



## Creating Emerging Markets – Oral History Collection

**Dr. Raghunath Anant Mashelkar, Former Director General,  
Council of Scientific and Industrial Research (CSIR)**

Interviewed by Tarun Khanna,  
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June 30, 2022 in Pune, India and Boston, Massachusetts, USA  
Video interview conducted in English

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*TK: Ramesh Mashelkar, thank you for joining us for the Creating Emerging Markets project at the Harvard Business School. We appreciate it greatly.*

**RM:** Thank you.

*TK: As you know, the purpose of this collection of publicly available, free video archives is to make accessible incredible life journeys of professionals who have contributed to the corporate tapestry in a very broad sense, particularly in emerging markets across the world. In these interviews, we usually ask people to reflect on the long arc of their careers and to try to think about specific moments that illustrate broader themes in their career. To this end, I'll pose a few questions, and then we can engage in the conversation.*

*I wonder if we could start with your experiences. These are the context in which I first met you, if I remember correctly, in an office in Delhi when you were chairing the CSIR. Perhaps you could explain the CSIR, how you got to it via the National Chemical Laboratory and what that experience taught you.*

**RM:** Yes. CSIR is the Council of Scientific and Industrial Research, and it's a chain of national research laboratories. When I took over, there were 40 of them. This includes the National Chemical Laboratory, National Physical Laboratory, and National Aeronautical Laboratory. CSIR covers an amazingly vast area of competencies and also geographical distribution across India.

I was teaching in England, and one day I got a telex from Dr. B.D. Tilak. At the time, we used to have telex. Dr. Tilak was the director of the National Chemical Laboratory, and he told me to meet Dr. Nayudamma, who had been the Director General of CSIR. He didn't say why, but he was my guru, and you always listen to the guru. So I went and met him. Then he portrayed the picture of an emerging India. I was barely 32 at that time. And he said "come and join this exciting journey." I said yes instantly. I called in the evening, and that is how I got to NCL.

It was a very tough journey, by the way. I had a salary of about 2,100 rupees per month, which is around \$30 in current contexts, but of course much more if you consider the fact that it was in 1976. And the conditions were very different at that time. India was not a \$2,000 GDP per capita country. It was a

\$100 GDP per capita country and it was a huge struggle. C K Prahalad and I had written a paper about how scarcity and aspiration are a deadly combination. It evokes you to do great things. And that's what happened.

I started my journey in CSIR as a scientist. I had to get started in a field in which I had developed some expertise – rheology and non-Newtonian fluid mechanics, and I wanted an equipment called Rheogoniometer. Can you believe it? It would take two years to come, because of DGTD clearance issues, “not manufactured in India” certificates, so on and so forth.

*TK: Those are all regulatory barriers that India had put in place.*

**RM:** All regulatory barriers. The country was poor. We didn't have foreign exchange. So we had to go through the rigamarole. This is what a scientist coming back in the 1970s faced in India. And then what do you do? I always tell young people that you keep on knocking on doors, and when they don't open, you open your own doors. Create your own windows. That's exactly what I did. I said, “I'm not getting that equipment.” I went into modeling and simulation.

And can you believe it? In 1977, I started work. In 1982, I got the Bhatnagar Prize, which is the highest-level prize that young scientists under 45 can get in India. It's considered the most prestigious. I was doing modeling and simulation of chains of polymerization reactors.

**TK:** *Did you get the Bhatnagar Prize because you found some aspect within your field that was less affected by capital constraints? Was that the innovation?*

**RM:** That was the innovation. I was a consultant for Indian Organic Chemicals.

We used to produce polyester fiber. The chain of making polyester starts with transesterification, ester interchange, polycondensation, melt spinning, and then you create a fiber. It was a black box. It was German-licensed technology. They did not know what was happening inside the reactor. I said that I would tell them what was happening within through this tool of modeling and simulation. The benefits of that would be improving the product quality. But I said “you must allow my PhD student to do his PhD on this and to publish research papers.”

We always talk about either scientific or industrial research. To me, this was scientific and industrial research, which are both beneficial. I got the Bhatnagar Prize. My student got a PhD. And the company benefited from that classic work. DuPont was the leader, by the way, in polyester manufacturing and PET manufacturing. And in one of our papers, we unraveled the mysteries of a polycondensation reactor anomaly. It went to Bob Secor who was the chief technology officer of DuPont, and his comment was that “we have been working for all these years on this, and this is the first time that we understand what it is.” The modeling and simulation that we did, the chain of papers that we wrote, basically became classic textbook stuff, and industry started using it. That’s how I began –

**TK:** *That's a wonderful illustration of a theme that I think comes up over and over in your career, which is how this dichotomy that many people imagine between academic research versus practice is perhaps overstated sometimes.*

**RM:** Indeed. And I've experienced it. If you asked me what the best and most memorable year of my life was, I would say 1998. On one hand, I got elected as a Fellow of the Royal Society. In 360 years, there are only three engineering scientists who have been elected to FRS. It's considered to be one of the topmost honors after the Nobel Prize. That was for my science. On the other hand, I received the JRD Tata Corporate Leadership Award in the same year.

