

## Arun Kumar Sharma

*Umesh C. Lavania*

Arun Kumar Sharma (AKS), a celebrated plant scientist of our country, is an internationally acclaimed cytogeneticist and cytotaxonomist. He attained scientific expertise researching throughout in India without going abroad for any formal training. However, he has delivered lectures at various scientific venues throughout the world and has attracted scholars from far and wide. His dedication to duty and sense of detachment are strongly influenced by his long association with the Ramakrishna Mission. Besides his own research activities on various domains of plant science, he has significantly contributed to the policy, planning and formulation of scientific and technical programmes for the growth of science in India in general.

AKS has had exceptional courage and conviction at the young age of 33 to start an international journal of cytology and allied topics *The Nucleus* (1958). He authored (jointly with Archana Sharma) the classic reference book *Chromosome Techniques: Theory and Practice* (Butterworth & Co. Ltd, London, 1965). The book has been extensively used throughout the world. It went into 2nd and 3rd editions in 1972 and 1980. *The Nucleus* currently running in its 57th year is published by Springer. These two most influencing contributions of AKS became possible by the intellectual and perseverant support of Archana Sharma (AS). Archana had her education in Rajasthan and joined Calcutta University as an M Sc student. Her work as a doctoral student was supervised by AKS. She became his life's companion later. The Sharmas (AKS and AS) have been among the most distinguished scientific couple in Indian science. Both independently received the coveted S.S. Bhatnagar Prize, adored the office of the General President of the Indian Science Congress Association (ISCA), and both were recipients of the civilian national award Padmabhushan, conferred by the President of India.

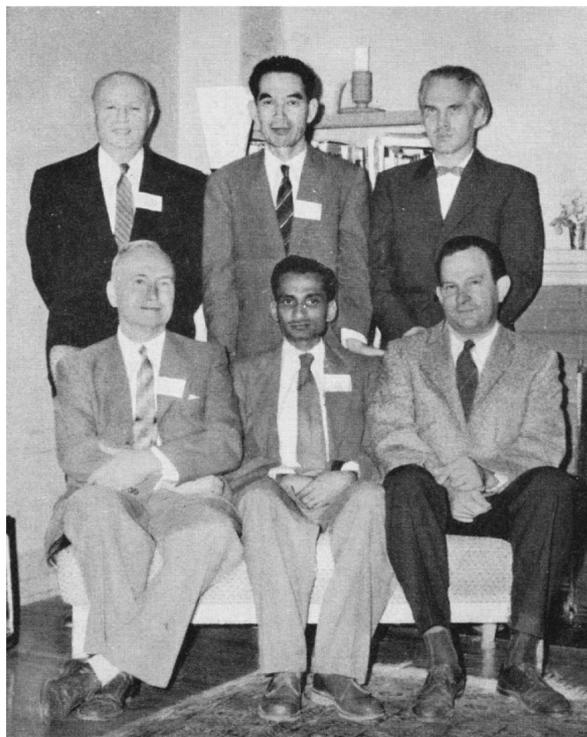
Arun was born on 31 December 1924 in Calcutta to Charu Chandra Sharma and Shovamoyee. He lost his father at the tender age of 8, when his father was engaged in building a home for the family,

on a land donated to him by his father's maternal uncle Mahamahopadhyay Ganapath Sen. Construction was stopped due to the untimely death of his father and financial problems. Arun was then taken to his maternal grandparents' home by

his maternal uncle, a lawyer. He grew up in a large joint family, loved by many of his grandma's relatives. His maternal uncle took care of his education. He had his early education at Mitra Institution (1933–39). Arun could not join the Presidency



AKS in his office in Calcutta University, 27 December 2011 (photograph: Y. Mukai).



Members of the Editorial Advisory Board of *The Nucleus* at the residence of Askel Löve in Montreal on 25 August 1958 during The International Congress of Genetics. Left to right – front row B. P. Kaufmann, A. K. S., J. H. Taylor, standing – H. P. Riley, H. Kihara, A. Löve (photograph: M. S. Cheennaveeraiah).

