ART. XXVI.—*A Study of the Structure of Paleozoic Cockroaches, with Descriptions of New Forms from the Coal Measures*; by E. H. SELLARDS.

[Continued from p. 134.]

Etolblattina coriacea sp. nov. Text-figure 29; and Plate I, Figure 11.

Tegmina long, very slender, pointed at the apex, costal border slightly arched, inner border full, very thick; nervation obscure. Subcosta extending to the apex. Cubitus comparatively short, reaching only a little beyond the middle of the wing. Anal area of medium extent; anal veins about ten in number, simple or forked.

The wing is of especial interest, because of its coriaceous texture in which the veins are almost obscured. Only a few terminal branches of the radius and media can be made out. The branches of the subcosta are entirely obscured. A noticeable feature of the wing is the sharp angle made by the anal area.

Formation and Locality.—Upper Coal Measures, Lawrence, Kansas. Type in the University of Kansas collection.

Etolblattina Hilliana? Plate I, Figure 4.

Scudder, Bull. U. S. Geol. Surv., No. 124, 1895, p. 99, pl. viii, fig. 11.

The wing of Figure 4, Plate I, is doubtfully referred to *E. Hilliana*. The subcostal area is broader than in the type, and the media apparently is not so sinuous.

Formation and Locality.—Coal Measures, Mazon Creek, Illinois.

Spiloblattina.

Scudder, Proc. Acad. Nat. Sci. of Philadelphia, p. 35, 1885; Mem. Boston Soc. Nat. Hist., vol. iv, p. 461, 1890.

The genus *Spiloblattina* was proposed by Scudder to include four species of cockroaches from Fairplay, Colorado. The essential characters of the genus are the wide divergence of the radius and media, and especially of the media and cubitus beyond the middle of the wing, and their subsequent convergence enclosing an elongate or ovate area, the "stigma." Associated with these are other well-defined characters, as the thin tegmina marked with light and dark patches, and dark bands accompanying the veins. The relative distribution of the veins and their areas in this genus are practically the same as in some species of *Etolblattina*. Nevertheless, the *Spiloblattina* group of species, with thin variegated front and hind wings, is evidently a natural one, and without doubt merits generic rank. The sterna of *Spiloblattina* appear from some Kansas

specimens to have a shape different from those of *Etolblattina*, being pointed instead of rounded posteriorly. *Spiloblattina* has not been previously recognized in the Coal Measures, the type having come from deposits which are either Triassic or Permian, but an examination of some Coal-Measure forms from new material convinces the writer that the genus is represented in these formations. In describing the cockroaches from Richmond, Ohio, Professor Scudder noted that some of the species approached closely to *Spiloblattina*, remarking that the disposition of the media and cubitus of *Etolblattina ramosa* is "much after the fashion of *Spiloblattina*." A reëxamination of *Etolblattina maledicta*, a closely related species, leads to its reference in the present paper to *Spiloblattina*.

Spiloblattina maledicta. Plate I, Figures 5, 6, and 10; Text-figures 26 and 27.

Etolblattina maledicta Scudder, Bull. U. S. Geol. Surv., No. 124, p. 83, pl. 6, figs. 1-3, 1895.

Etolblattina benedicta Scudder, *ibid.*, p. 84, pl. 5, figs. 14-15.

Tegmina narrow, two and one-half times as long as broad, costal border slightly arched, inner border nearly straight; tegmina broadest at the extremity of the anal area, apex obtuse. Subcostal area narrow, extending a little beyond the middle of the tegmina; branches mostly simple and oblique. The radius reaches nearly to the apex. The first branch is given off at about the extremity of the basal third, sometimes as early as the end of the basal fourth, and is usually twice forked. Three or four other simple or deeply forked branches pass to the border. The media gives off its first branch somewhat beyond the middle. The main vein and its branches fill the apex. The cubitus varies in extent, either reaching well on to the apical margin, its greatest extent being obtained by an outward curve near the termination, or, lacking the curve, ending short of the apical margin. The first five or six branches are straight, mostly simple, and parallel; the others are more oblique, not uniform in number, curved, and sometimes forked. The anal area extends approximately to the end of the basal fourth, is clearly marked off, and has six or seven mostly simple veins. The main veins of the wing originate close together somewhat above the middle of the base. The veins diverge in the central part, enclosing elongate, light-colored areas. The tegmina are delicate and thin, the veins thin, although appearing heavy in places because of the dark-colored bands accompanying them. The alternate light and dark areas give the wing a striking appearance (Figures 5, 6, Plate I). A dark band extends along the costal border obscuring the tips of the