**TK:** *That's a great illustration.*

**RM:** Yes. It was given by the corporate world. In fact, in 30-odd years, I am the only scientist who has gotten it. The highest scientific honor as well as the highest industry were in the same year. I have never had the particular conclusion that there will be science and its application, and that it's as simple as that. Sometimes, application can happen later. I think we put it in boxes. That's not necessary.

**TK:** *How did you take that insight, that inclination and that set of experiences – and as I recall some decades ago, catalyze change for many more scientists in*

*the CSIR system?*

**RM:** Yes, indeed. As a matter of fact, I would say that a lot that happened in NCL. I later on became the director of NCL (National Chemical Laboratory). When I became the Director General of CSIR, we scaled the laboratories up to 40. A lot of transformative things that happened there had an impact on CSIR. It was very interesting. Let me give you two or three instances.

I took over as the director of NCL in 1989, and I remember 1989 is two years before liberalization.

**TK:** *Before India liberalized and opened up its economy.*

**RM:** Yes, liberalized its own economy. And “multinational” was not such a good word at that time, as you remember. My challenge was that any time we did anything that was ahead of the rest of the world, the Indian industry wouldn’t take it. They would say: “Have Japan, the US or Europe done it?” So what do you do? I remember on the very first day, I addressed the entire 1,200-person family of NCL, and I said “let National Chemical Laboratory be International Chemical Laboratory.” What does that mean? I was saying something very daring, because in 1989, all that we were doing was import substitution – copying and reverse-engineering. We would copy any new drug from the US. And we were the fastest followers. We had developed that particular reputation. Of

course, it had its own advantage in terms of building the generic drug industry, for example. That was different. But we never created our own new molecules. That was number one.

Number two, this is what had happened. I had specialized in polymer science and engineering, and I had seen some breakthroughs by General Electric. In my speech, I said that we should be able to license out our polymer technology, even to General Electric. I remember a young man coming to me at the end, saying, “Sir, do you realize that General Electric’s R&D budget is two and a half times that of India’s R&D budget?” I remember telling him how it is not the power of a budget that matters. Rather, it is the power of ideas. That was a very important moment. Since you talked about GE, let’s take on GE.

You know this modeling and simulation that I was doing? There is a process called solid-state polycondensation. You know how you get the PET bottles? They are made of that. And I had done simulation on that. If that could be done for PET, why not polycarbonate? Polycarbonate is an engineering plastic, a tough one, in which GE had 40% market share.

**TK:** Globally?

**RM:** Yes, globally. I changed the culture at NCL. Rather than “publish or perish,” I said “patent, publish, and prosper.” Saying that we’d license out a patent was sort of audacious, because in 39 years of NCL’s history, they had not



created one single US patent. Here I was, saying that we'd license it out. **And we did. In 1991, we created three US patents on that solid-state polycondensation which I licensed for close to \$1 million.**

*TK: Ramesh, this was done purely by the force of exhortation and personality, not so much by money and incentives, or am I wrong about that?*

**RM:** You are absolutely right there. It is about reaching your potential. You can reach that potential provided you challenge people, because it was the same set of scientists who were copying and reverse-engineering that were able to create something which GE had not thought of. But bigger consequences came from that, I must very proudly tell you, because I got invited to Schenectady, where their R&D center was.

*TK: Upstate New York.*

**RM:** Yes. And by that time, our US patent was granted. They were surprised. They had never heard of NCL. Who were we, when they were the dominant leaders with 40% market share? Who was placing a flag on their territory? I remember by evening, the senior vice-president made me change my journey. I had a talk with him, and the GE team came first, of course, to validate and secondly discuss what we could do together. We formed a partnership, and that

was a very significant event. Why? When we formed the partnership, it was a win-win, simply because we understood how GE works and they also got access to our talent. We did so well. In fact, they tried us out on a project, and we delivered it in time and with a quality which was excellent. Then Jack Welch, when he came to know about it, asked: “if they are so good, why are we not there?” That is when the Jack Welch R&D center came into the picture.

**TK:** *In Bangalore.*

**RM:** Yes. I was invited to the inauguration – in fact, there is a small conference room there named after me. Once that was completed, there was essentially this sudden realization about the power of Indian talent. Today, people talk about India as a global research and development platform, and there are more than 1,200 companies that have set up their R&D centers here. **In some cases, one-third of IP is getting generated right here – Indian IQ is generating IP right there. But it all began with that inspiration.** I had a hard task. When I was in Delhi, people would come to me so they could see the GE R&D center. To sum up, what I’m saying is that aspirations are our possibilities. Keeping them high was extremely important. That is something we did at NCL.

