

CURRENT SCIENCE

Volume 112 Number 6

25 March 2017

GUEST EDITORIAL

Joy of discovery as a reason for pursuing a career in science

The Nobel laureate Serge Haroche while visiting India in January 2017 has been quoted as saying ‘Since they receive taxpayer’s money, the scientists can’t live in an ivory tower. They must go to the society to explain their science and spend the research (funds) in a responsible way....’ Further, speaking of the best students in the society, not necessarily limited to any particular country, Haroche notes, ‘The passion of doing science needs to be initiated among them and the best way to do that is by exposing them to science experiments. Also they need to be given a decent salary in their career to raise their family....’ Stated differently, it then becomes the responsibility of all, including theorists to convey the excitement of their work, so that young people can take up a scientific career.

The modern era has not been without instances of passion. In 2016, all over the world, through television and live streaming, one heard the words of the spokesman of the LIGO collaboration, ‘Ladies and Gentlemen: we have detected gravitational waves, we did it!’ Not that long ago, on 4 July 2014, at a press conference in CERN, Geneva, which had received just as much media coverage, one heard the words of Rolf-Dieter Heuer, the then Director-General say, ‘As a layman I would say: “I think we have it”. Would you agree?’, describing the data acquired by the CMS and ATLAS collaborations of the LHC experiment which were searching for the Higgs boson. These words capture the essence and joy of scientific discovery and will go down in history like the cry of ‘eureka’ attributed to Archimedes many centuries ago. In this era, it appears that all scientific work is of a highly collaborative, sophisticated type, especially in the fields such as physics and biology, where hundreds of scientists work on such daunting projects like LHC, LIGO, the human genome project or cancer research. At the other end, mathematics continues to be a romantic field with individual accomplishments. Recent examples being the progress made towards the solution of the notorious twin-prime conjecture by Yitang-Zhang and independently using different methods by a young postdoctoral fellow, James Maynard. Even more romantic tales make their rounds regarding the saga of the proof of Fermat’s Last Theorem by Andrew Wiles and the Poincaré conjecture due to Grigori Perelman. Tales of eureka moments abound in the lore: the story of how the structure of ben-

zene was discovered by August Kekulé; how the problem of Fuchsian functions was solved by Henri Poincaré, and the idea of the equivalence principle took birth in the mind of Albert Einstein. More recently, Andrew Wiles has spoken eloquently of how he solved Fermat’s Last Theorem in a BBC documentary on the subject. It is this kind of lore that is needed to enthuse the future generations.

While a lot has been said about the importance of hard work and concentration and dedication, it cannot be denied that a lot of scientific work can lead to results of lasting and durable quality only if there are sufficiently large number of individuals and groups working on important problems of the day. It is also important to support so called ‘blue sky’ or ‘green field’ research, to let the human mind and spirit roam free. In this regard, the recently deceased Peter Nowell, the discoverer of the Philadelphia chromosome and its role in certain types of leukaemia notes: ‘Serendipity plays a major role in biological progress.’ ‘That’s why I tell people who are starting in the game to keep at least three or four different lines of investigation going, because the one that pays off is the one you don’t think will. As my old chief used to say, the real trick is to keep going out on different limbs and then decide how far out to go before you go back to the trunk of the tree, which is the main area you’re interested in.’

In much of the above, one has encountered the legends whose lives and struggles have been well-documented. That said, it may also be admitted that many of them did not have to deal with social pressures in a manner that some sections of mankind have to deal with on a daily basis. If there is one section that has to fight against odds on a daily basis in all societies, it is women, and it is no less in the sciences. In the modern era there are inspiring and poignant stories of the struggles and achievements of such persons as Rosalind Franklin, who made seminal discoveries that paved the path to the discovery of the structure of DNA. Other inspirational figures include another recently deceased legend, Vera Rubin, who is credited with the Discovery of Dark Matter predated only by preliminary studies of Fritz Zwicky on different considerations. Julia Robinson is known for crucial steps in the solution of the Tenth Hilbert Problem on the decidability question of solutions of certain Diophantine equations. In

