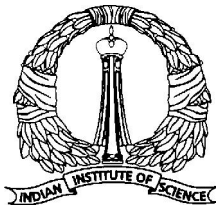
Down the Memory Lane:
Recollections of IISc Alumni



IISC ALUMNI ASSOCIATION
Bangalore 560 012, India

2009

MESSAGE

The Centenary Year of the Institute has provided a wonderful opportunity for the alumni to re-establish contact with their alma mater and to engage in many valuable ways with the activities of the Institute. The IISc campus can never be forgotten by those who have had the pleasure and privilege to study and work at the Institute. This collection of reminiscences by a diverse group of alumni provides a glimpse of the Institute's charm. Prof. Rajeswari Chatterjee, who has been so closely associated with the Institute for decades, has undertaken a labour of love in putting together this collection.

(P. Balaram)
Director, IISc

Editorial Board

EDITORIAL

I wish to thank all of you alumni who have sent us your reminiscences during your student days at the Indian Institute of Science and about how you have profited from your experience at the Institute in your later experience in your working life. Some of you have given some suggestions to the Institute to improve some aspects of the training given to the students. These are all very welcome suggestions.

It would very desirable to get feedback from you people again and again.

I wish to thank Mr K. Sreenivasa Rao, Assistant Editor, *Journal of the Indian Institute of Science,* for his help in editing the material and for overseeing its production.

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February 19, 2009

ALUMNI REMINISCENCES

A large number of Alumni would have stayed in the IISc Hostel, with only a small number who are from Bangalore and have their residences in the city staying away. Among those, a few would have become faculty at IISc and for them here are several years of events which they love to reminisce. Many consider IISc Mess to be one of the best and recollect a lot of incidences there. I had a friend who lives in USA and likes to eat "World's Best Uthappam" in IISc hostel whenever he is in Bangalore.

Prof. (Mrs) Rajeswari Chatterjee has always been a motherly figure in IISc and her request for reminiscences received an excellent response. The printing of this compilation is delayed and could not be brought out at the time of the Centenary Conference. We thought it is appropriate that it could be ready on the Founder's day of the Centenary year. I thank Mrs. Chatterjee for this effort and for publishing it through the IISc Alumni Association. Special thanks to Prof. P. Balaram who encouraged the publication of this "Alumni Reminiscences" adding to another excellent book of reminiscences published by IISc, which was released during the Centenary Conference.

Mr K. Sreenivasa Rao, Assistant Editor, *Journal of the Indian Institute of Science,* has taken enormous pains in editing the material given by the contributors. His efforts are solely responsible and made it possible to bring out this publication. Prof. P.R. Mahapatra of the Department of Aerospace and Alumnus Dr (Ms) Gladys Sumitra helped in planning this work. The Executive Committee of IIScAA unanimously accepted for including this with its Centenary Year publications. Sincere thanks to all those mentioned above for their help and contributions.

Prof. B. Dattaguru
President
IISc Alumni Association

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Rediscovery is a prelude to discovery

Prof. H.K. Anasuya Devi
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I was then a Lecturer in Sanskrit both at the Maharani's College and the BES College of Arts, Science and Commerce. I walked into the Indian Institute of Science in 1974 just to confront Prof. B.S. Ramakrishna of the Department of Electrical Communication Engineering (ECE), who wrote an article on the "Relative efficiencies of Indian languages" in *Nature* claiming that Telugu was more efficient than any other Indian language.[1] I was baffled. I always believed that Sanskrit, which is the mother of all Indian languages, should have precedence over any other language in matters of efficiency.

My first visit to the Institute enthralled me. I felt as though I was in heaven, the greenery, chirping sounds of the cuckoos, peace and tranquility that prevailed over the place mesmerized me. Faculty and students looked so informal and cheerful and at the same time were serious in whatever they were doing. What a place to do research! I met Prof. B.S. Ramakrishna (henceforth will call him just Prof.), who looked simple and soft-hearted. I introduced myself and asked him the question that was bothering me. Prof. was amazed at the way I argued. He was curious and asked: "You are right, but can you prove it? Do you know information theory?" I was perplexed. He showed interest in my questions and answered all of them. I wasn't sure if it was so easy to meet a Professor at the Institute with my background but to my surprise he was plain, straightforward and extremely poise and keenly interested in what I was arguing. He put me through a test in mathematics, which I passed successfully, and was glad to be told that I could be his student.

I went back to my colleges with lots of curiosity on one hand and on the other the opportunity for Ph.D. abroad was always lingering in my mind. I was corresponding with top universities and even got offers from Harvard University, University of California at Berkeley, etc. to do Ph.D. on Sanskrit in relation to Indo-European languages. However, my father was against sending me abroad—at that time girls going abroad before marriage was taboo in traditional families like mine. Had I got married at that time may be I would have been a mother of lots of children by now!

But destiny played otherwise. I chose research career over the option of getting married and settling down in life early. The Foreign Languages Section (FLS) in IISc was engaged in a project on translation and bilingual studies on syntactic patterns in widely divergent languages. The Section was looking for a person with background both in sciences and Sanskrit language. So, I was obviously the right person who fitted into the project with my background in both the subjects. Prof. also suggested that I join the project. I took the decision of quitting my teaching job believing that my work at the Institute will lead me to realize my dream of doing research in languages. I was selected after the interview.

I did learn Information Theory from Prof. He was a wonderful teacher. I still remember the ease with which he made me understand such complicated topics as stochastic process, probability theory and semantic measurements, etc. It did not take long to realize that the Institute possesses such world-class teachers.

[1]Relative efficiencies of Indian languages, Nature (25 February 1961), Vol. 189, No. 4675, pp- 614–617.

The project at FLS came to an end in 1975 and I had to look out for other means of sustenance. The two kind persons who recognized the good work I did for the project suggested that I re-enter the Institute through a different gate, i.e., through the entrance examination of the Institute for doing research. There was a tough competition for two vacancies, one in FLS and the other as an interdisciplinary research scholar between FLS and ECE. With some guidance and luck on my side, I tunneled through the examination and topped the list.

Then I joined as a Ph.D. student in the interdisciplinary research area, involving two departments, namely, the FLS and ECE, at the Indian Institute of Science, which I call the "Almighty". This unique entry nurtured my life throughout and gave me some foothold to build my own career at the Institute and thereafter. I must say here that I was the only candidate having this kind of background. It was worthwhile pursuing research and build the interface between the two departments in an interdisciplinary research area.

The persons who influenced my life significantly are: (i) Prof. Satish Dhawan, who was then the Director of the Institute, (ii) Prof. B.S. Ramakrishna, later Vice-Chancellor of Hyderabad University and (iii) Prof. H. Narasimhaiah, noted educationist and former Vice-Chancellor of Bangalore University.

It is a long time now to recall all the vicissitudes through which I had gone through. I had read about many anthologies of prose writings, discourses on style, expositions of communication theory, etc., theories of perception (to name only a few) which in those days failed to elicit sufficient response but one thing struck, "Why not study literary prose style as a problem in the patterns of human communication just as engineering people study fingerprints or handwritings or aerial surveys?" Why not, but how to was my problem! It was a fascinating analogy to be pursued further, but how would I know communication theory, pattern recognition theory and all such esoteric theories on which groups of people were working on? I moved from one expert to another learning their magic art.

One knows very little of how ideas, especially new ones, originate in one's mind and much less of how to cultivate the process. When you are a novice not used to think originally—or even not trained for that matter, like I was—but get an occasional input, your spirit soars high and your jubilation knows no bounds, until you discover to your utter dismay that someone else had already claimed your thoughts. After I had gone through a few such elations and depressions, I was prepared to draw the inevitable conclusion that research was not for me—were it not for a more palatable interpretation that the Prof. insisted upon. "Such discoveries", he said, "should strengthen your conviction that you are on the right track and that you can make the right kind of observations, never mind whether it is for the first time or not. Rediscovery is a prelude to discovery". I realized that besides a thesis adviser, I also had a spiritual guide in Prof.

I had several meetings with Prof. Dhawan who admired my research interests and continued to give his support in the area of stylistics. With his own interest and a degree in English literature, he was keen on my studying Bernard Shaw's style of writing. Further, both Prof. Dhawan and Prof. urged me to develop hardware for style of writing similar to speech-recognition system (VOCODER) that was developed at Bell Labs (which I must say is yet to be done at the Institute and is worth taking up even today; can then patent the product). Prof. Dhawan and Prof. had several meetings (in which I also had participated) and suggested that my research work should focus in the area of literary prose style, from the point of view of communication theory which is different from the run of the mill work in the areas of stylistics, linguistics and socio-linguistics. Prof. Dhawan took great interest

in my course work for Ph.D. programme and sent me to the Central Institute of English and Foreign Languages, Hyderabad, to take advanced courses in Transformation Grammar, and other related topics in M.Litt. that were important in the study of computational linguistics and also to conduct the experiment on "The Perception of Style".

I came back after successfully completing several courses in Hyderabad to take up my comprehensive examination. Perhaps I was the only candidate in the history of the Institute whose comprehensive examination was held in the office of the Director. Prof. Dhawan personally took interest in my Ph.D. problem and conducted the examination. I successfully cleared my comprehensive examination. He gave me many invaluable suggestions throughout my studentship.

Aldous Huxley in his book *Literature and Science* discusses the problem of communication that the scientists and the literary artists address themselves to and the manner in which they adapt language to their particular requirements. Science opens new vistas for the literary artist which he had not cared to explore.

Can art and science be married? Yes, it is true in the sense that the tools of the disciplines of science mate with art to unlock the secrets by which the artist produces his/her efforts to achieve a symbiosis of the two, which can be seen in my interdisciplinary thesis: the magnum opus—"Literary prose style: a communication theory point of view". A moral support for the unification of science and art, the topic of my thesis, came from Rangaswamy Narasimhan on Modelling Language Behaviour in which he asserts that “the formalism that is needed to study organismic behavior is the formalism that underlies the study of information processing machines".

Prof. Dhawan used to mention that the Institute needs a department where research work of interdisciplinary nature can be carried out, be it humanities or social sciences, but combine scientific methods of the chosen social problems in specific areas. He felt that such research will have direct impact on the society. I am sure that was the starting point for multidisciplinary research at the Institute and if it were pursued further it could have yielded wonderful results by now.

Prof. Ramakrishna also supported the idea and found that I was most suitable to carry out research in an interdisciplinary area with my background, since I was perhaps the first and the last one to do research of this type at the Institute. At the Institute's Centenary Conference many alumni urged the Institute to pursue interdisciplinary research in anthropology and archaeology which I had already started with my entry into the Institute way back in 1975.

I took 24 credits in all at various levels like one hundred, two hundred, three hundred and four hundred levels and the courses ranged from linguistics to foreign languages to mathematics to information theory, probability to statistics, programming to artificial intelligence. I tunnelled through the examinations strikingly and I recall with pleasure wonderful teachers like Prof. B.S. Ramakrishna, Prof. P.C. Ganeshsundaram, Prof. G. Clairon, Prof. P. S. Narayanan, Prof. R. Vittal Rao, Prof. G. Nath, Prof. S.C. Gupta, Prof. G. Krishna, Prof. V.V.S. Sarma, Prof. V. Rajaraman, Prof. S.K. Sen, Prof. Y.V. Venkatesh, Prof. S.J. Singh and others, and each one of them is really an exemplary personality. They taught me not only the courses but also the way to carry out my research. It is this strength and potential of the Institute that is unique in its nature. What I learnt at that time has stood by me in challenging the problems not only for my Ph.D. but also for future work that I undertook in later years such as natural language processing, soft computing methods, remote-sensing applications, GIS, epigraphy, archaeology, classical sciences, computers and Indian

languages. The Ph.D. training itself building my personality as multi-faceted and gave strength for endurance in different walks of life.

There was delay in submission of my thesis owing to complexity and special nature of my work. I had to spend three years for course work both at IISc and elsewhere. I had encountered several difficulties in obtaining extension of time. Then, Prof. G. Clairon, the then Chairperson of the Foreign Languages Section, and Prof. P.S. Narayanan, the then Divisional Chairman of Physical and Mathematical Sciences stepped in, reviewed the issue and granted time for submission of the thesis. Prof. Clairon, in fact, paid my thesis fee voluntarily since I was a special and unique student of both FLS & ECE then!

My association with the Institute continued as a post-doc. It was 1984. Prof. C.N.R. Rao had just then taken over as the Director of the Institute. One day, soon after obtaining my Ph.D. degree he called me in his inimitable style and said: "Look here, you have a job in EE (Electrical Engineering) Department, go and join". I was so jubilant to hear of this offer. I worked for two years in the EE with Prof. Y.V. Venkatesh and Prof. G. Krishna of the School of Automation on natural language understanding of block world manipulation of robotics. It is here that I learnt a lot on subjects concerning image processing, computer vision, pattern recognition and artificial intelligence. Prof. V.V.S. Sarma of the School of Automation was extremely kind and helpful in guiding and teaching subjects in research areas both while I was at the Institute and thereafter too.

Prof. B.L. Deekshatalu, who was Prof. Sarma's guide, also an alumnus of IISc, had by then left the Institute and used to visit the School of Automation occasionally. On one occasion, while I was discussing with Prof. Sarma on a scientific paper, he walked in to say hello to Prof. Sarma and enquired with me of my research work. Luck played again. He had interviewed me informally for Visiting Scientist position at the National Remote Sensing Agency (NRSA), Hyderabad, which he then headed, and enquired, if I were to be ready to work on remote-sensing application using artificial intelligence techniques; particularly building an expert system for soil taxonomy. I was hesitant to accept the offer as I knew my father would not allow me to go out of Bangalore, but Prof. H. Narasimhaiah intervened and persuaded my father to send me to Hyderabad. I was formally interviewed at NRSA and was offered the post. So I left for Hyderabad in 1987 where my lifestyle changed. Through training programme and discussions with experts I learnt subjects altogether different from my Ph.D. like remote sensing, its applications, subjects in earth sciences such as geology, geomorphology, soil science, etc. I learnt soil taxonomy from different experts and also from the soil management support service (SMSS) monograph lent by Prof. Deekshatalu. I took it as a challenging problem and built an expert system for soil taxonomy using remote sensing and ancilliary data with PROLOG. I did this work just before the Indian Space Research Organization (ISRO) launched the first Indian Remote Sensing satellite. All this was possible because of my Ph.D. training at IISc. My stay at NRSA shaped my destiny. I stayed in Hyderabad to get more exposure to different subjects concerning my post-doctoral research work. This was another unique experience I had in life. All this I owe to my alma mater.

Then I worked in various roles in Hyderabad, i.e., at Hyderabad University, Jawaharlal Nehru Technological University, Advanced Data Processing Research Institute, Institute of Public Enterprises, B. R. Ambedkar Open University, Centre for Ecological and Social Sciences (CESS), etc. for teaching and research work in remote sensing, GIS, Drought Watch Management System, programming, distance learning and artificial intelligence, and classical sciences.

Dr Raja Ramanna, the then Director of the National Institute of Advanced Studies (NIAS), invited me to deliver a talk at NIAS, Bangalore. Immediately after the talk, he offered me a faculty position at NIAS. Being a nuclear scientist, Dr Raja Ramanna was very keen to find out the truth in ancient texts in relation to certain observations made in planetary positions like Crab Nebula, Big Bang Theory and such others. He therefore wanted me to unravel the truth by deciphering such relevant texts in ancient sciences bearing these facts using my interdisciplinary background in sciences and Sanskrit language. He wanted me to build software that interprets the human expertise based on decipherment using various scripts, an area concerning both archaeology and epigraphy which I very much wanted to do at IISc itself.

During the Institute's Platinum Jubilee celebrations, I was fortunate enough to meet Mr J.R.D. Tata, whom I adore, and had a ten-minute conversation with him. He admired my work and research interests in inter-disciplinary areas and suggested that I work and contribute to the centre that he had planned to set up at the Institute which would bring classical sciences, humanities, anthropology, archaeology and epigraphy to the forefront.

It is a pleasure to recall my studentship at the Institute. I had the opportunity to work under Students Assistance Programme at different centres at the Institute, including Library, Computer Centre, Mess, etc., which gave me wide exposure to the activities at the Institute. I was a very active member and took major roles in several groups such as the Students Council (as Secretary), Hostel Warden, Mess Committee. It is remarkable to note the way the student representatives were treated by the honorable members of the Council. Whenever we took any problem to them, we were given ample time for discussions and we could directly correspond with the Director, Chairman and the members of the Council. I may mention here one particular incident about the scholarships. One of the students (whose name I withhold for obvious reasons) was not getting any scholarship because of the delay in submitting the thesis. He had no money to support himself. Nine of us from different departments went and talked to many professors and found out that the delay in submission of his thesis was not due to the student's actions, rather due to that of his guide. When we looked into the matter in the departments it became clear to us that in many cases the guides were either on sabbatical abroad or doing consultancy, or there was shortage of chemicals and instruments. The students were punished for no fault of theirs. We had several rounds of negotiations with the Director and the Council fighting for justice and it was a big success when the Institute sanctioned scholarships to them and gave extension of time to submit their theses. This happened because of logical reasoning, persuasion and coordination among all of us who initiated the programme. The problems were settled amicably and quickly. The Institute always gives full support and respects the student community, which once again is its great strength.

It was through my initiative that a separate new hostel was built for ladies. The structure of the hostel itself is very different and was built on an international model. We should remember the very pleasant days we had as inmates of the hostel, since we had total security, healthy atmosphere and good environment. The food in the mess was something to remember always—the Idli/Sambar and Masala Dosa on Sunday mornings at the A Mess, in particular.

During my Ph.D. days, I started the Samskruta Sangha along with Dr Nagendra (currently the Vice-Chancellor of The SVYAS) and Dr Wernekar. I am happy to see that the Sangha flourishes to this day and conducts various activities. We had initiated many programmes to bring in ancient wisdom and classical sciences to the modern world. We had wonderful

lectures, discourses and various activities from Pundits on a variety of topics. We also had cross-cultural activities. Members from different groups, Kannada Association, Telugu Association, Bengali Association and others, used to mingle with each other freely and exchange ideas and programmes. Gymkhana was one such place where we discussed many things, including sports and music. I was also responsible for starting coaching classes in swimming for ladies.

I am fortunate enough to be associated with students in my capacity as a faculty at the Centre for Continuing Education, IISc, where I have been teaching since 2002. Students are our strengths and research is our life. The Institute gives us the excellent ambience and the freedom to pursue our interests. A walk on the campus is as good as any Pranayama exercise. Its tranquility gives strength to anyone and I am sure this will continue in the years to come. I hope I will be able to contribute in many ways to the Institute activities.

I would like to add that not less than eight members in my family, beginning with my father, have had association with this Institute in some way or the other. The one significant paper by Prof. Ramakrishna and his co-workers attracted me to the Institute and the destiny had that I continue my association with it for a long time, keeping aside getting settled into a married life. However, it was better late than never. I was very fortunate to find the most lovable life partner in Dr S. R. Anantha Krishnan who was also an alumnus of the Institute. He was a Ph.D. student of Biochemistry but had left the Institute due to some family problems. He continued his interest in science and worked for National Institute of Research on Jute and Allied Fibre Technology (NIRJAFT), ICAR, Kolkota, for 25 years. He had obtained Ph.D. from IIT Delhi in Polymer Chemistry during his service period. He was an all-rounder. He won Gold Medals in both degree and post-graduation from Bangalore University. He excelled in science, sports (especially cricket being good batsman and bowler), cultural activities and possessed positive traits. He won several awards, honours; among them he cherished getting a national award for The Sportstar Essay Competition on the topic (Cricket) 'Does India need a new spin combination?' in 1980. He was a radio commentator for cricket covering Ranji Trophy matches. It is most unfortunate that he left this world very recently. The loss is unbearable but I am enduring it by pursuing some of his unfinished scientific work that he did with great passion in his career, which we both believe would offer solutions to future energy problems.

Let me end with the note that I wish to compare the Institute with Mysorepak, which is delicious and is a speciality of the state of Karnataka, making the students an all-rounder not only providing a research career but also helping in building personality. I wish to concentrate on the publications of rest of my work done once the patenting of the product negotiated is completed in all its finality. Through my connection with the Alumni Association as an Executive Member, it is heartening to see that many of the students from the Institute have occupied senior positions in well-known institutions in India as well as abroad and believe that all of them would extend full support to their alma mater.

We wish that the incubation centre at the Institute is made accessible to the alumni to pursue their academic and research activities. This would enable the Institute to connect its past with its present and the future towards totality.

Life of a Ph.D. student fifty years ago—fun and frustrations!

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I joined the Department of Biochemistry in 1956 hoping to work for a Ph.D. degree, although I was not sure if that was what I wanted! I had obtained an M.Sc. degree from Birla College of Science, Pilani, Rajasthan. I was advised to meet Prof. K.V. Giri, a class fellow of my father and seek his advice. I wrote him a letter and received a prompt reply that I should meet him the next day. I hurriedly took an overnight train from Madras (now Chennai) and reached the Department late in the afternoon. As I entered the portals of the Department in great trepidation, a person accosted me angrily, lost in thought, unmindful of his broad belt threatening to part with his pants, blue stains on his palms. When I mentioned who I was, he said that he was Giri, and he grabbed me by the arm and took me to his office. He asked me a few questions, fortunately none of them difficult, took me to BC office and asked that I be given some forms to fill and that I should pay the fees as I was already admitted! He then took me to the laboratory and told one of his senior students, P.R. Krishnaswamy (PRK) that I was Kuppu Rao, a new student who would be working with him on riboflavin metabolism in plants. I was not sure I wanted to work for a Ph.D. degree nor did I have the money to pay the fees! I took the plunge, borrowed money from my relatives and joined IISc, as a student. I have never regretted this decision that was made for me! When I finished the admission formalities and met Prof. Giri for his signature on the admission letter, I took the courage to tell him that I was not Kuppu Rao, he said it did not matter! When I gave him my first manuscript for publication, he wrote Kuppu Rao as one of the authors!, by then I knew him better, and changed the name! Looking back I am amazed how easy it was to enter the Institute then!

Student life was exciting and fun. The first thing, one of the senior students told me was that IISc had a few laboratories attached to the Mess (hostel with dining facility) and Gymkhana. I soon learnt how true it was. The mess served good food and was lorded over by a strict supervisor who kept watch on your attendance (much stricter than the departments) and chased away any student who dared to sit at the central table. It was reserved for the ladies! It was all right to meet them in the sylvan surroundings of the campus but not share a lunch in the mess! The faculty at the Institute made a beeline to the Mess every Sunday for masala dosa, best in the town! Hosting them was a sure way to win favors!

Each of the professors was unique in his own way and enforced discipline differently. Prof. Giri wanted to see the students early in the morning and late in the evening! He would come to the laboratory as early as 7.30 a.m., and all of us would dutifully be walking out of the laboratory. He would ask, "Oh, you have been working all night", a nod would be enough! He would leave the laboratory around 9 p.m. and we would be walking into the lab and he would be duly impressed! In between he would be working in his lab and rarely came into our laboratory in the day. We would be free to do what we liked. We would adjourn to the mess for breakfast and share notes with similarly placed students and return

leisurely to work. In the evening, Gymkhana was the major attraction and I became proficient at billiards if not at science!

Another unlisted facility of the Institute was the Gajanana cinema across the railway tracks at Yeshwantapur, screening mostly Tamil and Telugu movies. We were cherished customers at this place, as we occupied the highest class—benches, the other option was the floor! The theatre had only one projector and there were several intervals as the reels were changed to continue the story! This often led to amusing incidents. Occasionally, English action movies would be screened, the last reel would be screened in the middle and the hero would be gorged in a bullfight and come back in the next reel to romance the heroine! If we went a little late, they would restart the movie, and if MGR was the hero, the audience would love it as they could see their idol once again and break coconuts once more! I broke a record, which Tendulkar cannot match—saw hundred movies during a year, without affecting my work or finances! The reason for the latter was the price of the ticket was half a rupee! I would come back to the laboratory late in the night and continue the experiment. Another seasonal activity was music. Ramanavami concerts which would be held at Seshadripuram and Chamarajpet each year, a never to be missed opportunity to be seen by local people. Especially by the older women, in resplendent diamond jewellery, looking for a bridegroom and the younger ones in all their finery, for the obvious reasons. The divine music was a distraction!

In midst of all these activities, I managed to carry out research work. It was frustrating but was made easy by the comradely atmosphere in the laboratory. Prof. Giri's group consisted of about ten students working on three different problems. His obsession was developing new methods, especially chromatographic and electrophoretic. I was working on enzymes and was not subject to daily scrutiny. PRK was my mentor in the laboratory. My first experiment was to prepare ATP, a common chemical available off the shelf today but not then. It had to be prepared. The starting material was rabbit muscle. Although a few rabbits would cross your path on an evening stroll on the campus, they were too fast to catch! On a visit to Lal Bagh, I saw a few rabbits in cages but the attendant refused to part with them, as they were pets. Using a letter from Prof. Giri without mentioning why we needed it, we secured the poor rabbit. The experiment protocol required us to gently anesthetize the animal, as the chemical we were interested would be degraded on exercise. Seeing all the novice surgeons, who knew little of the procedure, the rabbit gave up the ghost halfway through our attempt at gentle anesthesia. None of us had dissected a rabbit, but extrapolating from zoology laboratory experience with a frog, we managed to collect the muscle. After a lengthy procedure lasting more than two weeks, we obtained a small amount of a white powder. I carried out the enzyme reaction with several plant extracts. The procedure of separation of the products of the reaction was circular paper chromatography where the expected products separate and can be visualized under an ultraviolet light. I was overwhelmed with joy on seeing the green fluorescent bands and ran into Prof. Giri's personal laboratory to show him the chromatogram. He jumped with joy and ran home to get his camera to photograph the chromatogram. He was an avid photographer and like most of them was more interested in getting it right than taking the picture. By the time he was ready, the color changed to blue due to degradation of the products in the strong ultraviolet light. With trepidation, I began redoing the experiment with Prof. Giri breathing down my neck wanting to see the result. Fortunately, the experiment worked and we managed to get a photograph, in slight modification of the well-known adage—fortune favors novice!

My troubles had just begun; Prof. Giri wanted us to write the manuscript for publication including the photograph, which he used to show proudly for the next fortnight to every visitor he met. After working round the clock for a week, and writing all night, we gave him a draft of a paper! He looked at it in a cursory manner, said get it typed and submit it to the journal *Nature*. We were apprehensive of its acceptance, as this journal was very highly rated even then. By cajoling as well bribing the office typist with snacks at a Malleswaram restaurant, we managed to get the paper typed and dispatched it to the editors. We were overjoyed to receive the acceptance letter a fortnight later and our names, especially mine (corrected once again) for the first time in print. Although I have published several papers since then, this was the fastest I have managed. Beginners luck! This spurred me on to try to complete my thesis work in quick time.

However my efforts suffered a serious set back as Prof. Giri suddenly passed away in July 1958. All the students in our group were at a loss as to what to do next. We did not realize our value until all four faculty members in the Department wanted us join their laboratory. We all decided to join Prof. Cama, a personification of a textbook English gentleman. More importantly he permitted us to continue to work on the same research problem and submit our thesis with him as a formal supervisor. This saved us a couple of years, as otherwise we would have to discard the work we had done and venture into a new research program. In spite of this dislocation, I completed all the experiments 12 months later and was able to convince Prof. Cama that I had enough data for the thesis. He agreed. Prof. S.C. Pillai, a world leader in biological mechanisms of sewage purification, for whom English composition was a hobby, agreed to correct my thesis. I did not realize what I was getting into! His students advised, accept all his corrections, do not argue. I realized the value of the advice as we could compose only two sentences on the first day! Thereafter I nodded my head to all corrections and after two months of long sessions daily, he was satisfied with what he had dictated but my personality was lost! May be I learnt too well, as my students have complained on the same account all these years!

Prof. Cama said he was busy and could spare only the weekends for thesis correction and we could do it at his home. He was a generous host, my only complaint was, he thought beer was too strong for students and served shandy—half and half of lime juice and beer! I would read and he would listen and when his attention wandered, I could skip a few pages. In two weekends, my thesis draft was approved. The next hurdle to cross was getting the thesis typed in five copies, long before word processors and Xerox machines. The savior was Mr. Seshadri who had a handicap due to childhood polio, a superb but fussy typist. He had to be sweet-talked into accepting the job. He was a bundle of idiosyncrasies and short tempered. He would give you two-hour slot between 6 and 10 pm with maximum of two sittings a week! If you were smart and fed him snacks, he would type 10 pages error-free with five carbon copies. If he made more than two mistakes, he would rip of the pages from the typewriter and throw it away, you paid for the paper and the carbons. If you told him nice stories, cheered him with snacks, you were favored with hot coffee in a silver tumbler, if not in a glass tumbler! In spite of the erratic schedule, he completed two hundred pages of my thesis in less than four weeks. Several years later when I met him and technology had over taken his skills and he had also grown older, he told me that he had typed 2017 theses covering subjects ranging from microbiology to electrical technology! He was a truly remarkable individual.

This was only the beginning of the troubles in getting the thesis ready. The figures had been drawn in Indian ink on tracing paper and ammonia-prints taken; the first required

charming the draftsman who knew little science. The process for making copies required bright sunlight, which was a rarity in May-June in Bangalore those days! The final hurdle was to find the resources to pay for these services and the fees to the University for processing the thesis.

Fortunately, I was appointed as a Project Assistant on a grand salary of Rs.200/- p.m., which enabled me to borrow money to meet these commitments with some confidence. In spite of all these distractions and frustrations, I managed to submit my thesis in three years and two months! In addition to the publication in *Nature* mentioned above, I published a paper each in *Naturschaften Wissen, Journal of Biological Chemistry, Biochimica Biophysica Acta,* Methods in Enzymology, two in Biochemical Journal and a few elsewhere! This was probably the most fun-filled and productive phase in my career.

This experience taught me many things—having fun is no sin, perseverance in overcoming imagined and real obstacles has its own reward, and most importantly a congenial atmosphere in the laboratory is the most important component in any successful training program. More than 50 scientists who have built their careers in our laboratory bear testimony to these obvious truisms.

The Initial Happening

Prof. S.N. Balasubrahmanyam
Formerly Professor, Department of Organic Chemistry, IISc.

1951 wasn't it? All arrangements at the IISc for holding the Science Congress could merit the description, "Perfect". A large stage canopied with canvas having large floral designs had been erected in front of the main building. The chairs were wooden of the folding type—the full-fledged plastic age hadn't yet dawned. There were "Open Days" to enable the general public to visit all the departments, the procession of visitors being regulated by providing "bunched" tickets, one leaf being torn off on entry to a department.

There was a procession of Nobel Prize-winning (and yet to win the Nobel Prize) notables in many different fields all of whom had agreed to deliver popular talks on what they had done, were doing and were going to do. It would be invidious of me to mention any names even though I remember ALL of them.

Visiting all those departments at the Disc (all by myself) during those Open Days and listening to the talks was a turning point in my life. But then my life had already been "turned", in a way. I had graduated from the Central College with a degree in "PCM" and it was more or less settled. I would join the BHU to "do" my M.Sc. in chemistry. That the specialization was going to be in Organic Chemistry for the Master's degree got settled from what my subconscious must have exercised, as I might as well have guessed.

April–May—M.Sc., June 3, 1953. Visit to the Institute. Walk into the Department of OrgChem. Professor B.H. Iyer, who was the officiating Head after Professor P.C. Guha had retired, was in earnest conversation in the corridor with a very academic and impressive-looking person (who, I learned later was none other than Dr Sukh Dev). He turned suddenly, beckoned me and, out of the blue asked me, "Would you like to join this department?" I think I did mumble, "Ye… Yess". "Come tomorrow". The rest was history, my history, that is, Organic Chemistry Encapsulated.

About a hundred years, from mid-19th Century to the mid-20th, may be considered the truly classical period of Organic Chemistry. It was shown that 'organic chemicals', once thought to be products exclusively of 'life processes', can be synthesized in the laboratory, in glassware (in vitro). It was realized that materials having the same empirical formula (composition, roughly speaking) could differ in properties, the difference attributable to differences in molecular structure, the way the atoms combine to form the molecules. Initial speculations about how a few elements in the initial part of the Periodic Table take part in chemical combination, how differences in structure can arise from the same chemical 'formula', and so on coincided with a period of laborious, careful and meticulous work. Structures of myriad organic molecules, including natural products, were established following certain rules of combination starting from initially determined compositions. Methods of increasing sophistication were developed for their synthesis in the laboratory. Speculations about how the natural products were elaborated in the living organisms were channeled into theories of 'biosynthesis' that would become increasingly difficult to challenge and would enhance understanding of life processes. The 'classical era' was succeeded by developments under several heads: the synthesis and manufacture of 'plastics' and artificial fibres through 'polymerization'; a pharmaceutical industry that once dealt mainly in 'extractives' and 'potions' graduating to testing and manufacturing drugs based on 'design'

and to preparing chemotherapeutics; culturing organisms to produce a host of antibiotics and so on. The period, starting approximately in the middle of the 20th Century and coinciding with the 'silicon chip revolution', saw the rise of new industries devoted to the manufacture of sophisticated instruments, a physics lab to the chemistry consumer transfer– high-resolution mass and nuclear magnetic resonance spectrometry, single-crystal X-ray analysis and so on. The end of the century saw the logical full-flowering of what began to bud in its 50s—the revelation of the genetic code and the transmission of information across generations leading to the possibilities not only of beneficial gene therapy but also to the not necessarily wholly beneficial genetic manipulation. Needless to say, fundamental understanding of how chemical bonds are formed, how complex 3-D structures are formed, how different grades of interaction among the molecules play their part has led to humanity getting its immense power.

The Department of Organic Chemistry

The earliest period saw people being trained in preparative chemistry so they can work on the development of cheaper, shorter or more efficient methods of synthesis of the newer drugs such as the sulpha drugs, anti-malarials, oral anti-leprosy preparations and generally learn how to handle materials in a pilot scale to be translated eventually into handling on a large scale. An interesting matter that deserves to be highlighted is the preparation during the '39–'45 war of brightly fluorescent dyes that would spread on sea water when released from a canister, useful for spotting airmen downed at sea. Interest shifted to the investigation of essential oils (one aspect of whose use is in perfumery materials) during the late 1940s. Both structural and synthetic investigations were undertaken with results that deserved peer-reviewed, internationally circulated journals. Plant-elaborated essential oils belong mostly to a class of organic compounds called alicycles. To the same class belong materials called steroids whose general chemical structures encompass the toad poisons, plant sterols, cholesterol, Vitamin D, the sex hormones and so on. The period from the early 1950s to the early '70s, during which Professor Dilip Kumar Banerjee was the Head of the Department, saw much effort directed towards the synthesis of steroidal materials with potential use in contraception. One of the aims in the preparation of steroids through synthesis in the laboratory was to produce them in "stereospecific" manner, so that they will have the structures and shapes that will be active in the living systems, as found naturally. It was also a time when there was a gradual acquisition of modern sophisticated instrumentation including that needed for analyzing complex mixtures. The same period also saw much work on synthetic peptides that might prove valuable as tuberculostats (controlling tuberculosis), on the identification of newer components in essential oils, in the synthesis of materials that might be useful in establishing or refuting a theoretical principle or illustrating the way an expected effect may operate and so on. Such work has been carried forward in recent years. Novel applications of synthetic procedures when once what is called retrosynthetic analysis (the way in which a structure might be generated from simpler or more generally available materials) had been carried out led to the synthesis of products with interesting structural features. Interest has also become sustained in the behaviour of complex fluids that may be made up of one class materials encapsulating (not chemically combined with) a material of another class. Much research was also carried out in the field known as Physical Organic Chemistry under which fall matters like determining the rates of reactions, studies of factors that control the nature of reactions, structural effects that control the behaviour of molecules, etc.

Students who have graduated from the Department with doctoral degrees have found employment in higher positions in industry and academia all over the world. Some have also worked in high positions in arms of the government that vamp and support research. Speaking of myself, I rose through the ranks to become a Professor of Organic Chemistry from which position I retired in 1992 on reaching the mandatory age of retirement of 60 years. I did continue my research activities as a Professor Emeritus for some 5 years longer, seeing the publication of results accumulated over the years. I mentored nearly three dozen young persons carrying out research leading to their doctorates. I am happy to say that all of them are now in positions of responsibility, both in academia and industry, here and abroad. I also managed to publish nearly a hundred papers in topics in organic chemistry varying from synthesis, reaction mechanisms, physical properties, interpretation of spectroscopic data, methods of separation and analysis, and so on.

All of what I just have said brings to mind the answer to the double question: "What do you do in chemistry and why are you a chemist?" The answer I like is: "Chemistry is so much fun and I enjoy doing it". However, anxiety bordering on distress has been expressed regarding fewer young people getting interested in and becoming committed to doing research in chemistry.

Generally speaking

An aunt of mine who had grown up in a traditional setting came from another part of India where she lived for a visit and short stay with me. As I drove her around on the campus she asked a question that stumped me for a simple answer: "They have built all these big fancy buildings. They have placed lots of bottles on "tables". They have put big "machines" that seem to do things which I can never understand. I find earnest-looking young people, who are said to be highly paid for studying, working in the buildings. Everything must cost a lot of money. What is it all for?" I couldn't think of anything spectacular to describe to her. [She was proud that "Raman", a man belonging to her own community, had won the "noble" (her pronunciation!) prize for having done "something".] I could have given her long-winded answers: The Institute has supplied early ALL of the academic staff needed to man the newly established engineering and research institutions founded all over India not too long after Independence. It had met the initial surge in the need for supervisory engineering talent in new construction and in new industry, both in the public and private sectors. It had trained and is still training researchers who wish to investigate the deep workings of organisms that cause diseases or design strategies that may 'cure' some diseases. There was also that work on how flowing sewage attains the quality of river water. It demonstrated that naturally occurring organisms begin the clean-up process once the level of oxygen dissolved in the sewage exceeds just about 15 of the saturation level, and so on. None of these would never have impressed or even satisfied her.

There was an occasion for me to engage an "autoriksha" to get to the Institute from the city. The young driver required much persuasion to enter the campus to allow me to get off near OrgChem. As we passed the back of the main building, the driver, evidently an out-of-towner, asked me in Kannada whether the place was an "aaspatre" (hospital). It was evident he did not understand me when I told him it was like a "Viswavidyalaya" (a term invented to stand for "university"). The incident came as a blow that made me aware of the gulf that exists between ordinary people and the so-called centres of higher education and research. The incident pointed to essential disconnects between society at large and what happens at an institution like the Institute. They teach "Naval Architecture" in one

of the IITs. Shouldn't the faculty and students seek out and exchange information with the boat builders of Kerala who are said to have built the original boats of Sinbad (Saindhava) the Sailor who, I do not believe, was a mythical character. And, there were those sailors who carried varied cultural messages and technology to Southeast Asia from the western shore of the Bay of Bengal. Why shouldn't the departments of metallurgy have contacts with the traditional metallurgists of various parts of India? After all ancient sculptors did use metal tools supplied by equally ancient metallurgists to sculpt those graceful figures that decorate temple walls. What about those metal mirror-makers of Kerala? In the West there has developed a robust relationship between what happens in a laboratory and its practical applications. In a bottom-up approach that may be traced to the Renaissance a mood of practicality that has manifestations like a farmer designing and operating his own agricultural machinery came into existence. Another example could be an anatomist mounting a dead horse on a stand and flaying it layer by layer so he can make drawings of its anatomy. One could cite the developments in the textile industry with the manufacture of synthetic dyes and, when the time was ripe, to efforts in understanding the connections between colour and chemical constitution or that between the latter and "fastness". Such robust and logical connections between a felt need and actions to meet that need did not develop in the history of India of recent times for many reasons. Some of these could be traced to mediaeval ways of thinking, a belief in astrology, magical cure for diseases, a fatalistic attitude in large sections of the population, invasions from the northwest, a non-questioning "past-is-always-right" attitude, and belief in political or ideological systems that originated in the West under specific circumstances not at all applicable to India, and so on.

Summing up, the methods on offer for providing consultancy services need to become user-friendlier than they are now. An attitude change is necessary. When the colonialists brought their own system of education, post-Maculae, they paid no heed to what was originally here. While this resulted in losing whatever was value earlier it also produced an attitude of shame in what the young were taught to believe about their cultural past. A few individuals did see connections between ancient Indian thinking and developments in modern science. [One of them was a young man named Naredranath Dutta, later to become Swami Vivekananda, who saw that a continuous line can be drawn between aspects of ancient Indian thinking and modern scientific understanding. If you skip a few decades you can see that a form of top-down approach became the norm since the time the Institute was founded, a hundred years ago. Yes, there was a felt need for power engineers meeting which was Mr Jamshedji Tata's primary motive for wanting to start a "native" training and research institution. What kind of manpower was available to run it? Most personnel were of the kind who had lost a footing in the true ancient tradition after receiving colonial education in the English medium.

Science and engineering are supposed to be culturally neutral. Nevertheless, a dovetailing of one's essential being with what one wants to achieve is essential, I think. I suspect that the absence of this simply leads to much posturing—"I am doing research" whatever that may mean. This is what underlies the under- performance of India in inventiveness and innovation in spite of large funding, especially in the research organisations operated by the government.

Another aspect that compounds what I think is a bad situation is the serious flaw as a consequence from our scientists and engineers remaining alienated from their cultural roots ("cultural" used in the broadest sense here). Under the strict compartmentalization that operates in the 'modern' (post-colonial) Indian educational "system" the "two-cultures"

dichotomy (C. P Snow) wreaks vengeance. The liberal arts graduate remains ignorant of how "science" operates and the "science graduate" wears blinkers, not acquiring a broader world vision. This sort of situation contributes in no small measure to the palpable lack of confidence on the part of the 'educated sensitive Indian' (ESI). S(H)e finds himself/herself unable to treat 'science' as a part of his/her cultural heritage but as something sourced from the West and 'given' during his/her training. The ESI, the "material" from which a candidate is selected to work for his/her doctorate degree at the Institute has been prevented from developing the awareness necessary to trace the thread-the continuous line—that could link his/her cultural being with the modern understanding to which he/she would be now exposed. I do believe this is what underlies lessened creativity.

Thoughts on current practices

There is at present a loudly expressed concern that not many young people come into the scientific research stream. A scarcity of trained scientific and trained personnel is already being felt in many fields—the space programme, the nuclear energy programme, public health administration, methods for combating increased pollution and global warming, etc. or even for manning bought-out turnkey projects. I think I am right in asserting that all this is due to what I call "aesthetic breakdown" the causes of which I have outlined above. I do not expect better emoluments (scholarships), better funding of research and like measures are going to be remedial even though the better emoluments one gets if one is employed in the information technology "industry" (software development, outsourced front and back office work, etc.) do have a highly distorting effect on wage structures. There is little hope of the situation getting any better since what is required is a big cultural transformation in Indian society and there is very little hope of that. I have no suggestions to make when there is no way to predict whether an individual is going to be original, creative and will have the ability to innovate.

I shall end with a couple of comments on what one meets with in the case of current admission practices of the Institute. There is perhaps some truth in the widely held belief that Indian educational standards are falling. Related to this is the raising of the question: Do present types of examination deselect the best and the most creative? Having thus questioned the education system the process of admission still gets based, quite irrationally, on judging the suitability of a candidate on the basis of marks obtained under the very same system. Some years ago a system of elective courses was adopted even for the Ph.D. degree in imitation of the American practice and students were graded using statistical methods.

The merits of providing electives and prescribing minimal requirements may not be questionable in the context of working for a "regular" degree or diploma. But how are such methods suitable when student numbers are so small that the application of statistical methods of grading is quite meaningless? And, the fact that in reality the mentor and the student grow (and age) together as they conduct their work for a period, say, of five years or so is forgotten.

A few years ago a programme was instituted to provide a "clear" path for young people who have just finished school to undergo training for research even while they work towards their first graduation and then go on to obtain a master's degree. They may become good researchers but at no time in this early part of their career are they exposed to any wide liberal values. How really creative and original is their research going to be? I joined the Institute when I was 21 years of age. I am now 76 and the Institute is a 100 years old. I am sure the Institute will go on in its way, fulfilling its mission, even as I go on mine, just to vanish.

Reintroduce the 3-year B.E. degree program

Prof. Bharathi Bhat
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I had my education up to S.S.L.C. in Kannada medium at my hometown, Sooda, a village in South Kanara. After my S.S.L.C., I did my Intermediate degree and B.Sc. at St. Philomena's College, Mysore. Sudden change from Kannada to English medium was tough to cope with, in the beginning. It was during the second year B.Sc. that I had the desire to go for Engineering and the 3-year B.E degree program at IISc was the best opportunity that I could avail of.

"Bring whole library if you wish"

Prof. S.V.C. Aiya, the then Head of the ECE Department, was a source of encouragement to students. In fact, Prof. S.K. Chatterjee, Prof. (Mrs) R. Chatterjee, Prof. N.S. Nagaraja, Prof. B.S. Ramakrishna and other younger faculty were all very helpful and easily approachable. My classmates were dynamic. Besides studies, there was fun. I remember, Prof. S.K. Chatterjee announced once an 'open book test' and he said 'you can bring the whole library if you wish'. On the day of the test, some of my classmates brought huge trunks loaded with books to the exam hall.

After my M.E. degree at IISc, I continued my studies at Harvard University, USA, and received M.S. and Ph.D. degrees. Although my M.E. degree was in 'Advanced Electronics', I opted to do my Ph.D. degree in the area of Electromagnetics/Antennas as I found in Professor R.W.P. King a kind and caring guide. The sound background I had in this area through the courses taught by Prof. S.K. Chatterjee and Prof. R. Chatterjee in the ECE Dept. helped me greatly to specialize further leading to my Ph.D. degree.

Projects of importance to the country

At the 'Centre for Applied Research in Electronics (CARE), IIT Delhi, where I had my entire academic career for nearly 32 years, I could put into practice what I learnt at IISc and Harvard. It was Professor P.V. Indiresan, the Founder and the first Head of CARE, who, on my joining, initiated me into the project on 'Indigenous Development of Ferrite Phase Shifters'. His vision for the centre was to combine teaching and research with goal-oriented projects of importance to our country. I could utilize this unique opportunity as Professor Indiresan provided every possible support at the Centre. For me, he was a true mentor. I was also fortunate to have able and dedicated project staff and students; in particular Shiban Koul, presently a Professor at the Centre, who has contributed in a significant way. With the excellent support from the entire centre, it was possible to successfully complete a number of sponsored projects leading to the development of ferrite phase shifters and millimeter wave integrated components.

Suggestion

Although there are a large number of engineering colleges in the country, reintroducing the 3-year B.E. degree program at IISc would offer a unique opportunity for bright and economically poor science students from rural areas.

IISc Provided solid foundation for research career

Dr Rangeet Bhattacharyya

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Reflections: The courses were thorough, instructive and full of information. The lab courses were excellent. Three-semester Masters' project was invaluable in the context of exposure to research. The knowledge and exposure gained during three years of masters were immensely helpful during the research years and beyond.

Research: The research experience at IISc is undoubtedly one of the best that our country can boast of. Starting from basic research training to advanced developments, IISc provided world-class facilities and guidance.

The training at IISc provided a solid foundation to build a future research career. It helped nurture and hone our skills without having to compromise the fun apart.

I still work on methodological developments in various branches of NMR. The training at IISc, under the guidance of Prof. Anil Kumar, still remains my most valuable aid in the world of spins.

General: Apart from two academic degree (masters' and Ph.D.), I could also find my life partner at IISc.

Vision 2020: I trust that IISc will become one of the best institutes in the world and be able to provide the same quiet yet vibrant environment to young researchers as we experienced.

Matters remembered

Prof. Chanchal Uberoi
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My interview for the Ph.D. programme in the Applied Mathematics Department lasted more than three hours. I was exhausted at the end of it and my father was ready to take me back home to Hyderabad, having lost all hope. But then, I was told soon enough that I had been admitted to the Department. Professor Prabhu Lal Bhatnagar, the Founder/Chairman, warned me that I have to do much hard work to obtain my doctorate. Any way, I became a student of the Department, one in the batch starting work in August 1961 and the saying "It is difficult to get into the Institute but it is perhaps more difficult to get out" proved right in my case. Except for the gap of a few years caused by my visits abroad, I stayed with the Institute for the next 40 years in diverse roles. Not only this, I met my life's companion, Professor S.N. Balasubrahmanyam of Organic Chemistry (no two could have been more different!) also on the Campus and I raised my two children, a daughter (Vibhavaree) and a son (Sameehana), there. As a woman scientist it would be remiss of me not to add that living on the Campus, a few minutes walk from my work place, was a great boon, especially when my children were small. I was easily able to adjust my time between my work and my children. Here I would like to recall that in 1976 Professor Satish Dhawan, Director, called me to his office one morning and, after a small discussion about housing allotment asked me if I would like to live in one of the newly built quarters on the Campus; he also added that these are beautiful houses and there are few takers as many found it too far from the city. It was too sudden for me as I was not aware of these new constructions on the campus. The offer also came at the right time as I was facing difficulties with the owner of the house where we were living. So within minutes my husband and I hurriedly went to the "DQ quarters", and chose a corner house. We got the key, then and there, from the watchman without any documents. That illustrates a most important fact: the Institute never had any rigourous bureaucracy. My daughter around 6 then asked if "Mr. Dhawan" was our new landlord. "He is so good compared to the earlier one, isn't he?"

The Department of Applied Mathematics was started as a "service department" to put within the reach of researchers in various disciplines mathematical methods they may want to use in their work. The teaching faculty and senior students of the department were expected to give mathematics courses at all other departments, especially those in the Engineering Faculty, according to their felt needs.

On a fine morning in the beginning of the academic session of 1963, I was asked to participate in giving mathematics courses in the departments of Metallurgy, Chemical Engineering, and Management Studies as they all had new course requirements for their doctorate and other programmes. Prof. Bhatnagar observed: "As you know, we are short of hands and I would like you to take up some teaching even while you are busy with your research work."

No talk or promise of money or position was mentioned, it was almost an order! Well, these questions did not also occur to me and I feverishly started preparing my notes for teaching. Looking back, it was fun taking classes for Metallurgy in the mornings, for Chemical Engineering in the mid-morning and Management Studies in the afternoon. Many

of the students had little or no training in mathematical methods beyond what they may have learned in high school. I had to make myself behave like an understanding, kindly, and elderly school teacher relating stories about mathematicians' lives to get them interested!

Some of the students of that period, I am very happy to say, are now working in high positions in industry or government. Or, some may have even retired from such positions after all those years. To my surprise and great joy, they recall little details of the topics I dealt with for them on those infrequent occasions I meet them. They tell me how useful my courses proved to be, not excluding those happenings when I had to wipe their tears (metaphorically) because the tests and submissions were not too easy. One, a General Manager of a large concern, walked over to me at a recent get-together and recalled well those 'tearful' days!

In 1965, I completed writing my thesis wherein the work described was mainly on the propagation of waves and their characteristic instabilities in plasma media and applications thereof to astrophysical problems. One chapter was devoted to "Transport Properties of Ionized Gases" employing what is known as the "BGK Model" (Bhatnagar–Gross–Krook Model, named after Professor Bhatnagar and the others) for describing the behaviour of gases of neutral particles. The results obtained were good and it could be shown that this famous collisional model could work equally well for ionized (or partly ionized) gases. The thirteen-moment method used required the evaluation of thousands of integrals and I had to work late into the nights using a calculating machine to numerate the integrals—it was, after all, about a decade before the dawn of the Age of the PCs. You couldn't yet programme something made of silica, sit back and watch the results being printed out.

After obtaining my Ph.D. degree, I was given leave of absence for two years from my position as Lecturer, a position to which I had been appointed retrospectively from the day I was asked to take up the teaching tasks on behalf of the department that still had the appellation "Department of Applied Mathematics". [The "Applied" description was dropped at a later time.]

My stay and work at the University of Cardiff and then at the Harvard Observatory I would regard as very successful—the scholarship I acquired in a place like the IISc got reflected in the academic work I was able to carry out in these prestigious institutions. With the dawn of the Space Age in the early 1960s both Plasma and Space Physics assumed great importance. I began to apply all my mathematics and plasma physics training to understand many a problem in the near-Earth space environment.

In 1972, I was able to establish a very important physical process described as resonant absorption of Alfvén Waves in inhomogeneous magnetic fields prevalent in space and astrophysical plasmas. [Hannes Alfvén was the recipient of the 1972 Nobel Prize in physics for the discovery of a new type of waves, later named after him, in natural plasma which constitutes the major part of ionized matter.] This was landmark work that has now found a wide range of applications in understanding various physical processes in natural plasmas. I am very glad to be able to say that I can trace the origin of this work back to my Ph.D. thesis in which I wrote a small chapter on Alfvén Waves. The work has also become greatly important in the study of heating of laboratory plasmas in fusion research. It also brought about a collaboration between me and Akira Hasegawa, a well-known scientist then working at the Bell Laboratories (now Lucent Technologies), of New Jersey, USA. The collaboration resulted in the writing of a monograph "The Alfvén Wave" published by the Department of Energy of the US government in 1982. The book is now considered a classic in the field of

Plasma Physics. It is interesting to point that it was written by postal correspondence, letters and telegrams, forgotten in these e-mail days.

In 1982, I was a founder member of the Joint Astronomy Programme (JAP) started to activate collaboration between the IISc and other academic bodies, the Raman Research Institute, the Indian Institute of Astrophysics, the Indian Space Research Organisation and the Tata Institute of Fundamental Research, Mumbai. It is gratifying to remember that, in one of the Space Physics conferences, one of the astrophysicists who came from abroad telling me that he learnt from my questions during the JAP interview how to see generalities in mathematical problems! That compliment was a most fulfilling moment of my life. Some students of the JAP who are now faculty members in famous observatories said they were immensely benefited from the Plasma Physics courses I conducted in the Mathematics Department.

In the late 1960s and '70s the Institute did not have many lady students and it was not much of a problem to find a proper home-like hostel to house them. At the time I joined the Institute there were only a handful (or, say 8 or 10) lady students. The rooms appeared luxurious. We had a small decorated sit-out. Mrs Kale, who was on the faculty of the Foreign Languages Section, a most gracious German woman who took German and French ("foreign" requirement for the Ph.D. degree), was the Warden at the time I joined. [As an aside, I may add here Mrs Kale was the wife of a past Librarian of the Institute and mother-in law to Prof. Harish Chandra, the famous mathematician working at Princeton University.] She took great care of us, making us feel comfortable, and tried to make graceful ladies of us(!). The professors' wives living on the campus made us feel like their family members, inviting us home on most special occasions. Thus I happened to attend the wedding of one Mr. Seshan who married the daughter of Prof. R.S. Krishnan, Professor of Physics, at one of the fine bungalows surrounded by a vast garden. [Such bungalows are being pulled down, one by one, for making room for box-like buildings to house new "departments".] Needless to add, Mr. T.N. Seshan became the Chief Election Commissioner to whom the Nation should be ever grateful for having introduced a modicum of discipline among politicians against many odds engineered to derail him.

When Mrs Kale retired, Prof. (Mrs) Rajeswari Chatterjee assumed charge as Warden. As she was not resident on the campus, I was asked to be the Assistant Warden to help her and, it goes without saying that we did not agree on (or had different ideas on) various issues, but then, everything was taken in good spirit, allowing matters to work out well.

The age of superannuation of the academic faculty of higher educational organisations was enhanced from 60 to 62 years in 1997 by a policy decision of the relevant administrative arm of the government. Thus I found myself not retiring from the position of Professor in the Department of Mathematics in 1999 when I was going to be 60 but, instead, being offered the position of Dean of Science, usually open for 2 years. I became the first woman dean in the long history of the Institute. I began to enjoy my daily interaction with the students and all the Faculty of the Institute and happy to say that I consider myself as successful at solving many difficulties faced by them at various times. I did notice, however, that girl students could certainly talk to me in what I thought was open manner. They seemed to assume that they could get all needed help due to the fact that a woman was the Dean. This was very satisfying indeed.

