CURRENT SCIENCE

Volume 113 Number 3 10 August 2017

GUEST EDITORIAL

An age-old question

One often hears that in India we venerate age and the wisdom that comes with experience, whereas America and Europe have youth-centric cultures. Indeed, a frequently levelled criticism against Indian science is that its systems have been set up so as to favour the senior most citizens. While I agree that in India we seem to be obsessed with dates of birth, I feel that it is the youth we worship, not maturity. What matters is not just what one achieves, but the age at which one achieves it: the younger, the better. Does not each and every one of us know of dozens of cases where parents have faked their children's dates of birth, so as to sneak their kids into school at an age earlier than that mandated by the rules? Do we not place matrimonial ads reading: 'Seeking match for girl, 29, looks 21...'? Are not all of us fascinated by child prodigies? Are not our newspapers and record books full of admiring reports of the youngest ever chess grandmaster, the youngest ever to climb a Himalayan peak, to obtain a Ph D and so on?

Tied in with this is the idea that to do good science, one has to be young, very young. This meme has its apotheosis in the tragic yet seductive appeal of tales of scientific geniuses who died young (e.g. Ramanujan, Galois, Abel, Moseley). However, it is also manifested in the way in which we shape our educational and scientific institutions. Age (or, rather, youth) becomes a criterion at every stage: admission to programmes of study, appointment to permanent positions, awarding of prestigious prizes, and finally, of course, at the time of retirement.

In India, the selection committees for many Ph D programmes enforce (usually unofficial) age cut-offs. If one wants to get a junior faculty position, the unwritten yet widely applied rule is that one must be less than 35 years old. In addition, of course to various Young Scientist awards, many of our major scientific prizes have restrictions on the age of recipients. One has to be under 45 years to be eligible for the Shanti Swarup Bhatnagar awards (the reasonableness of this requirement has been debated this journal (Sharma, A., *Curr. Sci*., 2015, **109**, 762; Rajagopal, N. R., *Curr. Sci*., 2011, **80**, 1116), while for the Infosys Prize, one is supposed to be under 50.

Several scientific awards worldwide also have age restrictions, though some consider academic age as an alternative to chronological age – for example, to be eligible for the Marlow Medal of the Royal Society of Chemistry, one has to be either under 35, or within 10 years of obtaining one's Ph D degree. Most famously, to be awarded the Fields Medal (probably the most prestigious prize in mathematics), one has to be under 40. Many people do not consider this to be a particularly restrictive or exclusionary clause. G. H. Hardy's opinion that 'No mathematician should ever allow himself to forget that mathematics, more than any other art or science, is a young man's game' is widespread (regarding both the youth and gender of mathematical geniuses). So much so, that when Andrew Wiles proved Fermat's last theorem at the ripe age of 41, some of the astonishment was because he had succeeded when he was so…well…'old'. More startling still was the case of Yitang Zhang, who had published only two obscure papers until the age of 58 (working part of the time as an accountant and delivery worker), and then in 2013 made a major breakthrough in a centuries-old problem concerning the gaps between prime numbers.

This begs the question: do all scientists peak at the same age? And does scientific productivity today follow the same patterns that it did a century ago, or even 30 years ago? When Thomas Kuhn wrote *The Structure of Scientific Revolutions* in 1962, he felt: 'Almost always the men who achieve these fundamental inventions of a new paradigm have been either very young or very new to the field whose paradigm they change.' However, since then, our way of doing science has changed, the composition of the scientific workforce has changed, and lifespans and lifestyles have changed. Is it not therefore time for us to re-evaluate practices in the culture of science that may have evolved in other circumstances?

For example, there is considerable evidence that the scientific productivity of women peaks at a later age than that of men. An obvious explanation for this would be that early in their career, many women have a significant fraction of their energy and time diverted away from scientific pursuits due to societal pressures and familial responsibilities, though further research is needed to understand this complex question more completely. I was recently at a meeting where the question was raised whether the age restriction for women to be eligible for various awards could be relaxed by five years, especially if they had had a break in their careers. This suggestion was mocked by one of the eminent scientists present: 'You women,' he said, 'want everything made easy for you… you do not want to compete as equals!' (Could one

not also argue that the present age limits help *men* by making things easy for *them*…they can scoop up the jobs and awards, while the women are otherwise preoccupied and unable to compete on an equal footing!) Perhaps a more obvious solution would be to remove age limits altogether.

