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GUEST EDITORIAL

What can scientists/science administrators do for ‘Make in India’?

‘A million simulations are not equal to a single well-executed experiment in worth. And the ability to compute how millions of gallons of gasoline could be obtained is insignificant in comparison to an ability to actually produce a single drop of refined petroleum.’ So wrote Pradip K. Ghosh, a retired professor of chemistry from the Indian Institute of Technology (IIT), Kanpur in his fiction, based on experiences, *A Long Day’s Night* (Rupa, 2009). Ghosh attempted to build the highest resolution optical spectrometer in the world at IIT Kanpur in the 1970s. It was not the best of time to build such a spectrometer in an academic institution in India.

Among the several initiatives pushed by our new Government, two factors have attracted widespread attention and debate. They are the ‘Clean India’ and ‘Make in India’ campaigns. One can blame history, economy or anything else on this planet and elsewhere; the fact is that most of us are averse to taking risks. A major clean-up of our mindset and equally that of our political/science leaders is needed before ‘Make in India’ can succeed. A system should encourage risk takers, ours rarely does. I had addressed some of these concerns earlier in a commentary titled ‘Is Indian Science too Theoretical?’ (*Curr. Sci.*, 2013, **105**, 15).

The Governor of the Reserve Bank of India (RBI) started a debate by twisting the slogan to ‘Make for India’. Not to be outdone, our Prime Minister when speaking at the RBI quipped ‘Couldn’t we at least produce the paper to print the Indian Rupees in India?’ We have been importing paper to print currency, but use the ink made in India. Whatever may be the objective for ‘making’, make it here was the loud message. Of course, everyone knows that most of the equipment used in our teaching/research laboratories is imported. Why is it the case nearly seven decades after independence? What can scientists, science administrators and political leaders do now to Make it happen?

To be fair to our founding fathers, they did plan for it. The Council of Scientific and Industrial Research was established and numerous laboratories were started with specific mandates. Indian Institutes of Technology were built. The Tata Institute for Fundamental Research, Bhabha Atomic Research Centre, Department of Atomic Energy, Defence Research and Development Organization and the Indian Space Research Organization (ISRO) came into existence. These institutions have succeeded to

various extents and have made important contributions to the Nation-building. Clearly, ISRO has done exceedingly well. The defence establishments have done well to conduct the controlled nuclear explosion taking India to an exclusive list of nuclear nations. Thanks to our agricultural and farm scientists, green revolution and white revolution happened and India proved the doomsayers wrong.

The elite academic institutions have done well in producing human resources. Some of them have done academic research of high standard that is appreciated globally. The National Programme on Technology Enhanced Learning (NPTEL) spearheaded by IIT Madras, working with the six other older IITs and IISc has been a phenomenal success. The lecture videos available on YouTube/NPTEL have been viewed over 250 million times, leading the world. Moreover, I recall an interview published in *The Guardian* about a cardiopad designed by Arthur Zang from Cameroon after learning from the NPTEL lectures. This would help the huge population in the villages of Cameroon that has no access to proper diagnosis and treatment. Clearly, a student from India could do this too and maybe, they are doing it already (<http://www.theguardian.com/technology/2014/oct/21/technology-heart-disease-developing-nations>).

Most of our high schools and colleges lack even the minimum required laboratory facilities to give hands-on training to the students. Not surprisingly, the students in India are afraid of handling instruments. One can contrast this with the kids growing in the Western world, often in a garage in front of the house learning to fix problems in a car or a bicycle, from the early days in life. R. Srinivasan has been conducting an experimental physics workshop all over India, supported by the three Academies of science. I am pleased that some common cause was found for working together. In this workshop, all the equipment and supplies are shipped to some colleges all over India and teachers are invited to perform various experiments. They are taught the underlying science. Srinivasan’s attempts to spread this to all the colleges in India have not met with success yet. He had written to leading organizations offering to help establish such laboratories all over India, but no response. K. P. J. Reddy (IISc) invented a desktop shock tube which can be introduced in engineering college curriculum across India. Our classrooms have become too theoretical and ‘hands-on training’ is too

important to be neglected. I wish such individual efforts can benefit schools and colleges across India. This is where science administrators could help.

