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EDITORIAL

Physics and Physicists

The public perception of science and scientists is dominated by impressions of physics and physicists. Newton and Einstein are names known to almost every educated individual; the former intruding in the school years, where mechanics and calculus intimidate most students, while the latter's portrait remains the most recognizable in the pantheon of scientists. I was sharply reminded of this fact while lecturing at the Bangalore Science Forum, an admirable organization which has held a weekly event on science and a month long 'science festival' annually, for over four decades. The talks used to be held in an unprepossessing lecture room, fondly called 'H. N. Hall', after H. Narasimhaiah, the Gandhian educationist and committed evangelist for science. He had, over the years, raised the National College and the Science Forum in Bangalore to a position that commanded both loyalty and respect from those interested in the public perception of science. This year, in keeping with changing times, the lecture hall had been completely renovated; shining floors, an air-conditioned ambience, state-of-the-art projection facilities, comfortable chairs and, most importantly for the speaker, a stage whose stability was ensured, greeted me. Even as I surveyed this inevitable inroad of modernity, there was a pang of regret for what has undoubtedly passed into history, to be slowly forgotten by fading collective memory; an austere and ascetic ambience that undoubtedly reflected the styles of two of the men, whose large portraits hung on the newly painted walls of this modern lecture theater, Mahatma Gandhi and H. Narasimhaiah. But, as I lectured, it was the third portrait, the iconic, dishevelled image of Albert Einstein that seemed to pose a question: 'Did not physics, especially theoretical physics, dominate the public perception of science to an unreasonable degree?' In a curious way, such thoughts seemed disloyal to the surroundings. I consoled myself by recalling that Narasimhaiah was fond of questioning conventional wisdom and provoking debate. He was trained as a physicist; so too were some of his closest associates. It seemed natural that Einstein's portrait must adorn the walls. Somewhat guiltily I realized that Einstein looked down benignly from the walls of my own living room; symbolic of the common perceptions about science. Surely, there is no other image that is so closely associated with science; even the photograph of the mushroom cloud after the first atomic explosion or the image of Watson and Crick by the side of their model of the DNA double helix fail to evoke the sense of power that science has wielded in the 20th century. But, the question persisted in my mind: 'Did physics and physicists have a disproportionate influence in shaping the public image of science?'

What of the other disciplines? Mathematics is too abstract, at times esoteric and forbiddingly austere; mathematicians, eccentric, remote, often preferring cold, mathematical 'beauty' over the mundane considerations that seemed to bother physicists and engineers, for whom mathematics is an indispensable tool. In Einstein's assessment: 'As far as the laws of mathematics refer to reality, they are not certain; and as far as they are certain, they do not refer to reality' (Einstein, A., *Ideas and Opinions*, The Modern Library, New York, 1954). Chemistry is prosaic, drowning in detail, at times unappealingly utilitarian. Even in an age dominated by economics and commerce, perceptions about science can be coloured by romanticism that can be traced to the extraordinary period in physics in the 1920s and 1930s. Chemists, too often are associated with smelly and accident-prone laboratories. Curiously, the quintessential scientist in most movies is surrounded by flasks and distillation apparatus in a surrounding that appears suspiciously like a chemistry laboratory. Biology seems too familiar and descriptive to a degree that is inhibitory; biologists, and I refer here only to the classicists, seem to be nature lovers practising an easily accessible craft. The new generation molecular biologists closely resemble chemists, drowning in a deluge of data, as genes, genomes, molecules and pathways multiply at an alarming pace. Molecular biology laboratories present a gleaming image but to an outsider the field appears to be shrouded in impenetrable jargon, obscuring the nature of the scientific problems being investigated. Geology bears an uncanny resemblance to classical biology; the former describing our inanimate surroundings, while the latter catalogs living forms. The new description of the science of the earth, 'Earth Systems Science', may hardly serve to shore up the image of an extremely important field, which is often considered a poor relative of the other sciences in India. Opinions about science are invariably shaped by experiences in

school and college. For students who read generally, and this number is shrinking alarmingly, books sometimes provide an important stimulus in shaping their thinking. There are many readable accounts of the lives of physicists and events in physics; far more than in other disciplines. Biology, arguably the dominant discipline of science today, can boast of two widely read books, separated by generations, which may have drawn wide attention: *Microbe Hunters* by Paul de Kruif (1926) and *The Double Helix* by James Watson (1968). Public perception of a field in the past was often influenced to a remarkable degree by a readable book.

