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THE NORTH AMERICAN CLEAR-WING MOTHS OF THE FAMILY AEGERIIDAE

BY
GEORGE P. ENGELHARDT

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The present work forms No. 190 of the *Bulletin* series.

ALEXANDER WETMORE,
Secretary, Smithsonian Institution.

FOREWORD

George Paul Engelhardt (1871–1942) devoted most of his life to nature studies, but his chief entomological interest for over 40 years was the lepidopterous family Aegeriidae. His approach to the study of this group was that of the field biologist and began with rearings of local species in the neighborhood of Brooklyn, N. Y. Thereafter, as he built his extensive collection, he followed through with biological and ecological studies and made trips to the several sections of the United States, Alaska, Europe, Central America, and British Columbia, collecting and rearing from larvae and observing the behavior and peculiar habits of the species of these regions. He thereby got an accurate and comprehensive biological picture of the American aegeriid fauna, discovered many new life histories, and was able to establish the more intimate relationships of several supposedly different species through their host-plant associations and the discovery of intergrading forms. His final objective was a monograph of the American Aegeriidae and a reclassification of that group upon the basis of structural characters coordinated with biological habits and host associations. This objective was only partially realized, for he died before he could prepare more than the preliminary draft of his manuscript.

For many years close collaboration existed between Mr. Engelhardt and the lepidopterists of the Bureau of Entomology and Plant Quarantine, whose headquarters are at the United States National Museum. His collection and manuscripts were willed to the National Museum, and it was his hope that that institution would publish his work. During the years 1939, 1940, and 1941, Mr. Engelhardt spent his winters at Washington working out, in collaboration with August Busck, the generic classification and incorporating the genitalic characters of the moths into a revised classification. At Mr. Busck's suggestion, drawings of male and female genitalia were made by Mrs. Mary F. Benson, of the Bureau of Entomology and Plant Quarantine, for the proposed paper. Mr. Engelhardt had planned his work on broad lines and had hoped to include larval and pupal characters in the definitions of categories but as the immature stages of several of the genera were still unknown this was not feasible; so at his request I prepared a short description of the larval and pupal characters of the family.

When the manuscript was examined after Mr. Engelhardt's death it was found to be substantially complete for the treatment of the species and their genera, but, as stated above, it was only a preliminary draft, with no introduction and no general discussion of the biology or previous systematic treatments of the group as a whole. The manuscript also required

considerable work to put it into form suitable for Museum publication, and this was undertaken by Mr. Busck, who was thoroughly acquainted with Mr. Engelhardt's intentions, scheme of classification, and method of description. He completed this task for his friend and colleague shortly before his own death on March 7, 1944. Since no one but the author could have supplied the proper introduction, no attempt was made to prepare one.

Thanks to the generous support of Edith F. B. Engelhardt, wife of George P. Engelhardt, and of George Bliss Engelhardt, his son, it has been possible to publish the 16 plates of colored figures which Mr. Engelhardt had hoped to have included with his text. Mrs. Engelhardt and her son have borne the entire cost of engraving and printing these colored plates. The drawings for them were done for Mr. Engelhardt by Mrs. William Beutenmüller and Mrs. Mary F. Benson, Mrs. Beutenmüller drawing figures 127, 128, 129, 142, 143, 144, 145, 146, 148, 150, 151, 155, 156, 160, 161, 162, 166, 171, 177, 180, and 186 and Mrs. Benson the remainder.

The publication of the manuscript is timely and appropriate. The family contains more than a dozen American species of considerable economic importance, these being known to the orchardist, gardener, and forester under the names peachtree borer, persimmon borer, strawberry crown moth, grapevine root borer, maple bark borer, ash tree borer, hornet moth, squash borer, etc. Their food plants include many kinds of cultivated fruits, shade and forest trees, as well as wild species, and the widespread damage inflicted by their larvae has long been the serious concern of economic entomologists. As a group these moths have for some time stood in need of the revision and nomenclatorial clarification that this work supplies. The paper will be equally useful to the student, the collector, the field naturalist, the economic entomologist, and the systematic lepidopterist.

Carl Heinrich.

CONTENTS

THE NORTH AMERICAN CLEAR-WING MOTHS OF THE FAMILY AEGERIIDAE

By George P. Engelhardt

DEFINITION AND CLASSIFICATION

The moths of the family Aegeriidae, the so-called clearwings ("Glasflügler"), are normally easily recognized by their general habitus, the narrow, mostly hyaline wings, and the dilated antennae, tufted at tips, although these antennal characters do not hold for some of the genera (*Bembecia, Zenodoxus*). Superficially they can be confused only with the so-called bee moths of the genus *Haemorrhagia* and allies of the family Sphingidae or with the moths of the family Syntomidae, from both of which the Aegeriidae may at once be recognized by the very different venation and especially by the locking system between the forewings and hindwings,[1] described in the following diagnosis and not found outside the family.

Tongue normally well developed, strong, naked, spiraled, but in some genera aborted and not functional (*Euhagena, Penstemonia*).

Eyes rather small, smooth, not hairy.

Ocelli present.

Antenna one-half to four-fifths as long as forewing; in the numerically largest groups dilated from the middle to the tip, ending in a small hair tuft, but in *Bembecia* and *Zenodoxus* tapering toward apex and not tufted at tip; the male in all groups with bipectination of various length on underside and with sensory areas especially on outer half; upperside smoothly scaled; the females with simple, smooth antennae.

Face, head, and thorax normally smooth, but rough-haired in a few genera (*Euhagena*).

Labial palpus well developed, more or less curved upright or obliquely porrected; second joint smooth or with a more or less developed brush of varying length; terminal joint short, bluntly pointed, upright.

Maxillary palpi rudimentary.

Forewing normally partially hyaline, devoid of scales in certain areas; narrow-elongate, normally slightly dilated beyond middle, with bluntly pointed apex and well-marked anal angle; normally with 12 veins present, 7 and 8 stalked, but in some genera with only 11 veins, 7 and 8 coincident (*Calesesia*) or 10 and 11 fused; veins 2, 3, 4, 5, and 6 usually well separated and nearly parallel, but 2 and 3 stalked in *Zenodoxus* and 4 and 5 connate in *Signaphora;* 9 and 10 stalked in *Sylvora;* 1c absent; 1a entirely

[1] The one diagnostic character of the family.

and 1b partly absorbed in a narrow longitudinal, elastic, downward fold along the entire dorsal edge of the wing; this downward fold of the forewing fits into a similar narrow upward fold along the costal edge of the hindwing, both bearing a series of short, recurved spines, which interlock and help further to keep the wings together. This structure (fig. 1a) of the interlocking forewings and hindwings, first pointed out by Busck (Proc. Ent. Soc. Washington, vol. 11, p. 115, 1909), is diagnostic of the family Aegeriidae and is a most effective method of keeping the wings together.

In the hindwing, besides the specialized locking structure, the family has retained the well-developed frenulum, normally a single strong spine in both sexes, although occasionally females are found with a divided frenulum. The hindwing is narrow but usually broader than the forewing, with the costal edge straight, apex bluntly pointed, termen evenly rounded, and normally with an indentation at vein 1c. The obscuring of veins 7 and 8 by the costal fold, as shown by Busck (loc. cit.), has caused earlier workers to conclude in error that two veins were absent in the hindwing, veins 8 and 5 (Meyrick) or veins 8 and 4 (Hampson), but if the wings are softened and carefully denuded, all eight veins are found to be present. Vein 2 from well before angle of cell; 3 and 4 usually connate or stalked, but 3 separate and before angle of cell in *Paranthrene* and other genera and in *Melittia* nearer to 2 than to 4; 5 and 6 widely separated, parallel; 6 from upper angle of cell; 7 and 8 from base and partly obscured in the fold or sometimes 7 out of 6 (*Bembecia*); the three anal veins normally present and a partial fourth vein, stopping short between 1a and 1b, is often present. This vein has been given special attention by Spuler (Die Schmetterlinge Europas, vol. 2, p. 311, 1910), who designated it "B1" and considered it of generic value in the genus *Chamaesphecia* Spuler. From comparisons with hindwings of many other genera of the family this vein seems to be merely a remnant of the basal fork of vein 1b, which in some genera is clearly defined and in others shows the gradual separation and disintegration of the lower branch of the fork. This, however, requires more study, especially of the pupal wings. John Henry Comstock was the first to suggest that there actually may be four anal veins in some of the groups of Aegeriidae (*in* Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 221, 1901).

The abdomen in the North American genera of the family is not constricted at the base as it is in some exotic genera, only the genus *Podosesia* having it somewhat constricted. The abdomen is smooth and in the male is provided with a fan-shaped or wedge-shaped anal tuft; in several genera there are long hair pencils (*Sannina*) or scaled processes (*Alcathoe*) from the eighth segment.

The legs, especially the hind ones, are variously modified, smooth or hairy (*Conopia*), and sometimes tufted or spined at the tibial spurs. The

modifications, especially of the posterior tibial and first tarsal joints, are useful as generic characters; these joints are very long in *Podosesia,* and the first tarsal joint, normally smooth, is thickened with rough scales in some genera (*Alcathoe, Synanthedon*).

The male genitalia exhibit many modifications, not always easy of interpretation. In the genera that are considered the more primitive (*Bembecia* and *Aegeria*) the uncus is short, divided, and hairy at the tip, suggesting socii. In the higher forms (*Paranthrene* group) the uncus becomes more elongate, still divided at the tip and with lateral sociuslike hairy pads at tip. In the genera regarded as most highly developed (*Synanthedon* group) the uncus is fused with the tegumen and is developed at the apex into large backwardly curved flaring pads, thickly covered with characteristic forked hairs, and very suggestive of socii, so much so that they have repeatedly been considered as such (Busck, Proc. Ent. Soc. Washington, vol. 31, p. 135, pl. 7, 1929). It is, in fact, still debatable whether this structure represents uncus or socii or a combination of both, but in this treatise it will be designated uncus.

The gnathos is more or less well developed normally, especially in the higher forms (*Synanthedon* group) continued in a narrow, wirelike, undulating ventral plate supporting the underside of the bulging alimentary canal.

The anellus is normally a small (in *Bembecia* large), triangular or rectangular plate with two lateral processes, supporting the retractable tube surrounding the aedeagus.

The aedeagus is normally long, slender, straight or undulating, often with a bulbous base and with short spines on or near the tip; the apex sometimes furcate or swollen.

The cornuti are normally present as short, often paired, thorns, but in some species merely as granulation.

