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FOSSIL HYMENOPTERA FROM FLORISSANT, COLORADO.

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No. 2. — *Fossil Hymenoptera from Florissant, Colorado.*

By T. D. A. COCKERELL

THE Tertiary shales of Florissant, Colorado, have been made famous through the writings of Lesquereux and Scudder, wherein are described hundreds of species of plants and insects preserved in fine volcanic ash and sand. The vast multitudes of individuals and species, and the wonderful state of their preservation, render the locality perhaps the richest of its kind in the world, and afford us as good an opportunity as could be looked for to reconstruct the fauna and flora of a remote age. Just what age this is, is a matter in dispute; but for various reasons, which I give in a paper to be issued in the University of Colorado Studies, I think it is almost surely Miocene.

Unfortunately, Mr. Scudder has not been able to finish the investigation of the materials he secured at Florissant. In his work on *Tertiary Insects* (1890) he indicated briefly the great wealth of undescribed species. Since then he has published some miscellaneous species (Bull. 93, U. S. Geol. Surv., 1892), the Rhynchophorous Coleoptera (Monog. U. S. Geol. Surv., 1893, 21), the Adepagous and Clavicorn Coleoptera (Monog. U. S. Geol. Surv., 1900, 40), and the Tipulidae (Proc. Amer. Philos. Soc., 1894, 32). The great work accomplished by Mr. Scudder can in some measure be understood by one who has learned the difficulties of this kind of investigation; the eye-strain involved in determining minute and often nearly obliterated features, and the wide knowledge and good judgment necessary in order to classify specimens which only exhibit part of the characters commonly used as diagnostic. It is not to be expected that another such master of palaeoentomology will appear to take up the work; but the valuable materials must not be neglected, and we may hope that with the aid of several workers they will all be made known.

The present contribution deals with the bees and wasps, and one species of Stephanidae, kindly entrusted to me by the Museum of Comparative Zoölogy. In addition to the species described, I have examined more imperfect specimens of perhaps as many others; but it has seemed best to publish only those which could be classified with

some certainty, and adequately diagnosed. If the imperfect specimens just mentioned had been all the Hymenoptera found at Florissant, it would have seemed worth while to give them more careful scrutiny, and to describe a number as well as possible. No doubt, by very careful and prolonged comparisons, such portions of the venation as could be determined would be found in many cases to reveal probable or practically certain affinities; but the work would be arduous in the extreme, and would test one's skill to the utmost. As it is, the numerous well-preserved specimens give us an excellent idea of the fauna, and the determination of the poorer materials may be at least postponed without any serious injury to science.

In numerous cases, owing to the wings being folded, or one beneath another, the venation looks at first sight abnormal, and will appear to disagree with the descriptions offered. The future student of these insects should therefore not conclude too hastily that the descriptions are inaccurate.

In general terms, it may be said that the Florissant Hymenoptera do not differ greatly from their modern representatives. While some of the extinct genera are apparently more primitive than the *dominant* genera of the same groups to-day, they are scarcely more so than certain genera which still exist in the modern fauna. Thus, among the Scoliids, we naturally assume that those forms with regular venation, like that of many other wasps, are more primitive — at least in respect to this character — than those with broken or irregular cells. The two fossil genera of this group are therefore less specialized in venation than the common species of to-day, but they are in the same general stage of development as the rare American genus *Engycystis*, and the Australian *Austratiphia*. Thus, if it were possible to restore the Florissant Hymenoptera to their original state, and send them to some entomologist as coming from an out of the way region, he would see in them nothing transcending the possibilities of the modern world.

It must further be said, that the types represented do not suggest tropical or subtropical conditions; they accord well with the vegetation in indicating a climate like that of the austral zones of the temperate region. The bees are principally of genera found flying in Colorado to-day, and there is no indication of the types especially characteristic of Mexico. Both among the bees and the wasps, the element which we regard as of neotropical origin is conspicuously absent. It is only just to remark, with regard to the bees especially, that the generic identity assumed from the parts preserved might in some cases be belied, could we examine the

mouth-parts, etc. The evolution of the bees has gone on principally in the development of the mouth-structures, the venation remaining nearly as in the fossorial wasps, or at any rate not undergoing any radical changes. Hence it may be that if we could see the tongue, palpi, etc., of the Florissant species of *Halictus*, *Andrena*, *Anthidium*, etc., we should be compelled to remove them from those genera; but the agreement of the wings and general appearance is such that I feel as confident of the generic determinations as is possible under the circumstances.

The families represented are exactly those dominant to-day in North America, and the absence of certain groups must no doubt be regarded as accidental.

One would infer from the evidence afforded by the Florissant Hymenoptera, that the genera of this group are more persistent in time than the genera of Mammalia, but less so than those of flowering plants, especially trees. The same conclusions might be reached independently by a study of geographical distribution, at least so far as they relate to mammals and Hymenoptera. No doubt the genera of Hymenoptera are more widespread than some other groups of organisms which may possess greater antiquity, owing to the ready locomotion of the former.

Unfortunately, we have no series of mammals known to be of the same age as the Florissant shales. The White River beds, which Matthew (1899) calls Oligocene, have produced in Colorado some 63 species of mammals, all referred to extinct genera except a few pertaining to *Didelphys* and *Sciurus*. These animals, very differently from the Florissant Hymenoptera, if produced alive would excite the greatest amazement. Species of *Titanotheriidae*, *Elotheriidae*, *Hyaenodontidae*, *Rhinocerotidae*, *Camelidae*, *Oreodontidae*, etc., would cause bewilderment to a zoölogist to-day. Even those pertaining to families still inhabiting the earth would for the most part look quite strange to us, being of extinct genera.

The Loup Fork beds, referred to the Upper Miocene, have produced in Colorado about 28 species of mammals, but even these are nearly all of extinct genera, though only two, possibly three, of the families are extinct. We note the arrival of the *Elephantidae*, and the great abundance and variety of *Equidae*. As the Florissant shales are certainly not *later* than the Loup Fork, but doubtless earlier, the opinion that the families and genera of aculeate Hymenoptera are much more conservative than those of Mammalia seems justified. The same facts lead us to believe that the differences noted by Scudder between the insects of the Green River series and Florissant surely indicate a considerable difference

in time; and since the Florissant beds must for a variety of reasons be held to be the later of the two, the probability that they are Miocene is augmented.

APOIDEA.

TABLE OF SPECIES.

- | | |
|--|------------------------------------|
| Three submarginal cells | 1 |
| Two submarginal cells | 5 |
| 1. Basal nervure strongly curved; marginal cell ending in a point on costa; insect small, about 6½ mm. long, anterior wing somewhat over 4 mm. | |
| | <i>Halictus florissantellus.</i> |
| Still smaller; length about 4½ mm., intense black | |
| | <i>Halictus scudderellus.</i> |
| Basal nervure not, or not strongly, curved; larger, anterior wing over 5 mm. long | 2 |
| 2. Second s. m. receiving first r. n. <i>before</i> the middle; anterior wing about 8 mm. long | |
| | <i>Calyptapis florissantensis.</i> |
| Second s. m. receiving first r. n. <i>beyond</i> the middle, or at apex; anterior wing less than 7 mm. long | 3 |
| 3. Point of marginal cell a short distance from costa; second r. n. bent near upper end; first s. m. shorter than second or third on cubital nervure | |
| | <i>Lithandrena saxorum.</i> |
| Point of marginal cell a short distance from costa; second r. n. not bent near upper end; size small | |
| | <i>Ceratina disrupta.</i> |
| Point of marginal cell on costa; second r. n. not bent near upper end | 4 |
| 4. Abdomen normal; second s. m. just three times as broad below as above | |
| | <i>Andrena sepulta.</i> |
| Abdomen clavate; second s. m. narrower, not nearly three times as broad below as above | |
| | <i>Andrena (?) clavula.</i> |
| 5. Stigma small; insect broad and robust | 6 |
| Stigma fairly or quite large; insect smaller, or less robust | 8 |
| 6. Abdomen subglobose, without visible markings; second r. n. passing well (about 120 μ) beyond apex of second s. m.; breadth of marginal cell about 630 μ | |
| | <i>Dianthidium tertiarium.</i> |
| Abdomen longer, banded | 7 |
| 7. Wings strongly infuscated; marginal cell about 720 μ broad | |
| | <i>Anthidium scudderi.</i> |
| Wings clear; marginal cell about 570 μ broad | |
| | <i>Anthidium exhumatum.</i> |
| 8. T. m. with the lower end most apicad, so that it forms an angle with b. n.; eyes prominent | |
| | <i>Libellulapis antiquorum.</i> |
| T. m. with the lower end most basad so that it is in line with lower end of b. n. | 9 |
| 9. Small, length slightly over 6 mm.; abdomen dark brown; width of marginal cell 255 μ | |
| | <i>Heriades halictinus.</i> |
| Larger, length 8 mm. or over; width of marginal cell 300 μ | 10 |
| 10. Abdomen light reddish brown; head smaller | |
| | <i>Heriades laminarum.</i> |
| Abdomen banded; head larger | |
| | <i>Heriades bowditchi.</i> |

The following abbreviations are used: b. n. = basal nervure; s. m. = submarginal cell; r. n. = recurrent nervure; t. m. = transverso-medial nervure; t. c. = transverso-cubital nervure. In the wing, breadth always means in the direction of the short axis in the case of the marginal cell and stigma.

