

A Tribute to Prof. S. Naranan on his 80th Birthday

From:

Colleagues at Tata Institute of Fundamental Research, Mumbai

>> Linguists, Physicists, and Mathematicians

April 17, 2010

S. Naranan (Reminiscences by B V Sreekantan)

Naranan after completing his M.Sc in Physics from Banaras Hindu University, joined the Tata Institute of Fundamental Research as a Research Scholar in 1950 and started working with me in the cloud chambers group. I had joined TIFR in 1948 and was involved in doing an experiment on the decay of cosmic ray mu-mesons. Towards the end of 1950, Dr Homi Bhabha our Director was organizing the first ever International Elementary Particle Conference at TIFR in Bombay for which he had received papers from several leading cosmic ray physicists of the world and who had planned to attend the conference. Some of the papers related to the discovery of new particles in cosmic rays. Perhaps influenced by these discoveries, Dr. Bhabha called me late one evening and suggested that I should take my meson decay apparatus down the Kolar Gold Fields and verify whether all the penetrating particles underground are mu-mesons.

It so happened that the 1951 Indian Science Congress was to be held in Bangalore at the Indian Institute of Science campus and Dr Bhabha was the General President of the Congress and many of us came down to attend the congress. Most of the foreign scientists who had come for the elementary particle conference at Bombay also came to Bangalore. Immediately after the conference, Naranan, myself, Dr Ramanna and Dr (Miss) Choudhuri another of our senior colleague went to Kolar Gold Fields to examine the possibilities of doing the cosmic ray experiment in the mines. We found that the facilities for doing the cosmic ray experiments at various depth were excellent and the mining authorities promised all help. We decided after discussion with Dr Bhabha that we should do an intensity depth measurement of the penetrating component of cosmic rays first and then plan the design of the more elaborate decay experiment, Naranan and myself built the experimental setup by May, 1951 and moved to KGF for starting the underground measurements. We carried all the equipment by train, some of it in the luggage van and most of it in our own compartment. We took a train to Bangalore via Guntakal. We left Bombay in the afternoon and reached Guntakal next morning. We had to change to the Meter Gauge train at Guntakal to go to Bangalore. We bought the morning paper at the station to know what the latest news was. To our horror and consternation, we read that there had been a rock-burst in the Kolar Mine and there was

lot of damage to the buildings on the surface. We stepped over in Bangalore for a day, arranged for a Van to take all our equipment and us also to the mines next day. Dr Ramanna who happened to be in Bangalore also joined us and stayed with us in the traveler's bungalow in a place called Robertsonpet which was about 4 kms from the Richard Shaft where we set up our experiments. We stayed on the traveler's bungalow for several months perhaps for more than a year before the mining authorities provided us one of their quarters near the mines. We used to hire cycles at monthly rate and cycle up and down the 4 kms everyday. We measured the intensities of the penetrating component at four underground depths, the deepest level being ~1000 ft below ground. To ensure smooth operations of the apparatus and also to ensure there was no fire hazard we kept a vigil round the clock. We spent the whole night underground by turn along with another mine employee who was deputed to ensure our safety. Dr Bhabha visited us at KGF on the 24th December 1951 which was Christmas Eve. The next set of experiments we started in the same mines with slightly different telescope which could be rotated to different zenith angles. By the time this second experiment started in 1952, Ramana Murthy had also joined us. This first series was followed by our setting up a round cloud chamber at a depth of 100 ft in another shaft - Okley shaft. By the time we could get the chamber operating, the mining authorities told us that we have to vacate since they are going to close down the mines. We moved to an abandoned tunnel in Khandala and continued the cloud chamber experiment the results of which formed the PhD thesis of Naranan.

I went away for a year July 1954, - July 1955 to MIT to work in Prof. Ross's group. In December 1954, Naranan, Ramana Murthy, Subramanian and Sahiar set up a double cloud chamber experiment at Ooty in one of the hutments in the Raj Bhavan area to look for the new s-particles in cosmic rays. For staying the Tamilnadu Governor had provided accommodation in the Gate House which was a big Bungalow at the entrance to the Botanical Gardens in Ooty. I went to Ooty in December 1954 and the first thing I did was to replace the GM counter triggering system by scintillation counters. The cloud chamber experiment ran for several years operated by Subramanian and Siddheswar Lal. Naranan and I set up three Air Shower experiments – a preliminary one on the roof of the B-block of TIFR at Navy Nagar, the second one at Ooty and the third one at Kolar

Gold fields. The KGF mines had not closed down. So we went back then for another three decades or so for a variety of experiments. The KGF Air Shower Experiment was the main responsibility of Nararan. I continued with the experiments at Ooty, where several developments were undertaken – the building of the Total Absorption Spectrometer, the Large cloud chamber etc. By this time several students were working with us for their PhD – Chatterjee, Murthy, Raghavan, Rangaswamy, at Ooty and Sivaprasad, MVS Rao, Viswanath at KGF. We also had several very capable and dedicated scientific assistants with us - Dinshaw, Apte, Khairatkar, Gonsalves, Gopal, Kalagaonkar, Manchanda, Kamat, Samuel. Since we spent long periods in the field stations, our families were also with us. We used to go on picnics and hikes over the week ends. In the evenings we played badminton or go to the movies. All this is just to give a flavour of the wonderful atmosphere in which we carried out our serious research activities in the field stations of our cloud chamber group. What was most important was the group activity and team spirit, long hours of work round the clock. Since cosmic rays poured down day and night but had feeble intensities at the energies we were interested, round the clock operation was inevitable.

