concepts are quite novel, will be able in general to follow the author's reasoning.

Howard C. Warren
Princeton University,
February 8, 1916

The Permo-Carboniferous Red Beds of North America and Their Vertebrate Fauna. By E. C. Case. Carnegie Institution of Washington.

In this monograph Dr. Case has summarized our knowledge to date of the vertebrates from these Permo-Carboniferous beds, which, for a period of over forty years, have been yielding remains of essential interest to paleontology; because the beds, laid down at a time when the amphibians were dominant and the reptiles were in the transitional stages, have preserved the most complete skeletons of these early vertebrates, and it is essential to know these Cotylosaurs, Pelycosaurs, etc., in order to attain a correct idea of the further development of the reptiles and the ancestry of the mammals.

His careful description of the beds and localities invites and clears the way for those who shall follow and collect in these beds, the tedious search for favorable localities and horizons, which hampered the pioneers in this field, being removed by the submission of all this data to the public; and it is a hard field, the fossils being scarce and fragmentary. Then his conclusions from the character of the beds as to the climates and environment are a great aid in the efforts to interpret evolution.

Case gives the range of this fauna as from the Pittsburgh Red Shales in the middle of the Upper Pennsylvanic (Missourian) to the top of the Clear Fork, which is about the middle of the Permic, as described by Schuchert. At this point in time the dominance of this fauna ends in America, though in Europe, it, or an equivalent fauna, runs up into the Triassic.

It is shown that all the amphibians of the fauna are carnivorous, the reptiles partly carnivorous, partly molluscivorous, and partly insectivorous. None were adapted to marine life; none were far advanced even toward fresh water life; but the fauna is typically one of the estuaries, swamps, alluvial plains and woodlands.

The eighth chapter presents summary descriptions of the best-known genera, illustrated by 23 restorations, which impress the reader with the heavy, slow-moving character of most of these animals, though the drawings leave something to be desired in life-like appearance.

An appendix gives a description of the Brier Creek Bone Bed and its fauna, the locality which has yielded the richest finds of Permo-Carboniferous vertebrates. Some twenty plates show detail photographs of the beds and fossiliferous strata, which will aid any one studying the conditions of deposition, or going into this field, so that with the minimum of experience they can get the best results.

As a whole the volume is one which will ably serve any student of the Permo-Carboniferous, as it brings him up to the present, and will long serve as the starting point for further studies of these beds.

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SPECIAL ARTICLES

AN ELECTRIC COUNTER FOR DETERMINING THE RATE OF A FREE-SWINGING PENDULUM

A heavy pendulum, vibrating through small arcs, and unconnected with clockwork or escapement, possesses several advantages for recording time in graphic experiments. It is simple, and easy to construct, and is more accurate than some more complicated apparatus used for this purpose. Its especial merit is that its consecutive swings are so perfectly isochronous that it can be employed for testing tuning-forks and other vibrating recorders. In testing tuning-forks and in similar work it is absolutely necessary that the time intervals should be equal. As the vibrations of the pendulum of a clock are liable to be affected by irregularities in the action of the motive power, it is possible that they may not be perfectly isochronous when their number in a considerable period of time is correct. This objection does not apply to the free-swinging pendulum.