CERATINIDAE.

Ceratina disrupta, sp. nov.

Black; probable length about 8 mm., or perhaps less; anterior wing about or not quite 6 mm., dusky, especially in marginal cell and beyond; head separated a short distance from body in type and seen in side view, about 2175 μ long and 1050 from back to front, with the broadly rounded cheeks and general appearance of *Ceratina*; stigma well-developed, its width about 150 (this and all following measurements in μ), its margin bordering marginal cell about 300; marginal cell 1350 long, 370 wide, ending in a point a little away from costa; first s. m. 800 long, its length on cubital nervure 525; second s. m. much narrowed above its length on marginal 200, on cubital nervure 600; third s. m. 300 long on marginal, nearly 600 on cubital; lower section of b. n. (bordering first discoidal) gently, not strongly, curved, about 675 long; length of first discoidal 1500; first r. n. entering second s. m. beyond middle; second r. n. entering third s. m. 150 from its end, the upper end of the nervure not bent.

Type. — No. 2001, Mus. Comp. Zoöl. Florissant, Col. (No. 9355, S. H. Scudder Coll.).

MEGACHILIDAE.

Anthidium FABRICIUS.

The species of *Anthidium* differ among themselves in the details of the venation, as shown in the following table:

- First r. n. meeting first t. c., or passing a very short distance beyond it.
- A. oblongatum* Latr. (Europe).
 - A. bernardinum* Ckll. (So. Calif.).
 - A. illustre* Cress. (Western U. S.).
- First r. n. passing a fair or long distance beyond first t. c. 1
1. B. n. meeting t. m.; t. m. of hind wing only moderately oblique
 - A. steloides* Spin. (Chile).
 - B. n. passing basad of t. m. (sometimes very slightly); t. m. of hind wing very oblique 2
 2. Basal angle of first s. m. about as acute as angle formed by basal and subcostal nervures *A. laterale* Latr. (Palaeartic).
- Basal angle of first s. m. obviously more obtuse than angle formed by basal and subcostal nervures *A. emarginatum* Say (Colorado, etc.).
- A. conspicuum* Cress. (Colorado, etc.).
 - A. scudderi*, sp. nov. (Florissant).
 - A. echumatum*, sp. nov. (Florissant).

It thus appears that so far as the venation shows, the Florissant species are nearest to some of those flying in Colorado at the present day. In the following descriptions, those characters are italicized which may especially be relied upon for the separation of the fossil species.

***Anthidium scudderi*, sp. nov.**

Robust, probably about 15 mm. long (the end of the abdomen is lacking); width of thorax about 5 mm. (probably increased by flattening), of head about $4\frac{1}{2}$; general appearance normal; head and thorax black, with faintly indicated light markings; apparently the clypeus was light, and a large patch on vertex, and a pair of longitudinal subdorsal stripes on anterior part of thorax (mesothorax), but these markings, vaguely indicated by reddish color, may not truly represent the tegumentary colors; mandibles apparently short and heavy; antennae and legs not visible; abdomen broad, very pale reddish, *with the hind margins of the segments infuscated*, the darkening strongest on the actual margin, and gradually fading anteriorly, the dark band occupying about a third of the visible part of the segment (much less on the first); on the second to fourth segments are rather poorly indicated dark marks in the subbasal region in the middle line, and on each extreme lateral margin, apparently indicating a subbasal band very broadly interrupted in the subdorsal region; it is perhaps probable that the abdomen was in life yellow marked with ferruginous; the apparent pattern is not quite like that of any modern species before me, but it is not difficult to see how it might become modified into some of the patterns seen in modern Rocky Mountain species. Quite a close general resemblance is shown by the abdominal pattern of *A. bernardinum*, but in that species the lateral subbasal dark spots are much nearer the middle line.

Anterior wings about 8 mm. long; *wings strongly infuscated*, except in the basal region, conspicuously hairy. Venation in general quite normal; *marginal cell broad*, its width about $720\ \mu$; b. n. going only just basad of t. n.; first r. n. joining second s. m. a long distance (quite $420\ \mu$) from base; discoidal nervure oblique and curved, so that *the second discoidal cell is conspicuously longer on lower than on upper side*, the upper outer corner being very obtusely rounded. Hind wing with t. m. long and very oblique.

Type.—No. 2002, Mus. Comp. Zoöl. Florissant, Col. (No. 11,381, S. H. Scudder Coll.). Dedicated to Mr. Scudder.

***Anthidium exhumatum*, sp. nov.**

♂ Robust; length $13\frac{1}{2}$ mm.; width of head a little over 4, of thorax about 5, of abdomen about $5\frac{1}{2}$ mm., these measurements (particularly the last) no doubt increased by crushing; head and thorax black without any apparent markings; mesothorax coarsely roughened; ocelli large, not approaching eyes, distance between middle and lateral ocelli a little less than the diameter of one; abdomen with broad pale reddish bands, *the hind margins of the segments not darkened, nor any spots visible*; apex broadly rounded, no processes or teeth being visible, but a large quadrate area is occupied by the genitalia, the exact structure of which cannot be made out; hind tarsi apparently broad and flattened; hind tibiae with a rather abundant hairy scopa. *Wings colorless; nervures pale; marginal cell not so broad*

as in *A. scudderi* (its breadth about 570 μ); -stigma shorter and smaller, more like that of *Megachile*; second discoidal cell with the upper and lower sides about equal, the upper apical corner hardly depressed; b. n. almost meeting t. m.; first r. n. passing some distance beyond first t. c.; second perhaps passing slightly beyond apex of second s. m.; second (morphologically third) t. c. strongly bent near the middle; t. m. of hind wing hard to see but oblique.

Type.—No. 2003, Mus. Comp. Zoöl. Florissant, Col. (No. 13,709, S. H. Scudder Coll.) and reverse of the same specimen (No. 11,388, S. H. Scudder Coll.).

This is not quite so typical an *Anthidium* as *A. scudderi*, but I think it cannot be referred to any other genus. These bees are referred to *Anthidium* and not to *Megachile*, not only because of the color of the abdomen, but also on account of the characters of the venation. The following comparison shows the difference in venation between *A. scudderi* and *Megachile calogaster*:

A. SCUDDERI.

B. n. goes a little basad of t. m.
 First r. n. joins second s. m. at a distance from its base almost as great as half length of r. n.
 Stigma larger and more pointed.
 Marginal cell conspicuously broader than greatest breadth of first s. m.
 First discoidal much broader.
 Second r. n. not well seen, but enters second s. m. at or very near tip.
 T. m. of hind wing very oblique.

M. CALOGASTER.

B. n. falls a little short of t. m.
 First r. n. joins second s. m. at a distance from its base not greater than one quarter length of r. n.
 Stigma small and truncate.
 Marginal cell conspicuously narrower than greatest breadth of first s. m.
 First discoidal long and narrow.
 Second r. n. enters second s. m. about as far from apex as first r. n. does from base.
 T. m. of hind wing not or hardly oblique.

Specimen No. 8444 is an *Anthidium* exactly agreeing with *A. exhumatum* in the width of the marginal cell and in the shape of the second discoidal, but having most of the venation obliterated. It differs by the strongly banded abdomen (suggestive of the living *A. occidentale*), which, however, is not spotted. It appears to be a female, and I little doubt that it represents that sex of *A. exhumatum*.