The next phase of the activities of myself and Nararan was in a different field altogether. After spending the period August 65 to Feb. 67 at MIT, working in the field of x-ray astronomy. I started the x-ray astronomy programme in TIFR with the help of the balloon flights group headed by Gokhale. Nararan joined us also in this activity. Later we got into rocket and satellite astronomy. We had collaboration with the Japanese and Calgary groups in Gamma ray astronomy. Though we have retired, these activities, are continuing in TIFR on a large scale and with great deal of sophistication.

I am particularly grateful to many colleagues, especially to Nararan for giving all the help in initiating these programmes and making them a success. I always cherish this long happy association with my TIFR colleagues. I wish Nararan and his family all the best in the years to come. Ratna had always a special affection to Vishalam and used to remember the early happy days spent together in Ooty.

A Tribute to Prof. S. Naranan on his reaching 80 years of Age

P. C. Agrawal

Tata Institute of Fundamental Research, Mumbai

I had privilege of close association with Prof Naranan at TIFR for more than 2 decades and therefore, I am very happy to share my reminiscences of him on his attaining this important milestone of 80 years.

I first came in close contact with him around 1970 when I was deeply involved in study of hard X-ray emission from X-ray binaries using balloon-borne instruments from Hyderabad. The field of X-ray astronomy was in its infancy and was developing rapidly with new and exciting results. Prof. B.V. Sreekantan had returned from MIT in USA around 1967 where he participated in several pioneering rocket-borne experiments in this field which led to important discoveries. X-rays of energy > 20 keV (hard X-rays) had just been detected from the supernova remnant Crab Nebula, Sco-X-1 and Cygnus X-1. Prof Sreekantan immediately realized that infrastructure for conducting balloon-borne experiments in X-ray astronomy existed at TIFR and there was a great opportunity for making important contributions in Hard X-ray astronomy. He seized this opportunity and several of us who were working in the studies of primary cosmic rays switched over to this new and exciting field. I distinctly remember that we were at Hyderabad for conducting a balloon experiment for studies of bright X-ray sources when Prof Naranan appeared there. He had just returned from USA where he participated in a series of rocket experiments conducted by the MIT group that produced many new and interesting results. Prof Naranan was very enthusiastic about the experiment and took keen interest in almost all aspects of the experiment. The balloon experiment was successfully launched in night and Prof Naranan remained present monitoring the progress of the experiment for the whole night. We obtained good quality data on several X-ray sources. After the conclusion of the flight we were preparing for the recovery of the instrument. The instrument had landed about 350 km away in a remote place near Ramagundam. It was first week of May and there was scorching heat in that area with day time temperatures in the upper forties. Prof Naranan also offered to join Shri Vasudevachar (a veteran in recovery work) and me in this arduous journey. It was quite a pleasure to talk to him and listen to his experiences of rocket experiments and involvement in some aspects of the first X-ray astronomy satellite, later named as UHURU, in this 2 day journey. He endured the hardships of the journey without ever complaining about the heat, the bumpy roads of the rural area or about lack of food or shelter in this journey.

During this trip Prof. Naranan talked about the possibility of conducting rocket flight experiments from India in X-ray astronomy. Soon after he and Prof. Sreekantan

submitted a proposal for studies of X-ray sources with Indian made Centaur rockets. ISRO accepted the proposal and 2 Centaur rockets were allotted for the experiments. Shri V.S. Iyengar and I were assigned the responsibility of developing the payload for the experiments. I took up the task of developing the proportional counters as X-ray detectors. I developed the detector and Shri Iyengar designed and fabricated the associated electronics of the instrument. We tested the instrument and in 1971 we went to Thumba for the rocket flight. At Thumba we found that the detectors were breaking down when HV was applied and traced this problem to moisture deposition on the high voltage seals. I suggested that this problem will be solved if we covered the seals in silicon potting compound. This was agreed by all and we did the potting little realizing that this will be disastrous as outgassing of silicon compound will poison the detector and ruin the energy resolution. None of us had prior experience or knowledge of the fact that any material used inside the detector if it produces electronegative molecules, the detector will not perform properly. We struggled for a month to restore the detector resolution but were unsuccessful. Prof Naranan did not lose patience or his cool composure throughout this period and was very understanding of the situation. I was feeling very dejected but he encouraged and said that we will solve the problem and come back for the experiment. Not once did he show any anger or ill feeling towards me. He called off the rocket flight and we returned to Mumbai to tackle this problem afresh. I got then busy in writing my PhD. thesis and Next year I left for USA to take up the offer of Research Fellow at Caltech. Meanwhile Shri Iyengar and Prof Naranan successfully made a new detector and conducted the experiment successfully in 1973.

When I returned from USA towards late 1975 I proposed measuring distribution of soft X-ray background in very low energy band ie. 0.1-2 keV band using detectors similar in design to those made for the HEAO- A2 experiment in which I was closely involved during my stay at Caltech. This proposal was also approved by ISRO and 2 RH-560 rockets were allotted for this purpose. Prof Sreekantan and Prof Naranan were the PIs and K.P.Singh and I were the CoIs. Dr K.P.Singh had joined in 1973 to work under the guidance of Prof Naranan and he was deeply involved in the development of the low energy detectors. We went to Thumba for the experiment but detected there problem of cross-talk in electronics which could not be solved despite efforts of several weeks and the experiment had to be postponed. This upset him but he did not lose his temper at any time. Cool and composed nature of Prof. Naranan and his understanding and appreciation of efforts encouraged us all a great deal to tackle this problem later. This aspect of the personality of Prof Naranan greatly impressed us all.