veins. Similar bands accompany the radius, media, and cubitus. Light areas occur in the interspaces between the main veins as well as between some of the branches. Two conspicuous, large, light spots, with irregular boundaries, occur in the apical part of the wing. The agreement with the types of the species from Richmond, Ohio, is very close. The two light spots on the apical part of the wing are not described for the type, probably because the apex was not well preserved.

In the original description of *E. benedicta*, Scudder expressed doubt as to its specific separation from *E. maledicta*. The differences which seemed to distinguish the two forms were the more arched costal border of *E. benedicta*, the less extent of the cubital area, and the approximation in the point of origin of the two radial branches. More than forty tegmina of this species are at hand for comparison. Camera lucida sketches of numerous wings show that, while those with a short cubitus have, as a rule, a more arched border, there is an almost con-

FIGURES 26, 27.—*Spiloblattina maledicta* Scudder, sp.: illustrating the extremes of variation of the species; $\times 2$. Figure 27, typical wing with extended cubitus; Figure 26, form with arched costal border and short cubitus. Originals in University of Kansas Museum.

tinuous series between, with no break sufficient to serve as a specific character. Figures 26 and 27 show the extreme limits in the extent of the cubitus, the two figures corresponding closely to the type figures of the two forms. In one the cubitus falls decidedly short of the apical margin, while in the other it extends by an outward curve and more numerous branches well on to this border. Other specimens show that the cubitus is variable in extent, and individuals can be found presenting a condition so nearly intermediate that a specific separation can hardly be sustained on this character. The third distinction given, the approximation in the point of origin of the first and second radial branches, is not constant. Occasionally a wing is seen having both a long cubitus and a close approximation in the point of origin of the first and second radial branches.

Hind Wings.—The hind wings are thin, and ovate in shape. The costa is submarginal, straight, and simple. The subcostal

area is narrow, has a few superior oblique short branches, and extends to, or beyond the middle. The radius reaches nearly to the apex and gives off about three oblique, widely forked, or simple branches. The media has four or five superior branches which fill the apex. The cubital area is well developed, the branches oblique, straight, parallel, and mostly simple. The anal area is supported by a few simple radiating veins. Eleven hind wings of this species have been obtained, one in direct connection with the tegmina. The hind wing is of even thinner texture than the front, and is also marked by light and dark areas. A dark area extends along the costal border and dark bands accompany some of the veins.

A few specimens preserving parts of the body, especially the abdomen, show evidence of light and dark areas on the body and are, for this reason, provisionally referred to this species (Figure 22). The abdomen is rather slender; the edges of the terga are of moderate extent. The sterna differ from those of *Etolblattina*, being pointed at the posterior angles. Length of the tegmina, 22 to 25^{mm}; width, 8 to 9^{mm}. Hind wings, 16 to 18^{mm} long; 8 or 9^{mm} wide.

Formation and Locality.—Lawrence Shales, Upper Coal Measures, Lawrence, Kansas.

Gerablattina.

Seudder, Mem. Bost. Soc. Nat. Hist., vol. iii., p. 97, 1879.

Gerablattina arcuata sp. nov. Text-figure 1; and Figure 7, Plate I.

