56.57(78.8)

Article III.— FOSSIL INSECTS FROM FLORISSANT, COLORADO.

By T. D. A. Cockerell.

Plate V.

NEUROPTERA.

Hemerobiidæ.

Polystœchotes piperatus sp. nov.

Plate V, Fig. 2.

Anterior wing about 30 mm. long and 13½ broad, of the same structure, general form and appearance as in the living *P. punctatus* (Fabr.), but the costal area is much broader (its breadth near the base about 4 mm.), and the apex is more rounded less produced, and not at all inclined to be falcate. The peppery markings, very well preserved, are very like those of the recent species, including the subterminal rather vaguely indicated band, which is about 3 mm. from the margin. The costal region is more or less blocked out into alternating light and dark areas, as can be seen in the recent species.

Florissant, Station 14 (*Geo. N. Rohwer*, 1907). *Typha lesquereuxi* occurs on the same slab.

Panorpidæ.

Panorpa arctiiformis sp. nov.[1]

Plate V, Fig. 11.

Length of wings about 13 mm.; a species with light bands on a dark ground, after the manner of *P. nuptialis* Gerst., from Texas. In *P. nuptialis* there are two light V-like marks, the first pointing outwards, the second downwards, and also a transverse light band. In the fossil, the first V is represented by a broad pale band, which includes most of the base of the wing; the second V is present, very broad, with its outer side bulging conspicuously (it bulges slightly in *nuptialis*); the subapical band (straight and comparatively narrow in *nuptialis*) is very broad, and has externally a sharp tooth-like process about the middle, and internally, near the lower end, a large process directed inwardly. The whole appearance of the insect strongly recalls a small Arctiian moth.

The closest affinity is found with *P. picta* Hagen, from Smyrna. *P. picta* has the same markings, or nearly so; the black apical area has the inner edge zigzag,

[1] Briefly described in Science, 1907, p. 446.

as in *P. arctiiformis*, whereas in *P. nuptialis* it is straight. *Panorpa rigida* Scudder, also a Florissant fossil, is closely allied. The third dark band (the last before the dark apex) is narrower than the white space on either side of it, in costal region, in *P. rigida*, whereas in *arctiiformis* it is broader. *P. rigida* is also smaller than *arctiiformis*. The type of *rigida*, in the Museum of Comparative Zoölogy, was compared.

ODONATA.

AGRIONIDÆ.

Agrion telluris *Scudder*.

Plate V, Fig. 10.

A good nymph from Florissant, Station 14 (*Geo. N. Rohwer*, 1907). I have compared it with Scudder's type, and have no doubt of its identity. Whether its exact generic position can ever be settled, I do not know; it is very probably a member of one of the extinct genera described from Florissant. Superficially, at least, even to the characteristic markings on the legs, it is exceedingly like the nymph of *Hyponeura lugens* Hagen (*cf.* Needham, Proc. U. S. Natl. Museum, XXVII, Pl. xlii, fig. 5), which I collected in New Mexico. The caudal flaps, however, are more attenuate basally, after the manner of *Nehallenia irene* Hagen. According to Needham, *Hyponeura* is one of the most generalized, *Nehallenia* one of the most specialized, of the Agrioninæ.

DYSAGRIONINÆ subfam. nov.

In Proc U. S. National Museum, Vol. XXVIII, p. 167, Mr. E. B. Williamson gives a table of the families and subfamilies of Zygopterous dragonflies, in which the *Calopterygidæ* are divided into two groups, as follows:

Antenodals 2	Subfamily *Lestinæ*.
Antenodals 4 or more	Subfamily *Calopteryginæ*

The *Agrionidæ* almost invariably possess only two antenodal crossnervures, but there is a group of the American Tertiaries, here proposed as a subfamily Dysagrioninæ, in which these nervures are more numerous. We thus have: —

Antenodals 2	Subfamily *Agrioninæ*.
Antenodals 4 or more	Subfamily *Dysagrioninæ*.