Our group at TIFR had submitted a proposal in early eighties for flying an X-ray Astronomy Instrument on board one of the satellites to be launched with the ASLV rocket. The proposal was accepted in principle with me as the PI. Due to limitation of the payload capability of ASLV, it was deferred to be launched as a piggyback experiment aboard a remote sensing mission of ISRO with the PSLV.

Meanwhile I took sabbatical leave in 1987 to spend a year at NASA/Marshall Space Flight Centre in USA to work on X-ray instrumentation. Prof Naranan happily agreed to work as PI during my absence and oversee the development of the Instrument. I returned towards the end of 1988 and a lot of development of the payload concept had taken place by then. He managed the team very well and his affable and gentle personality helped a lot in this effort. Several years after retirement of Prof Naranan, this experiment was flown aboard the IRS P-3 satellite by PSLV in 1996 and worked well for about 5 years producing many new results on X-ray binaries. I used to send him preprints of our papers. He appreciated the new scientific results that came from this mission and complimented me and my colleagues for this success.

He proved to be equally adept in the resolution of administrative matters and managerial issues. This was amply demonstrated during the years he served as Chairman of Standing Committee on Administration (SCA) at TIFR.

One quality of Prof Naranan that stands out is his deep understanding and love of mathematics and applying this knowledge in experimental work, interpretation of science data and modelling. While active in research in cosmic rays and X-ray astronomy, he pursued side by side the then emerging new field of Cryptography and indeed developed with the help of Shri John, a software expert in his group, a code to test his ideas in this area. He is today regarded as one of the leading experts in India in this field and his lectures in this area are in great demand. He also published several papers (including 2 in Nature) in the area of Bibliography and citations of journals.

It has been a great pleasure to have been closely associated with Prof Naranan over long years at TIFR. On his completion of 80 years, I wish him and his wife many more years of active, healthy and fulfilling life.

Dear Dr. Venil

Thank you very much for your mail. I was away at my hometown for a few days and returned only on Wednesday night. I am very happy to learn about your efforts on his 80th Birthday. I cherish every moment of my association with him who instilled in me the Joy of Learning. Though words cannot fully express my feelings about him I would like to say the following few humble lines.

" A man with insatiable passion for knowledge across scientific boundaries, indeed the hallmark of a true scientist. I have been fascinated by his deep interests in diverse fields, especially his love for Mathematics and beauty of numbers. I have seen his photographic perfections, admired his scientific oratory skills, keen sense of fine arts and I consider it was my fortune to be associated with him and learn from him a lot. He instilled in me the Joy of Learning. I observed his methods and majestic simplicity, fine aesthetic sense which triggered my interest to emulate him to try to be systematic in whatever I do. But I know for sure that even with my best efforts I will not be able to reach anywhere near his standards, the reason: he is Perfection Personified! ' To thee Sir, I bow with gratitude ad infinitum ' "

I and my entire family Wish you a VERY VERY HAPPY BIRTHDAY AND MANY MANY MORE OF THAT !

A.V. John

From *Surendra Kulkarni* :

I am glad that you have embarked on this endeavour.

I learnt a lot from him - some directly some implied.

I was initially entrusted the job to make copies of select films for TIFR - these would be screened on weekly basis. Somehow other colleagues ran into logistic problems of departing at a particular time - they resided farther away and had to take a particular bus/train to avoid undue rush and reach home to their families on time; and I was bachelor with no such responsibility. Prof. Naranan was also particular that the films should start with their NOVA or PBS signage and the credits/copyrights, etc. be screened till the end - most people differed with him stating that the signage takes about 40 to 65 seconds, the credits sometimes more than three minutes and the delay caused was avoidable.

I used to dabble into repairs and hardware. He encouraged me to learn designing circuits and study acoustics. He probed in a manner that made me run to the books which I never read, because I studied Economics for my BA - I self-taught myself in 'University of Naranan'. He got me all necessary test equipment and spares - I was self-sufficient when I designed and successfully tested and deployed various devices like Multi-channel Parametric Equaliser, Professional Grade 12 channel Audio mixer, Real-Time Analyser, 1KW audio Amplifier, etc. But for him, the HB Auditorium would have lost all the Lighting Equipment without a timely replacement.

He was known to be a soft-spoken person - opening up only if he knew the person well. My dealings were not merely limited to video screenings and maintenance of facilities; it went beyond that.

I recall telling him about my predicament about conducting ceremonies during my marriage - I wanted a simple court marriage - he had known my background and about my family from my conversations with him and me particularly well by then, to judge when to put sense in me - he told me that he is of similar opinion that the extravaganza at such functions should stop. He continued, "but then we are part of the society and sometimes we should consider the social and emotional needs of our families - you tell me that you are the eldest son of the only son of your grandparents - they both are alive must be above 80. Don't disappoint them, do what you feel is right and just for their needs. I can't tell you more than this - because then I might be wrong." Believe me, I went and discovered a place where the marriage could be done with all the rituals, etc. sans the extravaganza. I went and described this to him, which he seemed to approve and promised that he will attend the 'Kalyanam' to bless me and my bride.

