was an event to recall the ancient myth of Phaethon, who being entrusted to take charge of the chariot dragging the Sun across the sky drove too low and set the Earth on fire.

On 25 June AD 1178, five excellent men of Kent saw fire and sparks break out repeatedly from between the horns of a new moon. The body of the moon "writhed and throbbed like a wounded snake" wrote Gervase of Canterbury, a "phenomenon that was repeated a dozen times or more". After the flame had twisted randomly for a while the Moon returned to normal, except that the crescent was now dark instead of bright as it had formerly been. In modern times, satellites have detected a very fresh crater, named (ironically) Giordano Bruno, on the far side of the Moon, which seems to have been produced in an impact of the 100,000 megaton class, sufficient if it had hit the Earth to have devastated at least an entire continent. Clube and Napier do not mention that this event demonstrates the correctness of Gold's view of the dusty nature of the lunar regolith, for it was surely immense clouds of thrown-up dust reflecting sunlight that the men of Kent took to be the fire and the sparks. The basalt flows, so dear to the NASA establishment, would not have produced anything of the sort. It is interesting that an inexpensive but correctly motivated library search would have solved the problem of the nature of the lunar surface, whereas the immensely expensive NASA lunar missions did not — the difference one might say between an open-box mentality and a closed-box one.

Clube and Napier regard a date of about 1000 BC as being crucial in human history. Before 1000 BC, and especially in the third millennium BC, bolide impact was far more common than it has been in the period since. In earlier times the skies were ablaze with comets, the many companions of Comet Encke. The emergence of particle jets from comets was interpreted as being similar to the destructive effects of bolide impacts on the Earth. The comets were gods and in firing away with the evaporated jets they were at war with each other. This was the background to ancient myths of the war of the gods. One particular comet lasted in brilliance longer than the others and this became Zeus, king of the gods. On pages 198–199, the authors compare their views on the genesis of ancient myths with the usual explanations, and I must say the usual looks very thin when compared with the brew on offer. Were the bolts of Zeus nothing more than lightning flashes which have only a minuscule probability of killing anyone? Or were they Tunguska-like events about which even hard men would be pressed to maintain their composure. Such events causing forest fires in

regions where metallic ores were exposed at the surface could produce reduction to metals. Was this how metal smelting was discovered, in cosmically generated furnaces? Where, I ask myself, did the expression "bolt from the blue" come from? Is there a similar expression in other languages? Splendid stuff! The authors are to be congratulated on having produced a book which seems well calculated to annoy a commendably large number of people. □

Sir Fred Hoyle is at 102 Admiral's Walk, West Cliff, Bournemouth BH2 5HF, UK.

A passage from India

David Lindley

Chandra: A Biography Of S. Chandrasekhar By K. C. Wali. *University of Chicago Press: 1990. Pp. 352. \$29.95, £23.95.*

A NINETEEN-year-old prodigy, travelling by boat from India to England where he is to take up graduate studies in astrophysics, discovers a new, profound and surprising fact about the nature of stars. After a few years at Cambridge, as his reputation is beginning to spread, he makes his discovery known, and, to his great dismay, is attacked — mocked in fact — by a man who was supposed to be his mentor. And although the logic of the young man's argument is irrefutable, the physics of the matter is somewhat abstruse, and the position of his attacker so lofty, that he finds himself largely abandoned.

In this literate and engaging biography K. C. Wali tries, as a novelist would, to make of this episode in the life of Subramanyan Chandrasekhar a key to understanding his subsequent career. The story of Chandra's discovery — that stars above a certain critical mass could not settle down into quiet old age as white dwarfs, but would collapse further into some then inscrutable new state of matter — and of how Sir Arthur Eddington disparaged it not for reasons of physics but because he could not bring himself to believe that nature would allow such a catastrophe, is part of the folklore of astrophysics. Had Eddington, a great expert on relativity, not thrown his weight against the idea, black holes might have been recognized as an astrophysical reality twenty years earlier. But Chandra, though he never doubted his own rightness, chose to disengage from any bitter public dispute with Eddington, and embarked on no lifelong vendetta.

Instead, he moved in 1937 to the United States, first to Yerkes Observatory in Wisconsin and then to the University of

Chicago, where, for half a century, he has cultivated what might be called the high style of research in mathematical physics. He immerses himself in the study of some seemingly remote subject and, after some years of intellectual labour, delivers an encyclopaedic monograph: *Radiative transfer*; *Ellipsoidal figures of equilibrium*; *The mathematical theory of black holes*.

It may be, as Wali suggests, that Chandra's decision to avoid the frenzied and disputatious frontiers of science, finding his satisfaction instead in the full comprehension of each complex problem that he tackles, was a reaction to his fierce encounter with Eddington. But the habit of self-reliance seems to have been instilled at an early age. In British India, when Chandra was growing up, the best schools were reserved for children of the British and of local princes; Chandra was educated mostly at home, by a learned but stern father and then by private tutors. Even then, he supplied his own discipline, working on his exercises in mathematics beyond his father's requirements.

And later, when Chandra's reputation was established in Europe and the United States, he resisted efforts to draw him back to any science position in India, principally, it seems, because he wished to stay aloof from the incessant squabbling that afflicted Indian science. In the middle decades of this century there were a number of distinguished Indian scientists, including H. Bhabha, S. N. Bose, M. N. Saha and Chandra's uncle, the Nobel laureate C. V. Raman, most of whom seemed to spend a good deal of their time scheming against the others. Although Chandra at one time likened the quality of life in the United States to distilled water, his position in Chicago afforded him the calm to indulge his intellectual tastes.

