

Making of a leading scientist – C. N. R. Rao*

In a fine setting of the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore, one can find C. N. R. Rao. When one enters his office, it is hard not to notice a stack of Ph D theses of his students and a collection of books and photographs of the great chemists he admires. During an interview with Rao on 5 April 2011, I was fortunate to get a sneak peek into his wardrobe full of medals. In December last year, Rao published his autobiography, *Climbing the Limitless Ladder – A Life in Chemistry* (see Box 1), with an aim to highlight the positive aspects of his life and to narrate how science in India could be done when there is a dearth of equipments.



C. N. R. Rao at JNCASR

Primarily a researcher

Who were the significant sources of inspiration for you, Prof. Rao?

In personal life, as distinct from professional life, my mother was the most influential during my childhood. She was my teacher as I never studied primary school; I went to middle school at the age of six; she taught everything at home. She did not bore me to death like schools do! In science, my school teachers were quite inspiring. I never had good teachers in college though.

In professional life there are a few scientists who have inspired me much. But only those scientists who have worked all their life have inspired me; those who were great but published one good paper, got a Nobel Prize and then pursued something else, have not created an impression on me. In India, only two scientists (leaving out mathematicians) have inspired me – J. C. Bose and of course, C. V. Raman, whom I knew well.

I found Linus Pauling great. I read his book, *The Nature of the Chemical Bond* when I was young. Later, I wanted to do research in the area in which he wrote the book. When I was in Banaras Hindu University, I wrote him a letter to which he replied. Eventually, I worked in a similar field for which I had to go to the United States. Later, a Nobel Laureate in Chemistry, H. C. Brown, was an inspiration. Though I was not his student (I was a Ph D student working in some other area), I used to go and meet him whenever I had some small ideas. I published a lot of things on my own when I was young, because of Brown.

Much later, there was Nevill Mott of Cambridge, one of the greatest names in solid state physics. I was a young man and was invited as a Commonwealth Visiting Professor to Oxford University. Mott had come to Oxford to receive an honorary doctorate. He gave a seminar in the Inorganic Chemistry Department of the university. I went to meet him after the seminar. I told him about the kind of ideas I had and he asked me to meet him in Cambridge. Two to three days later when I visited him, he was waiting for me at the bus station. After that I visited him several times. I remember when he was 91 and I visited him, he was working on something. When I asked, ‘Prof. Mott, what are you doing?’ He said, ‘Prof. Rao, I am correcting proofs of a paper.’ You do not find such people nowadays. The year he died he published four papers. He was an extraordinarily kind and wonderful person. He would wait for me to have lunch together. For his 80th birthday and also for his 90th birthday, I and a Professor from Cambridge edited festschrifts for him. He was a great source of inspiration.

You have been a researcher, an administrator and the Chairman of the Science Advisory Council to the Prime Minister (SAC-PM) of India. Which role did (or do) you enjoy the most?

I am mainly a researcher. Though I play the role of a scientific advisor, most of my time goes in research. I have concentrated on research every day of my life. It is my 60th year in research, of which I have been a faculty member for 52 years. I adjust the rest of the activities to the

availability of time from research. If anything destroys my academic work (research work) I do not take it up.

SAC-PM does not meet every day; it is once a month or so. I have to write and correspond but it is a sort of a relief from the routine. In the last few years, particularly in the last 2–3 years, I have had a busy research time. Though I am getting old, I have been publishing interesting work. This has not been affected in any way by the other things I do. I give lectures to children; recently I went to Pune to give three lectures, and I continue to produce educational study material for children. My book *Understanding in Chemistry* was recently translated into Hindi and published by the National Book Trust. A booklet *Chemistry Today* has been translated into Bengali and other languages. The little book *Nano-world* has come out in Swedish and many Indian languages.

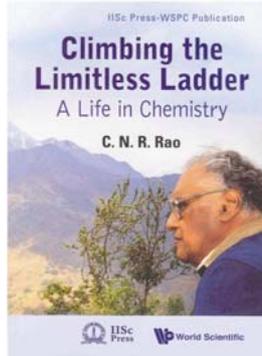
How influential were your mentors and colleagues in your recognition?