***Dianthidium tertiarium*, sp. nov.**

♂ Body black or dark brown, without visible markings; head lacking; length, exclusive of head, about 8 mm.; width of thorax about $4\frac{2}{3}$, of abdomen about $4\frac{1}{2}$ mm.; anterior wing about 9 mm. long, slightly dusky, with the nervures dark; abdomen subglobose, terminating in two rather small and obscure tubercles, which are about as far distant as the breadth of the basal joint of hind tarsus at apex; posterior claws with a strong inner tooth. Venation of anterior wings normal; first r. n. ending about 300 μ from base of second s. m.; second r. n. passing about

- (4) Second (morphologically third) t. c. strong (third weak in *H. similis*).
 (5) B. n. meets t. m., which is curved in an opposite direction to b. n., its lower end oblique and more basad than the upper (less basad in *H. similis*).

The *H. similis* used for comparison is the form obtained by Mr. Lovell in Maine.

From *Heriades laminarum*, the present species is easily known by its darker abdomen and smaller size, as shown especially in the wing-measurements.

Heriades bowditchi, sp. nov.

No. 13,761 is larger (length, with the head thrust forward, 10 mm.); the thorax was evidently very coarsely punctate, the punctures contiguous; the following measurements are in μ ; curved portion of b. n., 300; straight portion a little longer; width of marginal cell, 300; its length, about 1350. The t. m. is as in the other species. Head large, slightly wider than thorax; abdomen light-colored, with the apex brown (doubtless black in life), and two broad entire brown bands on the apical half. The anterior wing (not perfectly preserved) must have been a trifle over 5 mm. long. This differs from *H. laminarum* by the very decidedly larger head, and the banded abdomen. The apex of the marginal cell, seen from one direction, seems to be very obliquely truncate, but this may be illusory. The stigma is pale, but it is certainly much longer, and more slender than in *H. laminarum*.

A second example (No. 13,436, S. H. Scudder Coll.) confirms the validity of this species. The specimen is clearly a ♀.

The abdomen has broad entire reddish-brown bands on the first four segments, that on the first being faint; the marginal cell is pointed at tip, not obliquely truncate; its length, measured in this specimen, is the same as in the type. The t. m. curves inwards below, as in the type. The legs are hairy.

Type.—No. 2007, Mus. Comp. Zool. Florissant, Col. (No. 13,761, S. H. Scudder Coll.). Named after Mr. F. C. Bowditch, Mr. Scudder's companion at Florissant.

ANTHOPHORIDÆ.

Calyptapis, gen. nov.

Stigma small but rather broad, about like that of *Melissodes*, the part within the marginal cell smaller than that without; marginal cell large and broad, the tip away from costa, obtusely rounded, not at all appendiculate; three submarginal cells, the third very long, and considerably the longest, narrowed a little more than half to marginal; the third t. c. with a very distinct double curve, but not abruptly bent, the cell (third s. m.) slightly appendiculate at its apical point, which is not far from the point of junction of the second r. n., the latter joining at the end of the straight lower margin, at the beginning of the upward curve, about as in *Melissodes atripes*; second s. m. pentagonal, the lower inner corner produced to considerably less than a right angle; the cell is rather large, broader below than high, narrowing above,

from the obliquity of the first t. c.; it receives first r. n. before the middle, at a point almost beneath the upper insertion of the first t. c.; first s. m. longer and larger than second, but not very greatly so, its lower margin gently curved; giving it a considerable breadth; b. n. straight, except near the basal end, where it bends downwards, and is attached a short distance basal of the t. m.; t. m. not oblique; second r. n. gently curved outwards, its junction with the third s. m. forming an angle greater than a right angle; second discoidal cell longer below than above, but not very greatly; first discoidal not so long as marginal, but not greatly shorter. The structural characters of the body cannot be ascertained.

Calyptapis florissantensis, sp. nov.

Black; anterior wing 8 mm. long, venation distinct, brown. The following measurements are in μ : width of marginal cell, 630; length of t. m., 300; width of second discoidal cell at apex, 825; from insertion of second r. n. to appendix at end of third s. m., 135; distance between insertion of first r. n. and base of second s. m., 375; length of b. n. about 1875.

Type. — 2008, Mus. Com. Zoöl. Florissant, Col. (No. 4933, S. H. Scudder Coll.).

So far as the venation goes, this genus is not far from certain species of the modern *Melissodes*. If it were a living insect, differing from *Melissodes* only in the manner indicated, it might be held to typify only a subgeneric group; but under the circumstances, and with a probability that the mouth-parts, etc., if preserved, would afford additional characters, it seems best to treat it as a distinct genus. It is probably too much to hope that fossil Anthophoridae will ever be found, showing adequately the palpi and other minute characters so useful in segregating modern genera.

ANDRENIDAE.

Libellulapis, gen. nov.

♀ Eyes apparently very prominent, the anterior part of face produced; first s. m. not so long; second discoidal narrower at end; second r. n. curved or bent outwards (straight in *Parandrena*); size small, abdomen conspicuously banded. The head, as preserved, has a singular resemblance to that of a dragonfly.

Libellulapis antiquorum, sp. nov.

♀ Length about 6 mm.; anterior wing about 5 mm.; width of thorax about $2\frac{1}{2}$, of abdomen about 2 mm. Head and thorax black; eyes prominent; flagellum stout; abdomen colorless, with a large brown patch on each side of middle of third segment; segments 4 and 5 each with a very broad entire brown band; 6 with a fainter band; middle and hind femora stout; venation brown; stigma large, but rather slender, with a large part in marginal cell, width of stigma about $195\ \mu$ (all the following measurements are in μ); marginal cell long and narrow, the tip on costa, width of cell about 300; b. n. practically straight, except a slight bend at proximal end, meeting t. m., which is oblique, at least 45° out of the straight line

with b. n. ; first s. m. on cubital nervure about 630 long, its lower edge straight (which distinguishes it from *Halictoides*) ; second the same length, but only 360 long on marginal, the second t. c. with a double curve ; first r. n. entering second s. m. about 150 from base, second about 60 from apex ; breadth of second discoidal at base 195, at apex about 390. Compared with *Halictoides maurus* it differs by the second s. m. being much broader above, and receiving the second r. n. nearer its end, by the larger and narrower second discoidal, and the lower edge of first s. m. practically straight. Compared with *Hesperapis rhodocentrus*, the insertion of the recurrent nervures is different, and the second r. n. in particular is quite different in its direction, etc. ; the straight lower edge of first s. m. agrees. Compared with *Parandrena andrenoides*, the stigma is smaller, and the second discoidal is not so broad apically. It does not agree with *Diandrena* or *Biareolina*.

Type. — No. 2009, Mus. Comp. Zoöl. Florissant, Col. (No. 9061, S. H. Scudder Coll.).

A second example (No. 8560, S. H. Scudder Coll.) shows that the legs are dark and hairy ; the mandibles bidentate, the inner tooth rounded and small ; flagellum about 195 μ broad ; abdominal bands not well preserved, but a dark patch at apex. This example shows the same curiously prominent eyes as the type, hence it does not seem likely that the feature can be due in some accident of crushing. The eyes stand out on each side of the head to an extent of at least 300 μ , forming an angle with the anterior part of the face, which appears quadrate, twice as broad as long. The eyes of *Parandrena* are prominent, especially in the male, but they do not look like those of *Libellulapis*.

Halictus florissantellus, sp. nov.

♀ Length about 6½ mm. ; stout-bodied ; head, thorax, abdomen, and legs black ; width of thorax 2 mm., of abdomen slightly more ; length of anterior wing somewhat over 4 mm., stigma and nervures dark ; middle tibia very much broader than basal joint of its tarsus (breadth of tibia 263 μ , of basal joint of tarsus 120) ; b. n. strongly curved, normal for *Halictus*, curved part 465 μ long, straight (upper) part about 150 ; t. m. a little oblique, a little basad of b. n., but not separated from it by an interval, its lower end more apicad, as is normal for *Halictus* ; width of second discoidal at base 225 ; stigma large, about 165 μ broad ; marginal cell about 270 broad, ending in a point on costa ; wings quite hairy in costal region anterior to stigma ; first r. n. joining cubital nervure 690 μ from base ; submarginal cells not traceable.

Type. — No. 2010, Mus. Comp. Zoöl. Florissant, Col. (No. 921, S. H. Scudder Coll.).

Although only part of the venation is preserved, this, and the general appearance of the insect, agree with *Halictus*, and the generic reference seems safe.

Halictus scudderellus, sp. nov.

♀ Length about 4½ mm., anterior wing about 2½ ; intense black, including legs except tarsi, which are pale reddish ; antennae stout, breadth of flagellum about

150 μ ; legs normal, breadth of hind tibiae about 255 μ , of the basal joint of their tarsi about 150; dorso-ventral diameter of abdomen about 1350 μ , length of head about the same; costa somewhat arched; stigma large and black; marginal cell about 900 μ long and 195 wide, ending in a point on costa; first section of b. n. about 150 μ long; second section curved, fully 375 μ long; second s. m. on marginal a little over 150 μ long, on cubital nervure slightly over 300, the second t. c. curved outwards.

