MY ENCOUNTER WITH SSNTD: REFLECTIONS AND REMINISCENCES

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On 5th October, 1970, I landed at Orly airport in Paris as a Bursier du Government Française (French Govt. Scholarship-holder) and on 6th October I registered myself as a research student in University at Paris VI, Jussieu. Professor Max Marand, Director of my research laboratory was a cosmic ray physicist who was guiding research in Elementary Particle Physics using nuclear emulsion technique. My supervisor, Dr. Tsai Chu, was a Chinese scientist who was guiding a small group of research workers. I was told to learn scanning of nuclear emulsion plates exposed to 14 Gev Proton beam at Synchrocyclotron of CERN in Geneva. It was a difficult job and I could not find any 'white star' during first two months. However, I found nuclear interaction events (stars) with lot of dark and grey tracks. My job was to select 10 clean events (white stars) with high-energy secondary particles in the jet. It was quite a frustrating experience to look through the optical microscope for more than ten hours as a daily routine. My Chinese guide was a hard taskmaster and he claimed to have set a world record in scanning nuclear emulsion plates manually. My first lesson was to work hard with utter patience and grit to succeed in research. We held weekly meetings to discuss the progress in scanning.

After 6 months, my research problem was defined and I was asked to study relevant literature. Dr. Tsai Chu claimed to have identified a new lepton (L-meson) and my assignment was to confirm his finding. After scanning ten 'white stars', I started grain counting using Koristka microscope. Particle identification was done using Coulomb multiple scattering technique and an old IBM 1620 machine was at my disposal. When the analysis was done, I failed to identify any L-meson particle in 14 Gev P-N interactions. My Chinese supervisor was quite annoyed but adamant and he made me revise all my results. I stood my ground and reported the results to the Director of my laboratory who was quite pleased to know that I have found contradictions in the hypothesis of my own supervisor.

A tug of war started, my supervisor opposing my research findings and my director supporting me. Before writing my doctoral thesis, I visited Rutherford Laboratory in Cambridge University and reported my results in a seminar lecture. The group in Cambridge had earlier supported Tsai Chu but after my lecture, they were convinced that there is no L-meson production in high-energy nuclear interactions. Thus I learnt the second lesson of my research career, i.e., a research worker has to be consistent and objective in reporting his findings. In the jury, my supervisor opposed my thesis but all the other examiners highly recommended it for the highest grade (Très Honorable) of Paris University on 26th Sept 1972. I had most trying time of my life during writing of my thesis and then defending it but my faith in scientific values and courage to speak the truth helped me a lot. This training in defending the objective reality of research findings was a cornerstone of my research career but it led to some difficulties when the same philosophy was applied to my public dealings in India. So I learnt the third lesson of my life, i.e. scientific values have to be tampered with social and moral values of a country to succeed in public life.

While writing my thesis, I chanced upon to scan through conference proceedings in my research laboratory. I remember the SSNTD Conference series started in Strasbourg, France under the title 'Corpuscular Photography' during sixties. Most of the papers presented belonged to nuclear emulsion technique. It was at Clermont Ferrand Conference (1968), Professor R.M Walker participated and SSNTD theme was introduced for the first time. French workers, e.g. Michelle Monnin and M. Maurette, took the clue from Prof. Walker and started SSNTD research in France. Professor P.B. Price visited TIFR, Bombay and Punjab University, Chandigarh during sixties and SSNTD research groups came into existence with Professor D. Lal as a leading physicist in India. My supervisor had participated in SSNTD conferences held at Barcelona (1970) and Bucharest (1972) but I was denied this privilege.

I returned to India in October 1972, and joined my tenure position as a lecturer in Punjabi University, Patiala. High Energy Physics groups had shifted from Nuclear Emulsion technique to Bubble Chamber /Spark Counter as detectors. I had to choose my track in research as nuclear emulsion was out of fashion out as an efficient detector.

I visited Delhi University (Prof. Bhowmick), Punjab University, Chandigarh (Prof. I.S. Mitra) and Kurukshetra University (Prof. K.K Nagpal) to start a collaborative work as there were no facilities in my own university. I learnt the fourth lesson of my life, i.e., research collaborations work only if you are at a vantage point, otherwise you are bound to get a step – motherly treatment.

After wandering for a year hopelessly, I submitted two research projects, one in nuclear emulsion technique and the other in SSNTD field to UGC and CSIR, respectively. To my utter surprise, both the projects were sanctioned during 1974 and thus my encounter with SSNTD started.

I had my training in nuclear emulsion technique but it was fading out in India during seventies. We had the projects but no infrastructure, e.g. no laboratory, no research journals and no technical staff. My office room became my laboratory and we started from a scratch to build up SSNTD laboratory in Patiala, Sohan Lal Kaul was my first Ph.D. student, followed by Surinder Singh after a year. We borrowed reprints from R.L Fleischer, S.A Durrani and host of other SSNTD workers and everyone obliged us. Within a year, we published our research paper "Fission track ages of some biotites of Bihar mica belt in Indian J. of Pure & Applied Physics. Fission track dating of mineral crystals, uranium estimation and annealing of fission fragment tracks kept us busy for almost a decade. When heavy ion facility was provided by GSI Darmstadt in 1985, we embarked on our path – breaking research on annealing kinetics of heavy ion tracks in SSNTDs. S.K. Modgil, A.S Sandhu, R.K Bhatia and Gurinder Singh were instrumental in proposing new annealing models. It happened to be a 'golden epoch' of our SSNTD research. Single Activation Energy Model proposed by our group in 1983 at SSNTD Conference in Acapulco, Mexico was adopted by Australian fission track workers. Professor Price and his group at Berkeley gave theoretical formulation of our model and used it for identification of relativistic cosmic ray nuclei in Space Shuttle 'Ions' Experiment. I learnt the fifth lesson of my research career, i.e., an experimentalist must be strong enough in theory to interpret his results, otherwise he may be robbed of full credit due to him. Publication of results is more important than doing innovative experiments in this age of competition.

During 1980's, radon monitoring in the environment had just started in India and our group played a leading role. We tried to exploit radon in all possible ways, namely, to estimating radon dose in dwellings, monitoring radon in soil, ground water and thermal springs for uranium exploration, and using radon as a geochemical precursor for recording earthquakes. The group got international recognition in earthquake studies and radon/helium data established some hidden faults in Himalayas and will serve as a baseline data for future investigations. During the last decade, I tried my luck in frontier areas of research using SSNTDs, e.g. ion track filters, nanotechnology and polymer modification. There was a tough competition but our group etched its path in the field. Some interesting results were reported in the literature using ion track filters and ion beam modification of polymers. Fortunately, Pelletron beam facility at Nuclear Science Centre, New Delhi became operational in July 1995 and we our allowed the privilege of being the first user in India.

I always call SSNTDs a poorman's detector. During my thirty years encounter with SSNTDs, I have learnt many lessons, traveled around the globe participating in international conferences, making everlasting friendships with peers and retiring gracefully with the satisfaction that all of my research workers are employed gainfully. I salute the pioneers of SSNTD field R.L. Fleischer, P.B. Price, R.M Walker, and my friend S.A. Durrani for promoting SSNTD research in developing countries, starting the house journal 'Radiation Measurements' as its Editor-in-Chief and founding International Nuclear Track Society (INTS) to which I belonged as an Indian representative for almost two decades. I wish good luck to all young SSNTD researchers in developing countries.