There are lots of such personal incidents... He is like a father to me and let me too surprise him. You'll recall he used to like a few films from his collection more than others, Mauna Kea, Pleasure of Finding things out, Miracle of Life. I heard from him that the collection got damaged by fungus, etc. I wish to send him a copy of 'The Miracle of Life' on the occasion. I've his address of Teachers' Colony; is he staying in the same house or has he shifted? - if so, then kindly send me his new address and certainly his email.

There are many more things - probably someday I will write my memories *People in My Life* - Prof. Naranan will certainly be in first three.....

Regards

Surendra Kulkarni

Dear Ms. Venil,

Thank you very much for your e mail and for remembering me on the 80th birthday of Prof. Naranan.

Prof. Naranan was the Chairman of my department and a leading member of our Institute and has made invaluable contribution to the development of experimental astronomy in India. It was under his leadership that TIFR participated in several major space borne experiments and I had the privilege of accompanying him on a few meetings to ISRO to discuss the subtleties of the experimental payloads.

So even before I took up my current field of interest in History of Astronomy, I had a very high regard for Prof. Naranan. Prof. Naranan is an epitome of quiet but firm dignity, very high capability and a very unassuming style of encouraging all academic activity.

When I took up the work on Indus Script I had the privilege of studying his work on this unusual subject in even greater detail. The very fact that he had done research in this field was an inspiration to me when I took up the challenge of studying the Indus script. His pioneering work of using computer linguistics for a comparative study of Indus Script with relation to other written script was well ahead of its time and provided a lot of new insights. In many ways his conclusions, based on his pioneering work have continued to show strong resilience in the light of new research.

I therefore hold Prof. Naranan in great respect and as someone who lighted my path before me. I remain grateful to him for the same and I have always felt honoured to meet him and feel proud when he attends lectures from my group.

I look forward to a long and continuing productive life of Prof. Naranan whose work will continue to inspire us with new and unusual insights.

Please convey my deepest respects and regards to him on this happy occasion of his 80th birthday.

With humble respects,
Mayank Vahia
TIFR

Remembering the Good Old Days spent with Prof. S. Naranan

It is a pleasure to reminisce about my association with Prof. Sundaresan Naranan on the occasion of his 80th birthday. Ever since I joined TIFR in 1958, I worked with him as a member of the air shower group till he shifted his interests to X-ray astronomy. I would like to recall here some of the pleasant memories from those days.

We were 5 members in the group at that time; B.V. Sreekantan, S. Naranan, B.K. Chatterjee, G.T. Murthy and myself. We started an air shower experiment on the terrace of the C block of the TIFR building with 5 liquid scintillation (toluene) detectors and, I think, 2 neutron monitors. My first assignment was to build a 300 V power supply, which was required for all the electronics built from vacuum tubes those days. Dr. Naranan helped me in this project. I still remember one minor accident that took place at that time. One of the resistors used got overheated and caught fire when we left it on overnight. Since then we changed the type of resistors we have been using.

My next assignment was to help Dr. Naranan in building a mechanical computer to analyze the data collected from that experiment. It was an ingenious device originally designed by MIT, USA, which we tried to replicate. I enjoyed working with him on this project. To analyze the data further, he developed a punch-card system to sort the data. We used it extensively.

Our next experiment was at Ooty with much larger number and variety of detectors including muon detectors. I worked with him on setting up the neutron monitor detectors to study the nuclear active particle component. I learnt a lot from him about this detector. Study of these two components formed a major part of my Ph.D. thesis. Even though my thesis guide was Prof. Sreekantan, Dr. Naranan advised and guided me to a large extent as Prof. Sreekantan was away in MIT at that time.

He also helped me in finding a suitable lake in South India to carry out some under-water experiments in collaboration with Japanese scientists. That search took me into the interiors of Tamilnadu, where Dr. Naranan's help was crucial.

Back in Bombay, I undertook writing a program for analyzing the data collected from the Ooty experiment on the first digital computer built in TIFR using vacuum tubes. In this task, Dr. Naranan helped me a lot by discussing various mathematical and statistical procedures and algorithms in a very interesting and illuminating way. This program has, subsequently, become a bench mark program which the computer maintenance engineers used for testing the machine before releasing it for public use.

A few years later, after my return from USA, I joined the KGF air shower experiment, which was started by him. He helped me a lot in developing this experiment to its full potential.

Overall, it was a very pleasant and highly fruitful experience for me to be associated with him for a major part of my carrier. On a personal level, I almost thought of him as an elder brother. Our families also are very close to each other. In fact, I fondly remember those days in Ooty (before my marriage) when myself and Naranans were staying in the Woodville bungalow, Vishalam used to invite me for breakfast whenever she made some special dish like idlys.

All in all, myself and my family cherish those fond memories, and wish Prof. Sundaresan Naranan a

VERY HAPPY 80TH BIRTHAY & MANY HAPPY RETURNS OF THE DAY

M.V. Srinivasa Rao

A Few Reminiscences on the Occasion of Prof. Naranan's eightieth Birthday Celebrations.