Dysagrion Scudder, the type of the subfamily, has not been supposed to possess an unusual number of antenodals, but it is evidently allied to *Phenacolestes*, which has five; and Scudder's figure of *Dysagrion fredericii* shows two antenodals *beyond* the arculus, and as the first two of all Agrionids must certainly have been present, there were at least four.

Phenacolestes mirandus gen. et sp. nov.

Plate V, Fig. 13.

Length of wing 26 mm.; breadth 7½. Hyaline, with a large reddish-brown iridescent cloud in apical part, from level of origin of ultranodal sector (M_{1A}) to level of base of stigma.

Antenodal sectors five, of which only the first two continue to the radius, these being the two present in Agrioninæ. The second, however, does not meet, or nearly meet, the arculus, but ends on the radius 204 μ beyond it (a character also of *Melanagrion*). Antenodal costa arched.

Basal space long and narrow, breadth at apex about 714 μ, length nearly 5 mm.

Quadrangle with no cross-veins, and with its upper side not much shorter than its lower. Its apex is much less oblique than in *Melanagrion*, more as in *Cænoneura*. Its apical margin is parallel with the succeeding cross-veins, a character of *Disparoneura*, *Idioneura* and *Cænoneura*.

Arculus angulate in the middle, at which point the lower branch of the media leaves it; the upper branch leaves a little nearer to its fellow than to the radius. (In *Melanagrion* the first branch arises nearer to radius.) This arrangement is about as in *Megapodagrion*. In another specimen, however, the lower part of the arculus is conspicuously the longest, so that the two nervures leave close together from its upper third.

Subquadrangle with a cross nervure and formed as in *Megapodagrion* and *Melanagrion*, but the first cross-nervure from Cu_2 to margin, which falls beneath the apical part of subquadrangle, is a little more than its length from the end of the latter, not close to the end as in *Megapodagrion* and *Melanagrion*. A similar condition occurs in *Agriocnemis*.

In another specimen the first cross-nervure from Cu_2 to margin is distant from end of subquadrangle only a little over half its length.

Nodus 10 mm. from base of wing.

Median sector (M_3) separating from M_{1+2} nearer nodus than arculus, i. e. about 3⅓ mm. from arculus and 2⅓ from level of nodus. This character separates it from the *Calopterygidæ*, and agrees essentially with *Lithagrion* and *Dysagrion*; but the separation is not nearly so near the nodus as is usual in *Agrioninæ*.

Postnodal sectors 21. (27 in *Melanagrion*; 16 in *Lithagrion*; 18 to 19 in *Dysagrion*; 14 (anterior wing) to 17 (hind wing) in *Megapodagrion*).

Stigma elongated, bounding 4 cells above, herein resembling the *Lestinæ*, *Archilestes*, etc. Seven cells beyond stigma. No brace.

Media. M_1 and M_2 separating about 9¾ mm. from arculus; four simple cells (varying to three) between them before the doubling begins; then eight before the quadrupling; three rows of cells between the ultranodal sector and M_2 from apex of wing to level of posterior third of stigma (7 cells on extreme margin). The ultranodal sector and M_2 do not approach apically, as they do in *Megapodagrion*, *Orthostes* and *Melanagrion*, but run parallel from their widest point (opposite apex of stigma) on. This is like *Dysagrion*, and the Calopterygid *Devadatta*. The great number of cells in this region is a Calopterygine feature.

Between R_3 and M_2 there are eight cells on apical margin, then six, then four, then about four series of three, then four double, then 19 single back to origin of R_3, but five of these are basad of origin of M_2.

R_3 originates at level of nodus, the general arrangement, except as to the multiplication of the cells distally, being nearly as in *Argia* and the Agrionines generally, not at all as in the Calopterygines.

Beyond the quadrangle there are four cells, then two pairs, then about six series of three (becoming oblique), and many small cells in the marginal area. Beyond the subquadrangle are 16 simple cells before the doubling begins, and Cu_2 is arched downwards for the first part of its course (as also in *Dysagrion*), suggesting *Pseudophæa* and *Epallage*.

Between Cu_2 and the lower margin there are four cells at the widest part.

Hab.— Florissant, Station 14, two specimens (*S. A. Rohwer*).

Phenacolestes (?) **parallelus** sp. nov.