Tegmina about twice as long as broad, outer border strongly arched, the apex rounded; inner border nearly straight, interrupted by the anal area. Subcosta arched parallel to the inner border, reaching three-fourths the length of the wing, branches numerous, simple, curved, thin, and parallel. The radius is but slightly developed, branches first beyond the middle of the wing, and falls a little short of the apex. The media, like the radius, occupies a comparatively small area, and remains simple until beyond the middle of the wing, its four simple, oblique branches filling the apex. The cubitus is strongly developed and reaches almost to the apex. The first five branches are simple and nearly straight, the others are more oblique, closer, and curved. The anal area is well marked and has about seven simple veins. In texture and general appearance this species presents considerable similarity to *S. maledicta*. The tegmina, however, are much more strongly arched, and the subcosta has a greater development correlated with a reduction in the radius. Length of the tegmina, 24^{mm}; width, 9^{mm}.

Formation and Locality.—Lawrence Shales, Upper Coal Measures, Lawrence, Kansas. Type in Kansas Museum.

Schizoblattina gen. nov.

Small cockroaches; veins of the tegmina numerous, much branched, and united in all parts of the wing by frequent, comparatively strong, cross veins. The main vein trunks are free almost or quite to the base, and show a tendency to disappear by dichotomy. Subcostal area broad at the base, strongly developed, with numerous superior branches. Some of the anal veins end on the anal furrow.

Schizoblattina is apparently not closely related to any described genus. *Neorthoblattina albolineata* Scudder, a small species occurring near Fairplay, Colorado, resembles it in its numerous, much branched veins united by straight, comparatively strong, cross veins. The anal veins also present

FIGURE 28.—*Schizoblattina multinervia* sp. nov.; $\times 2$.

FIGURE 29.—*Etblattina coriacea* sp. nov.; $\times 2$. Anal area restored from the obverse side of same specimen. Original in University of Kansas Museum.

the peculiarities of *Schizoblattina*, the first anal giving off several branches which run toward the anal furrow. The other species, including the type of *Neorthoblattina*, have two of the main veins more or less completely amalgamated. That this is also true of *N. albolineata* is not clear from the figure, nor is this point specifically mentioned in the description. It is evident from the peculiar disposition of the anal veins, the occasional cross nervules, and the prolific branching of the veins, that *N. albolineata* is markedly different from the other species of the genus in which it is at present placed, and as far as it is possible to judge from the illustration seems to fall more naturally in *Schizoblattina*.

The geological age of the Fairplay beds, from which *N. albolineata* came, is unsettled, the formation having been referred both to the Triassic and to the Permian.

Schizoblattina multinervia sp. nov. Text-figure 28.

This Journal, vol. xv, pl. vii, fig. 6, April, 1903.

Tegmina small, a little more than twice as long as broad. Costal and inner borders both arched, sloping gradually and equally to the apex, which is placed about the middle of the

wing. Tegmina strong, supported by numerous close branches with frequent, comparatively strong, cross veins in all parts of the wing. Subcostal area broad at the base, triangular, extending a little beyond the middle of the wing. The branches are numerous, once or twice forked, the first arising from near the base and the distal more oblique than the proximal. The radius is clearly distinct from the subcosta. The first branch is given off about the end of the basal fourth of the wing and is two or three times branched. The main vein runs in a sinuous course, reaching the costal border a little short of the apex, giving off three or four oblique, once or twice forked branches. The media is close to, but distinct from, the radius. It dichotomizes first beyond the first branch of the radius, near the end of the basal fourth of the wing. Both branches dichotomize frequently, the numerous divisions filling the distal third of the inner margin and the apex. The cubitus divides early. The branches, dichotomizing two or three times, fill the middle third of the inner margin. The anal area is of moderate extent. The first anal vein gives off five superior branches. The first and second of these, arising close to the base, are once forked, the other three being simple. The first four run toward the anal furrow, the fifth turns down parallel with the furrow and passes to the inner border. A forked inferior branch is also given off from the first anal. The greater part of the area is thus occupied by the first anal and its branches. Three other short curved veins can be seen close to the inner border. Length of tegmina, 17^{mm}; breadth, 7^{mm}.

Formation and Locality.—Lawrence Shales, Upper Coal Measures, Lawrence, Kansas. Type in the writer's collection.