I never bothered about recognition! When I was around 30, Prof. Raman wrote me a letter, after seeing my book *Chemical Applications of Infrared Spectroscopy* and asked me if I would like to be a fellow of the Indian Academy of Sciences (that letter is reproduced in my autobiography). Another day, I got a letter informing me that I have been awarded the Bhatnagar Prize. I did not even know I had been nominated for the prize. That is how it was. I was 34 years old when I got the Bhatnagar Prize. Then I got the Marlow medal from the Faraday Society of England around the same time. I had no idea that I would get it.

I did not expect to become a Fellow of the Royal Society of London. Then every other Science Academy elected me – US National Academy, Pontifical Academy, French Academy, Japan Academy and so on. I have not asked anybody for a favour till now; others have been kind. I have a lot of friends and colleagues; I cannot say they are my admirers, but they have all been kind to me. Some of them must have nominated me for the recognitions.

In early years of your career you moved from one institute to another. Did that help you choose the best

*The complete version of the interview is available at <http://www.ias.ac.in/currsci/25may2011/1466a.pdf>.



Box 1. Autobiography of a leading figure in science – A review

Those days: Rao describes the first quarter of his life, from the childhood days he spent in Bangalore to the beginning of a scientific pursuit in Banaras. He was a teenager when he left his home town and decided to be a chemist. He admits that it was perhaps when he listened to C. V. Raman's lecture that he 'took the subconscious decision of becoming a scientist'. Something about his dreams is what most of us share: 'I frequently dream of those dreaded final exams and wake up with a start. I dream that the exam was in physics, but I would have prepared for chemistry...'

Pilgrimage for Knowledge: Banaras to Berkeley: Rao traces his journey in science from doing a master's at Banaras Hindu University, India, to getting a research position in the United States. 'It was in Banaras that I took the decision to pursue scientific research as my life's mission,' writes Rao. He used to be so excited about the work of great scientists

that his friends started teasing him by calling him a professor. After BHU, he spent a few days at Indian Institute of Science (IISc) and then at Indian Institute of Technology (IIT), Kharagpur. Dissatisfied at both places, he decided to join Purdue University in the US to study molecular structure by electron diffraction of gases. After leaving Purdue University he joined the 'academically empowering' University of California, Berkeley, as a research associate. Then came the decision of returning to India.

In Search of a Place and a Purpose: Rao returned to India in 1959 and joined the Department of Inorganic and Physical Chemistry at IISc, despite being offered the lowest rank and salary among the three offers he had in India. After about three years at IISc, Rao felt it was 'near to impossible to accomplish' what he wanted to do at IISc. So, he joined IIT-Kanpur as an associate professor. Soon he became head of the Department of Chemistry (at the age of 30!) and a full professor. Rao also shares some anecdotes about the 'unique characters and personalities' in IISc and at IIT Kanpur that a young reader could easily relate to.

A Long Journey: Rao visited Oxford for a year, and in 1976 joined IISc again, but this time things turned out differently for him as well as for the institute. He built two new centres – the Materials Research Centre and the Solid State and Structural Chemistry Unit – at IISc. In 1982, he was elected Fellow of the Royal Society of London. He became the first Indian to be chosen as Nehru Professor at University of Cambridge. He returned from Cambridge in 1984 and was appointed Director of IISc; his term was extended, ending in 1994. While he was Director of IISc, Rao started to build (in 1989) the Jawaharlal Nehru Centre for Advanced Scientific Research.

Labyrinths of Power: Rao discusses administration and bureaucracy, his involvement with the National Committee on Science and Technology and mentions how the excellent ideas thrown out at the time never saw light of the day. The establishment of the Department of Science and Technology itself faced resistance from the then head of CSIR. Rao was a member of the Scientific Advisory Committee to the Cabinet during 1979–83. He continues to be the Chairman of the Science Advisory Council to the Prime Minister.