College in Calcutta as the family lived in Bhabanipur and travelling by bus would have been a luxury. He obtained admission in Asutosh College close to his house in 1939 and studied there till 1941. He obtained B Sc in 1943 with 'half free scholarship', M Sc in 1945 and D Sc in 1955 from the University of Calcutta.

After obtaining M Sc degree in Botany, AKS appeared for Union Public Service Commission (UPSC) examination and qualified for selection. It was providential that K. P. Biswas, Superintendent of the Royal Botanical Gardens, Howrah, working for the Botanical Survey of India (BSI) was looking for bright scholars to develop the herbarium and the garden. He picked up five persons who had qualified in the UPSC examination. Young AKS was one of them. In those days the Botanical Survey was run by the British. They needed able botanists to be trained for building up the BSI. AKS was trained in field taxonomy during collection trips to high altitude regions. He had already worked for M Sc thesis under the supervision of P. N. Bhaduri in cytology and had nurtured love for plant chromosome research. Even though he worked at BSI, he used to visit the University College of Science in the evenings to continue cytological work. After Bhaduri left Calcutta to join the Indian Agricultural Research Institute in New Delhi, AKS continued as temporary teacher under P. C. Sarbadhikari. His own experience and practice of working as a temporary teacher remained in his mind even after attaining national stature and heavy professional commitments. He extended similar opportunities to many of his Ph D students who used to work till late in the evening hours, after attending to teaching jobs in Calcutta during the day. He was strongly influenced by S. P. Agharkar, whom Sir Asutosh Mookerjee had invited to Calcutta in the formative years of the Calcutta University. After completing his training at BSI and having published monographs on the taxonomy of *Sargasum* (a seaweed of the Phaeophyceae/brown algae) and *Sphagnum* (a moss plant that occurs in wet and boggy areas), AKS left BSI and joined the Department of Botany of Calcutta University as a full time temporary teacher in 1947, and then confirmed as a full time Assistant Lecturer in 1948 with a meagre salary of Rs 150. He was loved by all his teachers, notable among them was Amiya Ghosh, who would ask him to join the Sunday get together at his home.

### Professional career

Starting his professional career as Assistant Lecturer in the Department of Botany, AKS rose to the positions of Lecturer and Reader, and was appointed Sir Rashbehari Ghosh Professor and Head of the Department of Botany at the University of Calcutta (1969–1980). He continued as Ghosh Professor until 1988. He initiated studies on chromosome research and built an active school of cytogenetics and cytochemistry to conduct research on a wide range of problems of plant and human genetics. He mentored more than 80 Ph D and 10 D Sc scholars. Prof. L.F. Randolph of the University of Cornell referred his laboratory as the largest chromosome family in the world. Prof. J.B.S. Haldane had admiration to both AKS and AS and often visited his laboratory during his stay at Calcutta. He authored more than 500 research papers, including 6 in *Nature*, several papers in *Chromosoma*, *Naturwissenschaften*, *Theoretical and Applied Genetics*, and a host of well-known and specialized journals. He has authored/edited several reference books/special issues of the journals (see Box 1), contributed invited reviews/articles to *Botanical Review*, *Chromosomes Today*, *The Cell Nucleus*, *International Review of Cytology*, *Encyclopedia of Microtechniques*, *Biology International* and others. In addition to being the Chief Editor of the journal *The Nucleus*, he has served on the editorial boards of several journals: *Cytologia*, *Proceedings of the Indian National Science Academy*, *Journal of Cytology and Genetics* and *Indian Journal of Experimental Biology*. In recognition of his outstanding research work, AKS was awarded the Jawaharlal Nehru Fellowship by the Jawaharlal Nehru Foundation (1972–76) and the National Lectureship by UGC. The Indian National Science Academy (INSA) awarded him the Golden Jubilee Research Professorship from 1985 to 1990 at the University of Calcutta.

