

"We will no longer talk of the history of science, we will talk of the geography of science, the emergence of India and China"

It is not for nothing that he is called the 'Warrior of Haldighati.' India is emerging as a global platform for R & D and it started in Pune in a government lab called National Chemical Laboratories. The man who started the wave was RA Mashelkar. How did a boy, who lost his father at six and went barefoot till 12, go on to become India's best-known scientist in promoting and defending India's scientific interests at a global level? Here is that inspiring story told in a conversation with Sucheta Dalal and Debashis Basu of MoneyLIFE at NCL on Sunday morning. Published on 31st August 2006. Excerpts from the interview.

ML : We gather that you had difficult childhood. Can you take us through your formative years?

Mashelkar : I was born in a place called Mashel in Goa. My father died when I was six and my mother came to Mumbai in search of a livelihood. She was an illiterate woman and I was the only child. She did practically menial work or stitched clothes to bring me up. It was a tough childhood. Getting two meals a day was a problem. I call my mother the greatest food technologist. She had mastered the art of cooking one meal in a way that I did not feel hungry at night.

I went to a municipal school (Upper Khetwadi Primary School) and I remember, the school itself was so poor that they could not afford to buy question papers. A test was held every Saturday and we had to buy the question papers ourselves. One day, I remember, we did not have three paise that were needed to buy them. When I had to go from primary to secondary standard, we needed Rs. 21 as the admission fees.

ML : And your mother was determined to put you through schools?

Mashelkar : Absolutely, I will tell you something special about her little later, which I discovered when I myself turned 60. Coming back to my school days, a housemaid at Chowpatty came forward and offered those Rs. 21. It was her life savings. She gave it to my mother saying, "Your son should study." In my SSC examination, I stood 11th among 1,35,000 students - without any guides or any classes.

ML : During your school days, were you always a good student?

Mashelkar : I always topped the class. And the interesting part was that I took a great interest in all sorts of activities. For instance, I used to write in Marathi. When I was in the sixth standard, I wrote for a magazine called Manthan. There was a prize for the best idea called Ek Rupaiya Ani Ek Anka (1 rupee and magazine) and I won that. Can you imagine what the topic was? It was on love (laughs). I used to write for all sorts of magazines. In fact, I was very fond of seeing my name in print, I must admit. I wrote not just for children's magazines but also for a farmers' magazine on bananas by going to the library and researching on bananas. Nobody taught me, how to do it? I did it on my own.

I used to write out the pieces on a foolscap paper and to save on postage, I would deliver it myself. The problem was that I was too young and could not let anyone know that I was the writer. And so I would actually lie. I would say, "Raghunath Mashelkar has sent me with these articles." I missed the Ram Ganesh Gadkari prize (that is supposed to be the highest prize) by just two marks for a play, which I wrote, acted and directed in the ninth standard. But the funny thing is that I was so focused on directing that I actually forgot my own lines (laughs). So, even though I was poor, I lived a full childhood.

ML : And there was never any pressure on you to earn.

Mashelkar : My mother was determined to make me study. She even used to walk miles to get some stitching work. In fact, after I did my SSC, I said, "Enough now, let me look for a job." But because I had stood 11th, a lot of my friends came forward and supported me. They pooled together the Rs. 200 needed and I went to Jai Hind College. Then I got Sir Dorab Tata Scholarship of Rs. 60 a month for six years. I often say to Ratan (Tata), who is a good friend of mine, that you may not even have noticed the Rs. 60 a

month, but it made my life. After I did my SSC, my mother insisted that I go to college. When I finished my Inter-Science, I went to the University Department of Chemical Technology (UDCT). There again I stood first and went on to do chemical engineering.

ML : Why did you choose engineering and that too chemical engineering, when you could have chosen anything?

Mashelkar : My life was an unguided missile. In fact, we are now sitting in NCL, where I was a director for six years and I am supposed to love chemistry. Let me share something with you - I hated chemistry! Chemistry is something you have to mug as opposed to physics and mathematics. So, I wanted to leave chemistry at the first available opportunity. I had actually registered for mechanical engineering after being second in the university in 1962 in Inter-Science. Arun Dravid stood first. But Arun went to do chemical engineering in IIT and therefore I become the first. So, when the list came up for VJIT admission, my name was on the top of the list. But the story of my life is that of accidents. One day, I was standing at the bus stop and Arun was passing by. His father was an officer in the ICS. The year was 1961 and mechanical engineering was most favoured, while chemical engineering was among the least favoured. Arun told me, "Look, what I understand is that chemical engineering is going to be the big thing." He took me home and his father said, "You should never go by what is current. Look at the future." It was practically on the last day that I went to UDCT and filled up the form. And, that is how I became a chemical engineer.