Archoblattina.

Megablattina, Sellards (non Brongniart), this Journal, vol. xv, p. 312, April, 1903.

*Archoblattina**, Sellards, *ibid.*, vol. xv, p. 488, June, 1903.

Large cockroaches; body bulky, abdomen broad and fleshy; pronotum large, longer than broad, approaching a rectangular form, truncated or slightly emarginate in front, emarginate at the sides, broadest and rounded behind; front and hind wings large, overlapping the abdomen.

Archoblattina Beecheri. Text-figures 30, 31, and 32.

Megablattina Beecheri Sellards, this Journal, vol. xv, p. 312, April, 1903, pl. viii.

Myiacridæ sp.? Scudder, Bull. U. S. Geol. Surv., No. 124, p. 55, 1895, pl. ii, fig. 4.

Blattina sp.? *ibid.*, p. 142, pl. x, fig. 16.

Tegmina large, about three times as long as broad, costal border arched only very slightly, inner border nearly straight.

* *αρχων*, prince.

Subcosta curved parallel with the costal border and extending two-thirds the length of the wing, giving off numerous simple or compound branches. Radius forked about one centimeter from the base, and consisting of a few long, nearly parallel branches, which strike the border near, but above, the apex. The media forks first near the middle of the wing; the median

FIGURE 30.—*Archoblattina Beecheri* Sellards; type specimen; dorsal view.
FIGURE 31.—The same; pronotum and wing partly reconstructed.
Original in Yale University Museum.
Both figures are natural size.

area is narrow, consisting of a few long veins running to about the apex. The cubitus, although imperfectly preserved in the specimen at hand, is evidently of great extent, apparently reaching to, or beyond, the inner angle of the wing, and giving off numerous inferior branches. The anal area is of medium extent, strongly marked off by a prominent furrow, and consists of nine or ten simple or forked veins.

32

FIGURE 32.—Restoration of *Archoblattina Beecheri* Sellards; natural size.

The most distinctive character of this genus of huge cockroaches is the large, nearly rectangular pronotum, broadest at the base, and with sides and anterior border slightly emarginate. The abdomen is seen indistinctly through the wings; it is large and indicates a bulky body. The length from the front of the pronotum to the tip of the wing is 9^{cm}, making this probably the largest cockroach known. The tips only of the hind wings are seen. Apparently they are of about the same extent as the front wings. The large hind wing from the same locality, described as *Blattina* sp. by Scudder, is here provisionally referred to this species. If this reference is correct, the hind wings are very broad, with much rounded inner border.

The half-tone illustration accompanying the original description of the species was made from the mould of the dorsal surface. The figure given here is taken from the counterpart, in which the outline of the abdomen is more distinct. The two pairs of wings considerably overlap the broad abdomen. The life-size restoration is made from the specimen figured. The antennæ and legs are reconstructed from related genera. The position adopted is based upon an instantaneous photograph taken for this purpose, of the common oriental cockroach, while running. As represented in the restoration the first leg on the left side has just been thrown out in front, the second on the right side is in motion, while the third on the left is just ready to be drawn forward. The other set of three are, for the instant, supporting the weight of the body. It is not known whether the tibiæ of the genus are supplied with spines. These features are, therefore, omitted from the restoration (Figure 32).

Formation and Locality.—Coal Measures, Mazon Creek, Illinois. Type in the Yale University Museum.

Hind Wings not in connection with Front Wings.