The vinculum is long or short, strongly sclerotized, sometimes broadened and furcate at tip.

The harpes in the more primitive genera (*Aegeria*) are short and stubby, more or less quadrangular, with strong bristles on end near the edges. In the higher genera (*Paranthrene* group) the harpes are more elongate, rounded, with edges long-haired or spined, sometimes with forked spines on costal edge and on sacculus. These hairs are triforked or multiforked in contrast to those of the *Synanthedon* group, which are always bifurcate. In the highest groups (*Synanthedon* and allies) the harpes are elongate-ovate, sometimes with pointed apices, and the costal and terminal half is thickly covered with characteristic forked spines, similar to those on the uncus; these spines are shortly bifurcate and blackened in the cleft; sacculus with a more or less naked basal area, bordered costally by an oblique ridge (here designated "sacculus ridge") with prominent scales or thorns of various forms; the modifications of this

armature in different, definite arrangements are constant within the species and furnish excellent diagnostic specific characters and, in our opinion, also dependable generic characters.

The female genitalia have a simple, more or less cup-shaped ostium; the ductus is short, sometimes sclerotized on the terminal part; the bursa is normally simple, oval, thin-walled, and without signum, but in the *Paranthrene* group there are fine transverse wrinkled circles around the bursa, and in some forms of this group each wrinkle is slightly more sclerotized in a small dot; the longitudinal line of these dots constitutes a faint signum; in *Signaphora* there is a definite signum consisting of a single strong, short spine.

The pupa has transverse rows of spines on the dorsum of the abdomen, double rows on segments 2 to 6, inclusive, of the female and on segments 2 to 7 of the male; the female has one row on segment 7, and both sexes have single rows on segments 8, 9, and 10; the spines on abdominal segment 10 are broad, and the row extends nearly to the ventromeson. Maxillary palpi present. Wings narrow and pointed. Cremaster absent. Large spines always present on venter of tenth abdominal segment. Pupation normally takes place within the larval burrow.

The larvae are ivory white and without body markings except for some yellow or yellowish-brown shadings on the thoracic shield; cylindrical and tapering somewhat abruptly caudally; intersegmental incisions deep; thoracic segments more or less enlarged. Body and head with primary setae only. Body setae inconspicuous, pale, short; three setae on prespiracular shield of prothorax; setae IV and V approximate, on a single pinaculum and situated under the spiracle on proleg-bearing abdominal segments; setal group VIII bisetose on first abdominal segment, trisetose and arranged in a transverse line on second abdominal segment and unisetose on ninth abdominal segment; seta IIc of prothorax lying between Ib and Ic and closer to them than to IIb; all setae on ninth abdominal segment arranged in a transverse row, seta V much reduced and usually approximate to III and remote from IV; seta VI frequently reduced, sometimes absent, on ninth abdominal segment. Sclerotized areas about body tubercles very weakly pigmented, inconspicuous. Thoracic legs short. Prolegs of the normal number, but short; crochets uniordinal and arranged in two transverse bands, sometimes (*Bembecia, Melittia*) very small and weak. Spiracle on eighth abdominal segment located very high (subdorsally or dorsally) on segment, considerably larger than other abdominal spiracles. Anal fork absent.

Larval head appreciably smaller than prothorax; epicranium with incision of dorsal hindmargin deep and with posterior lobes produced and rounded; adfrontal sutures reaching to or very nearly to incision of dorsal hind margin; longitudinal ridge short. Ocelli 1, 2, 3, and 4 grouped together, trapezoidally arranged and remote from ocelli 5 and 6. Head

seta A_2 much closer to A_1 than to A_3; posterior seta P_1 on or very near the level of Adf_2; setae of anterior, ocellar, subocellar, and lateral groups crowded well forward on head.

The aegeriid larvae are all borers in the trunks, bark, stems, or roots of trees, shrubs, or vines, or in the stems or roots of herbaceous plants. A few are inquiline borers in galls on trees or shrubs. None is known to attack any of the grasses. They are easily distinguished by the peculiar arrangements of their ocelli and crochets from other lepidopterous borers having three setae on prespiracular shield of prothorax and setae IV and V approximate to each other on the first eight abdominal segments. A similar arrangement of crochets occurs in some Cossidae (notably *Cossula*), but there the ocellar grouping is different.

Based on the aforementioned adult characters and especially those of the antennae, venation, and genitalia, the family Aegeriidae falls first into two main divisions, which might well be considered of subfamily rank. The one to which the great majority of genera belong has a club-shaped antenna with the apex ending in a minute hair tuft, whereas in the other the antenna tapers toward the apex and does not end in a tuft. The former division falls, both on venation and genitalia, into the following groups, beginning with what we consider the highest forms: The *Synanthedon* group, consisting of 14 genera, and the *Paranthrene* group, consisting of 5 genera, both groups derivable from forms similar to *Aegeria*. Besides these large groups there are found single genera with possibly the same origin but highly developed along separate, diverging lines; such are *Cissuvora*, *Signaphora*, and *Calasesia*. Finally there is *Melittia*, an early separation from the *Aegeria* group. In the other main division fall *Bembecia* and *Zenodoxus*, which otherwise are not closely correlated.

These nine concepts may be separated by the following synoptic table based on the genitalia and antennae:

KEY TO GROUPS OF AEGERIIDAE BASED ON ANTENNAE AND MALE GENITALIA

1. Antenna dilated toward apex, ending in minute tuft 2
   Antenna tapering toward apex, tip without tuft 8
2. Uncus large, flaring, soft lobes with bifurcate hairs ..... **Synanthedon** group
   Uncus without bifurcate hairs 3
3. Harpe long, elongate-ovate 4
   Harpe short, angular 5
4. Harpe with apex produced or angular ..... **Melittia** group
   Harpe with apex rounded ..... **Paranthrene** group
5. Harpe with triforked or multiforked hairs ..... **Cissuvora** group
   Harpe with undivided hairs or spines 6
6. Uncus and gnathos divided at apex ..... **Aegeria** group
   Uncus and gnathos not divided at apex 7
7. Gnathos inverted-spoon-shaped, harpes with heavy armature ..... **Calasesia** group
   Gnathos pointed harpe without heavy spining ..... **Signaphora** group
8. Uncus divided into 2 short hairy papillae ..... **Bembecia** group
   Uncus not divided ..... **Zenodoxus** group

KEY TO NORTH AMERICAN GENERA OF AEGERIIDAE

1. Antenna dilated toward tip, ending in minute tuft 2
   Antenna tapering toward tip; tip not tufted 25
2. Hindwing with vein 3 nearer to 2 than to 4 ..... **Melittia** Hübner
   Hindwing with vein 3 nearer to 4 than to 2 3
3. Forewing with vein 7 stalked to termen 4
   Forewing with vein 7 stalked to costa or apex 5
4. Forewing with vein 9 out of stalk of 7 and 8 ..... **Cissuvora,** new genus
   Forewing with vein 9 separate ..... **Aegeria** Fabricius
5. Forewing with veins 7 and 8 coincident ..... **Calasesia** Beutenmüller
   Forewing with veins 7 and 8 stalked 6
6. Forewing with veins 4 and 5 connate ..... **Signaphora,** new genus
   Forewing with veins 4 and 5 well separated, parallel 7
7. Hindwing with veins 3 and 4 well separated 8
   Hindwing with veins 3 and 4 closely approximate, connate or stalked 9
8. Hindwing with vein 1c broadly and heavily scaled ..... **Vitacea,** new genus
   Hindwing with vein 1c normally scaled ..... **Paranthrene** Hübner
9. Hindwing with veins 3 and 4 closely approximate, but separate.
   Albuna Hy. Edwards
   Hindwing with veins 3 and 4 connate or stalked 10
10. Tongue rudimentary 11
    Tongue well developed, spiraled 13
11. Face, head, and thorax long-haired ..... **Euhagena** Hy. Edwards
    Face, head, and thorax normally scaled 12
12. Forewing with veins 10 and 11 separate ..... **Gaëa** Beutenmüller
    Forewing with veins 10 and 11 confluent at tip ..... **Penstemonia,** new genus
13. Posterior tibia and first tarsal joint very long ..... **Podosesia** Möschler
    Posterior tibia and first tarsal joint of normal length 14
14. Forewing with veins 10 and 11 coincident throughout 15
    Forewing with veins 10 and 11 separate, stalked or confluent at tip 17
15. Posterior first tarsal joint heavily thickened above with rough scales.
    Alcathoe Hy. Edwards
    Posterior first tarsal joint not thickened 16
16. Posterior tibia rough scaled ..... **Hymenoclea,** new genus
    Posterior tibia smooth with stiff hairs at spurs.
    Carmenta Hy. Edwards (in part)
17. Forewing with veins 10 and 11 well separated, parallel 18
    Forewing with veins 10 and 11 closely approximate, stalked or confluent at tip 23
18. Posterior first tarsal joint thickened with rough scales above 19
    Posterior first tarsal joint not thickened, smooth 20
19. Abdomen with long hair pencils, 5 in male, 2 in female ..... **Sannina** Walker
    Abdomen without such hair pencils ..... **Synanthedon** Hübner
20. Posterior tibia smooth or nearly so with stiff scales at spurs.
    Thamnosphecia Spuler
    Posterior tibia rough scaled above 21
21. Posterior tibia rough scaled throughout 22
    Posterior tibia rough scaled only on upper half ..... **Sanninoidea** Beutenmüller
22. Labial palpus with second joint nearly smooth ..... **Conopia** Hübner
    Labial palpus with well-developed rough brush ..... **Vespamima** Beutenmüller
23. Forewing with veins 10 and 11 stalked at base ..... **Sylvora,** new genus
    Forewing with veins 10 and 11 confluent at tip 24

24. Labial palpus with a short, nearly smooth brush.
Carmenta Hy. Edwards (in part)
Labial palpus with a strong, uneven brush.....**Ramosia**, new genus
25. Forewing with veins 7 and 8 stalked, 1 dorsal vein absent.....**Bembecia** Hübner
Forewing with veins 7 and 8 separate; all veins present.
Zenodoxus Grote and Robinson

THE SYNANTHEDON GROUP

Male and female genitalia.—Uncus, large flaring lobes more or less turned backward over the termen, thickly clothed with characteristically long, thick spines with shortly bifurcated tips and blackened in the cleft. Gnathos broadly emitted from tegumen, weakly sclerotized, cup-shaped; from it a long, thin, wirelike, undulating, ventral plate, supporting the underside of the bulgy alimentary canal. Anellus a small triangular or quadrangular plate with two lateral processes, supporting the retractable tube surrounding the aedeagus. Aedeagus long, slender, often with bulbous base and with short spines on or near the tip, which in some forms is furcate. Cornuti normally short, often paired thorns, but in some genera merely represented as fine granulation. Vinculum long or short, strongly sclerotized, sometimes broadened or slightly furcate at tip. Harpe elongate ovate, apex sometimes bluntly pointed; costal and terminal half thickly covered with characteristic biforked spines, similar to those on uncus; sacculus with a more or less naked basal area, bordered costally by a ridge, the "sacculus ridge" with prominent scales or spines of diverse form; the modifications of this armature constant within the species and, therefore, furnishing excellent specific characters. Female genitalia with simple, cup-shaped ostium, ductus short, in some genera sclerotized on terminal part; bursa simple, oval, thin-walled, without signum.