Great Fraternity: 'One of the most pleasant aspects of being a scientist is the opportunity to belong to a large fraternity. One gets to know people from everywhere through science, giving a sense of belonging to the world at large.' Over the years Rao got involved in various scientific organizations and committees across the world. From being a member of the chemical education committee of IUPAC, he became its president.

Reflections: Rao looks back into his past and there seems contentment in his words. In spite of his dedication to research, Rao enjoys teaching. He believes that the publishing virus that attacked him when he was young has benefited him, though he seems apprehensive of the refereeing system of journals. He is of the opinion: 'Big science has received undue importance in the country.... In reality, the world is being pushed forward more by small science.'

Honours and accolades, publications in the form of books and research papers, honorary doctorates, election to science academies and visiting professorships, are all integral to Rao's academic career. Rao admits, 'While friendships and collaboration are important, what really increases visibility in the community of scientists are research publications, reviews and books.' However, for him: 'Science is not...about getting awards or writing papers. It is a way of life.'

place to work? Will such an approach be useful today?

Going from one place to another is always for the better. The quality of my work immediately improved when I left Bangalore for Kanpur. When I came back, I built new labs with better facilities. After that, I built JNCASR, and I know that the best lab here, in terms of

facilities, is not comparable to what I have built elsewhere. One thinks of new problems and areas of research when one goes to a new place.

A little bit of mobility is a good thing, but unfortunately in India, mobility has become poor. The Government of India rules are such. Suppose you work for 20 years in a place and then go elsewhere, you lose all the benefits including pen-

sion. We are trying to fight the Government over this and I hope that we can rectify this soon.

How significant is collaborating with researchers abroad and in what ways does it help?

I have done most of my work on my own. Your neighbours can't feed you

every day. If you want to do good science, you better do it yourself. A little collaboration once in a while is okay. I have collaborated with a lot of people but that is insignificant compared to what I have tried to do. A couple of weeks ago I crossed my 1500th publication (research paper). I found out that in the last four years my citations and impact index have increased. My citations per year are around 3000 to 3500. You go on doing work and improving the quality of your work. There is no other metric or measure other than yourself. When you know the literature, you know where you stand. You must know how to compete, and to do research as good as in the West. I keep on doing it. There is no end to it. Collaboration is important, but cannot replace one's own efforts.

Returning to India – A tough choice

If your mother had not insisted on your return from the United States, would you have given up the best offers and returned to India? The choice of returning may have come with the risk of securing a position while declining the offers...

My mother was one of the reasons. I am the only child of my parents. There is a peculiar nationalism in me; I am proud to be an Indian. Somehow, coming to India was always behind my back. There is no doubt my mother was one but not the only reason. I also wanted to do something in India.

It was not a risk. It was a shock; I assumed that I took the best possible faculty position at the Indian Institute of Science (IISc). Facilities at IISc were pathetic. I remember if one had to go to a conference, he would be paid third class rail fare. As soon as I joined I took two Ph D students to work with me. Within one year I had four students. I had a small research group. Within the existing facilities I did what I could. Some of the papers I published there are cited even now. One of my papers of those times is cited about 300 to 400 times. It is a paper of 1960 or so that I wrote from IISc.

I was doing very well in the US; nobody believed that I would return to India from the US. I had published well and people believed that I would get a faculty position in some US university. I had some offers but I didn't proceed. I

had to take a sudden decision of joining IISc. If IISc had not offered me a job, maybe I wouldn't have come back.

In your autobiography you make two contradictory statements – you left IISc due to lack of facilities (and moved to IIT-K) and that IISc was the best place for a career start...

Facilities were absolutely terrible. Intellectually, IISc was the best place and it is like that now also. There is intellectual freedom. But this is also a problem with IISc. Many people don't work because of that freedom. If you want to build your own group, you should do your own work but many in the faculty don't work enough.

I enjoyed the extraordinary freedom of IISc. Intellectual freedom is one of the ingredients of success in science, but that alone is not enough, you need facilities and good students (young people). The reason I keep all their theses on the shelves is to never forget them in my life. This year, seven students are finishing Ph D with me. I have had a fantastic battalion of young people. It is necessary to have students.

