

Astrophysical fruit

Geoffrey Bath

The Left Hand of Creation: The Origin and Evolution of the Expanding Universe.

By John D. Barrow and Joseph Silk.
Basic Books/Heinemann: 1983. Pp. 256.
\$17.95, £9.95.

"THEORETICAL astrophysics is as exact a science as geometry", remarked the Oxford mathematician E. A. Milne in a paper in 1930. Milne's affirmation in the exactitude of astrophysics followed introductory remarks outlining the problem of radiative transfer through a spherical shell of gas. This introduction concluded with an outspoken defence of what Milne saw as one of the chief necessities for progress — namely, the need to simplify a complex problem into an analytically tractable set of conditions, in his case the simultaneous and self-consistent solution of radiative transfer through matter, including ionization and excitation. Milne confined his attention to "the simplest question that can be propounded". That is, the case of static grey material. Today those working in the field of radiative transfer are approaching the solution of non-LTE (local thermodynamic equilibrium), extended, relativistically expanding atmospheres. But no one working in the field would deny the truth of Milne's justification for a simpler approach in 1930. "Until we have fully and rigorously discussed the case of grey material we are unlikely to make useful progress with more complicated hypotheses."

It is salutary to reflect on the state of model atmosphere theory half-a-century ago in the context of developments within modern cosmology. In the past cosmology has all too frequently been dismissed as an insular, acroamatic subject; a science which, with only the one singular case open to investigation, was doomed to failure on the grounds of inadequate experimental verification. For after all, so the argument goes, how could Newton possibly have succeeded in his theory of gravitation with only the one instance of a single apple falling on his head as experimental proof? Amusing though the myth may be, it was the extensive studies of motion and dynamics for two thousand years, from Aristotle and Richard of Wallingford to Galileo and Newton himself, which permitted a precise theory of gravity to be formulated.

However to view cosmology as the study of one experiment of the Grand Designer is to mistake the vessel for the cargo it contains. Cosmology is not the science of one single aspect of the Universe. Rather it is all aspects, woven against the tapestry of time, space and the forces of nature. The attempt to understand the origin, development and ultimate fate of its constituents is

no different in principle from the aim of chemistry to unravel the code of chemical bonding, or of molecular biology to tease out the molecular basis of life.

Barrow and Silk present this quest with wit and gusto. Confident and experienced guides, they conduct their readers around the great debates in contemporary cosmology. At issue are such questions as the origin of the lack of antimatter, the source of spatial fluctuations responsible for all present structure in the Universe, the quasi-supernatural, as they seem superficially, properties of the vacuum giving rise to the paradox of black hole evaporation, and the progressive decomposition of the cosmic soup as time is run backwards towards the Planck time when the Universe was 10^{-43} seconds old, complete symmetry held sway, and all forces were indistinguishable.

No new development in fundamental physics can take place today without its influence on the evolution of the Universe being tested. Increasingly cosmology, and the astronomical evidence at its core, plays

a fruitful role as a guide to permissible physical theorizing, supplementing more orthodox laboratory experiment and verification. The resulting astrophysical theorems aim at an ultimate amalgamation of theory and observation which will account for the form and content of the Universe — a Universe seen as a necessary consequence of physical law, with only the most basic axioms as the starting point.

But do not turn to this book for proofs of those theorems. The excitement and challenge are captured, but the rigour is necessarily elsewhere. Just as for many young minds the bald statement of Pythagoras's theorem is the first step towards a clearer perception of the structure underlying the physical world, so this book is a primer to recent attempts at unification of the forces of nature, and the powerful patterns those attempts are creating in the science of astrophysics. □

Geoffrey Bath is a Research Fellow of Wolfson College, University of Oxford.

Fresh yeast

D.R. Harper

Yeasts: Characteristics and Identification.

By J.A. Barnett, R.W. Payne and D. Yarrow.

Cambridge University Press: 1983.
Pp. 811. £75, \$150.

MANY of the outstanding publications dealing with the classification, nomenclature and identification of yeasts have, in the past, come from the Centraalbureau voor Schimmelcultures in Delft. Jacomina Lodder, of the Centraalbureau, edited what has for many years been considered as the definitive work on yeast taxonomy, *The Yeasts: A Taxonomic Study* (North-Holland, 1970), in which she provided the characteristics of 349 yeast species and described relevant laboratory methods. However, her scheme for identification placed emphasis on the ability of organisms to produce ascospores. This led, inevitably, to practical problems associated with demonstrating sporulation.

In England, J.A. Barnett and R.J. Pankhurst approached yeast identification in a different way, and in *A New Key to the Yeasts* (North-Holland, 1974) presented a computer-derived key which involved only physiological tests. *A New Key* was based on the information given in *The Yeasts* and was intended to be used in conjunction with it.

Five years later, *A Guide to Identifying and Classifying Yeasts* (Cambridge University Press, 1979) brought together as authors J.A. Barnett and R.W. Payne, with D. Yarrow from the Centraalbureau. Improved methods of computing were used to generate identification keys consisting of either physiological tests or both

physiological and morphological observations. However, it was again necessary to consult Lodder's text for certain additional details.

The successor to *A New Key* and *A Guide* is *Yeasts: Characteristics and Identification*, an up-to-date book which does not rely on another work for any essential information. In it, Barnett, Payne and Yarrow discuss yeast classification and give commonly used procedures for yeast identification. In addition, they provide detailed accounts of 469 yeast species; responses to 83 tests and clear photomicrographs are also included.

The authors have revised the successful format of *A Guide* and incorporated it into this volume. They give 18 identification keys which deal with various groups of yeasts (for example, clinical isolates, yeasts associated with foods and beverages, and yeasts with particular physiological or morphological attributes). Lists of small numbers of tests for the identification of single species are provided. One chapter presents generic characteristics and another conveniently tabulates the characteristics of each species. The extra sections containing specific epithets and yeast names will undoubtedly prove invaluable given the confusion caused by nomenclatural changes in yeast taxonomy.

In producing this book, Barnett, Payne and Yarrow have met the daunting standards set by Lodder in 1970. *Yeasts: Characteristics and Identification* satisfies the requirements of being comprehensive and of containing easily accessible information. It will undoubtedly stand as the major text on yeast taxonomy for a considerable time to come. □

David Ross Harper is the microbiologist at the Metropolitan Police Forensic Science Laboratory, London.