Wali writes persuasively of the difficulties encountered by an Indian trying to make a career in western science. Chandra had to endure patronizing British officials who hinted that he would soon find himself out of his depth, and scientists too respectful of Eddington and their own caste system to come forthrightly to his defence. And when he had made his name in the United States he was sniped at by scientists and bureaucrats back in India for his refusal to return. Those who know Chandra through his scientific reputation will find here many clues to an apparently distant character. His pleasantly dictatorial stewardship of the *Astrophysical Journal*, which he edited for many years, shows a man who will do no favours and waive no rules. He offended many astronomers, who had until then regarded the journal as an outlet for whatever they deemed suitable, but he made the *Astrophysical Journal* into a serious publication. And if it seems

like arrogance for Chandra to have been so determined to do the right thing, we have to recognize that, almost always, he is right.

Wali's account of Chandrasekhar's life is a social and intellectual education; it recalls another era, and a scientific style that is out of fashion (no fifty *Physical Review Letters* a year from Chandra). The only failure of the book is that it presumes a certain familiarity with Chandra's achievements. Readers may well want to know what Chandra did after the momentous work on white dwarfs and the battle with Eddington, but Wali describes an eminent, greatly admired scientist without sufficiently explaining the eminence and admiration. It would be a shame if this kept a large audience from the book: there is much to be enjoyed in it. □

David Lindley is an Associate Editor of *Nature*.

■ Just published by Chicago University Press is volume 5 of the selected papers of S. Chandrasekhar: *Relativistic Astrophysics*. Price is £59.95, \$86.25 (hbk); £23.95, \$34.50 (pbk).

Astro aesthetics

David W. Hughes

Universe. By Michael Rowan-Robinson. Longman: 1990. Pp.180. £17.95. Published in the United States by Freeman as **Our Universe: An Armchair Guide**. \$24.95.

ASTRONOMERS usually, and quite understandably, wince when confronted with the following quotation.

*When I heard the learn'd astronomer,
When the proofs, the figures, were ranged
in columns before me,
When I was shown the charts and diagrams,
to add, divide and measure them,
When I sitting heard the astronomer where
he lectures with much applause in the
lecture room,
How soon unaccountable I became tired and
sick,
Till rising and gliding out I wander'd off by
myself,
In the mystical moist night-air, and from time
to time,
Look'd up in perfect silence at the stars.*

(W. Whitman, "By the Roadside".)

Rowan-Robinson uses this quotation to conclude the preface of *Universe*. The quotation is redolent with hints of C. P. Snow's two cultures. One culture is supposedly standing in awe and wonder and is receptive to beauty, and the other culture, replete with instruments, graph paper and computers, is only happy when it measures, dissects and understands. It is easy to see which side Whitman is on. He is liberal with his artistic sneers. To Whit-

man, the scientist is a deflowerer as well as a philistine. Whitman clearly knew too few. The joy of reading *Universe* was also not his.

Rowan-Robinson has taken great pains, not only to stride over the cultural divide, but also to pull the two sides together. His underlying thesis is that ignorance is not bliss; beauty is enhanced by understanding, and the more you know, the more the joy increases.

Universe is divided into twenty chapters, each devoted to a single object. Comets rub shoulders with the nearest star to the Sun, Vega with Mira, the ring nebula with the Crab, Andromeda with the Magellanic Clouds, radio galaxies with quasars and the Starburst galaxy with the Virgo cluster. The selection favours the rare, the exotic and the spectacular. New stars, demon stars, variability, explosions, gas jets and death throes are in, the mundane — the normal, slow, astrophysical drudgery of ordinary stars and planets — is out. In fact all the planets are out. Something as small, rocky and wet as the Earth is merely regarded as a punch bag for incoming asteroidal fragments and a supporting surface for astronomical observatories. Our life and the possibility of life elsewhere is not considered. The only thing that Rowan-Robinson seems to find really exciting within the nearest four light years is our once-in-a-lifetime

encounter with Halley's Comet. But this fact underlines one of the joys of the book. It is a personal selection and a personal romp through the visual heavenly wonders. I should stress the word 'visual'. The ideas that underlie the origin and evolution of the Universe and underlie our ever-changing perception of what the Universe contains, feature much less in this book than those contents of the Universe that can be easily imaged.

Each of the twenty objects is dealt with in nine pages. To say that the book is well illustrated is an understatement. It is a visual delight and colour abounds. Even Whitman would appreciate the astronomical aesthetic enhancement that has resulted from the employment of large telescopes and spacecraft instrumentation. Even he would realize that standing moistly and gazing silently is a poor

Shooting stars — Historical woodcut of the Leonids meteor shower, reproduced from *Universe*.

substitute for the more modern endeavours of the astronomical community.

The two cultures still exist. They still sneer and snipe at each other from their close-guarded battlements. But bridges can be built and astronomers have an easier task than the majority of scientists.

Rowan-Robinson has produced a beautiful, stimulating and rewarding book. It is a feast for both the mind and the eye. The scientist is treated to a host of literary quotations and artistic reproductions, and the liberal artist to a careful exposition of the physical and chemical mechanisms that underpin the activities of the exotic bodies in the Universe. There is something in this book for us all. □

David W. Hughes is Reader in Astronomy in the Department of Physics, University of Sheffield, S3 7RH, UK.