P.V.Ramanamurthy
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I am happy to note that Professor S. Naranan has turned 80 years old and that his near and dear and friends are celebrating his 80th birthday. We wish him a further span of 20 years healthy life culminating in a 'century' celebration by his friends and relatives.

I have known Naranan for nearly 6 decades, ever since I joined Tata Institute of Fundamental Research (T.I.F.R.) as a Research Student in the year 1952. My first exposure to the tools, both of hardware and of analysis, of research was in the small group of Sreekantan and Naranan. Prof. B.V.Sreekantan, being the leader of the group, was rather busy in planning and in the implementation of our research programme and somewhat remote to me. Naranan who joined the Institute a couple of years earlier than I did was closer to me in age and spent much time to introduce me to the design and fabrication of the equipment and to the methodology of research. I learnt all my ropes from Naranan and another senior colleague Prof. A. Subramanian. We had to make and wire all our power supplies and electronic circuits by ourselves, using vacuum tubes. There were no off-shelf plug-in modules at the time. Integrated circuits and PCBs were to appear on the scene only two decades later.

We, Prof. Naranan and I, both being bachelors and living in the TIFR hostel had plenty of time together not only to work on the experiments but to converse on every other matter in the universe. It came to me as a surprise that Naranan was proficient not only in his mother tongue, Tamil but in my mother tongue, Telugu, as well. This is because of his elementary and high school education in Berhampur (now in the state of Orissa) where the predominant language then was Telugu. His father, Prof. Sundaresan and his sister India Devi were also proficient in Telugu. Naranan was endowed with a very good handwriting, so pleasant to look at and easy to read. He communicated very lucidly both orally and in writing. I never saw Naranan getting angry or shout at his juniors or scientific support staff if something went against his expectations.

In the first few years of our research careers, our day-to-day living was not very comfortable. Our experiments were 'out-station', in the sense we had to go far off places like Kolar Gold Fields(K.G.F.) or Khandala Tunnels to carry out our work. Compared to the later-day facilities (like office cars and well-stocked kitchens with experienced cooks), our facilities were meagre. We had to either walk to our work or at best go by rented bicycles. In particular, our food was very bad. We hired a novice cook at K.G.F. As it so happened, Naranan's would-be

father-in-law and his friend visited us at K.G.F. They both were appalled at the insipid food we were eating then and sympathized with us. Likewise we were eating at a local roadside dabha when conducting experiments in Khandala. Day in and day out our menu consisted of chappathis, sliced onions, pickle and sprouted moong dal. We survived on that menu for nearly six months. In a sense such a hardship gave our stomachs a strong lining and we rarely had any digestion-related problems in our later lives.

Coming to the research aspects, our first experiments at K.G.F. were Angular Distribution of Cosmic Ray Muons (using Geiger counter telescopes) and Interactions of Cosmic Ray Muons (using a multi-plate cloud chamber). During those days Computers were not in existence and very little of the data recording was automated. We had to baby-sit the experiment in 8-hour shifts round the clock shared between Sreekantan, Naranan and myself. Being the novice in the group I was scheduled for the easiest shift, 6 A.M. to 2 P.M. Naranan volunteered for the toughest shift 10 P.M. to 6 A.M. the next morning. Naranan used to be a prolific letter-writer. One night, during the leisure time of his shift, he wrote an eight-page letter to his father Prof. Sundaresan at Berhampur, put it in an envelope and wrote the address on it. When I went to the underground site to take charge of the experiment, he gave me the envelope, asked me to go to the Oorgaum post office, buy the stamps and mail it on my way back after finishing my shift at 2 P.M. (post office was not opened at 6 A.M.). I agreed to do so. The next day when I met Naranan, I confessed to him that I did not remember if I posted the letter or dropped it somewhere and that I should tell him this in case the letter contained important material. Then Naranan rewrote the whole letter to his father and mailed it by himself. As it happened, Prof. Sundaresan received both the letters within a span of one day, with almost identical contents. This made him worried and, knowing the harsh nature of the night-long shifts Naranan was keeping, he wrote to Naranan enquiring if he was getting enough sleep and if his health was alright! One of the features of our cloud chamber work at K.G.F was a conspicuously more frequent of 'apparent' production of a secondary particle by muons, that was seen to be penetrating a thick material. Attention to this phenomenon was first drawn by a British scientist, Braddick, who termed it as Associated Penetrating Particle (APP) production. Naranan chose to investigate this further at Khandala, which formed the topic for his Ph.D. desertation.

After our return to TIFR headquarters at Bombay, we fitted a trailer (one engineer-contractor, Mr. Guzder built it for us), around the year 1954, with an air-conditioner, a cloud chamber and all the associated electronics, pumps etc and took and positioned it to a disused railway tunnel (we needed at least 150 feet of rock overhead the detector to filter out the electrons, pions and protons of the cosmic radiation) in Khandala to investigate the problem of A.P.P. By this time Sreekantan was busy writing his Ph.D. thesis and planning to go to U.S.A. Mr.Sahiar was leading our effort. We rented a house (Pradhan's Bugalow) to live and used to partake our meals at a roadside Dhabba. We gathered data over a

six month period and it was time to analyze the data, which required a lot of tedious and long calculations. There were no mainframe computers nor desk tops or laptops at that time. We had to do the calculations manually using logarithm tables or slide rules. Since the calculations were lengthy and complicated, Naranan and I agreed that he should check my calculations and vice versa. Finally, Naranan had conclusively shown that the A.P.P. phenomenon was false; it was a case of the more ordinary process of knock-on production by muons, albeit with some unusual fluctuations in the passage of electrons through the thick plates in a cloud chamber.