Universities in India don't work well because somebody is always sitting on your head, shouting at you, imposing rules against everything. You cannot do research because somebody won't allow you to spend the money you get for projects! IISc did not have this approach; it gave freedom to young people. In fact, at the age of 26, I had more students than the older fellows in my department. There is no contradiction in what I wrote. The reason I came back to IISc was because I received two huge grants which I could use to equip my laboratory. Otherwise, I wouldn't have come back. There was no well equipped place in India those days. If IISc was bad, then you can imagine what the universities were like. The only few places with some equipment were the national laboratories like NCL, Pune and NPL, New Delhi. I used to go to NCL to take some measurements.

About chemistry – a subject not so popular

Chemistry is generally perceived as a play with chemicals. The science of chemistry does not get through to the

public. How do you think one could achieve this?

Chemistry is a broad subject now. It has interfaces with every aspect of life and every aspect of science, whether it is biology, medicine, or advanced materials. Take any subject and you find a chemical interface. In fact, without chemistry biology cannot progress. Half of materials science and nanotechnology is chemistry. The chemistry we do in the research laboratory is different from what we teach in schools and colleges (which is terribly boring). Research is exciting. If you see my lab, there is hardly anybody working with coloured solutions and smoke. We have got an electron microscope, one of its kind in India, at JNCASR. Chemistry requires fancy equipment. For my Ph D work I had to build a diffractometer for electron diffraction of gases. Building instruments was a learning experience. In the early days building instruments was useful. Now there is money to buy them, people know little of instrumentation.

Chemistry, as perceived by the common man, has no relation to reality. The reality is that chemistry is exciting and challenging. In fact it is one of the more difficult subjects to compete in because there are so many chemists. It is the largest professional body in the world. To become well-known in chemistry is more difficult than to become well-known say, in physics (not that everybody becomes well-known in physics).

I recently received the August-Wilhelm-von-Hofmann Medal from Germany. It is awarded once in two years to a chemist. No Asian had received it. It was created by the Germans soon after the Nobel Prize was created by the Swedish Academy. I was told by my friends present at the medal ceremony that they were surprised that I got it because this medal had generally gone to organic chemists. People like me who work in physical chemistry, materials chemistry or instrument-oriented chemistry, normally do not get it. I did not know that. Even now, within chemistry there is dominance of organic chemistry, where people like me (with solid state or materials background) are not favoured.

What do you think is the problem with teaching of chemistry and how can it be fixed? How can school students, most of whom dislike chemis-

try, be made more interested in the subject?

They say because there is IT, web, etc. education will improve. I do not believe in this. I do not think that these artefacts, including computers, will help education that much; it will be useful to have these agents if you already have everything else. Eventually, it is the direct contact with the teacher that is crucial. The teaching profession has to be given more respect. Teachers should be given more salaries. A recent survey has revealed the best places for science education in the world. The number 1 rank has gone to Finland, second rank to South Korea and America is way down. Of course, India doesn't figure at all. In Finland, teaching profession has been made most respectable. Good remuneration is given and people like to become teachers there. We must get the best of our minds to teach science and engineering, in fact, in all subjects. If this is not done, I do not see how anyone can get excited about science at school. Chemistry is particularly not an easy subject to teach.

I used to teach first-year undergraduates at IIT Kanpur. D. D. Sarma and K. Vijayaraghavan (now in Bangalore) were my students. I tried to make chemistry exciting with demonstrations and stories. It takes a little effort. Not many people do this. As a matter of fact, the problem of poor science education is all over the world, not only in India. America is not doing well either. Even Europe is not doing well. India has a good chance in its villages where children are enthusiastic. I think we can improve our education at least in rural India where there is a lot of excitement. Cities are not as exciting, Bangalore is one of the worst cases.

