

ART. IX.—Types of Permian Insects; by E. H. SELLARDS.

[Continued from vol. xxiii, p. 355, May, 1907.]

PART III.—MEGASEOPTERA, ORYCTOBLATTINIDÆ and PROT-OETHOPTERA.

THE terms *Dromeus*, *Scopus* and *Therates*, proposed for genera of ephemerids in Part II of this paper, have been found to be preoccupied. As substitutes I suggest for *Dromeus* Sellards (non Reiche), *Misthodotes*; for *Scopus* Sellards (non Megerle), *Meos*; for *Therates* Sellards (non Latrielle), *Esca*. The term *Rekter* should read *Recter*; while *Typus* (Pt. I, p. 249) should read *Typus*. For these corrections I am indebted to Mr. Leonhard Stejneger of the National Museum.

Megaseoptera.

The Megaseoptera have four slender, equally developed wings, which are broadest at the middle and narrowed at the base. The anal area of the wing is notably reduced. Cross veins are not numerous. The abdomen is long, and is terminated by streamers.

The group is abundantly and typically developed in the Commeny Coal Measure deposits of France,* and is sparingly represented in some other European, and in the American Coal Measure deposits.† The Megaseoptera have been known heretofore from the Carboniferous only. Their extension into the Permian is indicated by the genus herein described.

Opter Brongniartii gen. et sp. n. Text-figure 7.

The genus *Opter* is based upon a single detached wing, the apex and a part of the inner border of which are wanting. The wing is thin, slender, and very much narrowed at the base. The costal border is straight. The subcosta is a thin vein running parallel to the radius. The media is united with the radius in the basal one-fourth of the wing. At its point of separation from the radius the media has a characteristic downward curve almost touching the cubitus. The cubitus is two-branched. Cross veins occur sparingly in the wing.

Length of wing estimated, 13 to 15^{mm}; width, 2½ to 3^{mm}.

Type specimen No. 1286.

* Charles Brongniart, *Insectes fossiles des Temps primaires*, pp. 280 et seq., 1893.

† Anton Handlirsch, *Die Fossilen Insekten*, p. 312 et seq., 1906.

et sp. n. Text figure 23.
 Sector is bifurcate. Media and cubitus are fused
 distance of one to two millimeters. M_1 is
 branched. Cubitus is divided at the point of
 media. Cu_1 is deeply forked. Cu_2 is simple.
 front wing, 7^{mm} ; width, 3^{mm} . Type, No. 295.

gen. et sp. n. Text figure 27.
 Wings are long and very slender. The sector
 and media are united for some distance and
 arises as a branch vein from the united main
 simple; M_2 is three branched. Cu_1 is bifurcate
 is simple.
 front wing, 10^{mm} ; width, $2\frac{1}{2}^{mm}$. Type, No. 31.

sa sp. n.
 wing is somewhat shorter than that of the type
 simple.
 front wing, 8^{mm} ; width, $2\frac{1}{4}^{mm}$. Type, No. 1272.

Delopteridae, family new.

family of small insects. The front wings are narrow.
 The subcosta is short, rarely reaching beyond
 the wing. The radial sector is one to three
 the cubitus, instead of dividing early into two
 continues simple until near the inner border
 off one or two thin, simple inferior veins. The
 marked off by a thin depressed line. Cross veins
 are present in any part of the wing.
 wings are of approximately the same length as the
 are probably expanded and plicated as in other
 is group.
 slender. The abdomen is much shorter than

minutum gen. et sp. n. Text figure 16.
 small insects. The subcosta is short. Radial sector
 branched. Media is two branched. Cubitus
 simple.
 wing, $4\frac{1}{2}^{mm}$; width, $1\frac{1}{4}^{mm}$. Type, No. 264.

elongatum sp. n. Text figure 20.
 much larger species, and may possibly be found
 separable from *Delopterum minutum*. Cubitus
 is branched.
 front wing, 7^{mm} ; width, 2^{mm} . Type, No. 61.

Delopterum latum sp. n. Text figure 17.

This species is broader and slightly larger than the type
 species. The sector arises very early. The sector is three
 branched. A fourth branch is given off but is lost in the
 wing membrane. Cubitus is branched.
 Length of front wing, 5^{mm} ; width, $1\frac{1}{4}^{mm}$. Type, No. 94.

Urba punctata gen. et sp. n.

