of even the most fiercely and proudly rational of us, without anybody noticing, least of all ourselves. (For example, how many of you are now holding a stereotype — 'feminist' — at the forefront of your minds, and using it to decide whether to continue reading this review? Come on, be honest.)

Traditional feminism accepts a masculine metaphor of rationality, and fights against the exclusion of women from the resulting worldview. Haste prefers to challenge the worldview itself. A special case that should be of particular concern to all scientists is to what extent the methods and objectives of science are biased by unspoken and unperceived cultural slogans about the male–female polarity.

Scientists typically take the position that science is a rational activity and that it is free of cultural biases. They hold that there is no such thing as masculine science or feminine science, any more than there is Western science and Eastern science. There is only Science — the formulation of rational hypotheses and their confrontation with experiment. In some sense this is surely true. For example, if scientific discoveries derived from an Eastern cultural background were in serious conflict with scientific discoveries derived from a Western cultural background, they couldn't both be right, and the rational scientific method should be capable of distinguishing between them. But this is the least interesting sense, because it describes an abstraction. Real scientists are people, and their cultural backgrounds bias them in the one place they seldom probe: not their experimental or theoretical methodology, but their choice of what problem to apply the methods to.

For example, in recent years there has been an enormous growth of environmental science. It is indeed the same science that went before, in the sense that the chemistry of chlorofluorocarbons is the same whether the problem is to devise a propellant for aerosols or to save the ozone layer. But think how different the consequences would have been if the science of the ozone layer had been attacked first, instead of that of aerosols. Think how different the development of that area of science would have been. Then ask yourself whether scientists can possibly pursue all avenues simultaneously; and since they can't, decide what you mean by 'science' as an abstract, acultural, ahistorical activity. Finally, ask yourself what relevance any 'sameness' in your answer can have to human concerns, especially your own.

Science in the abstract is a rational process, but one that has been tacked on to an intuitive one in order to limit human folly. It does not totally eliminate it, because humans never fully attain their ideals. But science wouldn't work if it were as purely rational as the conventional model holds. Every area of science has its accepted paradigms, which channel the directions that investigations pursue. It cannot advance without paradigms — it would be lost in an overwhelming morass of data. But paradigms do not have a wholly positive effect. Until very recently the study of animal behaviour was dominated by the behaviourist paradigm, which denied animals any vestige of wants, intentions, emotions or consciousness. Animals were organic machines operated by drives. This is a curious paradigm to come from minds that actually 'live inside' an animal and which would be appalled to have the same description applied to themselves; and it has seriously limited our understanding of animals.

The Sexual Metaphor is a thought-provoking and brilliantly targeted book. I particularly recommend chapter 11, "Science and Rationality", to anybody who wants to open this particular mental Pandora's box. I would recommend it even more to anybody who would prefer to have the box kept shut — but I know they wouldn't take any notice. □

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Pillars of cosmology

David N. Schramm

Cosmic Questions. By Richard Morris. *Wiley: 1993. Pp. 200. $24.95.*

COSMOLOGY truly is in a Golden Age. Never before have so many different kinds of experiments and observations been able to lead to conclusions about the entire Universe. Experiments on satellites, on balloons at the South Pole and other remote places are all mapping fluctuations in the cosmic microwave background radiation left over from the Big Bang. Telescopes, such as the new 10-m Keck telescope in Hawaii, are finding light elements in very primitive material as predicted by Big Bang cosmology, as well as mapping out the distribution of galaxies in the sky and finding huge structures, such as great walls, great attractors and superclusters. Researchers are building detectors deep underground to look for exotic dark matter passing through Earth. And satellites are searching in X-ray and gamma-ray regions of the spectra, probing the emission of galaxies in these non-optical wavelengths.

Just as physicists at the turn of this century acquired technical capabilities to study the structure of the atom, so now has cosmology progressed from a philosophical, theoretically based field to a true branch of physical science grounded in experiment and observation while still maintaining a close interplay with theory. Richard Morris accurately describes the nature of this revolution, which, he points out, has not overturned the standard cosmological theory of the Big Bang, but rather has added to its richness and led to a new round of questions at a much deeper level. He calls these and others the "cosmic questions".

In the past decade, there have been many popular books on cosmology. Some have emphasized the personalities as much as the science, such as Denis Overbye's well-written *Lonely Hearts of the Cosmos*. Some have been autobiographical, such as George Smoot's *Ripples in the Cosmos* (co-authored by Keay Davidson). Others have focused mostly on the description of the science itself.

Morris's book falls into the descriptive category, and it has the advantage of being very recent and therefore up to date in this rapidly changing field, covering, for example, the recent measurements of anisotropy in the microwave background radiation. Unfortunately, Morris, not being an active player in the field, occasionally gets details garbled. He mistakenly talks about a 'critical density universe' being one that expands to a fixed size. He misses the main problems of the popular cold-dark-matter model of structure formation, yet rightly points out that many cosmologists have questions about the model. I was pleased to note that Morris recognizes nucleosynthesis as one of the three pillars of the Big Bang along with the Hubble expansion and the microwave background radiation. But for some reason, he does not specifically mention the key figures in the nuclear area, although he bends over backwards naming very minor players in the more astronomical topics.

The book ends with the cosmic questions: What is the Universe made of? How did it begin? How will it end? What is time? Some of these long-standing puzzles are finally being attacked with real experiments and data. The author also delves into more philosophical questions, discussing, for example, the anthropic principle while asking "Why is our universe so hospitable to life?".

A useful feature of this book, and one unfortunately still rare in works of this type, is the inclusion of a comprehensive glossary. This should make the book much more accessible to the lay reader or the intelligent high-school student who wants to learn more about the excitement of modern cosmology. □

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