Students will naturally be interested if we teach them well. We don't have to ask them to be good in chemistry. Chemistry should be studied along with physics, biology and mathematics. Unfortunately, nowadays a student cannot have biology if he is a student of chemistry. If he took chemistry and biology combination then he is not allowed in many other fields. We should have all the four subjects and teach them properly. All we need is good teachers. JNCASR is starting a post-graduate Science Education Programme (one-year programme) for teachers. We have received lots of applications for this course.

How is research in chemistry different from that in other sciences?

Physicists are always looking for some universal laws or theory or for doing some fundamental experiments. In chemistry also we do that, we verify theory. In addition to everything, there is something called chemical intuition. People do not talk about physical intuition as much as chemical intuition. There is a peculiar feeling that something will work, why and how are unanswered; a new material will be formed, a new process will be created, etc. Chemical intuition is difficult to get; one has to work hard for it and over a period of years people get it. Some people never get it and die without it, after working for 50 years. Those who have intuition like Michael Faraday, one of the greatest chemists in the world, do unbelievable things. How did Faraday think of electricity and magnetism? How did he conduct electrolysis experiments when electron was not known? It still amazes me that he discovered benzene in those days. When he made the gold nanoparticles first, how did he know they were nanoparticles? There was no device to measure, no microscope. Those who develop this intuitive ability succeed. That is true of all subjects but more so in chemistry.

Publishing, more publishing

You have always laid an emphasis on publishing. But some express concern about the race to publish papers...

Even now I lay emphasis on publishing papers. I am not in any race to publish. I have always had about 20 people working with me. Because I worry about them a lot, I get more papers. I don't allow my students to waste time. I worry about everything they do and I talk to them everyday. Hence there is more productivity; in the same area, others publish one-third of what I publish, be it my friends in University of Cambridge or University of California where I am still a Professor. I am lucky that I publish more, that's all. It is not easy to publish. I consider not publishing as terrible. Those who say publishing is bad should not do science. Faraday and Raman believed in publishing. Faraday's famous statement was 'Work, finish and publish'; he published 450 papers. I do not know how he did

that without any students or assistants. To me publishing is an essential part of doing science.

China has claimed that in 2013 it will be ahead of United States in science in the number of publications, but I am not sure that China is going to beat America in quality for another 50 years. Our concern in India is not quantity but on improving the quality of science. If quality is good, India will do well, but we are not improving the quality. In biology there are only three people or so in India with an *h*-index of 30; there should have been at least 30 or 40. This is the case with biology which has the maximum support in India. There are a few chemists whose *h*-index is above 50. There are about 10 researchers in India with *h*-index 40–45, in all the sciences put together.

The best Indian scientists do not prefer publishing in Indian journals. What could be done to improve the quality of Indian journals so that researchers start publishing?

That doesn't matter. I also do not publish much in India; I used to. I have nothing to say about how we can improve Indian journals. I used to worry a lot about this; I started two journals of the Indian Academy of Sciences but our best scientists do not publish there. I tried to get at least one paper a year from them, but did not succeed. I published one paper last year in the *Journal of Chemical Sciences* and it has been cited. It is the first paper on the use of graphene for supercapacitors.

What are your views on the peer review process of scientific scrutiny? Has peer review been detrimental to your career at any point of time?

We can always criticize the peer-review process but there is no alternative. Some people are against the referee system of publication and refereeing of research grants, but there is no other way. It is true that there is some prejudice. I have been told that when Indians send a paper to certain major journals of the world, there is an in-built perception that Indian papers are not of good quality; they look down upon Indians. Maybe there is some truth in it but we have to fight. Sometimes you get discouraged. I called it in a talk of mine as 'referee fatigue' (Balaram

mentioned it in his editorial). There is no doubt about this; people get exhausted fighting referees. We have to fight to survive in science. I still fight with referees but I manage. God has been so kind that I could reach an *h*-index of 90 at my old age. If you go on publishing, people will cite your work if it is good enough.

Indian science and investments in science

Do you think the science share of budget 2011 is sound?

Not bad. We now have the new National Science and Engineering Research Board which will have about Rs 600 crores in the first year. I do not know if we can spend more than that. Eventually we will require more. After one year we will have to get more.