The generic position of this species remains a little doubtful, because only the apical half of the wing is preserved. It differs from *P. mirandus* in having the apex more produced beyond the stigma, and the light apical area (beyond the dark cloud) is larger.

Stigma bounds five cells above.

Cells between M_1 and M_{1A} (ultranodal sector) are single, not double, as far back as seven cells basad of level of stigma.

The cells between ultranodal sector and M_2 are regularly three deep only four cells from margin.

The cells between M_2 and R_3 (radial sector) are only three deep even at margin, they extend three deep about eight cells back, thus M_2 and Rs run practically parallel for a long distance, instead of rapidly approaching from the margin as in *P. mirandus*.

Hab.— Florissant, Station 14 (*W. P. Cockerell*).

If one takes a section of the wing down from the basal part of the stigma to Cu_2, and counts the numbers of rows of cells successively met between the longitudinal veins, it is possible to construct a formula, in which each number corresponds to the number of cells found, commencing with that between R_1 and M_1. According to this plan, the formulæ for the two species of *Phenacolestes* are:

P. mirandus, 1, 1, 3, 3, 3, 3, 3, 2.

P. parallelus, 1, 1, 2, 2, 3, 3, 3, 1.

In *Dysagrion* the region below Cu is filled with pentagonal cells; in *Lithagrion* it is filled with quadrilateral cells, or mostly so. *Phenacolestes* resembles *Dysagrion* in the mostly pentagonal cells below Cu_1 but these are not so numerous as in *Dysagrion*.

In the origin of M_2 *Phenacolestes* agrees with *Lithagrion*. It agrees with *Dysagrion* in the apical nervure of the quadrangle being parallel with the succeeding nervures, but differs in the much longer quadrangle, which is herein more like that of *Lithagrion* and *Melanagrion*. In having the cells between nodus and stigma mostly broader than high it agrees with *Lithagrion*.

Lithagrion and *Melanagrion* do not belong to *Dysagrioninæ*, as recently discovered materials, yet to be described, clearly show. I have examined Scudder's type of *Melanagrion umbratum*.

In an account of *Lithagrion hyalinum* Scudder (Bull. Amer. Mus. N. Hist., XXIII, 137) I observed that there was a brace vein, not shown in Scudder's figure. Unfortunately, in inking in the photograph the artist drew a straight vein instead of the brace, which can still be seen faintly indicated. Some months later, I examined Scudder's type of *L. hyalinum*, and found that *there was no brace vein*! Also, I could see only one antenodal cross-vein. The vein from the inner corner of stigma is in line with the inner side of stigma, and so hardly oblique; it looks like the other cross-veins. Notwithstanding these discrepancies, however, I think that my *L. hyalinum* and Scudder's are one species.

I am very greatly indebted to Dr. Needham for advice on *Phenacolestes*, and for a photograph of *Megapodagrion*. Dr. Needham writes concerning *Phenacolestes mirandus*: — "It is indeed a most interesting fossil, another synthetic type. I agree with you that it is Agrionine rather than Calopterygine, in spite of the many antenodals. De Selys *Podagrion* group of Agrioninæ includes the most primitive members of that subfamily, and this fossil is more primitive in several characters than any living forms — especially in the more numerous antenodals, and cross-veins beyond the quadrangle and before the level of the nodus."

ORTHOPTERA.

Locustidæ.

Anabrus caudelli sp. nov.

Plate V, Fig. 9.

♀. Represented by the hind part of the abdomen, with the ovipositor, excellently preserved. The ovipositor is about 18 mm. long, and in size, structure and appearance exactly agrees with that of *A. coloradus* Thomas, except that it is perhaps very slightly more curved, and the apex (in lateral view) is distinctly more attenuate.

Florissant, Station 14 (*Geo. N. Rohwer*, 1907). Named after Mr. A. N. Caudell in recognition of his recent valuable revision of the Decticinæ.

This ovipositor was compared with Scudder's types of Florissant Orthoptera. It is much too slender for that of *Lithymnetes guttatus*. Compared with that of *Orchelimum placidum* it is shorter and more curved; the length of the ovipositor of *placidum* is about 16 mm., of *caudelli* between 18 and 19.

