

Editorial

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Har Gobind Khorana: A Junoon in Science

'I have met people who believed they knew at a very young age what they wanted to do in their lives. I envied them, but my own life was not like that' is the statement Har Gobind Khorana (Gobind to friends and colleagues) made in his article, 'A Life in Science' (*Science*, 2000, Vol.287, p.810). For those who do science for the love of science, this is an ever inspiring statement. In the article, Gobind provides a true example of how the highest level of scientific achievement can go hand in hand with personal modesty. The contents of this article are also a vivid illustration of the saying 'Where there is a will, there is a way'. Among the many awards, prizes and accolades he received during his career, Gobind was a Nobel Laureate and recognised by his country with the Padma Vibhushan.

Gobind chose to work on difficult problems at the interface of chemistry and biology but chose them carefully and the methods to tackle them were always well thought out and futuristic. In doing so, Gobind defined and travelled new paths in an area that we now call Chemical Biology. Gobind's own research can be divided into three stages, (i) Chemical synthesis, largely of nucleotides and the related compounds during his tenure at British Columbia Research Council in Vancouver, Canada; (ii) Gene synthesis, cracking of the genetic code and establishment of biological activity of synthetic genes, which are really the first examples in Synthetic Biology, at the Institute for Enzyme Research in Wisconsin, and then in the early years at Massachusetts Institute of Technology (MIT), Cambridge, USA, and (iii) Pathbreaking studies on the mechanisms of signal transduction using bacteriorhodopsin and rhodopsin at MIT.



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I was fortunate to have many interactions with Gobind. But the incident that left an indelible mark on me was perhaps also our shortest meeting. We were exchanging pleasantries in the 'kitchen' of the Khorana/RajBhandary wing in the Biology Department of MIT. Gobind asked me what I had been doing. I told him that I was generating a mutant. He responded, 'That's our culture'. It was aptly said: science is a culture. Like a religion, the culture of science also requires discipline and has its own do's and don'ts. It evolves with time and, of course, with the pragmatic exploitation of emerging tools and technologies. Gobind had a *junoon* (passion) for the culture of science. In teaching by example, he spread it extremely effectively.

'Obviously, the highest type of efficiency is that which can utilise existing material to the best advantage.' This quote of Jawaharlal Nehru aptly describes Gobind's career in science. As readers will appreciate after going through the articles in this issue of *Resonance*, Gobind made the best use of the opportunities that came along his way. That was true of the opportunity to do a Master's in chemistry at Punjab University, Lahore (then a part of India), a PhD at the University of Liverpool, UK, post-doctoral research with Vladimir Prelog at Swiss Federal Institute of Technology (Eidgenössische Technische Hochschule) in Zurich, and with Alexander Todd at Cambridge University in the UK. It was equally true during his independent research career at Vancouver (Canada), Madison and Cambridge (USA). Gobind's vision of science combined with hard work ensured that wherever he was, he was extremely successful. It is no surprise that he is admired by a huge scientific community. Many innovative programs to support scientific research have been named after him. They include the Khorana Program for Scholars; Khorana Program for Technology Transfer; Khorana–Nirenberg Scholars Program for exchanging students and scientists between India and USA; and the Khorana Chairs at various institutions. These are but a few examples of Gobind's impact on the scientific community worldwide and the extraordinary respect his name continues to command because of what he gave to society.

An international meeting on the theme 'From innovations in nucleic acids research to regulation of biological processes' was held in December 2011 at Indian Institute of Science, Bangalore. It was put together to commemorate the scientific achievements of one of the most distinguished associates of Gobind, Uttam L RajBhandary (Tom). Tom did his post-doctoral research with Gobind at the Institute for Enzyme Research at the University of Wisconsin, Madison, USA, one of the places where history was made during the golden era of molecular biology. Even after starting his independent scientific career at MIT, Tom continued his associations with Gobind, who had moved to MIT too. During the years 1988–1991 it was my



good fortune to work as a post-doctoral associate with Tom. An unforgettable memory of the times is that researchers in the two groups worked together in perfect harmony; no boundary could be distinguished between what were formally two independent laboratories. So it was natural that people from both groups participated with enormous enthusiasm at the Bangalore meeting. It provided the perfect setting to celebrate Gobind's scientific achievements in a special session titled 'Remembering Gobind Khorana'. The fact that he had passed away very recently – on November 9, 2011 – gave a special tinge to the session. The rich historical content of the talks given at the session prompted this Special Issue. The scientific legacy of Gobind is truly international; a great many of those mentored by him have achieved high recognition in science. Still, of necessity, the articles in this issue are primarily by those who participated in the meeting.

We are happy to bring out this special issue of *Resonance* containing articles that represent Gobind's work from all three stages of his career. The first one is by none other than Tom RajBhandary. Tom lucidly describes the scientific journey of Gobind and the highlights of his research in Vancouver. Beautifully prepared, the second and the third articles by Dieter Söll together with Jiqiang Ling, and by Marvin Caruthers, respectively provide first-hand glimpses of working with Gobind and a taste of the electrifying research done in Wisconsin and during the early years in Cambridge. Marvin's article highlights the use of a DNA polymerase procedure used routinely in Gobind's laboratory to grow DNA. These procedures were so far ahead of their time that they were forgotten later, and Gobind missed his second Nobel Prize for innovation of PCR. Finally, in the fourth and the fifth articles, Sadashiva Karnik together with Sriram Subramaniam, and Thomas Sakmar together with David Farrens, wonderfully describe the excitements of research in the later years at MIT. In addition to these articles, the issue carries the text of a review that Gobind wrote for the journal *Science* in 1979 in which he describes the route he followed to the total synthesis of a gene and the demonstration of its biological activity.

I am indebted to the authors who enthusiastically agreed to contribute to this special issue. They have shared their memories of working with one of the greatest visionaries and researchers who ventured into unknown areas of science and charted new paths to leave behind an unparalleled legacy. The articles have been put together by way of paying our homage to Gobind. I hope they will serve to motivate and inspire students – to learn from the experiences of the authors, to learn from the immortal legacy that Gobind has left behind to break newer grounds in science, and, one hopes, to make us see more Khoranas.