I was quite well known on campus for being out of phase from normal timings. However, the strict timings for the innumerable meetings forced on me more disciplined timings for eating and sleeping (or waking). My efforts to swing in phase did not go

unnoticed and my colleagues in the administrative offices, especially, Prof. D.K. Subramanian, my contemporaneous Engineering Dean, could not help showing his amusement at my efforts in rushing out and running to attend meetings.

After my formal retirement, I continued to work, firstly, on an ongoing Indo-French Mathematics Programme on evolving methods suitable for conducting classes via satellite contact between India and France. Around the time the programme reached a certain satisfactory trial stage, I was offered a chance to continue my work as an Emeritus Scientist under the aegis of the UGC. The period that lasted for 3 years (until the end of 2004) saw some further publications. More recently, I was invited by Springer-Verlag, Berlin-Heidelberg, to contribute a chapter on Space Plasmas to be included in the projected *Handbook of the Solar Terrestrial Environment*. The book has now been published and it is gratifying to note that among the other twenty-one world famous scientists I represent India and that from the Indian Institute of Science.

My long association with the Institute has reached a point of closure but has really not come to an end. My visits to the campus have become less frequent over time, no doubt, but I continue to attend potentially interesting technical or public lectures or attend some conferences of my interest. Often, on my way to visit the Indian Institute of Astrophysics which is quite frequent I drop in at the IISc campus for a cup of tea at the Faculty Club with friends.

I strongly believe that the primary wishes of the Founder, J. N. Tata, and of his co-founders, have been largely fulfilled in that the Institute maintains a scientific environment, and it continues to provide highly trained teachers, scientists and engineers and scientific administrators and so on. The atmosphere of the Institute vibrates with the energy of these wishes. It may change with times to come, but only superficially, I assure myself. The quest for knowledge and learning which the Institute inculcates in you will always be there for ever.

Indian Institute of Science and me—my story

Prof. Rajeswari Chatterjee
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The Indian Institute of Science was born in 1909 in Bangalore in the old Mysore State ruled by Sri Nalmadi Krishnaraja Wodeyar Bahadur who donated a large piece of farm land situated north of Bangalore City beyond the northern extension of Malleswaram. The great Jamshetji Nusserwanji Tata of Bombay who had made a great fortune by trading with Japan and China wished some part of his wealth to be used for the enlightenment of the people of his motherland India, by founding a university which would teach young people all modern subjects and would add to the wealth and well-being of the people of his country. He could not find such a large piece of land in his own city of Bombay (now called Mumbai).

I was born on January 24, 1922, in Bangalore City, when the Indian Institute of Science (IISc) was 13 years old. When IISc was a teenager, I was a little baby in a house called "Casetta" on Sankara Mutt Road in the southern part of Bangalore City. Even when I started to go to school in 1928 when I was six years old, I did not know the existence of IISc. Probably in 1934 or so, the school children of our school Mahila Seva Samaja were taken in a bus to IISc (popularly known as Tata Institute) for an outing in the park-like campus. We ran around the park and finally arrived at a big double-storied bungalow where we were greeted by a middle-aged lady who took us into the house and led us to an upstairs verandah where she talked nicely to us in a mixture of Tamil and Kannada and served us some snacks like chakulis and fried avalakki (flat rice) served on banana leaves and some sweet lime juice. We were hungry and gobbled up the food, and did not even know that we had to thank her! However, our teachers thanked her, and we went down the stairs to play in the garden. On way back to our school, our teachers told us that the lady who was so nice to us was Lady Lokasundari Raman, the wife of Sir C. V. Raman, who was the Director of IISc and who was the first Indian to be awarded the famous Nobel Prize for Physics. Of course, none of us understood what the Nobel Prize was and we hardly knew any physics those days!

So after about a quarter of a century, IISc had the first Indian Nobel Prize winner as the Director, which is not a bad achievement at all. Of course, the research work, called the 'Raman Effect', which fetched the Nobel Prize, was done by C. V. Raman and his students in Calcutta (now called Kolkota) encouraged by Ashutosh Mukherjee who was the Vice-Chancellor of Calcutta University. So Calcutta has claimed the first Nobel Prize in Physics in India. But Bangalore nurtured Sir C.V. Raman as a great scientist till the end of his life.

I went on to high school in the London Mission Girls' School (now called Mithralaya Girls' School) on Mission Road from 1934 to 1937. After I passed my S.S.L.C. in 1937, I joined the Women's Intermediate College in Bangalore and passed the Intermediate Examination of Mysore University in 1939 with a third rank with optional subjects Physics, Mathematics and Economics. My next move was to join the Central College in the three-year B.Sc. (Hons) course in Mathematics. While I was in the first year of this course, Sir C.V. Raman, who was the Head of the Department of Physics at IISc was the chief guest at a function of the Mathematical Society, delivered a scholarly lecture on some subject which I did not understand at all. I have a group photograph of the function with Sir C.V. Raman sitting in the centre of the group.

After I passed the B.Sc. (Hons) degree with a first class first in 1942, I passed the M.Sc. examination of Mysore University in 1943 from Central College with a first class first.

World War II was raging in Europe and in North Africa, and nobody could predict the future. In the Far East, Japan was waging a war in China, and was conquering Indo-China, Malaysia and Burma, and was ready to enter India and was bombing Calcutta and Vishakapatnam. Our great freedom fighter Subhash Chandra Bose was pushing his Indian National Army towards the Indo-Burma border. He was broadcasting from the Saigon Radio, which we could hear on our radios. All the young people were excited, and wished that the Indian National Army (INA) would push the British out of India.

I wished very much to go abroad to England or the USA for higher studies in Mathematics to obtain a Ph.D. degree, but that was not possible during the war time. So, I decided to join IISc for research. There was no mathematics department there, though mathematics was required to understand some problems in physics. So I met Sir C.V. Raman and requested him to take me as a research student. After he found out that my degrees were in mathematics, he told me that he wanted only candidates who had an M.Sc. in Physics with a high first class.

I had to find some alternative to keep myself engaged and learn something new so that I can be better qualified to go abroad after the end of the war. Calcutta was too far from Bangalore for me to go for a Ph.D. degree, though I knew that there were very good mathematicians who could guide me towards a Ph.D. degree. If I were a young man, my family might have allowed me to go to Calcutta.

The next best thing I could try at the Indian Institute of Science was to apply for the three-year certificate course in the Department of Electrical Technology. So I put in an application to this department, and I was called for an interview by Professor S.P. Chakravarthy who was the head of this department. When I went to see him, he told me that though I was very well qualified to do this course, I would find it very difficult to go for summer practical training in far away hot places like Calcutta and Jamshedpur, because I would be the only young woman among twenty young men. There were no industries in Bangalore at that time. The Hindustan Aeronautics had just started and would not take any student for training. However, he told me that he was willing to take me as a research student on a scholarship of Rs 40 a month so that I can learn some electronics and electrical communication engineering, and work on some research problem on electron tube circuits and publish a few papers, and that would help me to obtain a scholarship to go abroad after the end of the war for further studies in the fast-growing subject of electronics. I decided to accept Professor Chakravarthy's suggestion, because he was a knowledgeable man who had a Master's degree from London University, UK, and who had done some research work at Calcutta University before coming to Bangalore.

So I entered the Department of Electrical Technology at the Institute in July 1944. Professor Chakravarthi advised me to attend a course on Electrical Communication Engineering which he was teaching to the third-year Diploma students, and also a course on vacuum tubes by Assistant Professor K. Sreenivasan, a course on Electro-acoustics taught by Dr N.B. Bhatt, who was a D.Sc. from the Massachusetts Institute of Technology at Cambridge, Ma, USA, and also a course on Line Communication by Dr S. Datta who had Ph.D. from England. These courses gave me an elementary knowledge of electrical communication engineering, but were not very theoretical. I tried to do simple experiments on vacuum tube circuits in the afternoons and I was helped by Dr Datta and Rajendra Nath

Dewan who was an M.Sc. (Physics) from Delhi University. After one year, I was awarded a scholarship of Rs 60 pm which could just take care of my hostel expenses in the girls' hostel.

How did I feel at this time? I was not sure whether I was progressing forward in my research career, or was waiting to go abroad to get better qualified in the upcoming field of Electronics and Electrical Communication Engineering.

I did enjoy the company of my mates in the girls' hostel coming from different parts of India. They were Anna Mani from Travancore (now called Kerala) working with Dr C.V. Raman in Physics, Indira Gajjar from Bombay, Violet D'Souza originally from Goa but educated in Lucknow, and M. Prema from Mangalore working with Mr Sreenivasaya on Fermentation Technology, Roshan Irani from Madras working with Prof. P.C. Guha in Organic Chemistry, and Mariam George working with Dr J.V. Bhat in Microbiology.

However, World War II ended in 1945, and soon afterwards, the interim Indian Government announced scholarships for science and engineering students to go to England, USA and Canada to get better qualified and to come back to independent India to build up the country's industry and economy, which had suffered terribly during 200 years of foreign rule and World War II.

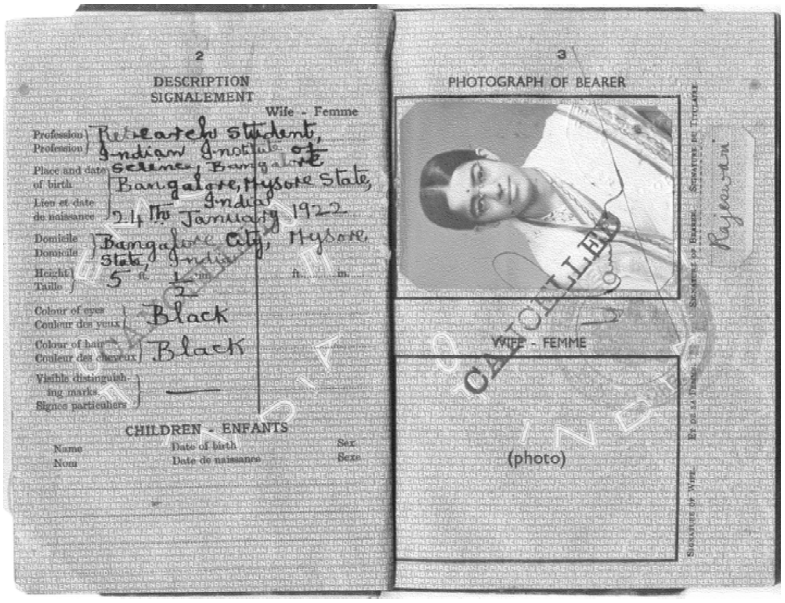
My two friends, Anna Mani and Roshan Irani, got scholarships to go to UK in 1946. I was the third among the women to get a scholarship to go to USA. Several of the men students also obtained these scholarships.

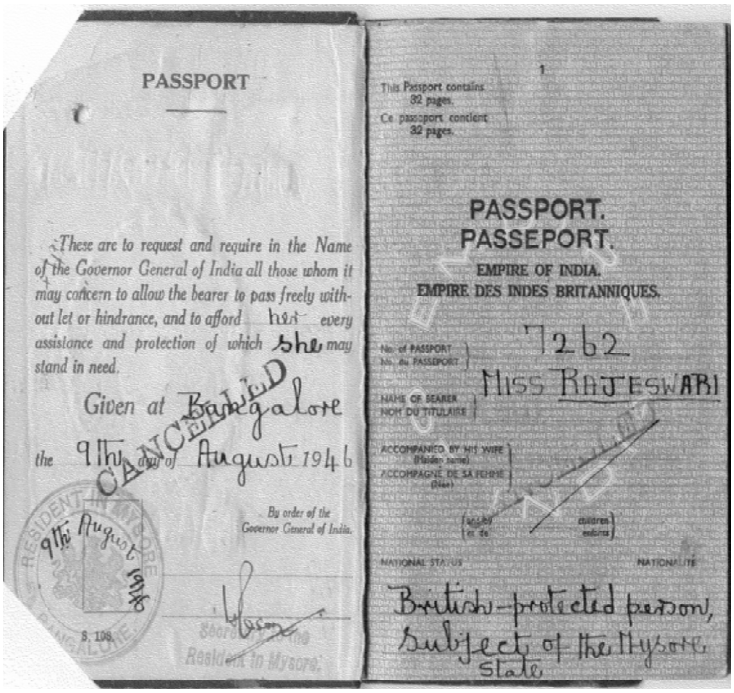
At last, I felt that I will leave India to go to a more advanced country to learn something different, maybe, for better or worse!

World War II was just over, and steamer bookings from India were not very easy, and air travel was still in its infancy. After I obtained my admission in the University of Michigan at Ann Arbor, Mich., it took several months for the interim Indian Government in Delhi to arrange my travel to USA in the converted troop ship S. S. Marine Adder from Bombay (Mumbai) to San Francisco, Ca., USA, which left Bombay at the end of June 1947 when the South West monsoon was just starting. I had two research publications with Prof. S.P. Chakravarthi and one with Mr S.K. Chatterjee who was an M.Sc. in Applied Physics from Calcutta University and who had joined the Institute as a lecturer in the Department of Electrical Technology in 1946. Did all this wonderful background of my Indian education and experience of a 25-year old prepare me for an unknown higher education in USA?

Once I was on the boat travelling to USA, I thoroughly enjoyed the trip and made a number of friends, many of them Indian students travelling to USA for higher studies in many different subjects and from different parts of India. We reached San Francisco at the end of July 1947, after one month of travel on the Indian Ocean and on the Pacific Ocean, touching Singapore, Hong Kong, and Shanghai. Mr Sundaram who was the Education Secretary at the Indian Embassy in Washington DC met us at the docks in San Francisco and made arrangements for the Indian students to go to our respective universities in USA or Canada by train or Greyhound bus, depending on the distance from San Francisco. The Embassy was started later on August 15th when India obtained Independence and the country was divided into two—India and Pakistan.

After a three-day stay in San Francisco and some sight-seeing in San Francisco and Los Angeles, a few of us left by the Santa Fe train to Chicago, and we found the journey comfortable as compared to Indian trains; it took two full days. From Chicago, I travelled overnight to Ann Arbor and reached there in the early hours of the morning when it was still dark. My friend Parvati Subramanian from Bangalore, who was doing her Master's degree





A Piece of history. The author went to USA on the passport issued by the Empire of India and returned on a new passport issued by Independent India.

in Psychology, met me at the station and took me to the rooming house which had been arranged for me by the University. The way Mrs Carol Woods who was my house mother treated me made me fall in love with the Americans.

After a month or so, I joined the Department of Electrical Engineering as a graduate (post-graduate) student. My Advisor Professor L.N. Holland advised me to take three undergraduate courses in the Fall semester before starting my graduate courses, because I did not have an undergraduate degree in Electrical Engineering. I did very well in them, so that I could take post-graduate courses on electron tubes, microwave engineering, electromagnetic theory and antennas, advanced network theory, partial differential equations, Laplace transforms, etc. during the next two semesters. So I completed the requirements for a Master's degree called M.S.E. (Master of Science in Engineering) by the end of January 1949.

I wished very much to continue my work to obtain Ph.D. degree by specializing in electronics and vacuum tubes, but the Government of India wanted me to take some practical training before returning to India after two years in USA. So I took training in radio frequency measurements at the National Bureau of Standards at Washington DC from February 1949 to middle of September 1949.

In the meantime, I had applied for the Barbour Scholarship at the University of Michigan to continue for my Ph.D. degree. When I obtained the scholarship, I requested the Government of India to give me permission to accept it, which they did as long as I would satisfy their agreement that I would serve India for three years.

I decided to work with Prof. William Gould Dow who had worked on microwave magnetrons in the Radiation Laboratories at MIT at Cambridge, Ma, during the war years. Professor Dow asked me to take some more courses on microwave vacuum tubes and allied subjects. I could get good grades in all these courses. After a year or so, I was able to select a research problem on vacuum tube trigger circuits which is the basis circuit which was used those days in the vacuum tube computers. Transistors were just being invented at the Bell Telephone Laboratories in USA at that time. When I visited MIT that year during a holiday, I saw one of the first computers which was housed in several large rooms! Can you imagine that the modern-day laptops which can be held on your palm can do much more work than those huge computers of the early days?

I also had to prepare for taking an oral comprehensive examination at that time. So the work became very heavy, and I started worrying whether I would ever finish my work and obtain my Ph.D. However, Professor Dow was very kind and talked to me very nicely so that I felt better. I passed the oral examination in 1951 and could finish my research work by 1952 and could submit my thesis in December 1952. Since the thesis was examined by a doctoral committee consisting of only professors from the University of Michigan, they gave a good report soon and I passed the final oral examination in January 1953. The Ph.D. degree would be given only in June 1954.

The Government of India asked me to return to India and arranged for my return trip in the big Cunard Lines Luxury liner "Queen Mary" from New York to Southampton in UK and then by the Polish steamer S.S. Batory from Southampton to Bombay. Fortunately, I could spend three weeks in England and could do some sight-seeing there. Finally, I arrived in Bombay on the 1st or 2nd of April 1954, after being in the United States for five and a half years!

How did I feel coming back to my country after five-and-a-half years? I had left India a month before Independence on a British Indian passport, when the partition riots were

beginning in the Punjab and also in Bengal. There were a few Indian students travelling with me on S.S. Marine Adder to USA, who were from these regions. I remember Dr Ram Parshad from Lahore who was very much worried about his family in Lahore, and also (Ms) Khaneez Ataulla from Lahore who went to Chicago University to do her Ph.D. Later on, I heard that she lost all her family in Lahore during the riots. Since I was going back to my hometown Bangalore in South India which did not suffer from these riots, I did not worry about these things very much, but was more worried about my future prospects in India. The first thing I did was to get married to Mr S.K. Chatterjee whom I had known earlier at the Indian Institute of Science. Soon after that, I received a letter from the Government of India that it would like to consider me as a lecturer in Electrical Communication Engineering at the Roorkee Engineering College in Roorkee in UP. At the same time, the Indian Institute of Science in Bangalore advertised for a lecturer's post in the Department of Electrical Communication Engineering, for which I was selected and given the letter of appointment by Professor M.S. Thacker who was the Director. My husband Mr S.K. Chatterjee was made an Assistant Professor at the same time.

So I joined as a lecturer in the ECE department in August 1953. I was asked to teach the subject of Electromagnetic Theory by Professor K. Sreenivasan, who was the Head of the department, to the final year students of the diploma course. The class of about 20 students had only one girl named Jaya and the rest were boys. They were from different parts of India, selected on their high ranks in their B.Sc. or B.Sc. (Hons) degrees in Physics, Mathematics and Chemistry. They were intelligent students who were eager to learn, though this was the first time that the subject of Electromagnetic Theory was taught in the department. I especially remember Mr B. S. Atal from UP and Mr O. P. Gandhi from Delhi who later on obtained Ph.D. degrees from USA and have done excellent research work in their own areas of specialization. I am very happy that Dr B. S. Atal has been awarded the distinguished alumnus award this year by the Alumni Association of IISc. Dr O. P. Gandhi who is a well-known worker in the field of Bio-electromagnetics has visited IISc many times and given lectures on his research work.

After a few years, the Diploma course was called the B.E. degree and M.E. courses were started in Advanced Electronics and in Microwave Engineering.

My daughter Indira was born on April 2, 1954, and I continued my teaching and research work in my special fields of Electromagnetic Theory, Microwave Engineering and Antennas. My husband S.K. Chatterjee also taught many courses on the above subjects as well as on many other subjects like satellite communications and so on, and guiding his research students on topics in these subjects. He guided 12 research students for Ph.D. and I 20. I have about 120 research publications in Indian and foreign journals.

I had several research projects from CSIR and UGC and from the Defence R&D, while my husband had a PL-480 project from USA. I was awarded the Ram Lal Wadhwa Gold Medal by the Institution of Electronics and Telecommunication Engineers (India) in 1978, and earlier the Meghnad Saha Award by IETE in 1975, and the J. C. Bose Premium of the Institution of Electronics and Radio Engineers (IERE), UK, in 1967.

One important Defence R&D project that I and my colleague Dr D. N. Bose of ECE department completed in collaboration with Professors A. R. Vasudeva Murthy and Narayanan Kutty of the Inoranic and Physical Chemistry Department was on the YIG-tuned microwave devices.

I have published four technical books on Microwave Engineering and three on Antennas in India and abroad. The last book *Antennas for Information Super Skyways* published by

the Research Studies Press in 2003 was written jointly with my old student Prof. P. S. Neelakanta of the Florida Atlantic University at Boca Raton, Florida.

A very happy day in my life at the Indian Institute of Science happened on January 1, 1989, when the old students of my husband, the (late) Professor S.K. Chatterjee, celebrated his eightieth birthday by holding a research seminar in his honour at the IETE premises in Bangalore, where many research papers were presented by his old students on microwave engineering and antennas. My daughter, Indira Chatterjee, also presented a paper by Prof. O.P. Gandhi, who was her Ph.D. research guide at the University of Utah in USA.

Today when I am 86 years old, I am very happy that I worked at the 'Tata Institute' for more than thirty years, and that I can still take part in its Centenary Celebrations in 2008.

I wish to make some comments on the changes that have taken place at this Institute in the fields of teaching and research for over 60 years that I have known this great Institute starting with my student days in the 1940s when World War II was raging and Indians were waiting for the British to leave India.

In the 1940s, the first and second rank students of B.Sc./B.Sc. (Hons) degrees of various universities that existed at that time were admitted to the three-year diploma course in Electrical Technology with two branches, namely, the Electrical Technology and Electrical Communication. The first two years of the course consisted of Mechanical Workshop Practice, Civil Engineering, and basic course on Electric AC and DC machines. Every afternoon was spent in the workshop, surveying and in the Electrical Machines laboratory. The third year had special courses for the two branches for the electrical communication engineers—the courses were Radio Engineering, Line Communication engineering, and Acoustics, while for the Electrical Technology students, the courses were Power Systems, Power Transmission, etc. Until 1946 or so, there were no formal examinations. These students were absorbed in electric power stations, Posts and Telegraphs, All India Radio and in Overseas Communications. Most of them got jobs, and so these courses were very popular among the best students of the B.Sc. degree holders of the country. In the early days, there were only a few English professors, but later on by 1944 when I joined the Institute there were only Indians.

When I came back in 1947 with a Ph.D. degree from USA, there was only one more Ph.D. in ECE (Electrical Communication Engineering) department and that was Dr B.S. Ramakrishna whose specialization was Acoustics. My husband, S.K. Chatterjee, had an M.Sc. (Applied Physics) from Calcutta University, where the great scientist Dr S.K. Mitra, who is known as the father of Ionospheric Studies not only in India but all over the world, had introduced Radio Engineering and Electronics together with the study of Electromagnetic Wave Propagation and Ionospheric Studies. The other staff members of the department were only DIIScs. However, over the years, a few more staff was recruited, like Mr S. Sampath who had a Master's degree from Stanford University, USA. At the same time, the EE (Electrical Engineering) department recruited Dr Joseph Vithayathil who had a Ph.D. degree from UK and had specialized in Power Electronics.

However, the two departments slowly tried to introduce research work in their activities, and during the 1960s could produce a few Ph.Ds after the University Grants Commission (UGC) considered IISc as a deemed university. Three of these Ph.Ds were absorbed as staff of the ECE department, and many new subjects were introduced. The number of Ph.Ds produced by the department also increased. In the 1970s and 1980s, the ECE department was considered one of the best departments in that subject among Indian universities including the IITs.

I retired in 1982, and the next 25 years or so has seen many changes in this department and many new subjects like digital and computer communications have been introduced.

I wish to make one more comment on the engineering departments of IISc, particularly about ECE department. The 3-year B.E. course after a B.Sc. degree continued in not only ECE department, but also in EE and Metallurgy departments till the early 1980s. Now it does not exist. I can easily make a remark that these B.Sc.-B.Es of IISc have certainly contributed to the building up of many industries in independent India. While the graduates of IITs have migrated in large numbers to USA, the IISc B.Es have lived mostly in India and know Indian conditions better. The reason for this is that nearly half of these students came from poor families in small towns and villages in India, while IIT students came from better-off families in the larger towns and big cities. Why did this happen?

The answer is simple. The Tatas of Bombay who pioneered the founding of this magnificent research institution also had some funds, interest from which could be used to give scholarships to the poor and needy but merited students of this Institute. For about 25 years of my service in ECE department, I was in charge of these scholarships for the B.E. students of this department. Year after year, I scrutinized the applications jointly with a junior staff member, and we decided to give those scholarships to the needy students taking merit into account. The value of the scholarship was only about Rs 75 a month, but that could take care of a student's expenses in the hostel at that time. They were also exempted from paying fees. Some of these students used to skip a meal in the hostel and send the money saved to their parents to take care of their families. One student from a Orissa village told me that his father owned three acres of land and had to feed a family of six people, and that both his parents were illiterate. Another student from a village in Andhra was the son of a village clerk who had to take care of seven people. And so on! The Karnataka Government gave two scholarships to merit students from the state, and some of the universities also gave a few scholarships of this type. Such students did not try to go abroad for higher studies, and were satisfied with Indian jobs, preferably in public sector industries like Bharat Electronics Limited or Indian Telephone Industries, and preferably nearer their home so that they could help their families.

Why not the Indian Institute of Science re-introduce such a B.E. course for the poor and needy students of this country by granting them scholarships, taking into consideration the reservations for backward communities and creamy layer while implementing this scheme?

I NOW WISH THE BEST TO THE INDIAN INSTITUTE OF SCIENCE, which is one of my alma maters and which I served for nearly thirty years of the hundred years of its existence.

Reminiscences of my stay at IISc

Prof. B. Dattaguru
Retired Professor, Department of Aerospace Engineering, IISc

Entry into IISc

It was 1959; I was just 17; Armed with a degree in science (B.Sc.) from Andhra University, Waltair, I have arrived at Bangalore, along with my father, for seeking admission into the B.E. (Electrical Technology) program at IISc. It was an exhilarating day for me as I was entering the portals of the institution where legends of the stature of Sir C.V. Raman had worked earlier. I was also pleasantly suprised to learn that the common devil, ragging, was totally absent from the Institute and seniors voluntarily helped the freshers. My roommate in C-15 was High Voltage Engineering Ph.D. student D.R. Raju and how lucky was I to have one like him help me in my initial stay at IISc! The Golden Jubilee celebrations of IISc were just over and how fortunate am I to be around to participate in its Centenary, exactly 50 years later! So, I will try and recall parts of 50 years of my stay at IISc.

Academic degrees and positions at IISc

After completing the three-year B.E. (ET), I switched over to the Department of Aerospace Engineering for Master's program and completed it in 1964 specializing in Aero-structures. After five years as a course student, I joined as a Technical Assistant in the Department of Aerospace Engineering and completed my Ph.D. in 1973 under the supervision of Prof. A.K. Rao. After receiving my Ph.D., I was promoted as an Assistant Professor from a lecturer and have retired from service in 2004 after serving the institution for 31 years.

I took Aerospace Engineering with Structures as major, having been inspired by Prof. C.V. Joga Rao who was a great classroom teacher and by Prof. A.K. Rao who was an outstanding researcher. My supervisor taught me to choose problems of relevance to the national aerospace scene equalling those tackled at world-ranking institutions

Research career

Synergy with industry

I am indebted to IISc which let my research career grow in a natural way. I have realized early that I was in the midst of a large scientific talent. Each one of my colleagues had a different dream of his own. Excessive competition for promotions did not interest me. I had the trust that when good work is done I could look forward to promotions, sooner or later. Stress was laid on the impact of one's research work on others. A section at IISc feels that the Institute should concentrate only on basic research, but in a developing country, where the industry is still in infancy, a different approach is required to dependence on foreign technology. Precious foreign exchange is spent on buying even simplest of systems in flight vehicles. Till the industry reaches a critical level of self-reliance, premier institutions—academic institutions and research laboratories—should collaborate sincerely and deeply with the industry. This will lead to self-sufficiency and will strengthen the industrial base of the country.

Several of my colleagues from Aerospace Engineering were deeply involved in major flight vehicle projects in DRDO, ISRO, ADA and HAL. Our association included working on critical projects, participating in design reviews and providing short-term solutions at critical moments. I have a few interesting experiences to recall.

i) I was once airlifted to evaluate the impact of cracks developed in a rocket motor just 48 hours before its scheduled firing. After a thorough examination, I have identified the problems and offered solutions. The rocket was then cleared and the firing took place successfully. I believe that the training given by IISc had played a significant role in resolving the issues at hand. Years of training, research, publications and presentations at national and international conferences helped me derive the simplest of equations to clear a flight costing large sums of money. The fact that I could help the country in its crucial moments of scientific experimentation filled my life with thrill and joy. The nation, in which scientific talent at IISc is a subset and each one of us is an element of the subset, in turn, derives its strength from such endeavours and attains courage to achieve bigger things for its people and the world. This was amply demonstrated in aerospace field in the past few decades due to the efforts of great visionaries like Prof. S. Dhawan and Dr A.P.J. Kalam.

ii) The excitement of working on national projects is humongous, where a small input to R&D pays in a big way. Under Advanced Technology Program, we had a Rs 3-lakh project to work on fracture mechanics and acoustic emission to evaluate proof-testing of vessels, each costing over Rs 3 lakhs. The Project Director, Gen. V. J. Sunderam, often said that if he could save one vessel from disintegration during proof-test, our project money would be paid off. These high technologies can be utilized in industry if backed by high-end research only.

iii) Aging components are evaluated for residual life-take for example, the platforms used for air-dropping of food to marooned people during floods or for dropping supplies and jeeps (or tanks) in forward army lines. Each platform costs Rs 30 lakhs to build and is designed for six drops. It costs Rs 5 lakhs per drop. After the designed life of six drops also the platforms are in a reasonable shape, and by servicing them we can extend their useful life. Imagine the benefit if their life is extended to ten drops and the cost per drop drops to Rs 3 lakhs. The science of aging structures can contribute to national prosperity in a big way.

Wealth is created for the country when high technology is transferred to industry. I can proudly say that our contributions have saved considerable amounts of foreign exchange and minimized the need for foreign technology or collaboration. I have quoted examples from structures area only, but there are valuable experiences from other areas of flight vehicles covering aerodynamics, propulsion and flight controls.

Team work

My teacher Prof. A.K. Rao always laid emphasis on team work. I realized it when a group of us worked at Jog Falls in 1985. A penstock at the Falls had ripped off the anchors and was damaged due to heavy rains resulting in mud flowing from hill banks. The Karnataka Electricity Board (KEB), which runs the power-generating station, after an unsatisfactory and expensive advice from a private agency, turned to the Centre for Scientific and Industrial Consultancy (CSIC) at the Institute to mitigate the problem.

The hydrostatic pressure due to the mud was very high and the anchors failed; the 450-ton penstock was pushed by 3–4 feet on the inclined slopes. The solution suggested by the private agency was to replace the portion of the penstock damaged which would cost tons of money; this was not acceptable to KEB. It was looking for an inexpensive solution and hence approached IISc. Prof. M.N. Srinivasan, the then Chairman of CSIC, set up a team including himself to work on this. Incidentally, the team had four members from Aerospace (myself, Profs H.S. Mukunda, C.R.L. Murthy and P. R. Mahapatra). The group had expertise in civil engineering, fracture mechanics, acoustic emission and

mechanical processes. It examined miles of ultrasonic scans, and evaluated the defects in welds using principles of fracture mechanics and suggested pushing back the penstock, replacing two segments (out of nearly 20) of the pipe, getting welded joints gouged and re-welded, all this at only 10–20% of the projected expenditure. When the penstock was filled with water the joints were monitored with acoustic emission equipment. I have experienced for the first time what a dedicated team can give to the nation pooling together a variety of expertise.

Basic research

I have opted for basic research only after interaction with the industry. Basic research is understood in many ways. If certain fundamental issues are settled whose implications are wider, it will impact the basics of engineering science itself! The engineering research at IISc does not belong to 'tightening nuts and bolts' as many in science groups believe in. In our group, the research was on the cutting-edge technology in joints and fracture. What was additionally required is conviction in science and courage to implement some of the items mentioned above.

Two components of our work had wider implications. In Prof. A.K. Rao's group, we were discussing for a long time of alternative ways of handling iterative contact stress problems in fastener joints. We proposed the idea of an inverse solution, which opened up a decade of research leading to unified approach to clearance, neat and interference fit joints. This work led to 6–8 theses and 30–40 publications and to equal number of publications by others who adapted our technique. From the national perspective, fracture mechanics appeared to be very promising. This is the second component where we have worked on the basics. The technique was proposed, but the lack of mathematical derivation prevented its generalization. We went in depth and generalized the energy release rate estimation. This gave us great thrill; it had wider impact. This can be contested as applied research, but what matters is that it was very useful to technology.

The inspiration to research for many of us in Aerospace came from Prof. A.K. Rao and Prof. R. Narasimha from engineering group, and from Prof. G.N. Ramachandran and Prof. C.N.R. Rao from sciences. We enjoyed research and were also involved in semi-professional activities by organizing conferences/workshops and working for professional societies. Wider participation unfortunately delayed publication of results and led to loss of recognition of our work. A work we produced in a thesis and not published on time was independently worked out by someone else, which later became a citation classic. This brings out a lesson for youngsters, i.e. not to miss contributions in international literature and not delay submission of results.

Administration at IISc

There were seven Directors and three Associate/Deputy Directors at IISc during the past 50 years. They always made it a point to make the administration friendly to faculty. Except for some minor complaints, which always exist anywhere, there were no major problems between faculty and administration. I have served as Convener of JATP, President, Gymkhana, Warden, IISc hostels, Chairman, CSIC, and Associate Chairman and later Chairman of Department of Aerospace Engineering and always enjoyed support from everyone in the administration.

Staff in Schemes Section used to identify me with 'ARDB', an external agency. Despite being an insider often they would be satisfied with authorization from me for ARDB projects. This level of trust existed amongst us.

Student activities

Student life at IISc is very enjoyable for those who know how to enjoy it without disturbing academic work. The sports facilities at IISc are not for producing champions, but are enough to provide relaxation for intellectuals. Billiards/Snookers, Table tennis, Bridge/Chess are where I personally enjoyed participation and won prizes. The fellowship at the games was amazing. After several decades, when I meet an old student on the streets of New York or elsewhere, we reminisce the noise we made in Billiards room in 1960s. We used to conduct Bridge tournaments and I was called "Director" for the events. In one of the tournaments, Prof. G. Padmanaban, the then director of IISc, came for prize distribution. I told him that IISc had several Directors and they change every 5–10 years, but there was one more Director inside IISc, i.e. 'Bridge Director', who never changed over the past several decades and that was me.

My years at the Indian Institute of Science

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My association with the Tata Institute, the name Bangaloreans are familiar with, began during my childhood days. It was then more an outing, traveling all the way from Cubbonpet to the Institute, spending time with a family that was residing in the staff quarters. We could play on the campus. What commenced as a time of enjoyment, friendship and fellowship during late 1940s took a new turn in early 1960s when I joined the Institute as a research scholar on a monthly stipend of Rs 250 in the Section of Economics & Social Sciences. This Section was located in the building where the cafeteria is today. The building had two wings—in one was the Section of Economics & Social Sciences,and in the other was the NCC Section. Being immediate neighbours, we enjoyed cordial and helpful relationship with those working in the NCC section.

Soon after joining the Institute, I had to obtain written permission from the Director of the Institute, waiving compulsory condition of staying in the Institute Hostel. I got the permission to stay with my parents at home and carry out research! The permission granted was a conditional one, that I abide by the terms and conditions applicable to the research students, and that the research work should not suffer. Thus from day one at the Institute, the ethos of the Institute with emphasis on commitment, devotion and dedication were imbibed in me.

The Section of Economics & Social Sciences had very few research students and the turn over before completing the thesis was quite substantial. Those who continued to reach the goal were considered as persons with grit and determination. The Faculty those days was meant to teach the students of the Diploma of IISc. Focus was not much on research; research areas were confined to Industrial Psychology, Industrial Economics, and Labour Economics. I did not belong to any of these. Breaking the convention, Dr M.C. Munshi gave me an opportunity to work in the field of planning and development. This proved a blessing in my career, a point elaborated later.

Even facilities were limited, of low-tech in nature, even though the Institute had the vision of promoting advancement of science and engineering. As a research student, that too in the broad area of humanities, I had to depend more on my human power—physical and intellectual—and less on advanced tools and equipment. Regression calculations involving solving three to five simultaneous equations had to be carried out using manually operated Facit machine, slide rule, 7-digit Clarke's Table, later electrically operated calculator. Later, I bought a pocket battery operated simple calculator for Rs 475 from a shop on Brigade Road to reduce the strain and increase the speed of the calculations. There was no xerox facility. Data collection was all manual. Long hours were spent in the Library, studying and making notes. There was no internet to download literature and data. Voluminous statistical calculations had to be carried out in HAL on IBM, with the help of a programmer in the Institute. This meant waiting in 'Q'. In my case, I had to wait for nine months to get through the calculations. There was no SPSS to assist us in the calculations.

Such an environment for research, no doubt, meant spending more time than warranted, but it had many blessings too. Without firming up the hypotheses, observing and critically studying the data, and verifying the authenticity, I dare not start the calculations using

the manual Facit machine! I had to be sympathetic towards my human body power. As every step of the calculation had to be written down, I could get the insights of the relationships among the values, which benefit is lost in modern computer calculations where the steps are hidden. Now, we take pride in speed; then it was in the joy of understanding, that too in a behavioural science. After giving all the data and confirming the programme for the statistical analysis, I utilized the waiting period by joining MES College as lecturer. I was close to the Institute and my guide. With these benefits, I completed the thesis while working in this College.

The Institute Library was a well-developed storehouse of knowledge, providing inspiration for concentrated work.

On the positive side, I received encouragement and made the best use of the freedom my final guide (late) Prof. K.S. Hanumantha Rao gave me. Prof. Rao was from Commerce discipline, while my work was in the field of Economics. He was magnanimous to allow me to get the benefit of discussions with specialists in my field based in Delhi, just to see that I complete the task satisfactorily and reach the goal. Again, I understood the value of self-effort, a benefit of taking a guide from a different discipline. Prof. Satish Dhawan and Prof. Arcot Ramachandran gave the needed support and encouragement to persevere in reaching the goal, without giving it up under trying circumstances. The smiling face of Dr (Mrs) Nalini Dhawan would cheer me up when the research work created tension.

Among those who were strong pillars of support academically were late Prof. Ratna Devanathan and Prof. Rajeswari of Applied Mathematics Department. I could go to them any time to clarify my doubts in mathematics. They took the trouble of understanding mathematical problems in my discipline and helped me to proceed with confidence.

At times when I felt the need for diversion, there were good ladies doing research in other departments, with whom I could spend some time in the Ladies' Hostel. There was only one hostel with about 20 students. To mention some names, Lizzy of Biochemistry Department, Radha, Sudha, Seethalakshmi of Physics Department, Ratna, Rajeswari and Renuka of Applied Mathematics Department, and Bharathi of EC Department. Another place of relaxation was the Institute nursery which had variety of plants.

We had some fun too. When Prof. Ramachandran was heading the Department of Industrial Management, we, the research students of the Department, participated in a sports events organized for the ladies at the Institute and won maximum number of cups — a surprise to every one, including the participants! Of course, this was the first and the last!

During my days as research student, the name of the Section of Economics & Social Sciences got changed to Department of Industrial Management. Later, it was renamed as the Department of Management Studies. With this, the focus too changed, and hence, the courses. There is something in the name!

I got the doctorate degree of the Institute in 1971. Between 1968 and 1998, I served for five years as lecturer, initially at the graduate level in MES College, and later at the post-graduate level in Central College, and for 25 years in various technical divisions — Economic Adviser's Division, Perspective Planning Division, Project Formulation Division, Area Development Division, and Plan Finance & Resources Division of the Karnataka State Planning Department.

In early 1970s, when late Mrs Indira Gandhi was the Prime Minister, the Government of India took the initiative to strengthen the Planning Department at the state level by creating technical divisions under the Center Sector scheme. During the initial years, the restructuring was totally funded by the Government of India. The purpose was to introduce

professionalism in planning and policy analysis by inducting technically qualified staff and free this task from the bureaucrats. In Karnataka, the first Division to be created was the Economic Adviser's Division with (late) Dr D.M. Nanjundappa as the first Economic Adviser. A little later, other divisions like the Perspective Planning Division, Project Formulation Division, Evaluation Division, District & Regional Planning Division, Plan Monitoring & Information Division, Manpower Division, and much later the Plan Finance & Resources Division and Area Development Division came into existence. Each division concentrated on specific area of planning.

In 1973, when I was teaching in Central College, my attention was drawn to the letter from the Planning Department of the Karnataka State Government inviting doctorate degree holders in Economics/Econometrics/Sociology for the post of Research Officer in the Economic Adviser's Division. I applied and got selected in 1973. I worked under late Dr D.M. Nanjundappa. Later, when other Divisions came into existence, I moved to the Perspective Planning Division as Joint Director, after some years became a Director and a few years before retirement became the Senior Director.

The research experience and skills I acquired as research scholar at the Institute proved a big blessing in teaching, and more significantly in my service in the State Planning Department. My choice of planning and development as my area of research when I joined the Institute as research scholar (breaking the convention!) became very relevant in this service. I could use the statistical and financial tools with confidence in the technical analysis required in planning and policy formulation. Even when some tools were new, I could learn them in minimum time and use them in the tasks assigned. Quite often, exercises were of inter-disciplinary nature. Here again, the Institute ethos with focus on Science and Engineering was an asset. I had no diffidence in learning some basics in other disciplines. During my service, I had the privilege of teaching the techniques as Guest Lecturer at the Administrative Training Institute, Mysore, Directorate of Agriculture, Bangalore, and HAL Staff College.

During the 25 years of service, I came on deputation to the Department of Management Studies of the Institute as Faculty member for nearly three years. I could work under late Prof. Amulya Reddy in the field of energy making use of the work I had done in the Planning Department. It was during this deputation that I learnt to operate a Personal Computer. Prof. Reddy would not leave me till I got over the fear and diffidence! I had the opportunity of learning new techniques in energy analysis. When I returned to the State Planning Department at the end of the deputation, I was one among the few in the department who could operate a computer and work independently, until others got the training.

I had the opportunity of another three years of deputation to the International Energy Initiative during the mid-1990s. Here again, my research and deputation experience at the Institute proved a blessing. I could train the staff of the Electricity Boards in energy analysis, using inter-disciplinary approach, in addition to carrying out analytical studies.

The research skills I acquired at the Institute and its ethos have proved to be a big asset in my entire career. Till date, continuous hard and concentrated work for hours has never been a problem. I continue to depend on self-effort, not given up learning whatever the field is, and am still involved in academic work in addition to social work. The strong foundation laid in the Institute has been a blessing. I got the opportunity to use all that I learnt as a research student, not only in the teaching profession but also in the large number of analytical studies carried out in the State Planning Department for facilitating planning and policy formulation. What the Institute gave me I have been giving back to the society. This is my humble and sincere tribute to my Alma Mater!

Prime Institution with a mixture of science and engineering

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Experience

(a) Experience in the Air Force for system integration of radars, communication network and computer systems in real-time multiuser, multitasking distributed environment for air-defence application.

(b) In the civilian environment, telemetry and telecontrol, and voice communication facilities in a distributed networked environment for operational control of oil and gas production and distribution for the Bombay High operations of ONGC.

(c) In the product development environment, development of multimedia access nodes and switch nodes integrating IP, TDM and ATM domains.

Reflections

(a) During the course

Electronics engineers working in the technical branch of the Air Force (as also the Navy and Army) are sent to institutions like IISc and IITs for refreshing and updating their professional knowledge. Generally, these engineers would have taken their Bachelor's degree about 10 years back and it was considered worthwhile to send selected few officers with good track record to undergo Master's degree in reputed institutions, so that the knowledge gained will be useful for handling state-of-art systems in the defence services. They will be able to design and develop more and more indigenized systems for the services. The following gives an account of usefulness of knowledge gained at IISc during the service career and post-retirement period.

(i) In the late 60s and early 70s, advanced solid-state silicon and GaAs devices were being increasingly used in state-of-art equipment. The exposure to the theory, fabrication and application aspects of such devices given during the course was very useful not only during the regular operational and maintenance activities but also during induction of newer systems for the Air Force network.

(ii) Exposure gained in the digital electronics area was really useful since systems and subsystems were going "digital". This foundation on digital electronics was useful towards better understanding of the architecture and hardware aspects of computer systems, which were gradually being introduced in the Air Force for real-time and offline processing applications.

(iii) Learning programming language from the fundamentals that too with mathematical background gave a good grounding for understanding the software aspects of operation of computer systems from high level, assembly level and machine code level at which the computer hardware actually implements the task.

(iv) Exposure to statistical aspects of Shanon theorem, Markov Chain, etc. was new and its usefulness in propagation aspects became apparent, while designing microwave line of sight (LOS), diffraction and refraction links for air defence network.

(v) Hands-on experience in project stage (in second year) gave good confidence in design and development of newer systems for the services.

Relevance of study to one's employment and work

For almost two decades after doing the M.E. course at IISc, I was engaged in designing and engineering multimedia networks in a distributed environment for the Air Force as well as for the civilian industry. The M.E. course certainly gave the confidence level to undertake design and development of state-of-art networks at systems level, although the requirement was not to develop individual hardware. Technology improves continuously and the confidence level to select and adopt newer and newer technologies in the network greatly improved because of the grounding given at IISc.

Coming to specifics, for almost a decade, as Chief Systems Engineer of Project TITAN (Telemetry, Telecontrol in Automated Network), I was in charge of designing and engineering a computer-based telemetry and telecontrol system including dedicated and shared voice channels in a distributed environment for the Bombay High operations of ONGC. The ability to conceptualize, implement and hand over for operation and maintenance of such a network without foreign assistance was possible because of the theoretical and practical knowledge gained during the course.

In the defence environment, as Project Director of Low-level Radar Networking Group (LRNG), I was given the total responsibility for integration of low-, medium-high-level radars in geographically distributed environment, including digital inputs from hand-held HF sets and airborne warning and control system (AWACS). The application was for real-time, multiuser, multitasking application for air defence purposes.

(7) Experience on any interaction with IISc past course

After the M.E. course at IISc, I worked at the Radar and Communication Project Office (RCPO) of the Ministry of Defence for about two decades. The RCPO, as systems engineering group, was set up to undertake indigenous capabilities for designing and engineering air defence network, integrating radars, communication network and computer systems. A national-level advisory committee was set up under the Scientific Advisor to Raksha Mantri (SA to RM) to assist RCPO towards greater indigenization. This committee had as members Directors of LRDE, DLRL, DEAL (then HRPU) and a few eminent scientists / engineers and the task of this committee was to interact with high-level institutions like IISc and IITs and sponsor competence-building projects. I worked as working-level secretary for this committee and had the opportunity to interact with junior- and senior-level project engineers and professors at these institutions. Based on the competence available at various institutions, I have identified specific programs for the IITs and IISc.

The following is a partial list of areas identified for such competence-building projects:

IISc

(a) YIG oscillator as direct microwave source for radars (instead of conventional crystal oscillator and series of multipliers).
(b) Surface acoustic wave (SAW) devices for modulated and signature-specific pulses for radars.
(c) Dielectric antennas for airborne radars.
(d) Optical signal processing for image enhancement, to improve the visibility of hidden objects with a priori signatures like tanks or vehicles or even human beings, hidden behind bushes and trees.

IIT Madras: High-power PIN diodes for phase shifters of high-power radars.

IIT Delhi: Digital signal processing for sonar and radar applications like clutter rejection, signature identification, etc.

IIT Kharagpur: (a) ADM Mux for multi-channel communication terminals, and (b) Electronic scanning antennas for high-power ground-based and airborne radars.

Interesting experiences/anecdotes

It was very easy to mix around with lecturers and professors at the institute and it was not a difficult task to get into the Institute environment, after spending many years in the defence operational environment.

Vision for 2020

The major IITs (Delhi, Kanpur, Kharagpur, Chennai and Mumbai) can be credited with churning out world-class engineering graduates. (It is a different matter that the cream of the IIT boys goes abroad for greener pastures.)

IISc is the only prime institution in India with a mixture of science and engineering streams for higher-level education and research. Science without following engineering/ technology will not be appreciated in this present-day, fast-changing and competitive environment. The reverse is also true. Technology without being supported by science behind it will have a very short life. Hence a judicious mix of science and technology is required for mankind to progress in the right direction.

Bangalore is credited to be the "Silicon Valley" and "Aeronautical Hub" of India. It is very difficult to name any world-class telecom/computer hardware/software/firmware firm not having an R&D outfit in Bangalore. The same is true of the large number of auxiliary industries in the aeronautical area in Bangalore and neighbourhood, churning out subassemblies and components for aeronautical giants like Boeing, Lockheed, Airbus Industries, ESA and NASA.

With specific reference to electronics/computer science, there is no reason why IISc cannot be a leader like "Oracle" in RDBMS or "CISCO" in networking products or Motorola/ Nokia/Ericcson, etc. in mobile multimedia networks. Such firms do recognize the potential at IISc and get bits and pieces done at the School of Automation or CEDT or ECE department. Also, DRDO laboratories and industries like BEL and ITI do refer some of their problems and get them examined at IISc off and on. But why IISc cannot look at total product or system from the conceptual stage, with due regard to current and near-future standards of ITU, CEPT, IEEE, ISO, etc. and reach complete ownership stage?

The Indian government (irrespective of the political party in power) has been saying for many years that financial resources will not be a constraint for Indian educational/ research and development institutions or industry finding solution(s) for major national-level problems. Some of the problem areas are: (a) quickly dwindling hydrocarbon reserves of oil and gas, (b) water all shortage/flooding. There are sectors like basic education, health, etc. There is no point in listing but select those which are relevant for advanced institutions like the IISc.

Given this scenario, the following are the suggestions or recommendations for action plan:

1) Telecom & computer networking area

(a) In respect of telecom/computer industry, form a Systems Engineering Group at IISc staffed with R&D engineers from ECE, CEDT, School of Automation of IISc and also

from industry and individuals, with good track record in designing and developing systems. Entrust this group with a time-bound task for developing multimedia mobile networks, comparable and inter-operable with present-day GSM, GPRS, CDMA, 3G, etc. networks, engineered by multinationals in India. Although this should have started few years ago, it is not too late either. Such mobile networks are relevant and will continue to be required in countries in Asia, South East Asia, Middle East and Africa. The aim is to come out with a total solution, following the existing standards or even a proprietary one, so long as it is inter-operable with the networks installed by Nokia, Ericcson, etc. The bottom line is that such a network should be at a much cheaper cost and simple in operation and maintenance, compared to the ones from multinationals who are monopolizing this area. The handset may be difficult to target, because of size, weight and power and getting into ASIC straightaway may also be difficult. One may not achieve that order of engineering, whereas these giants have enormous infrastructure to target such attractive and handy sets. However, the base stations and network architecture including BTS, BSC, and MSC, connectivity to PSTN and IP networks for multimedia applications do not have these constraints and one should come out with the static element of such mobile networks. A representative network complete in all respects, including antennas, power supply, etc., should be developed in less than 10 years. Such a network should be inter-operable with the existing GSM, etc. networks from Nokia, etc., already operating in the country. I am sure with indigenous efforts from ground up, such a network could be realised at fraction of the cost of what these giants are presently charging which poor countries like India are paying through their nose.

(b) Some measure of success has been achieved in PDAs like Simputer with connectivity to static and mobile telecom or IP networks (WiFi), but somehow or other it has not penetrated into the urban or rural environment. I am not sure whether it is worth while to attempt further miniaturization, lower power requirement, etc., whereas giants in the industry can do much higher level of ASICs, etc.

(c) Another group could be set up to address multimedia access nodes and switch nodes, integrating TDM, ATM and IP domains which are the predominant wide area networking architectures in the world. I am sure with concerted efforts, networking products like bridges, routers, switches for LAN and WAN including static and mobile environment with all latest features like real-time IP (for VoIP and video traffic), tunneling, VPN, MPLS to coexist with products from CISCO, etc., could be realised at much cheaper cost. Space and power may not be a constraint and look and feel could be sacrificed, if we can give reliable products and features.

2) National-level problems

To address the national level problems of energy crunch and alternate or renewable source of energy, form specific groups to come out with products/systems in these areas:

(a) World-class PV cell technology

A number of firms in India are engaged in solar power solutions for various capacities and they all import amorphous or single silicon or other material-based V cell modules and they only handle the assembly, paneling, etc. They export such finished products, since it is cheaper for advanced countries to get this task done in India rather than in their countries. IISc's silicon or GaAs laboratory or similar new laboratory could focus on PV cell area and come out with products/systems of world-class standards for efficiency at a cheaper cost.

(b) Fuel cell technology

Basic science of fuel cell as energy source is well known for decades. Yet, only few firms have developed products. Few examples of utilization of such source of power are IBM laptop powered by Toshiba or other firm's fuel cell for standalone use for the laptop or for augmenting the life of the inbuilt rechargeable battery. These cells use methanol or other substances for the fuel cell. In remote areas where there is no electric power for charging portable communication device or processing device, the use of fuel cell-based power is most appropriate since methanol or other substances can be easily carried and replenished. The Indian battery car manufacturer Reva uses UK-supplied fuel cell to improve the charging cycle of the battery. Japan and Germany are credited with solar panel, augmented with fuel cell source to provide electric power to remotely located individual homes or villages or townships. The electric company which serve these places gives incentive to those having solar cell and/or fuel cell-based local power generation, by giving power at concessional rates or pay for power to these sources feeding into the electric grid. IISc could address the technology aspects of fuel cell-based power source as a commercial product either for small-size hand-held PDA or laptop or telecom device. If found easier, address the higher power static application to power homes on standalone mode or augmenting PV sources.

(c) Wind mill technology

IISc can address the fluid mechanics aspects of the blades of wind mill power generator. It is understood that the blade technology of wind mill is much more complex than that of helicopter blade design. The aeronautical department along with material science and physics department could look into the science and engineering aspects and deliver products or design to the very few firms monopolizing the wind mill power sources.

Taught by good experience and knowledgeable professors

Prof. T. S. Jayashankar

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Twenty-five years of experience in research, development and technical know-how transfer to production agencies till free flow of production, in the fields of VHF/UHF radio communication, VHF/UHF Direction Finding Systems for Air force/Navy/Civil aviation, Integrated Tank Communication Systems with fiber optic internal communication and anti-jamming VHF/UHF radio communication systems for tank-to-tank communication for Armed forces and Fiber optics Data communication for Akash Missile project at LRDE, DRDO, Ministry of Defence, Bangalore. Served as Head of Calibration and Measurement group for one and half years at LRDE, DRDO, Ministry of Defence, Bangalore.

I have served in DRDO from Asst Foreman to ScE and have taken up teaching after voluntary retirement.

Reflections

During my 3-yr study period at ECE, I was taught by very good, highly experienced and knowledgeable professors in various Engg subjects. In this process of learning I have acquired a very good knowledge of various Engg subjects and got good exposure to leading textbooks and national and international technical journals and magazines available at IISc Library in subjects of my interest. This exposure gave me total confidence in proposing with great satisfaction to the higher authorities, the above futuristic Defence R & D projects and executing them within the scheduled time period. The benefit was a level higher at the entry level in DRDO. I was given the Republic Day Award 1983 for having completed the R & D working model of the VHF/UHF Direction Finding System for the Indian Air Force in a record time of one and half years, six months ahead of the scheduled time.