After that, I had a number of fellowship offers from the US and Canada, but I did something different. I had been very impressed with one of our professors, MM Sharma. He was just 28 and was extremely inspiring. One day, it suddenly dawned on me, "Here is my guru. I must work under him. Why should I go anywhere else?" So, I registered to do a PhD under him. Nobody would normally do that. The peer pressure was huge. Everybody was going to the top US universities. I finished my PhD in three years, which was a kind of record. This was during 1966-69. When I finished my college, my mother insisted that I do engineering. When I got my doctorate, she had found out that there is something more : post-doctorate. I had often wondered from where she got this kind of drive and vision to make me educated. And then, it came out during my 60th birthday. There was a symposium here in Pune and a big felicitation. During the celebrations, a reporter from Marathi daily Sakaal interviewed my mother. Normally she never comes out and speaks publicly. But the tape recorded was on and my mother just opened up to this reporter. She told her a story, which even I did not know. When she was young, she had gone to the Congress House for a job. She stood in the queue for almost a day and when her turn came, she was rejected. That was because she did not have the minimum educational qualification and do you know what that was? It was passing the third standard. She could have easily lied. There are no certificates for the third standard exam. But she has never done that. That was one of the values she gave me. While returning, she suddenly thought, "Today, I am in the state mainly because I am not educated. I will make sure that my son gets highest degree possible." She did not know what that was but she wanted me to go as far as possible. That's how she had figured out about post-doc. She is a remarkable lady, an unbelievable influence on my life.

ML : So, Where did you do your post-doc work?

Mashelkar : Here again, there were choices. It was fashionable to go to the US. I was somehow fascinated by the UK, where I had a choice to continue in my own area at the University of Manchester Institute of Science. I also had Leverhume Research Fellowship, but it was for a field I knew nothing about. But, somehow, I felt I should go for this. I should not continue with what I know. I moved to the University of Salford, which was not very well known. I was there from 1969 to 1976. In 1974, something interesting happened. Dr. Y. Nayudamma was then the Director General of CSIR. He was sent to the UK by Mrs. Indira Gandhi, who asked him to go abroad, pick up the brightest and the best and offer them jobs on the spot. I remember, I got a telex from Dr. Tilak of NCL, "Go and meet Dr. Nayudamma." He did not tell me the reason. But this was a big turning point in my life. I had made a name for myself and had offers from three US universities and Imperial College. I was going to make a career decision. Dr. Nayudamma talked to me about emerging India, the challenges and how that new India could only be built by young people. I was only 31. I was really inspired. I agreed to join him without even consulting Vaishali, my wife, who always stood by me. The story of my life is a story of these two determined ladies. My wife said, "If the nation is calling you, let us go back." I came to this laboratory, on November 15, 1976 on a princely salary of Rs. 2100. The conditions were very hard. My wife had to cook on a kerosene stove because gas cylinders were

scarce.

ML : It was a shortage economy, caused by the policies of Mrs. Gandhi - which was another side to her.

Mashelkar : Yes, telephone connections took five years and Bajaj Auto Scooters even more. And only last month, we added five million cell phone connections. It is unbelievable. Anyway, we had a small computer here with a memory of 32k. Journals used to come by sea mail and took four months. So, even before the students read them, these were old. Today, I have subscribed to some 4000 e-journals for CSIR. The students can read them, the day the journals are out. There was a shortage of dollars and I discovered that the organometer I needed would take two years to be imported because of the various certifications and foreign exchange. And things used to go in circles.

ML : But you were never tempted to go back?

Mashelkar : This was the interesting part. My passport was stamped in a way that I would get a permanent residence in the UK if I went back in two years. I ensured that I did not go back in two years. I had made up my mind that this is where I would work. It was tough. But I was not in two minds. Then, of course, I gradually built a reputation in polymer engineering and became the director of this lab in 1989 and that is where another interesting phase started. I remember every time we did something that was ahead of the rest of the world and tried to offer it to Indian industry, they said, "But have they (meaning the West) done it?" This was a challenge to us.

We had been doing reverse engineering till then, copying their discoveries and we said, this is not on. But the context decides the content. Since the national priorities were import substitution, that is what Indian industry was doing. But I said, "I am the master of the local context. National Chemical Laboratory will become the International Chemical Laboratory in scope. What is the business I am in? Knowledge is my product and it has a world market. I am going to sell it to the US, Europe, etc." This was in 1989, two years before the economic reforms started. This was a paradigm shift and few things became very clear.