**TK:** *When you go from aspirations, my recollection is that you introduced some structural changes or some personnel changes in the collection of laboratories in CSIR. It would be good to hear a little bit about that.*

**RM:** I did, but before that, you asked a very important question – is it that you just provide a challenge, or did you incentivize it through something else? I did.

In fact, we used to have an NCL Foundation Day, and there were awards given for different performance indicators – scientific research, industrial research, teams, and a whole range of things which mattered to us. One of the awards was created for US patents – those who filed the maximum. Later on, we changed the basis of the awards to not just filing, but granted patents. Then, we changed it from not just granted, but valorisation, and so on. When we started, it was just two to four patents that used to proceed. Then there was a time when 20, 25 patents started coming through, and I said “now we’ll stop.” The incentivization was there. It was not just the papers that we looked at. We also looked at the patents in terms of their performance evaluation. That was a very critical point in the journey.

And here is one more point I will tell you. Once again, it is an aspiration. I remember in my speech, I said that “it is not just development of products that matters, because consulting, particularly based on cutting-edge knowledge, can be a big business.” There was a World Bank project in China meant to reform their chemical research institution. I said “let us send a bid.” That was the first

time ever that we went to the World Bank from CSIR. Can you believe it? Life was very tough, because this was 1991. We didn't have foreign exchange. So many baseline things had to be organized. And I can tell you – we beat Arthur D. Little, ChemSystems, and International Development Planners – the three of them, to win that contract. Ambassador Ranganathan told me later on that this was the first time China had sought consultancy from India.

The main point I'm trying to make is that particular aspiration: "Yes, you can, and you can always do it the first time."

*TK: And when you come to the network of laboratories, as I recall, you had the ability to – please correct me if I'm wrong – determine who the directors were of the individual CSIR labs. That seemed to me like another organizational lever that you had. Tell us a little bit about the network and how you catalyzed scientific talent across the length and breadth of Indian science at that time.*

**RM:** Yes, that's a very important point. I became the Director General on the 1<sup>st</sup> of July 1995, and I have been the longest serving. I was the Director General until 2006. I'll tell you the challenge with the laboratories – there were 40 which all worked independently. There was no team CSIR. There was not one CSIR. In fact, they used to compete against each other. For example, two chemical laboratories would try to undercut each other for the same client. I remember creating a vision document in 1996, called "2001 Vision and Strategy" in which

I showed how we could collectively be a powerhouse. It was a businesslike document, because there were specific targets that were set. In fact, when Ratan Tata looked at it, he said it looked like a corporate document.

But the important part was the participation of all 40 laboratories. In one year, I visited 40 laboratories. This is a record, by the way. Because they're from all over the country, and I got them organized.

I think the analogy I can give you is the following. Let's suppose you take a piece of paper, and there are magnetic needles, and they're all in different orientations. Then you apply a magnet, and they all become aligned. This particular document functioned like that magnet. My biological laboratories were notorious in the sense that they thought they were restricted to science only. I recall someone saying that working with industry was akin to prostitution. The effect of this was a discussion that they had on a board where they had written our CSIR targets on one side. On the other side, they added what biological labs would contribute to that. I think the most important part of my first journey was creating that team CSIR, one CSIR, making one plus one equal to 11.

1998 was very significant to me because of the FRS and JRD Tata Corporate Leadership Award. It was also important for me because of what happened May 11<sup>th</sup>, 1998. We had a directors' conference – all 40 directors came together. I'm very happy to tell you that without my knowledge, they presented something to me on the third day, the final day of the conference. You know what that was? It was a document signed by all 40 directors entitled the

“Bangalore Declaration.” Below that, it said “India matters to us. We want to matter to India more.” All 40 coming came together and it was incredible.

**TK:** *It's the best gift.*

**RM:** The best gift. That's what is coming through now. I'll give you an example from COVID. The way Dr. Shekhar Mande, an outstanding Director General, galvanized the power of the entire CSIR is amazing. 2020 was considered the year of the pandemic. I would consider that the year of Indian science. It's amazing that when we started, we didn't have PPEs, diagnostics, vaccines, etc. CSIR laboratories came together and was a powerhouse in providing the country with a variety of things. Importantly, it is not one-off where Dr. Mashelkar comes and goes and that's it. As in your book, you talk about impact – how it last and for how many decades.