This genus is characterized by a slender elongate anal area
 traversed by three or four veins. The wing membrane has a
 punctate appearance, due probably to the presence of short
 spines bordering the veins.
 Length of front wing, 9^{mm} ; width, 3^{mm} . Type, No. 1117.

Correlation of the Insect-bearing Horizon.

The locality from which the insects described in this paper
 were obtained is three and one-half miles southeast of Banner
 City in Dickinson County, Kansas. The fossiliferous horizon
 occurs close to the top of the Paleozoic section of this part of
 the state and near the line of contact with the overlying
 Cretaceous. Fossil plants are associated with the insects. The
 matrix holding the fossils varies from an impure fine-grained
 laminated limestone to a hard concretionary limestone. Most
 of the insects were obtained from the laminated rock, while
 the plants come largely from the concretionary limestone.
 When the fossils were first discovered they were regarded as
 probably occurring in the Marion formation.

As a result of stratigraphic studies made for the Kansas
 State Geological Survey during the past summer, J. W. Beede
 states that he has shown the plant and insect horizon to occur
 within the Wellington shales lying next above the Marion,
 and immediately under the Cretaceous.*

Aside from doubtful forms, the paper contains descriptions
 of sixty species and thirty-five genera, all of which are new.
 To complete the faunal list, the cockroaches, not included in this
 paper, but described elsewhere, † should be added to this num-
 ber. Of this family ten species, all new, have been recognized.
 They are referred to two genera, one of which is new. Of
 groups larger than genera the following have been recognized
 in the Wellington shales: Odonata, Plecoptera, Megaseoptera,
 Gryetoblattinidæ, Protorthoptera, and Paleoblattidæ.

The order Odonata is represented in the Wellington horizon
 by at least one form constituting a new genus and species. The
 Odonate phylum is known as early as the Coal Measures, being

* Letter of Sept. 16, 1908.

† Paper prepared for the Kansas State Geological Survey.

somewhat abundant and including forms of an unusually large size in the Commeny Coal Measures of France. Handlirsch regards the Coal Measure types of Protodonates as constituting an ordinal group of equal rank with modern Odonates. With this classification I have been unable to agree, as the specimens, from the Wellington shales at least, possess the essential ordinal characters of true Odonata.

The order Plecoptera, or ephemerids, is somewhat abundant in the Wellington shales. In Part II of this paper I have described ten genera and thirteen species constituting a new family of this order. Insects which appear to be prototypes of the ephemerids exist in some abundance in the Coal Measures. Handlirsch* has recognized ephemerids as occurring sparingly in the Permian of Russia. With this exception, true ephemerids have not previously been identified from Paleozoic deposits. The relative abundance of this group of insects in the Wellington shales affords an exceptionally strong argument for the Permian age of that formation. That the members of this group, as it occurs in the Wellington, are provided with two pairs of fully developed wings and are otherwise far more primitive than modern ephemerids, by no means weakens the argument, since these are precisely the characters to be expected in early members of the order.

The order Megaseoptera is sparingly represented in the Wellington shales, a single specimen having been obtained. This order was described from Coal Measure specimens, from which deposit alone it has been known heretofore. The continuance of the order into the Permian, however, is not unexpected. Aside from cockroaches, relatively few genera of insects have been described from the Permian. This fact is sufficient to account for the previous lack of knowledge regarding the continuance of the Megaseoptera into the Permian.

The family Oryctoblattinidæ was established upon Coal Measure and Permian forms, seven Coal Measure and two Permian genera having been referred to the group. From the Wellington shales two genera of this family, both new, are described in this paper.

Protorthoptera is the predominant order of insects in the Wellington shales. This order is recognized as common to both Coal Measure and Permian deposits. Six families of the order are described in this paper, all of which are new. The forms making up these six families constitute twenty genera and forty-three species.

The cockroaches of the Kansas Permian have been described in a paper now being published in the reports of the Kansas

* See Pt. II, p. 345.

and including forms of an unusually large size from the Coal Measures of France. Handlirsch has recognized these types of Protodonates as constituting a family of equal rank with modern Odonates. With the exception of the latter, we have been unable to agree, as the specimens, in the shales at least, possess the essential characters of true Odonata.

The order, or ephemerids, is somewhat abundant in the Permian shales. In Part II of this paper I have described a family and thirteen species constituting a new order.

Insects which appear to be prototypes of the order exist in some abundance in the Coal Measure shales. Handlirsch has recognized ephemerids as occurring in the Permian of Russia. With this exception, they have not previously been identified from the Permian.