GRYLLIDÆ.

Lithogryllites lutzii gen. et sp. nov.

Plate V, Fig. 12.

Length 13 mm., apterous; reddish brown, not dark; anterior and middle legs normal, but quite stout, the anterior tibiæ about 700 μ diameter; hind femora swollen as usual, about 6½ mm. long and 2 broad; hind tibiæ 4 mm. long and about 830 μ broad; chitinous rings of middle abdominal segments about equal, some 850 μ long (in anteroposterior direction) and 4 mm. wide.

Hind tibiæ serrate with very short broad spines, in a row along the inner hind margin; the larger of these are about 153 μ long and 119 broad at base, the smaller less than half that size. These spines are placed close together, so that there are six in a distance of 850 μ. I see, poorly indicated, a spine about 221 μ long and 34 broad, thus short and slender, which may belong to a second row close to the first, but I am not sure that it is not of extraneous origin.

At the apex, the hind tibiæ have three large spines and one smaller one, at least. The innermost of the large ones is about 1020 μ long and 255 broad.

The middle tibiæ have short spines like those on the hind ones; apparently, but not certainly, in two series.

Hab.— Florissant, Station 14 (*S. A. Rohwer*, 1907). Named after Mr. F. E. Lutz, the author of some interesting statistical studies of Gryllidæ.

The specimen is not so perfect as one could wish, but it seems not to fit well in any modern genus. It may not be mature, but I think it is an adult male. *Pronemobius* Scudder, was based on three species of crickets from the Green River shales of Wyoming, remarkable for the total absence of spines on the hind tibiæ. Among the living genera, some are said to have the hind tibiæ serrate or serrulate (subf. Myrmecophilinæ), some spinose and serrate (subf. Eneopterinæ), and others spined (subf. Gryllinæ &c.). *Lithogryllites* belongs very decidedly to the serrate or serrulate division; the comparatively large size and the normal hind femora exclude it from *Myrmecophila*; the apical spurs of the hind tibiæ being apparently only four (surely not six), it is apparently not a *Mogoplistes*. The anterior legs appear to be much more robust than in *Cycloptilum*. There is a certain resemblance to *Ectatoderus*, but again the anterior and middle legs are much too robust, and the hind femora are much too short, not nearly reaching the end of the abdomen (extending beyond it in *Ectatoderus*). There appears to be no particular resemblance to the *Eneopterinæ*.

It may be supposed that the tibial armature of the Gryllidæ arose as a fine serrulation, and is little advanced in such forms as *Lithogryllites*. A much more developed stage is found in *Gryllus*, and the most developed in *Nemobius*, in which the long spines are movable. It is noteworthy that the basitarsus of *Gryllus* retains the *Lithogryllites* form of armature.

The genus *Myrmecophila* being very different from the other American forms assigned to the Myrmecophilinæ, it would seem that the latter might well be separated as a subfamily Mogoplistinæ. The Mogoplistinæ (Myrmecophilinæ B of Kirby) would then include *Mogoplistes* (Europe, Africa, Florida, and doubtfully Chili), *Microgryllus* (Chili), *Ornebius* (Asia, Polynesia, Florida, Cuba, Mexico, Argentina), *Ectatoderus* (Africa, Asia, West Indies, S. America, Lower California, California, New Mexico), *Cycloptilum* (U. S., Cuba, Brazil, Galapagos Is.), *Arachnocephalus* (S. Europe, N. Africa, Malay Archipelago, Fiji) and *Lithogryllites*. This distribution lends support to the idea that it is a waning type, formerly dominant, but now retreating before the higher forms. From the notes given by Messrs. Rehn and Hebard in Proc. Acad. Nat. Sci. Phila., 1905, pp. 48–49, it would appear that these insects are usually arboreal. They were captured on *Quercus* and *Ilex*, and these genera of trees were prominent in the Miocene Flora of Florissant.

DIPTERA.

GLOSSINIDÆ.