A. K. Sharma's virtues are his simplicity and affability, dedication to work and total lack of ego. His strongest source of inspiration, love, attachment and enormous assistance came from Archana Sharma and senior associates such as Sumitra Sen and Gita Talukder. AKS has been adored and respected by generations of students and colleagues. He invited G. C. Mitra (formerly of the University of Delhi and later worked at NBRI) to establish

Tissue Culture facility in the Department. He enjoyed the support and admiration at the national level from B. P. Pal, M. G. K. Menon, B. M. Johri, R. P. Roy, G. K. Manna, C. V. Subramanian, H. Y. Mohan Ram, S. S. Bir, T. N. Khoshoo, A. K. Koul, Manju Sharma and Asis Datta, and numerous botanists, biologists and agricultural scientists of India.

### Significant research contributions

AKS nurtured the Department of Botany at the University of Calcutta with its several disciplines, and also as one of the finest centres of research in cell and chromosome research – the only such centre of chromosome research in India. The University Grants Commission established the Centre of Advanced Study (CAS) in the Department in recognition of the high quality of research output. CAS is now running in the sixth phase. On a personal note, I would like to state that I joined the research group of AKS in 1976 as a UGC Teacher Fellow when the activities of CAS were at its pinnacle and the Centre had attracted research workers from all over India. Striving for excellence, the Centre organized several international conferences, seminars, colloquia and special lectures, attracting experts in chromosome research from US, Canada, Latin America, Japan, Australia and Europe. Several fellows of the Royal Society of London have interacted with researchers at CAS. Over the years, research by AKS group was principally oriented towards: (i) advancement in methodology for the study of chemical and physical nature of chromosomes, (ii) chromosomes in evolution and plasticity in their behaviour, (iii) establishment of a new concept of speciation in asexual organisms for the origin of new genotypes, (iv) chromosomes in taxonomy, (v) chromosomes in differentiation, (vi) chromosomes as affected by physical and chemical agents, their functional mechanisms and economic potentialities, and (vii) chromosome dynamism.

Several techniques developed by AKS and his group are widely used in the laboratories of cytogenetics and cytochemistry for the study of physical and chemical nature of chromosomes and clarification of finer details of structure, organization and behaviour of chromosomes of plant, animal and human systems. The major contributions are briefly mentioned below.

**Box 1.** Books written/edited by AKS.

- Sharma, A. K. and Sharma, A., *Chromosome Techniques – Theory and Practice*, Butterworths, London, Three editions 1965, 1972, 1980.
- Sharma, A. K. and Sharma, A. (eds), *Nucleus*, Proc. International Seminar on Chromosome, its structure and function. Suppl. Volume, 1968.
- Sharma, A. K. and Sharma, A. (eds), *Chromosome in Evolution of Eukaryotic Groups*, CRC Press, USA, 1983, 1984, vols 1 and 2.
- Sharma, A. K. and Sharma, A. (eds), *Impact of the Development of Science and Technology on Environment*, Indian Science Congress Association, 1981.
- Sharma, A. K. and Sharma, A., *Chromosome Techniques – A Manual*, Harwood Academic Publishers, Amsterdam, 1994.
- Sharma, A. K. and Sharma, A., *Plant Chromosomes – Analysis, Manipulation and Engineering*, Harwood Academic Publishers, Amsterdam, 1999.
- Sharma, A. K. and Sharma, A. (eds), *07 Volume Series on Plant Genome, Biodiversity and Evolution*, Science Publishers, USA: Volume 1, Part A, Phanerogams – Lower Groups, 2003; Volume 1, Part B, Phanerogams – Higher Groups, 2005; Volume 1, Part C, Phanerogams – Angiosperm: Dicotyledons, 2006; Volume 1, Part D, Phanerogams – Gymnosperm and Angiosperm: Monocotyledons, 2006; Volume 1, Part E, Phanerogams – Angiosperm, 2008; Volume 2, Part A, Lower Groups, 2004; Volume 2, Part B, Lower Groups, 2006.
- Sharma, A. K. and Sharma, A. (Guest editors), *Methods in Cell Science, Special issue: Synchronization in Mammalian Systems*, Kluwer, Boston, 1996, vol. 18.
- Sharma, A. K. and Sharma, A. (Guest editors), *Methods in Cell Science, Special issue: Synchronization in Plant Cells*, Kluwer, Boston, 1999, vol. 21.
- Sharma, A. K. and Sharma, A. (Guest editors), *Methods in Cell Science: Special issue: Chromosomes Painting – Principles, Strategies and Scope*, Kluwer, Boston, 2001, vol. 23 (nos 1–3).