The relative abundance of this group of insects in the Wellington shales affords an exceptionally strong argument for the Permian age of that formation. That the group, as it occurs in the Wellington, are not primitive than modern ephemerids, by no means is an argument, since these are precisely the characters expected in early members of the order.

Megaseoptera is sparingly represented in the Permian, a single specimen having been obtained from the Coal Measure shales, from which it has been known heretofore. The order, however, is not represented in the Permian, however, is not represented from cockroaches, relatively few genera have been described from the Permian. This fact accounts for the previous lack of knowledge of the Megaseoptera into the Permian.

The family Ectoblattinidae was established upon Permian forms, seven Coal Measure and two Permian, having been referred to the group. From the Permian two genera of this family, both new, are described in this paper.

This is the predominant order of insects in the Permian.

This order is recognized as common to both the Permian and Carboniferous deposits. Six families of the order are described in this paper, all of which are new. The forms described in six families constitute twenty genera and thirty species.

Some of the Kansas Permian have been described in the reports published in the reports of the Kansas Geological Survey.

* See Pt. II, p. 345.

State Geological Survey. A detailed account of the group is therefore omitted from this paper. It has usually been observed, in collecting from Paleozoic localities, that cockroaches exceed in number of individuals all other insects combined. In the Wellington shales the cockroaches are much in the minority. A collection of something over two thousand insect specimens was found to contain only about seventy cockroaches. From these, two genera and ten species were identified. Of the two genera, one is the well known Coal Measure and Permian genus *Ectoblattina*. The second genus is new. The ten species obtained are new. The rarity of cockroaches in the Wellington is in marked contrast to their relative abundance in most Coal Measure and early Permian localities.

Fossil insects have been obtained from the Birmingham shales near Steubenville and Richmond, Ohio, in the Conemaugh series just above the Ames or Crinoidal Limestone. Recently reptilian remains heretofore supposed to be Permian have been found near Pitcairn, Pennsylvania, in the red clay below the Ames limestone.* The presence of the reptilian remains has given rise to a question as to the age of the Conemaugh series. In the collection of insects from that locality, Scudder recognized twenty-two species referable to three genera. All of these are cockroaches, other families not having been found at this locality. Of these twenty-two species, seventeen were referred by Scudder to the genus *Ectoblattina*, three to *Gieroblattina*, and two to *Poroblattina*. Of these genera *Ectoblattina* alone is recognized in the Wellington shales, and as already remarked, the cockroach family is in the minority at that locality. No one of the twenty-two species of the Richmond locality has been recognized in the Wellington. On the other hand, two of Scudder's species, *Ectoblattina maladiecta* and *E. benedicta* (regarded by the writer as a single species and referred to *Spiloblattina*), have been obtained from the Leroy (Coal Measure) shales of Kansas.† It should be added, however, that Handlirsch‡ does not agree with the writer either in uniting these two species, or in identifying them with the specimens from the Leroy shales. Aside from the question of discrimination of species, about which there may be differences of opinion, the essential fact remains that a closely similar type of wing development is seen in species from the two localities. This type of wing venation is referred to by Scudder as the "remarkable openness of the neuration in the middle of the tegmina.§ Handlirsch assigns to the cockroaches of this

* P. E. Raymond, Science, xxvi, p. 835, 1907.

† This Journal, vol. xviii, p. 214-216, 1904.

‡ Die Fossilien Insekten, p. 240, 1906.

§ Bulletin U. S. Geol. Survey No. 124, p. 12, 1895.

type, family rank, the Spiloblattinidæ. The family as thus delimited predominates at the Steubenville and Richmond localities, and is known as high as the Cassville plant shales at the base of the Dunkard series of West Virginia. It is abundant in the Leroy shales of the Kansas Coal Measures, but has not been recognized in the Wellington shales at the top of the Kansas section. In Europe this group is reported from both Upper Carboniferous and Lower Permian. The type genus, *Spiloblattina*, was described from Fairplay, Colorado.

The Fairplay locality was placed by Scudder in the Trias. Lesquereux maintained, however, that from the plant evidence the formation could not be later than Permian. With regard to the plant material, Mr. David White states:* "The plant and insect beds at Fairplay, referred by Doctor Scudder to the Trias, and by Lesquereux to the Permian, can, on the evidence of the plants, not be regarded as later than Permian, if indeed they are above the highest Coal Measures." The insect remains as now interpreted are not in conflict with the plant evidence, and certainly do not require the reference of the formation to the Triassic.