the recent past, Maryam Mirzakhani has become the first woman to be recognized with the Fields Medal, while Ada Lovelace is widely seen as the first computer scientist. The achievements of these women are not as widely known as they deserve to be. Much work needs to be done to document the stories of women who have made great discoveries in science, and indeed to hear directly from them about their achievements. Young women entering science should get inspired by these women scientists and blaze a new trail. For instance, it was not so long ago that Dame Jocelyn Bell gave a talk to a full hall at IISc, Bengaluru of her discovery of hitherto unknown celestial bodies now known as pulsars. Her tour of India included many cities and many lectures, and one can only hope that it has the desired impact. Writing of her own humble beginnings as the offspring born into the second family of a rich person in Hong-Kong, Sau Lan Wu, a noted high-energy experimentalist and Higgs search pioneer, brings a human touch to the endeavour of science and her rise to become one of the leading scientists of the world. More such stories need to be become stock in trade in the business of conveying the joy of science.

This write-up so far has been replete with examples from another time and place. One needs many more examples of romance in science, and it is important for scientists to come out and speak for themselves, or to engage with qualified media personnel to convey to the youth what they are up to, and participate in the motivational project. One needs role-models with whom the youth can relate. Men and women in science in India must take up this challenge. While some stalwarts have indeed spoken and written about their adventure, there needs to be more. Most professional scientists in India spend their time on just getting their work done. Finishing each set of measurements or calculations and bringing the results to light is a challenge in itself. Getting a paper published in a journal, or filing for a patent and getting it granted is no mean feat. While it is a fact that teaching and research go hand in hand, in a developing country, to do both, is a great challenge. Add to this, onerous administrative responsibilities, and complicated family circumstances in a traditional society, and one has almost insurmountable odds. In this regard, I recall an event which was held a couple of years ago to celebrate the birthday of the then Director of my alma mater, the prestigious Indian Institute of Technology, Madras – M. S. Ananth. He was arguably one of the most successful Directors of the institution of national importance. At the end of a social evening when many colleagues, friends, well-wishers and former students spoke about Ananth's accomplishments, when his own turn came to say a few words, Ananth stated that while he could look back at his life, career and work with satisfaction, very few understand how hard life is in India. If these are the words of such a successful person, then one must wonder what it must be like for less celebrated, less popular and less accomplished persons. Furthermore, the fact that the scientific era came late to

India, compared to Europe and off-shoots of European settlements in North America, and elsewhere, led to its own challenges. In order to do science in such a society with such a historical background, one requires what Arnab Rai Choudhuri in an influential essay had written more than three decades ago – it requires the scientist to undergo a 'gestalt change'. That said, today there are several places in India where an active scientist can carry out his/her work on par with those in top international centres. Work remains to be done on conveying to the future generations regarding the nature of the calling of scientists.

One of the reasons why scientists themselves need to take up this task is that, in India there is practically no tier of science writers and popularizers, except for a dedicated handful who plough a lonely furrow. In fact, even in the genre of scientific biography, the number of serious attempts to write about great stalwarts such as C. V. Raman, J. C. Bose, S. N. Bose, M. N. Saha, H. J. Bhabha and S. Ramanujan is few and far between. In fact, often one has little choice but to recommend or read the vignettes written by G. Venkataraman on the work of such persons whose target was school- and college-going children and the interested lay public. Of lesser celebrities, there is practically nothing written or said. The shortcoming perhaps is that these persons have themselves not written or said, for reasons such as being absorbed in the hurly burly or (incorrectly) assuming that there is little or no interest in their work. Self-effacing scientists do not wish to bring the attention to themselves, but would rather let their work speak for them. While this may be a virtuous stand in itself, the changing times require that they come out and 'populate the courtyard' and speak their minds freely. They must explain that the pursuit of science is normal, and fun-filled and challenging, just like any other worthy pursuit in life. It may also seem that there are not enough fora for such activities. There are myriad opportunities to create such fora. Such motivational activities can be in the form of public lectures, writings in print media, as well as other influential media outlets, or through electronic media such as social media, web-logs and the like.

As if presciently to address this matter, *Current Science* brought out some special articles entitled 'Living Legends in Indian Science' featuring the work of many scientists who have made a mark. This could be just a beginning; and hope many will come forward and discuss their own life experiences and turn their scientific adventures into a living and breathing entity that could inspire the youth of this country and others. There are many challenges towards attracting youth to scientific careers and let no stone be left unturned in this endeavour.

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