**TK:** *Building an institution of some sort.*

**RM:** An institution of some sort, yes.

**TK:** *This is very helpful, particularly to get specific instances and particular events. I think it's very evocative in some ways. Thank you so much for that.*

*Maybe we can shift gears a little bit and talk about your work over the years with indigenous knowledge. As you know, I spend all my time in the emerging markets. Whether it's South Africa, Kenya, Brazil, Indonesia, or China, there's always this traditional knowledge and skepticism about it from the outside.*

*As an example, in health in India, we have the so-called AYUSH workforce, which is really quite large, and we have the allopaths. There's a lot of tension between them often in different ways. But stepping back for a second, can you reflect on the state of traditional knowledge and on some of the efforts that you've made? I know you've played an important role towards shepherding that knowledge base.*

**RM:** This is a very important aspect of what happened during the time. India has been very rich in traditional knowledge, like Ayurveda and so on, just as China has had great knowledge. There are several other countries that have, not just India. But we indeed have this rich heritage.

Based on that traditional knowledge, new IP was being created. The basic principles for patents are novelty, non-obviousness, and utility. There's an emotional part to it that I must mention, which inspired me to get involved. I did not have a well-planned strategy. **As you know, I was born in a very poor family. I walked barefoot until I was 12. I studied under streetlights. It was my mother who brought me up, gave me values, and raised my aspirations. She has had a big influence on my life.**

My mother, wife, son, and I were sitting on our terrace when a bird fell – its wing was broken. I remember my mother running and getting turmeric powder, making a paste out of it and applying it to the bird. She didn't question how something that works for a human would work for a bird. Anyway, the bird died. We all had fallen in love with it, and we cried. I still remember that.

Then one day, I was sipping a cup of coffee in the morning reading *Times of India*, when I saw that the wound-healing properties of turmeric were patented. I said, "come on." My mother knew it. My mother's mother knew it. How can you patent all of this? That is another part of my personality. I read that in the morning and in the evening, I had to give memorial talk at the National Physical Laboratory. I remember P.N. Haksar was chairing it, the former principal secretary to the prime minister, and I announced that I was going to fight it. This is wrong.

**TK:** *Let's pick up from you giving this talk.*

**RM:** Yes. I was giving a talk chaired by P.N. Haksar, the former principal secretary to the prime minister, and I announced that I was going to challenge it. Here again is one more challenge. As Director General of CSIR, I had all the freedom in the world, but as secretary to the government of India, all that freedom was taken away. I could not make any announcement unless the minister had approved it, as you know the process. But I announced it. And of course, hell



broke loose –could we win against the US?

*TK: Just to clarify, the patent had been issued to some US entity in the US for turmeric, which is known to have wound-healing properties in India for centuries.*

**RM:** Absolutely. That was the issue. It took us 14 months. We filed an application with the US Patent Office. Within 14 months, it was proven that all of this knowledge was prior knowledge. But the important part was that I said turmeric is one patent. How many others? And there were hundreds of such wrong patents that were being issued.

Here was a stroke of luck. The World Intellectual Property Organization – WIPO, as it is called, invited me to become the chairman of what they called the standing committee on information technology. I was the chairman for two and a half years – 176 nations were members.

I remember that I took up this particular case and raised a fundamental issue. WIPO did not look at traditional knowledge as knowledge at all. They had a patent classification system. They're all for industrial properties – textile, steel, and other things, but not traditional. I said “how can knowledge invented at Harvard, Caltech, MIT, and Princeton be knowledge, but knowledge invented by my predecessors is not? That is not on.

**TK:** *Very good question.*

**RM:** Yeah. I remember going to the US Patent Office. They invited me and I spent a full day in there. There were hundreds of incorrect patents. I took samples. Then I took shlokas, Sanskrit texts in which that knowledge was embedded which are ancient.

**TK:** *Just to clarify, these are traditional codified writings from centuries ago in India.*

**RM:** Yes, centuries ago. I translated them into English and showed that what they considered novel was already provided in the texts. They were very nice. They took me around and showed me when the turmeric patent was applied, and we did a search for turmeric wound healing powder. We didn't have access to the information digitally because it was all in ancient books. This is where the idea of the Traditional Knowledge Digital Library came from. I must give credit to Mr. V.K. Gupta, who was the mastermind behind this. We put together a team of almost 100 Sanskrit scholars, IT experts, IP experts, Ayurveda experts, scientists, and created the library.

Traditional knowledge was not being recognized and because of this case, suddenly an awakening happened. They believed that they had to correct the

system, and I agreed. You have the International Patent Classification, IPC system, and you have to have a subgroup of that. Without that, it doesn't get recognized. There was a committee created which included India, China, Europe, US, and Japan for IPC. The committee got 200 subgroups of traditional knowledge incorporated.