Type. — No. 2011, Mus. Comp. Zoöl. Florissant, Col. (No. 1966, S. H. Scudder Coll.).

Lithandrena, gen. nov.

A genus of Andreninae, allied to *Andrena*. It differs from *Andrena* and *Nomia* in the second r. n., which is strongly bent in its upper part, straight but oblique below; from *Andrena* it differs in the proportions of the submarginal cells (see the dimensions given below); and from *Nomia* by the tip of the marginal cell, which is pointed, and a little away from costa. The general appearance is that of an *Andrena*, but it cannot be referred to that or any other genus known to me. In Cresson's table it seems to run to *Ceratina*, but it is not allied to that genus.

Lithandrena saxorum, sp. nov.

♀ Length 8 $\frac{2}{3}$ mm., anterior wing about 5 $\frac{1}{3}$; diameter of thorax 3, head the same, of abdomen 3 $\frac{1}{2}$ mm.; head and thorax black; abdomen light, with a broad entire dark band on each segment; legs hairy; flagellum rather stout, diameter 195 μ . In the following account of the anterior wing the measurements are in μ : stigma well-developed, diameter 175, length of the part within marginal cell 360; marginal cell long and pointed, length 1620, breadth 405, apex pointed, away from costa, but distance from apex to opposite point on costa scarcely 65; three submarginal cells; total length of first s. m. 900, but its length on cubital nervure only 570, the first t. c. being remarkably oblique, and having its lower part curved; length of second s. m. on cubital nervure 615, but it is greatly narrowed above, its length on marginal being only 150; first r. n. joining second s. m. 90 from end; length of third s. m. about 675, but it is greatly narrowed to marginal, its length above being about 270; second r. n. with a strong bend at the end of the upper two fifths, the lower three fifths straight; length of first discoidal cell 1650; b. n. meeting t. m.; lower section of b. n. slightly curved (but not more so than in some forms of *Andrena*), and more than twice as long as upper one (length of lower section 630, of upper 300); t. m. oblique, its lower end more apicad (as in *Andrenines*, *Panurgids*, etc.)

Type. — No. 2012, Mus. Com. Zoöl. Florissant, Col. (No. 8219, S. H. Scudder Coll.).

Andrena sepulta, sp. nov.

♀. Length 9 mm.; width of thorax 2 $\frac{1}{2}$ mm., of head and abdomen about the same; abdomen of normal shape; flagellum stout; there is an appearance as if the eyes nearly met on the vertex, but I think this is illusory, resulting from the

way the head is crushed; head and thorax black; abdomen nearly colorless, with broad suffused reddish-brown bands on apical margins of the first three segments, the apex also dark; abdomen hairy all over; legs light reddish-brown, hind tibiae about $1\frac{1}{2}$ mm. long, tarsi hairy; wings very hairy. The following wing-measurements are all in μ : stigma large, pointed apically, width about 300, part within marginal cell about 450 long; marginal cell long and pointed, the apex on costa, length of cell 1605, breadth 375; three submarginals, first and third long, second short, much narrowed above, almost triangular, third much narrowed above; first s. m. on cubital nervure 810, its total length 1125; second s. m. on cubital n., 405, on marginal, 135; third s. m. on cubital n., 720, on marginal, 330; bend of third t. c. about 210 from cubital n.; first r. n. enters second s. m. at extreme apex, second enters third s. m. about 90 from apex; second r. n. leaves cubital n. at a right angle, but gently curves inwards, being nowhere at all bent; upper section of b. n. 330; lower section 630; lower section gently curved, but not at all as in the Halictines; b. n. falling about 60 short of t. m., which is oblique, its lower end more apicad.

Type. — No. 2013, Mus. Comp. Zoöl. Florissant, Col. (No. 14,288, S. H. Scudder Coll.). The venation is not exactly like that of any modern species with which I have compared it, but the differences are unimportant.

Andrena (?) *clavula*, sp. nov.

♀. Length 8. mm.; width of thorax 3, of head 2; length of anterior wing $6\frac{3}{4}$ mm.; eyes ordinary; flagellum stout, subclavate, rather short, about 300 μ broad near end; head and thorax black, femora dark; hind tibiae and tarsi apparently pale, but middle tibiae dark; wings somewhat dusky; abdomen subclavate, dark reddish-brown, with three rather narrow pale bands, occupying hind margins of segments 2 to 4 and the extreme bases of the adjacent segments.

Venation (front wings) as in *A. sepulta*, except that second s. m. is narrower and more parallel-sided. Measurements in μ : width of stigma 240; length of marginal cell about 1455, its width 360; lower section of b. n., 630; second s. m. on cubital n., 360, on marginal, 155.

Type. — No. 2014, Mus. Comp. Zoöl. Florissant, Col. (No. 6963, S. H. Scudder Coll.). The shape of the abdomen is like that of a ♀ *Ceratina*, or possibly certain Halictines, but the venation does not agree with these. As the venation is exactly the same (speaking generically) as that of *A. sepulta*, it seems that the insect should be considered congeneric.

SPHECOIDEA.

CRABRONIDAE.

Tracheliodes mortuellus, sp. nov.

Black; length 7 mm. or somewhat more; abdomen petiolate; wings short; metathorax coarsely striate or ridged; upper posterior part of pleura finely striatulate; ocelli large, in a fairly high but not nearly equilateral triangle; mandibles stout, bent inwards apically (*i. e.* the outer edge becoming very convex), with the

cutting edge sinuate, but not distinctly bidentate; venation nearly as Kohl figures for *Tracheliodes megerlei* (*Brachymerus megerlei* Dahlb.), but having the stigma longer and narrower; the cells are practically the same; the costal cell is almost obsolete. Measurements in μ : length of marginal cell, 705; its breadth, 225; its breadth at the truncate end, 135; length of stigma, 420; its breadth, 105; length of s. m., 750; length of first discoidal cell, also 750; length of second discoidal, 540; r. n. joining s. m. at middle; t. m. a short distance basad of b. n.

Type. — No. 2015, Mus. Comp. Zoöl. Florissant, Col. (No. 3200, S. H. Scudder Coll.). I use the name proposed by Morawitz (1866) for this genus, because *Brachymerus* Dahlbom, 1845, though earlier, is a homonym. The genus has not hitherto been recognized in America, and it may be that if all the parts (*e. g.* of the mouth, etc.) of the extinct form could be examined, it would be found generically separable. At present, however, I can find no grounds for separation.

PEMPHREDONIDAE.

Passalocus scudderi, sp. nov.

Length $6\frac{1}{2}$ mm.; black, with a large, broad (width about $2\frac{1}{2}$ mm.) head, globose thorax, and narrow sessile abdomen; breadth of thorax $2\frac{1}{3}$, of abdomen about $1\frac{1}{2}$ mm., hind margins of abdominal segments broadly rather pale brown; ocelli normal; anterior wing about $3\frac{1}{2}$ mm. long, venation rather pale brown; stigma rather large, about 135μ broad; marginal cell normal; first s. m. about 780μ long; second s. m. 255 long and about 375 high, its sides parallel; b. n. strongly curved; first r. n. entering first s. m. about 135μ from its end; second r. n. joining second s. m. very slightly beyond the middle; apical corner of first discoidal rather more elongated and pointed than usual; b. n. falling a little short of t. m.; second discoidal oblique, slanting downwards apicad.

Type. — No. 2016, Mus. Comp. Zoöl. Florissant, Col. (No. 8758, S. H. Scudder Coll.). Closely allied to existing United States species.

PHILANTHIDAE.

Prophilanthus, gen. nov.

Large and robust, with a sessile abdomen; stigma little developed; marginal cell narrowly but very obtusely rounded at apex, the apical point away from costa, and quite without an appendix; third submarginal cell very broad, and equally broad above and below; basal nervure joining subcostal a long way basad of stigma. Compared with *Philanthus albifrons* Cresson, the fossil insect showed the following differences:—

- (1) Portion of stigma in marginal cell shorter.
- (2) Marginal cell bulging basally, *i. e.*, in the direction of the first t. c.
- (3) Marginal cell with apex rounded, the apical point not on costa.
- (4) Third t. c. arched, with more or less of a double curve (a character of *Philoponus*).
- (5) Second s. m. broader, and receiving first r. n. more distinctly before middle.