I did the following short-term courses after my degree at IISc. : i) Avionics systems at IIT, Chennai, ii) Fiber optics communication systems at IIT, Kanpur, iii) R & D Management of large projects at Defence Institute of Works Study at Mussoorie, Uttaranchal.

These courses have given me more confidence in efficient handling of the above projects and made me mature professionally and discharge my duties with great confidence.

The courses at IISc are very much related to the jobs handled by me. It has transformed a raw science graduate like me into a responsible mature research, development and production scientist and engineer in the fields of electronic communication systems, direction finding systems and radar systems and also as a responsible student-friendly professor.

My interaction with IISc post-course has been very encouraging.

Vision for 2020

From past several decades IISc has achieved international ranking of one among the top 10 leading basic and applied sciences research & development Institutes. In India, it

has achieved top position from the time it started and continues to maintain this position. On technological front it has achieved 10th international ranking position for higher education and post Doctoral research.

IITs started several decades later and in a short time achieved the IIT brand name for 'Most Intelligent and shrewd businessmen' at international level by setting up many software and hardware companies in Silicon Valley, California, USA. It is true that the business growth is very fast in technological front. This may be the advantage IITian's have.

Vision for 2020

Improve the existing infrastructure to support basic and applied science research in every field of science and technology. There should be periodic explosion of research Work in every field of science and technology. This explosion of research work is indicated by some Indian scientists doing research at IISc Bangalore, being awarded either Nobel prize or some international award for innovations. There should be at least three times expansion of infrastructure in terms of area and facilities. The new Campus of IISc may be given the name' International Institute of Science and Technology'(IIST). This new campus may be planned near Srirangapattana near Mysore. It should be located on the banks of river Cauvery with all natural beauty and quiet atmosphere which is good for true research work. This new campus can admit international students, with overall control remaining with IISc. With this I feel that IIScians can establish knowledge banks in all the fields of basic and applied sciences and technology and can be called with the international brand name IISTian.

IISc-Some reminiscences

Kalyani Vijayan
Formerly Scientist, National Aerospace Laboratories, Bangalore

After completing my Master's degree in Physics from Presidency College, Madras (now Chennai), I faced the Ph.D. entrance interview in the Physics department of the Indian Institute of Science and it was my good fortune that I got selected. Professor R.S. Krishnan was then heading the department. On the day of joining, which was in August 1964, my father who was then living in Madras, had accompanied me and overwhelmed by the thought of leaving his daughter in a new place (and for how long, nobody knew!), he met Professor Krishnan in his office and made a rather emotional statement: "I am leaving my daughter in your hands". And promptly, the Professor gave him an assuring smile. Looking back, I feel that day, when my association with the Indian Institute of Science got started, must have been a blessed day in my life. I cherish and respect the association with this great institution, which we fondly refer to as 'Institute' - the one and only institute.

My direct association with the Institue was during my student days viz., 1964-69. My research work started with the supervision of Dr M.A. Viswamitra, then heading the X-ray group and also a Lecturer in the Physics department. However, the association with Viswamitra did not last very long because quite soon, he left for Oxford. The other senior members of the group were the post-doc Dr (Mrs) Shantha Venkataraman whose affection and care were given to me in abundance, Dr H. Manohar, through whom I got the first exposure to heavy atom phasing and structure refinement, Dr S.N. Vaidya, who was rather serious and exchanged occasional hellos, Dr K.K. Kannan, a staunch Iyengar not eating onions and M. Vijayan who always clarified many of my doubts in crystallography in a lucid fashion. As could be expected, all these seniors left one by one and by 1969 when I also left, the juniors had arrived. The juniors were J. Krishna Mohan Rao, B. Swaminatha Reddy, K. Jayalakshmi and Krishna Kumar. Interestingly, most of these junior colleagues have settled abroad.

What was it like to do research in the 60s? In contrast with the present-day facilities, in the 60s, experimental as well as computational facilities available for crystal structure analysis were rather limited. Ph.D. in X-ray crystallography implied recording multiple film Weissenberg patterns with hours and hours and hours of exposure (no UPS in those days and hence power failures had their own delaying effects); estimating the intensities visually* — data from one crystal involved several months of visual measurement; applying the LP and absorption corrections manually for the few hundreds or more number of reflections; computing two-dimensional Fourier maps using Beevers Lipson strips; manually drawing the 3D arrangement of molecules in the unit cell, etc. All arithmetic calculations were done with the help of an electric calculator — as big as a typewriter in size — and sometimes with manual machines also. The electric calculator in the X-ray lab had a special affinity for me; it used to get stuck only in my hands! Naturally, the electric calculators were not sufficient and with no computer facility available in the Institute at that time, it

* When I was very young and much before I joined the Institute, I had no idea what the term 'research' meant. I had seen cartoons of men with a lens in hand searching for something, depicting 'research'. And to my great amusement, I ended up spending several months of my research life at IISc, with a lens in hand, measuring intensities!

was necessary to visit HAL to use its Elliot 803 or occasionally NAL to use its Sirius Ferranti machine. I remember waiting for the doors of the A mess to open at 7.30 a.m. to gulp the breakfast and rush to HAL, once a week. The HAL and NAL computers were not big enough for structure refinement and so, like every other X-ray student, I also undertook the mandatory visit to TIFR, Bombay, to complete the refinement calculations on their CDC computer. Well, to the present generation of crystallographers, all these details may sound unbelievable. Well, that's how it was and despite the tedium, the student days were enjoyable.

Coming back to my Ph.D. work, as I mentioned earlier, Viswamitra left for England and with the rest of the group also migrating to different places, M.Vijayan who was then the seniormost person in the X-ray group faced the inevitable responsibility of looking after my work! It was under his supervision, my thesis work was brought to a presentable shape and then he also left for Oxford. My thesis was submitted afterwards.

The story of our marriage which took place later in 1969 at Oxford has been well documented in Georgina Ferry's book on Dorothy Hodgkin. I would only like to mention that in addition to getting a doctoral degree, Institute was responsible for finding my life's partner too!

In the 60s, we were very few ladies in the Physics department—I do not know how it is now—and as such, we were specially cared for. Professor Krishnan used to live on the campus and almost for every festival, the Physics department ladies living in the hostel got invited to his house to enjoy the goodies. I also specially remember a couple of occasions when on Sunday evenings, Susila, my close friend and senior and I were walking just outside the department when Mrs Nalini Dhawan driving that way, spotted us, stopped the car and took us out for a treat with Masala Dosa from Hotel Breeze located then, in Malleswaram circle. A very endearing gesture from the First Lady of the Institute who knew most of us individually. Of course, that was possible because we were so few ladies in the hostel.

During my five-year stint at the Institute, I lived in the Ladies hostel— there was only one then—situated very close to the Physics department. For the first few years, Dr (Mrs) Rajeswari Chatterjee was our unobtrusive and generous warden who allocated to us single rooms of our choice, whenever our turn came and the vacancy arose. There was something very special about that hostel. It was a single level, spacious construction of rooms around two quadrangles. The garden in the hostel included lovely jasmines and roses. We were about 30 in that hostel and as such, it was like an extended family. Members of this extended family were looked after by dear old Ganga, who did the chores of room cleaning, washing, ironing clothes, etc. My room-mate for the first one and a half years was Lizzy Kappan from Biochemistry. It is sad that the ladies hostel of yester years got demolished; perhaps for unavoidable reasons.

Another memorable feature of the Institute days was the library which was then situated in the first floor of the central building, in front of the Tata statue. Apart from providing the students with most of the needed books and journals, the library had wonderful wooden furniture and ungrilled open windows through which we could gaze at the inspiring Tata statue and the starry sky beyond. The ambience was very inviting for peaceful reading and I got into the habit of regular reading in this library.

After 1969, my links with the Institute have not been so very direct. When we returned from Oxford in 1971, my husband rejoined the Institute and I joined the Materials Science Division of the National Aeronautical Laboratory (became Aerospace, much later) under

the leadership of Dr S. Ramaseshan and continued until recently, in various capacities. During the NAL era of my career, which also includes links with the Liquid Crystal Lab of the Raman Research Institute, I have retained my IISc links, viz., from collaborative work, selection committees, library work, use of computer, etc. Apart from these, over the years, I have also enjoyed the privilege of my various visits to IISc as Mrs Vijayan.

Although it is nearly forty years since I formally left the Institute as a student, I feel proud and happy to claim that I am an IISc alumnus. This pedigree is special!

Me at IISc

G.V. Kamala (Gowri Venkatasubbiah Kamala)
Dept Management Studies—1965–1975;
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When I started to pen my experience at the Indian Institute of Science (IISc), most popularly known as Tata Institute, during my long stay on the campus for more than 29 years, first as a research student and then as a faculty member, I allowed my mind to roam at will to recollect the memories and moments-from where to start?

My family background

I was born in Mysore City and am singularly lucky to belong to a family of intellectuals; my father, the late G Venkatasubbiah, M.A. (English Literature), was sponsored to pursue D.Litt. in England those days, but could not proceed due to family commitments. He later joined the palace office of his Highness the Maharaja of Mysore, Sri Krishnaraja Wadeyar as Mokhtesar (Head), had close interactions with the king, commander-in-chief; participated in Khedda operations; knew horse riding, etc. My grandmother and mother, though belonged to the old generation, had all modern ideas about women and education. Their encouragement and support right from my younger days kindled desire in me to study well and stand first in my class which made me eligible for freeships and merit scholarships throughout my education and I did not spend any money at any stage for education. I completed my Bachelor's and Master's degrees in Economics with distinction from the University of Mysore. I started applying for jobs and for higher studies, and had also applied for Ph.D. program at IISc.

My entry into IISc

I got apprentice officer's job in Vysya Bank, now ING Vysya. I had successfully completed written tests in other banks too, which were nationalized later, but my love for higher education, opportunities to go abroad, and working with intellectuals attracted me to IISc.. Prof. C.V. Joga Rao of Aerospace Engineering Department used to chide me for declining bank jobs.

I got an interview letter from IISc. I had not travelled earlier alone to Bangalore and also was not very familiar with the city. A friend who was residing at Bangalore, applied for a day's casual leave, and accompanied me to IISc. Candidates not selected would be entitled for return train fare to home towns, but those selected would not get it! Those days, it was very difficult to get admission into this prestigious institution, and I was expecting my return train fare.

I went through the stringent selection process and the results were announced the same evening. I was selected for the Ph.D. program! I took permission for two-week joining time, went back home at my expense, consulted my mother and brothers, packed up things to leave home in Mysore for the first time. I reported at the Department of Management Studies, then called as Section of Economics, Social Studies and Industrial Administration, on August 14, 1965, and joined the Ladies Hostel the next day.

On my first day at IISc, the first thing I was asked to do was meet the Director, the Registrar, the Hostel Warden, the Librarian, the Doctor at the Health Centre (then called as Dispensary), and the chief of Gymkhana. I fixed up appointment to meet them. I wish to recall my meeting with the Director, Prof. Satish Dhawan. It lasted just 10 minutes. Considering my economics background, he advised me to focus on research with relevance to science and technology. His advice and guidelines helped me in planning my areas of specialization, research projects and my research career.

IISc was widely known for excellence in science and engineering. The Department of Management Studies was established long ago as the Institute recognized the importance of economics and management-related disciplines and believed thought contributions from these disciplines would make science and technology more relevant to the country's economic and industrial development scenario.

Life as a Research Student on the campus

The moment we enter the cool and beautiful campus, the sprawling island of research and academic excellence,,the first things we notice are the small aircraft parked near the gate, well-maintained streets lined with Mahogani, Gulmohar, Mirinji and other shady trees, old residential buildings with mango and jackfruit trees, student hostel blocks A, B, C, D…M, N with all facilities to live in.

Ladies hostel facilities require special mention. It was started in a small house-like building with only few rooms shared by girl students. The building had a small hall with a centre table and few wooden chairs. The framed photo of Lady Raman (Lokasundari Raman) was prominently displayed on the wall. I understand she took interest and initiative to start the ladies hostel. Guava fruits and flowers grown in the neighbouring Raman Research Institute sent by Lady Raman were kept on the table with a note "Help yourself"; home-made eatables brought by inmates also found place on the table. The hostel building also had many flowering plants and mango trees; mango fruits were harvested and sent to each room for students to eat and enjoy! All these made us feel more at home. Later, with many girls getting into IISc for higher studies, Aswini, Bharani, Krithika blocks were built. The Institute's estate officer Mr K.C. Reddy readied one room and invited all girl students to see and make suggestions, if any, to ensure comfort of the students. Such was the care and involvement of students and management.

Now, a few lines on mess facilities—A, B, C mess blocks were good and provided healthy food; weekly time table of items was prepared by students, the mess staff was very friendly; occasionally, home-made pickles brought by students moved from one end of the table to the other for sharing; all this provided a homely environment.

IISc provided good scholarships to all students and were generally free from financial worries. Well-qualified professors acted as research guides, research facilities were good and library was kept open for very long hours. Many Noble Laureates, experts in science and technology, visited the campus, and international conventions and seminars were organized; all these provided opportunity for students and researchers get wider exposure in their subjects.

A well-maintained swimming pool, Gymkhana, movie club were provided for entertainment and extra-curricular activities. All the above infrastructural facilities were thoughtfully created and developed by IISc to make life on the campus comfortable and hassle-free so that those lucky few who were selected to pursue their research and academic career could contribute and achieve their goals depending on their intellectual capabilities and aspirations. Degrees obtained and research experience gained by IIScians have been

well recognized and valued high by nationally and internationally recognized organizations. Today, many IIScians are holding respectable and high-ranking positions in institutions in India and abroad.

It is not out of place if I mention here that five generations of my family—my grandmother, mother, brother, his sons and daughter, her daughter—have come to visit me during my three-decade long stay on the campus. They have enjoyed the mess food, walked around the cool and fine, tree-lined roads, and totally enjoyed their visit to the IISc campus. Even to this day, in our family gatherings, they recall those cherished days.

My Ph.D. work and career at IISc

While deciding areas of research and work, I always kept in mind the advice given by Prof. Dhawan, the Director, on the very first day of my association with the Institute that my work should be related to science and technology, its relevance and application. During almost three decades of my research and academic career centered around various aspects of application of Science and Technology, R&D management, Technology transfer, Management of academia-industry interactions, and related aspects.

My Ph.D. work was titled "Agro processing industries-their problems and prospects". Agriculture and agro-based industries, though form the backbone of the Indian economy, did not get the importance they deserved even in our five-year plans. I decided to pursue research in this area and thought of looking at how they were functioning, what science and technology could do to modernize these industries, what growth effects can be realized from such a process, and what science and technology can do solving/minimizing their problems. Incidentally, the industries are mainly seasonal in nature.

Prof. S.M. Khot who had MBA and PhD degrees from USA had research experience and hence was very happy to be my research guide and took great interest in discussing this problem with the then chairman of the planning commission, Dr DR. Gadgil, and also its member Dr B.S. Minhas. I had extensive discussions with well-known economists from Bombay and Poona Schools of Economics-to mention a few names, Dr Lakdawala, Dr Dantwala, Dr PR Brahmananda. I also corresponded with Prof. Simon Kuznets of the Harvand University who had written a book on seasonal industries, and Prof. John W. Mellor of the Cornell University who appreciated my work in his reports to the World Bank.

I wish to make a special mention about my discussions and academic collaboration, a longstanding one, with a few faculty. Spreading over two decades, discussions with Prof. KN Krishna Swamy, Department of Management Studies, who had an in-depth knowledge of engineering and management combined with industrial and academic experience, helped me in giving an inter-disciplinary approach to my PhD work with application of engineering practices.

I completed my research work and submitted it to IISc for evaluation for award of Ph.D. degree. The Director of IISc used to select the Ph.D. thesis evaluation panel and the names of the panel members were kept confidential. My thesis evaluation reports were received and Ph.D. degree was awarded. I came to know at a later date that my thesis was sent for evaluation to Prof. Theodore W. Schultz, Noble Prize winner in Economics, Chicago University, USA, to Prof. Colin Clark of Monash University, Australia, and to Prof. S.S. Johl from Punjab Agricultural University. Both Prof. Schultz and Prof. Clark sent me a combined certificate. I quote from it: "I was one of the examiners of the thesis on which Dr Kamala was awarded her doctorate. I thought that her work showed not only unusual skill in analyzing a complex problem of industrial organization (the food

processing industries) but also wide and critical reading over many fields of economics. She wrote sensible comments on a number of outstanding theoretical questions. I understand also that the Institute in which she works has a high reputation. "—Dr Colin Clark. "As one of the examiners of the Ph.D. thesis of Dr G.V. Kamala it is my pleasure to concur with what Colin Clark has said in the above paragraph - TW Schultz."

I have given a somewhat detailed account of my PhD work because my goal of research was not just getting a PhD degree but to do good work, my thesis subject was very well received and widely discussed and formulated. It won the KU Patel Award instituted by the All India Food Preservers' Association. It was endorsed by Dr H.A.B. Parpia, the then Director of CFTRI, Mysore, who was also associated with Food and Agricultural Organization (FAO) of the United Nations.

ii) Career at IISc: My career at IISc spans from 1970 to 1994—Senior Research Assistant in the Department of Management Studies, 1970–1976; at the Centre for Scientific and Industrial Consultancy (CSIC) during 1976-1994 as Scientific Officer, Senior Scientific officer, and Principal Research Scientist. During this period, my research work, broadly speaking, was focused on various aspects of R&D management in food and other manufacturing industries, small and medium–scale industries, and management of academia-industry interactions and collaborations for technology development and transfer.

Though IISc–Industry interactions were going on for long, several institutions and industries were benefited by such interactions and owe their origin itself to IISc's association and contribution. For streamlining and further strengthening and development of this function, a separate unit, the Centre for Scientific and Industrial Consultancy (CSIC), was established in 1975. I joined CSIC in 1976 as the only full-time faculty member at the Centre. I was associated with all IISc–industry interactions, consultancy development and promotional activities, in the development of necessary information systems and in bringing out publications. I participated in all consultancy management and advisory body meetings, project meetings and discussions with scientists and engineers, and managers from industries. In performing these tasks I had the opportunity of interacting with the entire academic community at IISc which in turn provided me wider perspective of developments taking place in various areas of science and engineering at IISc and elsewhere.

With my research background and practical experience gained at the Department of Management Studies and CSIC, I had the opportunity to visit several countries in various capacities and participated in many international conferences; published nearly 30 research papers in reputed international and national journals and conference proceedings, submitted several research reports to the respective sponsoring agencies.

During my career at CSIC I could gain experience and learn a lot on finer aspects and details of academia–industry interaction and management from Prof. Mandyam N Srinivasan who was the then Chairman of CSIC; he took considerable interest in developing consultancy function at IISc.

Final Words: I am an IIScian, and I would like to be identified so. IISc is everything to me.

- An home for more than 29 years with its fine living conditions.
- A ground for nurturing my research and academic career and ambitions with its intellectual environment.
- An experience to remember and cherish for the rest of my life.
- IISc: My association with the name itself is enough; it made enormous scientific contributions over the last 100 years by providing scientific manpower, scientific

and technological inputs to various industries and institutions.

Finally, one day to remember forever—Founder's Day—March 3rd

- All IIScians gathering at the statue of J.N. Tata, the Founder of IISc and silent tributes paid with great reverence;
- The Director of the Institute walking towards the statue to pay floral tributes to the Founder.
- I take this opportunity to salute this great man whose munificence in establishing this Institute enabled me to be associated with it.

Choose faculty on wholesomeness of personality

C. Krishnamurthy

ECE (1954-57), Teaching: ECE, 8 months. Retired from the services of Bharat Electronics Ltd as GM (July 1993)

I have gained professional experience related to installation, management, improvement of production and quality systems related to electronic equipment and semiconductor devices.

Reflections: I was quite confident of usefulness of my studies for a subsequent professional career and hence I did not think about it.

During my employment at the Controllerate of Inspection, Ministry of Defence, I had to study new topics like piezoelectricity, semiconductors, etc.

Relevance of study: Generally relevant, but cannot be sharp on fast changing technologies.

Interaction: Not significant; my interactions were limited to assessment of a few departmental candidates for award of Ph.D. degree.

Anecdote: Late Sri J. R. D. Tata's lecture on a Founder's Day was energizing.

Vision for 2020: IISC should become a world leader in chosen fields be they IT, robotics or AI, etc. Always ready and be capable of advancing frontiers of knowledge, attracting students from abroad.

Suggestions: Industry–Institute interaction for improving quality of research and or teaching through a sharper customer focus must intensify if already begun. Emphasis must be on all–round development of students. Faculty need to be chosen not merely on academic attainments and embellishments but on wholesomeness of personality and fitness for intended purpose. TQM may be useful.

My experience at IISc—Random reflections

Prof. P.R. Mahapatra

Aerospace Engineering (then known as the Department of Aeronautical Engineering), M.E., 1968–70, Ph.D. (while on faculty of the Department) 1970–77, Faculty, Aerospace Engineering, 1970–Present.

I was struck by the balminess of the weather when I had landed on the IISc campus at the end of a July. It was baking where I came from, and the change was soothing. The campus and the city felt friendly, accommodating, gentle and unhurried. It was my first foray deep into the South, but the place and the culture somehow felt familiar.

We were welcomed into what was essentially a dormitory with some 12 newcomers like me sharing a tiled roof, and in a few days we were dispersed into bona-fide hostel rooms of double occupancy. In a couple of weeks the formalities of interview (which was the mode of selection then even for M.E.), selection, fee payment and admission were over and we were ready for the classes.

There was a bit of tradition those days that I remember fondly. As a part of the induction process into the Institute, every student got a chance to meet the top functionaries—the Deans and the Director. You stood in a line to shake hands and be welcomed individually by the Deans. The line continued on to take you into the hallowed chamber of the Director, then Prof. Satish Dhawan. You were let in to meet him one–to–one. He would cordially greet you, ask you a word or two about your background, and welcome you to your chosen course of study. It was all over in probably a minute, but you left feeling very special.

Avenues for employment were scarce those days. Most engineering jobs were in the public works departments of state governments. Many scholarly students didn't find them attractive, and opted for higher education. In my initial class strength of 37, almost a half comprised gold-medallists from top universities (most states had only one or two universities then). This made for an intensely intellectual and competitive environment for studying and socializing.

Later in life I have been asked many times as to what makes the Institute so special. Let me describe my own experience. I already had seventeen years of school and college education before I came to the Institute. So what difference did I find? The Institute was cosmopolitan, no doubt, but so was my earlier Regional Engineering College (now National Institute of Technology) which had, by mandate, half its students from out of state. Post-Independence, guided by Nehru's vision, India was building up hosts of new institutions. My old college's brand new campus was a sprawling one enclosing hills and brooks and fine buildings and laboratories. We had single-seated hostel rooms with fine furniture and panoramic windows. Before that, even my high school in a state capital had had fine buildings, playgrounds and laboratories. In terms of physical facilities, coming to the Institute seemed to be a demotion.

What about teaching? As far as classroom instruction was concerned, frankly, I wish I could write home. There were of course some bright teachers, but a good fraction of instruction, perhaps even the majority, was indifferent to the point that almost a quarter of our initial class strength (including some previously top-rankers) dropped out along the way. It did induce a need for intensive self-learning, which was a positive outcome. Again, that was not very different from my earlier experiences.

Many years and institutions later, I have come to the conclusion that the level of plain classroom teaching does not vary too much between the best and the mediocre institutions (give or take a Richard Feynman). Even from the podium, I have found the student response in a hallowed precinct in Pasadena or Rome or Warsaw to be not very different from that at some of the smaller colleges in India. And in each of these places I have heard the same grouses against the 'administration' as we hear back home. So what is it that makes the Institute (or a Caltech or a Cambridge) different?

In almost four decades on the IISc faculty and through extensive involvement with many agencies (government, educational, industry), I frequently meet people of all ages who are either our ex-students or have spent brief periods as student trainees, attendees of workshops, seminars, short courses, etc. At the first opportunity they would come up to you and very fondly reminisce their IISc days, even if very brief. Many would tell you that those were the best days of his/her life. Again you would wonder what aspect of the Institute impressed them so much.

I believe it is the 'culture', the ambience—not just the landscape and buildings and cafeterias but the intellectual one, the traditions, and the attitudes that make the difference. It is the feeling of freedom—to learn, teach, and experiment. It is also the 'messages' that the 'system' emanates.

In that sense the Institute has had plenty to offer. One organ of the Institute that had struck me as very different when I first came in as a student comprised the hostel messes. I have already mentioned that the hostel buildings and the physical facilities were modest, rather old-styled, even by contemporary standards. But the discipline and service were par excellence. I saw for the first time a student mess where the boarders sat in serial order as they came, irrespective of gender, much unlike the noisy groups occupying separate tables elsewhere. The service, by barefooted servers always on their toes, was prompt, courteous. You got a sense of personal care, even feeling and affection. After you had been a boarder for a few months, the servers would know your preferences (items, amounts, timings,…) and serve accordingly. If they ran out of an item towards the end of the mess hour, they would quickly turn up a substitute and keep you well-fed. The 'emergency curry' was often tastier than the original.

The students reciprocated this affection in full measure. The servers were seen more like brothers by the student community rather than as employees. In my decade of boarding in the mess I never recall any student shouting at or ordering a server. Four decades after my first encounter, during which I have served the hostels as a Warden and also as the Chairman of the Council of Wardens, I still occasionally meet some of the old 'brothers', now retired, and we fondly exchange greetings and inquiries.

You could bring in your personal guests, unconnected with the Institute, to join you in the mess. All it took was an entry in a guest book. Most guests enjoyed this experience, and many recall it today. Non-student fraternity of the Institute such as the faculty was also allowed to board in the mess. Down the line these facilities were seen to be unmanageable and were withdrawn. To many that was a significant loss of connectivity with the Institute fraternity, especially the student community. Perhaps a partial compensation is the many more eateries at various levels that the campus now has.

Incidentally, it is a matter of gratification that the Institute has now been able to provide its students much more modern residential facilities than where we resided, which were an assortment built over different epochs. During my tenure as the Chairman of the Council of Wardens, we had the pleasure of setting up and commissioning a large (almost

1000 rooms) modern hostel complex which is functionally and aesthetically superior while being compact in terms of land use.

The faith that the student community enjoyed and displayed appeared in other forms. One example was our departmental library. The books there were provided by the Institute library, but it was managed by the students, informally. The cupboards were never locked and the main door key was with a student. If you needed a book, you just borrowed the key from him, any time of the day or night, opened the room yourself, and just took out the book after entering your name on a register.

Besides books, the library also had a couple of 'computing devices' by way of hand-cranked mechanical digital calculators of Remington and Facit makes (those were the days before the advent of even the humble electronic calculator). Each multiplication required rotating a hand crank by a number of times equal to the sum of the digits of one of the multiplicands—you choose which—and periodic fiddling of a pointer with your other hand. But when multiplying large numbers accurately, it was still better (at least less error-prone) than hand calculation and much more accurate than the slide-rule.

At high-pressure times such as the days before tests and examinations and when a common assignment was due, the department library became a beehive of activity. We would finish our dinner in the mess and assemble in the library, some in pyjamas to feel easy for the night ahead. Examination preparation and working out assignments then became a community activity. Someone would read up a topic and announce it to all the others. Inverting a 5x5 matrix was a wrist-breaking task that many took turns on the hand-cranking-calculators to solve over the better part of the night. If you got tired or sleepy in the early hours you could take a stretch and catch forty winks on one of the benches while your friends carried the on the cranking. But in the end you had a close sense of togetherness, community and camaraderie.

That experiment came to an end in a few years when the library audit found progressively increasing numbers of books being lost in subsequent years. The books were returned to the main library and the library was closed down. In any case the 'computing facility' there had become redundant with the installation in 1970 of the IBM 360 'main-frame' computer as a central facility of the Institute. Most departments now have their local libraries functioning, but more formally, with an appointed library hand and generally open only during working hours.

The IBM 360 looked like a godsend. It was also impressive, occupying a large and airconditioned 'CPU Room' together with a battery of cabinet-sized tape drives, a high-decibel impact printer, and system consoles. It suddenly gave the Institute a fair amount of captive computing power, in a 'high-level' language like FORTRAN, and enabled the pursuit of certain types of research hitherto impossible. It also stopped the need for computation-based researchers to go for long stays at TIFR, Bombay or, for more frequently for smaller problems, to HAL, Bangalore. It helped me a great deal in my Ph.D. thesis, even with its excruciatingly slow speed, primitive software and input–output devices. To feed programs you had to punch IBM cards, one large card per line of code, at ungodly hours of the night when there was a manageable queue for the punching machines. You then carried back the deck of cards to the Computer Centre during the working hours and submitted it at a window for offline processing.

If you were in the programme development or debugging stage, you asked for a quick run of 2 minutes of CPU time, and got back the result generally the next day as a printed sheaf of fanfold paper. For a 'long' run of 40 minutes of CPU time, you typically waited for

a couple of weeks (yes, *weeks*) to get the results. You still dreaded if your run wasn't going to be aborted due to a syntax error in a small change you made between runs, and if it did then you cursed your stars, fixed the error hoping you have done it correctly this time, went back to the punching machine to incorporate the change, resubmitted it at the window, and cooled your heels for two more weeks. If you were lucky, you would get from that 'long' run what now comes from your own desktop PC in less than a minute. The biggest woe of your life came if you happened to drop the hefty stack of cards on the way to the Computer Centre, often on the carrier of a bicycle (due to the sheer weight of the stack). Then you would be sorting out and rearranging the cards serially for the next couple of weeks.

The only graphical output device was a Calcomp X–Y plotter for which the pen cartridge was in short supply. We had to innovate to replace the pen with empty ball pen refills to get a carbon impression of the plots. The only internal plot capability available was a 'Plot 10' command that would join two defined points by a straight line. You had to programme all other capabilities on your own. Since my thesis required extensive 3-D plots I had to develop the basic program in FORTRAN, including hidden surfaces. That seems like prehistoric times today when I feed the algebraic form of a function into a MATLAB programme on my desktop and take a press-like crisp laser printout of its 3-D variation with a simple and single 'mesh' command.

Desktop and laptop computers have given us a lot of independence in terms of computation and information. For those who need more, they provide direct access to the central computing facility, which is of a much higher order now.

Like the central computing facility, the Central Library has always been a main hub of the academic life of our campus and a primary reason for its excellence. Having had the privilege of managing the J.R.D. Tata Library at a critical period in its history, I am personally aware how much its holdings and journal subscriptions have been subjects of envy and awe for the rest of the academic and research institutions of the country. The Institute has been generous in allocating budget for the library (though the community has always wanted more). I have seen colleagues from sister institutions roll up their eyes and sigh in disbelief on hearing of our library's budgetary level ("I wish we had a third of it!"). In recent years the library has been subscribing to online information services. Their access through our intranet has reduced the need for physical visits to the library, much like those to the central computing facility.

The very same desktops now let us communicate with colleagues anywhere in the world in real time, unlike the 6-week turn-around time of postal letters in my early days at the Institute. But many believe we are taking this facility to the extreme. It is now common for many at the Institute to communicate with their colleague(s) in the neighbouring room via email. This reduces the warmth of the personal communication and collegial togetherness. This seems to be a global phenomenon, but we should still consciously guard against losing the personal touch in communication while enhancing its volume and speed.

Over-penetration of computers, as some think, may have also changed the nature of doing research at the Institute. Many lament that both analytical and experimental sciences and engineering are falling behind as more and more students choose simulation and computation-oriented problems. Yet others, sometimes dismissed as old-timers, believe that a section of researchers may actually be turning to computers and commercial software as a substitute for original thinking. But we should not forget that computers have come to stay as facilitators of research. It is therefore the task of the research community to

ensure that the high computing power and versatility available today is used symbiotically and holistically in conjunction with physical, analytical, experimental and developmental approaches.

Another very important aspect of research at the Institute relates to finances. Much of modern research, especially of the applied type, is expensive. To stay contemporary and competitive with the global peers we have to incur at least a significant fraction of international levels of expenditure for our research. Till the early years of my career the Institute depended essentially on the Government handout for all its programmes. At least for the engineering departments this meant little resources left after meeting the committed teaching programmes.

Over the last three or four decades progressively increasing funds for 'sponsored research' have flowed in. As the Indian Government has established many focussed scientific departments, the Institute faculty with a reputation for dedicated research has been able to attract significant funding. The Centre for Sponsored Schemes and Projects is among the busiest offices of the Institute. The tables have turned. Now many of our colleagues in the academia overseas look with admiration, perhaps tinged with a bit of envy, as to how readily the IISc faculty can access research funding in contrast to the West where it seems to be getting tighter.

Sponsored research has also brought the Institute faculty close to the activities of the sponsoring departments of the Government. Traditionally academic institutions such as IISc were expected to train and provide manpower for the Government and industry. But the IISc faculty has gone well beyond that to involve itself directly in the activities of external agencies. In my case this has meant strong interaction with many of the major national programmes on aerospace systems. It helps that a vast majority of the nation's R&D in these areas is concentrated in Bangalore. Physical proximity enhances interaction. This interaction takes the form of participation in actual problem solving, training their scientists in a focused manner through our course and research programmes, offering dedicated lecture series, consultancy and technical audit, and membership and/or chairmanship of research councils/committees and review committees. Diversified and intensively active departments like ISRO and DRDO offer exposure to immensely challenging practical problems. I have had the personal satisfaction of acting as the Institute's formal interface with some of these organizations. This interaction also helps us in imparting to our students the kind of education and training that would be relevant to our national programmes. In fact it always gives a nice feeling to see many of your own students occupying steering positions in the national aerospace organizations and programmes.

Another aspect of the Institute's change process that I have been intimately associated with relates to interaction with business and industry. In recent years our business and industry, in need of specialized manpower and technologies, have increasingly turned to academic institutions. The Institute, at the forefront of Indian academia, has large demands to fulfil this role. Orderly management of this role takes some effort, to which I have had the opportunity to contribute through involvement with the Centre for Scientific and Industrial Consultancy (CSIC) and the Society for Innovation and Development (SID). Particularly challenging was the latter, which we started ab initio. It was a difficult but satisfying task setting up this 'independently' registered society and steering it in its initial years in order to fulfil the expectations of business and industry with minimal adverse impact on the Institute's normal academic functioning. Maintaining a healthy balance

between these two aspects in the face of increasing external demands will require some introspection and conscious action on the part of the Institute in the years to come.

The Institute's interactions with foreign entities are also increasing at a rapid rate. This includes formal interactions with foreign universities and dedicated R&D undertaken for foreign technology companies, even government agencies. On a different plane, the visibility of individual Institute faculty members in international fora has also been increasing steadily through international conferences and invited lectures. As the costs of such international exposure keep escalating, there is a clear need for greater support to keep up the international profile of the Institute.

The Institute campus is getting crowded, but has still remained among the best green oases of this burgeoning city. The verdant campus spurs you into artistic creativity. From my early days I have used my innate photographer's instincts to capture many aspects of its changing moods. For some years I was a regular contributor of photographs for our official publications. I wish growth and 'development' does not take its toll adversely on this little tropical paradise.

I would end by saying that as the Institute grows vertically and horizontally, it must stay rooted in the traditions and values that have made it a great place to be in. I will recall one such tradition that I experienced in my early years on the faculty. Those days, coinciding with our Founder's Day, the Director used to host the faculty of the Institute, senior administrators, as well as student representatives in a candlelight dinner laid out on long tables in the open yard in front of the Central Office. It used to be a memorable evening that we looked forward to every year. Perhaps logistical and cost considerations made it disappear, but nothing similar has replaced it afterwards (the students' welcome get-together in August was there even then). I believe the Institute should foster many more activities at various levels, formal and informal, that serve to remove communication barriers and improve the community spirit.

Overall, it has been an exciting journey for me after I joined the Institute. I hope the Institute continues to give those who pass through its portals, to the nation, and to the greater cause of science more than what it has hitherto given.

My Institute, My Life

Prof. Manas Chanda
Formerly Professor, Department of Chemical Engineering, IISc.

Exactly fifty years ago, when I was an undergraduate student of chemistry at the Presidency College, Calcutta, I came to Bangalore as a member of the Presidency student group visiting South India. A visit of the Institute was included in our Bangalore itinerary and since all the members of the touring party were students of chemistry, especially interested in industrial chemistry, we made it a point to visit the Department of Chemical Engineering. What I saw then as the first sight on entering this Department is still fresh in my memory and it did influence my own career greatly. A very elderly professor standing atop a tall ladder was pouring ceramic rings into a large size fractionation column. This was Professor S.S. Ghosh, then acting head of the department. On seeing us, he alighted from the ladder, greeted us and then explained the functioning of the column. Professor Ghosh's commitment to experimental research and his deep involvement in laboratory made a lasting impression on me and, on that day, I resolved quietly in my mind to work with him and follow his footsteps after my graduation from Calcutta.

Several years later, during my final year in Applied Chemistry course at the University Science College, Calcutta, I chanced upon an ad in a national daily inviting applications for research admission in IISc, Bangalore. That scene of an elderly professor standing atop a ladder in the Chemical Engineering Lab and the quiet resolve that I made at that time flashed in my mind. Without any delay I sent an application to the Registrar for admission to the Ph.D. programme in Chemical Engineering. Reply came soon with an invitation to appear for an interview at IISc. But my excitement disappeared soon when I discovered that the date of interview was right in the middle of my university exam dates. I felt dejected and thought that my dream would not be fulfilled. But still hoping against hope, I dropped an ordinary postcard to the Registrar A.G. Pai expressing my inability to attend the interview because of conflict with exam dates. I still consider it as one of the biggest surprises in my life that a prompt reply came from Mr Pai. He asked me to come to the Institute after my university exams and meet the Head of Department of Chemical Engineering to face an interview by the faculty. Frankly, receiving such a sympathetic and personalised response from the head of Institute's administration was beyond my imagination.

So I came to Bangalore. During the 40-hour train journey from Howrah, I was all the time feeling nervous about facing an interview which would the first time in my life. It was the month of August in 1962, pleasantly cool with a touch of chill in the air and the Institute was like an Ashrama, absolutely calm and quiet, an abode of peace in the lap of Nature, a far cry from the hulla-baloo of Calcutta. It was difficult not to fall in love with this island of peace. With some trepidation in my mind, I slowly climbed up to the top floor of the old Chemical Engineering building and knocked at the door of Professor N.R. Kuloor, who had taken over as the new Head of Chemical Engineering, not long ago, replacing Professor S.S. Ghosh (which indeed had caused some resentment in him).

A very sweet and charming person in his middle age, Professor Kuloor was extremely cordial to me. As I showed him the letter of the Registrar, he asked me to sit, asked about Calcutta, its weather, about the train journey, stay in Bangalore, etc. all very personal things. Then he wrote on the corner of Registrar's letter "Please admit Mr. Chanda" and

asked me to walk down to the Registrar's office to pay the fees for admission. Bewildered, I asked "Sir, my interview?" "No interview for you, you are a topper in the university", came the prompt reply. I could not have imagined a more pleasant and easy entry to this august Institute.

Though I felt charmed and greatly impressed by Professor Kuloor, and despite the fact that he was the Head, I did not choose him as my guide because I was already committed mentally to work with Professor Ghosh when I had met him in his Lab way back during my South India tour. There was, however, a risk in joining Prof. Ghosh because the relation between him and Prof. Kuloor, as I realized as soon as I landed in Bangalore, was far from cordial, the reason being obvious. But it was the greatness and magnanimity of Prof. Kuloor that in spite of not being his student he loved me so much (perhaps more than his own students) and it was he who made me to stay back after finishing my Ph.D. work and directly inducted me into his faculty. Interviews used to be held for selecting faculty but in those days it was the Head of the Department who really made the choice. I do not feel that I was the best of the candidates who appeared for the interview but it was Professor Kuloor's choice that carried the day for me. I enjoyed his tremendous love and affection all throughout which I cherish even today.

Coming back to my early days at the Institute, I cannot forget the stark difference I felt between life in Calcutta and that in Bangalore, especially on the Institute campus, living as a residential student. Whereas in the Science College of Calcutta university we used to be forced out of the lab at 5 p.m. sharp, no matter whether our experiments were done or not, here at the Institute the research students would have access to the lab on any day, irrespective of holiday or not, and any time during the 24 hours of a day. The joy of having such freedom was unimaginable. The hostel, the lab, the library, that is, the places that were more important, being not far away from each other, it was an ideal ambience to carry out experimental research. I would come to the lab at 5 a.m., wearing pyjamas, work till 8 a.m., walk down to hostel mess for breakfast, and come back to lab after changing the dress. Such shuttling between hostel and lab would continue for the whole day and whole night could be spent in the lab, if necessary, no permission necessary and no question asked. So much freedom and liberty! It was indeed a joy to be a research scholar at the Institute.

Coming away from home we, however, used to feel lonely at times and particularly had difficulty in adjusting to southern food and fish-less dinner. The Bengali professors knew that very well and so at week-ends there used to be a dinner party at the house of any one of them. There was no need for any formal invitation to these parties and the door was open for any fish-loving Bengali student at the Institute. There used to be so much fun and gossip.

Those days, very few students used to come to IISc from Calcutta. So, the number of Bengali students at any time used to be very small, hardly 9–10. So any new arrival from West Bengal would be cordially welcomed into the miniscule Bengali student community. There were also only a few Bengali professors at that time, but all of them were stalwarts and very well-known personalities. I would specially mention D.K. Banerji, S.K. Chatterjee, and J. Ganguly, who were very popular with us. They were our source of strength. For any problem we would approach them freely, either at home or in the Department, and receive their help and guidance. That friendship and association continued even as some of us like me joined the Institute as faculty and in a sense became their colleagues. But to them we were still students and would rush to them whenever in need of help. I remember the problem I faced with my little daughter's admission to the Cluny Convent.

Living next door to the school, it was the ideal choice for her. But getting admission was very uncertain and almost impossible. Someone told me that Prof. Chatterjee could be of help. I immediately rushed out for him. It was a Sunday but I knew surely where he would be at the front table in the main Library. I barged into him, interrupting his studies. He gave a patient hearing, then wrote a letter addressed to a Cluny teacher and advised me to take it immediately to her in East Bangalore. It worked and my daughter did get admission to Cluny without any more hitch.

The overall size of the Institute was fairly small. So there used to be considerable intermixing of students and faculties of all departments. Some of the professors commanded awe and tremendous respect from us. Most of them lived on the campus. There were very few cars. As they would walk from their Bungalows to the departments we looked at them from a distance with reverence and admiration. One such professor was Dr P.L. Bhatnagar. He was steeped in mathematics and seemed to be carrying the burden of mathematics for the whole Institute on his broad shoulders. Once or twice every week he would hold classes for all, including students and staff, in the big hall of the then Power Engineering Department. Everybody was welcome and the classes used to overflow due to massive attendance. Those scenes are unforgettable. With vigour and passion and limitless energy he used to derive complicated equations starting from elementary principles. Everybody admired his depth of knowledge and great dedication. Besides these regular lectures, Prof. Bhatnagar often used to give seminar talks on his current research. So famous was the man that rising to introduce him in one seminar, Prof. Chatterjee only uttered one sentence: "Those who do not know Prof. Bhatnagar have no right to be in this room"! That was the briefest introduction to a speaker I had ever heard.

My experience as a faculty member in the Department of Chemical Engineering at the Institute has been like that of a member in a knit family. Having a lab where you could work hand in hand with your students and do research in any area of your liking with absolute freedom and no restriction of any kind would be a fond dream for anybody. I was indeed fortunate to have it in real life at this Institute where I had had a long innings of 40 years of academic life. The introduction of credit system in the sixties at the Institute which ushered in great freedom in the matter of choosing courses, cutting across departmental boundaries, had a large impact on my classes because the subjects I taught, namely, Materials Science, Polymer Science and Technology, and Computer Oriented Numerical Analysis, all found favour with both science and engineering students at the Institute and it was often difficult to accommodate all students in the class room. Though it increased my teaching load considerably, I got the benefit of coming into contact with many students of many departments, besides those of Chemical Engineering. With some students these contacts even transformed into deep friendship over the years.

Though I retired from active service at the Institute about six years ago, it has not changed my Institute life to any significant extent. At least, I do not feel that the Institute has changed or made to feel that way by anybody. I still come to the Institute every morning and spend the whole day in academic activities. It is the uniqueness of this Institute that a retired professor never feels unwanted here. The Department welcomes him with open arms and extends help and hospitality as much as possible. This attitude of friendliness and cordiality has sustained me. Having spent three-quarters of my life at the Institute, first as a student and then as a faculty member from the first day of my service career to the last, it would have been catastrophic to be dissociated from the Institute environ either mentally or physically. But this did not happen because this Institute is different from most others and is certainly the only one of its kind in the country.

Encourage entrepreneurship by students

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Physics Department was reputed to be one of the best in Crystal Physics and Instrumentation. We had a very dynamic head and disciplinarian in Prof. R.S. Krishnan, excellent faculty, brilliant post-docs who also taught courses and a rigorous training programme including a stint in the Central Workshop. Students generally built the equipment they were to use for their research. Admissions were tough. Fellow research scholars were very bright and hard working and some of them, E.S. Rajagopal, R. Chidambaram and Gopalan later came to occupy top positions in the Indian scientific scene and government. My own research guide, S. Ramaseshan, an enthusiastic young scientist, who had just taken over research in X-ray Crystallography from G.N. Ramachandran, was a great source of inspiration and often worked along with his students. He was a scientist of diverse scientific interests such as crystal optics, X-ray crystallography and later high pressure physics and materials science. He was also a great popularizer of science and editor of scientific journals. His distinguished career terminated in the Directorship of IISc.

I was fortunate to get a Faculty position in the Institute itself, where I was trained in research and also in the art of teaching. Therefore, the transition was smooth, except that I had switched from Physics to Inorganic Chemistry and therefore had to adapt my research accordingly.

The study of books on structural chemistry, chemical bonding, etc. required for my research for Ph.D. proved very useful during my tenure in a Chemistry Dept. I also had to devise courses in X-ray crystallography suited to students of chemistry, who had very little basic knowledge of crystallography. Before starting research I had to fabricate my moving film X-ray camera in the Central Workshop, which had its own problems, since I was not an engineer. However, the training I received as a research scholar in the Physics Dept. helped in this exercise.

Within a few months of training in the Physics Dept. as research scholar, three international tennis players, who had just turned professional, played some exhibition matches in Madras. Those days, there was no professionalism in tennis. Since I was an avid sports fan, I asked my research guide for a couple of days leave to watch the matches. He was taken aback that a newly joined student should have the temerity to request leave to watch a sporting event, instead of concentrating on his research! However, being a sports enthusiast himself, he promptly, said 'sure, go head and enjoy yourself!'

Having been associated with a Research Dept. (research in basic sciences) over a long period, I see some trends over the years. The quality of students entering the Chem. Dept. has gone down over the years. In mid-60s, the number of students who merited admission was much more than the number of vacant seats. However, towards the end of my career (1990), we had to fill in the quota of seats available with below-par candidates. It could be that bright students are attracted to jobs after graduation in IT and related sectors (IT coolies as Prof. C.N.R. Rao calls them) rather than spending 5 years

for a research degree and still not being certain of a job suited to their qualification! Also in IISc itself, more students seem to be opting for research in biological sciences, with better prospects of jobs in the private sector (pharma, bio-informatics, etc.). Suitable ways should be found to remedy this situation and attract bright, motivated students to basic sciences, like mathematics, physics and chemistry.

In order to become an economically powerful, developed country it is obvious that India needs a strong scientific and industrial base. IISc can become a leader in this effort. IISc is perhaps in the forefront among the academic institutions in the country. However, in the international rankings, it is way down even among Asian countries like Korea and China. Why is this? Unlike in my days, adequate funding for costly instrumentation and research projects is not lacking. Monetary compensation has also been increased, though not comparable to the private sector. Still top-class research of international standard is not evident, except in isolated cases. Perhaps the faculty is not up to international standards. Why are top Indian scientists working abroad reluctant to come back, as in China? Inadequate compensation and recognition of outstanding work (e.g. China), lack of a scientific ambience in academic institutions (more of politics, promotions on the basis of caste favouritism, etc.), little scope of a multi-disciplinary approach to scientific problems, which present-day research demands, lack of interaction with industry, which can lead to funding by private industry, easy movement of faculty to industry and vice-versa for short periods, etc., may be the reasons. My son, an alumnus of IISc, is a research engineer in a foreign university. His colleagues in his research project consist of physicists, chemists, computer specialists, biologists and finally doctors in a hospital! Is this possible in India? IISc can take steps to rectify the problems mentioned above to attract top scientists for academic positions. It is they who can take up research in emerging areas such as nanosciences and technology, biological sciences, information technology, microelectronics, communications, MEMs, etc., and make significant contributions. I am glad that during the Centenary Year, IISc is moving in this direction. Alumni Association of IISc can also play a very important role than in the past like that of the IITs. It is nice that a beginning has been made with the establishment of an Alumni Cell in the Administration and revitalization of Associations in countries abroad, particularly in USA. One last point I wish to make is the need for encouragement and support of entrepreneurship by students passing out, rather than depending on jobs. These are some random thoughts. I have raised a number of points but given very few solutions at least, they will give food for thought to people in charge. I have no doubt that this great institution, which I had the honour and privilege of serving, will reach greater heights in the years to come.

Science at IISc-Good, great, Outstanding, …? An inner dialogue

H. S. Mukunda

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Having lived in and with an institution for forty years (including six years of student life), one is apt to develop attitudes that may amount to self-praise or being overly critical. Notwithstanding these, one has opportunity to examine the institution from outside too, when you have visitors who make observations, or when you need to make careful observations during your visit to other institutions both in and outside the country.

Clearly, as far as I am aware, within India, IISc stands out as an extremely worthwhile place to stay and work either in basic or engineering sciences, for, you brush shoulders with a number of colleagues from various disciplines who can think deeply and who can provoke you to think deeply as well. Also it has always been headed by distinguished men whose engagement with science is unquestionable and successive governments have been respectful of this status. Does this entitle IISc to claim camaraderie with the best institutions in the World? Some faculty in authority (and some others as well) wish to assert this. And some who were in authority state that much is desired before achieving this. Either way, the subject needs examination by all and action on behalf of the men in authority. Has such an act not happened in the past or is it happening at the present are the questions for this dialogue. I have titled this as "an inner dialogue" for most of what is said here has been brought up for informal conversations with several distinguished men of science at IISc, but left behind for me to engage in a more assiduous inner dialogue.

Over years, several debates on teaching vs research, research in engineering departments vs science departments, meaning and role of consultancy in faculty output, and commercialization of intellectual property rights have taken place more informally in select groups rather than as specifically flagged items for full-scale discussion. Many of these have had inputs more personalized than institutionally focused.

Teaching has traditionally been the main forte of engineering departments; it is only in the 90s that science departments also introduced course requirements for research and this needed classroom teaching by science faculty. Many men of importance have generally regarded teaching as an unavoidable chore rather than a valuable professional activity; there used to be statements of slighting the teaching activity, some publicly in meetings and certainly more in private discussions. Hence teaching quality has remained at an average or poor over decades with perhaps cursory attention to repair or upgrade. By international standards, this will place IISc not in any great favor. Arguments are made that what is important is research. The connecting link between good teaching and students who could be fired up to do some interesting research is glossed over. The fact that good teaching is still practiced perhaps in pockets is in spite of rather than due to a supportive action towards teaching. This does not mean excellence in teaching has not been honored. Yes, they have been. But the atmosphere of the Institute does not breathe even partly of excellence in teaching.

There have been significant differences in attitudes on research between the science and engineering faculties. What is practiced in science departments is understood to be

research indeed. What is done in the name of research in engineering departments meets with the expectation of research only in parts. As such, there is an undercurrent of feeling that research in engineering departments does not measure up to that in science departments. Engineering departments also do not make their case of good science very strongly—there is no "lobby" in this regard. The lobby for goodness of science in science departments is far too well "understood" to be even doubted. But the claim to superior science in science departments is faced with answering the typical question: how many Nobel Laureates does institute have? Why is it that in the last fifty years, IISc has not been able to produce even one Nobel Laureate? It is not that the lack of a Nobel tag makes the quality of science poor, but it puts burden on making complex looking and long-winded arguments about the quality of our science. One often invokes the conclusions of the survey done on the standing of scientific institutions all over the world based on some select criteria that states that IISc is 18th amongst the institutions in the world and some others that may say IISc is No. 1 in the Asia-Pacific region, etc. These do not always carry the same weight as would be the case of having a 'Nobel Laureate'. One message is clear: Gaining position within the institution by looking down upon engineering research is not the best thing to do, for, one might be attempting to throw stones living in a glass house. As such, it is perhaps appropriate to ask a more relevant question; can institutions not aim to do 'Nobel'-quality science -in science or engineering departments? Stated differently, should faculty not debate questions about what class of problems in each area to address? Some problems are pedantic, the origin of which will lie in some path-breaking work elsewhere, pursuit of which will assure publications, will receive pat on the back by the more distinguished or those scientists established overseas, perhaps more of western origin. There are many reasons for this. Such an act assures quicker recognition, a possible sabbatical, a visiting position for a few months or at the least, an invited lecture. If one does path-breaking work here that disposes of a concept, disproves a hypothesis originated overseas, it is far more difficult to be recognized at least initially; it is an uphill task. One would need to keep attending meetings in several parts of the world and argue with each group about the sanity of one's own approach vis-à-vis the existing thinking.

There is an important distinguishing feature about working in science and engineering departments. In science departments the majority of the work can address questions that are universal and with marginal connectivity to "nation". Perhaps the choice of the problem could be such as to be of national interest as well. In engineering, a significant part of one's work has to be of national interest, for otherwise the connectivity with the real world becomes weak if not lost. In institutions in developed nations, the meaning and relevance of the work for the nation are not different from that for the rest of the world and hence one does not need to debate. In developing countries, one needs to do work in engineering departments that would help build up the research and development efforts somewhat directly. Problems that arise in defence and space departments need resolution in a local environment since overseas technology regimes impose 'sanctions' as in the recent past preventing access to developments. Sometimes this is regretted. But this act is perhaps very welcome—it helps indigenous build up of science and technology tools with self-reliance becoming an accepted strategy. The national need and relevance of faculty and scientists thinking about advanced subjects becomes established beyond the attitude of "poor engineering science". This is not always true of all fields in engineering. There are some fields like telecommunications, biotechnology in pharmaceuticals that have been entered into by multinationals who can afford to and actually bring together excellent scientists to

do meaningful frontier research and the question of academics making significant contributions becomes a more difficult aspect—the field becomes locally very competitive and it is not easy to choose outstanding areas to make contributions.

There was an interesting event during the regime of Prof. Padmanaban as the director. Sometime during 1996-97, some large-scale funding was supposed to come to the Institute specifically to ECE/CEDT aimed at creating a school, it was said. The Director held a discussion meeting on the issues associated with this. During the discussions, the primary aim seemed to fluctuate between providing teaching services at high personal remuneration and as yet unidentified research. For the perceptive, it was clear research agenda was low and perhaps, their investment was aimed at using the Institute for low-cost teaching or better termed as HRD by paying remuneration high by IISc standards and manageable by industrial standards. I had occasion to voice thoughts I have brought out in the earlier paragraph, but was thought having a negative thinking on the subject. Not wanting to be contained like this, I drafted a long letter on the philosophies of how research at IISc gets influenced by factors outside India including the thoughts above and sent it away to the Director. I have known that it reached the divisional chairmen's office and I also know I was not brought in for a discussion and I guess it saw its end!