*TK: Was this part of WIPO?*

**RM:** This was part of WIPO, because WIPO was responsible for creating it. Now, we have the Traditional Knowledge Digital Library, which is around 30 million pages. In fact, traditional knowledge and digital access – the ancient and the modern – they came together. It shows all that knowledge in the classified form, because that is the language that the patent examiners understand. If you had just given them a translation, it would not be understood. It now has major repercussions. I remember when Prime Minister Dr. Manmohan Singh was meeting President Obama, and just the earlier day, the US Patent Office and Indian Patent Office had signed an agreement stating that before granting any patent on traditional knowledge, they would be referring to the Traditional Knowledge Digital Library.

*TK: TKDL.*

**RM:** Yes, TKDL. Then, of course, Europe and Japan came into the picture. I would say that the little bird falling and fighting the turmeric patent battle led to these big events. I was fortunate to be the chairman of the WIPO committee, which has now put traditional knowledge in a completely different perspective.

*TK: Ramesh, you sound like an entrepreneur to me. What does an entrepreneur do? You look at the cards you've been dealt, and you maximize the possibilities from the cards. I think it's a wonderful story. I'm sorry, go ahead.*

**RM:** I think the most important part is the following. It is not about fighting to protect. What do you with this protection? You must create new products by merging this ancient knowledge with the modern. Having understood the power of this knowledge, my next attempt in CSIR was to bring modern science and ancient wisdom together. I called it a golden triangle, traditional medicine, modern medicine, and modern science. Modern medicine and modern science have always interacted with each other. Today, you would not have gene therapy if the structure of a gene was not known, or if DNA was not known. The doctors and practitioners like the Ayurveda have always fought with each other. Bringing them together was the next job. It was not just the CSIR team. It was going beyond that.

There, I had the following breakthrough. We had what is called Arya

Vaidya Shala in Kottakkal, Kerala. When you give up on someone, they take them there where this ancient knowledge and its use are so powerful. I went there, spent a couple of days at Arya Vaidya Shala, and signed an agreement with Dr. Warriar and CSIR. I remember Dr. Warriar, who brought us together, said “this is *sangam*” –

**TK:** *Union.*

**RM:** A union, a mixing of two worlds – one of ancient wisdom, that is Arya Vaidya Shala, and the second is CSIR. When you talk about traditional medicine, it is based on experiential wisdom, whereas the other is validated science of a different kind. These had never met, so we put them together. On the topic of no two laboratories working together – by the time I left, there were 19 laboratories across CSIR along with the other systems that were working together. And the benefits were new drug developments and new therapies.

**TK:** *That's wonderful. I think it's all very inspiring, and I think the connection for me between your efforts at CSIR and your efforts with the TKDL, the traditional knowledge repository, are similar in the sense that they're all about unlocking potential in a developing country. Potential is everywhere, as you've often said and as others have said. But unlocking it is itself an act of creativity and entrepreneurship. Of course, we all salute you for that.*

*I wonder if we could shift gears. Going back to your JRD Award in 1998 – you've had a fairly significant role in Indian industry and you continue to play a role as a statesman, leader and board member of some of the most important corporations in India. I wonder if you can maybe reflect on your experiences in and with corporate India, as well as the attitude of corporate India towards science?*

**RM:** Yeah, that's a very important question. Until 2006, when I was the Director General of CSIR, I could not be on the boards of the corporate world. But as soon as that was over in 2007, I was on several boards of leading companies such as Reliance, Tata Motors, Hindustan Unilever, Thermax, which was an energy and environment company, and so on.

**Wherever I went, I tried to create an innovation council to give innovation a special place.** For example, let me talk about Reliance. Today, Reliance is the most valuable company in India, with aspirations that are incredibly high. I remember chairing the Reliance Innovation Council, which included – and you know him – George Whitesides from Harvard. We had Nobel laureate Bob Grubbs from Caltech, Nobel laureate Jean-Marie Lehn, and C.K. Pralahad, whom you know. Bringing innovation to the forefront, rather than keeping it to the periphery, was the first important thing we did. It was done at other companies as well, like the Thermax Innovation Council or the KPIT Innovation Council.

The second thing about the corporate world that I tried to do was the

following. While at CSIR on February 18<sup>th</sup>, 2000, I remember getting a call from the finance minister. He said that on February 28<sup>th</sup> – it was a leap year – he was going to present the budget. And he said, “Mashelkar, I want you to do something that the scientific community will be excited about.” So I said, “Sir, how much time do I have?” He responded, saying “30 minutes.” Normally, you get into Delhi in 30 minutes.

I remember calling my personal secretary and dictating “New Millennium Indian Technology Leadership Initiative.” Leadership was in capital letters, because we were copying. We were reverse-engineering. We could not say something with great pride, that there was this new drug we created. But again, it was a unique partnership that we created. The gambler in me was there. I said “if you want to be a leader, you take risks. You are not following anybody. So you are bound to fail.”