**New techniques and effects of chemicals**

From the very beginning AKS and his group have been involved in developing innovative methods for the study of physical and chemical nature of chromosomes and chromosome segments. Several new schedules have been worked out enabling analysis of chromosomes from any organ including mature tissues and identification of finer details. Of the several techniques devised, the methods using aesculine, isopsoralene and umbelliferone for chromosome analysis as well as Orcein banding technique for repeated DNA sequences are noteworthy. One of the important findings is the demonstration of water alone as the pretreatment and mutagenic agent under certain specific conditions. Plant pigments too have been shown to induce chromosome breakage and mutation. Chemical and physical principles underlying chromosome clarification and chromosome breakage have been resolved.

**Chromosomes in speciation and taxonomy**

With the aid of improved chromosome techniques devised, his group has made extensive studies on the chromosome number and structural morphology of nearly all monocotyledonous families and a majority of dicotyledonous fami-

lies represented in India. The systematic status of different genera of both monocotyledonous and dicotyledonous species has been assessed and their evolutionary pathways have been clearly delineated. This has led to reorientation of angiosperm taxonomy on the basis of cytological data and establishing cytotaxonomy on a firm footing, as a valuable adjunct to plant systematics. Further, based on an in-depth analysis of C-banding patterns, it has been shown that the heterochromatin acquisition has an evolutionary strategy; initially acquired by the primitive species heterochromatin is gradually shed with species advancement. A digital account of plant chromosome work done by AKS and his group since 1950 on more than 1500 species (>3500 entries) was released by the Department of Biotechnology during the 100th session of the Indian Science Congress on 5 January 2013 at Kolkata, and is available at [pcic.bric3.cu@gmail.com](mailto:pcic.bric3.cu@gmail.com) of the Plant Chromosome Information Centre, Department of Botany of the University of Calcutta (<http://www.ibin.gov.in>).

**Dynamism in chromosome behaviour during reproduction, and establishment of a ‘New Concept of Speciation’**

From the studies conducted on species in which the principal method of reproduction is asexual as represented by several

lilies, amyryllids, aroids and other families of monocotyledons, it was revealed that such species evince dynamic differential chromosome behaviour. Such species continually produce new genotypes and cultivars despite the absence of the regular method of reproduction and fertilization, indicating that they have developed alternative methods of generating variability. Taking cues from the initial observations on *Caladium bicolor*, which has inconsistency in the chromosome complement in the somatic tissue, it was shown through a series of publications that in such asexually reproducing species, the somatic tissue represents a mosaic of chromosome complements in which the normal complement occurs in maximum frequency. This regular occurrence of inconsistency in the chromosome complement, plays a significant role in the origin of new genotypes through their participation in the formation of daughter shoots. Likewise, definite evidences on the role of altered chromosome complement in the origin of new genotypes through their participation in formation of daughter shoots were brought forward in several genera and species. These findings have led to the establishment of ‘A new concept of speciation’. The concept defines that in asexually reproducing species, the somatic tissue represents a chromosome mosaic in which the normal complement occurs in highest frequency. The altered

