mandira Chaudhuri (thesis, 1961) standardized protocol for

chromosome analysis in *Cycas* sp. The male and female plants of three species of *Cycas* showed same chromosome number ($2n=22$), however in two species *C. rumphii* Miq. and *C. circinalis* L., male plants showed heteromorphy in karyotype analysis. In Pteridophytes, he guided thesis on Cytotaxonomy of Osmundaceae (Arati Majumder, thesis 1959). Meiosis in *Osmunda regalis* L. showed clearly 22 bivalents and somatic cells with 44 chromosomes; *Adiantum gracile* Fée (Polypodiaceae) showed variability with $n=45$ or 60 bivalents. In *Lygodium japonicum* (Thunb.) Sw. well scattered metaphases showing $2n=108$ chromosomes were reported. In later years, investigations on structure and behaviour of chromosomes and DNA estimation in heterosporous and heterothallic pteridophytes such as species belonging to Equisetaceae (*Equisetum debile* Roxb. ex Vaucher $2n=216$), Isoetaceae and Marsileaceae was also carried out under his supervision (K.C. Das, thesis 1998).

Although microscopic plant body, with fragile vegetative and reproductive structures and difficulties in capturing proper divisional stages created major problems in cytological studies in algae, initiatives were also taken up by Professor Sharma with his student Probir Chatterjee (thesis, 1971), who standardized protocol for synchronized mitotic division of antheridial filaments and contributed to the study of cytology and cytotaxonomy of Characeae. His thesis shows excellent preparations of chromosomes of *Chara* sp., *Nitella* sp. etc. This was also taught to postgraduate students in practical classes when Dr. Probir Chatterjee joined the faculty in the Department of Botany, CU.

The clarification of chromosomal details is a prerequisite for all projects on improvement in biological systems and the elucidation of genetic diversity. The value of these researches on chromosomes, in addition to their fundamental importance, lies in their utilization in agriculture, horticulture and medicine. The contributions on cytogenetics by Professor Sharma and his associates at the CAS, Department of Botany, CU, as described above (including many unpublished work), has been digitized through DBT funded-IBIN (Indian Bioresource Information Network) programme jointly with School of Ecology and Conservation, UAS, GKVK, Bangalore and the DVD on "50 years of research on Plant Chromosomes 1948-1998 by Professor A.K. Sharma and associates" was released by Department of Biotechnology (GOI) during 100th Session of Indian Science Congress on 5th January 2013 at Kolkata in the presence of numerous admirers and dignitaries. Dr. Manju Sharma, former Secretary, DBT (GOI) and Dr. Renu Swarup, Senior Adviser, DBT (GOI), felicitated Professor A.K. Sharma on the occasion.

Besides his own research activities he has significantly contributed to the policy, planning and formulation of scientific and technical programmes for the growth of Science in general in India and various domains of plant science. Professor Sharma has also worked on problems related to environment, originally emanating from his studies on genetic effects of physical and chemical agents. His

Presidential Address at the 68th Session of the Indian Science Congress on “The Impact of the Development of Science and Technology on Environment” has provided incentives for the introduction of a number of programmes for conservation of environment and abatement of pollution in India. Since then, he had been engaged in different programmes on “Man and Biosphere”, and on biological systems as indicators of environment. His involvement in International Bio-indicator Programme has prompted him to publish treatises on “Cell biological tests for bio-indication” by International Union of Biological Science, Paris and Pennsylvania Academy of Sciences, USA.

MEMBERSHIP, AWARDS & HONOURS & ASSOCIATION WITH NATIONAL & INTERNATIONAL SOCIETIES

Professor Arun Kumar Sharma’s career is marked with numerous academic distinctions and honours. Professor Sharma was 34 year old when he started receiving invitations, in recognition of his work, for delivering Lectures and attending meetings abroad. At the International Congress of Genetics held at Montreal, Canada in 1958, he chaired the Session on Chemical Mutagens. He was the leader of the Indian delegation to the International Congress of Genetics held at The Hague, Holland in 1963. He attended the International Congress of Histo-Cytochemistry on invitation as Panel expert in Frankfurt, in 1964. During 1963-64, he visited different laboratories in West Germany, England, France, Italy, Hungary, Finland, Sweden and Switzerland on invitations. He was the Sectional Chairman of International Genetics Congresses held in Tokyo (Japan) and Seattle (USA) in 1968-69. He attended the 2nd and 3rd International Chromosome Conferences held at Oxford on invitation and visited different laboratories of Europe during 1967 and 1970. As an official delegate of INSA in 1973, he attended the International Union of Biological Sciences at Ustaoset (Norway). He was the Leader of official delegation to the International Botanical Congress, Leningrad (1975) and General assembly of the XXth International Union of Biological Sciences, Bangalore (1976). He attended the International Chromosome Conference, Helsinki (1977) on invitation. Professor Sharma participated as invited speaker in the “Tropical Botany Conference” held at Aarhus, Denmark in 1978. As an official delegate of Government of India, he attended the United Nations Conference on Science and Technology for Development (UNCSTD) held at Vienna in 1979, and as Leader of the official delegation, the International Cell Biology Congress in Berlin in 1980.