In either case, the demands on an academic in engineering science are two-fold—scientific contributions of significance at an international level, and technological or scientific supportive contributions at national level. It is possible that these have overlap, but more usually they are distinctive. This is the double demand of excellence that is not usually expected of an academic in science department. Excellence in international science is adequate. There have been new scenarios of even the academics in science department being concerned with spending a part of the time in capitalizing on the basic research. It appears as though this has to be done against the current trend tolerating disapproving looks from colleagues who matter. Thus though the area of consultancy and technology transfer are allowed to occur without any stumbling blocks, there is no active scouting of research work that has the possibility of being commercialized and connecting such work with industrial houses. In this age, industrial houses buy up advanced technologies from overseas and use them for commercial purposes. Sometimes there are hiccups in the process and there are opportunities for new work on modeling and offering solutions in a native approach. To be aware of new technology dimensions and capitalize on the new possibilities, it is useful to be in communication with industrial houses at equal par. Such a situation can be generated if enough respect can be created for the academic research—showing the relevance of the thinking to industry. Such thinking does not seem to have permeated into the academic community in any significant way till now.

It is important to return to the choice of research/technology problems for pursuit in academic arena. The event of IISc reaching a hundred years nearly coincides with the hundred years of eventful growth in science and technology the fruits of which are being savored by the current civilization. Scientific pursuits have answered many questions and areas that were green some time ago remain no longer so. To maintain uniqueness in research ideas requires far greater effort, for somebody somewhere has thought of a similar idea and has already published the work or is on the point of doing it. I have known one post-doctoral fellow at Stanford wanting to do some path-breaking work bring up ideas for pursuit of research, only to be told that most of them have been actively pursued already. The only way out of this appears to be exchange of thoughts with faculty presenting their areas of work justifying the uniqueness. In an environment where a technical criticism

from a colleague is usually interpreted as personal criticism, it is necessary to create structure of discussions in which things can be learnt on what one should be attempting to do and what one should definitely avoid. If such debates do not occur, creation of excellence becomes an accident and not a part of design. Surely, it is not possible to promise for oneself a Nobel Prize-winning work; but excellent work at the frontier is possible. Students should talk about it at the café, at the hostels amongst themselves and others as to how some piece of work going on in a certain laboratory is truly outstanding—in soft whispers to loud debates; the atmosphere will become charged with expectations. Creating such an environment is the demand on the leadership at the Institute. The concept outlined above is called co-creation in management jargon.

A very recent view of businesses across world articulated by Prof. C. K Prahalad*, a management guru now in the USA talks of co-creation as the order of the day for new business model. Co-creation implies involving the consumer in the creation of product of value. What has been articulated here—debates of the choice of problems for study, in a participative mode rather than being left to natural events shaping the career of individuals is somewhat similar. In one case, what is "sold" is a product or a service. In another case, it is scientific work of value.

*see a recent interview at "It's now the era of Micro-Innovators", *Business today,* May 02, 2008. Those who wish to appreciate what doing "Nobel" quality science in institutions implies can read "You and your research" by Richard Hamming by looking for it in any search engine on the Internet.

An institution the country should be justly proud of

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I was employed as a lecturer in the Electrical Communication Engineering Department of the IISc for four years from March 1950. Prior to this, I had gone to U.K. on a Govt of India scholarship for 3 years for specialisation in Radio Engineering and had spent 40 weeks at BBC, 6 months at the Marconi College of Wireless Communications, Chelmsford, and had also taken a research degree (M.Sc.Tech) from the Manchester College of Technology. All this experience was useful to me in my position at IISc. I was able to organise a course in Radar and set up a laboratory for this. I also handled the courses in Radio Engineering incorporating the advances that had taken place at that time. I was also able to carry out research in some of the areas of communication technology in which I had worked in U.K. I found my stay of 4 years very interesting as the students I had to teach were very bright and receptive and I also enjoyed the organizational work in the growing department of ECE. Further, I gained a great deal by the opportunity I had of updating my knowledge by studies at the IISc library. All the above were helpful to me when I joined the Indian Naval Physical Laboratory (now named Naval Physical & Oceanographic Laboratory, NPOL) in March 1954. During the period of eight years there, I was able to build a strong research group on SONAR Technology which is very important in anti-sub marine warfare. The foundation I laid was very valuable during the future growth of NPOL which is now a well-established centre for Sonar Systems Research & Development and many state-of-the-systems have been developed there and are being used by the Indian Navy after manufacture by the Bharat Electronics Ltd.

From Cochin, I was posted in 1962 to take over the newly started advanced electronics laboratory of the defence, namely, Defence Electronics Research Laboratory, Hyderabad. Starting from a small team, the laboratory grew into a major Laboratory with a strength of over 1200 (with a majority of scientific staff), over the period of 20 years when I headed this laboratory. This laboratory has been responsible for successful development of Cryptographic Systems, Radar Systems (such as Battlefield Surveillance Radar, Secondary Surveillance Radar, etc.) and Electronic-Warfare (EW) Systems and many of these have been manufactured by industry and supplied to the defence services. Of these, the contribution to the EW has been most important. In the present-day warfare, EW plays a key role and DLRL was given the responsibility of building up the technology. The broadband microwave components and antennas of a large variety, covering various bands (going up to 40 GHz and beyond) are needed in EW systems. These were being produced mainly in US. They are expensive and supply of many of them is restricted. In view of this problem, I organised a strong group to work in this field with the result that with about 40-year effort, most of these are indigenously available. In the same way, due to my initiative, high power microwave tubes needed for EW and Radar are also indigenously available to a large extent. I am recipient of Vasvik Award 1978, Padma Sri 1982, Life Time Achievement Award (DRDO) 2002, and Om Prakash Bhasin Award 2006. Many of the scientists who worked with me have also received several awards. I have written a book in 2007 entitled

"Reminiscences of a defence scientist; a quest for self-reliance" which has been published by DESIDOC, Delhi. This deals with my contributions to DRDO technology as well as an overview of the achievements of the DRDO. In conclusion, I wish to say that I have a high regard for the contributions made by the IISc over its long period of existence and the strong motivation and support it has given to the scientists who have been fortunate to be there as students and/or as staff. Now that it has expanded to a vast extent covering new frontiers, it is bound to play an even greater role in accelerating our country's growth in science and technology. It is an institution of which our country should be justly proud of.

Imprints

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It was a sunny afternoon; the year 1950; the afternoon breeze was cool and brazing through; the students of Mount Carmel College (Bangalore) standing eagerly under the shade of trees lining the avenue were eagerly awaiting the motorcade of our beloved Prime Minister, Pandit Jawaharlal Nehru. He would stay at the Mysore Maharajah's palace during his visit and had taken this route. Normally, he would have waved to us, but that day he got down, walked along the road, shaking hands with students, patting some and talking to some more. He neared where I was standing and then addressed the girls and urged us to contribute to the growth of our Bharat, live up to its ideals and be a beacon light to the coming generations of independent India! We all promised ourselves to work hard and study well and keep the torchlight of our independent India glowing. I was in the intermediate class then.

Later I attended Maharani's College for my B.Sc. degree. This was the only college offering this degree course for women. It did not have proper science laboratories and we went to Central College for practicals in both Physics and Chemistry. Ours was a 2-year degree programme and we took the examination once at the end of two years (Tough luck!) unlike the present Semester System and Annual Exams. I got a First Class but could not gain admission to M.Sc. as B.Sc. (Hons) was the criteria for admission. In 1960, a 2-year M.Sc. course was started for B.Sc. students. I got admission to M.Sc. Chemistry—our seniors who did B.Sc. (Hons) would jeer at us. I took Physical Chemistry as my specialization and got a First Class. Then I wished to continue my education. My husband, Shri M. S. Hanumantha Rao, was a lecturer in Zoology in Central College and had encouraged me to pursue further education. We had two kids by then. I approached Prof. M.R.A. Rao, who was the Head of the Department of Inorganic and Physical Chemistry (IPC) at the Indian Institute of Science with my credentials. He asked a few questions in Chemistry and later asked me to meet him along with my husband. He told us that he would admit me subject to certain conditions; one of them was that I should complete the course which would take 5 to 6 years and not have a child during that period, as in giving me admission he was curtailing a boy's career. We told him that we had two kids and did not contemplate any more and I would finish my studies for certain. What a sweeping change now!

I joined the Department of IPC and so did a few of my batch mates. In our group, a second class M.Sc. student got admission. At that point of time only first class and rank students were admitted. Now, academic excellence is only a part of the requirement and interview marks are a major necessity. We had to take compulsory courses offered by the staff of our department along with a foreign language (German, French or Russian). I had taken German; the classes commenced at 9 a.m. sharp in the IPC Letcure Hall. Latecomers were barred. "Excuse me please", "No excuse please, come tomorrow", there comes the reply from Dr (Mrs) Kale. We knew our professors and their fields of research well. I wanted to get into Electrochemistry, but missed out as some other student had already been selected. So I changed my preference to Inorganic Chemistry and chose Prof. A.R. Vasudeva Murthy as my guide. He was a great guide. Those days we had to collect

Chemical Abstract Data toiling for hours in the library. He would go through it diligently and advise us suitably. He personally came and supervised our practical set-ups, research data, etc. We published 8 research papers in reputed journals and submitted my thesis for Ph.D. at the end of five years. I got my Ph.D. in 1968. I wrote my thesis and got it typed. No typographical or grammatical errors were tolerated. There were excellent reports on the scientific content, which I still treasure.

I would like to mention a few anecdotes here:

1. There was then no separate toilet for ladies. I had to argue with the Chairman that though ladies wished to learn as much as men their physiological makeup was completely different and so that need be met separately. At last, one toilet was converted for ladies.
2. Our Lab helpers were very kind and helpful. They would clean the student's glassware. Kempaiah, our helper, would always be handy and ready, never grumbled and was proud to help. When he was not available, others would chip in to bring materials from the stores. (This completely changed when I became a staff member; they became job workers and not associate workers.)
3. Fluorine gas, the gas with which I worked, is a very toxic and dangerous one and requires fluorine-compatible metal connections only. Our workshop did an excellent job in fabricating an all metal line and metal joints as perfect as B14/B10 glass joints. Hats off to their skill, earnestness and enthusiasm!
4. When I joined the Institute as a student there was an academic air all around. There was peace and tranquility under the shady trees near the laboratory. The department worked as a unit. When a special lecture or a lecture by the staff of the department was arranged, all students irrespective of the discipline they worked in, were required to attend. The absentees were noted and explanation sought. We were requested to plan our lab experiments suitably so that we could attend. This helped us to gain knowledge of other disciplines and many a time helped in integration of projects. It widened our scope, thought and understanding.
5. A few students brought their lunch from home and would meet in a room allotted for the purpose, as we were supposed not to eat in the laboratory. It was pleasant sharing food and talk, for about 45 minutes. Sometimes, a few of the girl students would eat under the shade of the trees opposite the main building. If we had little time we would stroll into the nursery and enjoy the cool breeze of the garden, the scents of flowers and the chirping of birds. Back on the bench, it was hard work, planning, setting, clearing, drying, procuring things, etc.
6. By the time I joined the Department as a staff member, the whole set up changed with new entrants to the staff and new disciplines initiated.
7. To sum it up, I have pleasant memories of my stay at the Institute. My interaction with the Central Office staff, IPC Office staff, Security and Stores personnel was very pleasant. They were highly co-operative and the pleasantness still lingers on.

Now I will talk about a few academics research results.

After my Ph.D. submission, I joined Prof. T.L. Ramachar for post-doctoral work. I started on hydro-corrosion of metals and alloys. We wrote a review article, which was accepted without any modifications. Prof. Ramachar was very happy. We received monetary benefit which he shared with me (50%); great! He was grooming me to take up corrosion work in Civil Engineering Department, when Prof. Vasudeva Murthy sent word

and enquired whether I would like to work in Fluorine Chemistry. He told me that the gas was toxic, hazardous, but a challenge, as no one was working with it in the whole country. He told me that the products of Fluorine are much sought after in industry and research–for example, Teflon, Freons (refrigerants), fire extinguishers, surface active agents and metal fluorides were used in the ceramic and other industries. I always wished to do something different, and hence took up the challenge and moved back to Inorganic Chemistry. It took more than a year to set up the lab with all safety measures. I started experiments myself, and only when I understood thoroughly the handling I took students. All students backed out, but a few who were on the last of the admission list were sent by our chairmen (once in two–three years). I thank them for it. Once they joined, they were hardworking and co-operative. Since they were working on corrosive substances, thorough planning, safety measures, concentration when working, were important. I am glad and proud to say that God guided us and no harm came to the students or to the laboratory. Excellent results came in. We missed recognition with a few results of great importance as we did not have low-temperature IR or NMR equipment—for example, SF2 and Si+ ion. Now things have changed which I greatly appreciate.

I would like to mention that I guided only 11 students for Ph.D. degree and a few project assistants who joined the ongoing projects. Some students opted for academics and a few branched into industry. Most of them appreciated the training we provided which gave them confidence to handle corrosive, non-corrosive, gaseous, liquid and solid states of matter as well as skills in vacuum techniques and low-temperature techniques. We have published about 120 research papers in national and international journals. Some results have been presented at national and international Fluorine Chemistry Symposia held in France, Germany, UK, Canada, Japan and USA. Several projects granted by CSIR, UGC and defense laboratories have been completed successfully. I was elected and was awarded the Fellowship of the Royal Institute of Chemistry (FRIC UK), in 1979. I was a senior Humboldt fellowship awardee and went to Germany for a year in 1970–71, and later under the same fellowship visited several laboratories for short periods in Germany. I have visited and worked in the laboratories of academicians of excellence such as Prof. Cady and Prof. Olah (USA); Prof. Schmeisser, Prof. Naumann, Prof. Sartori and Prof. Schmutzler (Germany); Prof. Peacock and Prof. Emeleus (UK); Prof. N. Watanabe and Prof. Nakajimi (Japan) and Prof. MacDonald (Australia).

I would like to again mention that both fluorine gas and hydrogen fluoride gas are toxic and hazardous. Except for BARC in Bombay, nobody in India ventured to work with fluorine. It was a great challenge and we met it well at IPC, IISc.

We have developed a new fluorinating reagent, Pyridinium Poly(Hydrogen Fluoride) for synthesis of several metal and bi-metal fluorides, which are of great importance in solid-state chemistry. This low-temperature route, which is now used widely, gives products of high quality.

Another work worth mentioning is the low-temperature synthesis of Sulphur Iodide (S2I2). This pioneering work has been incorporated in "Inorganic Synthesis". It is with pride we hold the work of hydrogenating (partially) of Teflon, the most unreactive fluorinated plastic. Similar results of importance were obtained with sulphur, phosphorus, and silicon halides.

IISc is definitely a fine place to work as each staff member has independent charge on his project and can be creative.

An experience which needs mention here is that the COP (Committee of Professors of the Department) rejected my promotion and sent the report to the main office with its comments. Seven peers, mostly foreign professors, who evaluated my presentation, sent good comments and I got promoted. This is something I appreciated and am thankful to my alma mater for its fairness of approach.

On the lighter side it was a joy to interact with high school and college students in and around Bangalore on popular topics, lectures such as environmental pollution—cause, effect and remedies—the fascinating chemistry of fluorine, fluorosis—a permanent crippling disease-great scientists and their contributions. I had also delivered lectures on topics in chemistry at several workshops for college teachers.

Several symposia, workshops, international and national conferences were organised by me being the secretary of "The ElectroChemical Society of India", a professional body housed on IISc campus. Leading electro-chemists, both academic and technocrats from all over India and a few from abroad, have participated and enriched with their scientific presentations. Our papers at these conferences were well received. The *Journal of the Electrochemical Society of India* is also published by this professional body, and is internationally accepted.

The Institute organises lectures by reputed scientists and Noble Laureates. These inspire the budding scientists. The next hundred years should see many Noble Laureates from this outstanding institution.

My Tryst with IISc

G. Padmanaban
Department of Biochemistry, Indian Institute of Science

I joined the Institute as a Junior Research Fellow in a CSIR Scheme with (Late) Professor Padubidiri Subbaraya Sarma at the Department of Biochemistry. I think I got through because the girl listed to be at the top of the candidate list by the seniors in the laboratory (I was told later that this was based on the photograph affixed to the application!) did not appear for the interview! That was in January 1961. My tryst with IISc has continued till today. As a JRF in a scheme, I was not eligible for accommodation in the hostel and therefore, chose to stay with my seniors in a Bachelors' residential building near Mill Corner, a distance of about 5–6 km from the Institute. I used to end my lab work around 10 p.m. and often foot the distance to Mill Corner with other colleagues. Dinner was on the way side with Chakli, banana and Badam milk. We were invariably late for lunch at the Institute 'A' Mess and were treated to 'Emergency Curry". This was unevenly roasted potato with red colour on one side and none on the other! But, IISc Mess had a good reputation for food and many outsiders used to come as guests on Sundays for lunch, often without proper accounting for payment!

Professor Sarma gave me complete freedom in research, except that he was more interested in possible applications than just publishing papers. Professor Sarma was a unique combination of a visionary, generosity and strictness. He was responsible for ushering in research in modern areas of molecular biology and molecular endocrinology in the Department. He went all out to recruit new faculty and support them. At the same time we have to make a case to get 10 lbs of ice everyday or get a spatula issued, to be used for weighing chemicals. The adjoining Department of Microbiology (it was perhaps referred to as Laboratory of Microbiology) was headed by Professor J.V. Bhat, a well-known microbiologist at that time. Similarly, the Laboratory on Pharmacology had Dr Sirsi as its Head. Dr Sirsi was a medical doctor and did not have a Ph.D. Subsequently, these two units merged and eventually took the name 'Microbiology and Cell Biology Laboratory (MCBL)'. In the Institute we have nomenclatures such as Department, Laboratory, Unit, etc. with little difference in autonomy and are retained for historical reasons. For example, we have the Molecular Biophysics Unit, which is actually a Department.

For some unknown reason, the Heads of Biochemistry and MCBL were not in the best of relations! As students, we had to do tight rope walking, since all laboratories and facilities were open to students after 7 p.m., irrespective of the nature of relationship between the Faculty!

I got my Ph.D. in 1966. I became an Assistant Professor at the Department of Biochemistry in 1969 without any post-doctoral training abroad. This was a rather surprise choice by the interview committee, chaired by Professor Satish Dhawan, who had become director of IISc at a very young age. I was, perhaps, the youngest Assistant Professor at one point of time, except that I wanted to grow a beard to look older!

I have had training in carnatic music for about four years, when I was at school in Madras. I started my training again after I became Assistant Professor. This continued for a decade and I used to have two classes per week at home, one on Sunday and another on a week day. The music class on the working day would start around 8.30 p.m. and go on till 10.30 p.m. I never had motivation to give public performances, although I had

accompanied my gurus on a few occasions. I sang on the occasion of farewell to Professor Dhawan on his retirement.

I think I was a popular guide for Ph.D. students. I have so far produced 45 Ph.Ds and each is a unique experience! I don't remember to have had any problem with any of my students. I enjoyed working in the laboratory with my students and I did this till I became Director of IISc. I had a rather 'crazy' student, who was into isolating synapto-somes from rat brain to study the effects of a neurotoxin. The isolation procedure involved the use of ultracentrifuge and there was only one such equipment in the Department with Dr J. Ganguly. The equipment was available only to his students (for valid reasons, since any repair and getting spares were formidable tasks) and the room was kept under lock and key. But, with the connivance of his students, we would get the keys for the room and the instrument and perform the centrifugation in the night. We will start the experiment at about 10 p.m. and finish the experiment around 2 a.m. and then clean up the centrifuge, etc! Perhaps, not a great example to emulate!

Each faculty has his/her own perception of training the students. Some do it the hard way, making the students to struggle, to choose and work out the research project on their own. This is probably the correct way, but my students always had clear-cut projects and some colleagues used to tease me for spoon feeding. But, my involvement was so much that I used to feel nervous whenever my students appeared for viva-voce examination, etc! I was also sought after for counseling problem cases. In some cases where it was not possible to bring about a rapprochement, between the guide and student, I had become the guide or co-guide. This, I was able to do without antagonizing the concerned faculty. I have always felt that a student career is precious and used to feel bad when a Ph.D. was not in sight even after 5–6 years of effort.

My first trip abroad was in late 1969. I spent six months at St. Mary's Hospital Medical School, London, under the British Council–UGC Exchange Programme for Young Scientists. I spent a year at the University of Chicago in 1973. Dr Murray Rabinowitz, my host, took a liking for me and wanted me to stay back. I made it clear that my heart was in Bangalore at IISc. He was very generous to let me go to his laboratory any time and for any length of time. I had made 10 trips to his laboratory between 1975 and 1986 for periods ranging from one to six months to carry out research. I never took my research projects to the US and worked on any project of interest to Dr Rabinowitz. But, I could learn and indigenize many modern techniques that helped me to usher in gene cloning and other recombinant DNA techniques in the country in the early 1980s. My own research interests were in the area of regulation of eukaryotic gene transcription (using rat liver genes as the model system). Subsequently, I moved into studying malaria parasite biology and identification of new drug targets. I am not a prolific publisher of papers, not exceeding 3 or 4 per year on an average. But I never forgot Professor P. S. Sarma's advice to always look for possible applications of my research. Although, a drop in the ocean, my research over the years has led to possible new combination therapies to treat malaria (still under clinical trial) and development of modern molecular diagnostic tools. I have also stood by my younger colleague, Professor P.N. Rangarajan, who developed the recombinant Hepatitis B vaccine and a DNA vaccine against rabies.

Professor C.N.R. Rao, the then Director, appointed me Chairman of the Division of Biological Sciences in 1990. Professor A. Sridharan Chairman of the Mechanical Sciences Division was the convenor. It was an efficient office where all the five Divisional Chairmen could meet at a short notice and take decisions. That was my first real exposure to the

Engineering Community on the campus! For a long time I had not known where the guest house was on the campus!

I was appointed as Deputy Director 1993. Since, Professor Rao went on Sabbatical that year, I had to manage the Institute. Professor Sridharan had been with the administration all along and he was a great help. There were always ticklish issues with sections of employees and between students and mess employees. We were even gheraoed once for not taking immediate action on a complaint! I learnt the art of being flexible without compromising on basic principles. I remember that a Professor got so upset with his mal-functioning toilet that he chose to call the Director to make a complaint!

I was appointed as Director of IISc in 1994. It was a humbling thought to have succeeded some one with such national and international stature. Professor Sridharan was appointed Deputy Director. I would leave it to posterity to pass judgement on my tenure. But, by and large, I had excellent relationship with faculty, students and employees, although I had to put up with my quota of strikes. I had dedicated faculty to deal with tricky issues, apart from formal handling by the administration. Professor Sridharan bore the brunt, whenever difficulties arose in handling supporting staff issues. He also had a grip on the finances of the institute. Professor N. Balakrishnan always chipped in, especially in handling student matters. Professor H.S. Mukunda was part of the think tank. Professor B.R. Srinivasa Murthy, Registrar and faculty at the Civil Engineering Department, was always full of ideas and enthusiastically contributed to Institute's development. Professor Khincha had business acumen in his blood and provided imaginative leadership to the Society for Innovation and Development (SID). These are but a few names and many willingly came forward to help with promoting a vision for the institute and administration. The challenge was always to go ahead with modernization against a backdrop of conservatism. My own contribution was to give complete freedom to my colleagues, who were involved in solving problems with dedication. I think I could solve 50% of the problems by just giving a patient hearing to people! It is interesting that the Institute does not have written rules to handle a variety of administrative issues. Most often, convention was cited as the modus operandi! While this gave a certain flexibility to handle an issue, it also bred the impression that Institute can introduce any welfare measure without any approval and sky seemed to be the limit!

While the so-called Merit Promotion Scheme has failed in many universities and, therefore, abolished by the University Grants Commission, our Personal Promotion Scheme for Faculty every 6 years, based on thorough evaluation procedures, has by and large worked out exceedingly well. Similarly, while in other universities and research institutions, there is even unhealthy competition to become Head of a Department, at the Institute more often people have to be goaded to become Chairmen of Departments! I don't think any other institution which I know of, enjoys the degree of academic freedom of the faculty of IISc.

I had felt that the contribution of the engineering faculty was somewhat under-valued at the Institute. While, in the Science Faculty, we could publish papers in prestigious journals, get elected to the Fellowship of Academies and receive Bhatnagar and other awards in each scientific discipline, I had somehow felt that the contributions of the engineering faculty, which were more relevant to the country's development were not well recognized. Their publications, project reports and peer-reviewed conference papers were known only in a limited circle. It was my perception that in addition to the faculty, the scientific officers in the Engineering Faculty contributed very significantly when compared to their

counterparts elsewhere. Apart from taking up consultancy projects from industries, many in the Engineering Faculty were involved in expert committees as well as multi-institutional projects in Defense, Space, Power and Water sectors. These concepts are relatively new to the Science Faculty and industry interaction is also a more recent phenomenon and is not that widespread.

I realized that the Institute had many in the faculty, who had established a name for themselves internationally. Even so, they looked for recognition within the Institute and a back up by the Director. I never hesitated to back up new initiatives taken by the faculty, who established linkages with research wings of strategic sectors in the country. The only difficulty I faced was to inaugurate conferences on subjects about which I had very little clue! But, I made it a point to be present as a symbol of institute's interest and support. It is a matter of great pride that IISc has remained a fountainhead to provide leaders to the country in various R & D sectors, including industry.

An interesting episode was the visit of the Prime Minister, Mr Deve Gowda, to the Institute. We had earlier interacted with Mr S.R. Bommai, the then HRD minister, and convinced him of the need for an outright grant of Rs.30 crores to the Institute to modernize some of the old infrastructure. Mr. Sachidananda Swamy (brother of late Dr Viswamitra), a then member of parliament and our council, was a great help. Mr Bommai during his speech announced that the Prime Minister had agreed to give Rs 30 crores to IISc as grant! All along, the Prime Minister sitting by my side was shaking his head, saying 'No, No'! But during his extempore speech he announced Rs 30 crores to IISc as grant! Unfortunately, the amount came in bits and pieces since it was not budgeted (we were told!). We, therefore, could not execute a holistic plan to improve infrastructure.

Another event of note was the imposition of sanctions on the Institute by the US government, on the alleged basis that it was the think tank for the Pokhran nuclear explosion. I took the stand that the Institute had nothing to do with the nuclear explosion, but as an academic institution it had the right to do research on a variety of topics ranging from ecology to particle physics and the decision to impose sanctions was unfair. Institute did face problems for import of equipment, even totally unrelated to defence research, but by and large managed to face the ordeal.

There was some excitement at the time of my retirement in 1998 at 60 years of age. There was a move by the government to extend the retirement age of faculty to 62 years, although I had decided to retire that year. The order extending the retirement age to 62 years came around 5 p.m. on July 31, 1998, when I had distributed mementos to the retiring professors. It was still good news for 11 professors, who were scheduled to retire that year.

As for me, I have been continuing at the Department of Biochemistry with different post-retirement designations: Honorary Professor, Emeritus Scientist, Distinguished Biotechnologist and presently NASI-Platinum Jubilee Chair! It has been a wonderful time for me to have been able to continue with my research and to attend to several national commitments to promote Life Science research and Biotech industry in the country. I am deeply indebted to the Institute, the Department of Biochemistry and Professor P.N. Rangarajan who has hosted me all along. If I am still enthusiastic and energetic with a positive frame of mind, it is definitely due to the ambience of the Institute and the feeling that I can still contribute something useful. This also solves the problem for my wife to handle me, if I were to sit at home!

At this stage, I do want the Institute to do some introspection in the middle of all the celebrations, befitting its glorious knock of a century. I believe that the responsibility of the Institute as a trail blazer has increased several folds, looking into the future. Much is expected from the Institute to provide leadership in higher education, cutting-edge research, support to industry and generation of human resource. At times I do feel that we will become frogs in the well, if we do not realize the tremendous changes taking place in the country. We should be prepared to leave the comfort zone in research to take up fresh challenges. Given the past history, I am sure the institute will continue to be a paradise to tread.

Finally, let me finish with a bit of self-introspection! I have been chairman/ member of several committees promoting R&D in Life Sciences/Biotechnology in academic institutions and industry. I have always followed the philosophy that a thousand flowers should bloom and I have made my best efforts to support any initiative with a positive potential. Science can definitely do wonders to uplift a society. But, deep inside I do realize that science is incomplete and has a limitation. There is nothing like an absolute truth in Science. It remains true only as long as it is disproved or an exception has been found! Biology is in fact the Achilles' Heel of Science, where laws of chemistry and physics can fail. Whatever the progress, new questions will arise demanding answers. This leaves one in a constant state of excitement (or a disturbed equilibrium!). In my opinion, science has to evolve into art for spiritual evolution! For example, music in the true sense can help you to cross barriers and can take you to a world of unalloyed happiness and peace. But, for me, I will continue to do science, an imperfect instrument!

Gained confidence at IISc to tackle scientific problems

Professor M. Periasamy

Ph.D., 1975–79, Department of Organic Chemistry with Professor M.V. Bhatt Post-Doctoral Fellow with 1979 Chemistry Nobel Laureate Professor Herbert C. Brown, Department of Chemistry, Purdue University, USA, 1979–1982, Professor, School of Chemistry, University of Hyderabad, 1982-till date. Phones: Off.: +91–40–23134814; Res: +91–40–23010904; Fax: +91–40–23012460, 23010089.
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Reflections on study: Gained a lot of confidence to tackle scientific problems. My thesis was selected as the best in organic chemistry by IISc and was awarded the Professor B. H. Iyer Medal. Methods developed by us at IISc were further developed by others to produce naphthaquinone on tonnage scale in industries.

Developed innovative procedures for obtaining useful boron, transition metal and chiral reagents. Methods are widely cited in the literature, used by other scientists in their research work and used in large-scale processes in industries. A Hyderabad company manufactures certain chiral reagents following the methods developed by my students at Hyderabad. Awarded the S.S. Bhatnagar Prize in Chemical Sciences 1996, Elected Fellow of Indian Academy of Sciences, Bangalore in 1994 and Fellow of the Indian National Science Academy, New Delhi, in 2005, JC Bose National Fellow 2006-2011.

Relevance of study: Very useful in selecting problems for Ph.D. students to add new knowledge to chemistry and find solutions to problems of importance to industry and society.

Interaction with IISc: As examiner of several Ph.D. students of Department of Organic Chemistry and Department of Inorganic and Physical Chemistry in addition to participating in seminars and conferences.

Interesting experiences/anecdotes: Had enjoyed all aspects of student life at IISc and Bangalore. Participated extensively in the activities of the Tamil Peravai at IISc. Had many friends from several Departments—Veluthambi, Sugumaran, Sangaiah, Perumal, Bakthavatsalam alias Dabukku, Krishnamurthy alias Periappa, Balakrishnan alias Balki (currently Associate Director, IISc). Hope to see most of them during the centenary conference. It was the Golden Era of IISc under our beloved Director Professor Satish Dhawan. Fondly remember him appealing to us to end our one-night hunger strike to impress the IISc authorities to restore admission entrance test in centres throughout the country.

Vision for 2020: In my days there were many students with rural background at IISc. I find that higher education and research is becoming too much elitist these days. Hopefully, the situation will change and IISc will find ways to do justice to all sections of our society.

Suggestions: I am trying to convince the DST and Government of India to establish several renewable resources research centres/institutes (one in each state) and satellite training centres in several towns to train the youth from surrounding villages (<12th class) so as to help them set up small-scale manufacturing units using low-tech machines costing about Rs 2 lakhs to produce 10kW/h biomass/solar electricity, use 3kW/h for agricultural operations and store the remaining 7kW/h to regenerate Zn or $NaBH_4$ for use in fuel cells for both stationary power generators and in transportation vehicles to earn an additional income of about Rs.1000/- per day for their households. Hopefully, IISc will appreciate and help in realizing these objectives of one of its old students so that one such training centre can be established at IISc in the near future.

Ambience has great impact on working

Prof. Phoolan Prasad
Ph.D., Applied Mathematics, 1968, Faculty, Department of Applied Mathematics, IISc.
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When I joined IISc in 1965, the Department of Applied Mathematics had a brilliant, very dynamic, hard-working and dedicated Professor and Head of the Department (P. L. Bhatnagar), who built the department all alone into a leading centre of research in applied mathematics in India. Even then, it is sad that the department could not sustain itself as a great centre of research in applied mathematics as the Courant Institute, New York. India had TIFR, which developed like the Institute of Advanced Study of Princeton and if the Department of Applied Mathematics at IISc had developed like the Courant Institute, India could have had a balanced growth of mathematics. Today India has excellence only in a narrow area of mathematics, even in pure mathematics, which is very sad for a country of the size of India geographically as well as population wise.

The reason for the above situation is that initially IISc saw mathematics only as a tool to be used by scientists and engineers and not as guide to lead science and engineering. Prof. Bhatnagar struggled to transform his department at least from a service department to a research department. The Institute did not guide the Department of Applied Mathematics to develop into a department, where latest developments in mathematics and areas of applications grew together. I was left to learn mathematics on my own without intensive courses in most modern mathematics.

Vision for 2020: I would like IISc to see not just to retain its premier position in research in all areas of science in India but also become one of the most important research centres in the word. This is possible; IISc has an excellent group of young faculty. I would not like to suggest (it is not easy) what to do for research and teaching but would only hint that the emphasis in research should be more on quality than on volume. I would also like to see the administration of IISc to break away from the usual bureaucratic approach as we find in Government of India, so that the scientists find much more time to do research and to teach. Equally important is to create an excellence in ambience (excellent roads, good footpaths and excellence in services, maintenance, etc). The ambience has a great impact on working of the scientists.

Suggestions: Student–Faculty relation in any institution is quite difficult to describe. It depends on the faculty in a department, the nature of students and the relation changes with time. When I joined IISc 43 years ago, a Head of the Department had complete authority over the department. Department of Applied Mathematics was no exception. However, Prof. Bhatnagar was very kind and considerate to his students, worked very hard for them and was very strict and hard task master. This relation started changing in IISc somewhere around 1972 and now students' career is looked after by a set of rules formulated for the entire institute. Many of the earlier faculty were students of the Head of the Department but today most faculty is trained in other institutions, specially in USA. This is a very welcome change.

Association with and thoughts about the Indian Institute of Science

Prof. K. S. Prabhu
Retd. Prof. Electrical Engineering Dept, IISc

My long association with the Indian Institute of Science, Bangalore, started in the year 1946 when I joined as a first-year student of the newly constituted Department of Electrical Communication Engineering, popularly known as the ECE department. Mine was the first batch of students admitted for this course.

Till then, the IISc had only one teaching department offering a 3-year certificate course in Electrical Engineering with an intake of 30 students per year. This department known as the Electrical Technology department was unique in its own way. At the end of the two-year period, students had to choose one of the two specializations—one could take more courses in Electrical Engineering and become an Electrical Engineer or take subjects pertaining to Electronics and Communication Engineering and get a Diploma in Electrical Communication Engineering.

The IISc did not have the status of an university at its inception; it was authorised to award only certificates of proficiency in either Electrical Technology or Electrical Communication Engineering. This concept was changed when grants from Govt. of India were routed through the Education Ministry and later when the IISc came under the ambit of UGC it was converted into a deemed University and was allowed to award B.E., M.E., M.Sc. (Engg.) and Ph.D. degrees. As a result, the intake of students for each course was increased to 30.

After Independence, there was a spurt of growth of activities at the Institute. Several new engineering and science departments came into existence.

The Department of Power Engineering was started with four sections, namely, Electrical Engineering, High Voltage Engineering, Civil Engineering and Electrical Communication Engineering. After a few years, due to administrative considerations, they were converted into independent departments. Some years later the Department of Electrical Engineering was bifurcated into Electrical Engineering and School of Automation.

During 1951, before IIT Bombay was started, a Russian team of professors was staying at IISc. I had the privilege of associating myself with Prof. L.I. Baida, who was responsible in developing a course on Industrial Electronics for M.E. students. This helped me to initiate development work in the area of Electronic Instrumentation and Bio-engineering.

As years rolled on, the younger teaching staff felt it was time to change our teaching programme. I was assisted by Dr V.K. Atre, (Late) Dr K. Ramakrishna, Dr K. Soundara Rajan, Dr D.P. Sen Gupta, Dr Y.V. Venkatesh, Dr B. L. Deekshatulu, (Late) Dr I.S.N. Murthy and others. We had brainstorming sessions over this matter. We had discussions with old students, who were placed in responsible positions in organizations that mattered and were eager to bring about changes and modernise the courses. This resulted in the ushering of new courses at the BE and ME levels in the Division of Electrical Sciences.

To keep a check on the teaching programmes, we introduced an unique system of evaluating teachers in the Division of Electrical Sciences. At the end of each term, questionnaires were issued to students and their reactions were elicited in writing without divulging their names. This I think kept the staff members also on the alert.

I had the unique privilege of working as Chairman of the Electrical Engineering Department as well as the Chairman of the Electrical Sciences Division for a couple of

years each. This gave me insights in the working of the Institute. As Chairman of the Division, I had close contact with the staff at all levels and could understand their problems. I have the satisfaction of working unbiasedly in dealing with the problems of the various departments in the Division.

Till 1946, until the department of Electrical Communication Engineering was started, there was no formal examination system at the Institute. They were mostly asked to prepare project reports on topics assigned and present them at seminars. However, great stress was laid on assignments. With lot of opposition from the teaching staff the system of terminal examination was introduced and mine was the first batch of students to face this change. A minimum of 50% was required to pass a subject. The Diploma was considered equivalent to a first class engineering degree of any Indian university. More emphasis was laid on practical training at industrial organizations and utilities. This requirement, in my opinion, has helped me and all other students to work at places unknown to us and gain first-hand knowledge of these organizations. These training programmes were closely monitored by staff members of the two departments. On account of this programme the departments kept close liaison with industries all the time. This also helped the students in finding placements after the completion of their studies at the Institute.

The character of the Institute changed somewhat after the Institute was declared as a deemed University and students were awarded degrees. Semester system was introduced along with 5-point grading system. Students became more studious and alert.

The unique feature of teaching the programmes at the B.E. and M.E. levels was the introduction of modern subjects. This type of syllabus was not available at any other institution in India then. Later, many of them made use of these details in improving their syllabi.

Late Prof. Satish Dhanwan was the guiding star of the Institute and under his able guidance and forethought much boost was given to teaching and research activities.

Our department, the Department of Electrical Engineering, introduced more courses in electronics, power systems and started activities in electronic instrumentation and bio-engineering. I had the privilege of associating myself with the above two areas where both theoretical as well as practical work was conducted. In this work I was helped by Prof. I.S.N. Murthy.

The area of Power Electronics was ably handled by Prof. J. Vithayathil and at the time of his retirement in 1984 he left behind a very able and strong team to continue this progaramme.

Prof. H.N. Ramachandra Rao and late Prof. Narayana Iyengar were incharge of the activities in Power System Engineering. Planning with the help of the Network analyzer many power utilities in the country planned the expansion of their networks. The advent of digital computers helped the team under the leadership of Prof. K. Parthasarathy, Prof. H.P. Khincha, and others to solve any problem faced by utilities. This work continues still.

The teaching of new subjects every now and then helped me in improving my teaching activity. Some of the students found my lecture notes useful later in their regular technical work and expressed their appreciation personally.

The student project which was made compulsory at the B.E. and M.E. levels has given me immense satisfaction. Several outside institutions have made use of these reports for the benefit of their students.

I had full satisfaction of my contribution in teaching and research at the Institution when I retired in 1984. The Department of Electrical Engineering has grown and I hope and pray that it will reach greater heights in the years to come.

Learnt table manners at IISc

B.C. Pradhan
B.E., Metallurgy, 1958–1960
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I have got personal confidence and respect from the organisations worked because of the academic knowledge and overall exposure at the Institute. The study at the Institute has been very relevant as it gave confidence to face any technical problem at work. We had an Alumni Association in Rourkela Steel Plant which had about 15–20 Alumni in 1960s. Sadly after late sixties none from IISc joined RSP, SAIL.

The greatest experience in my life was the Golden Jubilee Celebration of IISc in 1958–59. Then we had the opportunity to see and hear many eminent persons of all time like President Rajendra Prasad, Vice-President Dr Radhakrishnan, Prime Minister Jawahar Lal Nehru, Prince Philip, Dr H.J. Bhaba, Dr Vikram Sarabhai, Sir C.V. Raman, Dr Visweswaraya. Most profound speech was by Dr Radhakrishnan who spoke for exactly 30 minutes and each and every word was worth remembering. As students we had opportunity to visit Raman Institute and the tour was personally conducted by the legend himself. He had arranged all exhibits so meticulously and if any of us tried to touch any of them he blasted us, but it was a very sweet reprimand. It was a lesson to us how small things can be so spectacular and how much a great person like him valued the collection which he built so painfully and carefully. It was an experience to see the dignified and always well-dressed Sir M. Visweswaraya.

We used to play practical pranks on languages. Our Tamil classmates did not know Hindi and on their request taught them choicest abuses which they unsuspectingly used on others to great embarassment. Some of them later occupied highest positions in academia and industry in the country. Of course, they paid us back in the same coin—they also taught us choicest unparliamentary words in Tamil which caused such an embarrassment to us!

I hope and pray IISc becomes the greatest Institute in the world with excellence in academics and also propagate world peace. It should be above regionalism and continue to be the Alma Mater of which we alumni are proud to have belonged.

I do not know of the present, but when I was a student (1958–1960) food in the mess was excellent and is the best I have tasted at any time in my life, including that in the 5-star hotels and many countries I have visited in the last 50 years. Coming from a small town in Orissa I was exposed to many facilities and games at the Institute, learnt to use knife and fork at the dining table, learnt table manners to say appropriately "Please" and "Thank you" and many other things. This trend should continue and further improved upon.

I cannot forget my first experience after getting down at Bangalore station for the first time. It was evening and the mode of travel was a horse-drawn tonga. When I asked the tongawala to take me to Indian Institute of Science he could not decipher where it was. After some permutations and combinations his face lightened up and responded "Ahha! Tata Institutah!" I nodded and we went through a brightly lit wide street in the light drizzle

and it gave a romantic atmosphere. This nice feeling from the time coming to the Institute till leaving it two years later remained continuously and whenever any of our old class friends meet we share the nostalgia.

Another thing which is sadly missing today is the abundance of colourful trees all over the campus. When I visited a few years later I find each time the gulmohurs and other beautiful trees are less in number and have been replaced by buildings. This is one thing which should be seriously looked into so that the heavenly campus of years ago is not replaced by inanimate concrete structures.

Training at IISc lingered on throughout my career

Prathima Agrawal

B.E., ECE, 1961–64, M.E., ECE, 1965-67, Technical Assistant, ECE,1964–65
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Reflections: The ECE department built solid foundations both in the theoretical and practical aspects of communications engineering at the undergraduate (B.E.) and graduate (M.E.) levels. In addition, M.E. students were trained in research and its applications to solve new and unsolved problems. Experimental verification of research results was encouraged. Professors spent a great deal of time with the students. This kind of individual attention was very helpful in shaping the thought process and to effectively interact with the academic advisor.

When I arrived in the USA, the most important and basic impact of my IISc education was that my Institute program was at par with the international standard. This pertains to class lectures, laboratory courses, home works, exams (concepts of open book/ closed book), projects and documentation of results in report form and carefully drafted and supervised M.E. thesis work.

Relavence: Since I spent most of my career in communications-related industry (Bell Telephone Laboratories belonging to AT&T) and academia, the research training I received as a student at IISc ECE department has lingered on for ever throughout my career.

The lectures by Prof. B. S. Ramakrishna on probability theory, information theory and acoustics came to mind routinely as I was walking the corridors of the Murray Hill Facility of Bell Labs, New Jersey. The auditorium at the Bell Labs premises, designed by Murray Hill researchers, brought nostalgic memories of the ECE department auditorium carefully designed by Prof. Ramakrishna.

It is interesting to note that the professors in the ECE department were on top of current research going on anywhere in the world. They kept current by spending enormous amount of time in studying literature in the library (remember there was no Internet those days!). In addition, they incorporated these and their own original ideas into discussing new technologies in the classroom. Examples of futuristic technologies discussed in the classroom by Professor S.K. Chatterjee are: satellite communications and infrared communications. As we know today, these technologies are deployed and are part of our everyday lives. The essence of proper education is to encourage students to think and experiment boldly in technologies that seemingly have no relevance to current times. This type of speculative research is very important for revolutionary advances in technology that can impact India and society on a grand scale. This type of unusual training was available to students of ECE at the B.E., M.E. and Ph.D. levels.

Interaction: I have maintained contact with IISc ECE department, faculty and some of the alumni during the last 40 years. Whenever I visit India, I visit the ECE department and have sometimes given seminars in the department.

Interesting experience/anecdote: Mrs Chatterjee introduced B.E./ECE students to American cuisine in her microwaves and antennas course. She was explaining the shape of the radiation pattern of a dipole antenna. "It resembles a doughnut," she said. When

asked by the students what a doughnut? was she replied: "It is the American version of a vada, only the salt in the vada is replaced by sugar!"

Prof. Aiya, the then Head of the ECE department used to encourage students to cultivate the habit of "out-of-the box thinking". In his classes, he would often ask questions and encourage students to discuss their thinking of new ideas, which he would refer to as "sparks." This stimulated the students and motivated them to boldly put forward unusual ideas.

Whenever I am flying westward to California and crossing Arizona State, the flat top Mesa Mountains, seen from an airplane, remind me of Prof. Sonde's lectures in which he introduced us to the Mesa transistor.

I was the only woman in my undergraduate class of 90 students (ECE, ET and Metallurgy combined) during my B.E. But having highly accomplished role models like Mrs Chatterjee was a very big plus. When I arrived in the USA, I was shocked to find out that there were hardly any female students in engineering departments. This shows how IISc was a trailblazer in encouraging women to pursue engineering very early on as contrasted to situations in advanced countries like USA that are still struggling in such domains.

Vision for 2020: IISc should maintain its status as a premier institution of learning and research in India and abroad. It should be an internationally recognized center of excellence.

Suggestions: IISc with its reputation, strong research focus and influence should champion a couple of Indian Institutes of Technologies (IITs) and National Institutes of Technolgies to be granted to Karnataka in cities like Mysore, Hassan, and Hubli or Dharwar. This will build strong intellectual pipelines for research by enabling superior students from these institutions to get advanced research-oriented degrees (Ph.D. and D.Sc.) from IISc. Similar educational infrastructures should be constructed in the other three South Indian states. India is badly behind China and USA in the number of Ph.Ds granted in engineering with the result that there is an acute shortage of properly trained faculty in engineering schools. IISc needs to actively work toward correcting this situation.

Whenever I visit IISc, I have noticed the fragmentation of IISc land and the haphazard growth. Instead, the precious land should be efficiently utilized to put up modern buildings to house research-oriented programs in various science and technology disciplines. The goal of this growth should be to increase the number of Ph.Ds who will feed academia and industry to advance India's position in the competitive international scene.

Association with Indian Institute of Science, 1961–2008

Prof. V.V.S. Sarma
INAE Distinguished Professor, Dept. of Computer Science and Automation, IISc
Born 7 May 1944, Vijayawada, A.P.
Student at the Institute-6 years; 1961–1966, B.E., M.E., Ph.D.
Service of the Institute–39 years; 1967–2006
Honorary Professor–2006 onwards

After obtaining my B.Sc. degree from Andhra University in 1961, I joined IISc as a student of B.E. in Electrical Technology. After my B.E. with distinction in 1964, I obtained my M.E. in Power Systems Engineering also with distinction in 1966. The most wonderful memory of my B.E. course was attending a popular lecture at the Raman Research Institute by Prof. Sir C.V. Raman himself on diamonds. Seeing him in flesh and blood and hearing his talk was a remarkable experience. I heard during my B.Sc. days about C.V. Raman and his work and his association with the IISc. I also read about Prof. S. Bhagavantham being the director of IISc then and his association with Prof. Raman. This was part of my motivation in joining IISc. My ideas of further studies were more in the fields of Mathematics and Physics rather than in Engineering in my college days. Engineering provided me the means to come to IISc soon after my B.Sc. I was reconciled to engineering only after I realized the role of mathematics and physics in engineering.

I got my Ph.D. in Automatic Control Systems for a thesis in Optimal Control in 1971 also from the EE department under the guidance of Prof. B.L. Deekshatulu. Prof Deekshatulu was responsible for starting a strong control theory research group in the EE department. I also became a lecturer in the same department in 1967 teaching courses on electrical measurements, electromagnetic theory and linear and optimal control systems for B.E. and M.E. students. I had the good fortune of association with Prof. Thomas Kailath of Stanford, who was spending a sabbatical year at the ECE department. I attended his lectures on estimation theory, and Wiener and Kalman filters. He also helped me in completing my Ph.D. thesis work in the study of stochastic differential games. This association with staff members from the ECE department interested me in Statistical theory of communication, Information theory, Speech communication, Speech recognition, Digital signal processing, Pattern recognition and such other subjects.

By the time we obtained our Ph.D. degrees, IISc was liberally funded by the Government of India for several new initiatives—the Rockets and Missile programme in the Dept. of Aerospace Engineering, the interdisciplinary Control and Computers programme at the School of Automation located in the Department of EE with support from ECE and ME departments and the Centre for Information Processing at ECE department under the ADGES programme of the Indian Army and the Indian Air Force. The era of computers was just dawning in India with preparation for the arrival of an IBM 360/44 computer and the role of computers in information processing and automation was being recognized. Networks of computers and role of communication were becoming important. Transistors and integrated circuits were revolutionizing Electronics. The period also had seen the commencement of the Space programme, where the control and communication technologies find extensive applications.

It is in this context of rapidly changing research environment that our research career commenced in the1970s at IISc. Changes in the teaching programmes were initiated and the introduction of unit system has provided flexible course programmes across departments in the Institute, consisting of core subjects — some times flexibility in this was also provided — elective subjects and a research project. This changed outlook helped me throughout my career. I guided several students drawn from various departments such as EE, ECE, AE, Maths, MS, ME and Met departments for their research degrees. The external registration programme for research conferment was another innovation attempted at IISc and this gave me an opportunity to know the work of organizations such as DRDO, CSIR (NAL), ISRO, IAF, etc. and contribute to research needed in Indian context. About half of my students were sponsored candidates.

The exciting 70s provided the context in which I joined the Centre for Information Processing (CIP) at IISc as Assistant Professor after being a lecturer in EE for six years prior to that. I spent four constructive years 1973–77 there. This period gave me an insight into much needed defence research in the Indian Context. I and Prof. Yegnanarayana, my classmate in B.E. from ECE (IISc staff 1967–1977, CMU 1977–80, ISRO–1981, IITM up to 2006 and IIIT, Hyderabad from 2006) started speech recognition research at IISc. His focus was on acoustics of speech production and speech signal processing while mine was on Pattern Recognition problems in Speech. We started new courses and started work in computer processing of speech. The centre was mainly focusing on four areas — Digital communications, Speech Processing and Acoustics, Surface Acoustic Wave devices and Optical signal processing. A new faculty team was recruited for these areas. While the centre itself did not survive after the project period of about 5 years, it gave impetus to IISc in initiating research programmes in frontier areas. It was also an important period for interacting with researchers from the USA and the USSR.

The two professors who played important roles in my career were Prof. H.N. Ramachandra Rao of EE department who was responsible for my joining EE dept. as a lecturer and Prof. B.S. Ramakrishna of ECE for my joining CIP as Assistant Professor. Prof. Ramakrishna was interested in acoustics, speech, languages, and systems and he believed that I can do something in ECE/CIP. Prof A.K. Rao of Aerospace evinced keen interest in my work on optimum maintenance of machines and reliability of equipment. He provided me with a Ph.D. student from aerospace (a squadron leader from the IAF) who was to work with me in the area of aircraft maintenance. This led to my submitting a project proposal to ARDB on reliability and maintainability of IAF trainer aircraft. This gave rise to several interesting studies. Our results were later used by Korean Air Force. This led to three outstanding Ph.D. theses. The first student later became the director of the DRDO lab CBS, the second was deputy director of NAL, who later worked at NASA on aerospace computers and the third got a gold medal for his thesis and is presently professor in the AE dept.

I moved to School of Automation (later to become Dept. of CSA in 1977 as the continuation of CIP was doubtful beyond the PDC of the project). I slightly reoriented my interests to work in Pattern Recognition, Artificial Intelligence and Reliable computing. I was invited to SA by Prof. I.G. Sarma who nurtured Computer Science education as part of the activities of the School of Automation. My colleague N. Viswanadham (now at Indian School of Business, Hyderabad) authored a book on "*Reliability of Computers and Control Systems*" published by North-Holland in 1987. I later worked in Artificial Intelligence and Expert Systems till my retirement in 1996. I received the Alumni Award for Excellence in

Research in Engineering, 1998 from the Indian Institute of Science. I guided about 23 students for their research degrees (18 Ph.D. & 5 M.Sc.) I was elected fellow of the Indian Academy of Sciences, Indian National Science Academy and Indian National Academy of Engineering. I am continuing as honorary professor at CSA since 2006 and am supported by INAE by its distinguished professorship.

The post-B.Sc. three-year BE programme at IISc was instrumental to my coming to IISc. I always felt that its discontinuation at IISc was a disservice. It allowed students from rural India to come to IISc. Also I always felt a B.Sc. prior to engineering gave me a well-rounded education in Engineering.

Relative lack of passionate interest in work adds to sense of frustration

Dr L. Sharada
Health Centre, IISc.

The student population I see at the Health Centre is grossly skewed towards the unhealthy (in body and mind) so the vast majority who are happily pursuing research have no need to meet me. As a medical officer at the Health Centre I have had opportunity to meet several students. My observation is that the students I see are grossly skewed towards the unhealthy (in body and mind). So the vast majority who are happily pursuing research have no need to meet me.

I will however list what I see as probable stressors and their underlying causes, from very haphazard encounters with students who choose to consult me.

The major cause of stress is poverty. Many students come from lower middle class and rural homes and though the stipend received is quite generous, there are still problems; mainly because they choose to and are expected by their parents to support the families back home from the stipend. Some young men and women part with three-quarters of the total stipend amount for this purpose. Others take massive loans from friends, banks, and then struggle to stay afloat under a crushing debt burden.

Such homes often have added burdens of chronic illness in a parent which means further drain on the finances as well as being a constant source of anxiety for the scholar. Unlike in the West where a youth in his twenties is quite emotionally detached from his natal home and is making his own relationships, in India the umbilical tie is very strong. Therefore, situations such as parental marital discord, unhappy life situations of siblings such as exam failures, unemployment, difficulty in getting sisters married, breakdown in the sisters' marriages, etc., have a profound and often debilitating effect on the youths' psyche.

Other students (male) from traditional homes get into arranged marriages with very young, uneducated and non-working women following tradition/parents. Often they have children well before they can afford to. The stress of keeping lonely wife happy or finding the financial wherewithal to maintain a family can be quite formidable. Conversely, girls from very traditional homes, which are resistant to new mores, face the stress of unwanted arranged marriages. The burden is worse in this case because the girl is aware that all her work may be a waste if her husband/in-laws 'order' her to stop working/research or force her to choose a job which is well below her capability/desire in order to 'mind' the family.

I also suspect that some of these poor students from deprived backgrounds come to research not by choice but by default—their relative lack of passionate interest in the work may further add to their sense of frustration.

On the campus, youth from poorer or more traditional homes encounter others from more wealthy and cosmopolitan backgrounds. These latter are necessarily more confident, more at ease with members of the opposite sex, more talented in extracurricular activities and more independent, having stayed in hostels during the undergraduate course. The former are often not fluent in English, whereas the latter are. A feeling of exclusion, alienation follows. They then seek others like themselves, from the same linguistic and

regional background and stick together in bands. The circle of friends is small, and there is no larger circle of acquaintances. Sometimes, the lab is a lonely place for such a one if there is no one else of the same linguistic/cultural background. If the dominant group in the lab is also non-English speaking and the chatter is in another language, this 'outsider' is literally all alone.