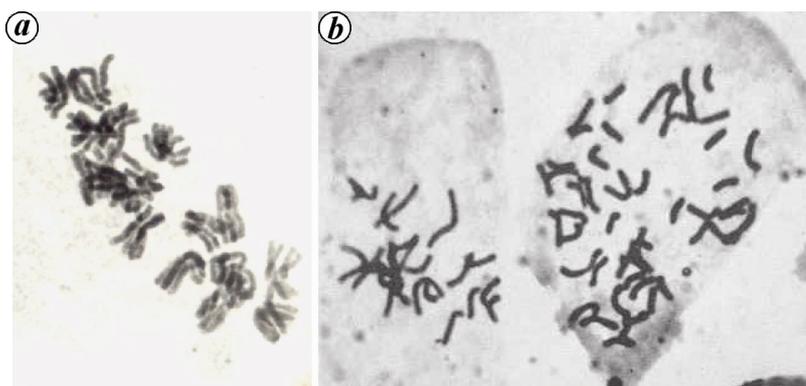
complements enter into the propagation of daughter shoots and new genotypes originate without involving the complicated act of fertilization.

### Induction of cell rejuvenescence and control of differentiation

AKS and his group was the pioneer in devising methods for the analysis of chromosomes in the differentiated or adult nuclei to understand chromosome behaviour during growth and differentiation. The induction of cell rejuvenescence could be achieved utilizing various plant growth regulators (PGRs) and 2,4-dichlorophenoxyacetic acid (2,4-D). Resolution of polytenic constitution of the differentiated nuclei as worked out by S. Sen and A. Sharma was made possible through such approach of induction of cell rejuvenescence and the deficiency of sugar moiety of nucleic acid was proved to be responsible for its polytenic state. 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 mature organs, the differentiation as such remains a continuous process despite the limited transcribing capacity of DNA molecule.

### Repeated DNA sequences and dynamic DNA

The biological systems in general and plants in particular require additional amounts of DNA in their chromosomes for growth and differentiation. Such a need for excess amount of DNA is met by amplification of repeated DNA to complement differentiation and diversification. From the hormonally induced division in the adult nuclei in the differentiated tissues it was observed that such nuclei show the occurrence of both diploid and polytenic states. Accordingly, it was suggested that such an occurrence of polyteny (i.e. endomitotic replication of chromosomes without cell division) may become necessary when the transcribing capacity of single-strand DNA is either completely exhausted or more strands are needed for transcription. Such an unorthodox response is resorted to by chromosomes in differentiating system, so that the need for differentiation can be satisfied without increase in the number of cells through its necessity for maintaining symmetrical growth. Such addi-



**a**, Four-stranded chromosomes from mature nuclei showing endomitotic replication/lateral amplification (courtesy Y. K. Bansal); **b**, Polysomy in somatic cells of *Zephyranthes mesochloa* depicting chromosome inconsistency (from *Chromosome Techniques: Theory and Practice*).



AKS and AS on their visit to Kihara Institute of Biological Sciences, Yokohama, Japan (1981); AKS is in the centre with Hitoshi Kihara on his left.

tional DNA has been referred to as 'Dynamic DNA' in view of the dynamic functions it performs. Such DNA sequences in the chromosomes do not necessarily code for structural proteins, but the vital genes in which they are involved control all aspects of the cell cycle and are subject to stress of physiological conditions, as demonstrated by his group in *Acacia* and related genera. These researchers have further shown that highly homogenous repeats are involved in the control of stability, whereas fewer repeats are responsible for generating variability at the intraspecific level in the legumes.

### Concept of chromosome dynamism

The theory of 'Chromosome Dynamism' put forth by AKS demonstrates that the

genetic material remaining constant, chromosomes show changing patterns in their chemical nature particularly during their developmental stages, to exert their supreme control over all aspects of metabolism, differentiation and evolution of species. An analysis of the 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 amplification of DNA and difference in ratios of basic and non-basic proteins. Such studies on chromosome structure and behaviour have shown that increase in complexity in chromosome structure has been associated with the evolution of genetically controlled flexibility of their behaviour.