After Naranan finished writing his Ph.D. thesis, our group moved (around January 1956) on to Ooty (now called Uthagamandalam) at an altitude of 7200 feet above sea-level, to carry out cloud chamber experiments on protons and pions of the cosmic radiation and also to initiate air shower experiments. The Laboratory premises and the nearby living quarters of the Raj Bhavan estate were offered by the then Governor Sri Sriprakasa to Dr. H.J.Bhabha, our Founder-Director who was in search of a suitable high altitude site necessary for the type of our investigations. Indeed our living quarters and the lifestyle were the best we ever enjoyed in our research careers. We were given a posh Bungalow, The Gate House, to live, giving us a breath-taking view of the government botanical gardens. Even the palatial Raj Bhavan did not enjoy such a fabulous view! We engaged, at Mr. Sahiar's insistence, four servants – a cook, a pantry boy, a butler and a servant boy – to keep up with the grandeur of the place. The cook, working in the detached kitchen, was not supposed to enter the main building. The pantry boy used to carry dishes from the kitchen to the pantry but not to the dining room. The butler is never supposed to visit the kitchen. His movements were between the pantry and the dining room. Both the cook and the butler steeped in the British traditions of their past masters, were paying the same attention to the presentation as to the taste of the dishes. For example, when they prepared fried fish as an *entrée* for non-vegetarians, they did not want the *entrée* for vegetarians to look any different. So the cook used to cut big chunks of cabbage in the shape of fish, tie each of them in a string so that the leaves do not fall apart, cook them in boiling water, dip in a batter and fry them. The fish and the cabbage *entrees* used to look alike when brought to the dining table. Only the butler knew how to tell them apart! The bedrooms were furnished with the best English spring mattresses and the bathrooms with geysers having electro-mechanically programmable power switches. For those times, it was indeed a lifestyle *par excellence*. It may be mentioned in the passing that, besides the adults living in Gate House, there was just one small child, Vidya (Naranan's eldest daughter), toddling around all the rooms in the house to the amusement of all of us.

A few years later, I moved back to K.G.F. in the year 1961 to carry out my work on muons and neutrinos. Sreekantan and Naranan too moved to K.G.F. to carry out Air Shower experiments. The K.G.F. offered the rare advantage of observing simultaneously both the components of electrons and high energy

muons. They were assisted in their efforts at Ooty and at K.G.F. by a group of talented young scientists like B.K.Chatterjee, G.T.Murthy, M.V.Sreenivasa Rao, S.C.Tonwar, R.H.Vatcha and K. Sivaprasad. Our (Naranan's and mine) research interests diverted from then on. Naranan, besides continuing his Air Shower experiments, also pursued balloon and rocket-borne X-ray observations in association with and leadership of Prof. Sreekantan. They were ably supported in these efforts by P.C.Agrawal, R.K.Manchanda and K.P.Singh. I continued my work on muons and neutrinos in collaboration with the groups of Sir Arnold Wolfendale (U.K.) and Saburo Miyake (Japan) and a band of bright younger researchers. I also expanded my activity into the field of High Energy Gamma Ray Astronomy, again in collaboration with several younger researchers.

Prof. Naranan's interests went beyond the immediate needs of his primary research areas. Besides colloquia on topics in Cosmic Ray Air Showers and Astronomical X-rays, Naranan gave two memorable colloquia at T.I.F.R., one on Cryptography (encryption, decoding and public keys etc) and pattern and frequency of appearance of words, sentences and groups of words in published material relating to a variety of fields. Naranan was also interested in popularizing science. He used to go to great lengths to obtain video cassettes of the popular science programmes, in the NOVA series first appearing on the American Public Broadcasting Stations (PBS) in U.S.A. and screen them in the Bhabha Auditorium of T.I.F.R. He used to schedule the screenings one day a week at 5 P.M. so that the administrators, accountants and workshop personnel besides the academics could all see and enjoy the films. In particular, I remember being thrilled at seeing the 'Life on Earth' series made by David Attenborough (brother of Richard Attenborough, of the 'Gandhi' film fame).

Professor Naranan was soft-spoken and well liked by all his colleagues and friends. He and Mrs. Visalakshi Naranan raised three daughters, Vidhya, Venil and, Gomathi who were all well educated and settled in life. In conclusion Naranan led a full life, both in science and in personal living. We wish him a further healthy life span of at least 20 years.

March 22, 2010

Dear Venil,

I am sure you are all looking forward to the great celebration on April 17. Please convey my best wishes and greetings to him on the happy occasion. I have also put a few lines below expressing my thoughts about him and the time spent by me with him. Geeta joins me in wishing him and Mrs. Naranan many many years of excellent health and cheerful living among loving family members.

It gives me great pleasure to recall the happy and very fruitful time that I was fortunate to spend with Prof. Naranan in the early years of my research career. Soon after joining the HECR group in August 1962, I spent a great fraction of my time in the laboratory at Ooty learning a lot from Prof. Sreekantan, Prof. Naranan, Dr. G.T. Murthy and Dr. B.K. Chatterjee. Since we were working together for most of the days whenever Prof. Naranan was visiting Ooty, I was able to discuss a broad range of subjects with him in a very fruitful manner, essentially due to his great patience with my questions and deep understanding of the subjects. Based on my personal experience, I considered him as a great teacher and keenly looked forward to discussions with him. His humility and infectious cheerfulness, combined with deep knowledge and understanding, made him very popular with all the younger group members in the laboratory.