Some students encounter young persons of the opposite sex for the first time on the campus. They also carry strange ideas of what is appropriate behaviour in this situation. They are unable to initiate/maintain the most basic conversations or casual encounters with persons of the opposite sex, due to inhibitions and inexperience.

Some hide within their own shells and go through the entire course under a 'purdah' of their own. Others long wistfully for some contact but do nothing about it. Still others wrongly attribute wildly exaggerated meaning and significance to chance encounters with this or the other boy or girl and are lost in silly dreams with no basis in reality. Worst of all, a few imagine they are in love and take 'action'—make a move, make a proposal, feel upset at a rebuff, or worst of all fall into depression for the same.

Lastly, students from inadequate undergraduate courses face a severe handicap here, where their ability to score marks is a poor substitute for adequate training. Some are frankly unsuitable for research (by their own admission), others are brilliant but do not possess essential skills, such as use of computers, familiarity with statistics, or mathematics, or computer programs. If these are unable to catch up or their guide is impatient, there is trouble.

Romancing the Institute*

N. Siva Kumar
B.E., CSA (1983-1986)

It was a hot summer day in Chennai. I received a telegram that I had passed the IISc entrance for B.E.-M.E. Integrated course. My friend and I decided to come down to Bangalore to enroll into M.E. (ECE) Integrated course. It was a rainy afternoon when we reached Bangalore City station. We took an auto to reach IISc campus at Malleswaram. As we reached the Registrar's office, the smell of fresh rain hitting the dry soil was intoxicating. I felt like a mad elephant and fell in love with the Institute at first sight. We enrolled and spent the day at IISc walking around enjoying the scenic campus.

Of the six of us who had prepared for the entrance exam for a few months and very intensely in the last month, five of us got in—three from Madras Christian College (MCC), one from Loyola College and the other from AM Jain College (all from Chennai). I still remember one of the parents escorting the five of us to the Institute as we got into the (in)famous "E" block.

I was pleasantly surprised that I was the all India topper in the entrance examination from a computer programmer who had the 'list' of entrants and that I had scored 51 in Maths and 89 in Physics! I had enrolled into M.Sc. (Physics) at MCC prior to getting the IISc results. I believe that India lost another scientist as I got into Engineering at IISc!

Mini-India with a southern bias

In due course, we started making quite a few friends. We were surprised to see the very easy-going environment along with a scenic campus and how easy it was to make friends. The batch was made up of students from a cross-section of India and it indeed looked like a mini-India with a southern bias. We enjoyed the mess and remember us calling the "A" mess as "Madras Cafe" and "Aiyar Mess" as they served only vegetarian and I remember "A" mess using separate plates for serving "omlettes" as the vegetarians refused to eat from the same plate! I was the Mess president for two years during my stay at IISc.

I always thought that the engineering students made the campus more colorful but still got a step-motherly treatment. It may be a good idea to have two deans or two Deputy Directors, one for the sciences and another for the engineering departments and giving both of equal importance.

We always wondered how the women's hostels were more imaginatively built whereas the "E" block was a dark, prison-like dungeon with a narrow passage running across the halls. But I still would like to buy a "brick" from that prison. I am still negotiating a price for that brick!

I believe IISc had always represented the soul of Indian science and the history of Indian science for 100 years. But someone recently quipped that we dont want to turn into a 'sole'. It is quite possible that,when compared with IITs, IISc has not been vocal about its success but I see IISc has been providing scientists and engineers across the country (and the world) and are the silent "jewels on the crown" for over half-a-century now. It is time IISc gets its due respect among the pantheon of scientific institutions. However, weightage must be given based on a much wider variety of parameters not just number of Nobel Laureates generated by the institution, number of million dollar patrons, etc. I

believe the Institute must exist for the sake of science and does not need to win any race or be compared against other institutions!

I was pleasantly surprised to hear,,during one of the alumnus meetings, that some IISc alumnus from Metallurgy department was running a company that provides/builds parts for Delhi Metro.

We enjoyed our presence at IISc during its Platinum Jubilee Year and attended a few of the lecture series including those of S. Chandrasekhar, Narlikar, Ronald McNair (who sadly passed away in a shuttle explosion in 1986).

We always enjoyed and felt privileged seeing Nobel Laureates walking around-I have seen Josephson (of Josephson Junction fame) and Subramanian Chandrasekhar walking along with a few of our professors.

Very recently when a bunch of IISc friends met in New Jersey, one of my friends asked me "who do you think is the most 'successful' from our batch"? I said "Chandrasekhar (he is now known as "Chanchalapathidas" of ISKCON, his internal nickname is "CPD") is the most successful as he has pioneered and is managing the Akshaya Patra program of ISKCON for several years now and it is feeding over 8 lakh children a day through mid-day meal scheme across India. Chandrasekhar was a brilliant student from PSG College of Coimbatore and had enrolled into M.E. (ECE) Integrated programme and dropped out after a year to join ISKCON. I still remember that when I lost a debate and ended up buying a copy of "Swami Prabhupada's" interpretation of Baghavadgita in a book exhibit at IISc. (buying for Chanchalapathidas"?)

On another note, I met my future wife at the Institute as a classmate and married her in 1987.

Anecdotes and incidents

I remember a bunch of us running out of the library when there was a mild tremor in Bangalore.

I remember watching at the Gymkhana along with a huge crowd India win the Cricket World cup in 1983 .

As part of Platinum Jubilee Celebrations, there were a series of lectures. Nobel Laureate Subramanyam Chandrasekhar had come down to IISc for a lecture in 1984. The faculty hall was packed with Doordarshan team too with bright lights recording his speech. As the flash lights followed Dr Chandrasekhar, just a few feet from his face, as he walked and lectured, the bright lights were bothering him, he shouted at the man "turn this light off"! The light was turned off promptly.

It was March 1986; there was drought and severe water problem in Bangalore. Prof. C.N.R. Rao was the director; all engineering students and other students met him at the faculty hall pleading for the early closure of the Institute for 'non-research' students due to water scarcity. When someone asked Prof. Rao why he was not sending the research students for a few months and keep only the engineering students to let them complete the semester; he retorted "it would be like sending our spouses to their parental homes"!

*This article is dedicated to the batch of 1983-86/87, everyone I had met and befriended at IISc.

Pleasant memories

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Who does not get intense nostalgic feelings while recollecting the early days of one's life as a student at the Indian institute of Science! The feelings are all the more intense when the teachers who were your mentors become your colleagues when you become a member of the faculty a few years later. Such was the situation in my case.

Immediately after graduation in Mechanical Engineering from the then Govt. Engineering College, which now is Visveswaraya College of Engineering, I was not sure what I should do next: whether to take up a job in PWD (which was offered by the then Govt of Mysore) or go for further studies. Without having any specific plans, one morning I walked hesitantly into the Aeronautical Engineering building of the Institute since it was the first building immediately after the main gate. A lean gentleman met me near the office and asked without any preliminaries "Are you planning to join the department? Come in and tell me where you are from?" It was this way a decision was made for me by none other than Mr G. Janakiram, a lecturer in the Department. Professor Tietjens was the head and the other faculty members were Mr T.N. Krishnaswamy; Mr Y.V.G. Acharya, Mr C.N. Laxminarayana, Prof. C.V. Joga Rao, Prof. P. Srinivasa Rao, and Mr Krishnamurthy (from the Air Force Technical College) became faculty members a few months later.

One person, whom no student or faculty member can ever forget was R. Krishna Moorthy, librarian, technical assistant, wind-tunnel operator, photographer, and more than any other role, a universal advisor to every one in the Department.

The DIISc programme of the department was of two years duration and consisted of six months academic programme and six months of Design Training at HAL factory every year. The class strength was not large; just 10 in our class. Prof. A.K. Rao, who became a faculty member later, was my classmate. Mr Ramamoorthy, who lived in Malleswaram, and I, living in Basavanagudi, were the only two students coming from outside. The rest, were boarders in the Institute hostel. After lunch break, none of the students living in the hostel would turn up in the Department. Ramamoorthy also, who would go home for lunch, would rarely come in the afternoons. I was the only student confined to the Department since my bus to Basavanagudi would arrive at the bus stand only at 5 p.m.! Mr T. N. Krishnaswamy's class on Aircraft Design which was scheduled in the afternoons was very rarely conducted.

Classes were never serious in those days. Teachers were very friendly, but would never tell us what books they were following. We could hardly find relevant books in the library. So, we had to copy whatever the teacher wrote on the black board. Needless to say, there was quite a mismatch between what the teacher wrote and what we copied.

German was another subject we had to study. The teacher was Mrs Kale, a Polish lady married to Dr Kale. She would bring to the class about 10-12 booklets consisting of about 15 cyclostyled sheets with German–English sentences. Since the class strength was more than 25 (it was a combined class with other departments), the reference sheets had to be shared among 2–3 students. There were no extra copies in any of the departmental libraries. Our proficiency in German language never got any better! But, Mrs Kale had a very beautiful daughter who was quite popular among the boys. During Holi, it was the

usual practice for all boys in the hostel to go to Dr Kale's house and smear colours and douse Miss Kale with coloured water. On one such occasion, about 25–30 boys went to Dr Kale's house to throw colours. Miss Kale met the group near the porch and went inside saying she would bring some sweets for distribution. While the crowd was waiting expectantly, buckets and buckets of coloured water came down pouring from the roof-top drenching the crowd with every kind of colour. Miss Kale had set up a full row of buckets on the first floor roof-top and had instructed the servants what to do!

Our interaction with other departments was very minimal. An attempt was made to bring together the Departments of Mechanical Engineering (headed by Dr A. Ramachandran), Internal Combustion Engineering (headed by Dr Havemann) and Aeronautical Engineering by forming an Association of Mechanical Engineering. Professor M.S. Thacker, the Director inaugurated it. But, not much activity took place. Once in a while a talk would be given by a faculty member. One of the talks was given by Mr. Janakiram on the use of magnesium alloys in aircraft industry. Sir C.V. Raman happened to attend the meeting. Prof. P. Srinivasa Rao, who was a close friend of Dr Raman, had informed him of this lecture. At the end of the talk, Sir. C.V. talked for some time on the qualities of bamboo and urged that some research work be undertaken to explore the suitability of bamboo in light-weight construction activities.

The Mechanical Engineering Association had also arranged a lecture by Sir C.V. Raman, with no specific title. Sir C.V. in his inimitable style talked on a wide ranging of topics including his favourite one, light. During the talk he mentioned that at the time he was investigating various aspects of light, he was urged to verify every established/accepted laws like law of reflection, law of refraction, diffraction, etc. several times and would not accept what was said in books. This investigative spirit, he said, was essential for all research activities. At the end of the lecture, Prof. Tietjens asked Dr Raman what time was best to study. Dr Raman's reply was: "5 o'clock early in the morning after a strong cup of coffee prepared by a South Indian Brahmin". There was no instant coffee in those days.

Dr Satish Dhawan joined the department during the end of my second year. I stayed on in the Department as a Research Assistant for about a year before I went abroad. During my stay as Research Assistant, Dr Dhawan and I shared a common room. He would come to the office at 10 a.m. every day and greet me with "Good Morning" and during the rest of the day, not a word would be exchanged between us! He would be completely engrossed with his work on the drawing board. He was designing a supersonic wind tunnel. When I joined the Institute several years later as a faculty member in the ME Department, I witnessed Dr Dhawan, the Director and Chairman of the Senate, talking incessantly in Senate meetings as if he was making up for all the silence he held during his early days in the AE Dept!

Interestingly, a majority of faculty members and students in the department happened to be from Andhra Pradesh, and most of the conversations would invariably be in Telugu. The department was commonly referred to as Andhranautics at the Institute! This picture did not change much in later years. By the time I joined the Institute several years later, this department had become one of the most vibrant departments in the Institute and also a very important R and D center in the country.

PS: Surprise!! Just four months ago whom do I meet? It was Mr G. Janakiram, who made the decision for me after my graduation and was my mentor. It was one of the pleasantest meetings I had. Mr Janakiram is settled in Hyderabad and happened to be at the house of a mutual friend!

My memorable days at the Indian Institute of Science

Dr K. R. Srinivasan,
President-Elect, IISc Alumni Association, and
Chairman & Managing Director, iQ infotech Ltd, Bangalore

August 3, 1961 was the turning point in my life; that is the day I joined the Indian Institute of Science, Bangalore.

I hail from Tamil Nadu and in 1961 I graduated in B.Sc. (Physics) from St. Joseph's College, Trichy, Tamil Nadu. In '60s, it was almost impossible for a Brahmin to get into engineering colleges. Hence, most of us were forced to look around to do our engineering in other states. At this point of time, a close relative,who lived in Bangalore advised me to join the Indian Institute of Science. Honestly at that point of time, I did not have any idea about IISc, except that it would be very difficult to get admission into it. In view of this, my relative suggested that I go over to Bangalore and study for 2–3 months and get acquainted with one or two professors and find out how to get admission into it. Fortunately, Prof. S. Sampath, who was at the ECE Dept, happened to be one of my distant relatives and I had the chance to seek his guidance.

Hence with great hope of getting admission into IISc, I landed at Bangalore some time in June 1961 and was staying at Chamarajpet with a relative. My daily routine used to be to get into the State Transport bus no. 33 which used to go around Bangalore and finally land up at Malleswaram 18th Cross after 1½ hours journey. From 18th cross, I used to walk to IISc, and then to the ECE Department, which, as you know, was at the end of the IISc campus. After a couple of hours of waiting, I used to meet Prof. Sampath who used to sit with big monster racks with all kinds of vacuum tubes which I understood later as a radio transmitter. He used to give a lot of encouragement and also assured me that I will be included in the main list for writing an entrance examination. Those days, the ECE Dept. used to take only 30 students for the B.E. course and there used to be a quota for different states in which Tamil Nadu had only five. I was very lucky to be included in the list of candidates for the written test and interview. Prof. S.V.C. Aiya was the Head of the Department and he himself conducted the written examination!

Can you imagine the first question in the examination was to draw a sketch of a "Bullock Cart "? Only later on I realized as to what the idea of this question was. As it is very clear that this can only give an idea about the person's idea about understanding dimensions and once you draw the bullock cart drawing we can always estimate whether the candidate has the idea of relative dimensions. Of course, I was only a candidate in the wait-list. Since I was also visiting the Electrical Technology (ET) department which was also called the Power Engineering Dept. (during my two-month stay), Prof. H.N. Ramachandra Rao, Head of the Dept at that time, was kind enough to give admission in the ET Department. Of course, a week later I got admission into the ECE Dept which I preferred and changed over.

This was the turning point in my life and a strong foundation was laid for my future career at this point of time. Of course, I am indebted to my close relative, my brother-in-law, who was instrumental in guiding me to IISc.

In a class of 30, I would rank myself as an average student and I was always at the 20th the rank. The most impressive lecture used to be by Prof. S.V.C. Aiya who not only covered the syllabus but used to give a lot of advice for becoming a successful engineer. He also used to emphasise the importance of working together as a team. He used to mention that 'two fools are always better than one fool" and he used to emphasise that an engineer should always express quantitatively and not qualitatively. I think this has really gone into my mind and it was extremely useful for my future career as a successful engineer in both design and development where I used to think very precisely and never brought any matter vaguely.

One of the important subjects which I really missed in the ECE Dept was that of Microwave Engineering, in spite of the subject being taught by a world-renowned teacher, Professor S. K. Chatterjee. Most of us knew that the Professor was extremely eccentric. Generally, he would not even know who is sitting in front of him as he will be deeply absorbed in delivering the lecture. Even when there are only 10 students in the class he would be under the impression that all the students were attending the class. Unfortunately, this motivated a lot of students to skip his classes. Moreover, all his examinations were of open-book type and we never failed in his examinations. On top of it, his evaluation of the examination papers used to be very strange. He used to tell us that as long as you write the examination papers neatly, clearly and without striking out anything, he would give very good marks irrespective of the contents. Unfortunately, this resulted in my not reading microwave engineering and still passing it. He used to give a very good example why he was doing this. In the 60s, there was a very expensive restaurant on MG Road called 3 ACES. He used to tell us that when we go to 3 ACES and when the attender comes with a neat uniform you pay him a tip of 50 paise. Of course, those days the costliest coffee used to cost Re 1 there. He also used to tell us that when you go to an Udupi hotel where the waiter comes half naked you do not pay him anything. Like that your answer papers should be neat and you can score high marks. It once happened that 3–4 senior batch members had failed in his subject and when they asked Prof. Chatterjee why they were failed, he said that he did not know that the pass mark was 50%, whereas he had given them only 45%. Of course, he immediately corrected it and made the mark as 50%, instead of 45%. As you know, he was a brilliant professor and was at the Institute till his last days as he was extremely dedicated and was true to his field of interest.

Of course, most professors were very kind and only one or two used to be a terror for us as they used to conduct surprise tests and all of us had difficult time, particularly with Prof. K.V. Swaminathan in Structural Mechanics, who finally went to Govt. of India as Secretary to the Dept. of Science & Technology.

We used to conduct survey together with all other departments like Metallurgy and ET and it used to be full of fun; we used to go up to the hill near the Power Engineering Department which was virtually the end of Bangalore.

I was extremely fortunate to spend a considerable time at IISc in various capacities, first as a B.E. student, second as an external Ph.D. student and finally as a staff member.

Our batch used to be unique and it had close-knit members with a lot of bonding. Of course, those days there was a lot of urge to go abroad once you are at IISc as it was easier to get admission in any American university with the Institute association. On looking back, I found that only a few went abroad from our batch and the majority excelled themselves in various capacities in India.

My second stint at IISc was as a Scientific Assistant at the ECE Dept during 1965. Immediately after graduating I joined the Electrical Engineering Dept of IIT Madras. I was advised by Prof. Sampath by which time he had joined the IIT, Madras. However, after 2–3 months study there, I found it not interesting, particularly after graduating from IISc I found the M.E. course at IIT Madras as too basic. Of course, in 1965, it was the initial stages of IIT Madras, particularly the Electrical Engineering Dept. When I casually visited the ECE Dept. of IISc and met Prof. Aiya, I told him that the course at IIT Madras was too basic and he was very happy and told me that IISc is the best place, particularly the ECE Dept, in the country. Immediately he asked me to join as a Scientific Assistant in ECE Dept. and I joined the same day. The one year I worked in the lab along with the great Prof. N.S. Nagaraja I learned a lot and my basics in electronics were firmed up during this period.

Subsequently, I joined the National Aerospace Laboratory as a Scientist and during this time I was very fortunate to have one more opportunity to be a student at the IISc. I got admission for Ph.D. in Physics Dept. as an external student and worked under Prof. E.S. Rajagopal. The three years I worked in the Physics Dept were really very exciting. The culture at the Physics Dept. where Sir C.V. Raman worked was entirely different and all the students and professors used to be in the department for almost 24 hours. This culture helped me a great deal in completing my Ph.D. within three years. As I was working at NAL also, I used to go to the IISc. at 6 p.m. and work as late as 6 in the morning. Since my Ph.D. work involved a lot of experiments and in those days there were no great instruments, computers and data loggings were available, we had to be present physically to take the readings. Invariably many days my guide, Prof. Rajagopal used to compel me to go home after midnight and he used to take over the job of taking the readings till the next morning. This is a unique culture of the professors at IISc. There used to be tremendous amount of bonding between the guide and the students and I consider myself very fortunate to be at the Physics Dept at the formative stages of my career. It is also worth mentioning that my Ph.D. thesis was highly commended by Prof. S. Dhawan, Director at that time; he used to mention to everybody that the Ph.D. theses should be like mine as it was very practical in nature. Incidentally, my Ph.D. degree was the second under the External Registration Programme. As part of my thesis, I developed a very unique equipment called Ultrasonic Pulse Echo Interferometer (UPEIN). It is gratifying to note that I could commercialize this UPEIM in my own company and I sold more than 100 units to various research laboratories and universities as also to the Material Science Dept of IISc. I understand from letters received that the equipment was extremely useful in fetching Ph.D.s to a large number of students.

Lastly, I could take the role of a faculty of IISc during the years 1975-80. When I casually visited the IISc and went to greet my earlier professor, Prof. B. S. Sonde, he took great pain in explaining me about the upcoming department that he was about to start called the Centre for Electronics Design Technology (CEDT). I was very thrilled to learn about these activities which were related to the industry and I jokingly mentioned to him how nice it would be if only I could also be part of this Dept. Prof. Sonde immediately told me that if I was serious I could join immediately. It so happened that I decided to join CEDT and became a Faculty Member.

As you are aware, CEDT conducts courses which are directly related to the industry. I had opportunity to be in Switzerland for more than a year to study the electronics industry and also the operations of the SMEs there. I also had the opportunity to work very closely with Swiss professors and engineers who were at CEDT.

During my tenure at CEDT, I had the pleasure of interacting with Madam Prof. Rajeswari Chatterjee, who was the Chairperson of ECE at that time. She used to be very cooperative and highly supportive. Even today she is so active and full of life, which many of us cannot match.

My tenure at CEDT kindled my spirits and is responsible for motivating me to start my present industry, called iQ infotech Ltd (formerly Systems Dimensions Pvt Ltd). Today we have over 60 people working in the areas of Defence, Automotive and other industries; we specialize in the area of embedded systems. One of the prestigious products which we have designed and are manufacturing is the heart of the REVA electric car, namely, the Energy Management System (EMS).

In 1989, we celebrated the Silver Jubilee of our 1964 batch. I understand that ours is the first batch to celebrate the Silver Jubilee of the passing out of a batch of ECE and ET students of the IISc and the get-together was held on August 5, 1989. Twenty faculty members and 25 of our batch mates attended the function which was indeed a great event to remember. The gathering was addressed by Prof. S. Satish Dhawan, Prof. S.V.C. Aiya, Prof. H.N. Ramachandra Rao and my batch mate Dr K.P. S. Prabhu. The speeches made by the professors were very interesting. We also brought out a souvenir on the occasion with the details of the batch mates and their whereabouts, etc.

Looking back, IISc has given me so many opportunities and I would like to return to my alma mater in some kind or the other for all the good things that it had showered on me. I now have the opportunity to extend my services to it as the President-elect of the IISc Alumni Association.

Reflections from a late entrant*

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"The essence of history does not reside in recorded facts but in the thoughts, emotions, ideas and aspirations of the human beings who have made it. Facts are the outer shell, the crystallisation and materialisation of ideas and emotions."

– Amaury De Reincourt
(From *"The Soul of China"*)

"Chadavanivadagnundagu
Chadivina sada sadviveka chaturta galugun
Chaduvaga valayaunu janulaku
Chadivinceda naryulodda chaduvumu Tandri".

(Those not educated will be unintelligent; education gives knowledge and wisdom; all should aspire for education; my son, study from the (feet of the) learned one). 'Prahlada Charitra' of Mahakavi Potana's "Maha Bhagavathamu".

My grandmother Rukminamma used to recite this poem frequently during my childhood. This is the advice that Hiranyakasapa, a demon, gave his son the pious Prahlada emphasizing the significance of education in one's life. The gentle advice had sown the seeds and urge in me for higher education, unheard of in the area where I grew up paving the way for a farmer's son to become a professor at a premier research institute. It is in no small measure due to the education that I received at IISc, more particularly from my teacher and mentor Prof. AKN who made people contemplate. IISc moulded my character (apart from my grandmother) instilling in me the values and virtues of education.

After my post-graduation in Mathematics, I joined as a research associate at the Indian Plywood Industries Research Institute (IPIRI), Bangalore, in 1978. I hardly had any work there and hence had plenty of leisure time. Being a book worm I used to visit the main as well as gymkhana libraries at IISc. These had excellent collection of English and Telugu books. I spent most of my evenings there. I came in contact with three 'musketeers'— Mr Rayudu (doing his M.S. and presently the head of Chirra Electronics, Bangalore), M. Rajanikant (doing his Ph.D. and presently the Principal, MSR Institute of Technology, Bangalore) and Mr Sudhakara Babu (doing his MTech; now a businessman at Bangalore), who later became very close friends. I used to visit their room D18, named 'Sunyasramam'. Serious discussions used to take place here on issues ranging from Naxalbari movement to new wave cinema. They were very active in Telugu Samskritika Samiti activities and used to write articles for the Samiti's journal "Teluguthota". They were original pieces with full of satire. Another person with whom I got in touch during this period was Mr K. Sreenivasa Rao (editing the *Journal of IISc*) who till date remains a friend and guide to whom I always turn to for advice. He widened my reading horizon and introduced me to Alvin Toffler, Khalil Gibran, and famous Telugu critic "Ra Ra".

* I had entered the PhD programme late, at 30.

Mr Rayudu had a vibrant social life and often used to throw informal dinners. He used to organize many parties. He knew everyone and their families, his remarkable memory and interest in people made everyone feel part of the community. He used to narrate many incidents, which were hilarious. One such concerned the visit of Prince Charles to the Institute. Those days Prof. S. Dhawan was both IISc director and ISRO chairman. Because of the pressure of a bigger assignment at ISRO he used to spend considerable time there, away from the Institute causing concern among IIScians. So when Prince Charles's visited the Institute, Rayudu and his friends protested uniquely with banners welcoming both Prof. Dhawan and Prince Charles!

There was a group at IISc, in early 1980s, mostly from Tamil Nadu (with Marxist orientation), which used to meet once a week and discuss issues on scientific temper. I became a part of that group. Sometimes the discussions were on books such as Bronski's *The Ascent of Man,* Alex Haley's Roots and Paul de Kruif's *Microbe Hunters*. Lectures were arranged every Saturday, and mostly by the Institute faculty. One such lecture by Prof. S. Rangarajan (IPC) on the theme Science and Society impressed me a lot. He was popular among the students and colleagues for his commitment to work. Some other well-liked lectures were of Prof. A.K.N. Reddy and Prof. S. Soundranayagam (ICE). Prof. Reddy was easily the best public speaker I have ever heard, and most who heard him agreed with that. From outside the Institute, the memorable lecture was on science and rationality by Abraham Kovoor, the Sri Lankan rationalist, in which he highlighted various frauds by god men. The scientific temper I had imbibed from him continues to this day and my sons too follow the same path.

I met Prof. K.V.N. Sarma (Civil Engg), a well-known Telugu writer (his stories such as "Publish or Perish" and "Conference Melas", are brilliant satires on academia), in 1982. I introduced myself to him during a Telugu Samskritika Samiti programme and told him how I adore his writings. From then on we became close and were like Krishna and Arjuna in Telugu Samiti activities and the relationship continues to this day. Along with Prof. Krishna Sarma (then faculty at MSRIT, Bangalore, and a student of KVN) we organized many programmes, invited popular Telugu writers such as Kalipatnam Rama Rao, Rachakonda Viswanatha Sastry, D.V. Narasaraju and C. Narayana Reddy. (Krishna Sarma was a great host; despite moving away from Bangalore quite a while ago, memories of many wonderful dinners at his residence linger. Our relationship continues to this day.)

I first read about Prof. A.K.N. (nephew of the legendary Telugu writer and educationist Kattamanchi Ramalinga Reddy) in Alvin Toffler's *Third Wave*. Prof. Reddy's work emphasises the sustainable use of energy, energy security to the poor and deprived, the degradation of environment and the technological solutions for these problems. To achieve this objective he had established ASTRA (Application of Science and Technology to Rural Areas) at the Institute.

I was eager to meet Prof. Reddy but was also hesitant. It happened, however, by sheer chance. At the swimming pool I used to see a tall gentleman swimming vigorously. One day, I introduced myself to him. His name was Siddharth Bhatt, son of Professor M.V. Bhatt (Organic Chemistry). He worked as a scientist at the Central Power Research Institute, a neighbour of IISc, in the field of energy analysis. At the first meeting at his residence he suggested that I associate myself with his research. We worked together, collected information on energy use in agriculture and prepared a research article and sent it to *Energy Management* for publication. To our satisfaction it was accepted and was published. One day I mentioned to Mr Bhatt of my interest in meeting Prof. AKN; he suggested fixing

first an appointment with his secretary Ms Niramala Das (incidentally the mother of noted singer Vasundhara Das) at ASTRA. I introduced myself to Ms Das and requested for an appointment with Prof. Reddy. She had arranged the meeting and I met AKN probably in June 1981 with the article which I had co-authored with Mr Bhatt. He had a glance at it and asked who had collected the data and who had written it. I told him that I had collected the data but the paper was written by Mr Bhatt. I tried to explain my background and limitations in writing research papers. He said "it is not important that you should know good English. You have the inquisitiveness and the drive. You can join as a research associate". I could not believe my luck!

After joining IISc, AKN wanted me to work on fuelwood consumption in Bangalore. I was bewildered! Would a city dweller use fuelwood? Anyway the task was assigned and I had to complete it. I had consulted several people, including the Chief Conservator of Forests, faculty at the Forest Research Institute, Bangalore; they all laughed at the idea. However, a gentleman at Aranya Bhavan, by name Seshagiri Rao, suggested that I visit weighbridges in the city where the incoming material is weighed. I visited all weighbridges in the city and to my surprise found that significant amount of fuelwood was being ferried to Bangalore city (1200 tones per day!). After that there was no looking back! For the next three months, I gathered information on the sources of fuelwood, its transportation modes and distribution pattern. I had tabulated the data and shown it to Prof. AKN. He was pleasantly surprised by the enormity of the data collected and suggested I do a survey on the pattern of utilization. It took six months to complete it. During that period, I visited AKN regularly at his residence. (Though from a royal family (of Kolhapur), Mrs Reddy was humble and a generous host who served us food herself and used to treat me as a family member.)

During interactions Prof. Reddy would guide me how to prepare the tables, analyse the data and draw inferences. He suggested making policy recommendations based on the inferences drawn from the data. He instilled in me the value of caring needed to the vulnerable sections of the society-the rural masses, the poor and the women. He stood outside of the crowd and remained immune from its stifling and mindless conformity. And that is the master image, if there is one, in all of Prof. Reddy's writings.

AKN wanted me to write an article on the data I had collected but I had no clue to writing one. He therefore wrote the entire paper titled "Energy in a stratified society: A case study of fuelwood in Bangalore" himself which later became a kind of a classic (and gave me co-authorship too!). He never spoke off the cuff, and always prepared his notes in long hand. The discussions I had with him during this period paved the way for my future professional writings.

Prof. AKN, impressed by my work and commitment, offered me a permanent position at ASTRA. At that stage I dared to tell him that I wanted to do Ph.D. under his guidance. He agreed to it on the condition that I get admission on my own merit. I could get the research admission in the Department of Management Studies (at that time called the Industrial Management) in 1984 and Prof. Reddy became my research supervisor. The Department was quite small, with a teaching staff of only six and a small number of students.

Prof. Reddy was not only an outstanding scientist but also a rare human being. He had powerful ability to reveal and challenge hidden assumptions. His observations are true to the man I knew and to his many writings. The questions he posed forced me to stand outside of myself to reconsider my thinking. I had learnt from him how to identify a

research problem, how to tackle it and analyse it from different perspectives. When I produced the first draft of my thesis, he was not satisfied. He felt it lacked original contribution. The data and analysis were not enough. He suggested me to develop a mathematical model.

I considered his suggestion and wanted to link technology diffusion in the mode of biological prey–predator relationship. I struggled hard to develop the model. I then turned to my friend Mr T. Srinivas, a research scholar at ECE (now a faculty there). He is an original thinker and despite his enormous knowledge, never exhibits it. I explained my problem to him; he patiently heard, wrote a couple of equations and explained them to me. I was overjoyed, worked on them and developed a detailed model. When I showed it to Prof. Reddy, he glanced at it and said "the Ph.D. degree is in your pocket"! However, it took more than a year to submit the thesis. Prof. Reddy corrected it over five times (I still cherish the versions corrected by him) (Mr Sreenivasa Rao of the Journal of IISc helped me in copyediting several versions of my thesis before submission to Prof. Reddy). He used to argue logically compelling me to clarify and integrate concepts. He always said that his reputation was at stake since the examiner might not know me but knew him and hence it was imperative that the thesis should be free from errors. I wonder how many such rare teachers we can find now. I try to emulate him.

Another friend worth mentioning is Dr P. Balachandra who joined the department in 1986. He is very talented and hard working too but speaks out his mind; he quickly came into the inner circle of AKN. During the initial phase of the famous work DEFENDUS (Development Focused End use oriented electricity scenario for Karnataka) he used to come out with innovative ideas. Initially, I was associated with that work, but somehow AKN did not appreciate diversion from my own research and slowly I was out of the loop. But my association with Dr Balachandra continues to this day and we have done many research studies together and have published several papers jointly.

Prof. N.J. Rao, as Chairman of CEDT, was really helpful in the final stages of my thesis. He made his computer available to me (access to a PC was difficult those days) to edit and print. Later, when he became the chairman of MS, we had regular interactions on issues pertaining to Technology Management. He extended his wholehearted support when Dr Balachandra and I mooted the idea of conducting a seminar coinciding with the 75th birth anniversary of AKN. It was a huge success and the department gave full cooperation for it. It was conducted in October 2005.

I have no count, but I sense a dwindling number of people in the academic world who are unclassifiable. I met two such gems at IISc—Prof. G.N. Ramachandran (GNR) and Prof. E.C.G. Sudarshan. G.N. Ramachandran was an outstanding figure in the field of protein structure. His discovery of the triple helical structure of collagen and his analysis of the allowed conformations of proteins through the use of the 'Ramachandran plot' rank among the most outstanding contributions in structural biology. Surprisingly, GNR was known to be afraid of ghosts. Prof. E.C.G. Sudarshan, inventor of takyon, was a rage among students. I met him in 1986 at the IISc guest house. He was very courteous and answered all my queries patiently (some of them very silly too!). Friends from science department used to tell me about the scientific works of Prof. Shashisekharan and his younger colleague Dr Balaram (the present director). I used to go for walks around 4.00 am and encounter the then Director Prof. C.N.R. Rao going to his lab at that odd hour!

At IISc, all are treated equally. That is a unique culture. Most faculty follow this in letter and spirit. Many a time I had noticed Prof. Ramaseshan and Prof. Padmanaban,

when they were directors, queuing up in the library to get books issued. Another noteworthy aspect is that faculty and students go together for tea/coffee and find out-of-the box solutions to many problems. Yet another custom worth remembering is that of faculty inviting students home for dinners and students reciprocating and inviting faculty and their families for lunch/dinner at the messes. When I got married in 1985, many faculty invited us for special lunch/dinner at their homes.

Prof. N. Somasehakara guided me during my first year at the Department. Credit in varying degrees goes to Mr Rajabapaiah (ASTRA), Prof. Rama Sarma (BC), Prof. G.S.R. Subba Rao (OC), Prof. V.M.H. Govinda Rao (CHE), Prof. D.P. Sen gupta (EE), Dr P.H. Prasad and Dr Radha Rama Devi (Health Centre) and Capt. M.S. Venkatesh (Unit III). With gratitude I remember all of them for their generosity to spare their valuable time for me and for kind support at various times.

I used to involve myself in various student activities and became the secretary of Gymkhana during 1985–86. We organized many events and the one I remember most was "Kalavahini", a cultural festival. Dr P.H. Prasad was its chairman and I was the secretary. It was a one-week event with music programmes, plays, mimicry, etc. But the uniqueness was its multi-lingual nature. On a given day we had a Marathi drama or Telugu light music, or a Tamil skit or Robindra songeet. Two programmes that caught the attention of the viewers were a Tamil play "Silappadikaram" in which Mrs Indira Rajaraman played the role of Kannagai and stole the hearts of the viewers. Another was the Telugu light music programme (Veena by Mrs N.J. Rao, Flute by Mr Subba Rao and vocal, among others by Mrs Vijayalakshmi Sarma and Mrs Lalitha Prasad).

Although hailing from different states, cultures and language groups, there was a strong bonding among the IIScians. It is still a lovely place to do research and feel that I am greatly indebted to the Institute and the faculty for what they have given me and my research. I am short of words to express but my heart is overflowing with gratitude when I think of my condition when I entered the Institute and that exists now and think of all the blessings I received there.

During my ten-year stay at the Institute I got married and was blessed with two sons. Later, I came over to Indira Gandhi Institute of Development Research (IGIDR), Mumbai, with wife Lalitha and sons Sandeep and Siddharth where I am working as a faculty since 1991. I have been extremely fortunate having IISc as my Alma Mater. I have a godly heritage and have been very fortunate to experience such a period.

The Institute always beckons and woos me and so have built a house closer to it in Bangalore to live in its shade after my retirement.

Prof. A.R. Vasudeva Murthy - Father of Indian silicon technology

Dr (Ms) N.S. Leela
Retired Professor, M.E.S. College, Bangalore

The densest concentration of innovative industries like computers, semiconductors, lasers, optic fibers, robotics, medical instrumentation and consumer electronics makes California the Silicon Valley of the West. So is Bangalore which is called Silicon Valley of the East. Having no connection with this name is a man in Bangalore called "Father of Indian Silicon Technology". He is none other than Prof. Attinganal Ramarao Vasudeva Murthy popular as ARV among his students. He is the retired professor of Inorganic and Mineral chemistry from IISc. When this man was introduced to the topmost Industrialist J.R.D. Tata, he questioned whether he was making chips. The immediate reply was that he was making materials to make chips. What is this material the professor is talking? It is nothing but silicon which is the key material for the electronics and electrical industries.

Prof. Vasudeva Murthy has a fascination to this seventh-most abundant element of this Universe and the second-most abundant element on Earth. Silicon is obtained by heating sand or silicate with carbon at high temperatures. It occurs in two forms—the amorphous or powdered form and crystalline form. The crystalline form, when doped with elements like boron, germanium, phosphorus or arsenic, could be used in the manufacture of solid-state electronic devises like transistors, solar cells, microchips and so on.

Prof. Murthy in collaboration with Prof. G. Suryan of the Physics Department developed the know-how for the production of silicon-based materials and transferred this technology for commercial exploitation. These two pioneers of this special technology were consultants to M/s Mettur Chemical and Industrial Production Ltd. If this technology was properly utilized in manufacturing units for the production of silicon tetrachloride and silicate on tonnage quantities could have satisfied the country and international market. Professor repents that it was not properly considered.

Professor Vasudeva Murthy was born in Tarikere in Shivamoga district on Dec. 29, 1925. He belonged to a Shanubhoga family. He had his Middle and High schooling at Beerur and Chitradurga, respectively. He shifted to Bangalore for his college studies. He has a wonderful school and college record of being always first in any test or exams. His original research is in the field of Sulphur chemistry. He later worked on phosphorus, Nitrogen, Fluorine, Silicon and their compounds. He was well known for his unique voice and was equally at ease in delivering classroom lectures and popular talks. He not only published technical papers but also popularized the Ancient Indian history of science. He is well versed with Sanskrit literature and is the supporter of Marxism.

He was invited to participate as an Indian delegate at the International Symposium on University and Industry Interactions in Chemistry organized by UNESCO. He was awarded Dr K.G. Naik Gold Medal for his research in the field of chemistry and chemical industry by Maharaja SayyajiRao University of Baroda. He was a technical consultant to various organizations like CSIR, BARC and Department of Atomic Energy. His name was recommended for Padmabhushan award but was missed due to a technical lag.

The turning point

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The Entry–1969

After graduating from Madras University with a Chemistry Degree, I wanted to take refuge in higher education primarily because of fear of competing for a job in the real world when the only thing I had known and felt comfortable with was cramming through the books and breezing through exams with fairly good grades. Even with the Gold Medal in my hand, I was not a welcome candidate in institutions which required a personal interview (communication) and some significant accomplishment in extra-curricular activities.

Thanks to the policy at the Metallurgy Department at IISc., "D" for "Direct Admission", which meant anyone who had passed their undergraduate exam with a Distinction in Physics or Chemistry was automatically granted admission into the three–year B.E. Metallurgy degree program with no personal interview and no need to submit evidence of extra-curricular activities. As a beneficiary of this policy, I entered into IISc Metallurgy Department.

The Experience: 1969–1972

The three years at the department and the Institute were filled with rich experiences—academic, social and even some athletic.

In the first month in the Department, I realized what competition really meant. Carrying a load of 13 courses in the first semester, and competing with fellow students, each one of them a rank holder from their respective universities, was an experience I will never forget. I very soon realized past methods of cramming and acing an exam would not work at this department; what mattered was meeting with the expectations of each of the faculty members and focusing on the desired results. Thanks to the well-qualified faculty with training from great institutes within India, the USA and the UK, I got to experience the quality and the format of teaching from some of the best universities in the world right in Bangalore.

From the social aspect, my experience at the Institute was really the turning point in transforming me into the person I am today. From the change of environment from an all-male college to an Institute full of intellectuals of both sexes who were very competitive, to learning the table manners at the mess halls, to discussing global sports and political scenes over a cup of coffee at the Gymkhana as if our views made all the difference, what I gained here was lots of general knowledge combined with some style.

I even tried getting into some athletics when I was at the Institute. Got introduced to Billiards and pool, tried my hand at table tennis and tennis and even ventured into the basketball court trying out some free throws. Not bad for someone who was a geek before coming to the Institute!

The Exit: 1972

Needless to say, I exited the Institute to join graduate school at Purdue University in USA, a very different person than the one who entered it, more confident, more communicative, more competitive, more knowledgeable and a person with some class.

Re-entry

After 35 years in the US, gaining additional experience on top of the strong foundation laid at the Institute, as a businessman with operations in India, I am exploring the opportunities for re-entry into the Institute in some capacity—a mentor sharing his experiences with the new generation students of the department and the Institute perhaps?

A tribute to the Directors of Indian Institute of Science: Reminiscences

Prof. Sushil Chandra Gupta
Formerly Professor, Department of Mathematics, IISc.

Enough has been said in speeches and told in writings by the academic fraternity, directly or indirectly associated with IISc, about the splendid research opportunities, academic freedom, intellectual curiosity, scientific culture and human touch at IISc. Largely, it is the result of the academic and research temperament and the congenial atmosphere prevailing at IISc. The liberal funding by various agencies, pleasant climate of Bangalore and serene surroundings have also helped. The growth and the level of excellence of any organization is a collective effort of all those who have been associated with it but in my opinion the key players are the Directors/Heads of the organizations who are the policy-makers and play the role of torch bearers. We at IISc have been very fortunate that all our Directors have been great academicians, visionaries and human beings par excellence and this has tremendously helped in the growth of the scientific temper at IISc. In what follows, I have tried to pay tribute to the Directors of IISc by highlighting their extra-ordinary human qualities through my reminiscences. Their academic achievements are well known and need not be discussed here.

After obtaining my Ph. D. degree in 1969 from IIT Kanpur and serving for one year as a Faculty Member at IIT Delhi, I joined IISc in July 1971 in the Department of Mathematics and retired as a Professor of Mathematics in 1997. I was awarded Doctor of Science (D. Sc.) degree by IISc in 1998. In this brief write-up, I am presenting some of my personal experiences of my association with some of the Directors of IISc. When I joined IISc Prof. Satish Dhawan was the Director who had initiated a big expansion programme of IISc and he used to meet the new faculty often. In one of the meetings when we were ready to air our grievances, he suggested that something good also must have happened to you people and before talking or writing about negative aspects first point out the positive things. This seemingly small piece of advice was a great learning experience for me and it proved to be a good "success mantra". I have used this advice several times and given it to many others including my children. On my joining I was told by my colleagues that Prof. Dhawan keeps track of the research publications of the faculty members. The Institute has grown in size and it may not be possible for him but he did remember the research interests of the faculty.

There are not many people who know the pulse of the Indian society as well as Prof. C.N.R. Rao. His sharpness in understanding the matters is extraordinary. He would have read even a five-page letter quickly and assessed the situation correctly in a few seconds and, if required, would take corrective action within no time. An incident which is personal but resulted in the form of a Council resolution which benefited all the faculty members is worth recounting here. For no fault of mine, my promotion from Assistant Professor to Associate Professor was delayed by about 9 months. Firstly, the Council meeting did not take place for want of quorum and after the next Council meeting the signing of Council minutes got delayed. In addition, I had myself delayed submission of my promotion papers by about a year as I was expecting a nod from the journals about my new research activity which I had initiated. I was very unhappy and represented to the Director (Prof. C.N.R.

Rao) to make my promotion effective from the date on which I had submitted my promotion papers. Meanwhile I met the Deputy Registrar of the Council Section to have some input. He told me that even if the Council accepts my representation I would not get the benefit as in the IISc history no Council resolution has been made effective from an earlier date. I immediately sought an appointment with the Director and mentioned the reasons for it. At the appointed time, I was hardly at the door of the Director's room when Prof. Rao said: "Gupta, it will be done". I was in a dilemma to go inside or not but somehow made it to his chamber. He told me, on his own, that he would see whether my one year delay in submitting the promotion papers can be condoned or not but up to 6 months the delay could be allowed. I got my promotion back-dated by a Council resolution and the Faculty Members were allowed a delay of their promotion papers submission by 6 months. Very few administrators can match Prof. Rao in his bold decision making and its quick implementation. I have many more such incidents to narrate about Prof. Rao and also about Prof. Mehta but I am preserving them for some other occasion in the future.

Prof. G. Padmanaban was one of the humblest Directors IISc. had. It is difficult to find a person who was upset after meeting Prof. Padmanaban that he/she was not shown due respect or did not get patient hearing. I found him always ready to oblige. I had submitted my thesis for the award of Doctor of Science (D Sc) degree when I was in service but it was awarded in June 1998. By this time I had retired. By tradition this highly prestigious D Sc degree is to be handed over in a Senate Meeting but since I had retired, the then Assistant Registrar of Academic Section wanted me to take my degree with the students. I argued with him and later on with the Registrar of IISc that just for 1 minute I will be in the Senate Meeting to take the degree and after that I will come out of the meeting. They did not agree and sol met Prof. Padmanaban. A Special Senate Meeting was being arranged by Prof. Vijayan to felicitate Prof. Padmanaban who was retiring on 31st July 1998. Prof. Padmanaban readily agreed to give me D Sc degree in the Senate Meeting after consulting Prof. Vijayan. I got my D.Sc. degree from Prof. Padmanaban with full honours at the Senate Meeting.

After my retirement, for about 6 years, I was busy writing a book which was published in October 2003 by Elsevier in their prestigious North-Holland Book Series of Applied Mathematics and Mechanics. This book which is at an advance level has been highly appreciated and got excellent reviews. So I sent my book and some reviews to Prof. Balaram for his kind perusal. In his hand-written reply he wrote "Thank you for letting me see your book ------". The language speaks for the humbleness of Prof. Balaram.

In my reminiscences I have tried to bring out some extra-ordinary human qualities of our Directors which are absolutely essential for an academic environment and without which IISc would not have risen to such heights. I wish wholeheartedly even higher heights of excellence.

We earn our bread through satellite communication Taught by Prof. S.K. Chatterjee

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I joined the Department of Electrical Communication as a research student in Jan 1965 after obtaining the M.Sc. degree in Mathematics from Mysore University. My guide was Prof. S. K. Chatterjee. The problem I worked on was heavily dependent on knowledge of mathematics which has always been my great love.

I did not know what to expect but like many of us who joined this institution, I was in awe of it! Familiarity definitely changes your perceptions. There were some good and some not so good things we faced there. Lots of great work was going on.. However, I have not met many from this institution who could give a usable practical solution to a technical problem. But amongst the alumni, I have met many outstanding working engineers. Probably, that explains many things I have mentioned below.

Many people I know must have wondered why I left the Indian Institute of Science because the general feeling was that one could become a teaching staff member if one stuck around long enough! I finished my Ph.D. work and joined the Microwave Antenna Systems Engineering Group of ISRO at Ahmedabad as a scientist in 1971. Working on and understanding all aspects of satellite earth station antennas were thoroughly enjoyable. After a year, quite reluctantly I joined the Indian Telephone Industries as an engineer in its R&D Division; reluctant because I was very happy in ISRO but the lure of Bangalore was always there. I worked there for 20 years. After some time I got totally absorbed in the industrial work and did not for a minute regret my decision. At that time our Department was called the Bell Labs of India. It was headed by Mr D. K. Sachdev who is an alumnus and a brilliant student of IISc. Taking voluntary retirement in 1993, I now work for our own company which is involved in satellite earth station installations all over the world. This is very hard work but for some one like me, totally enjoyable.

Why I left the IISc has nothing to do with the institution. This is a fabulous place. Dr Amarjit Singh, at that time Director of CEERI, Pilani, had told me that it was his dream to study there before he got the opportunity to go to Harvard University.

I had the guidance of a pioneer in the microwave field, the late Prof. S. K. Chatterjee. And what an unusual man he was! I had grown up fatherless as mine had left us when I was five. He was virtually my father. He taught us satellite communications in 1965. We earn our bread through that field now.

Then what did I want? My restless nature needed constant activity. Academic life was too placid and laidback for some one who wants thing to be happening all the time. Minutes should count. Even now Prof. (Mrs.) Rajeswari Chatterjee gets quite annoyed at the frequent calls I receive and make on my mobile phone whenever we travel together in a car!

The other reason is that I am not an intellectual, so I did not get satisfied with just ideas. I enjoyed seeing the tangible results of my endeavour-hundreds of pieces standing in a row, to be equipped into systems that helped communications somewhere.

That I played a part, however small, in establishing networks is what has kept me going even after many years and tears!

A Profile

Prof. Dr. S. Ramesh Babu

B.Sc., B.E. (IISc.), Ph.D. (IISc.), MIE, MIIM, MISTAM

(Born on 12 Feb, 1957)

#201,'Sadhane', 6th Main, 6th Cross, Tatanagar, Kodigehalli, Bangalore 560 092, India.

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Founder-Director: "TOP OF THE WORLD" CENTRE FOR EXCELLENCE

Aims set in life

1. To make a mark as a scientist by working in unexplored areas to generate new knowledge, develop novel experimental techniques and economize steel making processes; 2. To be the Indian with the highest number of World Records.

Skills

Mathematical modeling of Metallurgical processes, Numerical techniques, Developing softwares, Designing novel experimental techniques, Developing need based educational workshop modules, etc.

Professional experience

Visiting Scientist (NEUT, China,1986), Visiting Scientist (Tohoku Univ, Japan,1986), Monbusho Fellow (Tohoku Univ., Japan,1987), Post-Doctoral Research Fellow (UBC, Canada,1988), Associate Head (TCRDC, Patiala,1989), Assistant Director (NML, Jamshedpur,1990), R&D Manager (JSL, Hissar,1991), Dy. General Manager (NSL Ltd., Hyderabad,1994), General Manager, R&D (IPIL, Pune,1994), Professor (MSRIT, Bangalore,1995), Professor (PESIT, Bangalore,1997), Senior Research Scientist (AFTC, Bangalore,1999), Founder-Director,"Top of the World" Center for Excellence, Bangalore, since July 1999.

Education

B.Sc. (PCM), Collge Topper, Bangalore University XI Rank-1977

B.E.-Metallurgy (IISc), Distinction & V Rank-1980

Ph.D. Metallurgy (IISc), Distinction (in course work)-1985

Patents and publications

4 Patents, 7 Journal Publications, 30 Conference Papers, 24 Research Reports, 4 Unpublished works and 18 Invited Technical Talks.

Major Academic Achievements

Gold Medal in Physics (B.Sc.), College Topper in Physics, Chemistry and PCM, President of India Best Research Paper Award, 1985, IIM Best Research Paper Award, 1993, Refereed for the International Journal of Surfaces & Colloids, USA, 150 Reprint requests from 16 countries for the Ph.D. work published, First Indian Scientist invited by the Govt. of China, etc. In addition recently recognized with over 3 dozen National and International Awards and Honours.

Major non-academic achievements

Set 27 World Records including two Guinness Records and 7 National Records in Table Tennis, Shuttle Badminton, Kite Making, Bridling & Flying, Cycling, Scooter Driving, Lawn Tennis, Carroms, Oratory, Vegetable Cutting, Paper Plane Making & Flying, Sanskrit

Recitation, Cooking, Gift Packing, Frisbee Rally, Envelope Making, etc. IISc Carroms Champion 1980-1984. Over 100 individual prizes during the schooling period.

Present work: Founded the "Top of the World" Centre for Excellence in July, 1999 and in the first 8½ years alone, conducted about 670 workshops in Karnataka, Maharashtra, Delhi and U.P. which benefited nearly 83,000 people.

ACADEMIC ACHIEVEMENTS

1. Dr. T.D.V. Krishnan Memorial "Gold Medal" for Physics, 1977.*
2. Shri S.G. Shastry Memorial Endowment "Cash Award" for Chemistry 1977.*
   Shri K. Garduachar Memorial Endowment "Cash Award" for highest aggregate in 'PCM', 1977
3. Smt. Sarojamma Dyavanna Memorial Endowment "Cash Award" for Physics, 1977.*
4. "The President of India Best Research Paper Award" of the Indian Society of Theoretical & Applied Mechanics, 1985.
5. "Best Research Paper Award" of the Indian Institute of Metals, Calcutta, 1993.
6. Served as a referee to The Journal of Surfaces and Colloids, American Chemical Society, Washington, USA.
7. Adjudged as the "Most Impressive Speaker" of the 3-day Symposium on "Recent Developments in Manufacturing Techniques", Thapar Corporate R&D Centre, Patiala, 1990.
8. Ph.D. Thesis requested by the National Council of Scientific Research, Japan and of Canada, CECRI, Karaikudi, Prof. Martin Shanahan, France, NEUT, China and Universities in Britain.
9. Received nearly 150 reprint requests for the work published based on the Ph.D. work, from 16 different countries.
10. First Indian Scientist invited by the Government of China, for long term research in Metallurgy.
11. Chaired Conference Sessions.
12. Delivered Invited talks in several places of excellence.
13. I.I.Sc., M.E. Entrance Test Topper in Metallurgy, 1980.
14. I.I.Sc., Research Entrance Test Topper in Metallurgy, 1980.
15. I.I.T., Madras, M.E. Entrance Test Topper in Metallurgy, 1980.
16. Silver Medal in All the 4 Sanskrit Examinations conducted by Sura Saraswathi Sabha, Sringeri.1969-72.
17. Rated Outstanding for the research done at Jindal Strips Limited, 1992.