Genus SANNINA Walker

Sannina Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 63, 1856.—Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 242, 1901. (Genotype, *Sannina uroceriformis* Walker.)

Saunina Boisduval, Histoire naturelle des insectes: Species général des lépidoptères hétérocères, vol. 1, p. 465, 1874. (Misspelling.)

Sospita Hy. Edwards, Papilio, vol. 2, p. 56, 1882. (Genotype, *Aegeria quinquecaudata* Ridings.)

Phemonoe Hy. Edwards, Papilio, vol. 2, p. 97, 1882. (New name for *Sospita* Hy. Edwards, preoccupied.)

Tongue well developed, spiraled. Antenna a little more than half the length of the forewing, slender, moderately dilated toward the tip, tufted at tip; in male shortly and finely bipectinate; in female simple. Labial palpus upwardly curved, reaching the top of the head; second joint thickened with appressed, nearly smooth scaling; third joint shorter than second, bluntly pointed. Hindtibia and first tarsal joint thickened with rough scales above. Anal tuft of the male consisting of five long hair

pencils on segment 8, two lateral pairs and one anal; female with two shorter lateral hair pencils and anal tuft short, rounded. Forewing with 12 veins; 7 and 8 stalked; 7 to costa just above apex; 10 and 11 approximate but separate and parallel; 1b faint. Hindwing with 8 veins; 8 weak and obscured in the costal fold; 7 strong but also involved in the fold; 5 and 6 parallel; 6 to costal edge; 3 and 4 short-stalked. Male genitalia of the *Synanthedon* type; aedeagus long, straight, slightly bulbous at base, widened at outer third and there roughened and armed on one side with six to eight short stout spines; tip thinly sclerotized; cornuti, numerous minute spines; harpes pointed; sacculus sharply protruded at tip; sacculus ridge short, horizontal, sharply bent downward, with strong, flattened, forked spines, nearly reaching dorsal edge. Female genitalia with wide vase-shaped ostium; ductus strongly sclerotized and slightly curved on its terminal half; bursa small, oval, thin-walled, without signum.

The genus contains only the following species:

SANNINA UROCERIFORMIS Walker

PLATES 1, 4, 13, FIGURES 1, 28, 28a, 58

Sannina uroceriformis WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 64, 1856.—BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 242, 1901.—DYAR, U. S. Nat. Mus. Bull. 52, p. 365, No. 4172, 1902.—HOLLAND, The moth book, p. 382, 1903.—HERRICK, Can. Ent., vol. 39, p. 265, pl. 8, 1907.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8765, 1939.

Aegeria? quinque-caudata RIDINGS, Proc. Ent. Soc. Philadelphia, vol. 1, p. 277, 1862.

Saunina uroceripennis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 465, 1874.

Sospita quinquecaudata HY. EDWARDS, Papilio, vol. 2, p. 56, 1882.

Phemonoe quinquecaudata HY. EDWARDS, Papilio, vol. 2, p. 97, 1882.

Male.—Head and antennae blue-black. Labial palpus black, intermixed with orange at base of second joint. Collar orange. Thorax blue-black, patagia orange; underside and legs wholly blue-black. Abdomen blue-black, with segment 4 and sometimes segment 5 orange above; anal tuft and appendages black. Forewings opaque throughout, blue-black. Hindwings opaque, blue-black with small transparent areas between the veins basally. Underside of wings same as above.

Female.—Similar to the male, but with only two short anal hair pencils laterally above the short, rounded anal tuft.

Alar expanse: Male and female 28 to 32 mm.

Distribution.—Atlantic Coast and Gulf States from New Jersey to Texas, westward to Ohio, Indiana, Oklahoma, Missouri, and Kansas.

Food plant.—Diospyros virginiana.

Type.—Female, collected in the United States, without definite locality. In the British Museum.

Remarks.—This is the persimmon borer. In general, the insect follows the distribution of its food plant, the wild persimmon (*Diospyros virginiana*). It is found sparingly in New Jersey and Pennsylvania (Haimbach) and in Delaware (Frank M. Jones) and becomes increasingly numerous southward from Virginia. The moths are active fliers in sunshine but are not particularly attracted to flowers, although they hover about them in search of mates. Judged by their scanty representation in most collections they are captured only occasionally. In life and action the moths are perfect mimics of the black, red-banded wasp, *Lophopompilus atrox* (Dahlbom); also they bear a striking resemblance to the female of the peach borer, *Sanninoidea exitiosa*.

The life cycle covers 2 years, sometimes 3. In the South the time of emergence is April and May; in more temperate regions, June and July. The eggs are laid or dropped at the base of the trees, preferably young growth and saplings. Hedgerows and cutover woodlands are favorite places. The larvae are voracious feeders, tunneling downward into tap roots, 16 to 18 inches below the ground (Riley). On young shoots and saplings the injury causes wilting or breaking. Attacks on old trees are less serious.

The larvae, preceding pupation, prepare irregularly shaped cases of frass and chips extending outward and upward an inch or more, leaving access to their tunnels in the wood or root. On saplings the cases frequently are well above ground. This provides free movement for the pupa, which drops quickly down when disturbed and moves up into the case when safe. Heavy infestations have been encountered in Florida and Alabama. In Missouri, E. A. Brower obtained long series by breeding from pupae. He found it necessary to acquire wood sections containing galleries and pupal cases intact, as pupae, when extracted, rarely transform.

The injury caused to our own native persimmon, while serious, may not be considered as of prime economic importance. However, the insect may prove a serious menace to the growing development of the introduced Japanese persimmon, which is cultivated by grafting on native stock.

Control measures as practiced against the peachtree borer, *Sanninoidea exitiosa*, should apply.

Genus SANNINOIDEA Beutenmüller

Sanninoidea Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 126, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 265, 1901. (Genotype, *Aegeria exitiosa* Say.)

Tongue long, spiraled. Antenna three-fourths of length of forewing, moderately dilated to the tufted apex; in male with fine ciliation; in female simple. Labial palpus upturned to top of the face; second joint thickened with a short, nearly smooth brush; third joint short, blunt. Posterior tibia rough-scaled on upper half and tufted at spurs.

Venation: Forewing with veins 7 and 8 stalked; 7 to apex; 10 and 11 separate. Hindwing with veins 3 and 4 short-stalked. Abdomen slender; anal tuft of male long, wedge-shaped, of female short, blunt.

Male genitalia of the *Synanthedon* type; anellus with long, thin, lateral processes, aedeagus forked at tip; cornuti numerous; sacculus ridge with a slightly curved row of flat, forked scales. Female genitalia with ductus thickened for a short space beyond ostium; no signum.

Critical examination, based on ample material, shows no structural differences to justify specific separation of the forms and races of *Sanninoidea exitiosa* on the North American Continent. Structures, including venation and genitalia, conform, and differences in pattern and coloration indicate only races and variations of one species. There is so much overlapping that clean-cut divisions cannot be drawn.

SANNINOIDEA EXITIOSA EXITIOSA (Say)

PLATE 1, FIGURE 2; PLATE 4, FIGURES 29, 29a; PLATE 13, FIGURE 59

Aegeria exitiosa SAY, Journ. Acad. Nat. Sci. Philadelphia, vol. 3, p. 216, 1823.—BUTLER, Ann. Mag. Nat. Hist., ser. 4, vol. 14, p. 408, 1874.

Apis persica THOMAS, Amer. Farmer, vol. 6, No. 5, p. 37, 1824.

Paranthrene pepsidiformis HÜBNER, Zuträge zur Sammlung exotischer Schmetterlinge, vol. 3, p. 32, pl. 92, figs. 533, 534, 1825.

Aegeria persicae HARRIS, New England Farmer, vol. 5, p. 33, 1826.

Trochilium exitiosum FITCH, Third report on the noxious insects of the State of New York, 1856, p. 356, 1857.

Sesia xiphiaeformis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 409, 1874.

Aegeria xiphiaeformis HY. EDWARDS, Ent. Amer., vol. 3, p. 224, 1888.

Sanninoidea exitiosa BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 126, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 266, 1901.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8691, 1939.—SNAPP AND THOMPSON, U. S. Dept. Agr. Techn. Bull. 854, 1943.

Male.—Antennae black or blue-black, finely ciliate on inner sides. Palpi yellow beneath, black above. Head black, interspersed with yellow scales between the antennae and posterior parts. Collar yellow. Thorax black, with two longitudinal yellow stripes at wing base. Wings hyaline, nervures and margins blue-black; forewing with transverse mark and margins narrow. Legs black, with or without bluish reflections; posterior tibia narrowly banded yellow at the joints. Abdomen black, usually with steel blue or coppery reflections, with narrow, yellow bands on all segments or banded only in part, the markings on basal and fourth segments being most dependable; anal tuft hastated or wedge-shaped, edged with white at the sides.

Female.—Antennae, palpi, head, thorax, and legs black, violaceous. Abdomen metallic black with the fourth segment orange above and beneath. Forewing entirely opalescent, black, violaceous. Hindwing

transparent, heavily scaled at costal margin; outer margin and fringes black, violaceous.

Expanse: Male, 18 to 30 mm.; female, 23 to 32 mm.

Distribution.—Canada, United States east of Rocky Mountains.

Type.—Lost.

Remarks.—Regarded as of principal economic importance among the species of the Aegeriidae, the peachtree borer has been the subject of so many investigations that it would call for many pages merely to cite the published titles, but this is beyond the scope of the present revision of the family. *Sanninoidea exitiosa* is a North American insect, occurring in a number of varieties and geographical races. Its economic importance is based on the habits of the larvae, which are borers; originally the species developed in wild species of the *Prunus* family, such as the cherry and plum, but subsequently and since the introduction of peach and other stone fruits, perhaps 200 years ago, it has transferred its attacks very largely to trees under cultivation, causing enormous injury. Attacks are confined to the base of the tree and to the roots at or below the surface.