I was also deeply impressed by his very friendly and supportive attitude in social situations outside the laboratory, which was highly appreciated and admired by all of us. In fact, it would be more appropriate to describe him as a role model for the younger members of the group. My interactions with him gradually decreased during the 1970's as his scientific interests shifted to X-ray astronomy but I never hesitated to seek his advice and support whenever required, always confident of his positive attitude

and thoughtful and kind response. It was a great delight for me when he was able to attend the International Cosmic Ray Conference at Pune in August 2005 for a few days which permitted many of us to enjoy his company again after a relatively long time.

I must also add here that besides Prof. Naranan being a very thoughtful scientist with impressive accomplishments, he is also an excellent colleague socially and this quality is equally well matched by Mrs. Naranan with her grace and charm. Geeta and I would always cherish the times that we were fortunate to have spent with them over a long period of more than 40 years.

Suresh Tonwar

April 12, 2010

S. NARANAN: A MULTI-FACETED PERSONALITY

T. N Rengarajan

It is a great privilege and honour for me to write a few words about Naranan, my colleague and long time intimate and esteemed family friend on the occasion of his 80th birthday.. Though we have had many long discussions on science, I did not have the opportunity to work with him, but it gives me immense pleasure to share with others my personal experiences. He is a quiet, unassuming, friendly and pleasant person who surprised me more and more as I got to know him better. Science is his main passion, but his interests run deep into many other areas.

Naranan started his career as a Cosmic Ray physicist in TIFR and was one of the early pioneers in this field. Not content with his work in exploring cosmic rays through extensive air showers on the salubrious Nilagiri mountains in Ooty, he forayed underground in Kolar gold fields hunting for muons associated with the surface detected air showers. This was a unique and difficult endeavour and the reward was the first glimpse into the composition of high energy cosmic rays. Later on he climbed much higher to study astronomical X-ray sources using instruments carried on rockets, balloons and satellites. The only thing he seems to have left out is the interplanetary probe. While cosmic rays and astrophysics were his chief interests, he has had a life long dalliance with mathematics, information theory and encryption. Perhaps his interest in mathematics was triggered by his father who was a professor of mathematics in Behrampur. Naranan has been enchanted by number theory and always took pleasure in solving problems in the field. He also used to write small programs using a hand held programmable calculator to solve problems in mathematics. I was always fascinated by this and when I started flying a balloon-borne infrared telescope, was inspired to write a program using a 212 step programmable HP calculator to calculate the aspects to point the telescope in real time.

While in TIFR he started to work on several aspects of mathematical description of frequency of occurrence of letters, words etc in texts, patterns in musical notes and compositions and even DNA structure. Those who have heard many of his Wednesday colloquia in TIFR on this subject may remember his passion with binomial distributions, exponential and power law distributions, gamma functions and a host of others. After his retirement he settled down in Chennai, but continued with vigour his studies on this

subject using information theory. He and V. K Balasubramanian, another TIFR product wrote several papers and reviews. Naranan continues his illuminating studies of these topics and recently wrote a paper on the error distribution of cross word puzzles solving. What were the input data for this study? Of course his own! I knew of his great interest in solving cross word puzzles, but it was a revelation to me to learn that he kept a record of 40 years of his daily cross word puzzle solutions and used 10 years of data for his study. It is a pleasure to see such dedication, patience and perseverance and at times I envy him. Another unusual study was on the traditional kolams which proved to be very interesting.

Besides science, Naranan has many other interests. He has had a lifelong interest in music, films, photography, popular science films and videos. He had a big hand in equipping the Homi Bhabha auditorium with up to date audio and video equipments, recording instruments and improvement of acoustics. He had a large collection of videos on popular science covering a variety of topics. He assiduously collected many of these videos, broadcast in US and European television through his personal contacts. He started a weekly programme of shows which were attended by a large cross section of TIFR staff and their family members. To start with, these shows were held in the lecture theatre, but very soon had to be moved to the Bhabha auditorium to accommodate the enthusiastic crowds. It is no exaggeration to say that he exposed a whole generation of youngsters to the pleasure of science. These shows continued for many years.

Naranan is a quiet and unassuming person, not prone to seek public attention. But, besides the auditorium facilities, he was involved in many other activities of TIFR. Many remember his able chairmanship of the Library Committee. Not many may associate him with administrative affairs, but he served as an effective Chairman of the Standing Committee on Administration of TIFR. His patience and empathy with people were the chief sources of his success. I had many occasions to take up several issues with him. What I appreciated most was his willingness to listen, consult with colleagues and make fair decisions.

Naranan is deeply interested in photography. He is always willing to share his knowledge with others. I and my family members had frequently watched his slide shows, 8 mm films and videos and thoroughly enjoyed the shows and his comments. He has a knack to share his pleasure with others. He used to experiment and was using extension tubes to get large

magnification using standard lenses. He used to take and show highly magnified pictures of common and unusual objects and challenge people to identify them. It was a pleasurable exercise. He had a large collection of classic TV shows like Twilight Zone series and I Love Lucy. On numerous occasions we have enjoyed watching them in the company of his family. He has an abiding interest in puzzles and intelligent games. He introduced me to 'tangram', an imaginative geometric puzzle game.