India's investment in science is just not enough. If you look at the condition of our universities like Banaras Hindu University and Aligarh Muslim University (central universities) and compare them to a good university in America or Europe, and if India decides to bring up at least a few of them to world-class level, then we have to invest more. If you exclude such investment then what we have is enough. There is a new statement from SAC to PM about the essential steps for progress in higher education. It is a warning to Kapil Sibal and others who need to attend to these on a war footing.

At least one IIT should be like MIT. A few months ago I went to give the Arthur D. Little lectures at MIT. There is vitality; you can feel it in the corridors of the institution. MIT does not give up anything, be it research, technology development or publications. This is how an IIT or IISc should be.

In a recent interview with 'Science', you said you are 'a bit depressed and discouraged by the state of Indian science'. What problems were you referring to and what are the means to overcome them?

There is not enough 'India shining' in science. I was shocked to see the citation analysis done at the institute. I expected much better performance from India. I expected, say in physics, at least 20 people doing world class science. I am a member of many international award commit-

tees and there are hardly any Indian nominations, let alone awardees. We should have at least 100 highly recognized scientists and at least 20–30 top institutions.

What are your views on Indian Science Academies and their functioning?

They have generally let me down. The only Academy out of the three, the Indian Academy of Sciences, Bangalore, does best of all. It is more academic than others. I have not had much inspiration from Indian National Science Academy, New Delhi; I also didn't need it. The Royal Society, London, has come more to my help; it has recognized me with the Royal Medal, the Hughes Medal, etc. I was also the only scientist to deliver a talk at the Royal Society's 350th anniversary gathering in London.

What do you think about early specialization in science that has been criticized lately?

We should give broad science education with all the subjects in the beginning – a 'core' programme in science – somewhat like the Integrated M Sc course at IIT-Kanpur. In the first year or two students would learn computer science, physics, mathematics, chemistry, biology, etc. They specialize later. At present, a biologist does not know physics and a chemist does not know biology. It should not be like this. Over-specialization is bad. It is better to have a biology background and then pursue biotechnology. Lots of people do biotechnology or nanotechnology as a subject. One can do nanotechnology research but not get a degree in the subject. Let us not forget most problems we face require interdisciplinary solutions.

So, what do you think of interdisciplinary research in India?

My research has always been multidisciplinary. You don't have to go out of the way to call it so. Our approach to science should be multidisciplinary. For example, those who do chemistry must know physics or biology. The kinds of research problems you tackle decide the interdisciplinarity. Emphasis should be more on research of that kind. Instead of doing old fashioned organic chemistry or old

fashioned physics, one should take up problems which are challenging and multidisciplinary.

A lot of emphasis is laid on taking up post-doc positions abroad...

That is a serious matter. I have rarely had a good post-doc from India. My doctoral students get Ph Ds and they are ready to go abroad. Those who come to me from other universities in India are generally not well-trained. If you are looking for a post-doc to work in institutions like mine then you have a tough time. This is a serious problem in India.

India's stand relative to China

Do you think it is fair to compare India with China all the time in terms of scientific output?

With China, there is the number game. When I visited a university in China I enquired about the number of postgraduate (research) students in the chemistry department. I was told 600! In one department there are 600 students, and 200 professors. I had a Chinese Ph D co-worker in Japan. He just went back and is now a professor in China. Everybody seems to be called a professor in China. China has a large body of students, but it also has a lot of plagiarism.

I do not want to imitate China but we have to learn from them the way they have given importance to science, investment in science and building of institutions. They have invested a lot more than we have. We do not have to have thousands of students. There is Chinese nationalism that we cannot beat. Many Indians feel shy about things India has; they do not admire anything Indian and are generally negative. By and large, our students have better prospects, they get better money, but somehow they are also a bit negative. Look at our press, particularly TV channels; they are always looking for something to go wrong.

China has been criticized for its means to bring back its scientists...

That stage is over in China. They sent thousands of scientists at their expense abroad and got them back, which we have not done as much. In some of the areas where we need expertise or we do not have adequate knowledge, we should

send our young people abroad for Ph D or as post-doc fellowships to the right places and get them back.

