and Dr. A. W. Quinn outlined the geology of the vicinity of Newport in anticipation of the morrow's field-trip.

On Saturday morning a study was made first of the relations of the Carboniferous black shales to the Cambrian or Precambrian quartzites and greenstones near "Miramar," the estate of Dr. Alexander Hamilton Rice. The western peninsula of Newport was then visited. On the south shore, west of Viking beach, a series of banded black shales offered a complex study of secondary banding produced by flowage under pressure. Somewhat similar structures were found in a conglomerate composed of granite pebbles with quartzite lenses at the entrance to Fort Adams. The pebbles had been mashed and rolled until the resulting gneiss was hardly recognizable as a conglomerate. At Purgatory, near the public beach east of Newport, an igneous dike has weathered away, leaving a chasm a few feet wide with vertical walls composed of the Dighton conglomerate. Quartzite pebbles in the conglomerate have been elongated by pressure from the east into cigar-shaped forms. Fractures across the pebbles offer an important study in the mechanics of yielding under stress. Some of these Carboniferous pebbles were found to contain Cambrian brachiopods.

After a delightful luncheon at "Miramar," the party crossed by ferry to Jamestown and visited Mackerel Cove at the southern end of the island. Here the basal arkose of the Carboniferous rests on a granite. Two important questions were not answered: (1) Is the granite of the same age as the Sterling in eastern Connecticut or does it correspond to the Dedham granodiorite of southeastern Massachusetts? (2) Does the arkose rest unconformably on the granite or is the contact due to faulting?

Again the automobiles were driven onto a ferry and at Saunderstown the shore road was taken toward Narragansett Pier. Three miles south of the ferry the Kingston Carboniferous series is invaded by many pegmatite dikes. At Boston Neck near Watson Pier the waves have eroded away the less resistant shales and sandstones and the dikes stand out in relief. Some believe these dikes are members of the Sterling granite series and, hence, that the Sterling batholiths are post-Carboniferous in age. Others would assign them to another series and place the Sterling batholiths in a Pre-Carboniferous period. Manifestly, the correct solution of the problems at Mackerel Cove would also help to solve the difficulty here.

Twenty-three automobiles carrying between sixty and seventy students and teachers from nearly every college in New England made an imposing cavalcade. The wonderful weather and the hospitality of our hosts combined with more interesting geologic problems to make the excursion a memorable occasion.

WILBUR G. FOYE,
Secretary

SCIENTIFIC BOOKS

Kosmos. By WILLEM DE SITTER. Pages viii + 138. Harvard University Press, 1932. Price, $1.75.

DR. WILLEM DE SITTER has contributed so much to modern theories of our universe that any book from his pen must command the attention of the scientific world and of the intelligent reader who would keep in touch with the rapid expansion of astronomical concepts. This new volume puts in permanent form the substance of a series of lectures presented at the Lowell Institute in Boston in the autumn of 1931. It is a scholarly treatment of the evolution of ideas regarding the structure of the universe from ancient times to the present day.

After an introduction covering the aims and methods of scientific research and the attainments of astronomy to the day of Copernicus, Dr. de Sitter reviews in rapid succession the contributions of seventeenth century astronomy as exemplified in the labors of Kepler, Galileo and Newton. With the enunciation of the law of gravitation through the mathematical genius of Newton the classical laws of planetary motion became established and the foundation was laid for an analysis of the motions of planets and stars throughout the universe.

In no uncertain praise Dr. de Sitter does credit to the rare gifts of Herschel in envisioning concepts of the whole universe, while at the same time applying himself assiduously to details of observation necessary for the foundation upon which any satisfactory theory of the universe must ultimately rest. The conclusions which Herschel reached were based on assumptions that we now know are not valid. "Nevertheless no single astronomer either before or after him has done so much for the final solution as William Herschel."

High tribute is paid to the pioneer work of Kapteyn, of Groningen, in developing methods of attack on the problem of the distances of the stars through the new science of stellar statistics. The author's elucidation of the details of Kapteyn's method is somewhat technical in places, but even the general reader will be impressed with his painstaking care. In Chapter 5, somewhat more popularly descriptive, Dr. de Sitter reviews the contributions of modern photography and spectroscopy which have made possible the extension

of Kapteyn's method to even greater distances. Here we find a careful résumé of Shapley's analysis of globular clusters which forms the basis of present-day views of the galactic structure. The extraordinary size of our own galactic system, as compared with distant spiral nebulae, is still a matter of great concern in modern astronomy. Sad experience has trained the scientist to be wary of introducing the term "exceptional" in his conceptions of the universe.