(6) Third s. m. very much broader above, being equally broad (1050μ) above and below.

(7) Prothorax, mesothorax, and metathorax longitudinally striate, especially the prothorax. (Very faint striation of the prothorax is visible in *P. albifrons*.)

Other characters are: width of third discoidal at base somewhat less than greatest width of first discoidal; first t. c. not angulated at basal third; second discoidal cell more than twice as long as its width at apex; cubital nervure not bent, but slightly curved downwards, at end of first discoidal; lower section of b. n. (bordering first discoidal) about twice as long as upper.

Prophilanthus destructus, sp. nov.

Length about 20 mm., robust, with a thick sessile abdomen, which appears to have had very broad black bands alternating with narrower yellow ones; antennae 6 mm. long, ordinary, the scape thick, flagellum black; length of anterior wing $12\frac{1}{2}$ mm.; costa, up to base of marginal cell, broadly and very deeply infuscated, apex also clouded; marginal cell 3 mm. long, only just surpassing apex of third s. m.; first s. m. ~~3 mm. long~~; second and third submarginal cells combined, on cubital nervure, 3 mm. ~~long~~; first discoidal cell $4\frac{1}{2}$ mm. long, or nearly; second r. n. nearly straight, slightly bowed outwards; second s. m. very broad below; origin of first t. c. to insertion of first r. n., 450μ ; insertion of first r. n. to origin of second t. c., 975μ ; origin of second t. c. to insertion of second r. n., less than 150μ .

Type. — No. 2017, Mus. Comp. Zoöl. Florissant, Col. (No. 7762, S. H. Scudder Coll.).

NYSSONIDAE.

Hoplisidia, gen. nov.

Size rather large; thorax hairy, the hairs long and quite simple; abdomen sub-cylindrical, broadest at the apex of second segment; first segment comparatively small, but not petiolate; apex pointed; the form of the insect like *Gorytes* or *Hoplisus*; stigma very narrow, almost obsolete; three submarginal cells, the first at least as long as the other two combined, the b. n. joining subcostal very far basad of the stigma; second s. m. broad, receiving the recurrent nervures near the end of the first and second thirds, the second r. n. curved and bent backwards to its point of insertion; third s. m. about twice as broad below as above; marginal cell narrowly rounded at apex; first discoidal conspicuously longer than marginal; b. n. sharply bent at origin of cubital; b. n. meeting t. m., or practically so; hind wings with cubital nervure exactly meeting t. m., which goes downwards for a short distance, and is then bent, finishing its course very obliquely. Among the *Gorytinae*, this falls closest to *Hoplisus* by the venation of the hind wings. It is peculiar for the very long first s. m., the b. n. meeting t. m., the reduced stigma, and the long first discoidal, the whole combination seeming to exclude it from the modern genera. The upper apical corner of the second discoidal is obtuse, as in *Gorytes mystaceus*, not acute as in *G. (Hoplisus) quadrifusciatus*. The second t. c. is much less oblique than in either of the species just cited, being very nearly vertical, and not at all parallel with the third t. c.

Hoplisidia kohliana, sp. nov.

Length (but in a somewhat disintegrated condition) about 20 mm.; anterior wings about $11\frac{1}{2}$ mm., with a dusky cloud in the second s. m., and suffusedly below; length of abdomen about 10 mm., its width 4; measurements in μ :—length of marginal cell about 2250; its breadth 525; length of first s. m. about 2475; length of second s. m. on marginal, about 600; on cubital nervure about 1050; of third s. m. on marginal 600, and on cubital 1140; insertion of first r. n. from first t. c. 420; insertion of second r. n. from second t. c., 300; length of first discoidal, 3300.

Type.—No. 2018, Mus. Comp. Zool. Florissant, Col. (No. 742, S. H. Scudder Coll.). Named after the author of the most useful work on the genera of fossorial wasps.

Hoplisus sepultus, sp. nov.

Probable length about 10 mm. (head, much of thorax, and base of wings missing in the type); abdomen sessile, apparently normal, curved downwards as though in the act of stinging; hind tibia with tarsus about $4\frac{1}{2}$ mm.; wings with a dark cloud in base of marginal cell, filling second s. m., and extending suffusedly below, still showing brilliant iridescent colors, especially in second s. m.; nervures more slender than in *Hoplisidia kohliana*; stigma large, its breadth about 170 (this and all following measurements in μ); marginal cell about 1500 long and 300 broad, pointed on costa; b. n. beginning at or very near base of stigma, and going a little basad of t. m.; length of first s. m. about 1275; second s. m. hexagonal, its length on marginal 300, on oblique apex of first discoidal 170 to 270 (this variation in the opposite wings of the same individual); first recurrent nervure to second (both received by second s. m.) 300; second r. n. to origin of second t. c. 150; third s. m. oblique, its greatest length (from upper basal to lower apical corners) 1125, its length on marginal 450, its length on cubital nervure 750, its tip surpassing marginal cell a little; insertion of third t. c. to tip of marginal cell 570; length of first discoidal about 2100; second r. n. very strongly bowed outwards. Hind wing reversed in the specimen; cubital nervure meeting t. m.; distance from t. m. to t. c. 1800.

Type.—No. 2019, Mus. Comp. Zool. Florissant, Col. (No. 980, S. H. Scudder Coll.).

No. 2710, S. H. Scudder Coll., is a wing of *Hoplisus sepultus*, with a small portion of the body. The measurements are in part greater than in the type indicating perhaps the opposite sex or a larger individual, but evidently not another species. Length of marginal cell about 1500, its breadth about 300; length of first submarginal about 1350, the b. n. hardly going so near stigma as in type; second s. m. on marginal 240; distance between first and second recurrent nervures at insertion 300; length of first r. n. 750 (same in type); insertion of second r. n. to origin of second t. c. 150; greatest length of third s. m. about 1200; third s. m. on marginal 570; length of third t. c. 795; insertion of third t. c. to apex of marginal cell 600. Cloud in second s. m., etc., as in type.

SPHECIDAE.

Ammophila antiquella, sp. nov.

Head and thorax black; abdomen all light; hind legs apparently light, with the tarsi black, in strong contrast; form slender. Length 12 mm.; abdomen $7\frac{1}{2}$ mm., of which 3 mm. is petiole; width of thorax between wings $1\frac{1}{2}$ mm., of head perhaps a trifle less; hind tibia $2\frac{3}{4}$ mm.; scape rather stout, as usual in the genus, metathorax transversely striated; wings not preserved. Anteriorly to the transversely striate area on thorax, some longitudinal striae can be seen. The petiole of abdomen is two jointed, the first joint scarcely over one third the length of the second; the breadth of the apical part of the abdomen is $1\frac{1}{2}$ mm.

Type. — No. 2020, Mus. Comp. Zoöl. Florissant, Col. (No. 5974, S. H. Scudder Coll.). The specimen is poorly preserved, but as its relationships are evident, it is described.

VESPOIDEA.

SCOLIIDAE.

I here use this family name in a rather broad sense, including the Myzinidae and Tiphidae of Ashmead. The two extinct genera here introduced are evidently related to the Tiphid series, though not without features suggestive of the other groups. So far as I am able to judge, their affinity is closest with the rare and apparently primitive genus *Engycystis* Fox, found in Texas and Lower California. Curiously, however, a new genus from Australia is also related, and for purposes of comparison is herewith described. The following table separates the four genera from each other: —

- Basal nervure entering subcostal at a distance from stigma much greater than length of stigma *Austrotiphia*, gen. nov.
- Basal nervure entering subcostal at a distance from stigma less than length of stigma 1
- 1. T. m. strongly oblique; stigma very narrow, not nearly filling the large stigmatic cell; marginal cell not surpassing third s. m. *Lithotiphia*, gen. nov.
- T. m. slightly oblique 2
- 2. Marginal cell surpassing third s. m., its apex rounded; costal cell large. *Geotiphia*, gen. nov.
- Third s. m. surpassing marginal cell; apex of marginal pointed, on costa; costal cell small or rudimentary *Engycystis* Fox.

In *Engycystis*, the ventral constriction between the first and second abdominal segments is not nearly so marked as in *Tiphia* and *Paratiphia*, but in *Austrotiphia* the constriction is still less evident, being hardly appreciable. One would almost hesitate to place the latter genus in the Scoliids, were it not so obviously a Tiphid in every other feature. The otherwise different Australian

genus *Dimorphoptera* Smith, appears to share the same character. Unfortunately this character cannot be determined in the fossil genera, owing to the position of the specimens.