**Box 2.** Academic recognition received and scientific services offered by AKS.**Awards and honours received**

S.S. Bhatnagar Prize (1976), Jawaharlal Nehru Fellowship (1972), Paul Brühl Memorial Medal by the Asiatic Society (1972), Birbal Sahni Medal by the Indian Botanical Society (1974), First J.C. Bose Award by UGC (1976), Silver Jubilee Medal by INSA (1976), UGC National Lecturer (1977), FICCI Award (1979), Golden Jubilee Professorship by INSA (1985–90), O.P. Bhasin Foundation Award in Biotechnology (1993), G.M. Modi Award in Biotechnology (1994), Asutosh Mookerjee Memorial Award by ISCA (1995), M.N. Saha Medal by INSA (1998), VASVIK Award (2003), Eminent Teacher of Distinction by the University of Calcutta (2006), Rabindra Puraskar by Visva Bharati (2008), Life Time Achievement Award by the Indian Botanical Society (2010); President: Indian National Science Academy (INSA), National Academy of Sciences India (NASI), Federation of Asian Scientific Academies and Societies (FASAS) (founder President); President, Plant Science Section (1973) and General President (1981) of the Indian Science Congress Association, President: Indian Society of Cytologists and Geneticists (1976–78), Botanical Society of Bengal (1977–79), Genetic Association of India, Society of Cell Biology (1979–80), Indian Botanical Society (1980), President, Indian Association of the Cultivation of Science (1997–todate); Vice-President, The Asiatic Society (1997), Fellow: INSA, IASc, NASI, NAAS and TWAS; D.Sc (h.c.) – Vidyasagar University, Midnapore, and Banaras Hindu University, Varanasi.

**Chairman:** Biological Research Committee of CSIR, Biology Panel of UGC, Indian National Committee of IUBS-INSA (1978), Man and Biosphere Committee, Department of Environment (1981–89), Biological Sciences Fellowship Committee of TWAS, Trieste (1991–1998), Birla Industrial and Technological Museum, Kolkata (1990–98), Plant Biotechnology Committee, DBT, Steering Committee, National Bioresource Development Board (2000–todate), Plant Science Research Committee, CSIR (1998–2004); Research Councils of the Birbal Sahni Institute of Palaeobotany, National Botanical Research Institute, Central Institute of Medicinal and Aromatic Plants and National Institute of Plant Genome Research.

**Co-chairman:** Global Continuing Committee on the Role of Scientific and Engineering Societies in Development (AAAS-INSA-ISCA) (1980).

**Member:** Science and Engineering Research Council of DST, Governing Bodies of CSIR and ICMR, Executive Committee, IUBS, Paris (1982–85), IUBS Steering Committee on Biological Monitoring of the State of Environment (1983), and Board of Trustees, International Foundation for Science, Stockholm (1984–87).

**Chromosome chemistry**

Concomitant with the technical advances, AKS and his group used methods for analysis of the chemical nature of plant chromosomes *in situ*, including demonstration of *in situ* alkaline phosphatase activity, analysis of chemically differentiated nature with the aid of enzyme digestion and extraction techniques, the role of chromosomal proteins in nucleoplasmic transfer and the presence of RNA in plant chromosomes in certain phases of metabolism.

**Other contributions**

AKS 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 development of science and technology on environment' provided incentives for the introduction of a number of programmes

for conservation of environment and abatement of pollution in India – so much so, the creation of the Department of Environment of Government of India owes much to the recommendations based on this focal theme. At this stage Indira Gandhi, the then Prime Minister of India wanted him to become the first Secretary of the newly created Department of Environment. However, he could not undertake the same because of his commitment to the Department of Botany. Since then, AKS has been engaged in several programmes on Man and Biosphere Programme (MAB) and on Biological Systems as Indicators of Environment. His involvement in the International Bio-Indicator programme prompted him to publish treatises on 'Cell biological tests for bio-indication' by the International Union of Biological Sciences (IUBS), Paris and Pennsylvania Academy of Sciences, USA.