According to Austen, *Glossina* is a very aberrant member of the Muscidæ, "exhibiting several unique structural features, in addition to a very peculiar mode of reproduction." As, however, it is certain that the Muscidæ of authors is too heterogeneous to form a single family; and since we have evidence of the antiquity of *Glossina*, and its fidelity to its own peculiar type through long periods and extensive migrations, it seems better to treat it as belonging to a distinct family.

Glossina oligocena (*Scudder*).

Palæstrus oligocenus SCUDDER, Bull. 93, U. S. Geol. Survey (1892), p. 19.

Scudder describes *Palæstrus* as "a genus of Œstridæ remarkable for the very striking course of the fourth longitudinal vein, which finds no counterpart in living Œstridæ so far as I can find. Nor, indeed, can I discover anything of the sort among the calyptrate Muscaria....The genus seems most nearly allied to *Hypoderma*." One specimen was known, from Florissant.

Austen (Monog. Tsetse-flies, 1903, p. 66) says: "While there are many noticeable differences, the venation of the wing of *Glossina* resembles that of the Œstrid *Hypoderma* (Warble-flies) more closely than that of any other genus, especially as regards the shape of the first posterior cell....But in the wing of *Hypoderma* the anterior transverse vein is not oblique, and the fourth longitudinal vein before reaching it is not bent down in the manner so characteristic of *Glossina*."

A new specimen of *Palæstrus oligocenus*, found in 1907 by Mr. Geo. N. Rohwer at Station 14, Florissant, shows that the fossil insect is no Œstrid, but belongs to the Glossinidæ, and in fact is not separable from the genus *Glossina*. The formidable proboscis, about 6½ mm. long, is excellently preserved; the venation is exactly the same, except that the anterior basal cell is not quite so much produced apically; the abdomen, about 7½ mm. wide and 8½ long, is hairy as in the living species; the legs, with the hairy femora and comparatively stout tarsi, do not differ. The wings and thorax are as described and figured by Scudder. Not having seen the mouth parts, it is not surprising that Scudder referred the fly to Œstridæ, especially in view of the resemblance between *Glossina* and *Hypoderma* in the venation. The occurrence of the African *Glossina* in the American Miocene is a fact of especial interest, in view of its possible connection with the extinction of the American Equidæ.

The type of Scudder's *Palæstrus*, in the Museum of Comparative Zoology, has been carefully compared with our specimen, and no difference found.

CECIDOMYIIDÆ.

Cecidomyia (?) **pontaniiformis** sp. nov.

Plate V, Fig. 7.

An oval gall on the leaf of *Myrica drymeja* (Lx.) Kn., very closely resembling those formed by the species of *Pontania* on *Salix*. The gall is about 8 mm. long, and 5 broad, one side being contiguous to the midrib. Several examples were found. Florissant, Station 14 (*T. D. A. Cockerell*, 1907).

TIPULIDÆ.

Tipula maclurei *Scudder.*

Plate V, Fig. 8.

A very fine specimen, with the reverse, was collected by myself at Station 13. I compared it with Scudder's type (Museum of Comparative Zoology), and found it to agree excellently. Especially characteristic are the oblique markings on the abdomen, and the dark V formed by the shading of the inner side of cell VII_1. This is only the second example known.

LEPIDOPTERA.

NYMPHALIDÆ.

Nymphalites scudderi *Beutenmüller & Cockerell*, sp. nov.

Plate V, Fig. 6.

Anterior wing 39 mm. long; the lower margin about 23 mm., the outer about 26, the last practically straight, with a barely perceptible outward curve; apex pointed, forming an acute angle; costa almost straight, faintly arched, except at extreme base, where it is quite strongly arched; coloration apparently dark, except for a broad but rather obscure subterminal light band, about 4½ mm. from the outer margin (with which it is parallel) and 3 mm. broad; this band appears to be continued, perhaps less distinctly, on to the hind wings.

Hind wing about 26 mm. long, with the costa full and arched; the anal angle unfortunately destroyed. Venation not visible.

Body apparently about 22 mm. long, the head destroyed except at one side; thorax and abdomen (the latter doubtless flattened sideways) robust; thorax 6½ mm. long, the same wide; width of abdomen 4½ mm.