His visits abroad for image building of Indian Science and interaction with professional community, are innumerable. He was the Chairman of the Global seminar on the “Role of Scientific Societies in Development” sponsored by American Association for Advancement of Sciences, Indian National Science Academy and Indian Science Congress Association (1980). He visited different Universities of Japan and Australia under INSA-JSPS programme for a collaborative project and on

invitation from the Government of Australia respectively (1981). He was the leader of Indian delegation to IUBS General Assembly, Ottawa (1982). He attended the Detroit annual meeting of AAAS and the US National Academy of Sciences, French Academy of Sciences for discussion on collaboration and the Polish Academy of Sciences for Indo-Polish agreement on exchange of scientists between Academies. He also visited Japan, Thailand, Malaysia, Philippines and Singapore for discussions with respective Academies and delivering lectures (1983).

Professor Sharma as President of the Indian National Science Academy (INSA) and later as Founding President, Federation of Asian Scientific Academies and Societies (FASAS, since 1984), visited a number of Academies in different countries of Asia, Europe and USA, on invitation for giving lectures in 1983-1988 each year, 1990, 1992, 1993-1999 each year.

Professor Sharma held several positions in International bodies. He was the Chairman of the FASAS Commission on Science and Technology for Development in Asia in 1990. He played an important role as Chairman, Biological Sciences Fellowship Committee of the Third World Academy of Sciences, Trieste (1991-1998).

He acted as Convenor and Chairman—Asian Group—2nd and 3rd General Assembly, The Third World Academy of Sciences (1985, 1987). He contributed as Co-Chairman, Global Continuing Committee on role of Scientific and Engineering Society in Development (AAAS-INSA-ISCA) during 1980s. He acted as Member, Executive Committee-International Union of Biological Sciences, Paris during 1982-1985 and as Member, IUBS Steering Committee on “Biological Monitoring of the State of Environment” during 1983-1990. He contributed as Member of the Advisory Board of the International Congress of Cell Biology held in 1984 at Tokyo; Member of Programme Committee, XI International Genetic Congress held in 1988 in Toronto, Canada; Member, Board of Trustees, International Foundation for Science, Stockholm (1984-1987) and as Chairman, G-15 Committee on Gene Bank (India) in 1992.

Professor A.K. Sharma was Member of Scientific Advisory Committee to the Cabinet of Government of India during 1983-1985. He has served as Member of Policy making bodies/ Advisory committees of Government of India.

He acted as Chairman, Biological Research Committee, Council of Scientific & Industrial Research, GOI during 1980-1983 and 1986-1991; Convenor, Biology Panel, University Grants Commission (1976-1978 and 1980-1985); Member, Science and Engineering Research Council, Department of Science and Technology, GOI (1978-1986); Chairman, Man and Biosphere Committee, Department of Environment, GOI (1981-1989); Member, Governing Body, Indian Council of Medical Research (1978-1985); Chairman, Advisory Committee, Botanical Survey of India (1981-1986); Chairman, Research Advisory Council, Central Institute of Medicinal and Aromatic

Plants, Council of Scientific & Industrial Research (1982-1987); Member, Governing Body, Council of Scientific & Industrial Research, GOI (1982-1983); Chairman, Birbal Sahni Institute of Paleobotany, Lucknow (1981-1987); Chairman, Eco-Development of the Himalayas-Working Group-Department of Environment, GOI during (1985-1988); Chairman, Bio Productivity Panel-Department of Non-Conventional Energy Sources, GOI (1980-1985); Chairman, Research Council, National Botanical Research Institute (CSIR), Lucknow (1988-1990); Chairman, Regional Plant Resource Centre, Govt. of Orissa (1988-2013); Chairman, Crop Biotechnology, Department of Biotechnology, GOI (1990-1996); Member, Governing Body, National Council of Science Museums, GOI (1990-1998); Chairman, Executive Council for Birla Industrial & Technological Museum, Kolkata (1990-1998); Chairman, Plant Biotechnology Committee and Biofuel Committee, Department of Biotechnology, GOI (since 1997); Chairman, Steering Committee, National Bioresource Development Board, (since 2000); Chairman, Plant Science Research Committee, CSIR (1998); Chairman, West Bengal State Biodiversity Board (2004-2011).

