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Up Against Odds: The Story of an Indian Researcher

Hardev Singh Virk*
Visiting Professor, SGGS World University, Fatehgarh Sahib, Punjab, India

Abstract

The story of an Indian researcher is the scientific journey of a rural youth who tops in high school and is motivated by his teachers to study science. It depicts his fight against all odds to carry out his research activity in India after his training abroad. It is written to inspire other young Indian scientists who face the dilemma of working in India after their training in world class universities in Europe or America. It is a personal appraisal of author's own research.

Keywords: *Marie Curie University, particle physics, L-meson, geochronology, ICTP, radiation damage annealing, earthquake prediction, radon, nanotechnology*

****Author for Correspondence*** E-mail: hardevsingh.virk@gmail.com

INTRODUCTION

I was born in a small village *Majhiwala Bhuler*, in Faisalabad (then Layalpur) district of Punjab (United India) in August 1941, but my school teacher recorded it as 23 February 1942, as in our rural areas, no birth registers were maintained. I was admitted to Primary School of Kamo Ke Mandi, district Gujranwala, in March 1947, the year India was partitioned into 2 countries, India and Pakistan. I have vivid memories of days of Partition, our migration to Indian Punjab and settling down in a village, Chhokran, near Malerkotla. My schooling started in a one teacher Primary School at village Lassoi in 1948, with hardly any infrastructure for teaching and learning.

Learning was by rote and I mastered all the texts. I topped in Government High School Malerkotla (1957) and opted to study science (non-medical group) on the advice of my Headmaster. My interest and faith in science grew after reading a popular science book "The Universe and Dr. Einstein" by Lincoln Barnett, awarded to me for scoring second position in First Year of College Physics. I was so fascinated by the Theory of Relativity and Cosmology that Einstein became my role model in life. During M.Sc. at Aligarh Muslim University (AMU) (1961–63), I became interested in Metaphysics as well as history and philosophy of science. After my Master degree (M.Sc.) in Physics, my interest shifted to the study of elementary particles due to motivation of Prof. P.S. Gill, an authority in cosmic ray studies at AMU Aligarh. When I started teaching in Punjabi University Patiala in 1965, my favourite subjects were theory of relativity and particle physics including cosmic rays.

RESEARCH TRAINING AND RETURN TO INDIA

My research career started in 1970 when I was selected as a 'Boursier' (Scholar) of the French Government to pursue my doctoral research in Marie Curie University of Paris under Professor Max Morand in Particle Physics. Our group was working on nuclear emulsions exposed to proton beams at CERN (Geneva) and Fermi lab at Batavia. My passion to find a new particle or a resonance in high-energy nuclear interactions was so great that I started working round the clock in my laboratory. For two years, I worked in perfect isolation and got frustrated in my research pursuits. A visit to Rutherford Laboratory in Cambridge in April 1972 brought me on the right track and I submitted my doctoral thesis rejecting the hypothesis of L-meson put forward by my own research supervisor, Tsai Chu. My research career has been quite eventful but I bade good-bye to Particle Physics after failing to discover a new particle proposed by Tsai Chu.

I returned to India in 1972 to teach in Physics Department of Punjabi University, Patiala. During the seventies, India had no high-energy

accelerators. I had to travel to Delhi University for scanning my nuclear emulsion plates exposed to Deuteron beam at Dubna (near Moscow). It did not work-well and I planned to change from Particle Physics to Radiation Biology. In April 1974, Indian Institute of Science, Bangalore organised a four week Summer School in Biophysics under the supervision of world famous Biophysicist, Prof. G.N. Ramachandran, who encouraged me to submit a research project which was not approved by the funding agency (CSIR) as I had no background in biology or biochemistry. I was looking for an escape route from Particle Physics and took fancy for Geochronology after visiting research laboratory of Prof. K.K. Nagpal in K.U. Kurukshetra.

During 1974, I was sanctioned a research project by CSIR on "Dating of Rocks" and my odyssey into Earth Sciences began. Collection of Rock samples from different regions of India and Himalayas became my pastime. The first experiment was a success when we etched Mica samples with HF acid and observed needle shaped tracks under an optical microscope. After our publications in Geochronology, we became eye sore of Geologists who discouraged us to undertake dating work, but there was no option left and I had to study lot of books on earth sciences to justify our findings. Sohan Lal Koul and Surinder Singh Parmar both got their Ph.Ds. working under my supervision in Geochronology.

ROLE OF ICTP

ICTP, Trieste (Italy) played a great role in shaping my scientific career in India. During 1977, Professor A.H. Cook of Cambridge University conducted the first ten-week course on Physics of Earth at ICTP and I was lucky to join it. It gave me an opportunity to visit some laboratories in Europe. In those days ICTP funded such visits and the choice was given to the participant. I also made a friendship with Professor Abdus Salam, Nobel Laureate and Director of ICTP, which lasted till his death. We met frequently and discussed the problems of scientists from the developing countries. I advised him to start more courses of the applied nature, e.g., medical physics, soil physics, geophysics, and microelectronics, to which he agreed in principle but he had reservations about setting up research laboratories at the ICTP.