Florissant, Station 14 (*S. A. Rohwer*).

Very distinct by its large size, and produced apices of anterior wings. The markings recall forms of *Basilarchia*, but the shape of the wings is different. The generic name *Nymphalites*, founded by Scudder, includes Nymphalidæ of uncertain position.

COLEOPTERA.

SILPHIDÆ.

Necrodes primævus *Beutenmüller & Cockerell*, sp. nov.

Plate V, Fig. 1.

Length about 17 mm., with the general form and appearance of *Necrodes* (or *Silpha*) *surinamensis*, but the elytra short, about 11 mm. long. The broadly expanded thorax is formed as in *surinamensis*, with the lateral areas finely and conspicuously punctured, as in that species. The large scutellum is also finely punctured, and has a shield-shaped outline, broad above, just as in *surinamensis*. The elytra, as in *surinamensis*, have three longitudinal keels, all equally long, and converging moderately at the end. The abdomen, as is usual in these insects, projects beyond the elytra, in this case no doubt extended as a result of pressure. The hind femora are strongly incrassate.

Florissant, Station 14 (*S. A. Rohwer*, 1907).

Except for the much shorter elytra, it is difficult to separate this species by any tangible characters from the living *N. surinamensis* (Fabr.).

Cerambycidæ.

Dryobius miocenicus *Beutenmüller & Cockerell*, sp. nov.

Plate V, Fig. 5.

Elytron, length about 18 mm., breadth near base about 4; apex narrowly truncate, with a tooth at the inner corner exactly as in the living *D. sexfasciatus* Say; punctures strong on the basal fourth of the elytron, weak and scattered beyond, precisely as in *sexfasciatus*. It differs from *sexfasciatus* in the relatively somewhat broader elytra, and the presence of only two, instead of four, light bands. These bands are broad, one beginning about 2 mm. from the apex, and about 2 mm. in width; the other beginning about 4½ mm. from the subapical, and about 3 mm. wide.

Florissant, Station 14 (*Wilmatte P. Cockerell*, 1907).

Phymatodes volans *Beutenmüller & Cockerell*, sp. nov.

Plate V, Fig. 4.

Ventral surface, with elytra and wings expanded. Length about 10½ mm.; length of elytra about 5 mm., their width about 1⅓; length of wings about 6⅓ mm. Elytra broadly dark basally, after which comes a somewhat oblique rather narrow light band, then a narrow dark area, then a large light area, and the apex is dark. Under side of head and prothorax conspicuously transversely striated. Femora bottle-shaped, as is normal in the genus. Apex of abdomen truncate, slightly emarginate, as is usual in the genus. Coxæ normal.

Florissant, Station 14 (*S. A. Rohwer*, 1907).

Allied to the living *P. varius* Fabr., but the light areas on elytra are much more extensive.

Phymatodes dimidiatus, Kirby, lives at Florissant to-day.

ACARINA.

Eriophyidæ.

Eriophyes (?) **beutenmülleri** sp. nov.

Plate V, Fig. 3.

Small subtriangular galls, about 2 mm. diameter, at the angles formed by the junction of the principal lateral veins of the leaf with the midrib; four galls on the leaf found, 2 to 5 mm. apart.

