This book forms a vital purchase to only a few very specialist libraries. It is not recommended for the majority, especially those already holding ref. 2.—DEREK JONES.

References

(1) *e.g.* P. van de Kamp, *Long-Focus Photographic Astrometry*, in *Popular Astronomy*, **59**, parts of nos. 2, 3, 4 and 5, 1951.
(2) P. van de Kamp, *Principles of Astrometry with Special Emphasis on Long-Focus Photographic Astrometry* (Freeman, London), 1967, Part II.
(3) W. D. Heintz, *M.N.*, **175**, 533, 1976.
(4) J. L. Hershey, E. R. Borgman & M. D. Worth, *Ap. J.*, **240**, 130, 1980.
(5) G. Gatewood & H. Eichhorn, *A.J.*, **78**, 769, 1973.
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(8) J. C. Kapteyn, *First Report on the Progress of the Plan of Selected Areas* (Hoitsema, Groningen), 1911, p. 12.
(9) *e.g.* C. A. Murray, D. H. P. Jones & M. P. Candy, *ROB*, no. 100, 1965.

The Accidental Universe, by P. C. W. Davies (Cambridge University Press), 1982. Pp. 139, $8\frac{3}{4} \times 5\frac{3}{4}$ inches. Price £10 hardbound, £4·95 paper.

The subject of this short book is the anthropic principle, which purports to deduce from *biology* some constraints on the physical laws and the fundamental constants. The anthropic principle takes several forms. The *weak anthropic principle* asserts merely that the laws of physics must be consistent with the existence of intelligent life (a rather trivial requirement, since we exist), whereas the *strong anthropic principle* claims in a Berkelian manner that *any* universe must necessarily give rise to intelligent life at some stage in its evolution.

To give the flavour of how the weak anthropic principle is used to constrain fundamental constants, consider the strong interaction constant. Were this constant about 5 per cent smaller, deuterium could not exist, and without deuterium for the proton–proton chain it is doubtful if stable, long-lived stars could exist at all. On the other hand, if the strong interaction were about 2 per cent larger, then ${}_2He^2$ could exist, and almost all the matter in the Universe would be in the form of helium. In either case, intelligent beings like ourselves could not exist in a universe with a strong interaction constant much different from the value we actually observe. Conversely, the existence of beings like ourselves would seem to imply that the strong interaction constant is restricted to lie in a rather narrow range.

One can also use the weak anthropic principle to constrain the Universe's initial conditions. For instance, John Wheeler has pointed out that unless the particle horizon now is greater than 10^9 light years, the Universe would re-collapse in a time too short for human life to evolve. Thus the Universe must be at least as big as it is in order for us to be here and observe it.

The anthropic principle seems to generate strong feelings amongst astronomers. Some feel the principle is an intriguing idea which leads to a genuine insight into the workings of the Cosmos and our rôle in it, while others contend that the weak anthropic principle is banal and the strong anthropic principle is nothing but mystical, metaphysical bunk. In a recent review[1] of this book, Michael Rowan-Robinson denounced the anthropic principle as a reactionary "... return to an Aristotelian style of reasoning."

The scepticism with which many astronomers view the anthropic principle is due primarily to the fact that to date it has not been used to make testable predictions. I personally think that this lack of predictions is not an inherent defect of the anthropic style of reasoning, but rather a manifestation of a general unwillingness to look for such predictions. For example, Davies invokes the Many-Worlds interpretation of quantum mechanics to justify the weak anthropic principle: all possible sizes of universes exist, but we are naturally aware of only that universe which is large enough to be consistent with our own existence. Yet on the basis of the strong version of the principle, he could have inferred that universes smaller than 10^9 light years simply don't exist: the universal wave function does not include such universes. Since the Copernican Principle would imply that all universes which are consistent with the laws of physics must have equal probability, this would mean that there must be some undiscovered physical law which prevents such small universes from existing. Such a physical law must have some consequences for the observed universe. Here, then, is an example of an anthropic principle prediction, since there is no reason on the basis of known standard physics so to restrict the Many-Worlds ensemble.

When new scientific ideas first appear, they are quite often attacked as reactionary by contemporaries. This was the fate of the Copernican theory itself for the first fifty years of its existence. The historian Robert S. Westman has shown that German scholars at the time regarded the Copernican theory as merely an anachronistic rebirth of the theory of Aristarchus, which they believed had been refuted centuries before. It thus behoves modern scientists to be very careful in using historical analogies as a means to decide between theories.

Davies has done a fine job in providing an introduction to the anthropic principle. The book probably has a bit too much algebra for the lay reader unused to mathematics, but I can strongly recommend it to astronomers.—FRANK J. TIPLER.

Reference

(1) M. Rowan-Robinson, *New Scientist*, **97**, 186, 1983.

Introduction to Comets, by John C. Brandt and Robert D. Chapman (Cambridge University Press), 1983. Pp. 246, 9×6 inches. Price £6·95, paper.

Drs Brandt and Chapman set out here to provide a useful introductory guide to the whole of cometary research for students, scientists and interested members of the public. The practical difficulties of writing for such a varied readership have led them to divide the book into four major parts, covering the historical, current, future and lay perspectives respectively. This separation is quite uneven, and in fact the bulk of the book is devoted to a comprehensive review of current ideas, designed, according to the authors, to be essentially encyclopædic in style.

I found the historical introduction quite well written, with a particularly interesting account of the gradual development in our understanding of the underlying physics of comets. However, it was surprising to find no mention here of the various controversies over the origins of long-period *vs* short-period comets. This, I should have thought, would have been more grist for the mill in a book of this kind. It was also disappointing to find Lyttleton's