Empire of the Stars. Friendship, Obsession and Betrayal in the Quest for Black Holes. Arthur I. Miller. Little, Brown and Company, London. 2005. 400 pp. Price: US$ 26.

Petty academic rivalries and one-upmanship games are unfortunate realities nagging most scientific institutions. Arthur Miller's epic story of the discovery of black holes reconstructs the duplicity and bigotry that arrested scientific progress and left humanity ignorant for decades, about the mysterious voids that imprison both matter and light. A historian versed in human behaviour, the author asks for an understanding of jealousy and skulduggery not only in the context of racism, but also in the heavy psychological toll paid by scientists involved in cutting-edge research. High levels of intensity, competitiveness and solitary work sometime generate actions that undermine the very spirit of science.

Subrahmanyam Chandrasekhar was a supremely gifted mathematical astrophysicist, whose career was strewn with tragedy and disappointment. Though rehabilitated with the Nobel Prize towards the end of his life, 'the price was terrible. His great discovery had been overlooked for almost forty years' (p. 8). The leading scientific authority of the pre-World War II era, Arthur Eddington, subjected Chandra to public ridicule and persecution that went on for years, leaving scalding scars on the latter's sensitive mind.

Barely 24 years old in 1935, Chandra presented to the London Royal Astronomical Society (RAS), his dramatic discovery that massive white dwarf stars that burn up all their fuel collapse into nothingness. Eddington crushed the young genius' soaring dreams by arrogantly dismissing the theory as absurd, utterly wrong and 'stellar buffoonery'. Eddington was known to carry himself 'like a representative of the British Empire in its grandest days' (p. 12). He reserved caustic comments for any scientist whose findings disagreed with his ideas. Had the Englishman accepted Chandra's line, the former's 'fundamental theory' and whole mathematical system of *E*-numbers along with his fragile mental balance would have been toppled.

The RAS audience, overawed by Eddington's reputation and power, blindly accepted his preconceived ideas about nature and did not dare to question this illogical outburst. Chandra's own friends privately ridiculed Eddington's irrational tendency of bending the laws of astrophysics to maintain his personal hegemony over the subject he pioneered. However, not one senior sympathetic figure in the galaxy of scientists was prepared to stand up in public for the curious outsider hailing from India. They 'still basked in the belief in their innate superiority' and 'refused to accept that a young man from one of the colonies might have anything to teach them' (p. 13). Not permitted to respond in self-defence by the RAS, Chandra's humiliation came close to destroying his scientific confidence and bristled as an enduring incubus. When Miller met him in 1993 and thoughtlessly mentioned the Eddington episode 'his face clouded' (p. 6).

Chandra was born to a free-thinking, upper class Tamil household. Inspired by Srinivasa Ramanujan, one of the century's most original mathematicians, his earliest motive was 'to show the world what an Indian could do' (p. 24). When his illustrious uncle (later Nobel laureate), C. V. Raman made the ground-breaking molecular structure discovery, Chandra was 'swept along in the euphoria' (p. 33). He was an extraordinarily brilliant child, devouring mathematics texts and praying to God on the Marina Beach at Madras, to be allowed to become another Riemann or Einstein. Eddington's books kept him spellbound. He entered Presidency College for Physics Honours at the record age of 15 and usually scored more than 100% in examinations.

Chandra was not apolitical. He hero-worshipped Jawaharlal Nehru. In 1930, he shared a railway coach with an Englishwoman who began complaining loudly and added that the saving grace was that the native was 'at least wearing Western clothes'. An infuriated Chandra stormed out and returned in Tamil *veshti* and shirt!

The precocious youth met German physicist Arnold Sommerfeld in 1928, when he came to deliver a lecture in Madras. It opened new vistas to the emerging field of quantum theory and led to Chandra's first published paper on how light, electrons and atoms interact in a star. In 1929, Chandra was thrilled to chaperone Werner Heisenberg around Madras with enormous pride. Meghnad Saha invited the star pupil from Presidency College in 1930, to meet his group of scientists in Allahabad. That same year, the college offered him a scholarship to study in England as 'a very special case'.

Sitting on the deckchair of the Europe-bound ship, Chandra calculated that the velocity of electrons at the centre of white dwarfs was super-fast and that such stars had a maximum mass limit. The monumental discovery was not serendipitous, for 'equations spoke to him. He could lose himself in numbers and symbols. He had the vision to see the big picture' (p. 92).

At Cambridge, despite the staggering implications of Chandra's discovery, few took an interest in his detections. Racial prejudice was prevalent, especially as the upstart Indian was straightaway measuring up to the scientific 'big guns', instead of comparing himself to fellow students. Edward Milne pressurized him to formulate results so as to support his own theories, lining Chandra up as his front man to prove Eddington's basic assumptions wrong. In 1931, Milne forced Chandra to put aside his work on the collapse of burnt-out stars since 'it violated his thesis' (p. 110), rendering him a pawn in the bruising battle of heavyweight egos.

In 1933, Chandra was coerced into a traditional problem area for his Ph D due to the dirty politicking at Cambridge. He was elected a Fellow of Trinity College, the second Indian to do so after Ramanujan. In 1934, he lectured at Moscow University and found his reception there a welcome change from the stiff-upper-lipped discrimination in England.