Apart from his own research activities, involvement of AKS in various domains

of scientific and technological programmes of the country is remarkable. He has been actively associated with the various R&D organizations as an expert and policy planner (see Box 2). He strongly supported the Indian Science Congress Association for many years in various capacities as Treasurer, General Secretary and as General President. He believes that priority for research, though essential, should not be confined to the so-called 'immediate needs', and for a competent investigator and for a viable and innovative project, continued support should be extended.

Several Fellows of INSA felt that India has not done much in terms of exchange of know-how and shared our knowledge with the neighbouring developing countries. In order to meet such aspirations, AKS played a proactive role and was the prime force behind the formation of the Federation of Asian Scientific Academies and Societies (FASAS) founded in New Delhi on 15 January

1984 during the Golden Jubilee Celebrations of INSA. FASAS is committed to stimulate regional cooperation and self-reliance by sharing each others' experiences. The INSA, a founder member, has been supporting the activities of FASAS since its inception. In 2012, FASAS and the Association of Academies of Sciences in Asia (AASA) have been merged into a new organization namely the Association of Academies and Societies of Sciences in Asia (AASSA).

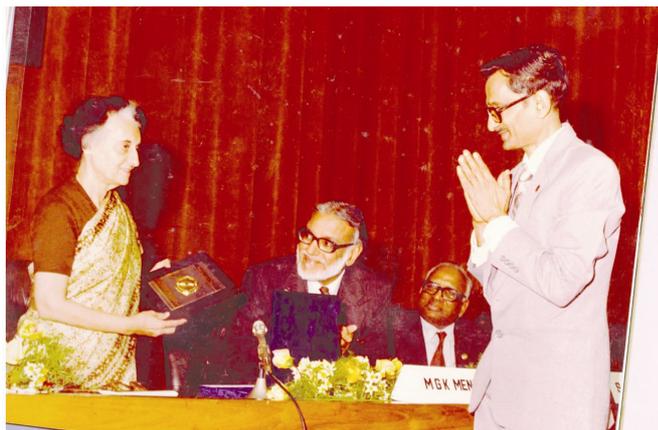
AKS continues to nurture the academic programmes of the Ramakrishna Mission and is currently editing a 8-volume series 'History of Science in India' to stimulate young persons to learn from the life and works of eminent Indian scientists in different areas. Experts from various fields of science and technology have been invited to contribute critical and inspiring articles for these volumes. AKS is the brain behind organizing the centenary celebrations of the Department of Botany of the University of Calcutta. His agility remains the driving force even today, and as the President of the Centenary Celebrations Committee, AKS has been fully engrossed in planning the programmes befitting the occasion.

### Awards and honours

AKS has received wide recognition by way of fellowships and awards (Box 2) for his contributions to cytogenetics, cytochemistry and cell biology, as also for his services to the cause of Science and Society. He has served as the President of the Indian National Science Academy, New Delhi (1983–84), National Academy of Sciences India (2010–12).

### Visits abroad and interaction with professional colleagues

AKS was invited as Chairman of various sessions in the International Scientific meetings, namely Chairman of the section on 'Chemical Mutagens' at the International Congress of Genetics at Montreal (1958), Tokyo (1968), Leader of the Indian delegation to the International Congress of Genetics at The Hague (1963), International Congress of Cell Biology at Berlin (1980), Chairman of the section 'Newer Concepts of Structural Organization of Chromosomes' at the International Congress of Genetics