The time of emergence of the imagoes varies in different parts of the continent. Along the coast of Connecticut, New York, and New Jersey it is from early in June through July; inland and northward progressively later, from July to September. Southward to Florida and the Gulf States, earlier emergences might be expected, but contrary results have been recorded. Inspection of orchard trees in Florida in April and May revealed mostly immature larvae, half grown or smaller. From Fort Valley, Ga., O. F. Snapp reports 75 percent of the moths as emerging in September, some during August, others in October, and one record as late as November 8. The life cycle is 1 year in length, occasionally perhaps overlapping into a second year. Wintering always occurs in the larval state in the burrow. The moths are day fliers, often attracted to flowers. Sexually the moths are remarkably fine examples of dimorphism and of mimicry.

From the Mississippi Valley westward the males exhibit a gradual broadening of the outer margins on the primaries, and the abdominal segments always are all narrowly banded with pale yellow; they finally merge with the race *barnesii* of Colorado. The females run true to type.

S. exitiosa apparently has followed the extension of peach cultivation westward to the Rocky Mountains. Minor variations indicate response to climatic changes and probably interbreeding with western races.

SANNINOIDEA EXITIOSA form FITCHII (Hy. Edwards)

Aegeria exitiosa var. *fitchii* Hy. Edwards, Papilio, vol. 2. p. 55, 1882.

Sanninoidea exitiosa var. *fitchii* Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 126, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 269, 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8691, 1939.

Female.—Like the typical *exitiosa* but with the hindwing heavily scaled between the space of the two inner veins, dividing the clear area into two parts. This variation occurs more or less throughout the range of the species.

Type.—Female. In the American Museum of Natural History.

SANNINOIDEA EXITIOSA form EDWARDSII Beutenmüller

Sanninoidea exitiosa var. *edwardsii* BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 12, p. 160, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 269, 1901.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8691, 1939.

Female.—Like the type form with abdominal segments 4 and 5 orange and the space between the two inner veins of the hindwing more or less covered with scales.

Type.—Female. In the American Museum of Natural History.

Remarks.—This variation replaces or nearly replaces the normal form of the species northward, in western New York and Canada. Otherwise, the variation is found occasionally only.

SANNINOIDEA EXITIOSA form LUMINOSA (Neumoegen)

Sannina exitiosa var. *luminosa* NEUMOEGEN, Ent. News, vol. 5, p. 331, 1894.

Sanninoidea exitiosa var. *luminosa* BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 126, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 269, 1901.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8691, 1939.

Male.—In the original description, based on exceptionally fine, lustrous, newly reared examples, the author enthusiastically describes the golden metallic sheen of his specimens. These beautiful reflections, alas, have greatly dulled with time. The types retain the narrow golden-yellow bands on all the abdominal segments but otherwise agree with typical male examples of *exitiosa*.

Type.—Male, collected at Long Island, N. Y. In the United States National Museum.

SANNINOIDEA EXITIOSA race BARNESII Beutenmüller

Sanninoidea gracfi var. *barnesii* BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 272, 1901.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8693, 1939.

Male.—Like typical *exitiosa* but with the transverse mark and the outer wing margins much broadened, black, more or less intermixed with golden scales on transverse mark and on costa, above and beneath. The abdominal segments are all narrowly banded yellow. Unbanded examples have proved to be old and too greasy for redemption.

Female.—Like typical *exitiosa* with abdominal segment 4 orange, a character the forms *fitchii* and *edwardsii* lack. The primary wings appear

to be slightly more rounded at the apices. Their opacity is less dense, with indications of a broad transverse mark in a more or less suffused area. In size this race averages smaller and slenderer than *exitiosa*.

Expanse: 22 to 28 mm.

Distribution.—Rocky Mountains, Colo., 6,000 to 10,000 feet.

Type.—Female. In the United States National Museum.

Remarks.—*S. e. barnesii*, described by Beutenmüller as a variety of *Sanninoidea graefi* (Hy. Edwards), is here treated as a geographical race based on personal field investigations, supported by ample material in the collection of the United States National Museum. It is a race indigenous to Rocky Mountain regions at altitudes above peach-orchard cultivation. The males found associated with this race erroneously have been designated by Beutenmüller as the males of *Sanninoidea graefi* (Hy. Edwards).

SANNINOIDEA EXITIOSA race GRAEFI (Hy. Edwards)

PLATE 17, FIGURE 88

Sciapteron graefi HY. EDWARDS, Papilio, vol. 1, p. 183, 1881.
Aegeria opalescens HY. EDWARDS, Papilio, vol. 1, p. 199, 1881.
Sannina pacifica RILEY, Insect Life, vol. 3, p. 393, 1891.
Parharmonia graefi BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 89, 1894.
Sannina opalescens BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 366, 1894.
Sanninoidea opalescens BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 126, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 271, 1901.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8693, 1939.

Male.—Antennae black, finely ciliate, palpi, head thorax, and abdomen wholly black with metallic reflections, blue or green. Anal tuft wedge-shaped, sometimes narrowly bordered with white at the sides. Wings hyaline, forewing heavily scaled on costa; transverse mark and outer margins broad, black with metallic sheen. Legs black, tibiae with whitish tufts at the spurs.

Female.—Antennae black, simple. Palpi, head, thorax, abdomen, and legs wholly metallic black. Anal tuft short, blunt. Primary wings heavily scaled, nearly or quite obscuring the broad transverse mark.

Expanse: Male 25 to 30 mm.; female 26 to 32 mm.

Distribution.—Nevada, California, Oregon, Washington, Montana.

Type.—Female. In the United States National Museum.

Remarks.—Hy. Edwards's original description of *graefi*, short but adequate, is confined to the female, without mention of the sex. He had three specimens, one male and two females, all bearing identical labels, "Nev." (Morrison), which had been submitted by E. L. Graef. One female, labeled type, is in the United States National Museum; another, likewise labeled type, is in the American Museum of Natural History. A male type, so labeled, has not been found. However, the E. L. Graef collection, now in the United States National Museum, contains two addi-

tional males from the same lot ("Nev." [Morrison]). One of these bears Hy. Edwards's label "*Aegeria opalescens,* Type." Hence, there is no question about the examples that served him for description. The type of *Sannina pacifica* Riley, a female (Santa Clara County, Calif., June), is in the United States National Museum. In addition, good series covering the range of *graefii* are at hand. Compared with examples from Washington and Oregon, the primary wings become increasingly more opaque southward into California and Nevada. Northward from Oregon and Washington, females occasionally show indications of yellow bands on the fourth abdominal segment. On examples from Montana the bands have developed to about the full width of segment 4 and are dull yellow, not orange.

PENSTEMONIA, new genus

Genotype, *Aegeria edwardsii* Beutenmüller.

Tongue rudimentary. Labial palpus with a short, rough brush. Forewing with veins 10 and 11 confluent at tip, 7 stalked to apex; hindwing with veins 3 and 4 stalked. Posterior tibiae smooth, with tufts of stiff scales at spurs; posterior tarsi not thickened. Anal tuft of male fan-shaped; some specimens with a hair pencil on each side, longer than the tuft. Male genitalia having sacculus ridge with flat, forked scales terminating on edge; cornuti paired, strong, short spines. Female genitalia with ductus strongly sclerotized posteriorly; no signum.

The genus is close to *Carmenta* and *Ramosia,* differing mainly in the rudimentary tongue. All the species are root or stem borers in species of *Penstemon.*

PENSTEMONIA EDWARDSII (Beutenmüller)

PLATE 1, FIGURE 3; PLATE 4, FIGURES 30, 30a; PLATE 13, FIGURE 60; PLATE 17, FIGURES 89, 90

Aegeria edwardsii BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 92, 1894.
Sesia edwardsii BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 142, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 313, pl. 32, fig. 16, 1901.
Sesia utahensis BEUTENMÜLLER, Ent. News, vol. 20, p. 83, 1909 (female).
Synanthedon edwardsi MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8761, 1939.

Sexes dissimilar.

Male.—Antennae violaceous-black, strong, rather prominently dilating to the tips, pectinations well developed. Palpus white, third joint mixed with black, densest at tip and behind. Head black, orbits white. Collar whitish yellow. Thorax metallic black, patagia with a narrow pale-yellow stripe, metathorax tufted with long sordid-white hair at the sides; beneath with sordid-white patches before and at the wing base. Abdomen metallic black, with fourth and last segment broadly banded with sordid white above and beneath and segments 2, 5, and 6 narrowly banded with sordid

white beneath; anal tuft fan-shaped, usually folded, not spread, black above, beneath claspers and outer edge white. Coxae and femora of front legs white, of middle legs and hindlegs black; tibiae of hindlegs more white than black on anterior half, on posterior half black between the spurs, which are sordid white; tarsi black, sparsely mixed with white on first tarsal joint. Forewing opaque, dull black, heavily scaled on margins and veins, less so between the veins, a narrow pale-yellow patch before the obscured discal mark and a few yellow scales between the veins near apex and before the wing base; on the underside the yellow scaling heavier and the discal mark more distinct. Hindwing heavily shaded and very broadly margined with blackish scales, only the inner half remaining transparent; underside well shaded with yellow. Out of a long series of rearings only one dwarfed specimen has the hindwings nearly wholly transparent.

Female.—Antennae black. Palpus yellow, mixed with black scales on terminal joint. Head black mixed with tawny scales, face and collar yellow. Thorax purplish black, patagia edged with yellow on inner side and metathorax with yellow tufts and scales; underside yellow before and at the wing base. Abdomen black; segments 2, 4, and 6 broadly banded with bright yellow above and beneath and segment 5 yellow only beneath. Some examples also with a sprinkling of yellow scales on segments 1, 3, and 5. The anal tuft short, rounded, yellow and black in alternating stripes, the yellow predominating. Legs like those of the male but marked with bright yellow instead of sordid white. Wings wholly opaque in a streaked mixture of black and dull orange, the orange shadings mostly between the veins and most pronounced on the upper half of the forewing and before the wing base of the hindwing. On the underside the orange shading much heavier than on the upper side.

Throughout the range of the species the color is subject to much variation, particularly in the females. Examples from Arizona average darker, more black than orange, while others from Utah are more dull orange than black. This latter variation Beutenmüller described as a distinct species, *Sesia utahensis,* based on a single female. Long series, including numerous intergradations now available, prove *Sesia utahensis* to be a synonym of the present species.

