

## Sohan Prabhakar Modak (1939–2022)

Prof. Sohan P. Modak, a stalwart of the Indian academia and an outstanding teacher passed away on the 23 March 2022. When Modak (or SPM as he was usually referred to by his students and associates) and one of us (S.G.) wrote an obituary for Leela Mulherkar, SPM's M.Sc. teacher and S.G.'s Ph.D. mentor, for *Current Science* in 2005, there was no inkling that one day we would be writing this note. With his childlike enthusiasm, tremendous energy, robust health and his way of living life king size, one thought that SPM might even defy death. It therefore came as a shock when he passed away at his home in Pune. However, SPM's contributions to the Indian academia and the legacy that he leaves behind are such that he will be remembered for years to come.

SPM was born in Nasik, Maharashtra in 1939 in a family with a mix of businessmen and academicians. His paternal great grandfather was a historian, while his maternal grandfather was a tutor to the Nizam's children. After his schooling in Nasik, he joined Fergusson College in Pune for his B.Sc. in Zoology and then moved to the erstwhile University of Pune (now Savitribai Phule Pune University, SPPU) for M.Sc. in zoology with embryology as his specialization. He completed his doctorate in the laboratory of Jerzy Gallera at University of Geneva, Switzerland in 1966. In his doctoral work, SPM showed that the hypoblast of chick embryos regenerates and consists of the cells invaginated through the primitive streak. After getting a license to practice science, as he used to refer to the Ph.D. degree, SPM worked for another 12 years abroad, initially at US Atomic Energy Commission Oak Ridge Laboratory, during 1966 to 1969. After spending about a year at the University of Kentucky Medical Centre in USA, he moved to Switzerland in 1970. From 1972 to 1977 he worked as a Staff Member–Group Leader at the Department of Molecular Biology, Swiss Institute for Experimental Cancer Research in Lausanne.

In the laboratory of Tuneo Yamada at the Oak Ridge National Laboratory, he began to understand the process of lens development. Although Yamada was largely working on lens regeneration, SPM characterized and showed that in the developing chick lens, the differentiating fibre cells do not proliferate while the lens epithelial cells retain their proliferation potential. This was

just the beginning of pioneering discoveries that he made in the field of lens development. SPM's stint with Fred Bollum led him to show that DNA fragmentation takes place during nuclear degradation in the differentiating lens fibre cells. For this analysis, he used tritium-labelled nucleotides and terminal deoxynucleotidyl transferase from calf thymus. This method eventually formed the basis of what is now called the TUNEL assay. In a landmark paper in 1977, SPM showed that DNA gets degraded in terminally differentiating lens fibre cells. The



impact of his work in the field of lens development was such that M. A. Wride in a review published in 2011 wrote: 'However, the first studies to carry out a thorough spatiotemporal analysis of the breakdown of the lens fibre cell nuclei in detail were those of Sohan Modak *et al.* in the late 1960s–1970s using the chick embryo as a model. This group also demonstrated that fragmentation of DNA occurs during lens fibre cell degeneration and that this fragmentation is associated with single-strand breaks and the release of free 3'-OH ends, which then can act as templates for calf thymus DNA polymerase and terminal deoxy-nucleotidyl transferase in an early version of the TUNEL reaction. Subsequently, double-strand DNA breaks occur resulting in the presence of low-molecular-weight DNA species of discrete sizes, and this is similar to the well-characterized banding patterns seen in DNA from cells undergoing classical apoptosis'. While there is a debate on whether this process can be called as the 'attenuated form of apoptosis', it is clear

that there are remarkable similarities between nuclear degradation in lens fibres and in apoptosis.

SPM returned to SPPU in 1979 as a professor in the Department of Zoology. Soon after joining, he completely transformed the department with his infectious enthusiasm. He spent most of his time in his office or laboratory. One of the first things that he did was to deliver a series of scintillating evening lectures in molecular biology for students and interested faculty. Everyone was completely stunned by his oratory skill, diction, body language, clarity of thought and charisma.