Professor Sharma, has mentored the National Institute of Plant Genome Research (NIPGR) even before its conception. The Institute came into existence in the year 1998 and Professor Sharma was instrumental in establishing and shaping the institute of National importance. Professor Sharma was one of the founding members of the Governing Body, and Society of the Institute and extended his invaluable contribution in the development and progress of NIPGR from the year 1998 till 2014. Additionally, Professor Sharma chaired the Scientific Advisory Committee (SAC), NIPGR from the very first year (1999) to 2014, and during this period he has immensely contributed in giving direction and guidance to the research activities of the Institute.

AWARDS AND HONOURS

Professor Arun Kumar Sharma has received wide international recognition for his contributions in cytogenetics and cytochemistry as also for his services to the cause of Science and Society. He was awarded the coveted Shanti Swarup Bhatnagar Prize for 1967 in Biology by Council of Scientific & Industrial Research; Jawaharlal Nehru Fellowship in 1972; UGC National Fellowship, 1972 (could not accept); Paul Brühl Memorial Medal (1972) by the Asiatic Society; Birbal Sahni Medal (1974) by the Indian Botanical Society; Silver Jubilee Commemoration Medal of the Indian National Science Academy (1976); 1st J.C. Bose Award in Life Sciences by the University Grants Commission (1976); UGC National Lecturer, (1977, jointly with Professor Archana Sharma); Federation of Indian Chamber of Commerce and Industry Award (FICCI, 1979); Padma Bhushan by the President of India (1983); Golden Jubilee Professorship by the Indian National Science Academy (1985-1990); O.P. Bhasin Foundation Award in Biotechnology (1992); G.M. Modi Science Foundation Award (1994); First J.C. Bose Memorial Medal (1994) and Sir Ashutosh

Mukherjee Memorial Prize (1995) by the Indian Science Congress Association; Meghnad Saha Medal by the Indian National Science Academy (1998); P.N. Mehra Memorial Award (1998); Eminent Teacher of Distinction (1998) by University of Calcutta; Satabdi Award (Centenary Award) in Biological Sciences by the Indian Science Congress Association (1999); Vasvik Award by Vasvik Foundation (2001); Rathindra Puraskar, Visva Bharati (2008); Tagore Peace Award, Asiatic Society (2010).

He received D.Sc. (*h.c.*) from the Benaras Hindu University, Varanasi and from several Universities in West Bengal, *viz.*, University of Burdwan, Burdwan; University of Kalyani, Kalyani; University of North Bengal, Dist. Darjeeling; Vidyasagar University, Midnapore; University of Gour Banga, Malda.

Membership of Learned and Professional Societies

Professor A.K. Sharma was elected Fellow of the Indian National Science Academy in 1970; Fellow of the Indian Academy of Sciences in 1975; Fellow of the National Academy of Sciences (India), in 1980 and Fellow of the National Academy of Agricultural Sciences, New Delhi in 1992. He was Fellow of the Academy of Sciences for the Developing World (TWAS, Italy); Corresponding Fellow, Argentinian Academy of Sciences and Corresponding Academician, Puerto Rican Academy of Sciences.

He held innumerable official positions in Scientific bodies and Societies in India and abroad. Some of the positions held in Scientific bodies in India- President, Indian National Science Academy (1983-1984); Vice President, INSA (1977-78). He was elected General President, Indian Science Congress Association (1981); General Secretary, ISCA (1975-1978) and President, Botany Section (1973), ISCA; President, Indian Society of Cytologists and Geneticists (1976-1978); President, Botanical Society of Bengal (1977-1983); President, Genetic Association of India & Society of Cell Biology (1979-1980); President, Indian Botanical Society (1980). He was President, Indian Association of the Cultivation of Science (1997-2000); Vice-President, Asiatic Society (1997). He also participated as Biological Secretary of the Asiatic Society; Secretary of the Indian Science News Association, Member of Council INSA, IAS (Bangalore) and NASI (Allahabad). He was elected President of the National Academy of Sciences (India) in 2011-2012.

