the forward thrust which always accompanied his rising at the bottom of the swing.

HENRY CREW

July 11, 1919

SCIENTIFIC BOOKS

The Evolution of the Earth and its Inhabitants. A series of Lectures Delivered before the Yale Chapter of the Sigma Xi during the Academic Year 1916–1917, by JOSEPH BARRELL, CHARLES SCHUCHERT, LORANDE LOSS WOODRUFF, RICHARD SWAN LULL, ELLSWORTH HUNTINGTON. New Haven, Yale University Press. 1918.

This volume of essays prepared at the suggestion of Professor Lull, as president of the Yale Sigma Xi, is an interesting and unique addition to the literature of the subject. Each lecture is a separate essay, the preparation of which involved considerable time, thought and original work. The first lecture by Joseph Barrell, whose loss too early in life we all mourn, is entitled: "The Origin of the Earth." It was especially fitting that Professor Barrell should give this lecture since his work on the age of the earth had drawn him into close touch with the astronomical and mathematical work involved in the problem of the earth's origin. The lecture reviews the various attempts to explain the origin of the earth, giving chief attention to the planetesimal hypothesis. The phase of the work on which Professor Barrell's own work bears is to be found in his discussion of "The Origin of Ocean Basins," "The Reign of Surface Processes and Beginning of the Archean." He closes his lecture with the thought:

> It is not known how close they (oldest Archean rocks) stand in point of time to the formative processes whose description has been attempted. With these oldest rocks, the dimly known, heroic and mythical eon of the earth is closed and the first historic eon opens as the remote and long enduring division of geologic time.

Professor Schuchert's lecture "The Earth's Changing Surface and Climate during Geologic Time" reviews in part the lecture of Professor Barrell pointing out the climatic features involved and extending Barrell's observations into the known periods of geologic history. The fundamental factor in climate is atmosphere, and Professor Schuchert's discussion of the "Origin of the Atmosphere" opens the problems of "Climates of the Past" which he is able to discuss so well because of his extensive studies in paleontology and paleogeography.

The "Origin of the Earth's Waters," "Source of the Salts of the Ocean" and "Origin of the Sedimentary Strata" give the reader the most modern ideas of these fundamental aspects of geology and lead up to the discussion of the changes in surface features which the earth has experienced in its evolution from a primordial mass to the recent. The discussion is accompanied by maps and tables explaining in a graphic way the thoughts of the lecture. Professor Schuchert is inclined to the view that geologic time has endured about 800 million years, supporting the ideas of Matthew, Shapley and Barrell from other evidences.

Professor Woodruff in his lecture on "The Origin of Life" has attacked a much more difficult problem because of the great dearth of evidence or analogy. He has handled the difficult task cleverly in discussing, first the nature of protoplasm, the individuality of organisms, and by giving an interesting historical account of "The Theories of the Origin of Life" under the following titles: "Vitalism," "Cosmozoa Theory," "Pflüger's Theory," "Moore's Theory," "Allen's Theory," "Trolands Enzyme Theory," "Osborn's Theories." It is rather disappointing to have Huxley and Darwin close this lecture, since it would have been extremely pleasing to know what Woodruff himself thinks about the "Origin of Life," and his research work has certainly given him some idea on this interesting topic.

No one could speak with more knowledge of facts as to the "Pulse of Life" than Professor Lull in the fourth lecture.

> The stream of life flows so slowly that the imagination fails to grasp the immensity of time required for its passage, but like many another stream, it pulses as it flows. There are times of quickening, the expression points of evolution, and

these are found to be coincident with geologic change.

The lecture might well have been called "The Philosophy of Paleontology," though the evidences are drawn chiefly from the vertebrates, the discussion being illumined by a very interesting diagram of the pulse of life, showing the influences of climate, continental elevation, and extinctions on the pulsations of vertebrate life. The discussion follows such interesting topics as "Emergence of Terrestrial Vertebrates," "Evolution of Terrestrial Foot," "Origin of Reptiles" and closes with the interesting comparison of the graph produced by a sphygmograph, recording the movements of the human pulse, with the graph deduced from the study of geologic and paleontologic evidences, recording the pulsations of life through many millions of years.

In the closing lecture of the series Professor Huntington discusses "Climate and the Evolution of Civilization." This is a proper closing for such a series, thus bringing out the influence of physical factors in the highest form of evolution. The lecture discusses the influence of climatic influence on certain primitive tribes and nations of America and is illustrated by a number of climographs.

The volume is thus a discussion, in brief form, of the chief factors bearing on the evolution of the earth and its inhabitants from the cosmical origin to the culmination of the highest phylum in the production of a high type of civilization.

ROY L. MOODIE
COLLEGE OF MEDICINE,
UNIVERSITY OF ILLINOIS,
CHICAGO

SPECIAL ARTICLES

A PRACTICAL LONG-PERIOD SEISMOGRAPH

A SEISMOGRAPH which is to record earth-motion with fidelity must have a "steady point" which shall be uninfluenced, as nearly as may be, by that motion. In existing instruments this steady point is the center of oscillation of a mass so suspended that when disturbed it vibrates slowly about an equilibrium position. The relative motion of the ground with reference to this steady point is then recorded with magnification on a sensitive surface by means of a suitable optical or mechanical system.

With suitable damping, and with a faultless recording system, the resulting record has considerable accuracy for rapid seismic motion whose period is not greater than the free period of the instrument; for slower motion the accuracy declines rapidly; and the instrument is wholly insensitive to motion whose period is several times greater. It is therefore of prime importance that the period of the instrument shall be as great as possible.

When this period is made large, however, a difficulty arises in that the equilibrium position of the heavy mass changes slowly, due to tilts of the support in case of the horizontal pendulum, to temperature changes in the vertical-motion instrument, and in both due to other less important causes. With the ordinary method of recording, these slow wanderings are magnified in the record, increasing the technical difficulty of obtaining the record, and excessively increasing the size of sensitive surface required. For these reasons practical seismometry has limited itself to periods rarely exceeding twenty seconds.[1]

Galitzin was the first to employ a method which permitted the recording of seismic motion without registering the wanderings. He employed an electromagnetic system which depended upon the velocity of the earth-motion rather than upon the displacement, thus avoiding the slow changes. In doing this, however, he sacrificed the flatness of the magnification curve of his instrument, so that his record not only did not represent the seismic motion directly, but did not permit its computation except in the case where such motion was simply harmonic—a case which does not occur in practise.

The writer has devised a method of record-

[1] From the literature one might infer that in practise, there is a low upper limit to the period of the horizontal pendulum. Walker sets this limit for laboratory purposes at forty seconds. But Omori has achieved much longer periods. The first pendulum constructed by the writer in the College of Hawaii laboratory had a period of three minutes.