At SPPU, SPM continued to work on the lens, albeit with a focus on lens proteins from various vertebrate taxa and their evolution. This work eventually led to the development of molecular phylogenetic trees in 3D-based analysis of vertebrate lens crystallins. The idea of phylogenetic analysis in 3D was further extended to prokaryotes by analysing bacterial aminoacyl-tRNA synthetase. Around the late 1980s, SPM became fascinated by the implication of cell cycle time in the regulation of animal development. The broader idea possibly was that differential cell cycle times, leading to differential cell divisions, would influence the levels of developmental signals and have a profound effect on the development. SPM along with his graduate students showed that the cell population doubling time, which directly depends on cell cycle time, changes during early chick development and that during gastrulation different germ layers exhibit different population doubling times. Using two perturbations, retinoic acid treatment and transplantation of post-nodal pieces, it was further established that the slow cell population doubling time is correlated with caudalisation of the embryonic axis. It was also elucidated that the neural inductive response of the chick ectoblast is inversely correlated with its proliferative status. Besides, it was shown that the increased induction time is required for the proper morphological organization of the neural tube via regulation of cell proliferation.

As a mentor, SPM expected the highest level of perfection from his students – whether it was performing experiments, collection and presentation of data, or writing manuscripts. While he was a taskmaster, he also gave enormous freedom to his students when they wanted to explore their

own research ideas. He would provoke, challenge and even poke fun at his students to get the best out of them. Life was anything but boring in his laboratory and around him. We used to have fun, parties, volleyball sessions and heated discussions and arguments in the laboratory. Every big and small success and achievement was celebrated with a party and as people began to enjoy and relax, some other plan took shape in SPM's head. Before the party ended, he would excitedly tell us what he was thinking of doing next. That often turned out to be a prelude to the next party.

SPM was far ahead of his times. In the early 1980s, he made his M.Phil. and Ph.D. students take courses in computers, electricity and electronics, and photography, which was then unheard of in biology departments. He revamped curricula for college and university courses so that students are exposed to landmark experiments and concepts in modern biology. With the help of the English Department, he introduced a course on oral and written science communication. He started the first-ever evaluation of teachers by students, which often made the teachers appreciate the concerns of the students. As with many of his other initiatives, there was some opposition in this case too, but SPM persisted and succeeded with this as he did with many of his other radical ideas. Way back in 1996, in a detailed article in *Current Science* (Modak, S. P., *Curr. Sci.*, 1996, **71**, 460–467), he made a strong case for a five-year integrated M.Sc. course in life sciences. One can find many of his suggestions incorporated in such courses offered today by various institutions across the country. Years before this, in 1988, he wrote a letter to late Obaid

Siddiqi (<https://archives.ncbs.res.in/node/658>), wherein he discussed the sorry state of B.Sc. curricula in India, the need to revamp it to attract bright students to biology and the necessity for everyone to come together to improve the situation. SPM frequently organized scientific meetings and workshops, wherein he invited some of the best scientists from all over the world; this provided the much-required exposure to Master's and doctoral students and post-docs to the latest research being carried out by leaders in various fields. SPM also played a major role in the birth of several academic institutions in Pune; in fact, they all took birth on the premises of the Zoology Department of SPPU and have now become independent institutions. SPM started one of the first five biotechnology teaching centres in the country as well as the Bioinformatics Centre in SPPU. He, along with the late Ulhas V. Wagh, set up the National Tissue Culture Facility which is now the DBT-National Centre for Cell Science on the SPPU campus.

SPM was an outstanding teacher. He used teaching methods that were quite unconventional in those days and even now. He would teach chromatin organization using a microphone wire and dusters lying around. The emphasis was never on conveying the contents of the book to the students but to discuss outstanding questions in the field, what experiments were performed to address those questions and to generate knowledge. His lectures would easily run for 2–3 h, without the students realizing it. He would ask questions every 10–15 min just to see whether the students understood him and would not hesitate to repeat himself if it was necessary. SPM was well aware

of the socio-economic background of his students. He coaxed them to participate in discussions and ask questions. Students loved his teaching and adored him. He was almost always the most favourite teacher of majority of the students in the years he taught at the Zoology Department in SPPU. He was the antithesis of a conventional 'Guru'. Despite all his unconventional ways, SPM was extremely popular amongst the students. They saw a brilliant and passionate mind that hated hypocrisy and an individual who remained invested in his students but did not expect them to put him on the pedestal.

SPM was truly a multifaceted personality; he was an excellent cook, a connoisseur of wines and wrote poetry in Marathi, English and French. It is in fact impossible to bring out all the facets of this maverick academician/researcher in a single write-up.

SPM is survived by his wife Sharmila (who is a Professor at Delhi University), a daughter and a son.

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