Naranan is very systematic and organized. He used to keep and update records of his collection of music, films, videos etc in neat way in beautiful handwriting. He used to take pleasure in solving not so usual problems and tasks. He wrote a formula and program to relate the numerical tape length monitor to the actual length of tape used up/remaining in reel tapes and video cassettes. Partly his motivation was to accommodate as much full recording as possible, but I think it is more for the pleasure it gave him. He is an avid reader of scientific and technical books. Any time I visited him I was sure to find books on his coffee table on different topics, be it chaos theory, encryption, astrophysics or number theory. I am sure that he would have mastered anything he took up. One area which he did not cultivate was finance and investment. He used to consult me whenever he had to decide on his investments. I hope my advice, limited by my little knowledge and vast ignorance, has been useful.

For many years we lived as friendly neighbours and all the members of both families had a wonderful time. We also used to meet and interact with numerous relatives of Naranan and Visalam. I specially used to enjoy the company of his father who was a self taught scholar ansient Sangam Tamil and a poet. In fact, he was particular in naming him with the old Tamil version of 'Narayanan' .My family (Vijaya, Jyothi, Rajesh and I) cherish our association of more than two scores years with Naranan and his family and wish him many more years of healthy and productive life.

On the occasion of S. Naranan's 80th birthday

In the life of a physicist one can clearly distinguish four epochs:

(1) He tries to learn something,

(2) He becomes a physicist and writes and writes....

(3) He intervenes in other sciences e.g. linguistics or biology or sociology and mixes up physical entities with linguistic, biological, sociological ones.

(4) He gets wise and starts solving crossword puzzles.

The fourth epoch is the most productive one. In this period the physicist does not invent atomic bombs and similar useful things but divides his day in two unequal parts: In the first part – which is again subdivided in unequal time intervals – he sleeps, for example at night, in the morning and in the afternoon but mostly during TV transmissions. The length of these periods differs with nuclear, thermodynamic, astrophysical, plasma and other physicists. The causes of this phenomenon have never been studied but recently the Institute of Mental Disorders at the MIT charged ten psychologists to examine a group of MIT-linguists who were able to sleep away long periods of evolution in linguistics. The project was an absolute flop because in contradistinction to physicists the pertinent domains of the brain of MIT-linguists analyzed are very different from those of the rest of the world.

The second – much shorter – part of the day in the life of a wise physicist is covered with solving crossword puzzles; the advanced physicists measure also the time necessary for solving them. It is almost needless to mention that this time is measured relativistically: either a crossword puzzle is solved relatively quickly or relatively slowly; it depends on the time between the periods of the first, more important period (= sleeping), on the quality and quantity of coffee drunk in the waking period and on dozens of boundary conditions on the subatomic and hormonal level.

Having solved a crossword puzzle in one of the 65 Indian languages and noting the relative solution time, the physicist immediately falls asleep and levitates to his dream-world in which he plays with gravitons, hadrons, leptons, bosons, mesons, fermions and onions, jumps over infinite sums, toboggans downhill on elliptic integrals and comes out perspiring from an inverted matrix which looks like a crossword puzzle in Malayalam.

One can say that a wise physicist's sleeping periods are much more laborious and dangerous than his waking periods. However, in his waking periods there are two

kinds of danger present: first, he falls asleep and falls from the chair. Many physicists have very thick Kashmir carpets around their desks where they can continue sleeping without interruption. The second danger is more serious: the tip of his pencil breaks and there is no pencil sharpener in the house. He goes into the kitchen and takes the sharpest knife... The hospitals are full of crossword puzzle solving physicists, and the world statistics is full of cases all of which are considered masochistic. They range from simple cuttings off the left thumb, up to left arm amputations. Here we have an analogy with chaos theory: small cause, great effect. The moral of this fact is evident: it is much easier to build a gigantic particle accelerator than to sharpen a pencil with one's own hands.

A wise physicist lives eternally. However, from time to time one hears that a famous physicist has passed away at the age of 111 years with an unfinished crossword puzzle in his hands because he could not find the solution to the definition "Einstein's first name".

A wise physicist begins his second life not later than at the age of 75 when the burden of the physical world falls from his shoulders and he ascends to the higher – and better – world of linguistics where he spends at least 25 years fully immersed in the ideal world of words which are either written in newspapers or placed by himself in crossword puzzles.

And this is what we all wish Sundaesan Naranan on the occasion of his round 10 times $(\pi + e + \gamma + \varphi + C)$ -th¹ birthday.

Tabula gratulatoria

Ioan-Iovitz Popescu, physicist, Romania

Jan Mačutek, mathematician, Slovakia

Emília Nemcová, linguist, Slovakia

Radek Čech, linguist, Czech Republic

Emmerich Kelih, linguist, Austria

Haruko Sanada, linguist, Japan

Fan Fengxiang, linguist, China

Reinhard Köhler, linguist, Germany

Karl-Heinz Best, linguist, Germany

Gabriel Altmann, linguist, Germany

¹ π , Archimedes' constant 3.1415926535... e , Euler number 2.7182818284... γ , Euler-Mascheroni constant 0.5772156649... φ , Golden ratio 0.6180339887... C , Catalan's constant 0.9159655941...