One, if I want to sell anything to GE or Du Pont and if I had copied it from them, they would kick me out and therefore, I had to be ahead of them. So, the benchmark for research in the lab went up. Two, I cannot sell it to them if I have not patented it there. Otherwise, they would be scared of an infringement suit. So, patenting was important. Can you believe it, though this lab was established in 1950, even after 39 years we did not have a single patent! Nobody had bothered. So I said, "Not publish or perish but patent, publish and prosper, in that order." This has always been the problem with India. Sir JC Bose was the discoverer of wireless, but when Sister Nivedita came to him he did not want to patent it, whereas a smart Marconi did, and that's what mattered. Today, nobody knows that it was Bose who discovered the iron-mercury-iron coherer, which is the basis of wireless technology. So, patenting started in 1988 and I fought the basmati patent that year. From Bose to basmati, it was a 100 year journey in realising how to create and protect knowledge in national interest. It led to an unbelievable change in mindset.

ML : NCL became a catalyst and you became a crusader on patenting that is why you are called 'The warrior of Haldighati'!

Mashelkar : My field is polymer science and engineering. I used to be so passionate about it that they used to call me 'Polymerkar', and later when I became a crusader about patents, they started calling me 'Patentkar'.

ML : Tell us a memorable incident of your ability to patent and prosper.

Mashekar : Polycarbonate, a substitute of glass, was patented by General Electric of the US. We made a breakthrough in the process, which was called solidstate polycondensation. It was unique and when the breakthrough came, we did not publish it but patented it in the US. This was like putting a flag on GE's territory. So, in 1991, I went to the GE headquarters to sell. I used to do the selling myself, by the way. I saw no point in sending a business development guy. He will not even be entertained. This was a scientific presentation in a meeting of scientists and I slipped in a 10 minute commercial about NCL. By afternoon, the composition around the table had changed. There were business executives who had joined. The word had spread that here is a guy who had something interesting to sell and by evening the senior VP met me. He made me postpone my flight to have an extensive chat. That is where a new journey began. They sent four people to visit us because they could not believe that we could offer them something new. When they came, they were surprised by the talent pool available. They wanted to start with some contract research. We were an unknown entity. Yes, we had an important patent and it could have been one of the lucky breaks. They wanted to test us out and wanted me to quote our fees. They knew the Indian salaries. Besides,

they had also been to the crumbling USSR, which badly needed dollars. I remember one of the GE team members said, "For this price, we can buy a whole Russian Institute." I said, "Go ahead and buy it. You will not get what I have to offer you."

ML : Even though Russia had as good or probably better talent?

Mashelkar : That was true, but I was arrogant. What I told them is, "I am offering brain hours, not man hours." So, don't count. They love aggression; they like if you talk like them. We delivered the project - in quality and on time. One of the projects we did was creating an intermediate for polycarbonate : THPE, as it is called. It is made in India now, and who produces it? Excel. It is something like a Rs. 50 crore business for them. So, jobs were created and wealth too with NCL research in India. I am particularly proud of the forward linkage being in India. Then the new journey picked up speed. After GE, Du Pont came, then Ciba Giegy, Genencore and so on. It did a number of things for us. One, the benchmarks were lifted. Second, If I held their hands, I had to run at their pace. If not, I would fall. GE was a fantastic partner. They trained a lot of NCL staff in Six Sigma (GE's approach to quality), which became available to the Indian Industry. These were the spin-off benefits. One consequence of that fruitful partnership was that it reached chairman Jack Welch, who remarked that if we were doing so well, why weren't we there ourselves, and the idea of Jack Welch R&D centre came up. I remember, Jean Heuschen and I were sitting in Maurya Sheraton in Delhi about 8-9 years ago, drawing the first blueprint of an R&D centre in Bangalore. It was a small plan for about a 100 people. When it reached Welch, he said, "Not 100, plan for 1000." Today, the centre has about 3000 people, about 1000 plus with PhDs. If today, India has emerged as global innovation platform, some of the seeds were sown here in NCL, Pune, 15 years ago. I remember in March 1995, I gave the Thapar Memorial Lecture titled 'India's Emergence as a Global R&D : New Challenges and Opportunities,' presided over by the then finance minister and the current prime minister. Nobody believed then that it was possible to do R&D and innovation in India.

ML : Even though NCL was already doing a great job!

Mashelkar : Yes, nobody believed it was possible. I had a theory. It is called 'skill-based competition'. Everyday products are transient in the marketplace. The company derives value from the market. But the critical part in competition is what skills you have, from what sources and how quickly you can put it all together to create a new product. This skill will not be permanent in a given company, they will be available all over the world, including research labs. My theory was that we can aggregate our technical skills and large manpower to create pools of resource and talent. Today, there are more than 150 such R&D centres in India and they are not small. If GE has 3000 employees, Intel has around 2800.

ML : So, Pune is emerging as a major hub for this, from where you started it all.