After Eddington's venomous, convoluted, obscure and inconsistent attack at the RAS, a crestfallen Chandra wrote, 'It is all really sickening – these underhand methods' (p. 139). The controversy did help him to become the first Indian to give university lectures in Cambridge. As his reputation grew by leaps, Harvard offered him a position in 1935. Instead, he decided to join Gerard Kuiper at the Yerkes Observatory in the University of Chicago in 1936.

Racism did not spare Chandra in Chicago, New York and in the American Deep South. One graduate student is said to have remarked that he was 'one of the

blackest people you would ever see' (p. 238). Many interpreted his touchiness to racial slurs as 'radical politics', though the maximum extent he ever went was to campaign for Adlai Stevenson as Democratic candidate for President in 1952.

Eddington's shadow continued to harass Chandra in the form of vituperative reviews for his two major books on stellar structure (1939) and dynamics (1943). Though they were invaluable contributions to astrophysics, Eddington derided them for 'ugliness'. At the 1939 Paris Colloquium on Novae, Eddington verbally fenced with Chandra and attributed his relativistic degeneracy equations to Western scientists. In 1944, Chandra was nominated Fellow of the Royal Society by Raman, who also proposed forwarding his name for the Nobel in 1948.

Although Chandra relinquished the subject of white dwarfs in America, advances in nuclear physics eventually led to the rediscovery of his theory and realization that he had been right all along. Robert Oppenheimer and his students showed how massive stars could perish and collapse completely, but they 'did not take Chandra seriously', feeling 'he was not a "real" physicist' (p. 201). Chandra, on his part, liked complicated mathematic methods and avoided collaboration with Oppenheimer. He also declined the offer to join the 'Manhattan Project' that produced the atomic bomb.

In his middle age, Chandra moved to definitive research on radiative transfer, hydrodynamic and hydromagnetic stabilities. He collaborated with Enrico Fermi on magnetic fields of spiral galaxies and served as a consultant at Los Alamos on turbulence, upon the urgings of Edward Teller.

When Stirling Colgate's supernova research proved beyond doubt that stars really undergo ongoing and endless collapse, Chandra was elated. He carefully edited, rewrote and published Colgate's work in 1966. He also published papers proving that super-massive stars could shrivel away and disappear into a niche in space and time. John Wheeler gave this cosmic receptacle the name 'black hole' in 1967. Chandra returned to his first love and performed astoundingly complex calculations to streamline emerging knowledge into his magnum opus *The Mathematical Theory of Black Holes* (1983).

After receiving the 1983 Nobel, Chandra's unflagging productivity took him to fresh pastures of gravitational wave collision with stars and analyses of Newton's *Principia* using 20th century mathematics. An Icarus who took risks and probed the reality behind appearances, Chandra was gifted with typical Indian humility and rarefied sense of aesthetics. Befittingly, the 1999 X-ray Observatory in space of space shuttle Columbia was named after this giant of astrophysics, whose salad days were sadly sacrificed at the altar of meanness.

How many more Chandrasekhars are being denied to the world by the subordination of science to politics?

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Insect Neuroendocrines. V. B. Awasthi. Scientific Publishers, 5a New Pali Road, Post Box No. 91, Jodhpur 342 001. 2005. 431 pp. Price: Rs 2350.

The volume gives an overall idea about the neuroendocrine system and its variation in different insect groups, as it has been known to vary in their morphological features from insect order to order. Not many Indian books have been published on insect endocrine organs and their physiology, excepting probably the volume by late K. K. Nayar. Through the 35 brief chapters, the author tries to give a brief idea about the general organization and variations of the insect neuroendocrine system, highlighting different endocrine components and identification techniques of different secretory neurons, including ultra-structural details. Different physiological influences imparted by various insect hormonal principles also have been dealt in subsequent chapters briefly. The last part of the book provides a good illustration of different epithelial endocrine glands using both photomicrographs and several electron micrographs of different insect endocrine components, representing selected insect orders that have already been published by either the author himself or pioneering insect endocrinologists. All micrographs have been reproduced in the volume in an excellent fashion. A selected reference list also has been provided by the author at the end of the first part of the text. Hence the book forms a good source of preliminary information to both students and beginners on insect endocrine research.

However, morphological details and also various physiological and functional details of insect endocrine components have been treated briefly and that too in the light of comparatively old literature. One shortcoming that could be identified with this particular volume is that the author has restricted to picturize the scenario and status of known information on insect neuroendocrines for a period of 20–25 years earlier, as is evident from the reference list and the kind of details that the author tries to deal in this book. So the volume must definitely cater to the needs of a beginner on various aspects of insect hormones and hormone-secreting components. But the level of knowledge on insect endocrines has drastically transformed during the last decade or two thanks to the different ultra-sensitive and precise analytical techniques that enable one to identify and characterize insect hormones. In this respect, the present volume probably does not give up-to-date information on recent trends and findings on insect endocrine components. Of course, for a beginner and for students of insect endocrinology, this volume is really an asset.

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Stress: From Burnout to Balance. Vinay Joshi. Response Books, Sage Publications India Pvt Ltd, B-42 Panchsheel Enclave, New Delhi 110 017. 2005. 209 pp. Price: Rs 185.

'Without stress there would be no life', wrote Hans Selye who coined the term stress. Certainly, stress has been with us from the early days of mankind. Yet, the