♀ Having exactly the appearance of a *Tiphia*, but related to *Engycystis*, from which it differs thus: basal nervure joining subcostal much more remote from stigma; first s. m. long, broken by a false vein which passes from near the origin of the first t. c. to near the base of the stigma (the same is found in the Myzinid *Plesia*); marginal cell broadly rounded, — almost truncate, at apex; second s. m. extremely broad below, the first and second s. ms. exceedingly oblique; first discoidal cell at base narrower than first submarginal; t. m. very oblique (a character of the fossil *Lithotiphia*); hind wings with t. c. oblique (its upper end more basad), and cubital nervure ending about as far basad of upper end of t. m., as half the length of the latter. Stigma well-developed.

Austrotiphia kirbyi, sp. nov. ♀. Length about 13 mm., entirely black, looking like an ordinary *Tiphia*; eyes and mandibles as in *Tiphia*, simple; punctures nearly as usual in *Tiphia*; hind margin of prothorax straight, or rather gently concave, with no median lobe; anterior part of mesothorax smooth; scutellum shining, with very sparse and small punctures; parapsidal grooves very strong; tegulae small; abdomen with small punctures, closer and much smaller and more regular on basal part of segments; apical ventral plate not greatly surpassing dorsal; legs much as in *Tiphia*, but hind femora much broadened, sharply keeled below; hind tibiae short, with five or six rather broad teeth on outer edge; basal joint of hind tarsus tuberculate on outer side, not spined; middle and hind tibiae each with two white spurs; last joint of hind tarsi normal. Shoalhaven, Australia (W. W. Froggatt, 186). Captured in 1895, and now the property of the British Museum. Named after Mr. W. F. Kirby, in recognition of his work on *Scoliidae*.

In *Geotiphia* the teeth on the outer edge of the hind tibia are very broad, not spine-like as they are in *Tiphia* and *Engycystis*. In *Austrotiphia* they are comparatively broad and short, and the last one, in particular, recalls that of *Geotiphia*. In *Tiphia* the suture between the first two abdominal segments is evidently depressed at the sides, the abdomen being viewed from above; this is not the case in *Austrotiphia*. In this particular, so far as can be seen, *Geotiphia* and *Lithotiphia* resemble *Austrotiphia*. *Geotiphia* has some appearance of having had emarginate eyes, a character of the true *Scoliids*, but it is impossible to be sure about it. The spotted abdomen is also suggestive of the *Scoliids*, but not so the venation and the large stigma. When one uses the compound microscope to examine the eyes, the appearance of emargination disappears, and so far as can be seen, they look normal for the *Tiphiidae*. On the hind leg of the ♀, the tibial spurs are very short in *Engycystis*, very much less than half the length of the first tarsal joint; in *Austrotiphia* these spurs are very long, the longest (the hind one) being fully three quarters the length of the first tarsal joint; in the two fossil genera their character has not been determined. *Tiphia* has them long, like *Austrotiphia*. The second antennal joint in *Austrotiphia* is conspicuously smaller than in *Tiphia*. In *Geotiphia* the middle joints of flagellum are broader than long; in *Austrotiphia* (♀) they are about as long as broad;

in *Tiphia* (♀) they are conspicuously longer than broad. In *Geotiphia* and *Tiphia* the claws are bifid; in *Austrotiphia* they appear at first sight to be simple, because the inner tooth is flattened, shortened, and directed somewhat inwards. In *Tiphia* the middle coxae are very widely separated by a bilobed projection of the mesosternum; in *Austrotiphia* they are considerably closer together, the bilobed projection, although present, being much smaller. In *Engycystis* they are more as in *Austrotiphia*. In *Tiphia* the middle tibiae have only one spur, in *Austrotiphia* and *Engycystis* (as in the *Myzinids*) there are two. *Tiphia* has an open marginal cell and only two submarginals; *Austrotiphia*, *Engycystis*, *Geotiphia*, and *Lithotiphia* have a closed marginal and three submarginals.

Geotiphia, gen. nov. *foxiana*, sp. nov.

Length about $11\frac{1}{2}$ mm.; black, with light markings on abdomen; femora black, tibiae and tarsi light, probably red in life; the abdominal markings, presumably yellow in life, consist of a broad transverse spot or patch on the first segment, rounded at sides and deeply emarginate posteriorly, a couple of transversely oval spots on second segment, and a pair of smaller and rounder ones on third; first segment broad, broadly rounded in front; width of abdomen about 3 mm.; head round, width about 2 mm.; middle joints of flagellum about $180\ \mu$ long and $225\ \mu$ broad; middle tibia apparently short, broad (breadth about $300\ \mu$), abruptly truncate; middle tarsi slender, first joint about $900\ \mu$ long, its outer edge straight on first half and convex on second, third and fourth joints each about $225\ \mu$ long, and quite slender; claw joint (excluding claws) about $300\ \mu$ long; claws bifid, the two teeth about equally long; hind femora stout but not at all subglobose, about $1500\ \mu$ long; hind tibia about as long, about $600\ \mu$ broad; basal joint of hind tarsus about $250\ \mu$ broad. Outer apical edge of hind tibiae with very broad teeth, with points directed apicad, and long straight or nearly straight upper edges. Wings with a large stigma (solid, filling stigmal cell), its breadth about 300 (this and all following measurements in μ); costal cell very distinct, the costal and subcostal nervures very heavy, and quite wide apart; marginal cell complete, broadly rounded at end, the actual apex not on costa, length of the cell $1500\ \mu$, its tip surpassing apical point of third s. m. by about 100, although the distance from insertion of third t. c. to apex of marginal is about 450; three submarginal cells, the first 1200 long; second very broad, 450 long on marginal, and 900 on cubital nervure, receiving the first r. n. exactly at the middle; third s. m. 600 long on marginal, its outer side strongly bulging; first (upper) section of b. n. less than 300 long, bulging at its lower end, just before the origin of cubital nervure; second (lower) section slightly over 300 long, meeting t. m., which is a little oblique; first discoidal 1500 long; second r. n. joining third s. m. not far from the middle.

Type. — No. 2021, Mus. Comp. Zool. Florissant, Col. (No. 14,292. S. H. Scudder Coll.). Named after Mr. W. J. Fox, in recognition of his work on *Engycystis*.

Lithotiphia, gen. nov. *scudderi*, sp. nov.

Length about $12\frac{1}{2}$ mm., anterior wing about $8\frac{1}{2}$; black, the abdomen without light spots; head round, its width $2\frac{1}{2}$ mm.; width of thorax (doubtless increased by crushing) about 4 mm.; abdomen about $6\frac{3}{8}$ mm. long and 3 broad; hind femora cylindrical, rather stout, with a little concavity followed by a prominence at apex beneath, as in other Tiphids; hind tibiae greatly swollen, apparently not dentate; hind tarsi very slender. Wings with apparently a very large stigma, but the microscope shows that this is the stigmal cell, not nearly filled by the long and slender true stigma, which is brown, as long as stigmal cell, but only about 105 (this and all following measurements in μ) broad; the stigmal cell is about 675 long, and 255 broad, broadly truncate posteriorly, and with a rudimentary cross-nervure before the middle, almost meeting the radial nervure (in a modern *Scolia* I can detect such a cross-nervure, but still more rudimentary); marginal cell entire, exceedingly broadly rounded apically, the actual tip not on costa, length of the cell 1650; three submarginals, the second very broad, 750 long on marginal, receiving the first r. n. nearly 600 from its beginning, and 450 from its end; third s. m. broadly bulging apically, not surpassed by the marginal; length of third s. m. on marginal 750 (same as second s. m.); second r. n. joining third s. m. 375 from its base, and 450 from its lower apical corner; the second r. n. joins the cubital nervure in such a way that the outer angle formed is less than a right angle. B. n. going very slightly basad of t. m., which is strongly oblique.

Type. — No. 2022, Mus. Comp. Zool. Florissant, Col. (No. 2440, S. H. Scudder Coll.).

POMPILIDAE.

Hemipogonius florissantensis, sp. nov.

Length nearly 15 mm., anterior wing about 10 mm.; anterior wings with a transverse dark cloud or suffused band at about the end of the basal third, a very large dark roundish patch in and below the marginal cell, and the tip dusky, a round area between the dusky tip and the large dark region appearing white. General structure of body normal, the abdomen sessile, with the first segment, seen in lateral profile, ascending and convex; spurs large; antennae about 7 mm. long, one curled under body reaching middle coxae, apparently not curled, or little curled, at tip; hind coxae long, hind femora about $3\frac{1}{2}$ mm.