Of the two remaining genera occurring at the Ohio locality *Etoblattina* is a Coal Measure-Permian genus. *Pöroblattina* is found at Fairplay, Colorado, and in the upper Carboniferous and Lower Permian of Europe. The insect remains thus far obtained do not therefore permit a close correlation of the Birmingham shales with the Kansas section. It seems probable, however, that that formation is of somewhat later age than the Leroy shales of the Kansas Coal Measures.

A number of insects have been obtained, principally by Mr. R. D. LaCoe from the Cassville plant shales at Cassville, West Virginia. This horizon lies at the base of the Dunkard series variously regarded as Permian or as Permo-Carboniferous, and occurs, according to I. C. White, some six hundred feet in the stratigraphic column above the Birmingham shales. In the collections from the Cassville locality, Scudder recognized fifty-six species referable to five genera all of which are cockroaches. I have been unable to recognize in the Wellington shales the presence of any one of the fifty-six species occurring at the Cassville locality, and only one genus *Etoblattina* is common to the two horizons. The predominance of the cockroach fauna together with the absence of such advanced types as true ephemerids, leads to the view that the Cassville locality, although possibly Permian, is much older than the Wellington shales of the Kansas section.

Among the few insects obtained from the Permian formation of Russia, Handlirsch recognizes, as previously stated,

* U. S. Nat. Mus., vol. xxix, pp. 667, 1906.

Spiloblattinidæ. The family as thus described at the Steubenville and Richmond localities as high as the Cassville plant shales at the base of West Virginia. It is abundant in the Kansas Coal Measures, but has not been found in the Wellington shales at the top of the Kansas Permian. This group is reported from both the Upper and Lower Permian. The type genus, *Spiloblatina*, was described from Fairplay, Colorado. The family was placed by Scudder in the Triassic, but it is evident, however, that from the plant evidence it cannot be later than Permian. With regard to the position of Mr. David White states: "The plant fossils at Fairplay, referred by Doctor Scudder to the Permian, can, on the evidence of the plant fossils, be regarded as later than Permian, if indeed they are the highest Coal Measures." The insect remains are not in conflict with the plant evidence, and require the reference of the formation to

the Olio locality. The Permian-Measure-Permian genus, *Poroblattina*, is found in Colorado, and in the upper Carboniferous of Europe. The insect remains thus far discovered permit a close correlation of the Permian with the Kansas section. It seems probable that this formation is of somewhat later age than the highest of the Kansas Coal Measures. Insects have been obtained, principally from the Cassville plant shales at Cassville. This horizon lies at the base of the Dunkard, which is regarded as Permian or as Permo-Carboniferous, according to I. C. White, some six hundred feet stratigraphic column above the Birmingham. The collections from the Cassville locality, Scudder has referred to five genera all of which I have been unable to recognize in the Wellington. The presence of any one of the fifty-six species of the Cassville locality, and only one genus, *Etoblatina*, to the two horizons. The predominance of the Permian together with the absence of such advanced forms as ephemerids, leads to the view that the Cassville is possibly Permian, is much older than the Wellington of the Kansas section.

The insects obtained from the Permian formation at Handlirsch recognizes, as previously stated

the occurrence of true ephemerids. The Russian deposits have also yielded forms regarded as representing Paleohemiptera and Mantoidæ.* These last two groups have not been recognized in the Kansas Permian. The presence of the ephemerids, however, forms a strong tie in common between the insects of the Russian and the Kansas Permian.

The insects of the Wellington are on the average of small size as compared with Coal Measure insects. This is particularly noticeable among the cockroaches, all of which are small. This dwarfing of the fauna is of interest as probably indicating unfavorable climatic conditions.

The Geological Relations of the Associated Plants.

Plants, as previously stated, are associated with the insects at the Banner City locality. A paper describing the plants from this horizon is being published by the Kansas Geological Survey. In the writer's opinion, the plant fossils indicate unequivocally the Permian age of the formation from which they come. The evidence as to the age of the Wellington shales, derived from the flora, is thus summarized in the report referred to; "More than two-thirds of the Wellington species are either identical with or most closely related to species or genera characteristic of the European Permian. The points which seem to have the most importance as bearing on correlation of the Wellington are the following: (1) The complete absence from the Wellington of species in any way confined to or distinctive of the Coal Measures. (2) The comparatively small number of species originating as early as Upper Coal Measure time. (3) The presence of a few species common to and characteristic of the Permian of Europe. (4) The close relation of the new forms to species characteristic of the European Permian. (5) The distinctly Permian facies of the flora as a whole and its marked advance over the flora of the Upper Coal Measures.

