Art. XXXI.—*Discovery of Fossil Insects in the Permian of Kansas;* by E. H. Sellards.

The question of the age of the Upper Paleozoic formations of Kansas has occasioned considerable difference of opinion among geologists and paleontologists. Professor C. S. Prosser, who, among others, has been a thorough student of the problem, in a recent very full review of the evidence from zoöpaleontology and stratigraphy, concludes, in harmony with his earlier results, that "the weight of evidence" favors "correlating the upper formations with the Permian."* In his synopsis of the views of geologists who have written on the subject, however, Professor Prosser makes it evident that this opinion, although perhaps receiving the greatest support, is not unanimous. Any additional paleontological evidence is therefore especially welcome. Until recently the discussion has been confined largely to the marine invertebrates, which unfortunately become extremely rare near the top of the series.

During the summer of 1902 the writer discovered a rich insect locality in the Marion formation, in the southern part of Dickinson county, Kansas. The condition of preservation of the insects is exceptionally good. A very large proportion of the wings are complete and their details of structure clear, even the minute hairs often being present. The entire bodies of the insects are occasionally preserved. A considerable number of insects had been previously obtained from the Coal Measures near Lawrence, Kansas, mostly by the University Geological Survey of Kansas. The insects from the Marion seem on the whole very different from those of the Lawrence shales and other Coal Measure deposits. The Coal Measure insects, as far as known, are on the average large; on the contrary, most of the Marion species are small. Cockroaches at this new locality are much in the minority. Of some six hundred specimens collected, not more than about sixteen are cockroaches and these are of small size and belong for the most part to the Coal Measure and Permian genus *Etoblattina.* Fossil plants were discovered in the Marion in 1899.† The collections made from the Marion and Wellington (?) during 1899–1900 seemed to the writer at that time to indicate a Lower Permian flora.‡ These collections have since been increased, and it may now be said with a good deal of confidence that, although a few species have survived from the Upper Coal Measures, the Marion contains on the whole a dis-

* Journal of Geology, vol. x, p. 728, 1902.

† The occurrence of two specimens of insects among the plants was noted by the writer in connection with the description of the Tæniopterid ferns from this formation (Kansas Univ. Quart., vol. x, p. 11, 1901).

‡ Trans. Kansas Acad. Sci., vol. xvii, p. 208, 1899–1900.

tinctly Permian flora. The marked change in the insect fauna in passing from the Lawrence shales to the Marion formation is therefore paralleled by the plant evolution.

From the biological side the discovery of a productive insect horizon in deposits of Permian age is of the greatest importance. Aside from the cockroaches, the number of insects known from the Permian system is confined to a few interesting specimens. The terrestrial habits of most adult insects, together with their soft bodies, cause them, as a rule, to be rare fossils as compared with marine shelled animals, especially in Paleozoic deposits. The conditions of deposition, however, during the latter part of the Paleozoic seem to have been more favorable for the preservation of insects as well as of plants, and thanks, especially, to the faithful researches of Scudder in this country and of Brongniart and others in Europe, a good deal is now known of Coal Measure insects. The degree of organization of Upper Carboniferous insects indicates a much earlier origin for the class, and their remains, if not already found, may be confidently expected in pre-Carboniferous deposits. Unfortunately there seems to be as yet no unquestioned record of the occurrence of Hexapoda back of the Carboniferous. Insects have been reported from three pre-Carboniferous localities,—Ordovician (Lower Silurian) of Sweden, Middle Silurian of France, and Devonian of Canada. Regarding the Ordovician fossil, Professor Moberg with commendable frankness has written the writer that, as no more examples of *Protocimex siluricus* have been observed, he is now of the opinion that it is not impossible that he and the entomologist may have been misled by a "lusus naturæ." Brongniart, although still retaining faith in the Silurian fossil *Paleoblattina Douvilli*, admits that it has been regarded by some as a piece of a trilobite. According to White, Kidston, and Ami, the "fern ledges" at St. John, New Brunswick, heretofore regarded as Devonian and from which several insects have been obtained, contain a Carboniferous flora closely related to that of the lower part of the Upper Carboniferous, or the Meso-Carboniferous. Papers by Dr. G. F. Matthew may be consulted, however, in which the deposits are referred to a much earlier terrain.

The classification of Paleozoic insects and their relation to Mesozoic and recent forms are still in an unsettled condition. The Permian types coming in the interval between the better known forms of the Coal Measures on the one hand and of the Mesozoic on the other will perhaps throw some additional light on the interrelation of the older and younger members of the class.

Paleontological Laboratory, Yale University Museum,
New Haven, Conn., June 24, 1903.