EXTRA CURRICULAR ACTIVITIES

The quintessential academician that he was, did he have any other interest outside academics? Yes, he was a voracious reader from his young days and endowed with an astounding memory. He could recite poems of Rabindranath Tagore, which he read in early life, even in the twilight of his life. Though not a singer, he keenly listened to Rabindrasangeet but felt disturbed by too many musical interludes in a

song, which, he thought, came in the way of the singer's expressions. That apart, like any Bengali worth the salt, football was a great fascination. During his student days, he, along with an uncle (who was close to him in age), would walk down to the Maidan to witness their favourite club, Mohun Bagan in action. A family member recalls that once, while trying to enter the ground through the ramparts, a crowd that included him got apprehended by the "gora" cops and chased away by the fearsome mounted police patrolling the Maidan. Wearing a dhoti as was customary those days, the experience of running away out of reach of the long arm of the law was anything but pleasant for Arun and his uncle. His interest in sports took a turn towards cricket and he would invariably keep himself posted with India's performance in international matches. This interest peaked when Sourav Ganguly burst on to the International cricket scene like a breath of fresh air for an icon-starved Bengal. Professor Sharma's heartbeats resonated with Sourav's on-field performances. His reactions to what Sourav was doing both on-field and off-field, wholly biased in favour of this feisty lad, brought out the child inside the erudite Professor.

In the Department of Botany, he took great interest in the annual reunion of the past students, research scholars, faculty and staff members. He would always make it certain to attend the reunion function, along with Professor Archana Sharma, and it was an event for his old students to come and meet him. He would wait, for lunch with the faculty, many of whom retired from time to time, many unable to come and attend, but since inception, the Sharmas were invariably the centre of attraction on the reunion day of the Department of Botany. His enthusiasm was unparalleled even during later years attending the last reunion held on 30th April 2017. He also took great interest in the activities of the Alumni Association of the Department.

LATER YEARS AND LAST DAYS

After the demise of his dear wife Archana in 2008, Professor Sharma preferred to stay alone in his flat at Meghamallar, Gariahat Road, being a very independent person leading a disciplined life throughout, never depending on others for personal needs. He continued taking part in the academic activities though his loneliness was evident to persons close to him. He had started editing the proposed book series on "History of Science in India", in 2013 (initially conceptualized in 2011). However, his health was failing. After a surgery in June 2014, he asked Sri Bimal Sharma, his cousin, to stay with him for three weeks in his flat. The Swamijis of Ramakrishna Mission Institute of Culture (RKMIC), who took great care of his medical needs then, tried to persuade him to relocate at RK Mission International Guest house, near his house. However he refused to leave. He soon suffered a head injury, had to be admitted for brain surgery in August, 2014. After surgery, he recovered, to the relief of one and all and the Mission authorities succeeded in persuading him by saying

“You are one of us” and since August, 2014, Professor Sharma was resident of room number 104, of RKMIC, Golpark, till the last day. He was provided with all facilities at the Mission. The Secretary, Swami Suparnanandaji Maharaj, visited him every day in the morning hours. His health improved and he started working on the Editions of “History of Science in India” sponsored by National Academy of Sciences, India, and the RK Mission Institute of Culture. The eight volumes had to be completed, with numerous interactions with contributors and all administrative staff, with continuous editing and re-editing as the language of the book had to be simple, without much of technical jargon as it was meant for common readers. Professor A.K. Sharma, who was over 90 years of age, recovering from a brain surgery, tirelessly worked and completed editing all the eight volumes for publication as scheduled.