Indian industry at that time was not prepared to take any risks. They were playing it safe, licensing technologies. I said, “let the government take the risk.” How? They would give money to the private sector at close to 0% interest, to be returned only if they are successful. It was not venture capital. It was adventure capital. The institutions would actually get grants, and the two would work together. This was a new model of partnership and it was a win-win because normally, CSIR labs will actually do something and then search for those who will buy the product. Here, the industry was involved right from the beginning.

Secondly, we incentivized the industry to do that. I will give you a

specific example of how it worked, because this is a very important model. In 2000, bioinformatics was a big word. But if you looked at the best software, it was half a million dollars. Small biotech companies couldn't afford it. What did I do? I went to TCS, Tata Consulting Services, where I met Dr. Vidyasagar who is a great leader, also crazy like me. I said I'm a 10X guy: 10 times better and 10 times cheaper. India is always affordable excellence – extremely affordable, but excellent. Why did I go to him? Because he knew how to make a product. His engineers knew how to make a product. My labs did not know. But they had no knowledge about new biology – functional genomics, and structural genomics.

**TK:** *TCS had no knowledge about biology.*

**RM:** About biology. So I lined up 19 laboratories, like the Center for Cellular and Molecular Biology. The 19 laboratories brought that knowledge. I put in just \$5 million – that's all. Within 18 months, they came out with Bio-Suite, which was launched in San Francisco within 18 months.

Here is the important part – talent, technology, and trust. We had all the talent, but it was all segregated. Talent in biology was here, talent in engineering a product was here – we got them together. They used the best of technology. But the most important part was trust. Why? Because if you see the government processes, not a single dollar or a single rupee can go to the private sector. Secondly, there's a process where you go to tender with the basis – no, I took a



call from here. They say this is the best. Nobody challenged me. I remember when Vidyasagar went to his board, they said, “OK, why are you robbing poor CSIR? We’ll give you the money.” He said, “no, I’m getting access to the knowledge of 19 laboratories.” When I went to my board – why are you giving money to the rich Tatas? I said, no, “I’m seducing them to get into that.” That’s the Bio-Suite story.

We talk about industry and their attitude – this particular magic of creating that partnership – and this is the biggest partnership, by the way. In fact, when I left, there were more than 100 private-sector companies and 250 institutions working together. I’m very proud to tell you – today, we talk about green energy, new energy, green hydrogen fuel cells, and more. In 2002, nobody talked about hydrogen. We started a fuel cell program in 2002. The challenge that I had posed was to create a fuel cell which is better than the state of the art, which is Ballard, basically. Dr. Ashish Lele from National Chemical Laboratory, who is the director now, led a team which created that. And I’m very proud to tell you that a fully indigenous fuel cell done by KPIT Technologies and with the National Chemical Laboratory, Central Electrochemical Research Institute, was launched a few months ago. As we speak, it is doing thousands of kilometers. Just imagine – it started all with NMITLI today, and India may have its own place as far as the fuel cell is concerned.

**TK:** *I want to pick up on these examples or in the same space of advances in*

*energy, which of course is crucial not just to India, but to the world. Recently, Reliance, whose board you were talking about a few minutes ago, announced a 1-1-1 target vis-à-vis green hydrogen. Can you explain to people in simple terms what that 1-1-1 is and how it stacks up to the status quo in Saudi Arabia, Chile, Japan, etc.?*

**RM:** Yes, I will do that. But I must tell you also how this all came about, OK? Just in three or four minutes. Because I'm a process man. What is the process which led to that? Because it's more important than the final numbers. 1-1-1 – one kilogram of green hydrogen for \$1 for 1 billion people – is a heady target, the toughest target. Even Australia, which is so good, they are setting a \$2 target. We are setting a \$1 target. This is what Mukesh is doing. He's an incredible leader.

**TK:** *Just to clarify, Mukesh Ambani is the head of Reliance Industries, an iconic entrepreneur in his own right. Green hydrogen is hydrogen that's made from renewable energy, which can then be used as a fuel.*

**RM:** Yes, that's right. Let me explain the colors. Gray hydrogen is one where you take natural gas and do reforming, so you produce carbon dioxide. Blue hydrogen is one where you capture that carbon dioxide. And green hydrogen is one where you take something like water and just split it by using electricity

which is not the grid electricity, but solar-generated electricity – solar sources of generated electricity. That is what the target is.