Digging into the autobiography

When you moved to BHU for a graduate course, you write in your autobiography, that you faced others who were more skilled than you. Besides, there might have been a culture shock too. How did you cope?

In those days Delhi University and Madras University had higher standards than Mysore University. They taught more, they had specialization in chemistry which Mysore University did not have. So I had a slight difficulty in the beginning but I made up fast.

I liked North India. UP was a wonderful place in those days. People were warm, and they welcomed everybody. BHU had a few students from U.P. When I was there, out of about 20 students, two or three were from U.P., rest were from Maharashtra, Kerala, Andhra Pradesh, Karnataka and Tamil Nadu. BHU was a national university. Madan Mohan Malaviya was indeed a great man. I lived in Kanpur and did not miss anything of Bangalore. I enjoyed IIT-K. But the city has nothing to offer.

In your autobiography you haven't detailed the difficulties you faced in your research career. For instance, you express that you faced insults and criticisms at IIT-K but not what they were...

I faced lots of criticism. People have a tendency to criticize others' research in India. Some said that the kind of research I was doing was not chemistry. I did not carry out research in old-fashioned chemistry that people used to do in India – making compounds. I did spectroscopy. For them it was new. India can be very negative and sometimes difficult to thrive in. This may not be so anymore. Being awarded the Faraday Society

Medal gave me tremendous confidence when I was young.

I wrote my first book in 1960 about UV visible spectroscopy published in London. They said, what's the big deal? When my second book was published from the Academic Press, New York, Prof. Raman wrote to me. When you cross a particular barrier beyond those who criticize, they become helpless. They will leave you alone after that. But in the initial stages it becomes difficult. Nowadays things are improving, maybe because there are more opportunities; maybe people are learning to be more generous. Young people are much better off at least in IISc and several other institutions. In many universities, this may not be so even now.

India can be cruel if you don't watch out. Those who have accomplished can get attacked in India. The way people attacked the space department in the recent scam was shocking. I am so happy that Kiran Karnik wrote an open letter addressed to the Prime Minister.

Bhopal Gas Tragedy – a tragedy in science

You were witness to discussions on the Bhopal Gas Tragedy when you were chairing the Science Advisory Council. Could you share your experience of the ongoing discussion at that time?

When I was President of the Indian National Science Academy, I had tried to arrange a meeting thrice to explore the scientific truth of Bhopal. At the last minute, all the speakers would back out; they were forced by their agencies not to attend. I had close friendship with S. Sriramachari, who was the Director General of ICMR and has been quoted in Balaram's Editorial. He would tell me many things. He wanted to come when the meeting was in Bangalore, but was not allowed. NCL scientists did not come either. Every one of them pulled out. We could not have a meeting on the scientific truth of Bhopal! This is one reason

Rajiv Gandhi got upset. My friends, whose names I won't mention now, were heads of agencies. When I was sitting with Rajiv Gandhi in a meeting, he asked if there was HCN in Bhopal or not. Nobody answered him. Neither yes or no. I told him that there seemed to have been some HCN according to my friend Sriramachari, but he could never make a public statement.

I feel ashamed because I was the President of the Indian National Science Academy, the obvious body to organize a science meeting. That was a tragedy of India as far as science is concerned. We must have scientific honesty and scientific integrity.

Success mantra for our budding researchers...

Take interest in what you like. Keep working hard and you will succeed. Those who persevere in India succeed even in India. We want a number of successful people in India and we need dedicated young people. There is hope because there is a large population of young excited people in India, particularly in rural areas.

About the journal *Current Science*...

I read *Current Science*, and find it readable. I do not read all the scientific articles published in it. I read the articles in the beginning. Some of the general articles are nice and reviews are okay. I don't read the technical ones because I do not need *Current Science* to learn chemistry. The book review section towards the end is fine.

I do not like most of the letters published in the journal. Letters are the same old, boring discussions of how we should evaluate research or something like that. Some of them should not be published because they are poor and there is nothing cerebral about them.

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