The advance in the flora consists in the number of species and in the abundance of individuals of callipterid and tæniopterid ferns, and of the new fern genus, *Glenopteris*, which appears to be related, on the one hand, to callipterid ferns of Permian types, and, on the other, to the Triassic genera *Cyclopteris* and *Lomatopteris*.

The evidence derived from the fossil plants as a whole seems to assure the reference of the Wellington to the true Permian in the European sense."

This conclusion drawn from the plant fossils is now fully confirmed by the evidence derived from the insects.

* Die Fossilen Insekten, 348, 1906.

END

sociation for the Advancement of Science.—
ing of the American Association is held at
re auspices of Johns Hopkins University, dur-
n Dec. 28, 1908 to Jan. 2, 1909; Prof. T. C.
leago is President. This is the seventh of
week" meetings; some twenty-four affiliated
Baltimore at this time. A Darwin commemo-
kes place on January 1, under the combined
sociation and the Society of Naturalists. Also
American Health League is called for Dec. 31,
Section I of the Association, as a symposium

of *Enzyme Action*; by W. M. BAYLISS. Pp.
s (Longmans, Green & Co.).—This is the first of
raphs on bio-chemistry planned to supplement
ook treatment of topics in rapidly developing
is science. Enzyme action is shown to be a type
ion the features of which are subjected to critical
thor, and compared with the behavior of other
d consideration is devoted to the nature of
ified in enzymes, to the reversibility of enzymes,
anges in the rate of reactions as affected by them.
e details, such as the relation of the enzyme to
influence of "co-enzymes" and "anti-enzymes,"
concentration, etc., are also discussed. The
e original.

L. B. M.

Scienza.—This valuable "International Review-
thesis," commenced in 1907, has now completed
ne. A recent number includes eight articles,
ay be mentioned the following: G. H. Bryan on
d dissipation of energy; W. Ritz on the rôle of
sics; G. Haberlandt on motion and sensation in
l; G. Schiaparelli, on the astronomy of the

Verlag auf dem Gebiete der Mathematik Naturwissen-
schaften und Grenzwissenschaften. Mit einem Gedenktage-
matiker und den Bildnissen von G. GALILEI, etc. Dem IV.
mathematiker-Kongress in Rom. 6-11. April 1908. Pp. 392.

OBITUARY

WOLCOTT GIBBS, from 1863 to 1887 Rumford
Applied Science in Harvard University and for
Associate Editor of this Journal, died at his home
I., on December 9, in his eighty-seventh year
erred until a later number.

WILLIAM EDWARD AYRTON, the eminent English
n November 8, at the age of sixty-one years.

THE

AMERICAN JOURNAL OF SCIENCE

[FOURTH SERIES.]

ART. VII.—*Revision of the Protostegidæ*; by G. R.
WIELAND. (With Plates II-IV.)

[Contributions from the Paleontological Laboratory of Yale University.]

THERE is no family among all American fossil turtles which, following the discovery of its initial type, has so steadily yielded new forms and additions to our knowledge of the structure and history of marine turtles as the Protostegidæ. True enough, no further members of the family were noted and few specimens were collected for twenty years after Cope's original discovery of *Protostega gigas*; but then came the addition of the related genus *Archelon* from the Pierre Cretaceous in 1895, since which time scarcely a year has passed without yielding new data to the structure, extent and significance of the Protostegidæ.

Indeed, even before the discovery of *Archelon* the attention of the brilliant and incisive Baur had been turned to *Protostega*; and since then Hay, Case, Williston and Wieland have all contributed in turn to the literature of the Protostegidæ,—while in Europe Dollo has published papers of the greatest supplemental interest dealing with the origin of marine turtles.

Furthermore the collection of the splendid cotypes of *Protostega gigas* showing the complete limb structure, now in the Carnegie Museum of Pittsburg, and more recently the mounting for exhibition of the huge type of *Archelon ischyros* in the Yale Museum, have contributed much toward the increasingly accurate picture of the Protostegidæ. With the description of new species, meanwhile, and the appearance of the great volume of Hay—easily the foremost contribution to the literature of the Testudinata yet made—it is already evident that the Protostegidæ include a series of forms of the greatest structural interest, and that further additions to the family are

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