Expanse: Male 18 to 20 mm., female 20 to 25 mm. A series of reared specimens from Arizona contains several males and females measuring only 13 to 15 mm.; they are dwarfs, not normal.

Distribution.—Arid canyon and mesa regions of southwestern Colorado and Utah, New Mexico, and Arizona.

Type.—Female. In American Museum of Natural History.

Remarks.—The type from Colorado is imperfect, and Beutenmüller's description and illustration are inaccurate in details. Not attracted to flowers because of an abortive tongue, the species has been collected rarely

until the recent discovery of the food plant, subsequent to which long series have been obtained by rearing, showing that it is common, at least locally. It is a root borer in various species of *Penstemon* but only in perennials of strong growth and rootstock. At maturity the larva tunnels up into the stalk a short distance above ground and pupates within the gallery without constructing a cocoon, thus permitting the pupa to move up or down at will. The larva prepares a circular exit, thinly covered by the outer plant epidermis. In hot, desert regions at low elevations the moths begin to emerge during May; at higher elevations in cooler climate, in June, July, and August. A hundred or more specimens of both sexes in about equal numbers were reared from *Penstemon centranthifolius,* Oak Creek Canyon (near Flagstaff), Ariz., June-July 1936, and from *P. parryi,* Box Canyon, Santa Rita, and Pima Mountains, Ariz., May to July 1936. Large roots may harbor six or more individuals. Lack of breeding facilities alone limited the number of specimens obtained. In addition, the larval work was observed at Mesa Verde, Colo., on *Penstemon strictus* and *P. unilateralis;* at Desert Arboretum, Superior, Ariz., on *P. eatonii;* and in Provo Canyon, Utah, on *P. unilateralis.* Records of captured specimens in the United States National Museum are one female, Prescott, Ariz., July 1–7, 1917 (Dyar); one female (*Sesia utahensis,* type), Bellevue, Washington County, Utah, June 1904 (Engelhardt); and one female (*S. utahensis*), Hualpai Mountains, Mohave, Ariz., May 24, 1931 (Barnes collection).

The discovery of the food plant and habits of *edwardsii* in 1936 led to more extensive field investigations in California and other Pacific coast regions, which so far have resulted in the discovery of four additional species not heretofore recognized, all closely related in structures, as well as in habits. This line of investigation has by no means been completed. Vast regions in the Pacific Northwest, in the Rocky Mountains, and in northern Mexico remain untouched. Undoubtedly several new species belonging in *Penstemonia* await discovery.

PENSTEMONIA HENNEI, new species

PLATE 17, FIGURES 91, 92

Sexes dissimilar.

Male.—Antennae black, pectinations fine. Labial palpus white, black at tip. Head black, orbit white. Collar sordid white, mixed with yellow. Thorax violaceous-black; patagia with a pale-yellow stripe, broadening at metathorax, which is tufted with long, fine, whitish hairs on the sides; prothorax with a small patch of flat yellow scales at the sides. Abdomen black with bluish reflections, segments 4 and 8 broadly banded with sordid white above, segments 1, 2, 4, and 5 edged with sordid white at the sides and beneath and segment 7 sordid white only at the sides; anal tuft fan-shaped, black above, beneath white at the sides; claspers dull yellow.

Femora of forelegs shiny white on outer side and black on inner side, of middle legs and hindlegs mixed black and white; tibiae of hindlegs bluish black, broadly banded sordid white before and behind the anterior spurs; first tarsal joint black, slightly mixed with white, posterior joints black. Forewing with narrow ochreous areas before and behind the large square, black discal mark; costa and broad outer margins black and a mixture of black-and-white scales between the veins; beneath shaded heavier with whitish scales than above. Hindwing transparent, veins and narrow margins black, fringes dull black.

Female.—Antennae black, annulated with yellow scales on undersides toward the base. Labial palpi bright yellow. Head above heavily scaled with black, mixed with yellow in front and at the sides; face smooth, lustrous yellow. Collar stiff-haired, bright yellow. Thorax violaceous-black; patagia prominently striped and metathorax transversely fringed with bright yellow; prothorax with a bright-yellow patch before and beneath the wing base. Abdomen violaceous-black, segments 2, 3, 5, and 6 broadly banded with bright yellow above and all segments beneath and at the sides banded with pale yellow; anal tuft narrow, rounded at tip, black and yellow. Femora of forelegs pale yellow; femora of hindlegs blackish, slightly sprinkled yellow; tibiae bright yellow, black before and at the lower spurs; first tarsal joint yellow, posterior joints black, slightly dusted with yellow. Forewing nearly opaque; before and behind the large, square, black, discal mark, narrow areas thinly dusted with yellow scales and a heavier yellow dusting between the veins at the broad, black, outer margins; only a very thin streak between the veins before the lower wing base remaining transparent; beneath yellow, except for the discal mark, costa, and outer margin. Hindwing transparent, outer margins black, broader than in the male, fringes dull black.

Expanse: Male 18 mm., female 18 to 20 mm.

Type.—U.S.N.M. No. 56822. Holotype male, allotype female, two male and three female paratypes. Collected in San Bernardino County, Calif.

Remarks.—To C. Henne, of Pasadena, Calif., is due the credit for first recording the food plant and for rearing moths of this *Penstemon* borer. It is a satisfaction to perpetuate his discovery by naming the species for him. The host plant, *Penstemon spectabilis,* as indicated in the name, is one of the showiest of the many beautiful species included in the genus. Where well colonized the plants set ablaze with rose, purple, and lilac the steep slopes on hills and in canyons of the Sierras in California. This borer is found in the crown roots and lower stems of the plants. The larvae, although nearly full grown early in summer, do not transform to pupae until late in July and in August. Hence, to assure successful breeding, plant cuttings should not be collected until about that time. From large roots several adults may emerge. The change to pupa takes place within

the larval gallery without the construction of a cocoon, permitting movement down to the root or up into the stem to a prepared exit hole, thinly covered by the outer plant skin. Liberal accumulations of small, pale pellets around the bases of plants serve to indicate the presence of feeding larvae. In breeding cages, most likely because of disturbances, the larva is apt to construct a soft tube of silk and sand grains extruding an inch, more or less, above the exit hole; this apparently does not occur under normal conditions out of doors. The species is annual.

The holotype and allotype specimens are labeled Mill Creek, San Bernardino County, Calif., August 28 and September 2, 1938 (C. Henne). Since the food plant and the habits are known, a larger representation of the species can be expected before long.

PENSTEMONIA CLARKEI, new species

PLATE 17, FIGURES 93, 94

Sexes similar.

Male.—Antennae black. Labial palpus yellow, on upper half of second and third joint sparsely mixed with black. Head black, face glossy yellow. Collar bright yellow, slightly mixed with black at the sides. Thorax violaceous-black, patagia narrowly edged with yellow on the inner sides and a yellow mark in front and beneath the base of forewing. Abdomen violaceous-black, segment 1 narrowly and segment 2 broadly edged with yellow, segments 4, 6, and 7 wholly yellow; underside of all segments yellow, except 3, which is black; anal tuft narrowly fan-shaped, black with yellow center, beneath yellow, thinly streaked with black. Femora of forelegs bright yellow; femora of hindlegs lustrous black; tibiae yellow, black between the spurs; tarsi yellow, slightly mixed with black on posterior joints. Forewing with costa, outer margin, veins, and large, square discal mark black; between the veins heavily washed with dull-yellow scales, leaving only small, more or less suffused, transparent areas before and behind the discal mark. Hindwing transparent, narrowly margined with black, fringes dull black; beneath the yellow suffusions heavier than above.

Female.—Like the male but body stouter. Abdomen broadly banded with bright yellow on segments 1, 2, 4, and 6 above and beneath on all segments, except segment 3, which is marked with yellow at the sides only. The short, blunt anal tuft black, with two yellow streaks in the middle.

Expanse: Male 20 to 22 mm., female 22 mm.

Distribution.—Pacific Coast States, intermountain regions, California, Oregon, Washington.

Type.—U.S.N.M. No. 56823. Collected at The Dalles, Oreg. Holotype male, allotype female, and 12 paratypes.

Remarks.—Named for J. F. Gates Clarke, well-known lepidopterist of the United States Bureau of Entomology and Plant Quarantine, who

recorded the first specimen reared from the roots of *Penstemon richardsonii,* collected at The Dalles, Columbia River, Oreg., August 1937. With this information it proved easy to obtain additional breeding material on a subsequent visit to The Dalles in 1938 (Engelhardt).

The food plant, ablaze with dark pink and red flowers, is conspicuous along the highway. Wherever the plant was well established the borers were found. They do not confine themselves to this particular plant, but also attack other perennial species of *Penstemon,* provided the rootstock is sufficiently strong to harbor the larvae.

To breeding records, as yet limited to Columbia River and Blue Mountain regions in Oregon, have been added the records of individual examples found, wrongly placed among other species, in the United States National Museum collection. These are one dwarfed male, Beaver Creek, Mont., 6,300 feet, August 1913 (S. J. Hunter); one male, Boulder Creek, Calif., July 18, 1932; one male, San Diego County, Calif., August 7, 1935 (R. H. Beamer); and one female, Sonoma County, Calif. (Barnes collection). The larvae, before pupating, construct a firm, silk-lined, oval cocoon of frass and chips. The moths emerge from late in July to early in September.

PENSTEMONIA DAMMERSI, new species

PLATE 18, FIGURES 95, 96

Sexes similar.

Male.—Antennae black. Labial palpus yellow, mixed with black at the tip. Head violaceous-black, face glossly blue-black. Collar yellow. Thorax violaceous-black, patagia striped and metathorax edged with yellow; a small yellow patch before and a large one beneath the wing base. Abdomen conspicuously banded with metallic black and bright yellow; segment 1 narrowly edged and segments 2, 4, 5, 6, and 7 broadly banded with yellow; segment 3 with a small yellow mark at the side; on the underside all segments except 3 dull yellow, with thin black transverse lines between some of the segments; segment 3 black; anal tuft short, black and yellow mixed, bearing two slender hair pencils, black above and yellow at the base beneath, which extend well beyond the tip of the abdomen. Forelegs with femora pale yellow, those of hindlegs bright yellow; and tibiae banded with black before posterior spurs; tarsi shaded coppery brown. Forewing heavily scaled, lustrous dark brown, slightly tinged with red on inner veins and margins and between the veins toward apex; a broad transparent area before and a narrow transparent area behind the large discal mark. Hindwing transparent with narrow coppery margins. Underside of forewings heavily tinged with yellow on basal half.