(*For best performance in B.Sc. examination)

26 WORLD RECORDS

1. 2007 INAUGURAL WORLD RECORD in Fastest Kite Bridling in 1 Hour. Successfully bridled 90 standard square paper kites of size 12" x 12" in 1 Hour, the Gandhinagar Higher Secondary School, Bangalore, on 8 Sept, 2007. (Accepted by the Limca Book of Records; to appear in the 2008 edition)

2. 2007 INAUGURAL WORLD RECORD in Longest Absolute Non-stop Frisbee Rally. (With Mr. M. Suresh, M. S. Ramaiah Medical College, Bangalore) 3139 Rallies in 1 Hr. 58 Min. 32 Sec., at the Sindhi High School, Bangalore, on 9 July, 2007. (Accepted by the Limca Book of Records; to appear in the 2008 edition)

3. 2006 INAUGURAL WORLD RECORD in Fastest Paper Plane Launching in 1 Minute. Successfully flew 296 paper planes of size 16 cm x 19 cm in 1 minute, at Green Country Public School, Bangalore on 22 Nov, 2006. (Accepted by the Limca Book of Records; to appear in the 2008 edition)
4. 2005 INAUGURAL WORLD RECORD in Fastest Kite Making Manually prepared 169 kites of size 12" x 12" in 59 Min. 50 Sec., without anybody's assistance, at Seshadripuram High School, Bangalore on 5 Sept, 2005. (Received certificate from the Limca Book of Records; Published with photograph in the 2006 Limca Book of Records, Paper back edition, page 34)
5. 2005 INAUGURAL WORLD RECORD in fastest Gift Wrapping Manually Gift wrapped and taped 216 standard saree boxes in 59 Min. 53 Sec., without anybody's assistance, at Stella Maris High School, Bangalore on 9 July, 2005. (Received certificate from the Limca Book of Records ; Published with photograph in the 2006 Limca Book of Records, Paper back edition, page 34)
6. 2002 INAUGURAL WORLD RECORD in Fastest Poori Making. Prepared 132 Poories in 59 Min, 50 Sec., starting from manual preparation of the dough, kneading, rolling and frying one by one, without any assistance, at the Green Country Public School, Bangalore, on 14 April, 2002.
   (Published with photograph in the 2003 Limca Book of Records, Paper back edition, page 26)
7. 2001 INAUGURAL WORLD RECORD in Fastest Sanskrit Recitation. Recited the 234 worded 36 lines of "Venkateshwara Sthotra" in 39.73 Seconds, in just 2 breaths, at the St. Philomena High School, Hassan, on 16 Jan, 2001. (Published in the 2002 Limca Book of Records, Hard bound edition, page 24)
8. 1999 INAUGURAL GUINNESS WORLD RECORD in Lightning Carroms Pocketed all the 19 carrom pawns (9 Black + 9 White + Red), in 39.613 Seconds, at The Karnataka Contractors Club, Palace Grounds, Bangalore on 21 Nov, 1999 ; (Received the certificate by the Guinness Book of Records; Published in the 2002 Limca Book of Records, Hard bound edition, page 26)
9. 1999 INAUGURAL WORLD RECORD in the Longest Uninterrupted Lawn Tennis Rally (with Mr. M. Suresh, Marker of IISc Gymkhana) 3129 Rallies in 1 Hr. 36 Min. 50 Sec, at the I.I.Sc. Gymkhana, on 1 Nov, 1999
10. 1999 INAUGURAL WORLD RECORD in Making and Flying Maximum Number of Paper Planes in 1 Hour. 264 Paper Planes in 1 Hr using 14.5 cm x 18.5 cm papers at Stella Maris High School, Bangalore, on 9 July, 1999.
11. 1998 INAUGURAL WORLD RECORD in Marathon Solo Carroms 24 Hr 1 Min. 40 Sec; 309Boards; 5360 Pawns Pocketed at an average clearance rate of 3 Min. 3.3 Sec. Per Board, played at Canara Union, 10 October, 1998.
12. 1998 INAUGURAL WORLD RECORD in longest Uninterrupted Solo Lawn Tennis Rally; 3174 Strokes on 40 Min: 29 Sec, at IISc, on 6 September, 1998.
13. 1998 INAUGURAL WORLD RECORD in Solo Marathon Highway Scooter Drive. Bangalore to Pune : 855 km in 20 Hr. 09 Min (1 May, 1998) Pune to Bangalore : 855 km in 18 Hr. 33 Min (6 May, 1998) Thus broke the previous Limca Book of Record-1998 LBR, Hard bound Ed. Page (Congratulated by the Guinness Book of Records)
14. 1998 INAUGURAL WORLD RECORD in Vegetable Cutting A Single Cucumber Weighing 1070 g and 28 cm. in length was manually cut into 1,20,060 pieces in 2 Hr. 52 Min. 21 Sec. At Bangalore, on 5 April, 1998. (Congratulated by the Guinness Book

of Records; Published with photograph in the 1999 Limca Book of Records, Hard bound edition, page 222)

15. 1997 INAUGURAL WORLD RECORD in Longest Uninterrupted Solo Table Tennis Rally; Played over the net using a vertically placed T.T. table half as the partner. 18,737 strokes in 1 Hr. 33 Min. 53 Sec. at Bangalore, on 9 August, 1997. (Position of the feet unchanged till completing 17,568 strokes in 1 Hr.28 Min.20 Sec.) (Congratulated by the Guinness Book of Records)
16. 1997 INAUGURAL WORLD RECORD in Fastest Uninterrupted Solo Table Tennis Rally, Played over the net using a vertically placed T.T. table half as the partner.
260 strokes in 1 Min. at Bangalore, on 21 February, 1997. (Personal Best: 278 strokes. Guinness Record of fastest T.T. rally between 2 Partners: 173 strokes in 1 Min). (Congratulated by the Guinness Book of Records)
17. 1996 INAUGURAL WORLD RECORD in Flying the Largest Kite singlehandedly without using any flying aids. 15 ft ×15 Ft synthetic kite (using aluminium, steel and PVC pipe frames) with 15 Ft ×1.33 Ft. Tail, totaling a surface area of 245 Sq.Ft. and weighing 3.262 kg. Flown at Bangalore, on 2 March, 1996. (Congratulated by the Guinness Book of Records, Accepted by the Limca Book of Records but has published a smaller achievement by oversight, 1999 LBR, Hard bound Ed., page 227)
18. 1996 WORLD RECORD in Longest Absolute Non-Stop Scientific Lecturing. Topic: Computer Aided Numerical Techniques. 2 successive long sessions of 8 Hr. 11 Min. and 9 Hr.11 Min. duration with only 15 Min. rest gap in between, at Bangalore, on 6 January, 1996. (Thus broke the previous Limca Book of Record - 1995 LBR, Hard bound Ed. Page 188)
19. 1995 WORLD RECORD in Longest Uninterrupted Solo Table Tennis Rally. Played over the net using 2 bats, one in each hand. 6670 strokes in 54 Min. 54 Sec. At Pune, on 14 April, 1995
Thus set a new Guinness Record of 5000 strokes in 41 Min. 27 Sec. (Published in the 1997 Guinness Book of Records, Paperback edition, page 584, and in the 1996 Limca Book of Records, Paperback edition, page 11)

20. 1995 INAUGURAL WORLD RECORD in Flying Kite with the Longest Thread. 14 km 186-m long thread at Sanaswadi, Pune, on 26 February, 1995.
(Also, scientifically proved to have flown at a minimum altitude of 6 km above the ground level, surpassing the century old Guinness Record of 3.81 km, but not recognized by the Guinness Book, for want of a directly measured altitude proof. Accepted by the Limca Book of Records, but omitted publishing.)
21. 1994 INAUGURAL WORLD RECORD in Fastest Uninterrupted Shuttle Badminton Rally. 130 strokes in 1 Min. (with Anil Sharma, Hissar) at a calculated speed of 60 kmph, at Hissar, on 23 April, 1994. (Congratulated by the Guinness Book of Records)
22. 1994 INAUGURAL WORLD RECORD in Longest Uninterrupted Solo Shuttle Badminton Rally.3977 strokes in 1 Hr. 3 Min. 20 Sec. at Hissar, on 19 April, 1994.
(Congratulated by the Guinness Book of Records)
23. 1994 INAUGURAL WORLD RECORD in Longest Uninterrupted shuttle Tossings, Alternatively on Both Sides of the Racket. 5011 Tossings in 1 Hr. 30 Min. 8 Sec. at Hissar, on 14 April, 1994. (Congratulated by the Guinness Book of Records)

24. 1994 INAUGURAL WORLD RECORD in Longest Uninterrupted Table Tennis Tossings, alternatively on both sides of the bat (without changing the position of the feet) 9900 Tossings in 1 Hr. 5 Min. 40 Sec. at Hissar, on 12 February, 1994. (Congratulated by the Guinness Book of Records)
25. 1993 INAUGURAL WORLD RECORD in Longest Uninterrupted Table Tennis Rally. 3000 Strokes in 26 Min. 48 Sec. (with Harish Sharma, Hissar), at Hissar, on 13 November, 1993. (Personal Best: 4072 strokes in 32 Min.)(Congratulated by the Guinness Book of Records; Accepted by the Limca Bookok of Records, but omitted publishing)
26. 1993 INAUGURAL WORLD RECORD in Longest Uninterrupted shuttle Badminton Rally. 3060 Strokes in 54 Min. (with H.Gopal, Hissar), at Hissar, on 26 August, 1993. (Congratulated by the Guinness Book of Records; Published in 1994 Limca Book of Records, Hard bound edition, page 15)

Recent Record: 2008 INAUGURAL WORLD RECORD in Fastest Envelope Making in 1 Hr. Made 225 Envelopes in 1 Hr. using A-4 size papers used on one side, on 13 Jan, 2008, at Gottigere (Under communication to the Books of Records)

NATIONAL RECORDS

1. 1996 NATIONAL RECORD in Flying a Kite with the Longest Tail 622.8-m long, 15-cm wide Synthetic Tail, Weighing 1.1 kg. At Jakkur Airport, on 14 July, 1996. (Published in the 1997, Limca Book of Records, Paperback edition, Page 311).
2. 1996 NATIONAL RECORD in Marathon Lecturing 26 HRs. of lecturing on Computer Aided Numerical Techniques, with only 3 rest gaps totalling 51 Min. Also, 1 Hr. 14 Min. eligible rest time was not utilized, at Bangalore on 6 Jan, 1996. (Thus broke the 1995 Limca Book Record of 24 Hrs. Lecturing, Ref: LBR, 1995, Page: 188)
3. 1994 INAUGURAL NATIONAL RECORD in Longest Solo Table Tennis Rally (played over the net using 2 bats, one in each hand) 3185 strokes in 30 Min. 19 Sec. at Hissar, on 14 Mar, 1994. (LBR acceptance letter: LBR/HS-END/170/95 Dt.17 March, 1994).
4. 1994 NATIONAL RECORD in Flying a Kite with the Longest Tail. 224 m long, 10 cm Wide Synthetic Tail, Weighing 417 g, flown at Hissar Airport, on 13 Mar, 1994. (Published by the 1995 Limca Book of Records, Hardbound edition, Pages: 195-196).
5. 1990 NATIONAL RECORD in Flying a Kite with the Longest Tail 50.485-m long, 10-cm Wide Synthetic Tail, flown at Patiala, 24 Feb, 1990 (Published by the 1993 Limca Book of Records, Paperback edition, Page: 21).
6. 1986 INAUGURAL NATIONAL RECORD for being the First Indian Scientist Invited by the Government of Peoples Republic of China, for a long term research. Visiting Scientist at the North-East University of Technology, Shenyang, China, Jan 1986-Aug, 1986 (Considered too special a Category for inclusion by the LIMCA Book of Records, Ref: LBR/HS-END/170/95, Dt. 17 Mar, 1994).
7. 1982 NATIONAL RECORD in Fastest All Karnataka Solo Cycling Covered 2700 km in 26½ days, alone, including 1½ days rest, on an ordinary HERO Cycle without gears, covering all the 19 districts of Karnataka, 1-27 Jan, 1982. (Considered too special a Category for inclusion by the LIMCA Book of Records, Ref: LBR/HS-END/170/95, Dt. 17 Mar, 1994).
8. 1980 NATIONAL RECORD in Winning the Highest Number of Prizes in Kannada Debates in the Shortest Time. 28 Individual Prizes and 12 Rolling Shields during 3 years of High School Career, mostly in Inter School Competitions, 1969-1972. (Considered too

special a Category for inclusion by the LIMCA Book of Records, Ref: LBR/HS-END/ 170/95, Dt. 17 Mar, 1994).

INTERNATIONAL RECOGNITION

A. Recognition by the American Biographical Institute, North Carolina, USA.

1. Distinguished Leadership Award and Dedication Honour (1998)
2. Man of the Year 1999 Award
3. 500 Leaders of Influence Award (1999)
4. Leading Intellectuals of the World (1999)
5. Leaders of Science, Technology and Engineering 2001
6. Great Minds of the 21st Century (Apr, 2001)

B. Recognitions by the International Biographical Centre, Cambridge, UK

1. Who is Who in Asia and the Pacific Nations (1998)
2. Outstanding People of the 20th Century Award and Dedication Honor (1998)
3. Who is Who in the Dictionary of International Biography (1998)
4. International Man of the Millennium Award (1999)
5. The First 500 at the New Millennium Award (1999)
6. 2000 Outstanding Scientists of the 20th Century (1999)
7. Outstanding Speaker Award (2000).

NATIONAL RECOGNITION

1. Distinguished achiever Honour, 2001
   (Accorded by Nrupatunga Kannada Sangha, Jakkur)
2. Diamond Jubilee Distinguished Alumnus Honour, 2000
   (Given by the Seshadripuram Education Society, Bangalore)
3. 100 Best Citizens of India Award, 1999.
   (Given by the International Publishing House, New Delhi)
4. 1998 Outstanding Indian Achiever Award
   (Given by the Indian Institute of Talent Search®, Mysore)
5. 1998 Vivekananda Youth Day Honour
   (Given by the Seshadripuram Education Society, Bangalore)
6. 1997 Outstanding Young Indian Award
   (Given by the Indian Junior Chambers, Hyderabad)
7. 1997 Outstanding Young Person Award
   (Given by the Zonal Council of Jaycees, Gangavathi)
8. 1997 Outstanding Young Person Felicitation
   (By the Bangalore Chapter of Jaycees)
9. 1997 Eminent Sports Person Felicitation
   (By the ITC Sports Club, Bangalore)
10. 1997 Outstanding T.T. Achievement Felicitation
    (By the Table Tennis Association, Bangalore)
11. 1996 Outstanding Alumnus Felicitation
    (By the Gandhinagar High School)
12. 1996 Outstanding Achiever Felicitation
    (By the M.S.R.I.T. Employees Association, Bangalore)
13. 1996 Golden Jubilee Eminent Person Honour
    (By the Uluchukamme Brahmana Mahasabha, Bangalore)

HOBBIES, INTERESTS AND OTHER ACHIEVEMENTS

1. Indian Institute of Science 'Carroms Champion' during 1981-84.
2. Long distance runner (Ran 18 km in 1h 20 min, Vancouver, Canada 1988).
3. Long distance Back Hand Swimmer. (Could comfortably swim 1.8 km in 50 min)
4. Long distance walking (Walked 21 km in 3 h 30 min)
5. Writer (Written stories, novels, dramas and travelogues in Kannada)
6. Actor in Kannada plays. (Won best performance prize in several plays).
7. Singing -Hindustani Classical Music (A disciple of Pandit Parameshwara Hegde)
8. South Indian Vegetarian Cooking.
9. Interior Decoration.
10. Photography (Held a Photographic exhibition at the Gujari Festival, Hisar, Haryana, 1993)
11. Creating Art Pieces using Stamps and Coins.
12. Organised educative exhibitions about India in China and Japan (including the one in Tohoku EXPO 1987 at Sendai, Japan) and about China and Japan in India, visited and enjoyed by hundreds of people.
13. Delivered lectures about India, while abroad, to receptive foreigners to promote cultural exchange, including an invited talk at the Rotary International Club, Monbetsu, Japan.
14. Gardening (Maintaining a 700 Sq. Ft. Garden with over 50 Species of flowers, fruits and vegetables.

Note: Won nearly 100 individual prizes in various competitions before entering college.

1. APPENDIX

I. ACADEMIC CAREER

YEAR	EXAM.		INSTITUTION	RESULT
1961-1971	Upto SSLC		Arya Vidya Shala, Seshadripuram Sthree Samaja, Gandhinagar High School	Throughout maintained I or II Rank in the class
1972	SSLC		Gandhinagar High School, Bangalore	Distinction
1973	P.U.C.	I Yr		Distinction
1974	P.U.C.	II Yr		I CLASS
1975	B.Sc.	I Yr	National College, Basavanagudi	I CLASS
1976	B.Sc.	II Yr	(Bangalore University)	I CLASS
1977	B.Sc.	III Yr		Distinction
1977	B.E.	I Sem		Distinction (GPA 2.9)
1978	B.E.	II Sem		Distinction (GPA 3.3)
1978	B.E.	III Sem	Department of Metallurgy	Distinction (GPA 3.6)
1979	B.E.	IV Sem	Indian Institute of Science	Distinction (GPA 3.6)
1979	B.E.	V Sem	Bangalore	Distinction (GPA 3.5)
1980	B.E.	VI Sem **		Distinction (GPA 4.0)
1980-85	Ph.D ***			Distinction (GPA 3.6/4)

* P.C.M.B: Physics, Chemistry, Mathematics, Biology

** B.E. Project : Studies on Removal of Phosphorous from cast iron and mild steel by Electro Slag Refining (Guide: Professor K.P. Abraham)

*** Ph.D. Thesis : Studies on Drop Formation at Conical and Capillary Tips (Guides: Prof. A.K. Lahiri and Prof. M. Mohan Rao)

II. ADDITIONAL EXAMINATIONS PASSED

SL.NO.	EXAMINATION	CONDUCTED BY
1-2	Sanskrit Balbodhe and Prathama	Bharatiya Vidya Bhavan, Bombay
3-4	Sanskrit Prathama and Kavya	Mysore State Samksrita Mahasabha
5-8	Sanskrit Prathama, Dwitiya, Tritiya and Turiya*	Sringeri Sura Saraswathi Sabha
9-10	Junior Air Certificate Exams I & II	Ministry of Defence, Govt. of India
11	Senior U.N. Certificate Examination	United Schools Organisation of India
12.	Graduate Record Examination	Education Testing Service
13.	Test of English as a Foreign Language	New Jersey, U.S.A.
14-15.	Everyday German I & II	Foreign Language Section
16.	English for Scientists and Engineers	Indian Institute of Science,
17.	English for Research Students	Bangalore

"Awarded Silver Medal in each of the four examinations for best performance

Editors' Note: This is an unusual profile. We chose to publish it as received than reorganize it into the usual format.

Some recollections-Little-known facts*

H.V. Venkataramiah
Formerly Registar, IISc

My initial appointment at the Indian Institute of Science in 1965 was as Assistant Registrar, while I was in the service of the Indian Central Tobacco Committee, Madras. Before joining the Tobacco Committee, I had also served the Indian Coffee Board. In other words, I had over 20 years of administrative experience in various capacities at the time of my joining the Institute.

1) Although I was in the service of the Indian Coffee Board Head Office at Bangalore, during the years 1944-48, I had hardly got into the campus of the Indian Institute of Science. I had imagined that it was a restricted area. It was during my service in the Indian Central Tobacco Committee, Madras, later, that I was asked by a couple of members of the Central Tobacco Committee, who were also members of the Council of the IISc, that I should explore the possibilities of holding the next meetings of the Tobacco Committee at IISc. We received a favourable response to our request from the Registrar. The meetings were fixed at the Council Hall of the Institute. We were promised all assistance in making arrangements for the meeting as also for accommodation in the Guest Rooms of the IISc. The Institute did not have Guest House then. We arrived on the previous day of the meeting at the Institute late in the evening. On arrival at the Guest Room, we were cordially welcomed by the staff and conducted to our rooms. The rooms were comfortable and very clean. We were served food in the dining hall attached to the Guest rooms and everyone relished it. After dinner we just went out to get ourselves acquainted with the neighbourhood and venue for the next day meetings. We could not get very clear idea of the places as it was dark. Streetlights were few and far in between. The tall trees on either side and the canopy of their leafy branches hardly permitted any light to penetrate. It looked as though we had entered deep into a forest area. In the morning after refreshing breakfast, we walked the distance to the Council Hall and were thrilled by the beauty of the surroundings, with flower plants, well maintained bushes and hedges and tall flowering trees on either side and all along the pathways. The air was fresh and very refreshing. The roads and drains were very well maintained. On reaching the main administrative building, we were awestruck by the majesty of the building and the lifelike statue of the Founder in front of it, and the vast well-maintained quadrangle, in between. The Council Hall, with well-polished wooden floor, oval round table and matching chairs, equally arrested our attention. There were photos of the then Maharaja, President, prominent members of the Bombay House, including that of J.N. Tata, the Founder of the Institute. The Hall had its own majesty and royalty. The front glass doors opened to face the statue of the founder and the rear ones to the vast expanse of greenery and privacy.

To me the vast campus resembled, in certain aspects, the Banaras Hindu University I had visited earlier. But nothing could be compared to the majesty of the IISc which had a hypnotic effect on me. Immediately a thought came to me that at least in my next birth God should grant me the wish that I should have the privilege of living and studying in this beautiful campus.

*First published in the Newsletter of the IISc Pensioners Association.

Little did I realize then, that very soon my wish was to be fulfilled in this birth itself and that I would be a part of the Institute life, not as a student but as a staff member. In grateful thanks to my wish having been fulfilled, I have given the Institute my very best I could offer, deriving in this process, the very best the Institute could offer. The service to the Institute was undiluted and was integral to my daily life, the memories of which I carry even after long years of retirement.

2) Prof. Satish Dhawan was the Director and Mr S.S. Prabhu, the Registrar at the time I joined the Institute I was briefed by the Director generally about the Institute and in particular of our approach to academic administration which is entirely different from what is normally understood in govt. establishments. I could not immediately comprehend his statement. He said I would understand what he meant gradually as I get exposed to academic discussions in academic forums and discussions with him. The emphasis of administrators should be to stretch the rule, keeping its essence to meet the growing needs of dynamic establishments and not limit its scope. Such a state of mind should accommodate the academic view points where warranted, to advance and promote academic interests. The role of administrator should be that of a facilitator.

Mr S.S. Prabhu, the Registrar, was also a great teacher. He thought it would be appropriate to take us along with him when he cleared the office papers. Prof. Dhawan would not like to read lengthy notes and cross-notes. He would prefer brief presentations, case by case, issues involved, decisions involved and the views of the Assistant Registrar and the Deputy Registrar on cases processed by them.

Initially the Registrar initiated the presentations. There would be questions by the Director, on various aspects, many a time from the rules angle. After a few exposure, when we became familiar with this procedure, we were asked to take charge of our files to clear them with the Director, the Registrar playing the role of an observer. This was a very valuable experience and it helped us to understand what the Director had meant by "academic administration" while briefing us at the time of joining. The learning and unlearning process started at this stage and has remained continuously as part of me, ever since.

I will illustrate this point with an example.

3) One of the professors in the Faculty of Science was also in charge of sponsored schemes in the Dept. One of the schemes had been extended for a brief period and was likely to be wound up in the next couple of months. The professor had immediate need of a refrigerator and a few books relating to the subject. No carry over of money was permitted while internal reallocation was permissible with the approval of the Director. The problem was that of acquiring capital items at the fag end of the scheme and that too towards the financial yearend. This was not looked kindly by the audit. Even so, I suggested to the professor that he should immediately address a letter requesting what he immediately required, how important they were to successfully complete the objectives of the scheme and why he could not anticipate these requirements at the time of budgeting, etc. Immediately, on receipt of the letter, I highlighted that the time frame fixed for the scheme, from the budgetary point of view, was different from preparing a final completion report by the investigator of the scheme. Even after the budgetary time frame there may be a need to do further work to finalise the report. The refrigerator may be needed to preserve the cultures without contamination and books required could be the ones, latest on the subject required not only for this work, but also to further advance the knowledge on the subject. There was therefore justification for the professor to immediately procure

them by re-appropriation from the budget heads for which the Director was the appropriate authority.

The internal audit did not see the point. They observed that making commitment of nearly Rs.40,000/- at the fag end of the financial year was a means for utilizing the savings, and in their view, not a convincing justification for re-appropriation of funds in the scheme. If the requirements were of such importance, it should be met from the departmental resources. Not anticipating such needs at the time of budgeting means, that there was no need for them. Realising its need at the fag end of the scheme was clearly an afterthought to utilize the unspent money which in their view would attract serious attention of the external audit. The Director called me for discussion, where I explained that contingencies would arise in research projects where priorities and requirements may have to be modified to meet the deadline and accomplish the tasks successfully. This perhaps, was one such case and he should approve the request in the interest of advancing academic interest, notwithstanding the observation of the internal auditor.

The Director approved the proposal with oral instruction that in case this figured in the external auditor's report, I should take care of it. As expected, it figured in the report of the External Auditor. The final report came up before the Director for discussion. The perspective of audit in academic institutions, where thinking on research issues was a continuous process that called for readjustment of needs and priorities was lucidly explained by the Director, while welcoming objections if it were on points on impropriety or if financial loss had arisen. If assets had been created from out of the existing resources in the scheme, within the flexibility built into the scheme, that was to be welcomed. The AG Karnataka, being convinced of the weighty argument, dropped the audit observation. I passed the test in my interpretation of what I had understood of academic administration and flexibility in the interpretation of rules.

4) The administrative officers were also given a lot of freedom and flexibility to meet dynamic needs of the faculty. The Registrar had realized the importance of keeping them constantly in touch and in discussing issues before taking decisions. He would call all the officers around 4 p.m. on all working days to join him at tea where invariably light refreshments too were served. It was a forum for all to express our views and opinion on any subject, official or otherwise. The Registrar would regale us with many anecdotes and parables to make it more interesting or to drive home his point. In fact, all of us looked for this get together which provided more depth into understanding issues and intricacies. He was the guide and philosopher with excellent qualities of leadership.

If any good work had been done by his colleagues, he would openly mention and give full credit to it. He similarly wanted that we should provide leadership to those who worked with us and encourage and appreciate any good work done. In fact, when one of the supervisors working closely with me was promoted as Assistant Registrar, the Registrar was the first to congratulate me for having produced an officer at the Institute from the clerical ranks. He mentioned that in spite of his long years of service as Registrar he had not produced an officer from within the clerical ranks of the Institute whereas I had groomed one to the officer's rank and therefore I deserved the credit. He became a role model for me.

5) I entertained no malice towards any one. In fact, when the office bearers of the Employees Association invited me to join them at a get-together, on my retirement as Registrar, the complement I received was that I made no discrimination between any section of staff. I had extended full courtesy to the office bearers of the Association and had

even placed the entire file before them to appraise them of full facts. They said despite differences, they admired my qualities of courage and conviction and my integrity, because of which, they held me in high esteem. My reply was that it is the greatest compliment that I have received from those in the warring group as it then was.

6) Mr Palanisamy, the Founder-President of the SC & ST Association at the Institute once saw me at the Health Centre taking some traction treatment for pain in my neck and back. He enquired what my problem was and how long I had been on this treatment. Later in the day, he came to my chambers and said the traction treatment had side effects and if I had no objection, he would cure it with extraction of juice from the leaves of a plant. I just listened and thanked him for his offer and for his concern for me. After a couple of days, he again came and enquired as to what I had decided on the treatment. I said I had not given any thought to it and that I would get back after consulting my wife. Next day he came to my bungalow in the morning and switched on to this subject with my wife and promised complete cure within a fortnight. It was only external application of juice from a plant and we should not have any apprehension. After a lot of persuasion from him, I finally agreed. He said that the treatment would start from the next day and that he would come to my place very early in the morning as the leaves of the plant were to be plucked before the sun rays fell on them. The only restriction was that I should be in empty stomach, not even coffee before the treatment.

The treatment started as scheduled. He spotted and selected a few places on my neck and back, squeezed the leaves and with its extract vigorously massaged by entire back and neck till it was absorbed into the skin. After it got completely absorbed, we would have coffee together and I utilized this time dwelling on the need for him to be moderate and set good example for others while discussing issues with the officials. He would leave promising to come again the next day at the same time. After he did the massage for a fortnight, I was feeling great relief and relaxed. Mr. Palanisamy was extremely happy to hear that from me.

Mr Palanisamy was openly criticizing that there was no constitutional reservation for SC & ST candidates at the Institute. He had petitioned the State & Central govts on the injustice that was being done in depriving reservation of posts and also in the matter of promotions. Often I had to clash with him and his group, in the meetings, for propagating hostility between different sections of employees. Later on, there were many occasions when we had to sit together on issues he would bring up on matters pertaining to SC & STs. Slowly I converted him from his hostility, when dialogue was the best method for resolving issues. In course of time the Institute brought many reforms to give proper representation to this section of the employees. Palanisamy realized that we were sincere to bring changes and that I was largely responsible in initiating measures for the changes. He had great admiration to me for my guidance and remained steadfast. He would often come with problems seeking solution and benefited and proved himself as an efficient supervisor in later years.

7) At the time of my retirement, I had completed 23 years of service at the Institute and was not eligible to receive full pension unless my previous service of more than 10 years of service was also counted. The office had asked my Service Register from Central Tobacco Committee, Madras, duly attested, to consider my claim for counting my past service for full pension. There was delay in the follow up and there was no response from the Madras Office. Due to pressure of work, I also forgot to remind them and reconciled to receive whatever pension was decided. It was at this stage that Prof. S. Rangaswamy,

on coming to know of my indifference where my own case was involved, chided me and said that he was likely to visit Madras on official work and he would look into my case in his spare hours. He wanted me to give him brief background of my service at Madras, the location of the office and names of colleagues who worked closely with me for reference. Just one month or so before my retirement, he went to IIT Madras, on official invitation. He utilized his spare hours to trace the establishment which had shifted from its original location, met the officials and staff concerned, particularly one Mr Balasubramaniam who had worked very closely with me. Mr Balasubramaniam was excited to know all about me and recalled the happy days he had worked with me. He asked the Professor to wait for a few minutes, to search out the service record in the old records room. After a few minutes he emerged, retrieving the Service Record Register and held it in front of him. He told the Professor that an official request must come from me, on receipt of which, the same day it would be sent by Regd. Ack. to the Institute. On reaching Bangalore, Prof. Rangaswamy came to my chambers and insisted that I should send a letter to the Madras Office for my service records, as he had done all that was necessary to have my records traced for being sent. In fact, he saw to it that the letter was signed in his presence for posting. The net result was that the SR. was received in time and I was granted full pension talking into account my past service. I am amazed at the concern an academic staff had for me and the efforts he put in to get me full benefit of my pension. I am indebted to him and my colleague, Mr. Balasubramaniam.

8) Ironically, I had to face an identical situation immediately on assuming office as Registrar. Periodical requests were received for certification of past services from outside establishment, in the case of a few who had long back rendered service at the Institute, to count their past service for full pension benefits in their present posts.

As the period of service rendered was more than 15-20 years earlier, and the service records could not be traced, routine regret replies were being sent, stating that the records were not traceable. In one case, a professor from IIT, Madras, who too had received similar regret letters, personally came and met me to explain how much a certification of his past services at the Institute counted for pension benefits. He pleaded with me that I should take personal interest in the matter and provide the required information, as he was at the verge of retirement. He was almost in tears and pleaded that the case should not be closed in a casual manner. Some special efforts and personal interest was all that was required.

My enquiries revealed that all the sections had dumped their old records into the cellar and it was full to the brim. It was possible that some establishment and service records could also have been dumped in the cellar. It was impossible to get into it . I thought that if the situation to clear the cellar was not addressed immediately, it would be impossible to contain in the event of an accidental fire. I immediately set up a task committee, with the approval of the Director, with clear directive that all the records should be pulled out from the cellar and sorted out section and unit-wise. The concerned officer and supervisors should take a look at the records separated and salvage what was required to be retained and earmark what could be disposed of. This exercise went on for a fortnight and the cellar was cleared of all that was dumped into it. In this process, three service records were retrieved. Of these one was that of the professor of IIT, Madras. I immediately informed the professor of this fact. He was able to get full pension, counting the services rendered at the Institute. On receiving this information, he immediately rushed

to the Institute to thank me personally for my personal interest in his case and the special efforts put in to trace the missing service register.

The reward of work should be sought in doing it better.

9) It has been a very difficult task for me to list out items for this article. There are numerous instances which are worthy of mention. The constraint is on limitation of space. I was associated in the reorganization of the central office, central stores and evaluation committees closely worked with the faculty in the reorganization of schemes and projects, introduced computerization of Service Records and Accounts in the Schemes Unit and introduced various measures to eliminate delays in the disposal of papers where action was called for. I worked closely with the chairman of the Council in bringing revision in the Scheme, Regulation and Byelaws, got rid of the slum on Institute land, got vacated the Institute land encroached by M.S. Ramaiah, cleared unauthorised cattle and buffaloes from the campus and consolidated the boundaries of the Institute with pucca stone wall.

In each of these measures taken, it was not easy to accomplish results. I have faced hostilities and even threats, when long-standing problems were addressed. Learning is a continuous process. I have satisfaction that I succeeded in all my efforts as I enjoyed the full confidence of the Directors and there was transparency in whatever I did.

The one lesson I have learnt is that information is a very powerful tool in the hands of administrators if one has to be effective and assertive.

10) I have been extremely lucky to have received assistance in many forms from members of the faculty in the various reform measures undertaken to streamline administration. They have spent hours of their time with me either in diffusing conflicts or in counseling where required.

In particular, I would like to make special mention of late Prof. M.A. Tirunarayanan, late Prof. H.V. Gopalakrishna, late Prof. P.S. Narayanan besides Prof. H.P. Khincha and Prof. A.R. Vasudeva Murthy, who extended their assistance in a variety of ways, unmindful of their faculty responsibilities. I derived my full inspiration from the encouragement and guidance I received from Prof. C.N.R. Rao, the Director, in all the reforms I undertook to improve the image of administration. He was like a galloping horse and it was not easy to catch up with his expectations.

I am also thankful to all sections of the staff for supporting me and co-operating with me in later years in all the measures I undertook in the interest of administration.

Formative years at the Institute and vision for the future

Prof. M. Vijayan
Molecular Biophysics Unit, Indian Institute of Science, Bangalore 560 012

The Temple. An affair of head and heart

I joined the Physics Department of the Institute as a research student in 1963. I had secured admission at other institutions including Madras University with Professor G.N. Ramachandran and Banaras Hindu University with Professor Ajit Ram Verma. But with the Institute, it was love at first sight. The moment I stepped into the Institute for the admission interview, a very informal affair then, I knew that this was my place, a decision that I never regretted. I formally retired as the Associate Director of the Institute in 2004, but continue as an Honorary Professor with a full complement of research activities. I have had the good fortune to be involved in almost all aspects of Institute life, academic and administrative. The Institute has all along been the platform for my international and national activities including currently as the President of the Indian National Science Academy. From 1963, I have been continuously at the Institute in different capacities except for four years at Oxford in the late sixties and the seventies. I am not a particularly religious person. In a sense, the Institute is the only temple that I have known well.

My involvement with the Institute has not only been with my head, but also with my heart in more ways than one. Like many of my senior and younger colleagues, I wooed and won my wife at the Institute. Kalyani was a student junior to me in the laboratory, joined me at Oxford where I was a post-doctoral fellow and subsequently worked at NAL from where she retired as a Director-grade scientist. In the sixties and the seventies there used to be only a small Ladies Hostel, which used to be later referred to as the Old Ladies Hostel and still later as the J Block. It was situated just across the road from the Physics Department. Kalyani used to live there along with other lady students. Later in life, it was with a heavy heart that I, as the Associate Director, authorized the demolition of that building! There is a car park now where the "Old Ladies Hostel" stood.

Student at Physics Department

I am racing ahead in time. When I joined the Physics Department, Professor R.S. Krishnan was its head. He took over the headship from Professor C.V. Raman in 1948 and continued in that position till 1970. Professor Krishnan was a man with a warm heart, but a somewhat rough exterior. His achievements were outstanding, but did not receive the recognition he deserved. He cared deeply for the department and its members. We all held him in high esteem and in awe. We thought that he disapproved of everything that distracted from work. That sometimes led to recourse to subterfuge. H. Manohar, who had completed his Ph.D. when I joined the department as a student, was, and still is, an avid cricket fan. Whenever he went to watch a cricket match, held in those days in the Central College grounds, he alluded to some personal reasons in the leave letter. When I did the same, in a moment of madness, I wrote 'going to watch a cricket match' in the leave letter as the reason for my absence. I was expecting an explosion when I came back. However, when I ran into Professor Krishnan in the corridor on my return, all that I received was an affectionate comment: "You are growing taller and taller, but your trousers are

growing shorter and shorter". Incidentally, even in later life my trousers somehow remained a little short, to the amusement of students and colleagues.

My Ph.D. supervisor was Dr. M.A. Viswamitra who had just then become a lecturer. He, then a bachelor, was all the time in the laboratory and it was wonderful working with him. He left for post-doctoral work in 1965 and I was substantially on my own since then. Crystallography, the discipline in which I work, involved a great deal of calculations and the arrival of a computer at HAL, I think the first to be installed in Bangalore, was a boon. It was an Elliot 803, with a 4096-word memory and five-hole paper tape for input and output. A similar computer, a Ferranti machine, was installed at NAL during this period. They were incredibly slow and crude by present-day standards, but ushered in the computer age at the Institute and elsewhere. For larger computations we used to go to the CDC 3600 machine at TIFR, Bombay.

Physics to biology and return to the Institute in transition

After Dr. Viswamitra left for his post-doctoral work at Oxford, as the senior most student, I used to look after the X-ray laboratory under the supervision of Prof. Krishnan. It was during this period that Professor Dorothy Hodgkin, who received her Nobel Prize in 1964 for the structure determination of Vitamin B12, visited the laboratory in January, 1967. I had by then submitted my doctoral thesis and she informed me that she was one of my examiners. At the end of the visit, she offered me a post-doctoral fellowship which I accepted with alacrity. I joined her laboratory in January, 1968 and participated in the structure solution of the protein hormone insulin. The stay at Oxford turned me into a macromolecular crystallographer, which is the most important component of what we now describe as structural biology, and facilitated by transition from physics to biology.

The Institute was structurally somewhat different from the one that I left, when I came back to the Physics Department in early 1971. Earlier, each department used to be an empire in itself with a permanent head of the department with at best only one other professor among the faculty. The set up was beginning to change at the instance of the Director Professor Satish Dhawan. The process got completed by the middle of the seventies. Many faculty members began to become professors through promotion. Headship was replaced by rotating chairmanship. The divisional structure came into existence. A structure of the type which exists today was in place by the second half of the seventies.

My plans for the return to the Institute were formalized when Professor Dhawan visited Oxford in late 1970. I was offered the ad hoc position of an Institute SRF which was stated as equivalent to an Assistant Professorship. He told me: "We know you. Come, find a house and settle down. By the time I would get you an Assistant Professorship". By the time I returned to India in 1971, the national scenario had changed. The Bangladesh crisis led to enormous economic strain on the country. Appointments to all but new departments were frozen. In the meantime, Professor Dhawan was on sabbatical leave during 1971-72 and assumed the additional burden of the national space programme on his return. It was a difficult time for me. Nevertheless, by 1973 he was in the process of arranging a position for me in the Physics Department. In the meantime, Professor G.N. Ramachandran had returned to Bangalore and he started building up the Molecular Biophysics Unit (MBU). He offered me an Assistant Professorship at MBU. I readily accepted and joined MBU practically in mid-1973 and formally in early 1974. That I guess marked the end of my formative years at the Institute.

Beyond the formative period

Much happened since then. I was involved in the activities of the Institute in very many ways; served for long periods successively as chairmen of MBU and Division of Biological Sciences, and as Associate Director; contributed to building up my area of research at the Institute and in the country; participated in myriad national and international activities, all with the Institute as the platform. These are difficult to summarise in a short write-up.

Vision

Professor Rajeswari Chatterjee has asked us to spell out our vision for IISc for 2020 also. My life has revolved around the Institute for four and half decades and my statement on the Institute's future can hardly be dispassionate. Having seen many other institutions at close quarters, I dare say that the most important thing is to keep the essential characteristics of the Institute, as they are. The half-life of vibrant existence of institutions in India is generally short. The Institute has, however, remained a vibrant, first-rate institution for all of hundred years and is still going strong. This, I think, is because of strong traditions based on academic freedom, absence of fossilized hierarchy, a healthy disdain for authority, emphasis on excellence and the overall academic ambience. It is important to preserve these traditions. At the same time I believe that we need to acquire some more resilience to enable us to meet the exacting requirements of modern scientific enterprise. Our primary task is to produce excellent science (including engineering science) and provide thorough training at the highest level. The system should be resilient enough to ensure that administrative and other requirements subserve this supreme purpose. Some years ago a sister institution organized an interesting symposium. It was called Deep Roots and Open Skies. That just about sums up my vision for the Institute: an institution deeply rooted in our time-tested and hoary traditions, but resilient enough to reach out to the open skies of scientific knowledge and wisdom. I am sure this great and beloved Institute will continue to be the leader of Indian science and a national resource facility in addition to substantially enhancing its already considerable international presence, in the years to come.

The one that got away[1]

Dr Revathi Narayanan
Ph.D., Molecular Biophysics Unit, 1974–79, Social Development Professional

I am not the usual sort of Institute alumnus. I got my Ph.D. in 1979 from a good laboratory with an inspirational supervisor after the usual sweat and toil, highs and lows that go with a Ph.D. program. However, my entire working life has been spent in the Social Development Sector. Strange, but true!

I came to Bangalore in 1974 with the hope of getting admitted for a Ph.D. program in the Biochemistry Department. Initial visits to the campus and the library as well as the ambience of the place made me determined to spend the next five years in this institution. My decision to do a Ph.D. and get into a career in teaching and research was shaped by a few wonderful teachers during my Master's program as well as through exposure to interesting universities during summer schools as a National Science Talent Scholar. I had an M.Sc. degree in Organic Chemistry from the Poona University and had applied to Biochemistry and Molecular Biophysics Unit.

I started my Ph.D. program in MBU since I did not make it to my first choice which was Biochemistry. My interview in the Biochemistry department was coloured by two incidents both of which, I am sure, were not deliberately designed to keep me out. The first was that some of us ended up waiting in the corridors for about eight hours since no one had the interview schedule. Then, there was the first question I was asked – "So, you are married, will you leave half way to start a family?" No doubt the learned Professor had decided that principles of "equal opportunity" were best left in legal tomes like the Constitution of India and were not seriously meant to be put into practice!

In retrospect, getting into MBU was the best thing that happened to me though it was fraught with challenges. In the first place, the Unit was top heavy with theoretical work built around the awe-inspiring reputation and presence of Dr G.N. Ramachandran. The only laboratory for experimental work to which I was suited was the fledgling laboratory of Dr Balaram who had joined the Institute the previous year. There was his equally awe-inspiring reputation, having completed in record speed and at a very young age, both a doctorate from Carnegie-Mellon as well as a post-doctoral from Harvard University with the great Woodward. At the time, Dr Balaram had one Ph.D. student who was jointly registered with Dr K.R.K. Easwaran. He was known to all and sundry as Beta Krishnan (to distinguish him from Alpha Krishnan who was doing a Ph.D. in theoretical biophysics in MBU). Beta was a "character"—bright, hard-working, full of ideas and willing to take risks in the laboratory and out of it. One of his pastimes, when not waiting in front of some centrifuge or the other, was fishing in the "nullah" behind the Organic Chemistry department for interesting creepie-crawlies. In late '74, we were this somewhat motley crew of a brilliant supervisor, a maverick senior student and I. We had some laboratory space in the old wing behind IPC and Organic Chemistry and possessed minimum equipment, some borrowed and some hand-me-downs. Beta had managed, in his own inimitable style, to get himself some space and equipment time in three other departments, a truly multidisciplinary Ph.D.!

[1] The title, used here in a light-hearted way, refers to a WW 2 movie of a thrilling escape by a German POW from an Allied prison. My only "escape" was from a stream I thought I wanted to one that I actually did.

I started my work in the old wing which looked like something out of Harry Potter, had the great advantage of being quiet but the equally great disadvantage of compelling one to walk around three departments to access a toilet after 5 p.m. By the end of my Ph.D. in 1978, we had established ourselves in the building—opposite the first floor of the old Chemical Engineering Building with many more students, good equipment and a reputation as one of the good Institute laboratories to work in.

Values of integrity and rigour

After my course work, I started work on the synthesis of fluorescent probes for biological membranes. This involved a lot of organic chemistry in the initial two years. Standards were high and results were not accepted unless they were replicable over 10 times at least. There were times when I set up the same experiment close to 50 times. This reinforced values of integrity, rigour and the importance of setting one's goal high to produce quality work. There were the highs when the peaks in the spectrum were exactly where they were supposed to be and the lows when they were not. Sometimes, I did feel that a lot of time that could have been spent in the library was being spent in sorting out the practical issues that may well not have existed in an established department like Biochemistry. However, I was quite happy to trade this security for the excitement of the work that I was doing and the place I was in. There was, however, the stress of long hours in the laboratory and not having time for much else. I have always had the support of my partner who cheered me on when I was doing well and cheered me up when things went wrong.

The resonances that helped

During these four years, I started wondering if I had made the right choices. Was there a resonance between my work and the skills I possessed? To this day, I am convinced that it is these resonances that help one work to one's full potential. I watched the ease with which my supervisor handled the subject, the clarity and simplicity of his scientific communications which can only come from a strong knowledge base. I saw my partner doing the work he was clearly born to do. There was some field where I would find such resonance. It was becoming clear to me that although I had been a brighter than average student of science, a career in scientific research was perhaps not what I was cut out for. I wanted to work with people, to share what I knew with those who really needed it.

I completed my Ph.D. in 1979 with several publications coming out of the thesis work. Several years later, as a Social Development professional, I went back to the old Chemical Engineering Building, this time to the little office of the Bharat Gyan Vigyan Samiti to discuss a popular science program for rural girls. Naturally, I could not resist going upstairs and meeting my supervisor. In the old refrigerator were test-tubes with some of the fluorescent probes I had synthesised; it was satisfying to know that they were being used by some of the students in the laboratory.

Things are challenging for women trying to have a serious career in any field. There are more expectations on the personal front, if not from partners, then from other people around. When institutions are dominated both by numbers as well as in decision-making by men, there is a need to institutionalise sensitisation programs and gender-friendly measures that ensure equal opportunity for women and men. Often, the discriminations are subtle and unconsciously practiced. But the effect of hurting her confidence and self-esteem remain the same. A woman student may put in 12 hours of work from 8 a.m. to 8 p.m. but she is often regarded as less hard working than the male student who comes into the laboratory post-lunch and works until 11 p.m. Some groups had subject-related

discussions with the supervisor in the canteen at which a woman student had to be pretty strong minded to barge in if she has not consciously been asked to join. The other big challenge that remains until today is that, for women, the ages 27–33 are critical for career growth as well as for starting a family. This is a cruel choice for women to make and often they have to compromise on their careers.

At the end of my Ph.D., I had decided to change tracks but was not sure how to go about it. I was overtaken by family commitments until I surfaced again to start work in the Social Development Sector with one of the leading lights on gender issues, Devaki Jain. To my hesitation that I had not trained in the Social Sciences, she said, "Meet me and we will see". Suddenly, I found that whatever I did was useful and being appreciated. One of our most exciting projects was on women in governance at a time when there was a country-wide movement for the 73rd and 74th Constitutional Amendments reserving a third of the seats for women. I read, wrote and listened as hard as I could. There was plenty of interaction with people—from women in villages, to scholars in the social sciences, to NGO and CBO workers, to donors and government officials. I went on to head the GOI Mahila Samakhya program in Karnataka, one of the most innovative and celebrated community programs and then to work in the United Nations Development Program. I realise that I had found my "resonance" when colleagues, senior and junior, after listening to me at a meeting or seminar, are surprised to hear that my Ph.D. is not in the Social Sciences, when Foundations increase the age limit for Senior fellowship opportunities for "women like Revathi", when I am able to contribute meaningfully to a winning strategy to get a program for 25,000 poor rural women, back on track.

There are times I wish I had added on a degree in Public Health which would have helped greatly in the field I chose. This was not an option except abroad when I finished my Ph.D. Now with the funding and need arising from the HIV/AIDS epidemic, this has become a good opening for young people. Looking back to the '70s, it looks like many young people did not have the wherewithal to make informed choices about careers. One got into something and continued there. I had the freedom to make choices and the freedom to experiment. It has been a rewarding journey.

Vision for 2020: Cutting edge research and teaching programs, nearly equal numbers of women and men students, new disciplines and programs linking science to the communities.

Institute gave me lot of confidence, broadened my horizon, and helped develop independent thinking abilities

Bulusu Lakshmana Deekshatulu

M.E. (Power Systems), 1958–59; Ph.D. (Control Systems) 1960–64, EE Dept., Lecturer, 1964–65, Asst. Prof. 1965–69, Associate Prof. 1969–70, Professor 1970–76, Currently Visiting Prof., Univ. of Hyderabad. Director, Center for Space Science and Technology Education in Asia and the Pacific (CSSTEAP), Affiliated to UN—1995–2002, Director, National Remote Sensing Agency, Hyderabad, Jan. 1982 –Oct. 1996. Retired as Distinguished Scientist (Secretary-Grade). deekshatulu@hotmail.com

The teaching at the IISC was, on the whole, EXCELLENT. Research environment/ encouragement were SUPERB. Dept. administration was VERY GOOD.

The study at IISc was very relevant and highly useful. My experience at the Institute gave me lot of confidence, broadened my horizon, and developed in me independent thinking abilities.

Interesting experiences/anecdotes: (1) In 1960, the EE Dept. purchased a Servo Analyzer for about Rs. 1 lakh and it was not used much. One day I met Prof. H.N. Ramachandra Rao, Head of the Department, in the corridor; he asked me if I was using the Servo Analyzer. I said 'no' since it is costly equipment; I might spoil it during my usage. He said: "You go and use the equipment, and come and tell me that you have spoiled it". What a confidence in me! (2) During my interview for Asst. Prof. (merit promotion) in 1965, the Director Prof. Satish Dhawan asked some questions on my work, lab. experiments, etc. At the end, he enquired as to how much salary I had asked for in my application. I said that I had mentioned Rs 800 as basic salary, but I would leave it to him. He looked at me and said: "I am giving you Rs 900 basic. Go". I was wondering how the accounts/ auditors will react to this/his decision!

Vision for year 2020: IISc should produce many FRSs and at least one Nobel Laureate. Research output from EE and Automation Depts. should be more.

I vow it all to my teachers at IISc

Prof. M. Satyam
M.E. (1958–1960), Ph.D. (1960–1963), ECE
Teaching and research (1963–1996)
Visiting Professor, IIIT, Hyderabad (1996–2003)

Reflections on study: As a student, I learned from my teachers several attributes that are needed for a teacher and a researcher. They are:

* Skills needed to design experiments, fabricate experimental set-up and carry out measurements and interpret them.
* The methodologies of approaching a problem, understanding the basics and questioning them if necessary.
* The importance of analyzing the performance of an electronic gadget in depth, to the last detail.
* The importance of freedom given to the student to allow him to evolve.
* Need for tolerance in academic activity and respect for other's views.

All these attributes may not be from one teacher, but the overall exposure to teaching community has made me acquire the above and I still cherish them.

As a teacher and researcher, I kept all the above in view and feel that this attitude, which I vow to my teachers, helped me to nurture several students who are instrumental in opening up several new research areas in the field of microelectronics. I cherish always the academic freedom that I enjoyed during my association with the Institute as a student, as a staff member, and as a retired staff member.

Relevance of study: I have spent all my time in teaching and research in the field of ECE

Interesting experience/anecdote: There are a few bad experiences which I cannot forget.

* An accident in the gas tank and the way the head of the department, Prof. S.V.C Aiya, my guide, has handled it, so that we did not lose our confidence and continued our work with more vigor.
* A similar accident in the hydrogen furnace and again the encouragement which we received to continue our work is unforgettable.

We had several good experiences and moments of thrill which come to my mind time and again

* The day we got electron emission (self-sustained emission) from dielectric layer cathodes a challenge to develop a cathode without heater).
* The moment we got the idea of self-rectifying circuits (circuits which can operate directly from AC mains without intermediate rectifier circuit).
* The moment we got the idea of analog tuning indicator for transistors
* Concept of shaped superconductor for electronic functions.

These are only examples of a few instances that come to my mind again and again and I still ponder over them.

Vision for 2020

As on today, IISc carries out research at different levels starting from pure investigations to making useful gadgets which are likely to have societal implications. While

this gives the impression of providing unbounded freedom to the workers, it also provides shortcuts and easy path to acquire fame and glory. I think a tradition is to be established in IISC, which draws in highly motivated people to carry out work in “cutting edge” and fundamental aspects of science and technology”. The institute should be a place for “new ideas” at very basics of science and technology and the utility of this should be left to other organizations. Institute should be a leading institute in carrying out research based on experiments and theory equally.

My student days at IISc

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On Founder's March 3, an announcement was made at the Alumni meeting that Centenary celebrations will be held in December. I realized that I had passed out from IISc exactly half a century ago, i.e. in May 1958! On top of it, at this meeting I was overwhelmed to see two of my professors Mr. H.N. Ramachandra Rao and Dr A. Ramchandran who taught me, at the Institute were honoured. I was extremely happy to talk to them after a long, long time.

I had the unique privilege of following foot steps of my father Mr T.K. Rao and his brothers (my uncles) Mr. T.S. Rao and Mr. T.A. Rao (Mr T.S. Rao was second/third batch student of in Electrical Technology of IISc), by joining the Institute in 1955 after post-graduation from Lucknow University, to do Electrical Technology.

I stayed in the hostel (as my parents were in UP at that time) and had wonderful and unforgettable three years of my life at the Institute. The hostel consisted of four blocks A,B,C,&D with rooms with roof tiles (built earlier) and new blocks E,F,G & H with RCC roofing. All the rooms were of single occupancy and well furnished. Most of the students preferred A, B, C or D blocks as rooms were big and cool (having tiled roof). The other blocks were two-storied buildings. There were two dining halls, one for vegetarians and other for non-veg. For some unknown reason, these were called as North Indian and South Indian mess, probably based on the type of dishes served. Non- vegetarian dishes were served only in North Indian mess. The food in both the messes used to be very good and the charges were very reasonable.

As far as academics are concerned, most of the students being rank holders, used to be regular and punctual in attending classes which used to be from 9 a.m. to 4 p.m. with break for lunch.

The extra-curricular activities such as sports and social activities were conducted at the Gymkhana. There was big hall which housed indoor games, reading room and a big radio set with external loud speakers. Most of us used to assemble there and tune in Radio Ceylon to hear Binaca Geet Mala programme. Every Saturday music/lecture/ entertainment programs were conducted. We had four tennis courts and many of the staff members used to play with us. There was a billiard table as well. We never felt that we were far away from home.

My north Indian friends were missing Tandoor rotis and tandoori dishes and

these were available in those days only at Kwality Restaurant at Brigade Road, only one with Punjabi cuisine. We had to catch a bus at 18th cross in Malleswaram to go to Shivajinagar bus stop and from there walk down to Brigade Road. Many a times we missed the last bus back to Malleswaram and forced to walk all the way to the Institute (In those days there were no autorickshaws).

Many of the staff members were staying in the quarters within the campus. Many of us used to visit them on special occasions, such as Diwali, Holi, etc. One of the pleasant incidents I remember was when some of us forced Dr Satish Dhawan to give us a party at his residence immediately after he got married. Dr Dhawan was at that time was professor of Aeronautical Engineering.

My most unforgettable moment was meeting Mr. J.R.D. Tata at the Founder's Day Celebrations, on March 3, which he used to attend every year and have dinner at the mess that night with staff and students. The dinner used to be very informal, no speeches. Mr. Tata used to mix freely with intimates of the institute, talk to them and listen to their feedback, etc. One my friends who hailed from Punjab told him that as Institute was awarding only Diploma certificates instead of Degrees, his parents were not getting proper marriage proposals for him. Mr. Tata said that, he himself was a bachelor–may be because of similar reasons but assured him to get a good bride for him, in case his parents fail. When one of us told Mr. Tata that many government and other agencies did not consider Diploma from the Institute equivalent to degree and not able to get jobs, he assured us to refer him such cases directly to take action. In fact, in my case the U.P. government's Electrical Inspectorate did not recognize the Diploma and my employer sent the letter to the Institute and within a month the Diploma was honoured.

The atmosphere at the Institute was that of one big family. We never felt that we were far away from home. Good times we had at the Institute still linger on even now, 50 years since I left the Institute.

Four engineers from the same family, All alumni of IISc

(1) I joined the Institute in 1955 to do the course in Electrical Technology and completed the same in 1958**,** exactly 50 years ago!

