Book Reviews

The Early Universe

Cosmologie Physique. Physical Cosmology. Papers from a summer school, July 1979. ROGER BALIAN, JEAN AUDOUZE, and DAVID N. SCHRAMM, Eds. North-Holland, Amsterdam, 1980 (U.S. distributor, Elsevier/North-Holland, New York). xxxiv, 668 pp., illus. $109.75. Les Houches, Session 32.

This is a remarkable document; never before, to this reviewer's knowledge, has the current wisdom from so many of the outstanding researchers in this dynamic field been gathered together in one place, and certainly not in the (generally) excellent pedagogical form presented here. The book is made much more attractive by the fact that recognition of the enormous potential of the grand unification schemes had burst upon the field just prior to the summer school from which the book stems, so much of the flavor and excitement that today surround the physics of the early universe are captured here.

The book begins with a quite comprehensive review of global observational cosmology by J. Lequeux, which makes use of the semiclassical approach of this reviewer in his 1978 Saas-Fee lectures—and which he can without undue immodesty say is excellent, since he himself borrowed much of it from much earlier work by Whitrow. Lequeux follows this introduction with an overview of observed structure and the various electromagnetic backgrounds. This and the other general reviews in the book—the lectures by Véron, Wagoner, Gott, and Rees covering active galactic nuclei, the early universe, galaxy formation, and almost everything, respectively—are excellent, with much attention to detail and presentation. These lectures provide a quite serviceable introduction to the subject and address well the outstanding questions in the field.

Rather more specialized papers by Tinsley on galactic evolution, Mészaros on galaxy formation in standard and some nonstandard cosmologies, and Audouze on determining the age of the universe represent quite fairly the range of currently envisioned possibilities. The review by Audouze is, to this reviewer, especially noteworthy because of the stress it places on the uncertainty and model-dependence of cosmochemical age estimates, which is often found lacking in works on this subject. The paper by Tinsley stresses again the difficulty of performing the classical global cosmological tests with real galaxies and raises the fascinating possibility of unraveling the evolution of galaxies with the new deep galaxy counts, an endeavor that is certain to attract much of the effort in observational cosmology over the next decade.

The role of the new ideas in elementary particle physics in our understanding of the physics of the early universe is touched upon by several authors, most notably Steigman, Schramm and Turner, and Hut and Olive. A comprehensive look at the effect of (the usually ignored possibility of) lepton degeneracy is provided by David and Reeves. It is well that it is included here, since the almost universal view now is that grand unification precludes a net lepton number much in excess of (and possibly exactly equal to) the baryon number, and the annoying fact that we have no real handle on the lepton number is likely to be further forgotten.

There are observational papers, and papers that interpret observations, by Tammann, Yahil, and Sandage and by Peebles. The presentation by Peebles, especially, is lucid and disarming in its simplicity. That the conclusions reached in these papers are vastly different is distressing, but not so much so, perhaps, as the fact that the difference is not addressed in the papers. The student faced with the evidence presented here will wind up believing nothing, and though that may be appropriate it seems a bit unfair to these and other workers in the field. It is, in any case, difficult to extract what is known from what is believed on the basis of (at least one set of) extremely shaky assumptions. The problem pervades the field, unfortunately, and must account in large part for the fervor exhibited by many of the leading lights for their own particular views.

No view of contemporary cosmology would be complete without some "nonstandard" models. These are represented here modestly, from an impeccable review by Carter on the formation of primeval black holes to a paper by Omnès on the seemingly unkillable baryon-symmetric models to a review by Maeder of models with variable G (whose impetus, the notion that gravitation should be scale-invariant, has, to the reviewer's mind, been seriously undermined by the recent clarification by Beckenstein, which showed that general relativity *is* scale-invariant) to a paper by Englert on his notion that the universe *began* as a spontaneous-symmetry-breaking event in some supertheory.

The book, in short, is an excellent introduction to the field and belongs on the shelf of any serious worker in the field, or of any scientist who is interested in the progress of this most ambitious scientific endeavor. Even its shortcomings represent the state of the subject; one may bemoan them, but it would hardly be fair to expect a mere book to correct them.

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Ecological Genetics

Evolution in Age-Structured Populations. BRIAN CHARLESWORTH. Cambridge University Press, New York, 1980. xiv, 300 pp., illus. Cloth, $44.50; paper, $13.95. Cambridge Studies in Mathematical Biology, 1.

Population geneticists and population ecologists approach evolutionary problems from different perspectives. The geneticist regards gene frequencies as the common denominator of evolutionary events, whereas the ecologist is more interested in organisms, their numbers and life-history attributes. Both disciplines have a rich theoretical tradition, and in fact both had their origins in the hands of mathematicians. In ecology, one of the first accomplishments of this mathematical work was a theory of population growth and demography. The early mathematical geneticists, for the most part, ignored this basic aspect of population biology and concentrated on gene-frequency change in populations with discrete, nonoverlapping generations. An exception is found in the work of H. T. J. Norton, who in the 1920's undertook an extensive study of the outcome of selection in an age-structured population. Norton's work was largely ignored by evolutionary biologists until recently, when interest in the determinants of fitness has led geneticists to incorporate ecological variables into their models. During the past decade there has been much work in evolutionary biology dealing with the effects on gene frequencies of age structure and