But how do you set such targets? This is an interesting part of it. I talked about the Reliance Innovation Council, the way Mukesh thinks and moves forward. There's an interesting story about it – the strategy. That is where India's future, I always say, has to be looked at differently. One day, Mukesh and I were talking, and he said, "Doc, we must leapfrog on something." I said, "Mukesh do you know why a frog leapfrogs? Because he's afraid of the predator, and he jumps a few feet in defense, and then again a few feet in defense, as a reaction. Do we want to do that, or should we pole vault?" The size of the pole determines the size of the aspiration. He loved it. We created a leadership program called "Beyonders" that led also to this book, *Leapfrogging to Pole Vaulting*. But the most important part of it was not leapfrogging to pole vaulting as bravery. The subtitle is more important – *Creating the Magic of Radical, Yet Sustainable Transformation*. In this Young Beyonders program, there are young people thinking of crazy ideas, taking risks, and going forward.

Because one of the important parts about pole vaulting was how Jio, which is our telecom wing of Reliance, went into 4G LTE and mobile phones. When Mukesh entered in 2017, we were 155<sup>th</sup> in mobile data consumption among 230 nations – 155<sup>th</sup>.

**TK:** *This is in what year? In which year is this?*

**RM:** 2017. And from that, within no time, we did not leapfrog from 155<sup>th</sup> to 100<sup>th</sup>. We pole vaulted to the number-one position, and we hold the number-one position today, with half a billion people getting something like 4 rupees per GB data and voice free, the cheapest in the world.

In the same way, this is like a democratization of access, basically. I remember my old times when I came in 1976. You're too young. We used to take six years to get a telephone, a landline. So that is the pole vault.

In the same way, Mukesh wants to pole vault by doing that 1-1-1 that I talked about. Is it possible? Yes. In fact, Reliance is known for speed, scale, and sustainability. Reliance is known for integration, innovation, and investment – integration, because as you know, they have businesses where an internal demand is served, because they are in retail and so on. But at the end of it, it's all about leadership, thinking big, and giving yourself a challenge.

**TK:** *I think the connection to your initial story, going back to GE and NCL before that, is just the power of aspiration in some ways, right? So 1-1-1 is an aspirational target. As you rightly said, even Australia, which is one of the leaders, is aspiring to something also ambitious, but still far more modest. And Chile is at \$5 and is trying to build a market with it and so on. It really is out there in terms of, as you would say, a pole vault target. Sorry, go ahead.*

**RM:** If I may just add a word on aspiration, we have what is called the Asia

Economic Dialogue in Pune – Pune International Centre, of which I am the current president. Dr. Vijay Kelkar, whom you know, is vice-president. And we have this particular dialogue. People have begun to call it Davos of the East right now – this is the way. I remember having a half-hour conversation with Mukesh on the way forward. Talking about aspiration, his is very simple – our raw materials are sunlight and water, basically, and technology. Technology was not affordable. Now, it is affordable. If we do scale, we should be able to reach that. And he has set a target that within 10 to 15 years, India could actually become a net exporter – half a trillion dollars. A net exporter – can you imagine? We are dependent upon –

**TK:** *Fossil fuels right now.*

**RM:** Yes, absolutely – fossil fuels right now. I think it is all about setting your goals and then galvanizing them with purpose, with perseverance, and passion.

**TK:** *Let me ask you to not wear your Reliance hat or your Dr. Mashelkar, the personal scientist, hat for a second and think about the society of which you're a part. When I look at the aggregate numbers, the ratio of R&D spending to GDP is very tiny in India. In fact, by some measures, it's getting smaller.*

*There is a gap in international patenting, which you helped pioneer in India – the idea that Indians should and can patent with the best of people in the*

*US patent system and other international patent systems. The gap between India and China, with which India has a rivalry of sorts, is widening. What is it that's missing institutionally and reform-wise? Where are the lower-hanging fruits? Where can we put, if you will, our thumb on the scale to make things happen?*

**RM:** That's an outstanding question. First, a frank admission – in 1998, our investment was 0.68% of GDP in R&D. Today, it is 0.68% of GDP, although our GDP has gone up substantially. There have been promises made by successive leadership to raise it to 2%, but that has not become possible. That is number one.

Number two is that when you talk about 2%, 2.5%, and 4%, 70% of it, or two-thirds of it, comes from industry. One-third of it comes from the government, like in China or Korea. It is exactly reversed here. We must raise the share from industry. There is no doubt about that. And it is innovative ways, like NMITLI – New Millennium Indian Technology Leadership Initiative which help us in different ways to do it. I think that is the second thing that we must do.

Education, research, and innovation are the currencies of the future, and very heavy investment in those are a must.

Of course, we always say that we give much more per dollar that you spend. Since I am a traveling salesman for India, I remember that I created a table once in which I looked at the number of scientific research papers, where we were very low. Then I looked at scientific research papers produced per

dollar, and we were right at the top. China was number two, and the US was number three. That is why we have all these global R&D centers, because we create very high-quality work – all these things. But we should not rest on that. In fact, I would turn the picture the other way around. If you invest, what one dollar is able to give in India is 10 times more than what a dollar is going to give in Japan. Therefore, if we increase the number of dollars, you can see how far we can go. That is the total mass.