Swami Chidrupanandaji (Joydeb Maharaj) of Ramkrishna Mission Institute of Culture, Golpark, Kolkata, kindly agreed to share some of his experiences with Professor Sharma particularly during his stay at RKMIC in the later part of his life. Joydeb Maharaj recalls “Professor Sharma was a member of Managing Committee of RK Mission and later served the Mission as Vice-President of the Managing Committee till the last day. I remember, he used to be very punctual for all his meetings in the Mission, rather he would be present before time. I met him for the first time in the Library of RKMIC, while he was selecting books to be purchased by the Mission. He was responsible for selection of science books of the Institute’s library which he diligently performed together with other distinguished members such as Shri Amalendu Dasgupta, Shri Dhiresb Bhattacharjee and others. I observed him closely during his stay at the Mission. He was an exceptional person, a true Karma Yogi. He used to regularly attend meetings and seminars at the RKMIC and later became associated with the Research wing of the Institute. He used to spend time twice a week in the evenings at the Research wing. He would always discuss about events or experiences related to scientific research elsewhere but he could not be counted among those who engaged in self praising. In fact, he was never vocal about his personal ups and downs. Once in 2011, on a Sunday, I was surprised to find Professor Sharma at ‘Bancharam’ sweet shop in Gariahat (near his residence) having some snacks for lunch. When asked about the reason, Sir casually replied that on most days he visited the shop for his lunch when his cook did not come. Considering this as a concern for his health, I went back to the Institute and appraised Swami Prabhanandaji and Swami Sarvabhutanandaji Maharaj about this. They gave me the responsibility to find a way to solve this problem. I went to his residence at ‘Meghmallar’ and asked him for Rs. 2500. When Sir asked me the reason, I promptly told him that it would be needed for an arrangement. Soon after, I bought two tiffin boxes and managed a worker of RKMIC to deliver the food regularly from Mission to his residence. Since then Sharmaji occasionally started communicating over the phone with me (Joydeb Maharaj).

In another incident of 2013, on the occasion of Swami Vivekananda's 150th birth anniversary, the Institute had to organize seven seminars in a single year. Professor Sharma helped me immensely in organizing the event, became involved in selecting eminent speakers from all over the world and suggesting the programme for the seminars. During a course of discussion, he suggested that as Swami Vivekananda was known to have great interest in the history of science in India, the Institute could publish a book on 'History of Science in India' highlighting different branches of science in separate volumes. His idea was appreciated by everyone present. He approached around 20 scientists from different fields and within a span of one year, eight volumes of the book was successfully published. This would have been indeed a very challenging task for anyone but Professor Sharma carried out the task with so much ease. Such was his ability to stick to commitments and strategically execute plans, disregarding physical discomforts. Around the same time, Professor Sharma suffered another sudden stroke while he was in his room at Ballygunge Science College, CU. He was escorted to Ramakrishna Mission Seva Pratishthan immediately and on his way he called for me. When I went to see him there, he told me that he was absolutely fine and wanted to go home. I smiled at him and requested him to give me a little time. On learning his condition from the doctors at Sevaprathishthan, I consulted our close friend and eminent Neurosurgeon Dr. R.P. Sengupta. Dr. Sengupta asked me to bring Professor Sharma immediately to the Institute of Neurosciences hospital. He recovered quickly after brain surgery and resumed his work schedule back at the Mission. Additionally, I would like to mention that Professor Sharma had to take chemotherapy sessions, leading to impairment in his movements and he had to use a wheelchair. What was really remarkable about him was that through all these emotional and physical adversities he followed his daily routine without fail. There was so much one can learn from him and his life. He woke up daily between 4:30 a.m. to 5 a.m. At 6 a.m. he used to take a walk for some time after which he would sit for study. He believed that investing at least two hours for oneself each day helps in making the rest of the day fruitful and for keeping good health. He greeted Swami Suparnanandaji who visited him every morning with a warm gesture, responding to his queries regarding his health with a sweet positivity, that he was well, that he had no problems. Every evening I used to visit him in his room after office hours, he would gladly welcome me and ask me how I spent my day. He would also narrate his daily routine of studies, writings or about his working experiences from past. Besides several qualities of this esteemed Professor, I would like to mention about his unflinching memory. He never forgot names of all the acquainted scientists and colleagues as well as events from his life. I have heard him speak over the telephone and the conversations which he initiated with '*Ami Arun Sharma bolchi*' sounded wonderful.

In spite of his deteriorating health conditions, he presided in the last meeting at Ramakrishna Mission Institute of Culture as the Vice-President of the Committee. He

was even unable to move his hands; still he somehow managed to put his signatures and carried all his official duties till the end with a smiling face. Professor Sharma was the personification of dedication, patience and hardwork. He was a humane person- a 'Dev manav'. When I reflect on his eventful life, I recognize that he not only served the scientific world but also paved the path for future generations to follow. Imprints of his peaceful work-life will remain etched in gold in our hearts forever."

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