# Book Reviews

## Earthworks and Archeologists

**Mound Builders of Ancient America.** The Archaeology of a Myth. ROBERT SILVERBERG. New York Graphic Society, Greenwich, Conn., 1968. xiv + 369 pp., illus. $8.95.

It seems almost an anomaly that no professional archeologist has ever attempted to produce a thorough history of archeology in America. A few papers are published piecemeal in journals, and an occasional small book may document activities in a state university or large institution. It appears that a dedicated writer of Silverberg's quality will be the one to do the job. This author has already established himself as a popular historian of archeological subjects. He has made the stories of several ancient civilizations, of Asia, Africa, and Middle America, into lively and intellectually satisfying reading.

The present book goes far toward meeting our need for a history of American archeology. In a clear, interesting, understandable manner, the author recounts the historical development of the belief that the innumerable earth mounds that are scattered over much of the eastern United States were the remains of a mysterious, gifted extinct race. These great architects and statesmen were, it was thought, exterminated by the later rude and savage red men.

Silverberg shows that, from the time of DeSoto, in the 16th century, there was an awareness that even the great truncated pyramidal mounds were the work of Indians. Pyramidal mounds—usually called Temple mounds—are earthen foundations upon which sacred buildings were erected. Some of these tower 100 feet high, and their flat tops may be several hundred feet on each side. These mounds represent an enormous amount of manual labor.

It was the conical burial mounds that first attracted the attention of such notables as Thomas Jefferson and, later, the yet-to-be-president William Henry Harrison. The content of some of these mounds was so spectacular that it excited the imagination of layman and scientist alike in these early-19th-century days. It was the magnificent workmanship and rarity of the burial furniture that led archeologists and historians of the day to attribute this work to peoples other than pesky redskins. Israelites, Vikings, Atlanteans, and hordes of other lost peoples were resurrected and endowed with amazing peripatetic abilities.

The polemics engendered by the discoveries in various Ohio burial mounds are rather adroitly narrated by Silverberg. Because this phase of development of American archeology was largely dominated by several strong personalities, the author has been able to make this a personal history. The names of greats in the 19th century—J. W. Powell, Cyrus Thomas, Ephraim Squier, Dr. E. H. Davis, Caleb Atwater, and others—loom large in this give-and-take argument about the agents responsible for construction of the great mounds. It is very interesting reading for all, and especially enlightening and useful for the teaching archeologist.

The last third of the book shows a marked shift in emphasis, from personal documentation to the empiricism of modern archeology. The new approach is exemplified by the work of such as William S. Webb, who directed the archeological salvage in the Tennessee Valley Authority development of the 1930's. These remorselessly scientific men reduced the myth of a superior pre-red-man people to ashes and gave American archeological endeavors a new dimension. However, it is in this arena that the author slips a bit in the sands of time and does picadorian violence to modern knowledge, for example in assigning the famous Poverty Point and Tchefuncte sites of Louisiana to the late Temple Mound period (fig. 47). Both of these sites were probably abandoned 1500 years before Temple mounds reached their greatest development around the 14th century A.D. Actually, however, the author has a remarkably good grasp on the chronology of the prehistory of eastern United States. This may be attributed, in part, to the timely publication of the first volume of Gordon R. Willey's *Introduction to American Archaeology* in 1966.

After all, Silverberg, like all of us in archeology, is indebted to the scholars of the past, and he gives each his due. For example, he reminds us that Caleb Atwater was the first to try to derive mound building from Mexico. Today, a century later, Albert Spaulding is objectively furthering this same theory. Silverberg singles out the giants of the past and discerns their lineal descendants in modern times. The names he uses are names honored by the whole profession—William S. Webb, James A. Ford, James B. Griffin, Don Dragoo, among many others. This is a good book, one to be enjoyed by professionals and laymen as well.

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## The Physics of Gravitation

**Relativity Theory and Astrophysics.** Proceedings of the 4th Summer Seminar on Applied Mathematics, New York, July–Aug. 1965. JÜRGEN EHLERS, Ed. Part 1, Relativity and Cosmology, xvi + 289 pp., illus., $9.40; part 2, Galactic Structure, viii + 220 pp., illus., $8.10; part 3, Stellar Structure, viii + 134 pp., illus., $6.70. American Mathematical Society, Providence, R.I., 1967. Lectures in Applied Mathematics, vols. 8, 9, and 10.

Of the four fundamental forces of nature (gravitation, electromagnetism, weak interactions, strong interactions), gravitation is the least emphasized in the education of a physics student. Typically he meets Newton's laws of motion during one or two lectures of his freshman physics course. He encounters Newton's gravitational field and is told of its similarity to the electric potential a little later. And that is the end—unless he becomes one of those rare graduate students who take a course in the general theory of relativity, or unless he trundles over to the astronomy department to take courses. Contrast this with the intense research interest in gravitation which has been generated among physicists in the last few years: The glamour of gravitation physics is beginning to approach that of elementary particle physics. Who has not been swept up in the

excitement of pulsars, quasistellar sources, gravitational collapse, Dicke's challenge to general relativity, and the cosmic microwave radiation with its implications for cosmology?