In terms of the character of innovation in India, you will find that we are 48<sup>th</sup> on the Global Innovation Index, whereas China has jumped 22 spots. Totally agree. China and India were at a similar level at a point in time. We are not now. They are way ahead. No doubt about that.

**TK:** *Way ahead.*

**RM:** In 2003, for PCT Filing – patents, copyrights, and treaty filings – WIPO used to produce a list of Asian companies. You know who was number one? CSIR. Number two was LG. Number three was Samsung. And number four was Huawei. I believe Huawei is number-one in the world, not in PCT filings, but overall. We have lost it out there. I think, therefore, that innovation is very important – it's not just investment.

**TK:** *I want to go back to a comment that you made about 20 minutes ago or*

*half an hour ago, when I think you had an alliteration of three Ts – technology, talent, and trust. I want to focus on trust for a second. When I have an opportunity to address Indian corporate leaders or Indian university leaders, the two groups that I often engage with in India, I see rampant mistrust.*

*I see that the median corporation – not the extraordinary ones and the leaders that you mentioned – is very dismissive of science in India. The median scientist, even in the top-20 universities, is still in his or her heart dismissive of corporate India. So I wonder if that characterization strikes you as correct or incorrect. If it is even remotely correct, what is it that we can do about it?*

**RM:** Tarun, what you are saying is fundamentally correct. India's problem is not a budget deficit. It is a trust deficit. And it is not just with regard to technology. There are other areas where there's a big challenge, as you know. Let's not get into that, but I think the point that you make is very important. Therefore, I keep on asking, "how can you increase that trust?" There are a number of means. Let me give you just one example.

I created the Anjani Mashelkar Inclusive Innovation Award in my mother's name. The award is not for best practice. It is for next practice. I'm not a great believer in best practice, because you are following somebody's best practice. This is the 11<sup>th</sup> year of the award, and there is a cover-page story by *Civil Society* on these 11 awardees. You have seen amazing breakthroughs by young people with innovation, compassion, and passion. They have created



affordable excellence, like a breast cancer test for \$1 and so on, which is going to a number of countries. In fact, one of them has gone to 12 countries.

One of the breakthroughs was by Dr. Navin Khanna – I'm arriving to your point about trust. Once you have dengue, it takes a day or two before you know whether you have it. He made a breakthrough whereby he could detect dengue within 15 minutes. This was also at the worst stage. It was US FDA cleared. It had US patents. But nobody would take it. Why? Because we were importing from South Korea, from US, and from Australia.

Then came the pandemic. Our kits were getting exhausted. We went to these three countries. Two of them said no. Only South Korea said they could supply at the time. And you know what happened, interestingly? They loaded those kits on the wrong ship, which went to Africa. It didn't come to India. We had no kits, and we had no other way but to go for Navin Khanna's kit. Navin Khanna's market share at that time was 0%. Today, it's 78-80%.

*TK: So the point here is that prior to that serendipitous market breakthrough, nobody trusted Mr. Khanna's test.*

**RM:** Yes, absolutely. It proves that particular point. Therefore, I'm very happy to see the new emergence of these things. For example, until 2019, we had one unicorn per year. In 2021, we practically had one unicorn per week with 44 making it to the list. I did an analysis of these and found that close to 50% of

them came from Tier 3 cities, Tier 2 cities, and some were dropouts. Can you imagine? So that world is changing now. Somehow or other, there is venture capital availability. Of course, there have been other factors which have been responsible. Digital access, very frankly, would not have existed in Tier 3 cities, for example. For that matter, open source software available, cloud storage, affordable data also wouldn't have existed.

People call me a dangerous optimist. I'm dangerously optimistic because of our young people, like with what you see here. All of these breakthroughs are often made by young people in their 20s. It is this opportunity and this trust, I think, that will catapult India to where it rightfully belongs.

*TK: Let me say that one of the reasons why I feel I am privileged to have engaged with you over the decades is that I admire that optimism and I respect it. I aspire to it in different ways. Ramesh Mashelkar, thank you so much for giving us an hour of your valuable time. I'm sure that our viewers, who are a very global audience, would value this perspective. We will come back to you with an edited version of it that you can approve before we use it. Thank you so much.*

**RM:** Thank you very much, Tarun. Thank you very much for having me. It has been a rare privilege and honor talking to you.

*TK: I hope our paths cross physically very soon.*

**RM:** Very soon. Thank you.

**TK:** *And thank you to the camera crews. Thank you, guys. Thank you, Makena.*

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