

Lalji Singh (1947–2017)

Dr Lalji Singh is well known among biologists, investigative agencies, the judicial system and common people, due to his hard work and commitment to science and the society. Singh was born on 5 July 1947 in a middle-class family in Kalwari village, Jaunpur district, Uttar Pradesh. He obtained his Ph D degree (sex chromosomes in snakes) under the supervision of S. P. Raychaudhuri at the Banaras Hindu University (BHU), Varanasi. Then he went to the laboratory of K. W. Jones at the Institute of Animal Genetics, University of Edinburgh, UK on a Commonwealth Fellowship to work on his own research problem of sex determination (in snakes), which is still one of the major unsolved problems in biology. For the first time, he demonstrated the predominant existence of highly conserved sex chromosome-specific satellite DNA (Banded krait minor-satellite or Bkm) in the female banded krait, a highly poisonous snake. Singh also demonstrated that this satellite DNA is found in all vertebrates, including humans. He might not have imagined that this satellite DNA (Bkm) would have a huge impact in the field of biology, forensics and judiciary.

Accepting invitation from P. M. Bhargava, founder Director of the Centre for Cellular and Molecular Biology (CCMB), Hyderabad, Singh returned to India after spending 13 years (1974–1987) in the University of Edinburgh, and joined CCMB (1987) as a senior scientist. His Bkm studies further resulted into the development of a DNA probe, which led to the establishment of the first indigenously developed multilocus probe for DNA fingerprinting. Interestingly, this was developed almost simultaneously with the first DNA fingerprinting probe developed internationally. India was only the third country in the world (after UK and USA), which developed this multilocus DNA fingerprinting technology. Singh not only developed this technique but also took it to the users, appeared in the court and provided witnesses, which helped in solving a large number of criminal and civil cases. Now, DNA fingerprinting technology has reached to common people all over India and is providing them a justice which otherwise would not have been possible

for them to obtain. In fact, this is the best example of how the fallout of basic research on sex determination could lead to such a high-impact applications.

In 1991, when Singh's DNA fingerprinting evidence was accepted by a Sessions Court of Tellicherry in Kerala, it created a history in the Indian judiciary. Since then, this indigenous technique has been used for providing evidence in solving hundreds of cases, including the assassination of the former Prime Minister of India, Rajiv Gandhi; the Tandoor murder/Naina Sahni case; the assassination of the Chief Minister of Punjab, Beant Singh and the cases of Swami Shradhdhananda from Bengaluru and Swami Premananda from Pudukottai, Tamil Nadu. Providing scientific evidence was not an easy task; I still remember once Singh narrated his



experience in the court and how difficult it was to provide scientific evidence. He used to share his experiences while delivering talks on DNA fingerprinting. Singh also brought out a book entitled *My Travails in the Witness Box*, where he shared some of his experiences.

Realizing the need for promoting DNA fingerprinting technology, Singh founded the Association for Promotion of DNA Fingerprinting and Other DNA Technologies (ADNAT) in 1993, with the main objective of bringing the advancement in DNA technologies and their applications to researchers in the field of biological sciences, agriculture, medicine and forensic science by organizing annual symposia and hands-on training courses. ADNAT has always been taking

the lead in introducing various emerging DNA technologies in this part of the globe through participation of world leaders in the field. The very first conference that ADNAT organized was the Third International Conference of DNA Fingerprinting in 1994. Subsequently, every year ADNAT along with CCMB used to organize conferences and hands-on workshops in the emerging areas. In fact, this has benefited a large number of young colleagues from various institutes and universities.

Envisaging the potential implications of DNA fingerprinting technology, Singh proposed, pursued and set up the Centre for DNA Fingerprinting and Diagnostics (CDFD) at Hyderabad, an autonomous institute of the Department of Biotechnology (DBT), Government of India. As the first In-Charge Officer on Special Duty at this Centre, Singh had immensely contributed to its initial development (from October 1995 to February 1999). The Centre, has been providing DNA fingerprinting and genetic diagnostic services to the nation since its inception. These pioneering contributions to the society earned him a title 'Father of DNA fingerprinting in India'.

Singh became the Director of CCMB in 1998 and transformed the centre with excellent state-of-the-art scientific infrastructure facilities. I think, in the 90s not many labs, both in India and abroad would have had such fantastic facilities under one roof. On one occasion, Singh proudly mentioned that 'Dr Bhargava made CCMB for the 20th century and I upgraded it for the 21st century'. Singh brought with him his unique style of leadership. He always used to think big and executed his plans very well – be it the creation of infrastructure facility or organizing the Third International Conference on DNA Fingerprinting (1994), or organizing the Guha Research Conference (1998), or organizing silver jubilee celebrations of CCMB (2002). Some of his initiatives are unique and made big difference not only to CCMB, but also to other institutions; for example inviting postgraduate students from remote universities to carry out project work, with the condition that they bring blood samples from tribal populations of their respective places. This had mutually

benefited both the students and CCMB. While students had the opportunity to perform hands-on experiments in the best-equipped laboratory with unique research environment and culture, CCMB benefited in setting up a huge DNA bank. This initiative made a big difference to the students who were trained in CCMB. We have trained more than 200 postgraduate students; most of them have completed their Ph D, PDF and are holding faculty positions in various universities and national, and international institutes.