Female.—Similar to the male. Forewing a lighter shade of brown and beneath more dull yellow; transparent areas before and behind discal marks reduced. The black-and-yellow banding on abdominal segments more evenly divided; the short anal tuft yellow with a black streak at the

base and two slender, black hair pencils, one one each side, not extending beyond the tip of the abdomen.

Expanse: Male 20 to 24 mm., female 24 to 27 mm.

Distribution.—Southern California, Los Angeles, Riverside, San Bernardino, and Orange Counties in foothills and mountains.

Type.—U.S.N.M. No. 56824. Holotype male, allotype female, and 20 paratypes. Collected on Mount Wilson, Calif.

Remarks.—The first two female examples of this species, submitted by C. M. Dammers, of Riverside, Calif., in whose honor it is named, were collected in Commander Dammers's garden on *Penstemon* plants of heavy growth, July 12, 1935. During the season of 1936 (Engelhardt), good series of both sexes were obtained by rearing from the roots and lower stems of *Penstemon cordifolius,* which grows luxuriantly along the old toll road just below the observatory on the top of Mount Wilson. The plant, really a deciduous vine, climbs to considerable height over shrubs and on precipitous, rocky embankments. In midsummer the brilliant-red, trumpet-shaped flowers are a beautiful sight. Most of the plants showed evidence of borer work, recent or past. During July larvae were found in various stages of development. A 2-year life cycle is probable. This is not a rare species and is best obtained by rearing from root cuttings and stem section of the food plant, which usually is anchored in rocky crevices on steep embankments. Immature larvae, less than 25 mm. in length, failed to transform in the breeding cages. Fully grown larvae began to pupate from late in July to the middle of August. Emergence dates for specimens from Mount Wilson range from August 27 to September 13, 1936. Another smaller series reared by T. W. Hower in Orange County from the same species of *Penstemon* emerged August 27-29, 1939. The earlier record from Riverside, July 12, 1935, is explained by the lower altitude, 1,000 feet against 6,000 feet on Mount Wilson.

The larval tunnels extend several inches from the roots up into the stems. Before pupation a circular, thinly covered exit hole is prepared at the upper end of the tunnel, allowing up-and-down movement to the pupa.

With Commander Dammers as companion and guide, I worked out a number of life histories of aegeriid species in the environment of Riverside and more distant regions in California. Aegeriid larvae have been found in the yellow-flowering *Penstemon antirrhinoides* and the monkeyflower, *Diplacus aurantiacus.* Their identity is still a matter of speculation. A single worn specimen, labeled San Diego, Calif. (Riley), in the Hy. Edwards collection, American Museum of Natural History, was determined easily as a male of *dammersi* from the genitalia.

PENSTEMONIA BREVIFOLIA, new species

PLATE 18, FIGURES 97, 98

Sexes similar.

Male.—Antennae black. Labial palpi dull yellow. Head above deep black, face lustrous brownish black. Collar dull yellow. Thorax black. Patagia striped dull yellow; a patch of the same color before the wing base at the side and another near the wing base beneath. Abdomen metallic brown-black, segment 1 narrowly edged and segments 2 and 4 broadly banded with dull yellow; underside of all segments brown, narrowly edged with dull yellow, except segment 3, which is wholly brown; anal tuft short, yellow and brown, with two black hair pencils, one on each side, edged laterally with yellow and extending slightly beyond the abdominal tip. Legs dull yellow shaded with brown; posterior tibiae banded with brown before the second spurs; tarsi metallic dark brown. Forewing nearly opaque, lustrous light brown; a small, roundish, nearly suffused clear area before and a short, narrow nearly clear area behind the discal mark. Hindwing transparent, narrowly margined and fringed with dark brown. Beneath the wings are shaded slightly lighter than above.

Female.—Similar to the male. Forewing quite opaque, paler brown than in the male and with a small dull-yellow spot before the discal mark. Abdomen mostly dull yellow, only segments 1 and 3 metallic black above and at the sides; the other segments divided by thin black edges; beneath all segments dull yellow; anal tuft very short, yellow and with two short, blackish hair pencils, one on each side, not extending as far as the abdominal tip.

Expanse: Male 20 to 22 mm., female 21 to 24 mm.

Distribution.—Mountains of central and northern California, 2,000 to 5,000 feet.

Type.—U.S.N.M. No. 56825. Holotype male and allotype female; one male and one female paratypes. Collected in the Green Horn Mountains, Calif.

Remarks.—While closely related to *P. dammersi,* this species is easily recognized by the nearly opaque, brownish forewings of the male and the wholly opaque forewings of the female. *Penstemon breviflorus* and its near relatives, all hardy woody shrubs, have been known for some years as the food plants of this species, but rearing attempts were unsuccessful because root cuttings were collected too early in the season (Placerville, Eldorado County, 3,000 feet, May 1936, Keifer and Engelhardt). C. Henne had better results. He obtained his cuttings in midsummer in the Green Horn Mountains, Kern County, Calif., and the moths emerged August 12 to September 9, 1939. As far as known, no imagoes have ever been captured at large. It is a hazardous and strenuous job to cut out the tough, woody roots without injury to the borers.

RAMOSIA, new genus

Genotype, *Sesia bibionipennis* Boisduval.

Male antennae shortly ciliated; female antennae simple. Tongue present, spiraled. Labial palpus with a rather strong, uneven brush on second joint, third joint upright, smooth, hardly reaching vertex. Head and thorax smooth. Forewing with 12 veins; 7 and 8 stalked, 7 to apex or above, 10 and 11 confluent near the edge of the wing. Hindwing with 8 veins; 3 and 4 short-stalked, 7 and 8 concealed in costal fold. Posterior tibiae nearly smooth, with small tufts of stiff scales at spurs; first tarsal joint smooth, not thickened. Anal tuft fan-shaped. Male genitalia of the *Synanthedon* type; uncus large, covered with bifurcate hairs; tegumen curved; aedeagus long, slender, slightly bulbous at base; harpes elongate-ovate, costal and terminal half thickly clothed with bifurcate hairs, sacculus ridge with blunt, flat scales; vinculum rather short, bluntly pointed. Female genitalia with terminal part of ductus more or less sclerotized, bursa without signum.

The species in this group are outstandingly beautiful, lustrous black, yellow, and red, and they are remarkable for color variations. Early authors erected on too scant material species which prolonged field investigations and long series of reared examples prove to be only color varieties.

The group ranges from north Mexico to Alaska. Much more carefully labeled informative material is needed to conclude to what extent species, races, and variations are involved.

RAMOSIA POLYGONI (Hy. Edwards)

Pyrrhotaenia polygoni Hy. Edwards, Papilio, vol. 1, p. 202, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892; vol. 6, p. 95, 1894; vol. 8, p. 144, 1896.

Pyrrhotaenia achillae Hy. Edwards, Papilio, vol. 1, p. 203, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892; vol. 8, p. 144, 1896.

Pyrrhotaenia cremocarpi Hy. Edwards, Papilio, vol. 1, p. 203, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.

Sesia polygoni Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 308, pl. 32, figs. 8, 9, 1901.

Synanthedon polygoni McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8749, 1939.

Sexes dissimilar.

Male.—Antennae metallic black. Labial palpus red, black at the sides and on third joint. Head black. Collar black, mixed with red. Thorax lustrous green-black, patagia striped with red and a red mark at the sides, behind the collar. Abdomen lustrous green-black, segments 4, 6, and 7 red above and all segments red laterally; anal tuft fan-shaped, red in the center, black at the sides. Legs predominantly black, posterior tibiae red before and between the spurs, tarsi black.

Forewing opaque, lustrous green-black, streaked bright red on inner margin basally, fringes brownish, beneath dull red at the wing base. Hindwing transparent, veins and narrow margin black, fringes brownish.

This description is based on a well-marked, bred specimen. The species is variable, particularly in the red bands on abdominal segments, which intergrade from broad to narrow bands or are absent. The posterior tibiae vary from broadly banded with red to wholly black.

Female.—Head, thorax, abdomen, legs, and forewings like those of the male; hindwings opaque, red, broadly flushed with black from the margins inward, beneath red, margins black, narrower.

RAMOSIA POLYGONI variety ANIMOSA (Hy. Edwards)

Pyrrhotaenia animosa Hy. Edwards, Papilio, vol. 3, p. 156, 1883; Ent. Amer., vol. 3, p. 224, 1888.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 146, 1896.

Scsia animosa Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 310, pl. 31, fig. 29 (male), fig. 30 (female), 1901.

Synanthedon animosa McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8754, 1939.

Male.—Like the male of *polygoni,* except that the legs are wholly black and the abdomen is red above only on the last two or three segments and at the sides cephalad to segments 4 or 3, subject to individual variation.

Female.—Differs from the female of *achillae* by the wholly black legs and the wholly black hindwings. The abdomen is all black or shaded with red on only the last segment and at the sides.

Expanse: Male 15 to 20 mm., female 18 to 22 mm.

Distribution.—California, Arizona, New Mexico, Colorado.

Type.—Male. In the United States National Museum.

Remarks.—Few of the biological groups in the Aegeriidae are subject to as much color variation as the one here designated as the buckwheat root borer. With insufficient and often imperfect examples at their disposal, it is not surprising that early authors failed to distinguish between species and color varieties. However, in external structures and in structures of the genitalia these borers are so alike they must be considered conspecific.

The uniting with *polygoni* of *achillae, animosa,* and *helianthi* as color varieties or geographical races is based on extensive biological field work. *R. praestans* on the same grounds is continued as a separate species. The status of *fragariae* and its several varieties and races, on the other hand, still remains a problem. Only a few examples have been reared, and, in view of its wide distribution from along the Pacific coast to Alaska and inland to and throughout the Rocky Mountain system, much remains to be done to clear the confusion.

The early stages, habits, and food plant of *polygoni* were first described and illustrated by F. X. Williams (Ent. News, vol. 20, p. 59, pl. 5, 1909).

It is an excellent account and a credit to the author's keen observations. The food plant cited is *Polygonum paronychia,* a prostrate perennial at Lake Merced in the San Francisco suburbs. When I visited this locality in recent years, I found it had undergone drastic changes by incorporation into the city parks, and so Williams's experiences could not be repeated. Examples of the Lake Merced series bred by Williams and submitted by the California Academy of Sciences are typical *polygoni.* We do not know whether this holds true for the whole series. The Academy Museum has a large accumulation of buckwheat root borers from various Pacific coast regions, rich in forms and varieties, but lacking in data on food plants and habits. On Twin Peaks in San Francisco proper the work of a borer in the roots of a low-growing species of *Eriogonum* was observed, duplicating exactly the description by Williams of the root borer in *Polygonum* at Lake Merced. Imagoes were not obtained, however.