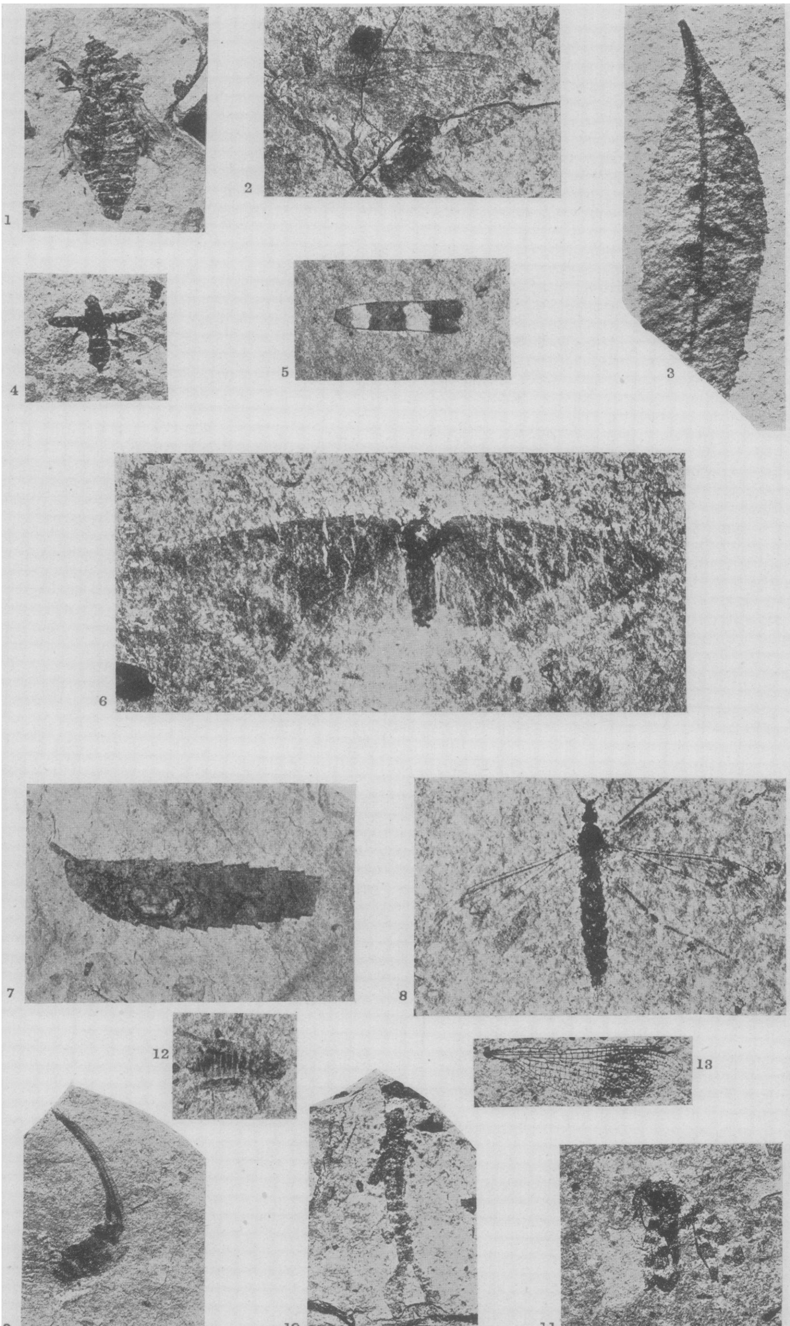
The leaf is broadly lanceolate, with a tapering base and irregularly serrate margins; the apical part is wanting. It is possible that the leaf should be referred to *Salix*.

Florissant, Station 14 (*Geo. N. Rohwer*, 1907).

Mr. Beutenmüller suggested to me that this gall was the work of a mite, and it certainly resembles very much various *Eriophyes* galls.

EXPLANATION OF PLATE.

1. *Necrodes primævus* Beutenmüller & Cockerell sp. nov., nat. size.
2. *Polystœchotes piperatus* sp. nov., nat. size.
3. *Eriophyes* (?) *beutenmülleri* sp. nov., nat. size.
4. *Phymatodes volans* Beutenmüller & Cockerell sp. nov., nat. size.
5. *Dryobius miocenicus* Beutenmüller & Cockerell sp. nov., nat. size.
6. *Nymphalites scudderi* Beutenmüller & Cockerell sp. nov., ½ nat. size.
7. *Cecidomyia* (?) *pontaniiformis* sp. nov., nat. size.
8. *Tipula maclurei* Scudder., nat. size.
9. *Anabrus caudelli* sp. nov. ♀, nat. size.
10. *Agrion telluris* Scudder, nat. size.
11. *Panorpa arctiiformis* sp. nov., nat. size.
12. *Lithogryllites lutzii* gen. et sp. nov., nat. size.
13. *Phenacolestes mirandus* gen. et sp. nov., nat. size.



FOSSIL INSECTS, FLORISSANT, COL.