Length of stigma 900 (this and the following measurements in μ), its breadth about 285; costal cell distinct; length of marginal cell about 2400, long and narrow, its breadth about 525, its apex pointed and on costa; distance from insertion of third t. c. to tip of marginal, 765; length of first s. m. nearly 2250; first t. c. bowed inwards (basad), its length about 525; stigma to insertion of first t. c., 270; second s. m. on marginal, 750; third s. m. on marginal, 795; outer angle formed by insertion of third t. c. on marginal less than a right angle; distance from insertion of second r. n. to lower apical corner of third s. m., 825 (the second r. n. enters third s. m. toward the base); b. n. very far basad of stigma, and its origin 450 basad of t. m., its lower section about 600 long, the upper one (bounding first s. m.) considerably less; lower edge of second discoidal 1275 long, its breadth at apex

800, at base 300. Hind wings with cubital nervure inserted a short distance beyond (apicad of) t. m.

Type.—No. 2023, Mus. Comp. Zoöl. Florissant, Col. (No. 8647, S. H. Scudder Coll.). Easily known from *H. scudderi* by its larger size. The specimen shows several venational characters which were not preserved in *H. scudderi*, and they confirm the generic reference.

Hemipogonius scudderi, sp. nov.

Slender, length about $10\frac{1}{2}$ mm.; antennae $5\frac{3}{4}$ mm., the scape thickened; width of head 2 mm.; length of anterior wing about $6\frac{1}{2}$; length of thorax almost $3\frac{1}{2}$; of hind tibia and tarsus about 7; hind spurs large. Wings hairy; stigma distinct; marginal cell sharply pointed on costa, its length and that of first s. m. the same, $1575\ \mu$; greatest width of marginal cell only $405\ \mu$; second s. m. pentagonal, broad, receiving first r. n. a little beyond its middle; length of second s. m. on marginal $450\ \mu$; third s. m. larger than second, shaped as usual; b. n. about $120\ \mu$ basad of t. m.; t. m. $255\ \mu$ long, not at all oblique. Stigma dark, and a dark cloud in the region of b. n. and below; also a diffused brown cloud occupying marginal cell, the second and third submarginals, and the third discoidal; this region still shows bright iridescent colors. Somewhat allied to the living *H. alienatus* (Smith), but larger. The wings are shorter, and much more strongly clouded, than in *H. fortis* (Cresson). The sutures of the antennal joints are black.

Type.—No. 2024, Mus. Comp. Zoöl. Florissant, Col. (No. 8640, S. H. Scudder Coll.). A beautifully preserved specimen. No. 10,813, S. H. Scudder Coll., is the reverse of the same example.

Ceropalites, gen. nov.

Abdomen very convex, the first point narrowed to a distinct petiole; stigma very well-developed, elongate, lanceolate; subcostal nervure quite widely separated from costa; first discoidal cell very narrow, the part of the basal nervure bounding it being less than half as long as the part bounding first submarginal; b. n. passing only just basad of t. m.; marginal cell large and elongate, probably pointed; antennae long.

Ceropalites infelix, sp. nov.

Length 13 mm.; as preserved, entirely light reddish-brown, probably red in life; wings hyaline, with the apical margin broadly dusky; stigma dark, with a brownish spot immediately below it; length of anterior wing 10 mm.; of abdomen 7; height of abdomen (dorso-ventral) 3; length of thorax anterior to wings $1\frac{1}{2}$ mm.; length of marginal cell over 4 mm. (the apex gone); of wing anterior to stigma about $5\frac{3}{4}$ mm.; length of stigma about $1500\ \mu$; its breadth about 375; first section of radial nervure, passing almost straight down from stigma to junction of first t. c., about $450\ \mu$ long; width of marginal cell $1095\ \mu$; from first to second t. c. on radial nervure about $1650\ \mu$; beginning of b. n. from stigma, $600\ \mu$; distance of subcostal nervure from costa at this point, 300; first (upper) part of b. n. about $1110\ \mu$, second (lower) part 300; hind part of metathorax with some transverse keels.

Type. — No. 2025, Mus. Comp. Zoöl. Florissant, Col. (No. 6013, S. H. Scudder Coll.). The first abdominal segment having a distinct though short (less than 1 mm. long) petiole is suggestive of Sphecidae, but the insect does not otherwise agree with that group. The first abdominal segment really recalls the winged Mutillidae allied to Photopsis, as much as anything; but the ventral surface of the abdomen is perfectly straight (or rather, gently convex), without the least sign of a depression between the first and second segments. The well-developed stigma is suggestive of Ceropales, but the venation differs from that of any modern genus known to me. I cannot see the third submarginal cell distinctly, but it appears to have been present. The dark spot below the stigma is still slightly iridescent.

VESPIDAE.

Palaeovespa, gen. nov.

With the general form of *Vespa*, the thorax broadly rounded, and the abdomen sessile and broad at base; the first segment of transverse form, yet by no means so broad as in true *Vespa*. Venation more like *Polistes*, the marginal cell being pointed, the apex of first discoidal oblique, and the recurrent nervures joining the second s. m. far apart, not both entering the basal half of the cell, as in *Vespa*. The b. n. joins the subcostal nervure nearer to the stigma than is usual in *Vespa*, but not at its base, as in *Polistes*. It is impossible to see whether the hind wings have an anal lobe or not. This is a very interesting genus, having the appearance rather of *Vespa* (it would never occur to any one to refer the specimens to *Polistes*), but retaining the apparently more primitive venation of *Polistes*, or a close approximation to it. *P. florissantia*, the largest species, is taken as the type, but the characters of the genus are not all ascertainable from the single specimen of that insect.

Palaeovespa florissantia, sp. nov.

Very large and robust; length to beyond middle of fifth abdominal segment, 25 mm.; length from base of abdomen to apex of fourth segment, 14 mm.; thorax narrow for the size of the insect, its width between wings about 7 mm.; breadth of abdominal segments in mm. (1) $6\frac{1}{2}$, (2) $8\frac{1}{2}$, (3) $8\frac{1}{2}$; color dark, evidently black in life, with the hind margins of the abdominal segments broadly but suffusedly pallid; no distinct abdominal markings; wings apparently reddish. The venation is obscure, but the wings appear to be folded, and the very long first discoidal cell of the Vespidae is plainly visible, its length about 10 mm., while its breadth is only about $1\frac{1}{2}$; the lower part of the basal nervure is about 6 mm. long, and the first s. m. on cubital nervure is about $3\frac{2}{3}$; the second s. m., very faintly indicated, appears triangular, the first t. c. oblique, its upper end most distad, the acute angles formed being of about 45° ; the apex of the first discoidal, between the first t. c. and the insertion of the first r. n., is obliquely truncate, — considerably more obliquely than in a modern *Vespa* examined.

Type. — No. 2026, Mus. Comp. Zoöl. Florissant, Col. (No. 11,741, S. H. Scudder Coll.). This is the largest by far of the Florissant Hymenoptera seen

by me. It gives one the impression, at first, of a large Scoliid, but it is unquestionably a member of the Vespidae.

Palaeovespa scudderi, sp. nov.

Length of anterior wing about 13 mm.; of head, including mandibles, 6; of thorax, 8; of middle femur and trochanter $4\frac{1}{2}$; of middle tibia and tarsus, 7; of first discoidal cell, 7; of marginal cell, which ends in a sharp point on costa, $3\frac{2}{3}$; eyes deeply emarginate, as usual in *Vespa*, but contrary to what obtains in the modern species, the part of the eye above the emargination is almost if not quite as large as that below it; mandibles shaped as usual in the genus; the large lateral lobes of prothorax are strongly vertically striate, the striation resembling that found in the same region in species of *Myzine* and *Ammophila*; pleura without such striation; head and thorax, dark, doubtless black in life; the middle leg seems to have been black as far as the beginning of the apical third of the femur, or thereabouts, and beyond that yellow or red; apex of first discoidal cell about as in modern *Vespa*, but narrow; marginal cell much more pointed than in the modern forms, but venation otherwise normal; abdomen missing. Lateral ocellus about $270\ \mu$ broad, and 300 from eye; width of marginal cell about $900\ \mu$; of oblique nervure terminating first discoidal, $225\ \mu$.

Type.—No. 2027, Mus. Comp. Zoöl. Florissant, Col. (No. 9065, S. H. Scudder Coll.).

