

Book Reviews

Theoretical Physics

General Relativity and Gravitation. One Hundred Years after the Birth of Albert Einstein. A. HELD, Ed. Plenum, New York, 1980. In two volumes. Vol. 1, xviii, 540 pp. \$49.75. Vol. 2, xx, 598 pp. \$49.75. A Publication of the International Society on General Relativity and Gravitation.

Of all the collections on relativity published in the Einstein centennial year, these two volumes stay closest to Einstein's classical general relativity. They contain historical papers by J. Stachel on the "missing link" in Einstein's discovery of general relativity and by H. Hora on stimulated emission of radiation, lasers and their applications in tests of relativity. Relativistic thermodynamics and electrodynamics of continuous media are surveyed by W. Israel and J. M. Stewart. I. I. Shapiro presents a timely and complete survey of experimental tests of general relativity. J. Weber gives what will probably be the most accessible and complete review of his original search for gravitational radiation by means of a sensitive elastic-wave antenna. Newer quantum and electromagnetic detectors are treated by L. P. Grishchuk and A. G. Polnarev and sources of gravitational collapse by J. C. Miller and D. W. Sciama.

Observational cosmology and Friedman models are reviewed by E. P. T. Liang and R. K. Sachs. In a few pages, they bring this fast-developing subject almost up to date, referring to chaotic and tepid cosmologies, particle and entropy production, and the generation of baryon asymmetry in hot models with initial baryon number zero.

In the spirit of canonical relativity are excellent reviews by J. Isenberg and J. Nester, by C. Teitelboim, by P. G. Bergmann and A. Komar, by J. N. Goldberg, by S. Benenti and M. Francaviglia, and by Y. Choquet-Bruhat and J. W. York, Jr. Algebraic computing and its applications bearing on general relativity are reviewed by R. A. d'Inverno. Because

the catalog of analytic solutions is so quickly exhausted in general relativity, as in hydrodynamics and other intrinsically nonlinear theories, and because general relativity dynamics is now so important in astrophysics and cosmology, these applications of large electronic computers will certainly have decisive impact.

The book moves from classical general relativity to a group of reviews on developments in topology and field quantization that have become most important in attempts at a final unification of elementary particle physics. Recent years have seen a renewed interest in local problems of differential geometry and unified field theory and in global and topological problems, such as magnetic monopoles and instantons. These developments are reviewed by A. Trautman and by Y. Ne'eman in two papers that necessarily lean on more recent mathematics than do most of the other papers in *General Relativity and Gravitation*. Also rather mathematical are papers on isometric embedding of Riemannian manifolds by H. F. Goenner and on complex variables in general relativity by E. J. Flaherty, Jr., and by C. P. Boyer *et al.* The asymptotic structure of space-time is discussed by E. T. Newman and K. P. Tod and by A. Ashtekar. Twistors are reviewed by R. Penrose and R. S. Ward and singularities and horizons by F. J. Tipler *et al.* The latter paper contains an interesting historical survey, going back two centuries, of ideas about the global properties of space-time, particularly its large-scale causal structure and geodesic connectivity.

The other main thrust of recent research in general relativity has concerned its quantization. The semiclassical approximation in which matter is quantized but gravitation is treated as a classical background field is dealt with by P. C. W. Davies. His two-page summary of regularization methods is a gem, and his treatments of the Casimir effect, of black hole evaporation, and of the

conformal anomaly are clear presentations for the reader not familiar with these subjects. Two papers on supersymmetry and supergravity by S. Deser and by S. Ferrara and P. van Nieuwenhuizen bring the reader to the frontiers of efforts aimed at the unification of fermions and bosons, of space and spin, and of relativity and quantization.

These two well-edited volumes are an enjoyable review of where general relativity is now and how it is moving to finally unify geometry with the rest of theoretical physics.

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Stellar Associations

Star Clusters. Papers from a symposium, Victoria, B.C., Canada, Aug. 1979. JAMES E. HESSER, Ed. Reidel, Boston, 1980 (distributor, Kluwer Boston, Hingham, Mass.). xxii, 516 pp., illus. Cloth, \$63; paper, \$31.50. International Astronomical Union Symposium No. 85.

Stars tend to begin their lives in the close company of other stars and spend much of their early lives near their cosmic siblings, usually in loose family groups that astronomers call stellar associations. A few stars are bound closely enough by the family ties of gravitation to remain in tightly knit groups called star clusters. Those that do remain clustered have provided astronomers with an immense amount of information that would otherwise have been difficult if not impossible to obtain. Our concepts of stellar evolution, especially, would be rudimentary and uncertain at best if star clusters were not available to show us how stars evolve.

The last 50 years have seen notable advances in our understanding of star clusters, but no book on the subject has been published during that time. This volume is therefore a valuable addition to the astronomical literature. It is the proceedings of an exciting meeting and captures that excitement. Most of the leaders in the field were present, and their voices are heard not only in the formal papers but also in the candid discussions that follow each paper.