The difficulties of nomenclature met with in the systematic treatment of the nymphs of fossil cockroaches are again encountered in dealing with such detached hind wings as lack sufficient characters to identify them with their respective front wings. Several well-marked types of hind wings, presumably representing at least as many species, have been recognized in the collections studied, three of which can be identified with the front wings. The hind wings of *Spiloblattina maledicta* have been described above in connection with the tegmina of that species. The hind wing of *Promylacris rigida* (Figure 36) is taken from the type specimen (No. 38045, U. S. Nat. Mus.). It is of special interest as revealing the form and

venation of the hind wing of the Mylacridæ. The wing is narrowed at the base, the costal border being nearly straight or a little concave at this point. The inner border although not complete is evidently rounded, and the apex obtuse. The most interesting feature of the wing is the position of the costa, which is some distance from the margin and gives off a thin superior branch. The subcosta is a stronger vein, but has only one offshoot. The radius is more developed; it divides into two nearly equal parts near the base, both of which are compound, the ultimate divisions supplying the border from the termination of the costa to the apex. The media also divides into two compound, nearly equal divisions close to the base, the branches running to the apical border. The cubitus gives off a few inferior branches which curve regularly to the border. Only a small part of the anal area is preserved. The wing just described is the left wing of the specimen. The costa of the right has two thin superior branches. The radius differs in the detail of its branching; the first and second offshoots of the lower division of the main vein are united for a short distance at their base, making a single forked branch instead of two simple branches. Length of the wing, 24 or 25^{mm}; breadth, 11 or 12^{mm}.

Formation and Locality.—Middle or Lower Coal Measures, Mazon Creek, Illinois.

The type of hind wing most abundant in the Lawrence Shales is that illustrated in Figure 33. There are nine specimens of the species, all conforming closely to a common type. The wings are uniformly ovate. The inner border is full and rounded. The costa is straight, simple, and reaches about one-fourth the length of the wing. The subcostal area is, as usual, in the hind wing, narrow and of slight extent. A few thin superior branches are given off from the main vein beyond the extremity of the costa. The radial area reaches nearly to the apex and has about four forked branches. The median area is large and fills the apex. The cubitus has several very oblique, simple, parallel branches. The few anal veins are parallel and usually simple, longer and more curved than in *Spiloblattina maledicta*. The wings are all of a brownish color. The species doubtless belongs to the genus *Etolblattina*, as the wings are of the ovate type, with full inner borders, thus resembling other species of that genus. Length of wing, 18 to 20^{mm}; width, 9 to 11^{mm}.

Formation and Locality.—Upper Coal Measures, Lawrence, Kansas.

Another species, the generic reference of which is doubtful, is represented by three specimens. The wing is contracted at the base and has an unusually narrow attachment. The costal

border near the base is quite concave, and the wing otherwise shows evidence of a specialized condition. The subcosta, radius, and media are united for some distance from the base. The first to separate is the media, which occupies a comparatively narrow area, branching first about the middle of the wing, its divisions running to the apex. The radius then separates from the subcosta 5 or 6^{mm} from the base, and reaches almost to the apex. The subcosta has only a few thin superior branches. The cubitus has the typical, very oblique, mostly simple veins. The anal area is long and has a few curved, forked, and rather loosely placed veins. Length, about 17^{mm}; width, 9 or 10^{mm}. Figures 34 and 35.

FIGURES 33-36.—Hind wings. Figure 33, *Etoblattina* sp.; Figures 34 and 35, undetermined; Figure 36, *Promylacris rigida*, from the type specimen: all twice natural size. Originals of Figures 33 and 35 in University of Kansas Museum; of Figure 36 in the National Museum.

Formation and Locality.—Lawrence Shales, Upper Coal Measures, Lawrence, Kansas. Types in the University of Kansas collection.

General Considerations.

The cockroaches have proved themselves a remarkably persistent type. They are known to range in time from the Middle Carboniferous to the present, and doubtless took their origin somewhat earlier. The Carboniferous representatives, as described above, were in many respects much like their modern descendants. The body had, as Scudder has well said, essentially the same shape. The legs indicate the same habit