No. 7738, S. H. Scudder Coll., badly preserved, appears to be a second example of *P. scudderi*, as it shows well the striation of the prothoracic lobes; a feature which is not to be seen in any of the specimens of *P. gillettei*, though it may not really be absent. This specimen has the abdomen, and indicates that *P. scudderi* was about 18 mm. long. The hind margins of the last two abdominal segments were broadly light (probably also the two before these), and the light color (no doubt yellow in life) sent a rounded lobe upwards on each side of the last segment, these markings being of the same type as in modern *Vespa*. The antennae are normal.

Palaeovespa gillettei, sp. nov.

Length about $14\frac{1}{2}$ mm.; of anterior wing about 10 mm., with the nervures more delicate than those of *P. scudderi*; breadth between wings slightly over 4 mm., of abdomen 5; black, with indications on the mesothorax of what appear to have been two longitudinal yellow stripes; venation as in *P. scudderi*, with the same sharply pointed marginal cell; length of first discoidal a little over 5 mm.; width of marginal cell $600\ \mu$. The abdomen is not so broad basally as in modern *Vespa*; it is nearly parallel-sided, with the broadest part beyond the middle. The species is allied to *P. scudderi*, but smaller in every way, with more delicate venation.

Type.—No. 2028, Mus. Comp. Zoöl. Florissant, Col. (No. 16,325, S. H. Scudder Coll.). No. 2029, M. C. Z. (No. 11,920, S. H. Scudder Coll.), No. 5986, S. H. Scudder Coll., and No. 2030, M. C. Z. (No. 14,305, S. H. Scudder Coll.) are also *Palaeovespa*, and presumably the present species, but they do not show the venation so well. The first two show very distinctly

two light lines or narrow bars on mesothorax, not reaching the anterior or posterior margins, and 5986 also shows a narrow light anterolateral margin, probably really on the prothorax, as is common in living forms. The antennae appear to be as in *Vespa*. Nos. 2031, 2032, M. C. Z. (Nos. 18,382 and 7868, S. H. Scudder Coll.), are two isolated anterior wings of *Palaeovespa*. They exhibit a good deal of difference in small details, but are, I think, certainly referable to *P. gillettei*. From them it is possible to ascertain several characters not clearly discernible in the type. Both show a dark cloud in the apical part of the costal cell, such as occurs in modern *Vespa*. The junction of b. n. to subcostal, which in the type is some 450 μ from base of stigma, is only about 300 from it in No. 18,362, and 345 in No. 8981, but it is difficult to say exactly where the basal n. leaves off, and where the stigma begins, the fusion being gradual. The size is throughout too small for *P. scudderi*. The following measurements are in μ :

	Length of second s. m. on marginal.	Length of third s. m. on marginal.
<i>P. scudderi</i> , Type No. 2027, M. C. Z.	450	825
No. 2032, M. C. Z.	345	675
No. 2031, M. C. Z.	225	675

	First r. n. from beginning of second s. m.	First r. n. (on cubital n.) from second r. n.	Second r. n. from end of second s. m.
<i>P. scudderi</i> , Type No. 2027, M. C. Z.	225	665 ?	375 ?
<i>P. gillettei</i> , Type No. 2028, M. C. Z.	?	?	225 ?
No. 2032, M. C. Z.	150	535	375
No. 2031, M. C. Z.	150	375	300
<i>Vespa</i> (modern)	195	240	750

P. gillettei is named after Professor C. P. Gillette, in recognition of his work on the entomology of Colorado.

EUMENIDAE.

Odynerus palaeophilus, sp. nov.

♀ Rather slender, length 9 mm., anterior wing 8 mm.; black, the wings dusky; first abdominal segment in lateral profile (*i. e.* seen from the side) presenting a curve which is uniform, not abruptly bent at any point, and is equal to about a quarter of a circle; abdomen broad and convex, with the apical part separated, doubtless originally marked off by a suture, as in some living forms; marginal cell very broad, in the form of an elongated triangle, the apex downwards; apex of first discoidal only moderately oblique (much less so than in a modern species compared); second submarginal cell narrowed almost to a point above, its length on marginal being only 60 μ , while its length on cubital nervure is 555 μ ; width of marginal cell, 600 μ ; width of third s. m. on marginal, 525 μ . It would be easy to misinterpret the venation of this insect (as also of the species of *Palaeovespa*), owing to the folding; but it is easily understood when compared with modern

examples similarly folded. This insect has the closest possible resemblance to a species still living in Colorado, but it differs in the venation in two respects: (1) the second submarginal cell is more contracted above, (2) the cubital nervure is abruptly bent at the end of the first discoidal cell, as in *Vespa*, whereas in the modern species it is straight.

Type. — No. 2033, Mus. Comp. Zoöl. Florissant, Col. (No. 10,657, S. H. Scudder Coll.)

Odynerus praeseputus, sp. nov.

♀ Black, apparently with two light longitudinal bars on mesothorax; length nearly 11 mm., head and thorax about 4 mm., anterior wing 7 mm.; wings folded, somewhat reddish; flagellum thick, (the end tapering, not clavate,) dark above, light below; abdomen sessile, second segment not swollen, dorsally or ventrally; in lateral profile, the dorsum of abdomen is gently curved, the venter nearly straight, no segment markedly different from the one before it. Stigma large, its width (short diameter) about 200 (this and other measurements in μ); marginal cell subtriangular, 1350 long, about 450 broad, narrowly obliquely truncate, the truncation about 150 broad; tip of marginal cell about level with apex of third s. m.; b. n. inserted at base of stigma, its upper section about 450 long; first s. m. 1425 long; stigma to insertion of first t. c., 450; second s. m. much narrowed above (150 long on marginal), and receiving both recurrent nervures; first r. n. from origin of first t. c., 250 (lower basal corner of second s. m. very acute); distance between insertion of first and second r. n., 300; cubital nervure not at all bent at end of first discoidal; insertion of second r. n. to origin of second t. c., 105; lower margin of third s. m., 600; third s. m. on marginal, 450; insertion of third t. c. to apex of marginal cell, 450.

Type. — No. 2034, Mus., Comp. Zoöl. Florissant, Col. (No. 11,944, S. H. Scudder Coll.). This is readily known from *Palaeovespa* by (1) marginal cell obliquely truncate at end, the tip not on costa; (2) cubital nervure not at all bent at end of first discoidal, (3) b. n. originating at base of the very large stigma. It appears to be one of the Eumenidae, the venation agreeing with that group better than with the Vespidae. Among the Eumenidae, from the venation and structure of the abdomen, it can go only in Odynerini, and it is referred to *Odynerus* in the old, broad sense. The modern genera of Odynerini are separated mainly on characters which are not discernible in the fossil.

ICHNEUMONOIDEA.

STEPHANIDAE.

Protostephanus, gen. nov.

Head rounded or subquadrate, rugose or tuberculate; prothorax broad but produced, with a median longitudinal groove, and fine lateral oblique striae; abdomen sessile; hind coxae elongated, about $\frac{2}{3}$ the length of their femora; hind femora moderately stout, not toothed; stigma rather large; costal cell very distinct; terminal part of subcostal nervure, for a distance nearly equal to the length

of the stigma, much thickened and appearing black; marginal cell long and quite narrow; b. n. strongly bent at beginning of cubital nervure; t. m. opposite b. n., the latter very slightly more basad; only one s. m., which is considerably broader than the first discoidal; first r. n. meeting first t. c., which is continued in a straight line with it, making, with the cubital nervure, a large \times . This interesting genus differs from those hitherto known by the combination of an elongated prothorax, unarmed hind femora, and sessile abdomen.

Protostephanus ashmeadi, sp. nov.

Length about $9\frac{1}{2}$ mm.; anterior wings clear, with brassy iridescence still showing, their length about 6 mm.; hind coxae transversely striate; hind tibiae claviform, swollen apically, the hind tibiae and tarsi about as long as hind coxae and femora, but the tibiae somewhat longer than the femora; pleura finely striate; measurements in μ :—width of head about 1500; length of thorax anterior to wings about 1200; length of hind coxae about 1200; width of hind tibiae at apex about 450; breadth of hind femora about the same; extension of abdomen beyond apex of hind femora perhaps 1500; breadth of stigma about 180; breadth of marginal cell about 300; length of first (and only) s. m. 975; length of first discoidal, 900; length of the quadrate second discoidal about 795; length of t. m. not quite 300; length of second section of b. n. (bounding first discoidal) about 450.

Type.—No. 2035, Mus. Comp. Zool. Florissant, Col. (No. 13913, S. H. Scudder Coll.). Named after Mr. W. H. Ashmead, whose writings were most useful in determining the affinities of the insect.