To meet the rising tide of interest in gravitation physics a number of physics departments may develop new courses in the next few years. The three volumes of *Relativity Theory and Astrophysics* would make an excellent textbook for such courses, until rapid research developments outdate them.

Each of the volumes begins with a comprehensive introduction to a major area of gravitation physics (volume 1, general relativity theory, by Alfred Schild; volume 2, galactic structure and dynamics, by Lodewyk Woltjer; volume 3, stellar structure, by Edwin Salpeter). The comprehensive introduction is then followed by in-depth reviews of the special topics of greatest recent research interest.

One of the most striking features of these volumes is the extent to which some of the reviews of special topics have become outdated in the three years since they were written. Until recently one was accustomed to thinking of gravitation physics as an area of painfully slow progress, particularly on the experimental side. However, a brief perusal of these volumes reminds one of the great changes of the last three years: (i) Volume 1 contains a beautiful description by Freeman Dyson of the *proposal* for testing general relativity by reflecting radar signals off Venus and Mercury, as they pass behind the limb of the sun. The experiment has since been carried out, confirming to an accuracy of ±20 percent the general relativistic corrections to Newtonian theory. (ii) One sentence in volume 1 mentions that if the sun's gravitational field has a quadrupole moment, that would produce part of the perihelion shift of Mercury, resulting in a discrepancy between the measured perihelion shift and the predictions of general relativity. Eighteen months ago—too late for them to get any mention in these volumes—R. H. Dicke announced the results of measurements which show the sun to be optically oblate, and by implication perhaps to have a quadrupole moment. The uproar caused by Dicke's experiment and the resultant detailed theoretical studies of rotating solar models would receive considerable attention in any review volume written in 1968. (iii) In a short (six pages) chapter Joseph Weber describes the design of a detector for gravitational waves. But of course there is no mention or detailed discussion of the strange "events" which such detectors, now in operation, have been recording roughly once a month over the last year. (iv) The theories of the origin of galaxies discussed in lectures by W. B. Bonnor are almost wholly out of date. The discovery of the cosmic microwave radiation in early 1965 (described in these volumes by James Peebles) has created deep new insights into physical conditions in the early stages of an expanding universe and into the accompanying problem of the origin of galaxies. These new insights are only now beginning to reach the pages of the *Astrophysical Journal*, and they are developing and changing so rapidly that a comprehensive review of galaxy formation will be impossible for several years to come. (v) Volume 2, on stellar dynamics, does not discuss—indeed, could not discuss in 1965—the new insights now coming from computer studies of up to 100,000 gravitationally interacting stars. (vi) The reviews of the observation and theory of quasistellar sources and x-ray sources are so out of date after three years as to be virtually useless. (This was foreseen when the articles were written; so they were kept short.) And, of course, there is no mention of the most recent mysterious class of objects, the "pulsars." (vii) These volumes do not touch on the powerful singularity theorems for gravitational collapse and cosmology, proved in 1964 through 1967 by Roger Penrose, Steven Hawking, and Robert Geroch. Those theorems and their implications are now posing deep problems of principle for theoretical physics.

I cite these examples not as an indictment of these volumes—no books written in 1965 could be more up to date—but as a measure of the excitement brewing in gravitation physics today. And I hasten to add that these examples of outdated material constitute less than 5 percent of the material in the books—albeit the 5 percent that could have been the most exciting. The remaining 95 percent of the material is so fundamental to current and future research in gravitation physics that these books belong on the shelves of everyone with a desire to follow in detail the new developments as they break.

A word of warning should be given to physicists who contemplate using these volumes as textbooks: The level of sophistication required to understand the various chapters is quite uneven. For example, the long introductory chapters of volume 2 (galactic dynamics) and volume 3 (stellar structure) should be readily understandable to any first-year graduate student in physics or astronomy. (And I must add that Salpeter's review of stellar structure is the clearest, most beautiful discussion of that subject I have ever read.) By contrast, Schild's introductory chapter on general relativity (volume 1) will be very rough going for anybody who does not know the subject in advance, at least partially. Nevertheless, it is an article well worth plowing through, since of all introductions to relativity now in print it is one of the most lucid, complete, and concise; and it is certainly the most up to date.

The greatest strength of these volumes is their uniqueness: No other book or set of books brings together with such completeness the various aspects of gravitation theory. It is here that a relativity theorist can turn for insight into stellar structure and evolution, or into the statistical mechanics of star clusters. It is here that the conventional astrophysicist can seek an understanding of general relativity or of the theory of relativistic gravitational collapse. And it is here that the young physics student can discover the many and varied aspects of gravitation theory all brought together into a quasi-coherent whole.

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## Molecular Biology

**Biological Ultrastructure.** J. B. FINEAN. Academic Press, New York, 1967. viii + 384 pp., illus. $15. Second edition of the work by A. Engström and J. B. Finean (1958).

For the second edition, *Biological Ultrastructure* has been almost completely rewritten by J. B. Finean. The contents conform strictly to the dictionary definition of ultrastructure as "the invisible ultimate physicochemical organization of protoplasm"; only rarely does the subject matter reach to that commonly accepted realm of ultrastructure, the field of cytology beyond