of locomotion. The pronotum was as characteristic a feature of the Carboniferous as of the recent cockroaches, and formed quite as secure a protection for the small inflexed head. The front wing had a similar arched form, and the anal area was as well defined. Nevertheless, a closer inspection of the successive types reveals the fact that the group has by no means remained stationary throughout its long existence, but, like other organisms, is subject to the laws of advance and specialization. As will be gathered from what has preceded, the most marked changes from paleozoic to recent times have been in the structure of the framework of the front and hind wings, as well as in the abdomen and the ovipositors, and are thus in accordance with the general rule of change from the simple to the more complex, or from the generalized to the more specialized condition. In the front wings the tendency has been toward a reduction of the main veins by fusion of one or more of them. The main veins of both wings have approached more closely to the costal border. These changes have been accompanied by a less uniform development of the main veins and their branching systems. The hind wing has acquired a longitudinal, and in a few genera a transverse fold, and in most genera a fan-like plaiting of the expanded anal area. Numerous and comparatively strong cross veins, rare in the front wings, and unknown in the hind wings of paleozoic forms, have now become very commonly developed in both wings. Not only have both wings departed more widely from the primitive type, but differentiation between the front and hind wings has increased as well.* The front wings have become, as a rule, more resistant, although there were species in the Carboniferous with wings more opaque than some of the thin-winged living species. Important changes have occurred in the abdomen. The terga and sterna have been modified, tending toward a reduction in the number of abdominal segments. The genital pouch has been perfected, and the ovipositors have become reduced and adapted to perform a specialized function.

The division into coördinate groups, based originally on the differences in the venation of the front wings, was strengthened by the discovery of a well-developed ovipositor in paleozoic forms. More complete knowledge of the second pair of wings brings out additional distinctive characters. In the meantime, forms more or less intermediate are coming to light, and it may be confidently expected that the late paleozoic and early mesozoic will in time yield other intermediate forms. The exact point of disappearance of the *Paleoblattidæ* and origin of the *Blattidæ* is at present unknown. The geological age of the Fairplay deposits in South Park, Colorado, which contain the latest forms of the one in association with the earliest of the other,

* See also, Scudder, Mem. Boston Soc. Nat. Hist., vol. iii, p. 31, 1885.

has not been entirely established. Lesquereux, on the evidence of the flora, referred the deposits unhesitatingly to the Permian. Scudder, from a study of the insects, insisted on the Triassic age of the beds. The plants were found to represent several characteristic paleozoic genera. The insects belonged to eight genera, seven of which were cockroaches. Three of the cockroach genera were otherwise known only in the paleozoic, the remaining genera were new and at that time peculiar to the locality. It may not be out of place to add in this connection that the range of cockroach genera, as understood at the present time, is much less contradictory to the evidence drawn from the plants than was supposed when the papers in question were written. Five of these seven cockroach genera are now known to occur in the Coal Measures and Permian, leaving only two peculiar to the Fairplay locality and of Triassic affinity. In view of the occurrence as low down as the Coal Measures of the advanced genus *Schizoblattina*, described above, it would not be surprising to find true Blattidæ as early at least as the Permian, and should the fossil here tentatively identified as an egg case, prove to be such, it must be accepted as evidence of the existence of Blattidæ along with Paleoblattidæ as early even as the Upper Coal Measures. Of the Paleoblattidæ, the Mylacridæ will doubtless be found the older. The broad pronotum with but slightly rounded posterior border, the greater distance of the subcosta from the costal border, and the presence of a branched submarginal costa in the hind wing, all indicate the earlier position of this tribe. The Blatinariæ, on the contrary, are more diversified, continue later, and lead up to more advanced types.

In the course of their development, the cockroaches afford illustration of laws of evolution which may be summarized under the headings: Specialization by reduction; parallel evolution; mechanical principle of evolution; and recapitulation of ancestral characters.

Specialization by Reduction.—The long ovipositor of early cockroaches seems to indicate that a well-developed ovipositor is a primitive character in the Orthoptera, its reduction in the modern Blattidæ being an expression, like the peculiar egg case and genital pouch, of a specialized condition of the external genital organs. In this respect the Gryllidæ and Locustidæ present, no doubt, a closer approximation to the early condition than do the cockroaches, although on the whole the latter seem to be the more generalized. The more or less complete fusion of two or more of the main veins at their base or throughout a part of their course appears to be a second illustration of the law of specialization by reduction.