In the United States, 'ageism' (discrimination on the grounds of age) is considered illegal, and hence there is no mandatory retirement age in universities. To Indians, this seems like a radical idea. After all, the notion that one must withdraw from active worldly pursuits (like science) after a certain age has deep cultural roots here, with our concepts of 'vanaprastha' and 'sanyasa'. Further, we need people to retire, in order to address two problems: the shortage of employment opportunities for young scientists, and the fact that many of our universities and institutes have a significant population of 'dormant' scientists, whom it would be hard to justify keeping on indefinitely. New rules permit a small fraction of 'distinguished' scientists to be given extensions after reaching retirement age. But to how many should this facility be extended, and for how long?

In this context, it is interesting to note that increasingly, landmark discoveries are being made by scientists in their 80s. These are all people who did outstanding work in their youth, had long and productive careers, and are now demonstrating to a startled and admiring world that they can be 'mighty at eighty'. I will mention just a few such recent examples.

In 1964, as a young(ish) man of 33, the Japanese–American mathematician Heisuke Hironaka solved the problem of reduction of singularities in characteristic zero; for this he was awarded the Fields Medal in 1970. After a distinguished academic career (he was a professor at Harvard, USA and President of Yamaguchi University, Japan), he retired in 2002. Then, seemingly out of the blue, earlier this year (at the age of 86), he posted on his webpage a more general proof valid in all characteristics. Mathematicians worldwide are now scrambling to understand his proof and validate it.

India too has famously active octogenarian mathematicians. In 1965, the world of mathematics sat up and took notice when M. S. Narasimhan and C. S. Seshadri, also at the age of 33, intertwined algebraic geometry and differential geometry by proving the 'Narasimhan–Seshadri theorem' which connects stable and unitary vector bundles on a compact Riemann surface. Both of them (they are now 85) have published important papers in the past year. Narasimhan (he also happens to be my father) tells me that he sees in his latest paper a confluence of several themes in his mathematical trajectory; he could not have written it without the knowledge and expertise gained over many decades.

It is not just the theoreticians and mathematicians who continue to flower late in life. When I entered Harvard as a Ph D student in 1985, Isaac Silvera, a professor in the Physics Department, told our class about how he was looking for students to join him in his dream of finding experimental proof that hydrogen becomes metallic when subjected to very high pressures. This had been predicted by Wigner and Huntington half a century earlier, but never shown experimentally. Now, at the age of 80, Silvera has finally succeeded in his decades-long quest, after many abortive attempts. His results have been published in *Science*, and await confirmation by other researchers. Silvera is still a professor at Harvard (remember – no retirement age) and is also currently visiting India under the GIAN programme.

Of course, India's most widely celebrated experimental scientist also continues to be extremely productive in his 80s. In 1967, as a 33-year old, C. N. R. Rao was awarded the Marlow Medal for his early discoveries in solid state chemistry; he remains the only Indian to have won it. Today at the age of 83, he continues to publish over 25 papers a year, in prestigious journals such as the *Journal of the American Chemical Society* and *Angewandte Chemie*. Recently, for example, he has made important contributions to the challenging problem of finding ways to split water so as to produce hydrogen (needed as a clean alternative to fossil fuels). I have frequently heard Rao say that he believes that the past decade has produced some of the best science of his career.

Why is one hearing more nowadays about outstanding octogenarians, and comparatively less about terrific teens? Of course, lifespans have increased, thanks to modern medicine (not to mention the relative paucity of Great Wars, and the practice of duelling having fallen out of fashion). However, it also takes longer to master a scientific discipline today than it did a century ago, except perhaps in a very few fledgling fields. Long-unsolved problems in mathematics have been finally solved, not by a moment of insight in a bathtub, but by years of slogging away, using advanced techniques that require in-depth knowledge of several disparate areas. In empirical sciences, technological challenges have been overcome using not just the access to sophisticated instrumentation and ample funds which are more likely to be available to long-established researchers, but also the kind of physical intuition developed over time.

When people want to console someone on growing older, they often say: 'Age is just a number'. The problem, of course, is that as scientists, we tend to think that numbers are all-important. We feel most comfortable when we can quantify things (witness our embracing of impact factors and other metrics). I will end by quoting Plato: 'A good decision is based on knowledge and not on numbers.' When making decisions about students and fellow scientists, we need to evaluate them based on their scientific capabilities, potential and achievements, and ignore their dates of birth.

Shobhana Narasimhan

Jawaharlal Nehru Centre for Advanced Scientific Research,
Bengaluru 560 064, India
e-mail: shobhana@jncasr.ac.in