Don't blind kids with science



Jayant V. Narlikar

IN THE higher secondary school, I happened to come across E.T. Bell's book *Men of Mathematics*. Written in 1937, it starts with Zeno in the 5th century BC and brings the reader to Cantor in the middle of the 19th century. I thoroughly enjoyed reading the book, although in retrospect I wish the author had not limited his visors to the European mathematics. For example, important contributions from the Indian subcontinent, Arabia, China, etc. are noticeably absent.

Nevertheless, it was a revelation to a schoolboy that the subject he was taught in school as an abstract exercise confined by logical reasoning had been developed in a non-systematic way with flashes of genius prejudices, rivalries and priority claims playing no minor roles. Indeed, after that book I had the chance to read about development of science in general and found the same phenomenon. Isaac Newton had been opposed to the wave theory of light and his impressive contributions had such impact on contemporary science that future developments in that field had to wait till Newton was no longer on the scene. That science can advance and overtake major players in the field was shown when no less a person than Lord Kelvin, after spending a short period in retirement, walked into the department of his university to enroll himself as a graduate student. He wished to relearn physics which had changed so much since the time when he had made seminal contributions to it.

Indeed, in general, our school science texts seek to present the subject in a cut and dried form so that the student gets the impression that it was always that way. He is not aware of the birth pangs suffered by the scientists involved, often being misled, sometimes running a race to establish priority, or even making an over-claim so as to attract more funds for future work. Ambient social conditions can play a significant part in deciding which way science moves. The rapid research on the atomic bomb was inspired by its potential importance as the ultimate weapon during World War II.

Then there are episodes like Fermat's Last Theorem which are still short of their logical conclusion. Fermat, a leading mathematician from Europe, had conjectured in 1637 that there are no triplets of integers a, b, c such that for any n, an integer equal to or exceeding 3, the nth power of the first two added together gives the nth power of the third. Fermat had noted that he had a "truly marvellous" proof which was too large to be given in the margin of his copy of Diophantus' book *Arithmetica*. Fermat did not give the proof anywhere else. Although he was a mathematician par excellence, most modern mathematicians now believe that Fermat may have been misled into believing that he had found a proof of his theorem. For, modern attempts to prove the theorem, including the finally successful one of Andrew Wiles in 1995, use methods well ahead of those known in Fermat's lifetime.

Take the case of the idea of continental drift. The idea that the continents on the Earth's surface are plates sliding on the surface under the dynamical forces was proposed and defended by Alfred Wegener throughout his life against hostile criticism of the leading geophysicists. He died in 1930, more than two decades before his idea could be blessed by the establishment. Today it goes under the name of "plate tectonics" and has received considerable supporting evidence. But a student just reading a statement to this effect in his or her textbook will miss the trials and tribulations faced by its originator.

That the objectivity and critical assessment can, on occasion, take a backseat when new findings are announced is apparent in no uncertain terms when we look back at Arthur Eddington's announcement of the results of the experiments his two teams had carried out in Sobral, Brazil, and in Principe in the Island of Guinea at the time of the 1919 total solar eclipse. The purpose of the experiment was to test if the ray of light from a background star changes its path under attraction by the Sun; and if it does whether its "bending" is as predicted by Newton or by Einstein. The expected bending was as small as 1.75 second of arc as per Einstein and half that value as per Newton. (We may mention here that the second of arc is an angle which is 3,600th part of a degree. Thus, we are talking of some 2,000th part of a degree.) Hilarious accounts exist of the chaos and confusion at the actual experiments and the compromises made with the ideal observing conditions. The error bars for various quantities that might have affected the measurement had not been fully appreciated. Indeed, it was in the mid-1970s that radio and microwave measurements gave a reliable verdict in favour of Einstein. But in 1919, the unequivocal verdict given by Eddington in favour of Einstein had already launched relativity on a media-blitz with Einstein as a world figure.

In 2010, there were scientific meetings to pay tributes to the late Subrahmanyan Chandrasekhar on his birth centenary.

Chandrasekhar is credited with the discovery of the mass limit on stable white dwarf stars. Reading the technical account of his work conveys the imaginativeness and depth of understanding of the young scientist, then under 25 in age. But such accounts do not convey his mental agony when he had to face severe criticism and ridicule from an unexpected quarter. No less a person than Eddington, in an unexpected attack on Chandrasekhar's ideas, tore his theory apart. This confrontation took place in the august debating hall of the Royal Astronomical Society in London. The typical neutral person in the audience left the meeting under the impression that the idea of a rather inexperienced young scientist had been demolished by an experienced leader in the field. Yet, in science an ultimate objectivity eventually prevails. Within a few years Chandrasekhar was vindicated and went on to receive the Nobel Prize. But episodes like these need to be part of the student's curriculum so as to give him or her the right perspective on science and its practitioners.

■ *JAYANT V. NARLIKAR is a professor emiritus at Inter-University Centre for Astronomy and Astrophysics, Pune University, and a renowned astrophysicist*