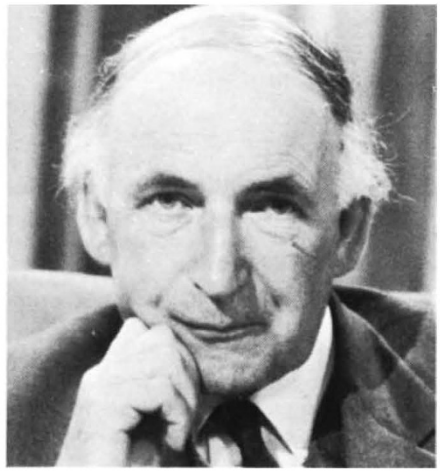
In search of our place in the Universe

Joseph Silk

Emerging Cosmology. By Bernard Lovell. Pp.208. ISBN 0-231-05304-5. (Columbia University Press: 1981.) $14.95, £10.80.



Sir Bernard Lovell, now tackling the history and philosophy of cosmology.

PHILOSOPHERS arise! Cosmology is beckoning. For mankind has found a niche in the Universe as it expands from an origin shrouded in mystery to an unknown future. Sir Bernard Lovell's new book tells the story of the development of human awareness of the Universe. Lovell leads us from the geocentric cosmology of the ancient world via the heliocentric cosmology of the Renaissance and the egocentric cosmology of the nineteenth century. His destination, of course, is the big bang theory of the expanding Universe, where fundamental issues still await resolution. Some of these issues differ little from the questions which faced the cosmologists of antiquity. Sir Bernard Lovell is an eminent radioastronomer who has no cosmological axe to grind, and it is especially refreshing to discover that his popular account of the evolution of cosmology manages to be both readable and enthralling.

We learn about the epicycles of Hipparchus and Ptolemy, and about how Thomas Aquinas incorporated Aristotle's crystal sphere cosmology into an apparently irrefutable argument for the existence of God. With Copernicus, the heliocentric hypothesis re-emerged and, against all odds, survived, while Tycho Brahe established the first accurate and systematic records of planetary data. Brahe punctured the immutable crystal spheres with his studies of comets and of the famous supernova of 1572. His assistant, Johannes Kepler, derived the laws of planetary motion after a painful decade of sifting endless mathematical permutations of the planetary data, and despite unflinching belief in the celestial harmony exhibited by the five regular solids. Next, Galileo's observations with a 4 cm aperture telescope caused an immense stir that led to an unavoidable conflict with the geocentric dogma upheld by theologians. Galileo saw sunspots, the moons of Jupiter and the phases of Venus, all of which established that the heliocentric system was a reality, and could no longer be thought of as a computationally convenient hypothesis. It remained for Isaac Newton to express the universal law of gravitation in a way that gave a theoretical understanding of Kepler's Laws.

The stage was set for modern astronomy. One of the great pioneers was William Herschel, who counted stars and mapped our Milky Way galaxy. Not, however, until the twentieth century was the Sun finally displaced from the centre of the Universe. Harlow Shapley resoundingly overthrew the egocentric view of the place of mankind in the Universe by using the newly calibrated period–luminosity relation for Cepheid variable stars to establish distances to remote globular star clusters. These were found to surround the centre of our galaxy some 30,000 light years from the Sun. Much happened subsequently: the discoveries of the expansion of the Universe and of the cosmic microwave background radiation are two of the highlights that have now led cosmologists almost unanimously to adopt the big bang cosmological model.

All of this forms a backdrop to Lovell's theme, which is the evolution of cosmological thinking. Lovell's book forms part of a philosophical series entitled "Convergence" and founded, planned and edited by Ruth Nanda Anshen in order to explore the new consciousness which marks mankind's recently acquired ability to tinker with the evolutionary processes of nature. Our unfolding knowledge of the cosmos traditionally places cosmologists in the role of passive observers acquiescing in the thrill of new astronomical explorations of the frontiers of the Universe. Unlike most natural scientists, astronomers cannot perform controlled experiments in a warm laboratory; rather they take whatever the Universe has to offer.

One might think that such a discipline would have little in common with philosophers who concern themselves with the interaction between human beings and their environment. However a current cosmological theme provides a remarkable bridge between the philosophical undertones associated with the origin and fate of the Universe and the human perspective. This is the anthropic principle, according to which the properties of the Universe are determined by our presence as observers. Conditions must be congenial for intelligent life to evolve. This means, for example, that the early Universe could not have been highly irregular, inhomogeneous or chaotic, nor however could it have been perfectly regular, otherwise galaxies and stars would not have formed. The anthropic principle accounts for the various large-number coincidences involving powers of 10^{40}, the ratio of electromagnetic to gravitational coupling constants. These include the mass of a star and the mass of the observable Universe, as well as the coincidence between nuclear, stellar and Hubble expansion time-scales. It even purports to account for the approximate values of the constants of nature: if they differed significantly from observed values, human beings could not have evolved.

Where does this leave us? The uniqueness of our Universe can be attributed to our existence as observers, if we accept the anthropic principle. But have we really advanced our understanding of any aspects of cosmology? In 1925, A.N. Whitehead perceived about cosmology that "there is no parting from your own shadow". Is the Universe merely our shadow? Or perhaps the cosmologists are deceiving themselves and the roles are reversed. The truth may very well be that with only one Universe to explore, we can never resolve this paradox.

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All around our star

David W. Hughes

The New Solar System. Edited by J. Kelly Beatty, Brian O'Leary and Andrew Chaikin. Pp.224. ISBN 0-521-23881-1. (Cambridge University Press: 1981.) £9.95, $19.95. *Orbiting the Sun: Planets and Satellites of the Solar System.* By Fred L. Whipple. Pp.338. ISBN 0-674-64125-6. (Harvard University Press: 1981.) $20, £14. *Daytime Star: The Story of Our Sun.* By Simon Mitton. Pp.191. ISBN US 0-684-16840-5; ISBN UK 0-571-11659-0. (Charles Scribner's Sons/Faber & Faber: 1981.) $14.95, £10.

WE LIVE in the Solar System. Our planet, Earth, orbits the Sun and the theme of these three books seems to be that the more we know of such bodies the better. In effect we are presented with a progress report. Governments have spent large amounts of money on investigating our neighbouring planets and star. What have we got from it? Where do we go next? Why bother doing more? The books under review try to answer these questions.

The investigation of the Solar System has passed through three phases. The classical period encompassed the works of scientists such as Galileo, Copernicus, Kepler and Newton. This was a time of discovery and astronomy was almost entirely concerned with the planets, stars being