The closing chapter of "Kosmos" deals with "Relativity and Modern Theories" and gives an excellent summary of the contributions of Einstein and of the author with regard to the more theoretical aspects of the properties and distribution of matter and space. In conclusion, Dr. de Sitter remarks:

> Our conception of the structure of the universe bears all the marks of a transitory structure. It is not possible to predict how long our present views and interpretations will remain unaltered and how soon they will have to be replaced by perhaps very different ones, based on new observational data and new critical insight in their connection with other data. . . . By the use of mathematics, that most nearly perfect and most immaterial tool of the human mind, we try to transcend as much as possible the limitations imposed by our finiteness and materiality, and to penetrate ever nearer to the understanding of the mysterious unity of the Kosmos.

HARLAN T. STETSON

PERKINS OBSERVATORY,
DELAWARE, OHIO

Electric Clocks. By F. HOPE-JONES. xv + 259 pp.; 127 figs. London: N. A. G. Press, 1931. 12s. 6d.

EVER since the discovery of electromagnetism, nearly one hundred years ago, men have sought to find some way of time measurement. The author in this volume has made an exhaustive study of the evolution and development of devices which have been proposed for the improved measurement of time.

He has grouped his discussion about three heads, namely: (1) Independent self-contained clocks whose motive power is electrical; (2) synchronizing systems in which a signal is transmitted at regular intervals to correct the hands of independent clocks of all kinds; (3) electrical impulse dials, in which a master clock transmits impulses at minute, or half minute intervals, to propel the hands.

His descriptions are generally clear, but suffer in places by being too brief, or otherwise inadequate to convey the idea which he is trying to impart. Many of the figures also are too crude or too carelessly drawn to be readily understood by one who has not seen the mechanism. From a perusal of the work, one idea above all others emerges, namely, the astounding accuracy of the free pendulum and slave clock, to which the author contributed the remontoir, and W. H. Short the impulse mechanism, and the method of synchronizing the slave with the free pendulum. The performance of the Short clock has equalled if not exceeded the accuracy of the transit observations themselves.

It seems as though the author ought to have mentioned the application of the quartz-crystal controlled oscillator to time measurements. At the last reports on the performance of this device, it showed a constancy of one part in ten million over a period of some days.

The author mentions the Telechron system, by which a wheel work is actuated by a synchronous motor, operated on city service A. C. circuits, which are held to a constant frequency, but does not seem to know of the very extensive vogue which the system has attained in the United States. The convenience of obtaining a clock which requires no attention, and is accurate to four or five seconds, by merely plugging in on a house lighting circuit, seems likely to displace all other clocks for civil purposes. This, combined with the frequent distribution of time signals by radio, has changed the attitude of the whole world towards clocks.

F. E. BEACH

YALE UNIVERSITY

An Introduction to the Literature of Vertebrate Zoology. (Based Chiefly on the Titles in the Blacker Library of Zoology, the Emma Shearer Wood Library of Ornithology, the Bibliotheca Osleriana and Other Libraries of McGill University). By CASEY A. WOOD, xix, 643 pages, colored frontispiece. Oxford University Press, 1931. Price, 3 guineas.

IN the preparation of this work, Dr. Wood has rendered an important service to students of vertebrate zoology, who have been greatly in need of a systematic and comprehensive treatment of the literature of their field. An undertaking of this magnitude inevitably presents features for blame as well as for praise. As a bibliography of a large division of the field of zoology, it leaves much to be desired. It suffers from the limitation of having been compiled in the libraries of a single university. The entries vary in completeness from full citations to fragments, such as "Zooiasis. 1834–6? Leipzig." The treatment of periodical literature is extremely inadequate. Pamphlets are in many cases referred to simply as "author's reprints," with no indication of the original place of publication. But on the other hand the work possesses outstanding merits more than sufficient to compensate for its shortcomings Where else can one