In India the birth of modern science coincided to a great extent with the heroic age of physics. While J. C. Bose was the acknowledged pioneer, the Bengal renaissance with C. V. Raman, Meghnad Saha and S. N. Bose in the 1920s and 1930s ensured that the public image of science would be dominated by the successes of physics. Homi Bhabha's remarkable achievements as a builder of institutions and his championing of the power and potential of atomic energy strengthened the case for great investments, in economically difficult times, in areas of science dominated by physics. The mid-20th century revolution in biology traces its roots, not to the established laboratories of chemistry and biochemistry in the West; but, to the Cavendish Laboratory in Cambridge, presided over by W. L. Bragg, one of the founders of crystallography. Molecular biology's origins, both structural and genetic, may be traced to the work of Linus Pauling and Max Delbruck at Caltech. Pauling, an early practitioner of quantum mechanics and crystallography, tasted the atmosphere of physics of the 1920s in Europe; Delbruck began his career with Niels Bohr, Francis Crick began in physics; so too did G. N. Ramachandran. The mid-20th century drift into biology coincided with a feeling that 'physics' as perceived by the romantics of the 1930s was reaching an end; biology might indeed provide the setting for uncovering new laws of nature.

In thinking about physics and physicists, I was blessed by the appearance of two books on my table. The first was an unexpected gift from a friend who brought me a 'used copy' of a book that is now out of print: *The Physicists* by C. P. Snow (Little Brown and Company, Boston, 1981). I found the second while browsing, inevitably in an airport bookstore: *The Strangest Man. The Hidden Life of Paul Dirac, Quantum Genius*, by Graham Farmelo (Faber and Faber, London, 2009). Farmelo's biography of Dirac will undoubtedly interest those who enjoy accounts of the lives of scientists of formidable intellectual achievement. Dirac's 'strangeness', while manifest in his behaviour, was most evident in his work. He was the 'purest' of the theoreticians, who built the edifice of contemporary physics. I cannot resist reproducing two assessments of Dirac's work and style, which Farmelo uses in his eminently readable account. The first is from a talk by Steven Weinberg on the occasion of the Dirac Centenary: 'Dirac told physics students they should not worry about the meaning of equations, only about their beauty. This advice was good only for physicists whose sense of pure mathematical beauty is so keen that they rely on it to see the way ahead. There have not been many such physicists – perhaps only Dirac himself' (Farmelo, p. 428). The second is by Freeman Dyson: 'The great papers of the other quantum pioneers were more ragged, less perfectly formed than Dirac's. His great discoveries were like exquisitely carved marble statues falling out of the sky, one after another. He seemed to be able to conjure laws of nature from pure thought – it was this purity that made him unique.'

Snow's book is a classic. It is a first draft, written 'largely from memory' and published after his death. Snow lived, and for a while worked, amongst the Cambridge physicists led by Rutherford. In his career as a scientist and administrator, Snow witnessed history as it was made. In chronicling the events of his times, Snow's writing is direct and simple. A keen observer of men, he brings 'the physicists' to life. In describing two great contemporaries, Rutherford and Einstein, Snow reflects on 'the disparity in the treatment of the great experimentalists as contrasted with that of the great theoreticians. . . In terms of popular esteem, experimentalists felt, and still feel, as Rutherford did with his usual horsepower, that they got an unfair deal. The names of theoreticians survived in intellectual currency: the names of experimentalists didn't. Einstein provided the most vivid illustration'.

I began this column mildly puzzled by the public perception of physics and physicists. There may be no better way to end than to return to Snow's reflective assessment: 'The most incisive tribute to Einstein was made by Dirac, who doesn't inflate his words. Dirac said first that if Einstein hadn't published the Special Theory of Relativity in 1905, someone else would have done it within an extremely short time, five years or less. . . But, Dirac went on, the General Theory which Einstein published in 1916, is an entirely different matter. Without it, it is likely that we should still be waiting for the theory today. That is one of the most striking things ever said of one great scientist by another. . . There was no injustice in Einstein's transcending fame. Still it is possible that the *mana* of his personality encouraged it. . . When he felt deeply, he was rather like an Old Testament prophet, or else a benign deity being patient with human stupidity and worse – but also like a benign deity who had considerable physical resemblance to a handsome and inspired golliwog. No one who knew him expected to meet anything like that again: and they were right.'

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