As my father Mr T. K. Rao and his two brothers were also old students of the

Institute, I was delighted to pursue studies in this prestigious Institute. I narrate below their stories:

(2) Mr T. K. Rao (Krishnaswami Rao)—My father

He did his courses in Electrical Technology as well as in Electrical Communication Engineering during1931–35. He joined a private power company and was involved in power distribution in Guntur, Tenali and Repalle in Andhra Pradesh. He was also involved in erecting HV transmission lines in that area.

After a stint at HAL in 1942, he joined the central government and was posted at Allahabad as a mechanical-cum-electrical engineer to look after aerodromes. After independence, the department was merged with the PWD of UP state in 1948. He was for some time the head of the Electrical Inspectorate of UP. He was posted as an Officer on Special Duty at Rihand Power Project in UP in1959. He passed away in 1960 while still in service. He was a member of the Institution of Engineers (India).

(3) Mr T. S. Rao (Seshagiri Rao)—My father's eldest brother

He did his B.E. in Mechanical Engineering from Bangalore's College of Engineering (now called UVCE) (second or third batch) and joined the Institute to do a course in Electrical Technology which just started at that time. His professor, as I recollect, was Mr Alfred Hay.

He started his career at Bombay with Metropolitan Vickers Ltd, an UK-based electrical company. He was later inducted into the Indian Railways. After training in UK he worked in the North Western Railway at Karachi, Sakkar and Lahore (all now in Pakistan). Later, he was deputed to the central government as a Joint Secretary in the Central Electrical Commission at Calcutta and Shimla. He dealt with power projects for the country. Just before Independence, he was recalled by the Railways and posted to Lahore, New Delhi and Madras.

BES&T, Bombay, requested him to take up the underground Metro project for Bombay. He had retired earlier from the Railways and joined BES&T as Chief Engineer (Elec). He

drew the plans for the underground railway system in line with other metro cities in the world. He studied similar systems abroad. However, the project was later shelved, but last year the Prime Minister Dr Mamohan Singh inaugurated this project. He retired in May 1960 and is now settled down in Bangalore.

During the post-Independence period, he was associated with various committees set up by the Government of India on Heavy Industries, power projects, etc. He was also a member of the Governing Council of the IISc (probably in 1953–58). He was conferred with the title of Rao Bahadur by the British Government.

He was also a member of the committee for drawing standards for electrical equipment for the Bureau of Indian Standards.

(4) Mr T. A. Rao (Ananthswami)—My father's elder brother

Like his brother, he also joined the Institute in the Electrical Technology course after completing B.E. in Mechanical Engineering from College of Engineering, Bangalore, in 1927 (exact year not known). He joined the Electricity Dept. of Madras state and later worked for the private power supply companies at Ernakulam, Salem, Vellore, Vizag, etc. He also worked for some time at HAL, Bangalore.

This is all about my father and his brothers. As far as I am concerned, I joined the Institute after my M.Sc. degree in physics from Lucknow University in1955. After passing out in1958, I joined the General Electric Company at Kanpur and later worked with BSES and Easun groups.

I was associated with design and development of vacuum circuit breakers and type testing at CPRI. I presented a number of papers at various seminars. I was a member of the Institution of Engineers (India). After retirement, I did some consultancy work in the field of energy management.

American companies perceive IIScians and IITians as the best employees

Parvathy K. Hadley
B.E., ECE 1969–1972. Endress+Hauser
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I currently work for a German company, Endress+Hauser, in Process Automation. I am doing Signal Processing for radar in the millimeter wavelength range, used for very precise level sensing.

Prior to this I worked for Delco Electronics (a subsidy of General Motors) which became Delphi Automotive Systems. I worked as the speech technologist, for putting Speech Recognition and Text-to-Speech in many languages into hands-free phones, navigation and entertainment systems in cars. These products went into vehicles made by Honda, Toyota, Opel, Saab and several GM lines.

Before that I worked in numerical controls/machine tools, designing multi-axis controls and desktop CAD systems. Some of these products are at Larsen & Toubro in Bangalore and other cities in India, the Integral Coach factory, Kirloskar, and other Indian companies.

When I recall my Indian education, it is difficult to separate my studies at Kerala University and IISc. Overall both focused on a very strong mathematics background, and that has always given me a competitive edge over people who received their basic education in the USA.

How Kerala improved its science program?

In the early 1960s, Kerala was not seen as being strong in science. Thus, when we came along, Kerala University launched a new effort to cut 'school' from 11–10 years and replace a 1-year Pre-University course with a 2-year Pre-Degree program that allowed us to select groups of three majors. I was in Math-Physics-Chemistry. This was followed by a "Special B.Sc" (similar to Honors) program where we were taught M.Sc. topics. This put Kerala graduates ahead of others even when we came to take the IISc entrance test.

Then at IISc we had to do engineering drafting and mechanical labs, which was another valuable experience. IISc was then weak in hardware, and our labs did not have the latest equipment. But that gave us time to focus on strong communication theory. Thus when I became 'speech technologist', I was able to quickly catch onto very difficult topics. And now when I joined a radar group, I could easily make that transition. Once I arrived in the USA, I focused on taking as many hardware courses as possible. The various CNC machines I mentioned above are working on hardware that I designed.

Cyber coolies—May be

The biggest achievement of my generation has been to gain respect for India and the Indian education. At my first job I was the first woman engineer, and the Americans around me had all sorts of doubts. But soon I became the fastest-promoted person there, and was written up as "most valuable employee". This was not just me, other Indians from IISc and IITs were perceived as the best employees at many American companies. By the 80s, companies were already planning to move software operations to India.

Unfortunately, some Indian software companies have chosen to 'get rich quick' by cashing in on this bonanza and staying as contractors of cheap labor. During the 25-30

years that Microsoft has been around, they have taken over PC software and the vast majority of offices around the world use Microsoft products. Do you see a single original product coming from Infosys/Wipro/Tata Consultancy? In the 90s when American managers referred to India as a "low-cost site", we protested, we now agree with them. These companies provide very unchallenging jobs, and young people jump around from company to company. I myself have given nice speech projects to Delphi's division in India, and found that the engineers there consider hard work to be beneath them—they think that "C programming" is some kind of elite skill. This is sad.

Ratna Devanathan—people listened to her respectfully

When I was new at IISc, several students in the Ladies' Hostel told me that Ratna Devanathan was a brilliant teacher, and I must not miss out on taking one of her classes. I had no idea who Ratna was. Around the same time I used to see a terribly crippled polio victim limping along past our hostel. Her one leg was much shorter than the other, and her face too was shrunk on one cheek. Then one day I came to the hostel, and this cripple was sitting in the common room talking authoritatively, and several M.E. students were standing, listening respectfully. It then hit me that this was the famous Ratna. Yet not one student had referred to her disability. To people who knew Ratna academically, she was 8 feet tall.

This was a deeply impressive lesson for me; there are many diversity education programs in the USA, but none came close to this.

IISc needs a Technology Incubator program

IISc today has the ability to produce world-class engineers. They need to stay there and achieve higher skills. An important thing for IISc to do would be to team up with a **"technology incubator"** program.

Here in Indiana there used to be a big brain-drain problem—students would graduate from Purdue or Rose Hulman Institute and head to California or Texas. So this state came up with three such incubator programs. You can Google "BioCrossroads" to see what I am talking about. Thus if a scientist from IU or Purdue (or other) do promising research or development, but don't know how to turn that into a marketable product, these Technology Incubators will help them get a cheap lab space, marketing guidance and startup capital, in return for promising to stay in Indiana for three years. Such companies have a successful launch rate well above 90%.

If you do this, smart IISc grads will become producers of original ideas and products, and they will not rush out to be cheap labor at software companies.

Association with Institute has been very fruitful and rewarding

Prof. K.C. Patil

Department of Inorganic and Physical Chemistry (1972–2002)

CSIR Pool Officer, UGC Research Associate, Scientific Officer, Asst. Professor and Professor and Emeritus Scientist (CSIR), Professor-Emeritus, Consultant and Advisory Professor, Nanjing University of Science and Technology, Nanjing, China (2002–current)

Teaching: Inorganic Solid State Chemistry, Explosives, Coordination Chemistry, Nanochemistry and Laboratory courses for integrated PhD.

Research: Broad areas of research have been:

(i) High-energy materials based on metal-hydrazine derivatives;

(ii) Combustion synthesis of advanced ceramics: Alumina to Zirconia;

(iii) Synthesis of nanocrystalline oxide materials by controlled combustion of aqueous solution containing redox mixtures and combustible redox compounds.

(iv) Nanocatalysts, M/oxide and metal ion-substituted ceria and titania.

The research work carried out in these areas has resulted in the publication of nearly 200 papers, 25 Ph.Ds and one D.Sc. theses. We have just now completed writing a book titled "Chemistry of nanocrystalline oxide materials: Combustion synthesis, properties and applications". It will be published by World Scientific, Singapore. Our work has been recognized worldwide as seen by the awards received and DSc degree of the Indian Institute of Science.

Awards:

- Netzsch–ITAS award (1989),
- MRSI medal (1993),
- Diploma (Scientific Center of Russian Academy of Sciences in Chernogolovka and International Association "Self-propagating High-temperature synthesis" (SHS-AS) award with jubilee medal for contribution to R & D in SHS (2007).

Reflections: Looking back, my association with the Institute since 1972 has been very fruitful and rewarding. The atmosphere in the Department and the Institute has been very ideal for carrying out original and creative research. In recent times although the Institute has grown in terms of faculties and students the ambience is still very good and encouraging for carrying out research. Internet facility and broadband connection have enabled every individual to be in contact with the scientists around the world and keep abreast with latest developments. I have personally benefited by having the Institute e-mail id since I am getting invitations to participate in international conferences in China, Singapore and Russia even after my retirement.

Relevance of study: Today, nanoscience and nanotechnology has emerged as a frontier area of research all over the world. In this context, the pioneering work of our group at the Institute has become very promising. Our work in the field of nanocrystalline oxides, magnetics, dielectrics, pigments, phoshors and nanocatalysts has resulted in couple of patents and several industrially useful products. Patents on nanocatalysts for H_2-O_2

recombination, three-way catalytic convertor for auto exhaust and defluoridation of borewell water are available for commercial application.

Vision for 2020: There is a great future in nanoscience and nanotechnlogy as it is still virgin area. The nano initiative research programme of the Institute can be a launchpad for converting the nanoscience developed at IPC. The importance of this work can be seen by the number of citations in the literature (H index 27).

The disappearance of post-B.Sc. students made the Institute lose much of its throb and warmth

Prof. D.P. Sen Gupta
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I joined the Department of Electrical Engineering of the Indian Institute of Science in the year 1970, previously having served as a lecturer at the University of Liverpool for about 5 years. When I went to see Professor Craggs, the then Chairman of Electrical Engineering in Liverpool to tell him that I wanted to join the Indian Institute of Science and would like to resign from my job, he advised me to go on a year's leave, find out how I liked my new job at Bangalore and send my resignation from there if I felt happy or come back to my job at Liverpool if I did not. "Sir, I have been very happy here and I know my first year in a new environment is likely to be difficult and I may catch the first flight back if I leave any tags behind." I told him.

Professor Craggs smiled. "Well, I shall accept your resignation but most reluctantly I must say. Do remember you are welcome back if you do not like it there, but it is a very good Institute that you are going to and I wish you all the best." I thanked him for his kindness and after a few months later, on our return to Calcutta, boarded a train to Bangalore along with my wife.

We were robbed of almost all of our money in the train and landed almost penniless in Bangalore. Mr S.S. Prabhu, the registrar, seemed like a fatherly figure and he immediately arranged that I should be given an advance of Rs 300/-. I offered to write a receipt for the advance he had paid me, but he said. " Don't bother. You did not leave your job and come all the way back to run away with three hundred rupees. Go to the Guest House and rest." I was touched by his kindness and also by the kindness from Professor S.K. Chatterjee of the ECE Department who took me round places a couple of days later, in his Standard Herald, trying to find an accommodation for us. For all the years that they were at the Institute, I received nothing but kindness and affection from these two wonderful persons.

Most members in the EE Department were friendly and although I felt unhappy from time to time, I decided to stick on.

The Founder's day on the March 3 used to be celebrated with great pomp. In Tug of war in the morning, the well-fed faculty members always won against the students and the supporting staff. There used to be a lavish dinner in the evening. As the number of members of the Institute grew, these events disappeared.

Apart from the beautiful ambience of the Institute and the general friendliness, what struck me as odd were the rather casual attitude towards teaching, supervision in laboratories and a general absence of concern for extra-curricular activities of the students.

That research can be trying for some students and in the absence of outlets in the form of games and other activities and not so-friendly teacher–student relation in some cases, it may land the more vulnerable ones into disasters, were brought home by occasional suicides in the campus. These incidents, I must confess, I found shattering, and I still do.

Having spent many happy years as a student at Calcutta Presidency College , IIT, Kharagpur, and later in the University of Liverpool, as a research student, I fail to

comprehend to what misery a student must be driven to take his or her own life. Don't we have a responsibility to help them out of their crises?

The abolition of the Integrated M.E. programme in the Engineering Departments clearly reflected apathy towards teaching. Even when the three-year B.E. later changed to the four-year M.E. programme, not many senior professors ever bothered to teach the first-year students. Some of them taught only 300-level courses. In England, the practice is just the opposite. Only professors can teach first-year students and the junior faculty members teach the senior students. The reason is obvious.

With the abolition of the integrated M.E. programme at the Institute, the number of 'young' students in the Engineering faculty has steeply come down. As Jerome K. Jerome remarked, "A house isn't a home without the patter of little feet", the disappearance of post-B.Sc students who used to run down the stairs of their Departments anxious to go to the next class or play in the Gymkhana or crowd music programmes or plan the "Vibrations", has, to me, made the Institute lose much of its throb and warmth.

Looking back, the most rewarding of my modest activities were my involvement with students and my efforts to help the cultural ambience at the Institute. Almost all the Directors offered their support but I would particularly acknowledge Professor C.N.R. Rao's unstinted help.

Courses very beneficial with excellent teachers

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The courses offered were very beneficial with excellent teachers and practical training. The research training was extremely useful for my professional career.

Highly challenging and interesting research and development work in employment in the area of microwave technology, satellite technology and satellite communication.

Interaction: I have been examiner for several MTech and PhD thesis submitted by IISc students and also a Member of the Space Technology Cell.

Vision for 2020: IISc should become one of the highest seats of learning and research in engineering science and also should take up state-of-art technology development and consultancy.

IISc taught us to be humble

Dr C.V. Manjunath
Managing Director, Bruker India Scientific Pvt.Ltd

My memories of the Indian Institute of Science, Bangalore, go back to my school days. I used to visit a few relatives of ours, who were faculty in IISc, along with my maternal grandparents and parents. Although for a young boy, the campus used to look larger than the schools we were used to, IISc was still not as 'developed' as it is today. There was a lot of greenery and monkeys were to be seen everywhere. When we moved into our new house in Sadashivnagar, which was then almost next door to IISc campus, our visits to the campus became more frequent. In 1966, I and my brother even used to cut across the IISc to catch the route 11 bus from Malleswaram 18th cross to National College in Basavanagudi for our PUC classes. Security checks were non-existent those days and the only Depts I remember passing-by were the Internal Combustion Engg and the High Voltage Depts. The campus in that area was full of trees and we used to pluck mangoes unhindered. We also used to hear the thunder-like sounds emanating from the corona discharge type expts in the high voltage dept.

Between 1966 and 1972, our visits to IISc were less frequent since I and my brother joined Central College to study B.Sc. (Hons) and M.Sc.(Physics). My younger brother C.V.

Natraj was doing the same degree but in Chemistry. We still did maintain our contact with IISc but in a different capacity. The Gymkhana of IISc was a nice place to play cricket and we played a few KSCA cricket league matches there. We even played a cricket match against IISc students in late 1960s on a cricket ground which existed in the present-day Applied Mathematics Dept (opposite to Aeronautics Dept which was our 'pavilion').

During our M.Sc. days, our teachers used to speak highly of the work going on in the Physics Dept at IISc and once we even had the good fortune of listening to Prof. Raman in Central College—a few years before he passed away. When I obtained second rank in M.Sc., I thought I may be good enough to pursue a Ph.D. degree in IISc. The other incentive was the proximity of our house to IISc and my parents wished that we should walk across and get a Ph.D. each. My parents also used to cite the achievements of our close relatives such as Prof. H.N. Ramachandra Rao, Prof. Rajeshwari Chatterjee and her husband Prof. Chatterjee who were already senior faculty in IISc. More importantly, and quite naively, I felt that working in the same Dept as Prof Raman did many years ago, I may also be bestowed with similar fame. Due to this attitude, a few of my friends used to call me Sir CV since I had the same initials. So, immediately after getting my M.Sc. degree in 1972, I applied for Ph.D. and M.Tech. courses to make sure that I would get selected in one capacity or the other. Preliminary selection in IISc during those days was by consideration of the ranking in M.Sc. and hence I got a call. My younger brother also applied for Ph.D. in Chemistry and he too got selected.

Selection for Ph.D. in IISc was possibly not as tough as it is today. There was a written test in the morning and an interview in the afternoon. We were then handpicked by our guides. I was directed to do research work in Electron Paramagnetic Resonance which is a branch similar to NMR/MRI. My guide was Prof. R. Srinivasan.

I had a few friends from my college days who were doing their M.Tech. I felt at home since a large number of my brother's classmates in Central College joined the Organic Chemistry Dept which was then newly built. We continued playing cricket (Physics vs

Chemistry). The first year of Ph.D. course was fun-filled since there was virtually no lab work (but only course work).

We were offered a monthly scholarship of Rs 250/= with the fees being Rs 25/= if I remember correctly. We were proud to open bank accounts on the campus. Canara Bank had just then opened in a small room near the present-day Coffee house and SBI used to operate with one person manning a small cubicle near the Director's office.

At that time, IISc was one of the very few institutions in India which used to encourage students to attend symposia and present papers with nearly all expenses paid. We used to make yearly visits to the famous DAE symposia every December held in metropolitan cities in India. Our Professors used to travel along with us in the train .The first-ever symposium I attended was in 1972-73, which was a visit to TIFR, Mumbai, for the International Symposium in Magnetic Resonance. As freshers, we were taken aback by the amount of work going on in this area and the paper which caught our attentions was by Prof. Lauterbur on Zeugmatography (MRI) which happened to be the first-ever paper on the subject. He then went on to get a Nobel Prize for his original work on MRI and I would have not had the privilege of listening to him if I had not joined IISc.

In the second year, we started our lab work seriously. I had a background in electronics and hence had to construct an EPR spectrometer to start with. The main advantage of IISc, as compared to lesser-known institutions in India, was that the Professors of IISc were of high caliber and used to get invitations to work in well-known labs abroad. Prof. Srinivasan also used to make a yearly visit for a few months to UBC, Vancouver, and hence had access to circuits needed for developing electronics in my field. Electromagnets weighing more than a ton had to be fabricated in the workshop. Unlike other Institutes, emphasis in our Dept was to be self-reliant and to build our own instruments. The workshop was fully equipped and even some of us, who were science graduates, were taught to operate lathes. This experience has stood us in good stead later in life. The other reason for in-house instrumentation was the lack of commercial instruments and even if present, they were too expensive and difficult to import with the various restrictions in place. Although I am not clear about the exact quantum each Professor was allocated for instrumentation, I presume it was not more than a few tens of thousand rupees. Therefore, many of the electronic items, aluminium sheets for consoles and iron, copper materials for electromagnets were obtained from a well-equipped Dept stores. I feel sorry that this atmosphere of stores, workshops and in-house instrumentation is on the wane in IISc due to the influx of commercial instruments.

Instrumentation used to be hard work and in the process one can lose touch with the core subject of Physics. But then, this never happened due to the enlightened Professors in our Dept who used to organize lectures and further group discussions were encouraged amongst our group of students under Prof. Srinivasan. I still used to take-off on Sundays for league cricket matches much to the chagrin of my guide. He was a tough task master who felt I had wasted a Sunday. He even used to work with us till at least 8 p.m. and sometimes used to drop me home since, unfortunately, he lived very close to our house in Sadashivnagar. The next morning at 8 a.m., he used to enquire what I achieved in the preceding 12 hours!! Fortunately, there was some relief for me, since his attention used get diverted to guide other students under his command, working in varied fields such as high-pressure NMR, wideline NMR, etc. Talking of colleagues, I had friends who were talented in other fields too. Ramani (Karnatic classical), Ramanathan on Mrudanga, Vikram Dhar (literature) to name a few. Our guide was not too keen that his student should spend time

on literature. As a result, Vikram Dhar was forced to write excellent articles in the monthly IISc magazine under a different name of 'Mavrik Hard'. Although our Professor appreciated the articles very much, Dhar was lucky enough that he was not scanned by the Professor's radar. Some of us who were talented were picked to showcase our talent in the Dept club called pi-delta-alpha. I had a senior (who co-guided me in EPR) and was related to Prof. Raman. As a result, Lady Raman used to visit our lab and chat with her. We were very particular that we clean up the lab on that day, keep chairs handy and make Lady Raman's visit as comfortable as possible.

Instrumentation can also be of some advantage as far as young students are concerned. We were often sent on errands to buy some exotic electronic items (notably IC chips which were then introduced in Bangalore markets by BEL) on SJP Road. We used to take off, on the sly, for a matinee. One of the other events which I cannot forget is my inability to see the first cricket match in the new KSCA stadium in 1974, India vs WI, due to pressure of work and my guide's reluctance to permit me. The only redeeming feature was that the test match was watched in bits and pieces on CCTV which was put up in the Gymkhana and possibly for the first time in Bangalore.

Obtaining the first EPR signal was a cause for celebration and was also a proud moment as a builder. Photographs of the machine were taken and filed. Any small success entailed group dinners in choice hotels in Bangalore along with the Professor and family. In 70s, there was only one restaurant in IISc and was run by the Airlines Hotel group. Since there was no decent hotel in Yeshwantapur area, and there was no security checks at the gate, IISc restaurant used to be a haven for outsiders and also for the famous 'coffee breaks' for IISc faculty during working hours and for group lunches/dinners.

IISc also was very generous in helping universities and I remember students coming from universities in Bangalore, Madras, Trichy, etc. working along side us on our instruments and we also used to help them run their samples on the machines we built. I had to spend more time on an advanced technique called ENDOR which was possibly attempted in a couple of institutes abroad. Unfortunately, due to lack of stability in the magnetic field and the rf electronics, and also the absence of temperatures lower than 77K (we had a liq. Nitrogen plant in IISc but not liq. helium) I did not succeed. I had to satisfy myself by doing phase transition work in EPR but the next student did achieve success in ENDOR.

Ph.D. in IISc was also eventful with regular interaction with snakes, sweaty summers (we had a 'zinc sheet roof' lab), leaky rainy seasons (due to old tiled roofs), routine theft of cycle dynamos in the parking area, etc. When I joined as a student, I was amused by the presence of a US Army truck in front of our lab and in the middle of the quadrangle. The story goes that it was from the Second World War. Its big tyres were removed and stored inside the truck and the chassis was mounted on stones instead. This was possibly done so that the truck is not stolen! During our research work, we used to pull up the metal shutter of the truck and jump inside to ransack the insides looking for variable air capacitors, potentiometers and much more. The truck was a treasure house for rugged telecommunication items of war vintage.

Once, due to a short circuit created by an IISc electrician in the generator I used for my expts, my eyesight was nearly blanked out for a week. I was treated by the then newly appointed Dr. Prasad at the IISc clinic and even today he continues to be my tennis partner. Needless to mention the bonds (both chemical and physical) in IISc are very strong.

In mid-70s when my instrumentation phase was complete and spectral interpretation took over, we were excited to use the IBM360/44 computer in the Instrumentation facility. Stacks of cards used to be printed and submitted only to find by evening, when the computer output worth kilograms of paper was handed out, that the whole exercise was futile since a comma was missing in the program!!

These impediments used to prolong our Ph.D. career and anyone submitting within about 4 years was considered either lucky or a genius. My brother C.V. Natraj belonged to this category. He joined IISc (along with me in 1972) as a student of Prof. P.K. Bhattacharya in the Organic Chemistry Dept and submitted his Ph.D. in a near-record three years and at the young age of 23 years. He also was not as 'silent' a student as I was and he had a Yezdi motorbike (donated by our elder brother) which was made deliberately noisy by my brother much to the annoyance of many professors in his lab. In 1975-76, he went off to Univ of Cardiff for post-doctoral work. His success put enormous pressure on me and also on my guide but then intermittent failure of in-house electronics and coupled with a minor scooter accident put the brakes on an early submission. Prof. Srinivasan was not amused by this setback and used to chide me for the scooter 'circus'. I finally submitted in 1978 after working for 6 years. There was one good draughtsman in IISc who used to blueprint our drawings, and one good typist in our Dept for typing and cyclostyling our thesis in the evenings. These personnel used to be busy throughout the year and hence our speed of thesis submission would depend on how well we 'pleaded' with them.

Once the degree was awarded, there was no elaborate convocation but a simple collection of the certificate from a clerk in the main building. The highpoint of the award of degree was a mention in the local newspaper with the name and the Dept. In every quarter of a year, there were only about half a dozen Ph.D. awards and many of them were from the engineering faculty. In 70s, activity of engineering Depts was highly visible but then from 80s onwards, IISc has come to be recognized as a centre for excellence in science and as Alumni we are proud that IISc is ranked one among the top 20 research institutions worldwide.

Since commercial EPR instruments were still difficult to get in late 70s, I was employed in a project to build an EPR spectrometer for IPC Dept. This was successfully completed and handed over and the project was terminated.

I then had to look for a job seriously. My colleagues took up jobs in national laboratories and a few in IISc itself but there were very few openings for EPR experts. IISc mostly recruited young faculty from all over the world who had worked with distinction in their respective field. One such was Prof. Anil Kumar who joined our lab. A product of IIT Kanpur, he worked for his Post-Doctoral work in ETH Zurich with scientists like Ernst and Wuthrich, both of whom went on to get Nobel Prizes, and a large part of the credit should also go to Prof. Kumar who co-authored papers on 2D NMR, Fourier Imaging, etc. His return to India necessitated procurement of a state-of-art high-field supercon NMR. IISc, against many odds of import, funds, etc, still managed to buy an NMR at 270 MHz from BRUKER/ SPECTROSPIN in 1977. The magnet needed weekly fill of liquid helium and around that time the Cryogenics Dept of IISc also got a liquid helium plant. My guide Prof. Srinivasan was in-charge of the cryogenic facility and IISc had the credit of running this plant non-stop for the first time in India. I also vividly remember the problems involved in charging the superconducting magnet to field and the 'quenches' that took place resulting in a cloud of helium gas collecting in the roof. IISc thus heralded the beginning of high-field NMR culture in India.

Maintenance and sale of such NMR systems in India needed someone who knows the subject and I was recruited by the company Spectrospin/Bruker. I was possibly one of the first few students who dared to join a private company. (I continue to serve the company even today.) At this juncture, my tenure in IISc ended but then I still maintain regular contacts with various Depts in IISc as the nature of my job demands. IISc has grown both in size and stature. I am yet to meet a student of IISc who has not succeeded in life and work.

IISc taught us to be humble students and this has guided us in life with our feet firmly on ground. It is very satisfying to note that when we mention that we are a product of IISc, our standing in society goes up a few notches. True to its age, IISc campus and faculty still maintain an old-generation-simplicity which is unmatched in other institutions of learning in India.

We all foresee a very bright future for IISc and wish that it will become one of the top-most research institutions in the world. It was necessary to spread the culture of IISc to other parts of India and this has already happened with the opening of IISER in Pune, Chandigarh, Kolkata, etc which are modeled along the lines of IISc.

(Abbreviations: NMR=Nuclear Magnetic Resonance; EPR=Electron Paramagnetic Resonance; ENDOR=Electron Nuclear Double Resonance; 2D NMR= 2 Dimensional NMR; MRI=Magnetic Resonance Imaging)

Avoid undergraduate programmes

Dr R. A. Rao (Rayavarapu Adinarayana Rao)

M.Sc. (Engg), Department of Internal Combustion Engineering during 1958–61, Indian Institute of Petroleum (CSIR), 1961–69; (b) Lubrizol India Ltd. (PSU) Ministry of Petroleum, 1970–89; (c) Indian Additives Ltd. (PSU), Ministry of Petroleum, 1989–95.

Retired from service in 1995, but remain a consultant to oil industry. Also serve as Chairman, Petroleum Divisional Council of Bureau of Indian Standards and its various technical committees; also actively involved with several NGOs working for the rehabilitation of disabled children and empowerment of women and other weaker sections particularly in rural areas

Reflections on Study: During the course

i) Learnt real engineering through the course lectures/ME level, prior to taking up project work

ii) Had to build the experimental setup from scratch (literally) on account of limited local availability of equipment and imports taking over 2 years of time

iii) Worked 16-18 hours a day for early completion of project (even then it took over 2 years)

Post-course employment/research

i) Found immediate relevance of work started at IISc, that enabled me to set up the country's first full-fledged engine-testing laboratory at IIP, Dehradun for performance evaluation of automotive fuels and lubricants, and also for subsequent R&D work in the same area.

Relevance of study: It enabled me taking prime lead in formulating national standards for petroleum products and related R&D work, initially as a member and subsequently as Chairman of the various committees under the Bureau of Indian Standards. Later on, I could also represent India on Petroleum committees of the International Standards Organization.

Interaction with IISc: (a) Surprisingly, very limited interaction; (b) Eventually, the Department of IC Engineering was itself wound up and was merged with Dept of Mechanical Engineering.

Experience: (a) One classmate being forced to quit the course as he failed in just one subject at the end of the mandatory course programme without the benefit of a second chance. It was a very painful episode. (b) A great 'weekend' in those days merely meant going to India Coffee House on MG Road, and taking a vegetable cutlet and coffee!

Vision for 2020: (a) A world-class teaching-cum-research institution drawing on the rich talent of competing students and faculty from all over the world; (b) Housing pools of 'think-tanks' inter-disciplinary in character which can aid/assist in framing, implementation and monitoring of policies and programmes of corporates and government entities.

Suggestions: Avoid having its own undergraduate programmes, but there is a need for its own entry-qualifying course of say one-year duration for its research degree programmes instead of merely depending on GATE or its own entrance tests.

Acknowledgment: (a) Having entered IISc in its 50th year (1958–59) for my M.Sc. (Engg) degree, it is a nice feeling to be around for its centenary celebrations in 2008-2009. (b) A still nicer feeling is to find my son, Dr R. V. Ravikrishna, as Associate Professor in the same discipline at IISc from which I graduated.

Some memories of my time at the Institute

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When I look back on my 60 years of my life, there are very few dates that I remember. The year I got married, the years I had my two children, my parents' demise, these have been some important events in my life. However, 1976 remains in my memory firmly because it was the year that I joined the IISc (which I will refer to as "the Institute" as most of us do).

On a morning in early Jan of 1976, I received an envelope with an application form for the position of draughtsman at the Institute. (The application form was given on request). I did not know who had taken the trouble to send me that application by mail. I filled up the form and sent it over to the Institute. A week later, I received an intimation letter, asking me to appear for a personal interview in the Civil Engineering Department of the Institute. I went to the Department before 8:00 a.m. and inquired at the office about the interview, but they had no information about it. Assuming that I was about to join there as an employee, the people in the office, asked me for my appointment order. After they realized that I was a candidate for a position and was attending an interview, they wished me the best at the interview. I was, however, the only candidate there. I was asked to wait for the Chairman to return after he finished his class. At about 9:30 a.m., the chairman of the department Prof. B.V Ranganatham entered the office after his class and apologized for making me wait and offered me coffee and biscuits. He also told me that I would be taking a drawing test between 10:30 and 11:30 a.m. and Prof. Keshava Murthy would administer the test.

Prof. Keshava Murthy pointed me to an enormous drawing table, which initially scared me, and asked me to get started on a drawing he had composed for me. After I finished the drawing, four professors, Prof. B.V. Ranganatham, Prof. Keshava Murthy, Prof. R. Narayan Iyengar and Prof. K.T.S. Iyengar, asked me questions about the drawing for almost an hour. They asked me to come back to the office after lunch. When I returned form lunch they informed me that I had cleared the drawing test, and asked me to go to the Central Office for another round of interviews at 3:30 p.m. At the central office, two elderly professors who were seated behind a large round wooden table pointed me to a blackboard and asked me questions on some simple concepts in engineering drawing, and asked me to write down my answers on the black board. I can vividly recollect that the professors had a very calm demeanor, a simple questioning style and a clear slow talk, which put me at ease at once. It surprises me to this day about the enthusiasm all of these senior professors showed to interview a single candidate, that too for a supporting staff position. After deliberating for about half an hour, they informed me that I was selected for employment at the Institute. Two days later, I received my appointment order; I joined the Institute on 23rd Jan 1976, a career that lasted 28 years. When I joined the Institute there were about 20–25 draughtsmen in various departments. I was however, the only "draughtswoman". I was also the only woman staff member in the Civil Engineering Department then. There were three women students who became my friends instantly, and who are in high position today, all to this day remain very close friends.

My work included drawing figures for the manuscripts, reports and thesis that the faculty and students of the Civil Engineering Dept produced. The students also provided me with the figures that they drew on graph sheets and which I had to draw on tracing paper with Indian ink such that they could be printed or copied. Even though it was a part of my duty to produce good figures for the students for their thesis, the students always included me in the acknowledgement sections of their thesis and always made it a point to come and show me their completed thesis personally. In spite of working so hard on their research, the students told me how my drawing a few figures helped them immensely. I always felt so honored to be present among these incredibly humble students and faculty. I met Prof Rajeshwari Chatterjee in my department (after her retirement). I did drawings for her four textbooks.

One year after I joined the Institute I got married, and subsequently had two children. I always made it a point to bring my children to the Institute during their school vacation days. Nobody objected to this at the Institute. The Institute also started providing some summer short courses for children. I have always been very attracted by the humility of the professors and students, the intelligence and their dedication to their subject. I realized the importance of education, research and science, and the honor and reverence that comes with it. I also always pointed to my children about the importance of a scientist and researcher. I also always dreamt that my children should also become doctoral degree holders and work at the Institute.

Several years rolled by and I got to meet many students, many of whom became faculty at the Institute. Slowly, personal computers became more accessible at the Institute and students started using them to produce figures on their own. The work of a draughtsman reduced drastically, eventually the faculty also started to use computers to produce their own figures. We did not have any work then. By this time the number of draughtsman at the Institute had dwindled down substantially. Even though we were encouraged to learn computer programs like CAD, there was not much avail to this. I took retirement from the Institute in 2003. I look back on those wonderful times I had, on the beautiful campus that I called my home for so many years. It brings me great joy to this day to tell people that I worked at the Institute.

One hundred years of IISc Library

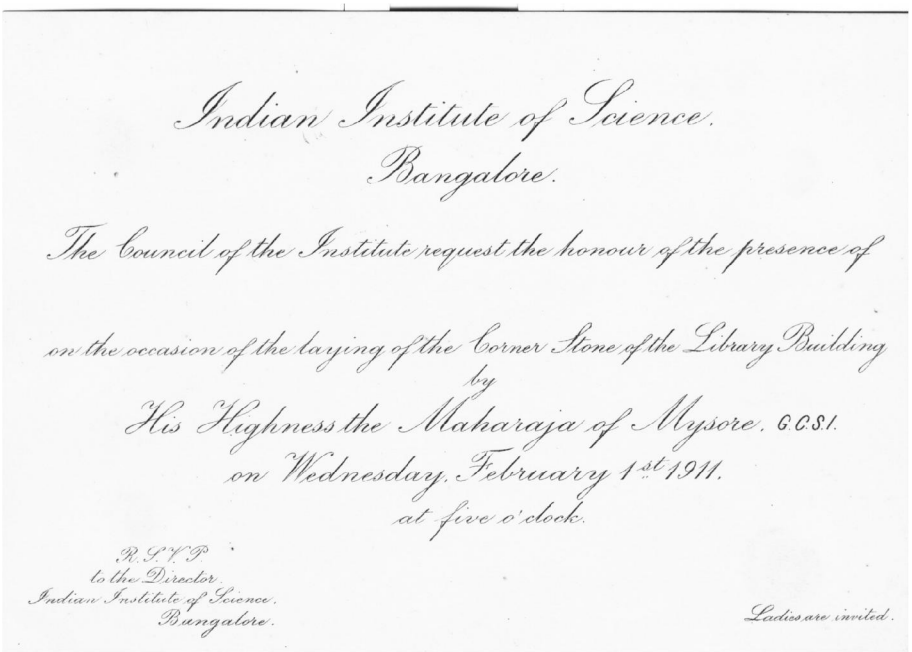
Dr Uma Jagannath*
Formerly Deputy Librarian (1966–2007)

Libraries and information centres are essential components of education, research and development. The quality of education and research not only depends on resources like laboratory, building, technology, etc. but also on the availability and use of information. Hence, library and information centres are the vital components of academic activities and play a vital role in supporting the objectives of the parent organization through provision of information services and other facilities.

The Indian Institute of Science Library functions as the hub of information transfer among its faculty, research scholars and students. It has grown in size and services in consonance with the growth of the Institute itself. The Institute being an academic in character offers courses at an advanced level and promotes developmental, applied and fundamental research in a variety of disciplines.

Establishment

The library was established in 1911. It was one of the first three departments started at the Institute. The foundation stone of the library building was laid by His Highness The Maharaja of Mysore Krishnaraja Wodeyar IV, on February 1, 1911 at 5 p.m..



Indian Institute of Science.
Bangalore.

The Council of the Institute request the honour of the presence of

on the occasion of the laying of the Corner Stone of the Library Building
by
His Highness the Maharaja of Mysore, G.C.S.I.
on Wednesday, February 1st 1911.
at five o'clock.

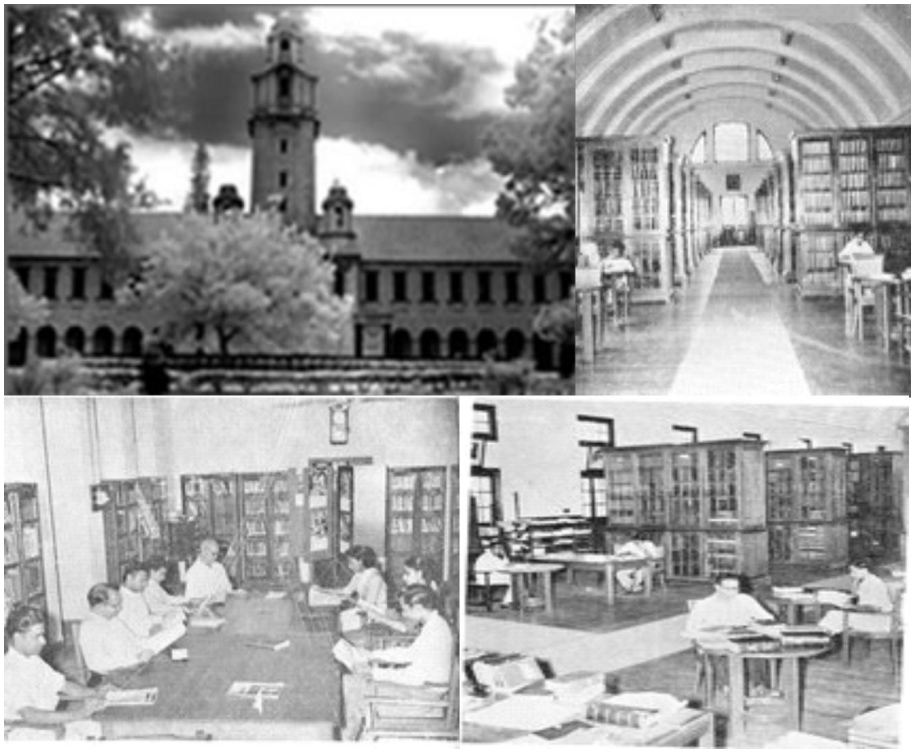
R.S.V.P.
to the Director,
Indian Institute of Science,
Bangalore.

Ladies are invited.

Invitation card of the library foundation stone ceremony.

Library building under construction.

Speaking on the occasion the then director of the Institute Morris W Travers said: “As the library is the centre of the academic organization so is the library building, the central feature of the building scheme. A library is an asset of ever-increasing value and it is due to it that it should be housed in a building of handsome appearance and permanent construction. The perspective of the building forms the frontispiece of the pamphlet and a model of this is also in view at the side of the pandal. You will agree that Messers Stevens and Company, our architects, have produced a design worthy of the purpose for which building is intended.”



Golden Jubilee Library building.

The complete first floor of the building was earmarked for the library.

Library functioned in the first floor of the tower building from 1922 to 1965.

Until the completion of the Central Building in 1922 the library was accommodated in the south wing of the Electrical Technology laboratory, now the Department of Physics.

Since 1965 the library is functioning in this building.

Electrical Technology Laboratory, now the Department of Physics.

The Library functioned in the eastern half of this building from 1911 to 1922.

The students of the Institute were allowed to use the library without any permission. But others had to apply for permission in writing to the Director.

To commemorate the Golden Jubilee Year the present building was constructed. The then President of India, Dr Sarvepalli Radhakrishnan, laid the foundation stone in 1961

The library is housed in a 50,000-sq.ft. four-storied building having facilities and aesthetic environment for serious study. It was built out of the grants provided by the University Grants Commission (UGC) in commemoration of the Golden Jubilee celebrations of the Institute. In 1994, the library was named as "J.R.D. Tata Memorial Library", after Jehangir Ratanji Dadabhoy Tata, the president of the court of the Institute from 1954 to 1994. The primary mission of the library is to support the educational and research programmes of the Institute by providing physical and intellectual access to information consistent with the present and anticipated educational and research activities of the Institute.

Librarians since inception

1911–1924: C. F. H. Tacchella
1925–1940: K. Amrita Rao
1940–1950: G.T. Kale
1951–1968: B.V. Raghavendra Rao
1969–1988: T.K.S. Iyengar
1989–1999: N.M. Malwad
2003–to date: S.Venkadesan

Objectives

The primary objective of the library is to support and promote the objectives of the parent organisation. Thus, the objectives of the library include-

- to develop a comprehensive need -based collection of documents for use by users of different categories.
- to classify and organise the collections using modern methods and techniques.
- to provide access to information resources.
- to examine the information needs of users.
- to provide information services to meet the requirements of users.
- to extend library and information services to all academic, R&D and other industrial organisations in the country.
- to modernise the library and information services using the latest information technology for better use.

Collection

The Library became operational in 1911 with a collection of 6055, classified as under:

Journals, Reports, etc.— 4,503 volumes

Textbooks, Dictionaries and works of reference—1,055 -

Indian publications (bound)—497

The collection has grown steadily over the years and thus the present strength has risen to 5+ lakh volumes. The collection includes books, journals, reports, patents, standards, microforms, CD-ROMs and Institute theses.

Over the past ten decades, the growth and development of the library has kept pace with expanding aims and activities of the parent institute in the field of science and technology.

The library has provided outstanding assistance to pursue research work in all the departments and sections and has played a key role in the achievements of the Institute in important investigations by subscribing/acquiring journals, books and other documents on those subject areas from time to time.

The basic plan in collection development emerged from a series of decisions made jointly by library executives, the library committee and active participation of academic departments. The decision to concentrate on improvement of the working collections recognized indirectly the areas of specialization which might be developed in depth at IISc from time to time.

To achieve the above goal, the library was supported with continuous and consistent financial assistance from the management of the Institute by sanctioning adequate budget to meet the library's acquisition programmes.

In accordance with the objectives of the Institute, the library acquires, organises and provides access to library resources required for teaching and research activities of the Institute.

The details of library collections are as follows-

	Types of documents	Number
1.	Books	1,96,000
2.	Current periodicals	1,736
3.	Bound volumes of periodicals	1,98,000
4.	Theses	6,000
5.	Standards	35,000
6.	Technical reports	86,900
7.	Patents	50,000
8.	CD-ROM	600

Organisation of the collection

The organisation of library collection on scientific lines provides better use of library collections and is a unique activity of librarianship. Realising this, the collection of J.R.D. Tata Memorial Library is organised.

The books are classified according to Dewey Decimal Classification (DDC) and catalogued according to Anglo American Cataloguing Rules (AACR 2) with local variations. Sufficient number of index entries is made to provide access to contents of the documents. The documents are also arranged with proper guide boards.

The periodical publications which are the important resources in library collections are organised through displays and other systems. Reports, standards, theses, patents and other publications too are organised on modern lines to promote wide usage.

The library has a good number of CD-ROM databses at the library's Annexe building.

Books: Books meant for circulation, series publications (Advances and Progress Series) are housed in the Ground Floor stack area; reference books like encyclopaedia,, handbooks and directories are arranged in Tier-2.

Periodicals: Periodicals are arranged according to alphabetical order of titles.

Technical reports, standards, patents and theses: These materials are housed in the Library Annexe building, and are available for consultation from 0900 to1700 h on working days..

Technical reports are arranged by report number code, country and organization- wise.

Standards and patents: A complete set of Indian patents and some sets of abridged British, American and DIN (German) standards and patents are filed numerically in the filing cabinets.

Gifts and exchanges: The library receives 85 advanced scientific and technical journals as gift from national and international scientific and technical organizations. These gifts from the above institutes have come a result of the climate created by the management by highlighting the scientific and technical research activities and its achievements which was made known to the rest of the world. Thus the receipt of these journals on exchange and gift basis reflects on the universal acclaim of the Institute.

Library staff

Library staff is an important component for the effective and efficient management of the library. The library collections are spread over different units and to service them it requires the support of well-trained library staff. The library staff of the Institute consists of both professionals and also semi-professionals.

General Information

The library functions from morning 8.00 a.m. to 10.00 p.m. It is kept open on all days in a week except on special occasions such as Republic Day (26th January), Independence Day (15th August), Gandhiji's Birthday (2nd October) and Christmas (25th December)

Information technology and library services

The library has acquired LIBSYS, a library management software package with all the modules for use in different sections of the library. Computers are located at various locations mainly to access the OPAC of the library and internet facilities. Users can also access the online catalogue from their respective departments.

The search can be made by author, title, subject, keyword, Boolean search, etc. Current journals received in the library can also be searched.

Details and assistance to access OPAC can be had from the library homepage (http://www.library.iisc.ernet.in)

Services

Information service is an essential part of any library activity. To support the educational and research activities of the institute, the library offers various kinds of documentation and information services to the users. The types of information services offered by the library are as follows:

1. Reference service: Reference librarians are available in the reading rooms to suggest sources of information and assist in the location of reading materials.

2. Current awareness service: Weekly list of books and journal issues received every week are regularly sent to all the users on the campus through e-mail, and is also available in the library homepage for the benefit of external users.

Latest issues of periodicals are displayed every Thursday in a separate room on the first floor similarly books are displayed every Monday in the ground floor lounge.

3. Inter-library loan service: The library has cooperative arrangement with a number of institutions, libraries and information centres throughout the country. It supplies to the reader the material not available in the library by locating the material through inter-library loans sourced from other libraries.

4. Circulation service: Each member of the library may borrow books and periodicals to read the same outside the library (Faculty can borrow four books/periodicals at a time, and research and course students three books/periodicals at a time). Reservation, renewals and recall facilities are also available.

5. Photocopying/xeroxing service: Xeroxing of materials available in the library is provided on payment basis.

6. Document delivery service: The library provides document delivery service to its users. The requirement of document (or their photocopies) of Indian and foreign origin is generally met through the library collection. Other local libraries are approached if the document is not available in the library. In case a document is not available in any of the libraries in India, it is arranged from National Library of Australia or British Library Lending Division, UK and delivered to the user.

Apart from the above, the library has uniqueness in the following ways:

1. has the largest scientific and technical document collection in the country.
2. serves large pool of scientists and researchers across the country.

3. subscribes to 1534 journals spending over Rs 10+ crores annually.
4. serves over 230 corporate users who are engaged in R& D activities.

Users:

The user community of the library includes faculty, researchers, course students and other administrative staff of the institute.

The library serves a much wider readership than the members of its parent organisation. About 230 industrial concerns in and around Bangalore make use of the library against their corporate membership and about 600–700 students from other academic bodies in India

The usage of library resources is growing significantly during the last several years. The details of users and other features are shown in the following table.

Access to online catalogue 250 per day (approximately)
Circulation (Issues and returns): 700 per day
Number of users : 600 per day "
Number of documents consulted: 5000 per day "
Number of pages xeroxed: 2000 per day "

Researchers and scientists at IISc have the privilege of accessing literature survey through electronic media and also through hard copies. The hard copies (printed copies) are available for intensive study at the library, while electronic material is available for quick literature survey at the National Centre for Science Information (NCSI) which is located on the Institute campus.

The library improved its infrastructure by providing PCs (personal computers) at various points in the library for accessing OPAC. The conventional approach on the library services is replaced by the digital approach. The speed and accuracy of information retrieval system is also planned in the form of setting up of a highly professional and academic digital library.

The library has a very high potential to serve as National Library for Science and Technology, as it has a very vast and diversified collection of books and periodicals in advanced areas of science and technology. Thus, the future vision of the library is to serve the changing diversified information needs of users with the latest tools, techniques, methods, expertise, etc.

Thus, the J.R.D. Tata Memorial Library, popularly known as the Indian Institute of Science Library, is one of the best science and technology libraries in India and has become a precious national resource centre.. The library is spending over Rs 11 crores annually of which subscription towards periodicals alone is about Rs 10 crores which is unparalleled in this part of the globe.

The National Board for Higher Mathematics (NBHM) has recognised this library as Regional Center for Mathematics for the southern region and continues to award a special grant towards subscription to journals in mathematics.

The primary mission of the library is to support the educational and research programmes of the Institute by providing physical and intellectual access to information, consistent with the present and the anticipated educational and research functions of the Institute. In accordance with the objectives of the Institute, the library aims to develop a comprehensive collection of documents useful for the faculty and the research community of the Institute. The secondary mission is to serve as a resource center for the scholars and scientific community of the country. The collection of the library which includes books, journals, reports, standards and patents is regarded one of the richest collections in the

country, in the field of science and technology. This rich and valuable collection built nearly over a century has some of the rare reference materials and several important journals. This vast reservoir of knowledge, on a conservative estimate, is worth over Rs 400 crores. Over 10,000 journals are accessible online with INDEST subscription. The total holdings of the library are about 5 lakhs.

The library offers services such as Reference Services, Referral Service, User Guidance Service, Circulation Service including Inter-Library Loan and Document Delivery Service, Weekly Display of Recent Additions of periodicals and books including E-mail distribution of these lists to users on the mailing list, Bibliographic Service, Xerox Service, etc. Current awareness service is provided comprising regular display of xerox copies of articles published by the Institute faculty and students, in various periodicals that are being received in the library. Under the Corporate Membership Facility (CMF), reference alone facility has been extended to corporate organisations/industries involved in R&D activities. Currently about 200 organisations/ industries are availing this facility.

The JRD Tata Memorial Library Annexe and Digital Library located opposite NCSI was inaugurated on March 12, 1998, by Mr Ratan Tata. Some library collections like technical reports, standards, patents and theses are located in this building.

Nautam Bhagwanlal Bhatt (1909–2005)

Nautam Bhagwanlal Bhatt, recipient of the 'Padmashri' from the President of India in 1969, passed away peacefully at his home in Madison, New Jersey, USA, on 6 July 2005. He was born in Jamnagar, Gujarat, on 10 April 1909. After high school in Bhavnagar and college studies at Samaldas College, Bhavnagar, Bhatt completed his undergraduate education at Gujarat College, Ahmedabad. He then obtained his M.Sc. in physics under the Nobel Laureate, C.V. Raman, at the Indian Institute of Science (IISc), Bangalore. Following a year of teaching at Samaldas College, Bhatt was awarded a fellowship by the Maharaja of Bhavnagar to study at Massachusetts Institute of Technology, where he obtained his Doctorate in Science in 1939, for his research on the application of wave theory to architectural acoustics, under the theoretical physicist, Philip Morse.

Bhatt returned to India after his studies and spent a major part of the 1940s at IISc as a faculty member, and became Professor and first acting head of the newly created Department of Electrical Communications Engineering. In 1949, two years after India's independence, Bhatt joined the Defence Science Organization, where he remained until his retirement. He was one of the pioneers in the initial development of the Defence Science Laboratory in Delhi. From 1953 to 1957, his services were lent to the Council of Scientific and Industrial Research (CSIR), Government of India, to plan and build the Central Electronics Engineering Research Institute (CEERI) in Pilani, Rajasthan. He then returned to Delhi to organize a radar research unit, which evolved into the Defence Research Development Laboratory in Hyderabad, later headed by the present President of India, A.P.J. Abdul Kalam. From 1962 until retirement in 1969, Bhatt established the Solid State Physics Laboratory in Delhi and was its founding Director. His role in founding several institutions at the forefront of scientific research in the decades around India's independence is unique among scientists in India.

Under his leadership and active involvement, the Defence Laboratories undertook several important research projects, including the development of semiconductor-grade silicon, development and fabrication of solar cells, and fabrication of helium neon and semiconductor lasers. Several of his own projects were classified, such as the development and deployment of proximity fuses for the Department of Defence.

Bhatt was a Senior Member of the Institution of Radio Engineers, New York (which later became IEEE); Fellow of the Institute of Physics (UK); Member, Institution of Electrical Engineers (UK); Founder Member and Fellow of the Institution of Telecommunication Engineers, India (later IETE); Life Member of the Acoustical Society of America, and Member of Sigma Xi Science Society (USA).

After retirement, he continued to pursue his passionate interest in science, engineering and acoustics. He spent a year as Scientific Advisor to Alembic Chemical Works in Baroda. In addition, he was a frequent advisor to the Union Public Service Commission of India, was on the advisory board of the Indian Institute of Technology, Madras and served on numerous Science Advisory and Policy Committees for CSIR and Government of India. In 2003, he received the Distinguished Service Honour Award of the IETE, presented by the deputy Prime Minister of India.

Bhatt's other love was Hindustani classical music. He was an accomplished vocalist, who learnt the intricacies of the classical style from the late Ustad Lal Khan. At a benefit concert for India's independence movement, when he was a student at Gujarat College,

Bhatt received a record eighteen requests for encore performances. He was a founding member of the Bhartiya Kala Kendra, and helped the nation's capital discover several young artists from across the country, such as Shiv Kumar Shukla and Rasiklal Andharia. As a long-standing member of the All India Radio's audition board with top musicians such as the late Ustad Amir Khan, he was responsible for rating and encouraging upcoming musicians, such as Budhaditya Mukherjee and Ashwini Bhide.

Bhatt's dual love for music and acoustics led him to design the acoustics of several theatres and concert halls. Noteworthy were the acoustical designs of the first two 70-mm theatres in India—Sheila and Odeon in Delhi, as well as Birla Matushri Sabhagruha in Mumbai. In addition, he designed the acoustics of several concert halls specifically for Indian classical music for a more natural sound, which did not require the use of powerful audio systems.

Bhatt is survived by his wife of 58 years, Indira, two sons, two daughters, ten grandchildren and eleven great-grandchildren.

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Working with Prof. P.L. Bhatnagar stood me in good stead all through my life

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Dean, Science Faculty, IISc, 2003—2005,
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Atria Institute of Technology, Bangalore 560 024. renrav@math.iisc.ernet.in

Working with Prof. P.L. Bhatnagar was something which stood me in good stead all through my life. His discipline, his clear mathematical thinking and his sheer joy at giving a lecture are properties we all tried to emulate. Unfortunately, he was not at his peak, when I joined the department. I only wish I could have worked with him early in his career.