Even before our independence, J. N. Tata was planning for the nation. He planned to build a steel plant, power plant and IISc. He had also planned a township in which all the workers of the steel plant could have a good quality life. It was a surprise to learn that Tata decided on building this township after visiting the mill towns in Liverpool and Manchester in the UK. He observed workers living in poor conditions, 'that made dysentery, typhus and typhoid endemic' as Peter Casey points out in his recent book *The Greatest Company in the World? The Story of Tata* (Portfolio, 2014). Tata did this during the time, the British had colonized our nation! He built plants that were superior to the ones established in England, not only in producing steel, but also in providing a better quality of life to all the workers. If Tata could plan and make things in India even before independence, it is astonishing that the Prime Minister of India has to make this slogan nearly seven decades after independence! What has gone wrong?

Dashrath Manjhi single handedly built a road through the mountain to give the people of his village in Bihar proper connectivity. He had lost his wife as she could not be transported to a hospital on time crossing a mountain on foot. It is an irony to learn his story, through a recent biopic, when the whole world is talking about connecting everyone in the globe (*Manjhi: The Mountain Man*, A film in Hindi, released August 2015). Did our system help Manjhi? No, it tried hard to discourage and stop him. His story tells us that nothing is impossible when an individual, irrespective of the background, decides to build something and focuses on the job. Manjhi took the mighty mountain down with a hammer and chisel working for over 22 years! In a way, much of what has been built in India is a result of such dedication of a few individuals. More often, such success stories in India happen not because of an enabling system, but despite the system. We need a system that can nurture individual talent and harvest it for common good.

One question that pops up in many places is why have we not produced a Nobel Prize winner after C. V. Raman. During Raman's time, we also had J. C. Bose, S. N. Bose and Meghnad Saha who may have deserved the Nobel. What we need to realize is that if we have a hundred scientists who make contributions worthy of a Nobel Prize, one or two may actually get it. One wishes that the advice of Saha, to ensure that all the universities were nurtured, was heeded in addition to building elite institutions. I am pleased to note the formation of the UGC-INFONET consortium and the specific programmes such as INSPIRE and PURSE started by the Department of Science and Technology in the last decade. These initiatives should help all universities promote excellence in research. It is not enough to have a few Centres of Excellence. We need to have excellence all over the country to make Nobel winners from India.

There is indeed a perception, often expressed in various quarters, that our academic institutions have not done much for the common good. Recently, Infosys founder N. R. Narayana Murthy while delivering the 2015 Convocation Lecture at IISc declared that no invention has come from the elite Indian institutions to help people at large. Some have responded to his comments; I would rather not. What is striking to me is that he made these comments in the most inappropriate circumstance. The graduating students lost an opportunity to hear a motivational talk, which could have been more appropriate for a convocation address. This is something both our political and science leaders should ponder over. While constructive criticism in an appropriate forum is always appreciated, we should desist from making negative remarks that attract undue attention.

In recent times, two big projects were discussed in Indian science establishments. One is about establishing a supercomputer network, perhaps mostly imported, for the Big Data projects. Another is building a synchrotron. The former seems to have succeeded and the latter appears to have been shelved for now. Clearly, both are important projects and our system has evolved in a way to support the former first. It is important to think about why seven decades after independence, we are not able to support, plan and build a synchrotron. Saha emphasized that we need to build the infrastructure first before building rockets and bombs. India has evolved into a global nation with rockets and bombs, but one cannot find a good oscilloscope made in India. Abha Sur's *Dispersed Radiance* (Navayana, 2011) is a good read for those interested in learning the history of Indian physics in the first half of the 20th century. Saha had a long-term vision for the future of the nation, not limited to the self. It may not be wise to insist that India produces everything it consumes in the global scenario today. However, India cannot ignore the strategic importance of capacity building in modern science and technology.

From my observations, our society looks up to people who do not need to work and earn a living, often with envy. It looks down on people who struggle all day to make ends meet. We need to learn to celebrate work and ensure dignity of labour. If not, India will be cited as an example to prove John W. Gardner who said: 'The society which scorns excellence in plumbing as a humble activity and tolerates shoddiness in philosophy because it is an exalted activity will have neither good plumbing nor good philosophy: neither its pipes nor its theories will hold water.' There is enough evidence in the system today that we are indeed learning. May 'Make in India' succeed!

E. Arunan

Department of Inorganic and Physical Chemistry,
Indian Institute of Science,
Bengaluru 560 012, India
e-mail: arunan@ipc.iisc.ernet.in