My food-plant records are confined entirely to species of *Eriogonum,* all plants of shrubby growth and with hard, woody rootstocks. These plants are prominent in the floral display of central and southern California, covering sandy flats and steep hillsides with a pinkish hue during the summer flowering season. This abundance of food plants, however, does not indicate an abundance of the insect. The borer appears to exist in colonies, rather scattered, often widely apart. Where present the larvae throw out small, reddish pellets, easily seen as they accumulate around the top of the roots. The larval galleries extend 3 or more inches down into the root and sometimes upward for a short distance in a stem of the plant above ground; they are largely filled with pellets of frass, with about 1 inch left clear for pupation, this portion being silk-lined and having a thinly covered exit at the upper end. The moths appear from late in March to July or even later at high elevations. They are strong fliers, and away from their breeding places stray examples may be encountered anywhere from sea level to above timberline. They frequently visit flowers. This habit led authors to name them for plants on which they were captured, a procedure not to be recommended, except when the plant has been proved actually to be the host. Thus, the name *polygoni* applies very well, while such names as *achillae, eremocarpi, orthocarpi,* and *helianthi* are misleading.

The conclusions given here regarding *polygoni,* the typical form and its color variations, are based on long series of reared examples, augmented by large numbers of specimens captured throughout the range of the species. Additional breeding experiments by T. W. Hower, of Orange, Calif., and by C. Henne, of South Pasadena, Calif., have given identical results. All told, several hundred specimens have been examined. A number of species of the plant genus *Eriogonum* serve as food plants. In California *E. fasciculatum* and in Arizona *E. wrightii* are found

most suitable for breeding purposes. Between typical *polygoni* and the extreme color variety *animosa* there are so many intergradations it is difficult to draw dividing lines. The forewings of both sexes always are opaque. The hindwings of the males are transparent, those of the females opaque, red, broadly margined with black, to wholly black. The abdomen and posterior tibiae range from black and red to all black.

Breeding records of series with mixed variations are from Laguna Beach, Orange County, Calif., April-May 1936 (Hower); Mint Canyon, Los Angeles County, Calif., 3,000 feet, June 26, 1936 (Henne); Santa Rita Mountains, Pima County, Ariz., 2,000 feet, March-June 1935 (Engelhardt); Sierra Ancha Mountains, Gila County, Ariz., 4,000 feet, June 1928.

Records of captured specimens cover California from San Diego to San Francisco and from sea level to elevations of 8,000 feet. Many of the old records are labeled only California or Arizona.

RAMOSIA POLYGONI race HELIANTHI (Hy. Edwards)

Pyrrhotaenia helianthi Hy. Edwards, Papilio, vol. 1, p. 203, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 95, 1894; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 307, 1901.

Pyrrhotaenia behrensii Hy. Edwards, Papilio, vol. 2, p. 123, 1882.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892; vol. 5, p. 26, 1893; vol. 8, p. 143, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 307, figs. 1, 2, 1901.

Pyrrhotaenia elda Hy. Edwards, Ent. Amer., vol. 1, p. 49, 1885.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892.

Synanthedon helianthi McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8747, 1939.

Male.—Compared with the male of *polygoni* the most obvious differences are the red abdominal segments 4, 5, 6, and 7; segment 5 is broadly banded with black in typical *polygoni*. The posterior tibiae are red, barely touched with black at the upper and lower joints.

Female.—Hindwings opaque, red with narrow, even, black margins, not broad and suffused as in typical *polygoni*. The abdominal segments 4, 5, 6, and 7 are wholly red or slightly shaded with black in the center above and beneath; segments 1, 2, and 3 are black above and beneath and red at the sides. The posterior tibiae are red, black at the upper joints.

Expanse: Male 20 to 22 mm., female 20 to 24 mm.

Distribution.—Central and northern California, Oregon.

Type.—In American Museum of Natural History.

Remarks.—This race differs from typical *polygoni* in the banding of the abdominal segments 4, 5, 6, and 7, which are red or only slightly touched with black posteriorly. The hindwings of the females are red, bordered narrowly and evenly with black. A small series of captured specimens, three males and three females, in the United States National Museum,

comes from Sonoma and Shasta Counties, Calif., which are north of the range recorded for *polygoni*. Provisionally and until proved or corrected by breeding, *helianthi* is considered a geographical race of *polygoni*.

RAMOSIA FRAGARIAE (Hy. Edwards)

Pyrrhotaenia fragariae Hy. Edwards, Papilio, vol. 1, p. 202, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892; vol. 5, p. 26, 1893; vol. 6, p. 95, 1894; vol. 8, p. 143, 1896.

Pyrrhotaenia meadii Hy. Edwards, Papilio, vol. 1, p. 204, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.

Pyrrhotaenia orthocarpi Hy. Edwards, Papilio, vol. 1, p. 204, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 307, 1901.

Sesia fragariae Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 307, 1901.

Sesia fragariae semipraestans Cockerell, Can. Ent., vol. 40, p. 329, 1908.

Synanthedon fragariae McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8746, 1939.

Male.—Antennae black. Palpi red, edged with black on outer side. Head lustrous steel blue. Collar red, mixed with black. Thorax steel blue, patagia with a red stripe, broadening on lower part; a red patch before and at the wing base beneath. Abdomen shiny steel blue, segments 1, 2, and 3 black above and in the center beneath, broadly red at the sides; segments 4, 6, and 7 red above, at the sides and beneath to the center, which is black; anal tuft fan-shaped, red, black at the sides. Forewing with a broad margin and a large, square, discal mark, metallic green-black; transparent areas reduced; inner margin red to about the middle of the wing. Underside as above, costa and inner margin red basally. Hindwing transparent, margined with bronzy black outwardly and reddish on basal half.

Female.—Head, thorax, and abdomen like the male; forewing heavily scaled, nearly opaque, greenish black and red on inner margin basally; a transparent spot before and a thin, short, transparent streak behind the discal mark; beneath shaded with red on basal half. Hindwing broadly and irregularly margined, black outwardly, orange-red inwardly and between the veins to wing base; underside suffused with orange-red to the narrow, black outer margins. Specimens from Colorado and Utah have the hindwing nearly or quite opaque, orange-red. Anal tuft wholly red or marked with black at the base and sides.

Expanse: Male 18 to 20 mm., female 20 to 22 mm.

Distribution.—Northern California to Alaska, Rocky Mountain system, Utah to British Columbia.

Type.—In the American Museum of Natural History.

Remarks.—The maintenance of *fragariae* as a distinct species is questionable. There are no structural differences to warrant separation from *polygoni*. However, while equally subject to variation, especially in the

females, the color patterns of *fragariae* are distinctive. The forewings of the males always show transparent areas before and behind the discal mark. Such areas also are always present on the forewings of the females, though often much reduced and suffused. The hindwings of the females are broadly margined and shaded inwardly with scales between the veins, sometimes so much so as to render the wings opaque. The heaviest shading has been noted on females from Colorado, Utah, New Mexico, and Nevada. Such examples are not easily distinguished from females of the race *helianthi* from California.

The habitat of *fragariae* appears to be confined to regions of high elevation, 4,000 to 10,000 feet, from the Pacific coast eastward to the Rocky Mountains and northward through British Columbia to Alaska. It is a root borer in *Eriogonum*. Only two authentic rearing records have been submitted so far, a male from Pack Lake, Grant County, Wash., on *Eriogonum compositum*, May 31, 1935, and another on *Eriogonum* sp. from Wawawai, Wash., June 7, 1935 (J. F. Gates Clarke). Evidence of the borer's work in the roots of various herbaceous species of *Eriogonum* has been found on several occasions, although not at a time that would permit breeding. The imagoes are encountered most frequently and sometimes in numbers on flowers, not especially on *Eriogonum* but on many different kinds. A thorough study of the group of buckwheat root borers, their early stages, habits, species, and variations is needed. This is beyond the scope of the traveling investigator. It is a task for an entomologist with ready and continued access to the habitat of the species. Problems in taxonomy, biology, and genetics are involved.

Many of the old records are lacking in exact locality, date of collection, and elevation. A large number of specimens are labeled Plumas County, Siskiyou County, and Tuolumne County, Calif. Other material available includes a female, Warner Mountains, Modoc County, Calif., 5,500 feet, July 15, 1922 (A. W. Lindsey); one female, Wenatchee, Wash., "on yarrow," July 2, 1914 (E. J. Newcomer); a series, males and females, from Bitterroot Mountains, July 1902 (C. V. Piper); a series, males and females, from Eureka and Stockton, Utah, May-July 1910 (T. Spaulding); three females, Fort Wingate, N. Mex., June 8, 1915 (J. Woodgate); a male, San Juan Mountains, Colo. (Oslar); two females, Florissant and Boulder, Colo., June 27, 1922 (Cockerell); males and females, labeled only "Colo.," and a small series, males and females, labeled Lazy Bay, Alaska.

The name *fragariae* does not fit the species for, although the imagoes undoubtedly visit the blossoms of strawberries as well as many other flowers, strawberry is not a food plant of the larva.

RAMOSIA PRAESTANS (Hy. Edwards)

Aegeria praestans Hy. Edwards, Papilio, vol. 2, p. 98, 1882; Ent. Amer., vol. 3, p. 224, 1888.

Pyrrhotaenia praestans Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 144, 1896; vol. 9, p. 216, 1897.

Sesia praestans Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 306, pl. 32, fig. 27 (male), 1901.

Synanthedon praestans McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8745, 1939.

Male.—Antennae blue-black. Palpi, head, and collar orange, eyes black. Thorax blue-black, patagia broadly striped with orange and thorax beneath well marked with orange. Abdomen with segments 1, 2, and 3 blue-black above and at the sides; segment 4 wholly red above and at the sides, segment 5 wholly black above and segment 6 black, edged with red posteriorly, segment 7 black and red mixed and segment 8 red; beneath all segments red, each touched with black centrally, forming a broken black-and-red chain; the anal tuft fan-shaped, red in the middle and black at the sides. Posterior tibiae bronzy red, tipped with blue-black at the lower spurs; tarsi black touched with bronze. Forewing with costa, outer margins, and discal mark black, broadly edged with coppery red inwardly and between the veins; lower margin bright coppery red; transparent areas more or less diffused with reddish scales. Hindwing transparent with a narrow border, black touched with red at outer margin, increasingly red at lower margin and quite red toward and at wing base; veins also touched with red. Beneath the wings are shaded heavily, orange rather than red.