The topics covered range from the youthful stellar associations and their relation to galactic structure to the ancient globular clusters and what they tell us about primordial conditions in our part

of the universe. Both exhaustive review papers and briefer papers on special topics are included. Some of the review papers cover key topics far better than they have been covered in review journals or elsewhere, and the coverage is up to date. Gösta Lyngå provides a particularly helpful review of how stellar associations and clusters relate to the local structural pattern in our galaxy. Ivan King presents an eloquent and gratifyingly frank appraisal of present dynamical models of star clusters. Gretchen Harris presents a wide-ranging discussion of our progress in understanding stellar evolution through the study of star cluster color-magnitude arrays. S. C. B. Gascoigne gives a particularly clear discussion of the older, puzzling clusters in the Magellanic Clouds. Several contributors take up the difficult and hotly debated issue of elemental abundances in clusters. These contributions and careful consideration of many other topics fill out the portrayal of our present understanding of star clusters in our galaxy and elsewhere in the universe.

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Mesolithic Europe

The Early Postglacial Settlement of Northern Europe. An Ecological Perspective. PAUL MELLARS, Ed. University of Pittsburgh Press, Pittsburgh, 1979. xii, 412 pp., illus. \$36. New Approaches in Archaeology.

The early postglacial period, once considered to represent a hiatus in European prehistory or to show, at best, an impoverished "Mesolithic" remnant of Paleolithic glory, is now viewed as a time of dynamic cultural adaptation by hunter-gatherers to changing environments following the retreat of the last great ice sheets. This postglacial warming was but the most recent of a series of dramatic climatic alterations punctuating the Pleistocene, and the Mesolithic is archeologically the most accessible period for studies of human adjustment to such profound environmental change.

This collection of papers is an important contribution to these studies because the area it deals with has long been a major focus of Mesolithic research. A concise historical overview of this research is presented by Clark, who is largely responsible for bringing Mesolithic studies into the mainstream of archeology. The succeeding 13 papers are

specific studies that range in scope from investigations of single sites to surveys of entire national areas. Despite this diversity, the papers show a common emphasis on subsistence and settlement—a welcome change from traditional preoccupations with typology and chronology. In the papers on regions where relatively few surveys or excavations have been done, such as Ireland (Woodman), Norway (Indrelid), northern Sweden (Broadbent), and the northeast Baltic (Zvelebil), the focus is indeed on the establishment of chronological and typological frameworks, but even in these papers an attempt is made to suggest economic and settlement systems by posing hypotheses amenable to future testing.

The most stimulating studies are those conducted in areas where there has been sufficient previous research to allow investigation of specific problems. As the book's subtitle indicates, these problems are approached through "an ecological perspective." Consequently, much attention is devoted to environmental reconstruction, resource distribution and behavior, and the costs, benefits, and effects of exploiting specific resources.

The basis of at least two of the papers (Bailey; Bay-Petersen) is the idea that big game animals are such large food packages that hunting must have been significantly more energy-efficient and therefore more important than gathering, fowling, and fishing (Bay-Petersen) or shellfish collecting (Bailey). Bay-Petersen supports this idea with the scarcity of plant, bird, and fish remains at Danish sites, even though such remains would typically show poorer preservation than large bones of big game. Bailey, by contrast, argues for the dominance of hunting in coastal Denmark and Spain despite the scarcity of big game remains relative to mollusk shells by emphasizing the low meat yield of shellfish and the exceptional preservation of shells (he assumes in one example that shells showed 100 percent preservation, in contrast to an estimated 2.8 percent for mammalian bone). The emphasis on the energetic efficiency of hunting ignores other possible determinants of resource selection, such as the reliability of particular resources. The uncertainties of hunting have been noted in many ethnographic contexts, and in this volume Welinder suggests something of the risks of Mesolithic hunting in Denmark by citing evidence (healed wounds) of repeated unsuccessful attacks upon the same animals. Despite the fact that plants, fish, and shellfish represent small and possibly dispersed food packages, they may have

constituted a reliable dietary component in many situations, and the evidence should be analyzed with this in mind.

Common to several of the papers is a tendency to argue against the appearances of the data. As noted, Bailey downplays the economic importance of shellfish in areas characterized by huge shell mounds. Jacobi suggests communal summer hunting by large groups in the uplands of northern England despite small site sizes. Indrelid emphasizes the importance of terrestrial resources in coastal Norway despite the predominance of fishing equipment. In each case the interpretation derives from an attempt to go beyond site-specific data to examine the broader context of behavior and site formation.

This collection addresses many questions of the relative value of different types of data. Faunal remains are examined in light of problems of differential preservation, sampling, and the representation by age and body part. In this connection, Bailey's economic interpretations from shell midden samples could take note of Mellars's description of the nonuniform distribution of materials within Scottish shell mounds. Bay-Petersen interprets the predominance of adult males among Danish red deer remains in terms of energetic returns and long-term herd conservation, whereas Jacobi relates a similar age distribution in north English sites to the need for large antlers as raw materials.

Lithics receive less attention. The papers deal largely with gross functional categories such as points and scrapers, although Whallon stresses the lack of adequate attention yet given to relating form and function and to differentiating multipurpose from specialized tools. Jacobi attempts to determine social groupings on the basis of patterns of association between microlith forms (styles?) and raw materials.

Site and artifact distribution is stressed in these studies. Whallon's discussion of intrasite patterns raises the problems of differential life-span, curation, and deposition for various tools and suggests the examination of lithic waste and food debris as a more profitable approach to the determination of activity areas. Topographic differences in site locations are interpreted in terms of seasonal altitudinal movements by several authors, although Price, working in the relatively undifferentiated topography of Holland (perhaps a reasonable approximation to a uniform plain?), must utilize theoretical modeling techniques to suggest hypothetical patterns of settlement