In 1979, I moved to Guru Nanak Dev University (GNDU), Amritsar to start a new department of Physics. It was a big challenge in my life. For a while, we continued our pursuit of dating of rocks but in 1981, ventured into domain of Radon studies in the environment. There was hardly any other group except Prof. Rama of TIFR and Dr Ghosh of AMD, Hyderabad working in this area. We tried to exploit Radon anomalies for Uranium exploration and Seismic activity in the area of Siwalik Himalayas in 1984. Fortunately, our research efforts were supported by funding agencies (CSIR, DST and Punjab Govt.) and by 1990 we could set up a Seismic station in GNDU campus and two others in Punjab (Hoshiarpur and Thein Dam) for monitoring Earthquake activity in and around Punjab. Radon monitoring was also carried out at 6–8 stations in a time-series mode along a profile running from Punjab plains to N-W Himalayas. Our group scored a century of Papers and some of these are considered as bench mark for Earthquake prediction research using Radon as a Precursor [1–5].

After my training at the ICTP, I ventured into new fields of research in Earth Sciences, namely, Geochronology, Exploration Geophysics, Earthquake Prediction studies. Professor Abdus Salam visited my laboratory in 1981 and was surprised to see a Particle physicist transformed into a Geophysicist. I also attended courses in Medical Physics at ICTP and on return to India set up the Radiation Physics laboratory in Guru Nanak Dev University, Amritsar.

During 1980s, we took a diversion from Geochronology to radiation damage studies in minerals, plastics and glasses. The aim was to study annealing of radiation damage in all type of materials, popularly known as Solid State Nuclear Track Detectors (SSNTDs). Another century of research papers were published by our group in radiation damage annealing. The highlight of our work has been recognized in the form of a dozen publications on single activation energy model in SSNTDs of all types starting with mica and ending with

quartz [6–10]. Recently, I published review paper [11]: "Modgil- Virk Formulation of Single Activation Energy Model of Radiation Damage Annealing in SSNTDs: A Critical Appraisal" which is based on work carried out during a span of almost 20 years.

RESEARCH COLLABORATION

Our collaboration with GSI Darmstadt started in 1985 when I attended the meeting of User Committee held in Oct. 1985. Dr. Reimer Spohr from GSI visited our Laboratory in 1990s and we planned some experiments using Heavy ion beams from UNILAC facility. Most of our SSNTDs were irradiated at GSI using ion beams from Xenon to Uranium and etching and annealing studies were carried out in our laboratory at GNDU Amritsar. One of the highlights of our investigations was fabrication of Ion Track Filters which found applications in medical diagnosis of cancer cells and microstructures of mica and plastics.

During 1990s, heavy ion beams became available in India with the setting up of a Pelletron facility at Nuclear Science Centre (NSC), now re-christened as Inter-University Acceleration Centre (IUAC), New Delhi. However, the beam energy at IUAC is of lower energy, lower fluence and choice of ions is also limited in comparison with UNILAC facility at GSI. But it is serving the purpose of Indian researchers quite well.

At the time of my retirement in June 2002, our research group could boast of 300 research publications covering vast areas of research from Particle Physics to Geochronology, Geochemistry and U Exploration, Radon and Earthquake Prediction, Seismology, Radiation Effects in SSNTDs, Heavy Ions and Modification of Materials. In 2008, I joined as Director Research in DAVIET, Jallandhar and got an opportunity to explore the field of Nanotechnology. Our journey in nanotechnology was short-lived but we were successful in developing some important nanomaterials and nanowires. Production of a variety of nanoflowers as a by-product of nanowires was a big surprise in store which was appreciated by one and all. We had research collaboration with some universities in India and abroad. Our Physics Department was affiliated to ICTP for almost a decade. A centre for the promotion of science was set up under my supervision for popularisation of science in Punjab; research grants were received from ICTP in a project mode; the book *Ideals and Realities* by Abdus Salam was translated by me into Punjabi under the title "*Adarsh ate Haqiqat*" and I had the honour to work as a Senior Associate of ICTP (1988–93). ICTP proved to be a launching pad for my research activity in India, culminating in the publication of 380 research papers, 150 popular science articles and 35 books during my scientific career [12].

CONCLUSION

I visualize a change in Indian scenario after my retirement in 2002. Inter-disciplinary research is being promoted by funding agencies; liberal funding is being provided to support research activity in the universities with no cap on funds as it was during our times during 1970-80s. The biggest advantage is availability of manpower for research in India. There is a paradigm shift in the trend of admissions from engineering courses to basic sciences since 2012. Out of 25,000 seats in engineering colleges in Punjab, just 10,000 have been filled up during first counselling.

It augurs well for promotion of research in Indian universities. But, we have to be vigilant on mushrooming of third rate universities which are diluting standards by registering candidates for Ph.D. without any infrastructure. Since there is a big market for Ph.D. seekers in India, these universities exploit the gullible and almost sell the degrees. Universities have to be ranked purely on the basis of research output for accreditation and to bring them at par with world class universities, where we have none among top 200 at the global level.

End Note

The title of this paper is borrowed from the book of Professor PS Gill, my role model and teacher of Physics in AMU Aligarh. I feel inspired by his struggle to earn a Ph.D. from Chicago University working under Nobel Laureate, A.H. Compton, and then his meteoric rise in the field of Cosmic Ray Physics.

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