Mashelkar : Yes. Dow Chemicals wants to come here. Novartis is here. A big team from Glaxo SmithKline was here a few weeks ago. The global interest is immense. Everybody wants to come through CSIR. In the last few months, we had Owens Corning, Dow, Du Pont, Johnson & Johnson, Procter & Gamble, Eli Lilly, Glaxo, Shell, Carnegie Mellon, you name it and they have come to explore. I feel very pleased that here in NCL, we create the first ripples of this change. Recently, I had the audacity to lecture at MIT under the title : 'India's Emergence as a Global Innovation Hub : Phenomenon and the Consequence.' I said, we will no longer talk of the history of science, we will talk of the geography of science, the emergence of India and China and how this will be the centre of gravity. It has strategic consequences too - economic, political, social consequences. Once, when someone asked me to speak about strategic issues and what science & technology could do for them, I said, "Allow them to set up R&D centres here." They were surprised. I remarked that if India becomes a knowledge production centre with global linkages, they cannot hurt us. It has strategic along with social and cultural implications. Last years, when I went to GE's R&D Centre in India, I found that out of 2600 people, 700 were young Indians, who had come back. In fact, around 30,000 people have come back in the last three years.

ML : The reverse brain drain has begun indeed.

Mashelkar : Yes. It has started for a number of reasons. Now, people are not looking only at physical incomes but also at psychic incomes. If the latest Intel chip is designed in Bangalore, if the latest aero engine is designed in India, if the latest tuberculosis drug is being designed in Hyderabad and so on, they will come. Secondly, when I spoke in MIT, it was an exciting lecture, people were charged and three Indians came and said, "We want to come back." I said, "Look, you are in an artificially energised state after hearing me. So, please send me a mail after a month when you have cooled off a bit and I will believe

it." Two of them did. One of them said something interesting. He said, "At \$250 a month, we will be able to buy a car and hire a chauffeur in India." They know all the numbers - monthly installments, salary of a driver, etc. Coming back to India is not such a bad deal anymore. It is not only new opportunities and challenges but living conditions have changed. This is a new India.

ML : What you have done is created a change. You have changed the whole CSIR. It was like managing a large enterprise with many divisions. It needed leadership and management skills. Would you like to say something about that?

Mashelkar : In 1995, I became the Director General of CSIR. I remember in the very first interview, I was asked, "What is your dream for yourself and for CSIR?" I told them that I would like to be the CEO of CSIR Inc. and I wanted to do research in a businesslike manner. I did not want to warm up that chair as a Secretary to the Government of India. There were apprehensions in CSIR - 'Oh my god, this fellow will turn it into a business entity.' In 1989, when I became the director here, I had created a business development division and hired the first management guy in CSIR. I remember some top scientists telling me "you have brought the word 'business' here, that is going to corrupt thing." But that has not been the case. This year has been the best for CSIR in terms of both revenues and academic progress. In terms of business, we have done more than Rs. 350 crore of which earnings from the private sector were Rs. 100 crore, which is more than three times of what we had three years ago. In terms of academic work, we have crossed 3000 international papers in peer-reviewed journals. The Average Impact Factor, which signifies quality, has crossed 2, which is almost the same as that of Indian Institute of Science, our top institution. The same organisation was the best in science and one of the best in business. In 1998, I became a Fellow of Royal Society it is one of the JRD Tata Corporate Leadership Award, a very high business achievement award from the business community. CSIR is the only institution that figures as a case study in Sumantra Ghoshal's book **Managing Radical Age**, where all the other examples are companies like Infosys.

ML : How did you achieve this? What were the steps?

Mashelkar : I created a white paper called CSIR Vision 2001 through wide consultation. It became our roadmap. It created five goals and quantified them. I remember one staffer telling me that this will create problems because the government auditors will look at the targets and if we have not matched them, we will get hauled up. I said, "Wonderful. Let us be accountable." Dr. A. P. J. Abdul Kalam was a member of the advisory board. He said, "Make it Vision 2020, not 2001." I said, "Sorry, I retire in 2003 and would like to be judge before I retire."

ML : How many targets did you achieve?

Mashelkar : I will be honest with you, I missed four of them. We really aimed high. I always believed in diving and stretching. The process definitely did something to CSIR. We had a total of 38 needles, all pointing in different directions. My vision document was like a magnet. Everybody was oriented towards one direction. I did another thing. In my first year, I had visited all 40 CSIR labs. This was a record. No other director had done this. Everywhere I used to gather all the people and speak to them. It was a charging exercise for all directors and people down the line. I did not go to any management school. It was common sense and drive.

ML : What are your future plans?

Mashelkar : I will be coming back to NCL as a CSIR- Bhatnagar Fellow which is the highest award this country gives to a scientist. I will take up research fulltime. I will continue to be the president of Indian Science Academy and also of Global Research Alliance which is a forum for CSIR like institutions around the world.

ML : You have made so many changes. Is there anything you regret?

Mashelkar : CSIR is only in its third gear. The change has been too slow. What it has accomplished should have been done five years ago. I wish things moved faster.