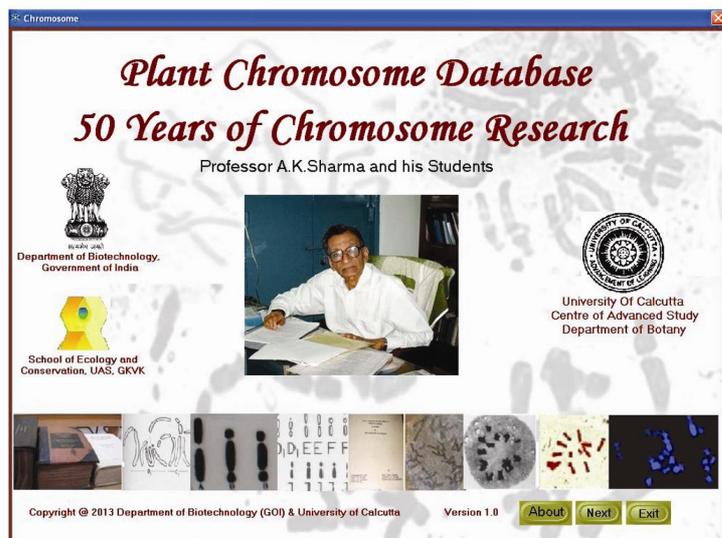
AKS (then President of INSA) greeting Prime Minister Indira Gandhi during the inaugural function of the Golden Jubilee of INSA on 16 January 1984; also seen are M. G. K. Menon (past President) and S. Sriramachari (then Vice President) (courtesy INSA).



AKS with the members of the consultative committee representing other science academies and societies of Asia during the birth of Federation of Asian Scientific Academies and Societies at INSA on 15 January 1984 (courtesy INSA).



Manju Sharma, former Secretary of the Department of Biotechnology, felicitating AKS commemorating 50 years of plant chromosome database by his group on 5 January 2013. Seen in the picture from left to right – U. C. Lavania, Renu Swarup, A.K.S., H. Y. Mohan Ram, Manju Sharma, Sumita Jha.



Front cover of DVD released on 5th January 2013 during the 100th Indian Science Congress in Kolkata.



AKS with other invited speakers of the Plant Science symposium during the 100th Indian Science Congress at Calcutta on 5th January 2013. Left to right – U. C. Lavania, P. P. Jauhar (USDA, Fargo), A.K.S., Y. Mukai (Osaka K. Univ., Japan), S. P. Vij, H. Y. Mohan Ram.



Longtime associates of AKS – from left to right: sitting – Sumitra Sen and Archana Sharma; standing – Bani Gajra and Dipali De.

held in New Delhi (1983). He attended the International Congress of Cyto and Histochemistry at Frankfurt (1964) as an Expert, invited speaker at the Oxford

Chromosome Conferences (1967, 1970, 1977), International Botanical Conference at Seattle (1969), Tropical Botanical Conference in Denmark (1978),

visited Norway as official delegate to the IUBS General Assembly (1973), UNCSTD conference in Vienna (1978). He had been to Washington DC in 1980 as the Chairman of the Joint Organizing Committee of the Global Seminar on the Role of Scientific Societies in Development, jointly organized by the American Association for the Advancement of Science, Indian Science Congress Association and INSA, the final conference being held in Delhi during 1–5 December 1980, in which about 50 countries were represented, and remained Co-Chairman of the Continuing Committee with Prof. Boulding, ex-chairman of AAAS. As President of INSA and later as Founding President of FASAS, he was invited to give lectures (1995–1999) by a number of Academies in different countries of Asia, Europe and USA.

On a closing note it is befitting to say that the research group of AKS was truly national in character and everyone felt at home without any discrimination of region or religion. He commands huge admiration amongst the alumni of Calcutta University of all ages. Presence of a large number of alumni of 1930s and 40s attending the inaugural function of the Centenary Celebrations of the Botany Department of Calcutta University organized under his guidance in September 2013, which I happen to witness, speaks volumes of his popularity amongst the botanists of generations. AKS and AS may not have their biological children but their associates and students take pride seeking in them their own parents, and saintly figures constituting large academic progeny. We very much miss Archana di in the 90th year of 'Sir' who would always stand as a mother to the students. We feel fortunate to have been associated with such great human beings.

**ACKNOWLEDGEMENTS.** I thank the students and well wishers of AKS, particularly Profs Sumitra Sen, H. Y. Mohan Ram, Mr G. Madhavan (IASc), Drs Alok K. Moitra and A. N. Thakur (INSA) who helped with valuable inputs.

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