Singh established two excellent centres within CCMB—the Laboratory for the Conservation of Endangered Species (LaCONES) and the Clinical Research Facility (CRF). Based on the studies of his team on wild animals, Singh envisaged the need to have a dedicated Centre for studies on wild animals. Hence he set up LaCONES close to the Nehru Zoological Park, Hyderabad, in collaboration with the Central Zoo Authority of India, New Delhi; the Department of Forests, Government of Andhra Pradesh and DBT. This was dedicated to the nation by the then President of India, A. P. J. Abdul Kalam on 1 February 2007. To the best of my knowledge, this is the only laboratory in the world which is dedicated to studying endangered animals. CRF was conceived and set up by Singh along with the Nizam's Institute of Medical Sciences, Hyderabad, for basic research on stem cells and tissue engineering with the specific aim of their application to the treatment of human diseases. Now the CRF complex has emerged as a much happening place in terms of translational research, skill development, innovation HUB, Atal Incubation Centre, incubating small-scale industries, etc. The present Director, Rakesh Mishra, who initiated the new activities in CRF said 'I have not met many people who possess optimism to the degree Lalji did and level of trust in his colleagues. Lalji succeeded in many ventures he tried, which went on to be the milestones of CCMB's history of achievements'.

Some of Singh's socially relevant contributions include the setting up of DNA and chromosome-based diagnostic services in CCMB for many genetic disor-

ders. These services were of tremendous help to the common people in reducing their agony, whenever therapeutic intervention was possible. Another socially relevant contribution of Singh and his colleague, was development of 'universal probe' for wildlife forensics. Using a drop of blood or semen, or hair or piece of meat or bone or skin and without knowing its source, it is possible to carry out an analysis and decide whether the sample(s) belong to humans or other animals and, if the latter identify the species. This work is being done at LaCONES and has so far helped in solving hundreds of cases of wildlife crime. Beyond wildlife forensics, this technique has also helped the Air Force, in identifying species in case of bird strike. For the discovery of this technique, Singh and his colleague were honoured with the CSIR Technology Award in 2008. In recognition of Singh's overall contribution to science and technology, Government of India honoured him with the civilian award 'Padma Shri' in 2004.

One of Singh's internationally well-recognized scientific work is studies on Indian populations. Our joint efforts led to the conclusion that Onge, the Great Andamanese and the Jarwas of the Andaman and Nicobar Islands are the first modern humans to have migrated out of Africa (65,000 years before present). The finding was published in *Science* and led to several new international collaborations and publications in high-impact journals, including *Nature* (2009). After hearing about Singh's demise, David Reich (Harvard Medical School, USA) with whom we have been collaborating, wrote to me 'I am so sad to hear this. It was a great honor to work with Dr. Lalji Singh on our many projects together. I hope that as a testament to him we can continue to do the work together that he was a fundamental part of starting'.

After superannuating in 2009, Singh continued his research in CCMB as a CSIR-Bhatnagar Fellow until December 2014. During this period, Singh got the unique opportunity of becoming the 25th Vice-Chancellor (VC) of BHU (August 2011–August 2014), where he did all his higher education. After a few quiet years, it seems that Singh's appointment as VC rejuvenated his institution-building capa-

bilities. He made extraordinary efforts to make BHU a world-class university. Singh's efforts in BHU will be remembered forever, as he established a Bone Marrow Transplant and Stem Cell Research Centre, a Central Discovery Centre (a centralized facility for high-end sophisticated equipment), and a cyber library to help BHU students connect with other international universities and research institutes. He modernized several facilities in the Faculty of Science, Institute of Medical Science, for the benefit of patients. He also envisioned establishing a big convention centre with a capacity of 10,000 seats at BHU. It is worth mentioning that during his stay in BHU as VC, Singh did not take any salary, as he was availing his Bhatnagar Fellowship.

After completing his term in BHU, Singh returned to CCMB and continued his research under Bhatnagar Fellowship and J. C. Bose Fellowship. After the Fellowship term (July 2015), he fully devoted his time in the 'Genome Foundation', which he had established and registered under Section 25 of the Companies Act, 1956. He was the Managing Director of the Genome Foundation, which provides DNA diagnostic services to both rural and urban populations of the country at affordable cost.

As if to say goodbye to the city, where he had stayed in various capacities, Singh spent his final hours in Varanasi on 10 December 2017, when he passed away due to massive cardiac arrest. He is survived by his wife, Mrs Amaravati, sons, Abhishek Singh and Praveen Singh, and grandchildren.

In his passing away, we have lost an eminent scientist, great visionary, an able administrator and an institution-builder, who encouraged and inspired all those around him to excel. Although he is not with us today, his legacy in the areas of biology, forensics, law and wildlife conservation will live on.

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