Parallel Evolution in the Orthoptera.—The plication, so constant a feature in the hind wings of modern Orthoptera, is,

as Scudder maintained, a comparatively recent acquisition. It is to be noted that the plaiting as well as the fold of the hind wing of cockroaches developed subsequent to the differentiation of these insects as a distinct phylum. A comparatively broad anal expanse was, however, common to the early Orthoptera, but the plaiting itself has originated independently in more than one division of the order. The same is true of cross veins. It is probable that at the time cockroaches were differentiated, well-marked cross veins were entirely lacking. Now, on the contrary, cross veins are numerous and not unlike those of other Orthoptera.

Mechanical Principle.—The plications are doubtless developed largely in response to mechanical need. Mechanical principles seem also to have had an influence in developing cross veins.* The interchange of the circulating fluids of the wing, tending to follow within established paths, probably also influenced the development of cross veins.

FIGURE 1.—*Gerablattina arcuata* Sellards: illustrating venation of a typical Carboniferous adult cockroach wing.

FIGURE 37.—Wing of a recent nymph; showing venation. (After Packard.)

Recapitulation of Ancestral Characters.—The recurrence during the ontogeny of the individual of characteristics found in the adult condition of earlier representatives of the phylum is familiar to the student of any group. The insects are not an exception to the general rule. In the accompanying figures the nervation of the wing of a modern nymph cockroach is brought into comparison with a typical Carboniferous adult.

* It is interesting to notice an analogous progressive evolution in the vegetable kingdom. The Carboniferous flora contains a great majority of simple veined leaves, while at the present time netted-veined leaves predominate. In the case of plants, both mechanical and physiological factors have doubtless operated.

Homologous veins bear the same number. The close similarity is very apparent. The modern cockroaches thus present in their ontogeny an interesting illustration of the recapitulation of ancestral characters.

EXPLANATION OF PLATE I.

FIGURE 1.—*Mytaeris elongata* Scudder. An adult, slightly enlarged. Same specimen as illustrated by Text-figure 8. The head projects in front of the pronotum. The abdomen is noticeably short in comparison with the thorax and long wings.

FIGURE 2.—*Etolblattina mazona* Scudder. Nymph with ovipositor preserved. Same specimen as Text-figure 13.

FIGURE 3.—*Mytaeris (Dipeltis) diplo-discus* Packard, sp. Type specimen. The head projects from beneath the pronotum. The impressions of the first pair of legs are indistinctly seen through the integument. The femora of the second pair of legs can be detected in the photograph. For a line drawing of the specimen, see Text figure 4.

FIGURE 4.—*Etolblattina Hilliana*? Scudder.

FIGURE 5.—*Spiloblattina maledicta* Scudder, sp. The wing shown in this photograph, also in Text-figure 26, is of the form or variety of the species with arched costal border and short cubital area.

FIGURE 6.—*Spiloblattina maledicta* Scudder, sp. Typical wing of the species having slightly arched costal border correlated with great extent of the cubitus. Same as Text-figure 27.

FIGURE 7.—*Gerablattina arcuata* sp. nov. Type specimen. The wing, as the photograph shows, has light and dark areas similar to those of *Spiloblattina*, to which genus possibly the species should be referred. The same specimen is illustrated by Text-figure 1.

FIGURES 8, 9.—*Etolblattina* sp. Detached hind wings. Same specimens as Text-figures 34 and 35.

FIGURE 10.—*Spiloblattina maledicta* Scudder, sp. The hind wing is of thinner texture and has color area similar to those of the front wing.

FIGURE 11.—*Etolblattina coriacea* sp. nov. Same as Text-figure 29.

Figure 1 is but slightly enlarged; Figure 3 is a little less than twice natural size; all others are enlarged approximately two and one-half diameters.

Figures 1-4, from the Coal Measures of Mazon Creek, Illinois: all others from the Upper Coal Measures of Lawrence, Kansas.

Originals of Figures 1, 2, and 4, in the Yale University Museum; of Figure 3, in the National Museum; all others, in the University of Kansas Museum.