I spent 40 years as a student/faculty in the Mathematics Department (earlier the Applied Mathematics department), almost the entire life of the department. There were some petty quarrels and jealousies, but then it is a part of human nature. On the whole, we were busy, teaching and doing research. The best part was that we could spend years abroad on sabbatical and vacation. I found I had spent more than 8 1/2 years of my thirty eight years service, either in Germany or the USA. It was a means of rejuvenation. As I moved from student to faculty, it was a very smooth transition.

My only unpleasant memory of IISc was when one of the later Chairmen of the department decided to throw out all the theses gathered painstakingly over the years. Every single thesis written in the department was in one of the cupboards in the office. The "new" faculty felt that it was merely taking up place and was not being referred to by anyone, so why keep it. All the pleas of the "old" faculty fell on deaf years and the theses were dumped.

The celebration of Ramanujan centenary and 300 years of the Principia in the late 80s were delightful events. Before retiring from IISc, I walked to the top of the main tower, an unforgettable experience.

I hope by 2020 will earn a few Nobel Prizes. IISc is unique, let it remain that way.

Jamshetji would have been delighted

Dr S. Ramachandra Rao
M.Sc., 1959, Ph.D. 1962, IPC, Senior Research Associate,
Department of Mining and Materials Engineering McGill University, Montreal, Canada
ram.rao@mcgill.ca

The lectures attended, laboratory training, seminars, symposia all added to my gaining sound knowledge and opportunities to apply it for potentially useful purpose. The time spent at IISc. was extremely fruitful for developing my interest and opening doors for further continuous progress.

My supervisors (Dr. C.C. Patel and Prof. M.R.A. Rao) were great teachers and meticulously supervised my work, advising me of the vast scope of research and inspired me for deeper understanding of the subject.

The training at IISc shaped my career as a teacher and researcher. I have delivered countless number of lectures, in the classrooms, seminars, symposia and conferences and have been conducting research, both fundamental as well as applied. All these endeavors are rooted in my IISc training.

I taught chemistry at IIT Delhi for almost 9 years. During that period I also conducted fundamental research in flotation chemistry, which was the subject of my Ph.D. research at IISc. Later, I continued research in mineral processing, which was the result of my training at IISc. I am now at Mining and Materials Department of McGill University in Montreal, Canada, continuing research and giving lectures on the subject to which I was first introduced and trained at IISc.

I visited IISc. last year January and renewed contacts with some of my contemporaries, who are in the faculty. I was delighted to find, they remember me so well (in fact, they had no difficulty recognizing me I did not have to introduce myself even after 35 years!). That is a clear confirmation of the strength of the bonds of friendship created at IISc. They are too strong to get weakened! I was also happy to see the great progress in the last 35 years.

I always cherish the spirit of cooperation between students and faculty at IISc. During my research, while two leading faculty members were my official supervisors, several other faculty members as well as senior students helped me whenever such help was needed, for instance, in setting up research apparatus, discussing difficult topics, etc. It was a great atmosphere conducive for interesting study and research.

Were the gods testing the determination of IIScians?

A most interesting memory is that of the Golden Jubilee celebrations in 1959, the tremendous excitement and many hours and days of preparation, writing posters manually (computer technology had not arrived), exhibition for the public when throngs of people passed round the laboratories and I was one of the students to explain our accomplishments every day afternoons for a week until 8.30 p.m. It was hard work, yet most enjoyable team work. Our illustrious Founder Jamshetji Tata would have been delighted!

Wonderful Team Work

I should also mention the first day of the main celebrations held in a not very robust pandal, and inaugurated by President Rajendra Prasad and presided by Mr J.R.D. Tata in

the presence of many distinguished luminaries from all over India and abroad, one of the most prominent being the greatest son of Mysore, Sir M. Vishveshvaraya, in his 100th year. The startling thing happened in the evening when unseasonal, completely unexpected rain storm took everyone by surprise (as February was supposed to be a "rainless month" in Bangalore) and brought the pandal crashing down to ground zero! Then, what a wonderful team work that followed soon after the storm moved out. Almost everyone joined hands and festored the pandal, cleaned and placed the furniture in order for the following days' program. Next day, the clouds cleared, the sun started shining bright and warm as if to happily smile at the wonderful team work of IISc mates! The following days' programs went on well just as they had been planned, including speeches by two of the pioneer builders of modern India, our first Prime Minister Jawaharlal Nehru and the great scientist Homi J. Bhabha, founder of India's atomic energy program. It was a great inspirational celebration.

Broaden the horizon of IISc

I would like IISc to broaden its horizons to reach out to a much larger segment of Indian society, to bring the benefits of science and technology to every citizen of the country. The work initiated by Dr A.K.N. Reddy and now being continued to bring science to rural areas by developing appropriate projects should be strengthened to put into productive use, the vast natural and human resources for the benefit of all, to ensure good living standards and promote scientific outlook on life. I would also like IISc to take lead in developing knowledge and technologies for clean environment encompassing air, water and land and applying them for reclaiming and ensuring healthy environment for all citizens to enjoy. By 2020 or even sooner, IISc should be a national leader and one of the world leaders, not only in creating new knowledge but also in applying it for progress, peace and prosperity for all. I believe, that will be just in line with the farseeing vision of Sir Jamshetji Tata and his sons who founded the great institution.

During the Golden Jubilee year (1959) (when I was in my 3rd year at IISc just about to complete my Master's and start on my doctoral program), IISc, conducted a series of technical symposia on a wide range of topics, with strong international participation. (I presented my very first three research papers at one of those, a symposium on Mineral Beneficiation, conducted by and held at the Department of Inorganic and Physical Chemistry with participation by many scientists from all over India). I suggest, similar international symposia be planned for the centenary year 2009.

M.S. Vasudeva

B.E. (Electrical), Mysore University, M.E., ECE, IISc.

M. S. Vasudeva retired as senior Director/Scientist G from the Department of Information Technology, Government of India, and since retirement is involved in consultancy. He is Hon. Secretary Admar Mutt Education Foundation which is building the Poorna Prajna Institute of Scientific Research.

His tenure in the Department of Information Technology saw a number of R&D initiatives taken by him in control engineering, power electronics, etc., with application areas in power transmission/distribution, transportation, industry, etc. The major effort pioneered was the indigenous development of high-voltage direct current (HVDC) technology in the country as an integrated R&D-cum-commercial venture. The project brought in a national team effort with BHEL taking the primary role with support drawn from BARC, NTPC/Power Grid, CPRI Research and academic institutions like IITs and IISc, CEA, Dept of IT, etc.

The successful completion of Stage I-100 MW/100KV at a total cost of Rs 30 crores led to the implementation of Stage-II 200MW/200KV at a total cost of Rs 105 crores. The successful completion of Stage II enabled the indigenous development of state-of-the-art digital controls. This initiative paved the way for commercial introduction of HVDC technology in the country. More than six commercial HVDC links are operative in the country today.

Shri Vasudeva has been recipient of the following awards:

Shri Om Prakash Bhasin Award for S&T efforts in energy including Atomic Energy, 1992.

Dr Bimal Bose Award of IETE for R&D in power electronics-1992

The Jawaharlal Nehru Birth Centenary Award for R&D efforts in Energy from Central Board of Irrigation and Power-1992.

Dear Professor R Chatterjee,

I am so pleased knowing your e-mail address from Hiroshi Hashida's email that I do not have enough words to express it. I am really happy knowing that you are in good health and doing well. Madam, I cannot wait any longer to see you. I wish to fly to Bangalore to touch your feet for your blessings. You will be surprised to know that I always remember my best days with you at the IISc, your every word, your affection, love, advice, teaching, guidance and so on.

Madam, I love to receive a few lines from you about your well being, present activities, and above all your health. Please find my short professional profile. It seems Hiroshi Hashida is doing well. He has started a wind power company jointly with Hitachi. I have a plan to visit him in June/July during our semester break.

I look forward to hearing from you.

Kind regards and best wishes,

Dr Sajal K Palit,
Senior Lecturer in Electronics and Telecommunications Engineering
School of Engineering and Advanced Technology (SEAT)
Massey University Wellington, New Zealand
Tel: 64–4–8015799–62218 (extn). 64–276145387 (M); Fax: 64–4–8012694
e-mail: s.palit@massey.ac.nz

Dear Ret Prof. R. Chatterjee 12th-Feb-2009

Today, it received e-mail from you. You think of the state which is necessary, being extremely fine, being glad sincerely.

It is a 25 after letter. Thank you really.

Then, it confirmed all e-mail contents. I established the company of the name of Toyamax 5 years before at present. Then, it is doing large-sized wind power generation business practically jointly with Hitachi in Toyama Prefecture at the hometown. It makes the electric power of a maximum of 1800 kw a local major power company by electric-power selling at the scale of the facilities (600kw 3) at the power plant, generating electricity. It plans to generate electricity in the electric power of a maximum of 14000 kw at the more (2000kw 7) and the scale as the plan in the future. However, now, it is making an effort to the general solution by 3 persons of the research institute of government and Toyamax and Hitachi in the thunderbolt measure about the season of the winter as the maximum problem. Also, it is the one of the most world size on the Miyazaki seashore in Asahi-cho which is a strong wind zone at the other site in Toyama Prefecture.

It aims at the power generation of a maximum of 120000 kw at the scale of the construction project (6000 kw 20) in the extraordinarily large wind power plant. This plan is arranging the system of the surface cooperation about the maximum work in my life and becoming Hitachi, too. It concentrates all power to succeed. Then, we ask when wanting to host an international conference and a symposium with environment and energy in Toyama Prefecture. At present, as for the large-sized wind power generation, India is in the rank as much as the world 4 and in the amount of electric power generation, it is heading Japan roughly.

In the future, it is in the boiling where there are many points to learn from India. It is the one which wants to cooperate each other. Then, it introduces the technology of the communication-control-system, too, to these technologies and the microwave engineering and the antenna engineering, too, are useful in many boiling.

Things above mentioned are the status of present Dr. Hiroshi Hashida. Then, last year, Mr Palit Sajal of the friend, too, can catch the contact and it plans to come to the house of me in Takaoka in the summer this year. It makes that it is possible to meet 25 later pleasure. He is making a spectacular showing now in the university in New Zealand. From lastly, September, Indian embassy (Dr Thadathil Pankajaksshan) in Tokyo last year It did discussion of being the best invention scientist in the world with (Dr Yoshiro Nakamats) at two of me. It visits to IIS in the result, this year and it plans a lecture. Already, Prof. M.R.S. Rao of JNCASR receives a e-mail guide from the Indian embassy in the message that it is possible to point at the help willingly there about this matter when visiting India. Then, it is the place to be waiting for the reply of the other requirements as the request date of the lecture on the side of India to hope for. We request your the person concerned of IIS to do maximum support and to do maximum cooperation to be realized.

Yours Sincerely

(Dr. Hiroshi Hashida)

Editors' Note: Dr Hashida was a student of ECE over 25 years ago. His email is unedited and is reproduced as such to give a flavour of his ideas conceived in his own language.

One of a kind

Sharat Ahuja
IISc Archives Cell

"Many of would have seen a wizened elderly gentleman, dressed at gray flannel uniform, moving to and fro on the campus, usually on a bicycle or sometimes striding purposefully towards a department or towards the residential books with a pipe wrench or a water tap or valve in his hand. He is Mr Muniappa, the longest-serving member in the Institute. It is his boast, and no mean one at that, that he could trace every water pipe that has been laid down in the Institute. Mr Muniappa works out of the "PUMP HOUSE", an office that is juxtaposed to the Microbiology and Cell Biology Department. Mr Muniappa is 76 years old and has been working at the Institute for the last 55 years. Mr. Muniappa was born and raised in Peenya in an agrarian family (Peenya is now one of the major industrial areas in Bangalore). He began working at the age of 17 and after trying out a few jobs, he joined the pump house at the age of 20 at a salary of Rs 70/- month. In 1990, he was promoted to the post of senior mechanic on a salary of Rs 8000/- month. He retired in July 1991 and since then has been working on a contract basis. In his first year, Mr Muniappa walked to work from his home in Peenya, following which he purchased a bicycle and has been commuting by it for the last 54 years. Standing ramrodstraight beside his bicycle and with a gleam in his eye, Mr Muniappa stated "I have myself repaired and maintained this bicycle. I have never been to a doctor all these years and I cannot recall the day when I have missed work on account of an illness". His juniors in the pump house regard him in reverence, almost to the level of hero worship.

Mr. Muniappa has been married for 56 years and has three daughters and two sons all of whom are happily settled in and around Bangalore."

Briefly speaking

"I did my course in communication and I am in telecom service-provider company. Prof. Satyam's project guidance was superb. Could learn shuttle, bridge and gymnastics."

Gangadhara Rai, N.
B.E., ECE, 1978–81, Tech. Mahindra R&D Services
grai@TechMahindra.com

"I am currently working in retail financing NBFC. Over 18 years experience in banking. Training at IISc has given me a high level of sense of integrity, intensity in whatever I do, self-confidence, lesser focus on materialism, huge dose of humility, respect for fellow human beings. I consider the time spent at the Institute as the best in my life. The Institute training has made me a better human being. I continue to interact with the Institute and treasure the memories.

Among the interesting experiences are seeing people like E.C.G. Sudarshan, Raja Ramanna, Satish Dhawan as simple guys eating in the mess. Another is listening to JRD at the Platinum Jubilee function. The Institute should continue to train people to make better citizens."

Dr D. Krishnaraj
M.E. Mech. Engg. (Foundry) 1983–1985, Ph.D. Mech Engg (Foundry) 1987–1989,
Mech Engg Foundry, Scientific Officer (DST Scheme), 1987–1989,
dkrishnaraj@hotmail.com

"Relevance of the study to one's employment and work: Highly useful, it brought out the true potential in me. The training at IISc has been highly useful; it brought out the true potential in me and has exposed me to cutting-edge research. Among interesting experiences/anecdotes during the tenure at IISc, I had the chance to meet Nobel Laureate Prof. Charles Townes, Prof.Thomas Kailath and Prof. N.S. Jayant.

IISc should become Number One institution in Asia-Pacific and to become a world leader in basic sciences research. Alumni Association should be strengthened."

Prof. K.C. Raveendranathan
M.E., ECE, 1993; Electronics & Communication Engineering,
Government Engineering College, Barton Hill, Thiruvananthapuram - 695 035
rav.nathan@gmail.com

"I have got good exposure to Microelctronics and communications. I am working on mobile baseband development. IISc should become world's Number One in research."

Anmol Bagbai
ME (Microelectronics), CEDT, 2006;
Sr. Design Engg. Infineon Technologies (I) Pvt Ltd.;
bagbai@rediffmail.com

"Best research institute at par with MIT."

Dr Vishwanath Hegde
M.E. (System Science & Automation), EE Dept., 1989–1991;
Ph.D., HV Lab, EE Dept., 2003–2006;
Assistant Professor, Department of EE Engg.,
Malnad College of Engineering, Hassan 573 201, Karnataka.
Ph: 08172 245093 Extn 272; Ph: 08172 245763 (O); Mobile: +91 9449207412.
hegde_mce@rediffmail.com;

"My stay at IISc has been a gateway to my life. The teaching, assignments and examinations were unique and gave way to higher level of thinking and improved attitude towards education. I had exposure to different possibilities; Library had been a great source and inspiration; the way of thinking and approach to problem solving. My education at the Institute is totally relevant to my present work as I learnt simulation and mathematical modeling at the Institute.

Hostel life has been great. It was amazing the way Radhakrishna used to remember who takes omelettes in the breakfast and the way he used to serve wherever one is sitting.

I wish to see the Institute develop into a leading centre of excellence in various fields including nano technology and space research. There is need to set up an independent centre for space research."

Dr V. A. Sastry
M.E. (Applied Electronics and Servo Mechanism), Department of Electrical Engineering, 1966, Ph.D. (Canada), Consultant for IT companies in quality and productivity improvement.
568, 6th Cross, HAL 2nd Stage, Bangalore 560 038,
vas1@vsnl.com; Mobile: 98450 25121

"From the substandard environment of my undergraduate engineering school (which is generally the case in most engineering schools in India), this was a tremendous transition to a world-class institute. I got the opportunity to learn the subjects from basics to advanced levels as also got exposure to research. The study and knowledge gained at IISc is the basis of most of the work I have done during my employment.

Since studies form the basis of all employment, more practical problems should be discussed in the classrooms to illustrate theory. Students must be encouraged to deal with real-world problems. IISc should become the hub of knowledge and research in India and should be known for world-class research output, attracting top-class talent from across the globe.

IISc should lead the way in creating a research university system in India. It should strive to generate funds from industry partnership and encourage entrepreneurship from within. IISc should encourage big campus-wide interdisciplinary projects which can become successful commercially viable products useful for society.

The memorable experience I cherish at IISc is having tea/noodles at 1:00 am daily at the 'Tea Board'."

Vijay Ahirwar
M.E., ECE, 2005,
Communication Systems Design Engineer, Conexant Systems Pvt. Ltd.
vijayahirwar@gmail.com

"Studies at IISc have widened my vision and instilled self-confidence. On relevance of the study to one's employment and work, I would rate at 8 on a scale of 10. I wish that IISc becomes world's top practical research institute."

Ashish Bhavsar
M.Tech., CEDT, 1996
ashishbhav@gmail.com;
Currently involved in business:
1) Medical equipment manufacturing company,
2) Industrial automation company, and
3) Medical equipment trading company.

"Studying at IISc was the unique and best experience I had in my total academic career. After gaining the flavor of academic research, it was really easy and interesting to understand difference between industry research and academic research.

On relevance of studies to employment, it is about 80%; except for a few course works, all the courses are relevant for me today also. In fact I refer most of the time my class notes for understating/solving some industrial problems. The whole experience at IISc was interesting. I wish the Institute maintains and even improves upon the quality of teaching and research. It should make more impact on the community by larger interaction with industries and local people."

Jayesh Jain
M.E., Mechanical, 2005, Technologist, Applied Combustion Lab,
Energy and Propulsion Technologies, GE Global Research, #122,
Export Promotion Industrial Park (EPIP), Phase II, Hoodi Village,
Whitefield Road, Bangalore 560 066, India.
Ph: +91 80 4012 2844; D: *901 2844; C: +91 9901998812.
jayesh.jain@ge.com; http://research.home.ge.com

"I have developed my research skills at the Institute only. This has helped me in my employment as well as my present research. I have worked in core area after course; it was extremely beneficial. I cherish many experiences at the Institute, especially the cultural interchanges were specifically interesting. The Institute should improve research in engineering sciences and make them more industry-oriented rather than theoretical."

Dr Asha Viswanath
M.Sc. (Engg), Department of Civil Engg, 2005, Ph.D.,
Department of Engineering Sciences, 1st year, UK,
enrolled for Ph. D. after 2 years of Industrial
experience at Cranes International Ltd
asha.viswanath@gmail.com

"The degree I obtained from IISc was the requisite qualification for getting my future employment. The training I obtained from IISc is highly important for my present research career.

I have good experience with IISc, after completing my course. Presently I have a joint project along with IISc, supported by DBT. A few years back I had few publications with my IISc friends."

Dr Dhananjay Bhattacharyya
Ph.D., Molecular Biophysics Unit, 1992, Employment: i) National Institutes of Health, Bethesda, MD, USA during 1993-1995 as Research Associate, and (ii) Professor-F, Biophysics Division, Saha Institute of Nuclear Physics, Kolkata, since 1995.
Phone: +91–33–2337-0379 Extn. 3116/3506(o); +91–33–2663–5503(R),
Fax: +91–33–2337–4637; dhananjay.bhattacharyya@saha.ac.in

"The relevance of the study to employment and work is very appropriate and am currently working in the same field. IISc should become sole fundamental science and technology provider to the nation. There should be greater interaction with the industry to extend the benefits of science and technology to the masses."

V. Bangarusamy
B.E., Dept of Metallurgy, 1979–82; M.Tech., CEDT, 1989-91;
Electronic product & technology development
for many industries, Indigenization of Avionics.
v.bangarusamy@gmail.com

"Right now I work in combustion of energetic materials. The knowledge I gained at IISc has given me a very good platform to continue my work. Course work and research at IISc has been extremely helpful in my present studies. I speak to my adviser at IISc, Prof. J. Srivnivasan, a number of times to discuss my research here at Penn State. My two-year stay at IISc has been a very memorable. It changed my outlook towards everything. I emerged as a completely different person when I passed out. The whole of the 2 years were full of interesting happenings.

Beyond 2020, I see IISc as a major contributor to India's well-being and progress. I myself aspire to be a faculty at IISc."

Neeraj Kumbhakarna
M.E., Mechanical Engineering, 2005–2007.
nkumbhakarna@yahoo.com

"During the course I have learnt a lot in IISc; academics and the course work for the research students is really good. The knowledge gained at IISc is highly relevant and I am employing it in my current work, and the approach which I learnt at IISc is really enduring. I had encountered a lot of problems in achieving the results but never lost hope; that's the best IISc has given to me, i.e., a realistic approach towards my goal. It is the best Institute in India and I expect the research standards to climb higher so that it could be counted among elite intellectual properties of the world."

Dr Ashima Bagaria
Ph.D., Physics, 2007, Post-Doctoral Associate
at Yale School of Medicine, Yale University
ashima.bagaria@yale.edu

"I have been thoroughly trained in my research field (Crystallography) at IISc and the base has been formed there. The studies there have been totally relevant to my present work. It should be recognized as one of the top-most research institutes in the world."

Dr Parthapratim Munshi
Ph.D., SSCU, 2005, Post-Doctoral Research Associate
Chemistry, University of Western Australia, 2005–2008
partha.munshi@gmail.com

"The relevance of my study at IISc to my employment and work is excellent. I wish to see the Institute at a higher rank than at present. There should be more industrial courses and projects."

Alok Kumar Sinha
M.Sc. (Engg), HVE, 2003–2005
Mobile: 09448105582
aloksinha_iisc@yahoo.com

"Very thorough and rigorous curriculum; outstanding and dedicated faculty; focus on basics as well as recent technological advancements; very good lab and computing facilities; interaction with senior research scholars an added advantage; students come from some very good colleges all over the country, hence there is a competitive environment; good socio-cultural activities within the campus; very good gym and sports facilities; mess and hostel stay was pleasant. Overall it is a once-in-a lifetime opportunity to be in IISc.

I am presently continuing the work on design engineering and am able to adapt to challenging practical problems and providing solutions through knowledge gained at IISc. The Institute should continue to be a top class research and technological institute with much more improved lab facilities and student exchange programs."

Kulkarni, Anand
M.Sc. (Engg.), Mech. Engg; 2003,
Design Engineer, GE Infra, Energy,
anand1.kulkarni@ge.com

1964–1971—Research and teaching at IIT Madras
1971–2005—IISc retired as Professor, Dept. Mathematics
Taught various courses and supervised 9 Ph.D. theses
Written around 100 papers and published them in reputed national and international journals.
2005–2007 Emeritus Scientist, CSIR
On an Alexander von Humboldt Senior fellowship carried out research at Aerodymics Institute, Aachen, during 1977–1983.
Visitor for 3 months in 1978 at AMTP Cambridge University associated with Sir James Lighthill
Visiting Professor of DFG, Bremen University, during 1990–1991.
Reinvited by Humboldt Foundation to spend at University of Bremen which is given without any application but recommended by a German professor.
Given several invited talks at national and international seminars and conferences.

All the above things were possible only through the knowledge and experience gained at IISc.

Ramachandra Rao Adabala
1960, B.A. Andhra University; 1963, M.Sc., Mathematics,
Sri Venkateswara University; 1964, D.I.I.T., Nonlinear Mechanics,
IIT, Kharagpur, 1970, Ph.D., Rotational flows IIT Madras,
Research consultant for a DST Project at S.V. University, Tirupati.

"The IISc experience has made me choose a career in research. It is an amazing place to be in. I keep in touch with my teachers and classmates. IISc should strive to be in the top 20 in the world alongside MIT, Stanford, and Berkeley. The number of publications in international journals and conferences from students and teachers has to increase many times. IISc alumni are not as well networked as IIT alumni. They have to connect better."

Arindam Pal
Computer Science, CSA, 2000–2002, Ph.D. student at IIT Delhi,
Technical Lead at Yahoo! (R&D), Software Engineer at Microsoft (R&D)
arindamp@gmail.com

"I particularly enjoyed working with Prof. Joseph Vithyathil who showed by example how to learn and how to think clearly. What he taught has stood me in good stead thereafter. I merely added to my speed, efficiency, targeting, etc. thereafter. The courses were okay. Interaction with ECE and CEDT was very useful.

Prof. Narendra (Harvard) and Prof. Srinath (Southern Methodist U) were in IISC during my ME course and their discussion sessions were very energetic. IISc should be a place to rival MIT, Mass, USA.

Open windows to foreign universities, make the degrees awarded equivalent with rise in standards and let professors and graduate students of Germany, USA , UK work here so those students earn degrees here. This will raise the standards to international level in teaching and research. Invest in infrastructure and pay. Audit the quality levels yearly with independent experts."

S. Gururaja Rao
1960–63 B.E. (ET), 1963–65 M.E. (Applied Electronics and Servomechanism), Retired.
siragrao@hotmail.com

"The knowledge gained at the IISc course was very useful for my work with consulting organizations. It helped in the design work I am involved in right through my career. IISc should become an institute of excellence in the fileds of: a) Semiconductor Research, and b) Superconductivity."

S. Selvakumar
M.E. (Electrical), Dept. of H.V. Engineering, 1978,
Senior Manager, HOD, Electrical & Instrumentation,
Valdel Engineers and Constructors, Bangalore 560 025.
s.selvakumar@valdelec.com

"Very good training; helped me a lot in developing confidence. Can aim to become Harvard/ Cambridge-like institution. Modernisation of infrastructure is urgently required."

Dr Gautam Das
Ph.D., 2001–2007, MCB, Post-doctoral fellow in
UMass Medical School, Worcester, USA.
gautambio@gmail.com

"All the courses are useful and helped a lot in my later stage. We do lot of R&D on cutting-edge technology software solutions in the practical field. The studies at IISc are not exactly relevant to the present work, but research work helped me a lot in our day-to-day work. IISc should achieve breakthrough results in all fields and lead the world."

Dr C. Mathiazhagan
Ph.D., Aerospace Engineering, 1995, Managing Director, MKT Group of Companies,
www.mktindia.com, www.htssindia.in, www.market-i-jp.com
nihongomathi@dataone.in

"Microwave engineering which is essential for sales of the more sophisticated microwave products that Varian/CPI make. For a brief description of the sophisticated nature of the CPI's products kindly visit www.cpii.com. You will see that the products are used for exotic applications in space, defence and broadcasting, etc. To understand these products, and to sell them, a good foundation in microwave engineering is essential.

IISc should become a global centre for excellence in microelectronics engineering, biotechnology, aeronautics and space engineering. We should also do pioneering work in sub-micron semiconductor fabrication."

Subash N. Thadani
B.E. with distinction, Electronics Communications Engineering 1966–1969, 1969–1979, Marketing into India of Hewlett Packard and Varian Products, 1979–Till date: Chief Representative, Communications & Power Industries. Mobile: 98 100, 39451; Tel.(Office) +91-11-2614 6716, 2614 4371; Tel. (Home) +91-11-2921 1724. Email: cpi@airtelmail.in/cpiind@vsnl.com/subash_thadani@hotmail.com

"As a research student worked on nonlinear vibrations of a stretched string which resulted in the publication of a fairly seminal paper, "Non-linear character of resonance in stretched strings" by G.S.S. Murthy and B.S. Ramakrishna in JASA, 1965. In addition to having been referred to in several subsequent papers on the subject by others, the paper has also been referred to in the body of the book, "Nonlinear Oscillations" by A.H. Nayfeh and D.T. Mook.

I became eligible to appear for Engineering Services Competetive Examination conducted by UPSC only because of obtaining DIISc. The knowledge gained in Telecommunications during DIISc course provided a solid ground on which I could build expertise in telecommunications during my entire career of 34 years as an engineer and a technocrat.

I have interacted with Dr B.S. Ramakrishna prior to publication of the paper referred above and after I joined Dept. of Telecom. I also had the opportunity to interact with IISc while I was General Manager, Bangalore Telephones, during 1986-92 in connection with the upgradation of telecom facilities in IISc. Both interactions were most pleasant and enriching.

Prof. K Srinivasan was the head of the dept. of ECE and he used to take classes at 7:30 a.m. As no student could enter the class after 7:30 a.m., we had to make special efforts to be in the class on time. One of our classmates switched to ET course simply to avoid his strict rules. Although he was a stern disciplinarian, he was kind and affable too. He called his students for tea at his residence once a year.

Works of several academics of IISc deserve Nobel Prize."

G.S. Srinivasa Murthy
DIISc, ECE, 1956–59; Research: 1960–61; Retired from Dept. of Telecom, Govt. of India, as Advisor (Operations)/Worked at various levels and assignments in Dept. of Telecom for 34 years.
murthygss@gmail.com

"IISc is comparable with a state school in the United States. The relevance of the study to my employment and work is ENORMOUS. I wish to go back to the golden period of mid-70s till mid-90s. IISc has to maintain the best qualities of both university and research institute. It has to remain pro-teaching all the time."

Dr Abhijit Chakrabarti
Ph.D., Department of Biochemistry, 1985–1990, Professor, Biophysics, Saha Institute of Nuclear Physics, Kolkata
abhijit.chakrabarti@saha.ac.in

"I have worked as a research engineer in Research and Technology, Honeywell Technology Solution, Bangalore, and am currently a PhD student in Dept of Computer Science, University of British Columbia, Vancouver, Canada. I learned a lot during my stay in the university, both in courses and while doing research. The main contributing factor was peer interaction with fellow students. I continued working in the same area as my masters, and I am currently doing my Ph.D. My learning in IISc has been of great help to me. My vision for the year 2020 is better faculty, more interdisciplinary research, more open culture, better infrastructure, and more collaboration."

Emtiyaz Khan
M.Sc. (Engg), ECE, 2004.
emtiyaz_khan@ yahoo.com

"During the course, I recall events: (i) JRD Tata's speech and question/answer session during Annual Dinner. He said, 'Ask Any Question on Earth.' His ability and self-confidence has ever since been my career guidance,(ii) Dr. C.D. Deshmukh as Chairman of UGC visited the Institute and was visibly nervous to speak before the Institute's high-caliber students and teaching staff. That gave me confidence to be successful in life because we are highly technical and India's cream, (iii) Pt. Ravi Shanker played Sitar for 2 hours. I was spell bound even though, before his play, I did not appreciate instrumental music. That gave me an insight to always try to be perfect in my career performance.

The Institute should excel or at least match the teaching and performance standards of Stanford University and MIT. Advise the alumnae as to how one can be of help to the Institute."

Shiva S. Gangal
D.I.I.Sc. (E.T.), 1954–1957; 3512 Coco Lake Drive, Coconut, Creek, FL 33073, USA, (954) 698-0162. (a) Retired in 2002. (b) 2 Years of teaching M.Tech. student at J. K. Institute, Allahabad University. (c) 8 years as Electrical Design Engineer at Rourkela Steel Plant, India. (d) 7 years as Electrical Design & Maintenance Engineer at Steel Plants, USA. (e) 9 years of middle-level management at G.E., Reliance Electric; Lever Brothers; and Aluminum Plant in USA. (f) 19 years as CEO of Engineering & Construction Firm in USA.
shivalata@comcast.net

"My first brush with independent scientific thinking and research was with guidance from my supervisor, Prof. A. Surolia. The biochemistry, molecular biology and cell biology skills I learnt during my Ph.D., and other things like learning to plan and execute a research project, writing papers and analytical methods will always be useful to my research, wherever I go. The green and wonderful campus helped me grow in more ways than just scientifically. It was a wonderful experience that I shall always cherish. I would love to see a green IISc going strong in 2020 in all fields of science and engineering research."

Dr Ramya T.N. Chakravarthy
Ph.D., MBU, 2006, Post-doctoral Research Associate at The Scripps Research Institute, La Jolla, California, USA.
ramya.tnc@gmail.com

"Brand value and core technical background gives self-confidence to deal with new assignments particularly in Power sector. I am in contact with my ME guide Prof U. Shrinivasa even now. Working late at night for project work in SERC computer lab is a memorable experience. Institute should become a global brand in general. There should be incubators for alumni for starting new ventures. City-wise online database of Alumni should be in place."

Venkateswarlu Talluri
M.E., Mech., 2002, Deputy Director, Central Electricity Authority, Ministry of Power, GOI, New Delhi.
venkat_talluri@yahoo.com

"The knowledge gained in the 3 years of study in ECE at IISc has been the firm foundation for the knowledge gained later in my career due to rapid advancement of technology. The early morning classes held by Late Prof. K. Sreenivasan in the final year not only rooted in us the fundamentals of electronics and communications but instilled in us a sense of discipline which helped me to advance in my career. All the other professors at that time imparted excellent knowledge which helped me to understand the new developments in the line better.

IISc has been a premier institution and I visualize it to be world's topmost centre for both academic and research activities by 2020."

Y.N. Keshava Murthy
D.I.I.Sc. (Elec. Commun. Engg), ECE, 1954.Research AIISC (part) - June 54 - Nov. 54, ECE, Nov. 1954 onwards, Broadcast and Power Line Carrier Communication with Voltas Ltd. Consultant and Chartered Engineer

"I have gained confidence to accept any challenge in life after the studies at IISc. It was a memorable experience to interact with Prof. K. Parthasarathy, Prof. H.P. Khincha, Prof. D.P. Sen Gupta, and Prof. Y.V. Venkatesh. I feel honoured to visit IISc campus and the department. I always get charged up after every visit.

Interesting experiences: Writing the final exam between 6.00 and 9.00 p.m. in Computer Control of Power systems. Standing in queue for 3 hours to submit computer assignment programs punched on cards for execution on DEC-10.

IISc should be rated in the top 10 institutes in the world."

K.N. Balasubramanya Murthy
M.E. , Electrical Engineering, 1986, Principal and Director of PES Institute of Technology, Banashankari III stage, Bangalore - 560 085.
principal@pes.edu

"The course at IISc gave me a solid base on the way to becoming a professional electronics engineer. Breadth and depth of the intensive course was of the highest order available anywhere in India. Unlike in a university, where a prescribed syllabus is strictly followed, the faculty had the freedom to teach the latest developments and emerging technologies. Though practical hands-on training was limited, the good grasp of fundamentals one got during the course gave a distinct advantage to an IISc student over his peers from elsewhere. The success I achieved in executing several development projects in microwave communication, avionics and electronic counter-measures in the Air Force is ample testimony to the breadth of the course and ability to do creative thinking I have imbibed during the years spent at IISc.

I was fortunate to participate in the Golden Jubilee of IISc as I was udergoing training in Jalahalli at that time. IISc is no longer the rather small community it was during the '50s. It has grown several-fold. I wish to see it as a vibrant, cohesive institution nurturing talent and innovation in all disciplines of human endeavour. It should remain the best in India and amongst the top 5 in the world."

A. Srinivasa Murthy
ECE, 1954–1957, Indian Air Force as Aeronautical Engineer, 1958 to 1990. Retired as Air Vice-Marshal. Partly involved in the activities of Institution of Electronics and Telecommunication Engineers, Bangalore Centre.
murthyas@vsnl.net

"Enthusiastic students and faculty; good research environment; ideal campus for research; recognition for research and degree; easy to find positions abroad; highly relevant studies.

I've been in touch with my thesis supervisor (Prof. T.V. Sreenivas) and it has been pleasant interacting with him. I'm also continuing to collaborate with him.

Vision for 2020:

(i) An institute with highly motivated faculty and students, on par with the international standards; cutting-edge research, and professional conduct of highest standard on part of the students and faculty and state-of-the-art research facilities.

(ii) A campus that is greener than the current one.

(iii) Attract better faculty; Salaries to be decided and hiked on the basis of performance. Salaries should match that of the industry to attract the best minds.

(iv) By 2020, I hope that every department and hostel in IISc will have clean, hygienic toilets and good drinking water.

(v) Please stop felling those trees (including the sandalwood ones) in the name of development and security. Plant a sapling for every tree that has been felled.

(vi) By 2020, please fix the leaks in our hostel rooms.

(iv) By 2020, please replace the existing TMSC canteen, Tea Board and Coffee Board with more hygienic and professional cafeteria. These places are currently major carriers of sicknesses and infections on the campus."

Dr Chandra-Sekhar Seelamantula
Ph.D., ECE Dept., 1999–2005, Post-doctoral fellow.
whozchash@yahoo.com

"During 1986–92, research environment was excellent. I learnt scientific temperament. IISc has highly talented faculty and an excellent campus. I use my exposure at IISc to develop NISA—A general-purpose finite element program. I always enjoy interacting with IISc for any advances in basic research and technology. Nature Club provided us a lot of fun coupled with exciting experiences such as trekking to Himalayan ranges, Western Ghats, etc. Encourage group effort.

Vision for 2020

Of late, the direction is more of application orientated. Bring back basic research temperament and develop private partnership to convert research to reality."

Dr B. Sreehari Kumar
Ph.D., Civil (Structure), 1992, Vice-President, NISA Development,
CAE R&D Services, CSIL, Bangalore, Sreehari.
kumar@cranessoftware.com

"The knowledge gained at IISc is great. However the student in the initial phases of his stay at IISc needs to be exposed to various aspects of IISc goals, its role in Indian science, technology, education and research.

I gained a lot of knowledge and could become what I am today because of the study at IISc. I had the opportunity to interact with various engineers in and across the globe, and found that the engineers/scientists from IISc undoubtedly stand out among the top 5. The level of engineers coming out of various other institutions in India as well as abroad is nowhere near the IISc level. I feel proud to be a graduate from IISc. Keep it up; don't dilute it at any cost!

The specialisation at IISc has helped me to go ahead and achieve a lot in my career. The study at IISc is quite relevant. Only one should be able to get the right job!

I did one course at IISc during my employment, but that was not much help to me. The course was on "Optimisation Techniques". I had interacted with a few professors from IISc and found them quite good. However, IISc does not have very good interaction with industry. This needs to be improved.

The entire stay at IISc was very special for me! I enjoyed the "Vibrations", the food and the Gymkhana. I had the opportunity of working with Prof Soundranayagam, learn from Prof. and seeing Prof. Satish Dhawan closely.

I wish to see IISc to be the no. 1 institution in the entire world in the field of science and technology. I see IISc to produce more and more PhDs, Nobel laureates and more importantly solutions to the problems facing India.

Keep the standard of IISc as high as possible, do not compromise on it!"

Dilip Bhalchandra Kulkarni
M.E., Mechanical Engineering Department, 1980.
dilipkulkarni_57@yahoo.co.uk

"I have got selected through IISc campus interview program and am employed with Cisco for the last 6+ years. I did my M.E. thesis under Prof. L.M. Patnaik. I will never forget those 6 months. I learned how to conduct independent research from him. This knowledge you can never get from any books, you can get it only by working with a great person like Prof. L.M. Patnaik. My current job profile doesn't require lot of research skills. But any time in my life, I am confident of conducting independent research and coming up with a result of international standards. I filed four US patents through Cisco. I will attribute the success of it to IISc.

Other thing I liked in IISc is the culture. All professors and support staff treat with you great respect and affection. Your confidence and can-do attitude is at its best when you are in IISc. In all, it is a lifetime experience to be in IISc.

Vision for year 2020

I would like to see IISc as launchpad for numerous successful start-ups. IISc already has environment favouring students and professors to have technology start-ups. But we need some big names in the industry to showcase the IISc success story with start-ups. IISc should focus on improving the distant learning courses and make it reachable to remote areas in India."

P.P. Guru (gurupp)
M.E., Computer Science and Automation, 2001,
Senior Software Engineer, Cisco Systems India.
gurupp@cisco.com

"Working as a Director (R&D); have over 18 years experience in the software development industry. During the course, I feel that I benefited mainly due to my fellow students in the batch—who helped me push further my understanding of core compute science concepts. I enjoyed most of the courses. In particular, I would like to recall the teaching of Prof. R. Vittal Rao (Applied Mathematics Dept.). His classes were the best, both in terms of understanding the concepts and additionally they kindled my interest in those subjects (Discrete Structures, Computational methods of Linear Algebra, etc.). The studies at IISc have been greatly relevant.

During our final year (May 1989 to be precise), we had planned to go on an industrial visit to Goa (National Institute of Oceanography (NIO) and wanted to combine this with a pleasure trip to Goa's beaches as well! With just about an hour left to go, we received a fax from NIO, Goa, that they would not be able to host us and that they deeply regretted the inconvenience. We spoke to our Dept Chairman (Prof. M.R. Chidambara) and he refused permission to us to continue the trip (as per the rules, of course). But we were greatly disappointed and went and had a meeting with the then IISc Director, Prof. CNR Rao. He gave us a patient hearing and greatly helped us to continue with the trip by speaking with Prof. B.S. Sonde (who was the then Electrical Sciences Division head). I must say that this incident remains green in my memory and is unforgettable!

Vision for 2020

Retain its position as the premier research institute of India. Extend help to students from economically underprivileged background to do research by design by actively seeking out such students from all parts of India. Only this will help alleviate (and potentially eliminate) the unhealthy scene created by caste-based reservations done by successive Indian governments."

S. Shankar
B.E., CSA, 1989.

"Whatever I had studied in IISc is benefiting me still. DSP and multimedia still give sharp edge to me."

Umesh Bankaria
M.Tech., Dept. Instrumentation, 2002,
Embedded Software Engineer, ISRO Ahmedabad.
baumesh@yahoo.com

"I have worked in finance, media, defence, and hi-tech companies earlier, in various capacities ranging from analyst to vice-president. Have over 14 years of experience in financial analysis and software engineering.

I have studied chemical engineering, but worked in financial analysis and software engineering. Though the knowledge I have gained at the Institute is not directly useful in my career since I deviated from the subject of study for survival reasons, my training in mathematical analysis and disciplined approach to solving problems is helpful. I am in constant touch with Prof. Kesava Rao Kaza of Chemical Engineering Dept, which is very pleasant always.

Vision for 2020

IISc has the best science and engineering talent available in the country. But, it is only in one direction as I know of, academics and research. The culture of IISc (at least, as I know of then) discourages entrepreneurship. It needs to promote the culture of entrepreneurship also from gross-out level with enough importance. Each knowledgeable entrepreneur produced out of IISc could create enormous wealth and large number of jobs for the society. The country, which is becoming the knowledge backbone of the world, needs the best and knowledgeable entrepreneurs at this juncture, more than ever, for a prosperous India.

I envision the labs and industries started by the alumni of IISc would become world-class companies. Why not we see the Dr Reddy's of the world coming out of the best scientific talent at the best research institute in India? That too, when IISc itself was started by an entrepreneur.

Suggestions

Please get tax-exempt status for the Alumni Association as in major countries, so that it would be beneficial to IISc. I wanted to contribute some money to Prof. Kesava Rao's work at IISc a couple of years ago. Looks like IISc Alumni Association does not have the tax-exempt status (I think it is called 501 c 3 in USA). Please get the tax-exempt status for the Alumni Association in USA, so that the interested parties can contribute. This status gives the following benefits:

- tax exemption for the contributor.
- many companies will match the funds, only for those organizations which have this status. Hence, the contribution multiplies (double in most cases). If the USA Alumni Association now has the status, please let me know, so that I could initiate the contribution."

Ananthu Srinivasa Chakravarthi
M.E., Chem. Eng, 1989–1991; Sr Systems Analyst, Merck & Co.
ananthu_chakravarthi@merck.com

***"Reflections**: A unique opportunity to learn and further knowledge thoroughly in various topics (pure and applied) related to Physics and Materials Science. My field of research was "Investigation of Ferroelectrics", and earned the first Ph.D. thesis in India.*

The knowledge acquired so could make me competent and smart at interviews such that I got selected every interview I had appeared.

I could contribute much to PD research because of the training received at the IISc, and could become Ph.D. supervisor to produce standard research papers by students and earn them Ph.D./M.Phil. degrees in a university laboratory without even the essential infrastructure facility. Further, a copy of my Ph.D. thesis was bought by a library in France in 1973.

Relevance: Of course, the study was not relevant to the employment at the University of Kerala.

Interaction: IISc has a peculiarity that, I have to be frank, never encouraged me once I left the institution; though I had been amicable. No interaction. No intimation of summer schools/symposia, etc.

Interesting experience/anecdote: Very fortunate to have been with Prof. C. V. Raman at least on six occasions at the Raman Research Institute. Once attended his lecture and surprisingly the then Director Dr Dhawan was also one among in the audience.

Vision for 2020: IISc can definitely establish itself as one among the best institutions for higher studies and scientific research in Asia.

Suggestions: IISc has been awarding the best alumni awards to those who have retired from service. I have noted that the awards of recognition are only given for those who retire from IISc. It is certainly prejudicial that several alumni who have left the IISc and worked elsewhere in India have also contributed enough for recognition; some of whom worked with less infrastructure facility elsewhere but have been much more knowledgeable or equal to the alumni who continued in the IISc."

Prof. S. Devanarayanan

Ph.D., Physics, 1963–1970, SRA, 1968–1970, a) SIDA Fellow, Inst of Physics, Uppsala, Sweden, 1970–1971. b) Lecturer in Physics, Univ. of Kerala, Trivandrum, 1971–1975. c) Reader in Space Physics, Univ of Kerala, 1975–1985. d) Professor in Appl. Electronics, Univ of Kerala, 1985–2001. e) Professor in Physics, Univ Puerto Rico, RioPiedras, USA, 1989–1991. f) Professor & Head, Deptt Physics, Univ of Kerala, 1993–2001, and g) Principal, KVVS Inst Technology, Addor, Univ .of Kerala, 2003–05. chsd1976@gmail.com, sdevanarayanan@yahoo.com

"Reflections: (*a) Gained fundamental knowledge on engineering; foundation for electronics and communication engineering; Urge for continuing research; (b) Abundant experience in dealing with problems and people.*

Relevance of study: The basic knowledge gained in the studies has been applied to actual work and thus the results were successful.

Interaction: Even though I worked outside, I had lot of opportunities to work with IISc: a) by giving lectures, b) being an examiner for Doctoral Thesis evaluation, c) being member of interview committees for Promotions, and d) being coordinator between industry (BEL) and IISc.

Interesting Experience: Every event was interesting and memorable.

Vision for 2020: IISc should be the best Institution for science and engineering research."

Prof. V. Venkateswarlu

B.E., ECE, 1963–1966, M.E., ECE, 1966–1968, Teaching: ECE, 1968–1971, and 1983–1984 (as Guest Lecturer), Research: ECE, 1968–1971:1977–1983, Professor & Head of Department, VTU Extension Center, UTL Technologies Ltd, Yeshwantpur, Bangalore 560 022. vwarlu@utltraining.com

*"**My first day at IISc**: That was July end of 1977 and my my first visit to the Department of Electrical Engineering at IISc where I had been offer—admission to the M.E. programme. As I entered the Power Engineering building and looked around, rather unsure of myself. I heard someone call me, "Good morning Mr. Sinha".*

I looked in amazement at the frail-looking man behind the counter of what I later came to know was the office of the Electrical Engineering Department and asked, "How do you know me, sir? This is the first time I have come to this place."

"We have your photograph on your application application here," he smiled, "and I have been waiting for you."

The bond that was established between me and Mr. Seshachalam, the then office supervisor of the Electrical Engineering Department, continues unbroken to this day."

Prof. S.K. Sinha
CEDT, IISc

"Thoroughly trained on my research field (Crystallography). Base was formed at IISc. Studies are totally relevant. Post-course or employment interaction with IISc has been good

Vision 2020: Become a part of the top most research institutes in the world.

Dr Parthapratim Munshi
Ph.D., SSCU, 2005
Post-Doctoral Research Associate, Chemistry
University of Western Australia, 2005–2008

"Relevance of study is excellent. It should attain a higher rank than at present by 2020. Need more industrial courses and projects."

Alok Kumar Sinha
M.Sc. (Engg), HVE, 2003—2005
0-9448105582

"The IISc experience made me choose a career in research. I keep in touch with my teachers and classmates. IISc is an amazing place to be in. It should strive to be in the top 20 in the world along side of MIT, Stanford, and Berkeley. The number of publications in international journals and conferences has to increase many times. IISc alumni are not as well networked as IIT alumni. They have to connect better."

Arindam Pal
Computer Science, CSA, 2000—2002; Ph.D. student at Department of Computer Science and Engineering, IIT Delhi
Technical Lead at Yahoo! (R&D), Software Engineer at Microsoft (R&D)

"I have 29 years of experience as an electrical engineer with consulting organizations in power plants and oil & gas sector.

The knowledge gained at the IISc course was very useful for my work with the consulting organizations and right thro' my career. I have interacted with the professors at HV dept for reports for Dept of Scientific and Industrial Research, Govt. of India, on: a) Technological status of industry and manufacturing in India for lightning arrestors, and b) Technological status of industry and manufacturing in India for circuit breakers. IISc should become an institute with authority in the fields of a) semiconductor Research and b) superconductivity."

S. Selvakumar
M.E. (Electrical), H.V. Engineering, 1978, Senior Manager, HOD (Electrical & Instrumentation), Valdel Engineers & Consructors, Bangalore 560 025

***"Reflections on study**: Very personalized teaching, where almost each instructor knew my capabilities well, and molded his instructions accordingly.*

The research focus at IISc molded me to be in R&D all through my professional life. I have had a very satisfying professional life so far. For 2007–2008, I shared the most coveted and prestigious GE Research Award, called Dushman Award. This is probably the first international award in India for engineering research coming from the world's biggest business house working on all frontier industrial research areas.

My basic engineering learning happened at IISc, and this knowledge always helps me in my work, whether directly or indirectly.

***Vision for year 2020**: IISc should get into the top 10 institutes/universities of the world. Hope that prestigious awards like Nobel Prize and alike are won through interdisciplinary work between science and engineering departments. I would love to see parking spots like "reserved for Nobel Laureates" on the campus.*

Go green. I see lots of deterioration in the last 20 years."

Sohan Rashmi Ranjan
B.E. Elec. Tech Electronics 1983–86; M.Sc. (Engg) Elec Engg 1986–89, Lead Scientist, Imaging Technologies, General Electric Global Research

"Very good academic environment, development of good personal and intellectual skills. Stint at IISc has given confidence to compete at any level. The studies have been extremely useful. I have attended one alumni meet and gave a talk at a student symposium at the Department of Materials Engineering in 2007. I have memories of a number of talks and cultural events there.

Though IISc is probably the best in India, its brand is not known that much in Europe. To attract talented Ph.D. students a raise in scholarship would probably help, especially with IT boom consuming them all."

M.G. Basavaraj
M.Sc. Engineering by research, Department of Materials Engineering, 2002, Ph.D. student, Department of Chemical Engineering, KULeuven, Belgium

"Confidence level improved. Wonderful Lab developed. Got promoted. Received consultancy projects, both from government agencies and private establishments.

The exposure and the research culture that I could receive at IISc have completely changed my approach towards a problem. An everlasting curiosity has been created in me and I wish I could stay there longer. The exposure through talks of eminent personalities at IISc enriched me in a big way. The thirst for knowledge has helped generate new ideas. Lectures by Hon. Dr A.P.J. Abdul Kalam, Dr R. Mashelkar, Prof. M.M. Sharma, Prof. S. Subbu, Dr P.J. Lemstra, etc. have enriched me in a big way. The Institute should be in the top five institutions of the world. It is possible with the help of alumni and the dedicated faculty and students. The alumni activities need to be made more proactive and regular follow-up required. Sometimes being in touch helps. Our best wishes are always with the Alma Mater."

Dr Sujay Chattopadhyay
Ph.D., 2002, Chemical Engineering
Assistant Professor, Department of Chemical Engineering
Dr Babasaheb Ambedkar Technological University
Lonere 402 103. Raigad, Maharashtra.
Phone: 91-2140-275142 (o); 275198 (r); 0-9421254932 (M);
Fax: +91-2140-275040

"Had done my M.E. thesis in control systems; career is in the same broad area, nice coincidence.

Prof. Dhawan chasing the 'miscreants' who were splashing colour on students coming out of the library on the Holi Day was an interesting anecdote. Lots of wonderful times spent at the Gymkhana listening to the Juke box, and playing shuttle badminton as well as table tennis after a very satisfying lunch as a Day Boarder in the Hostel Mess.

IISc should become a globally favoured destination for quality post-graduate education and research with encouraging, dynamic and forward-looking faculty. Construction activity on the campus should stop. Restore the green cover of the 1970s."

Krishna V. Prasad
M.E., EE, 1976
Head, Power Initiatives, TCS.
krishna.vp@tcs.com

"The experience during studies and thereafter too has been excellent. Mt studies at IISc have been extremely relevant at work. There have been frequent interactions with various faculty members of Electrical and CSA departments on various areas of mutual interest. Have made lots of friends and classmates from all over India. It provided a great exposure and respect of national scenario. The relationship with most of them is continuing and really cherishing at any time. The brand equity of IISc has helped me in my career on many occasions. I wish IISc to be the most outstanding research institution in the field of science and engineering in India. Also, it should contribute to national growth through academic and industry cooperation. There should be more cultural programmes to improve relationship among alumni.

Dr C. Subramanian, M.E., Electrical 1971, Ph.D., CSA, 1991
Chief Scientific Officer, BAeHAL Software Ltd, Bangalore 560 017, India. Ph: 91-80-25225867/ 98804 46746 (Mobile)

"I could conduct independent research and tackle new engineering problems in microwaves, antennas, and communications. The research experience I have gained at IISc in the field of dielectric antennas has been successfully utilized in developing low-cost high-efficiency (70%) antenna systems and feed for ISRO, NRSA and DRDO."

Dr Surendra Pal, Ph.D., ECE, 1984
Distinguished Scientist/Programme Director, Satellite Navigation Programme,
and Deputy Director (Digital and Communication Area),
ISRO Satellite Centre, Bangalore 560 017.
Phones: 91-80-25083301/25205275(o)

"Twenty-five years of experience with Central Water and Power, now changed to Central Electricity Authority, Government of India, 12 ½ years of experience in the Power Division of Asian Development Bank (ADB), Manila, Philippines. The training at ECE was very relevant and useful application to carrier communication and relaying for the protection of HV transmission systems associated with a number of power projects in India and in other developing countries in south-east Asia and south Pacific with which I was associated with while at ADB, as well as in load dispatch in power systems in these countries.

One experience of IISc deeply etched in my mind is the late hours spent in the wonderful library, so quiet and inspiring. I hope that this prestigious institution with a galaxy of brilliant and dedicated scientists and professionals will grow in stature in the future and continue to lead not only the country but also the entire region as a premier scientific/ technical institute."

V. Srinivasa Rao, ECE Dept, 1950
raopam@rediffmail.com

"It is a pleasure and honour to write about IISc after 35 years. My IISc degree helped me get admission at the University of Minnesota. Back in those days, IISc was the only Indian school with name recognition at the University of Minnesota. The foundation education that I got at IISc went a long way in helping me at the U of Minn. After getting through IISc getting a 4.0 GPA at U of Minn was a piece of cake! Unfortunately, of late, all the people I knew at ECE have now retired and maintaining contact has become a challenge.

I remember the time when the textbook in one of the ECE courses that I took was not available in an Indian edition. Of course, most of the students in our class could not afford to pay the cost of the imported text from USA. There was only one copy of the text available in the library in the textbook section. I remember signing up for a one-hour slot to get the book at an ungodly hour in the middle of the night! But I think the experience that I gained at IISc is responsible for my work ethic today.

I would like to see IISc produce a Noble Laureate by 2020!

The IISc alumni association is a great idea. It gives us a change to stay connected with our past."

B.R. "Raja" Suresh
B.E., 1973, ECE; M.S. (1975) and Ph.D. (1979)
(all in Electrical Engineering) University of Minnesota
B.Suresh@gd-ais.com