Female.—Similar to the male, but with transparent areas on forewings nearly filled with red and margins of hindwings broadly suffused with red inwardly and at the base. The posterior tibiae are wholly coppery red.

Expanse: Male 20 to 24 mm., female 20 to 26 mm.

Distribution.—Washington, Oregon, inner mountain regions.

Type.—Male collected in 1882 in Washington Territory. In the United States National Museum.

Remarks.—The male type, described by Hy. Edwards in 1882, remained the sole known specimen until the species was rediscovered by W. W. Baker and J. Wilcox in 1932. It is a root borer in *Eriogonum compositum,* a plant robust in growth and with a tough, fibered root. The larvae live in tortuous channels in the crown roots, ascending into the stalks to pupate late in May or in June without constructing a cocoon. The final exit usually is capped by a silk-lined, short tube made of chips. The moths emerge from the middle of June into July. They are active fliers, not easily netted. A fairly large series of specimens shows little variation, either in color or size. In appearance *praestans* suggests a larger edition of *fragariae.* The genitalia are alike. Breeding records are limited so far to Titus and Kima Counties in Washington. This is in-

sufficient to decide on the specific status. Both *praestans* and *fragariae* are in need of much more extended field investigations, particularly in the Pacific Northwest.

RAMOSIA CHRYSIDIPENNIS (Boisduval)

Sesia chrysidipennis Boisduval, Ann. Soc. Ent. Belgique, vol. 12, p. 64, 1869.
Sesia tacoma Beutenmüller, Journ. New York Ent. Soc., vol. 6, p. 240, 1898; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 304, pl. 32, figs. 28, 29, 1901.
Synanthedon bibionipennis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8697, 1939.

Male.—Antennae black. Palpi yellow, fringed with long black hair at the sides. Head black. Collar sordid yellow. Thorax black, hairy, sparsely mixed with yellow, a yellow patch beneath at the sides, and metathorax tufted with sordid yellow. Abdomen black, segments 2, 4, and 6 banded with yellow on posterior half, segment 7 touched with yellow, and all segments beneath edged with yellow. Anal tuft fan-shaped, black, slightly edged with yellow at the sides. Femora black; tibiae heavily scaled, yellow, broadly banded with blue-black at posterior spurs; tarsi yellow. Forewing transparent, outer costa and margins black, inwardly edged with red, broadly so on lower margin basally; the veins and areas between the veins at apex heavily scaled with red; the discal mark black, edged with red. Hindwing with veins mostly red, margins brown-black, tinged with red inwardly and red at base. Beneath, wings shaded prominently with red and orange, the margins dull black.

Female.—Much redder than the male. Palpi wholly yellow. Abdominal segments 2, 4, and 6 broadly banded with yellow above, segments 4, 5, and 6 yellow beneath; anal tuft a short, roundish brush, black intermixed with yellow. Transparent areas on forewing much reduced and suffused with red, the narrow, black center of discal mark broadly margined with red, underside bright orange, margins dull black.

Expanse: Male 20 to 22 mm., female 20 to 23 mm.

Distribution.—Pacific coast mountains at or above timberline, northern California to British Columbia.

Type.—Male. In the United States National Museum.

Remarks.—Exposure to frigid climates naturally calls for warm covering. *R. chrysidipennis,* in its habitat at timberline, has adjusted itself to such an environment. It is clothed with hair much denser and longer than that of its near relatives at lower elevations.

My first encounter with the species was at Crater Lake, Oreg., 8,000 feet, during July 1921. The moths were swarming on open meadows between snowdrifts. Low-growing, large-leaved plants, subsequently determined as *Polygonum davisiae,* were the attraction. A hundred or more specimens were easily netted, and a number of the plants were uprooted in a search for larvae and pupae. Only one larva and two pupae, the

latter in pupal cases in the crown of the roots, could be found. The roots were enormous, 1 to several inches thick, deeply anchored and scarred in many places. In view of the abundance of the moths, it was surprising that the work of the borers was so little in evidence. No other plant in the neighborhood seemed suitable. Possibly the mature larvae leave the roots for pupation in the soil. The types of the species were collected in Paradise Park, Mount Rainier, formerly known as Mount Tacoma. The species is common on all the high mountains in Washington, Oregon, and northern California, provided the food plant is present. It has been recorded from Mount Adams, Mount Baker, the Cascades, and Mount St. Helens in Washington, and from Mount Hood and Mount Jefferson in Oregon. Examples from these peaks, all dated during July, show very little color variation. A fine series from Mount Lassen, Calif., July 14, 1934, displays considerably more bright red, in the females particularly. A few specimens from the Bitterroot Mountains of Idaho are in too poor condition for comparison, but there is a long series from the Elkhorn Mountains of eastern Oregon, 5,000 feet, July 31, 1938, which averages smaller in size and much darker, almost black in color. The food plant here, while also a *Polygonum,* is a different, small-leaved species with much smaller roots. A few larvae, but no pupae, were found. The difference in size, color, and in the food plant of this series warrants recognition, and I have named it *wallowa,* a geographical race of *chrysidipennis* (Boisduval).

J. F. Gates Clarke, on a visit to Sheep Lake, Yakima County, Mount Rainier, Wash., early in August 1930, found the moths of *chrysidipennis* swarming on open alpine meadows, elevation about 6,000 feet. He also reports an abundance of the larvae and pupae in the roots of *Polygonum davisiae.* The larvae, before pupating, frequently had constructed silk-lined tubes protruding 1 to several inches beyond the exit of their burrows.

RAMOSIA CHRYSIDIPENNIS WALLOWA, new race

PLATE 18, FIGURES 99, 100

Male.—Palpus with a strong uneven brush, mixed black and yellow in color. Head black. Collar sordid yellow. Thorax black, hairy, sometimes with traces of yellow on patagia. Abdomen black, with segments 2, 4, and 6 narrowly banded with pale yellow above; beneath and at the sides with traces of yellow in irregular arrangement; fan-shaped anal tuft wholly black. Posterior tibiae black, tarsi black, touched with yellow. Forewing transparent, costa, outer margins, and discal mark black with only a sprinkling of orange scales on and between the veins on inner margins and on the veins before the wing base. Hindwing transparent, borders dull black, costa and wing base touched with orange. Beneath, wings shaded a deeper orange.

Female.—Differs from the male by yellow palpi, a large yellow patch at the sides and beneath thorax, abdominal segments 2, 4, and 6 banded with bright yellow, posterior tibiae with a mixture of black and yellow on upper half and blue-black on lower half, wings more prominently dusted with deep orange or red on and between the veins, on inner margins, and at apex and costa.

Expanse: Male 16 to 18 mm., female 18 mm.

Distribution.—Eastern Oregon, Wallowa and Blue Mountains at timberline.

Type.—U.S.N.M. No. 56826. Holotype male, allotype female, six male and four female paratypes. Collected in the "Elk Mountains, Oregon."[2]

RAMOSIA MARIONA (Beutenmüller)

PLATE 18, FIGURES 101, 102

Sesia mariona BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 308, pl. 33, fig. 21, 1901.

Synanthedon mariona MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8748, 1939.

Male.—Antennae black. Palpi sordid white, blackish at tips. Head with vertex roughly scaled, rusty yellow, face lead color. Collar flat scaled, blue-black. Thorax violaceous-black, shoulders and upper part of patagia orange, beneath black and coppery. Abdomen blue-black, with prismatic reflections; anal tuft fan-shaped, lustrous black and coppery. Legs with coxae sordid white, femora and upper part of posterior tibiae blue-black, lower part of tibiae and tarsi pale yellow. Forewing opaque, lustrous blue and violet-black, heavily scaled on costa, margins, and veins, less so between the veins, but lacking transparent areas. Hindwing transparent, margins and fringes brownish black. Beneath, wings flushed with white and pale yellow.

Female.—Forewing opaque, dull black, broadly edged on lower margin with dull orange from wing base to below apex. Hindwing opaque, dull black, except for a narrow clear area between veins 1 and 2. Beneath, wings slightly dusted with pale whitish or yellowish scales. Legs wholly metallic black. Otherwise like the male.

Expanse: Male and female, 16 to 18 mm.

Distribution.—New Mexico, Arizona, Colorado.

Cotypes.—Two females, United States National Museum; one female, American Museum of Natural History.

Remarks.—The female types and additional examples of the same sex in the United States National Museum collection do not show two transparent areas on the hindwing as illustrated in Beutenmüller's "Monograph of the Sesiidae of America, North of Mexico," pl. 33, fig. 21. Only one clear space between veins 1 and 2 is present.

[2] Specimens so labeled. Presumably a local name for Wallowa Mountains—C. H.

R. mariona closely resembles *polygoni* var. *animosa* in coloration and size, but differs in the large orange thoracic shoulder patch of both sexes and in the aforementioned clear space on the hindwing of the female. Structures of the genitalia differ but slightly in the two species. *R. mariona* is a root borer in perennial plants of the family Boraginaceae, so far bred only once from a species of *Amsinckia* in Oak Creek Canyon, Coconino County, Ariz., June-July 1936 (Engelhardt). Larval borings noted in roots of *Amsinckia* in Mesa Verde Park, Colo., and along the Columbia River Highway, Oreg., indicate a wider distribution of the species than is known at present. The type specimens were collected at Trimble and Pagosa Springs and Durango, Colo., July 6-30, 1899. A number of specimens, in poor condition, were submitted by John Woodgate from Jemez Springs, N. Mex.

RAMOSIA RUBRICINCTA (Beutenmüller)

PLATE 19, FIGURE 103

Sesia rubricincta BEUTENMÜLLER, Ent. News, vol. 20, p. 84, 1909.
Synanthedon rubricincta MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8717, 1939.

Female.—Antennae blue-black. Palpi orange, black at tips. Head blue-black. Collar lustrous bronzy, edged with orange anteriorly. Thorax metallic green and blue-black, patagia tinged with orange and an orange patch beneath at the wing base. Abdomen lustrous black along the back and orange at the sides; underside of the first, second, and last segments black, all other segments orange, the last segment orange above and the anal tuft greenish black, orange in the middle. Legs steel blue, touched with orange on the inner side and at the joints. Forewing broadly margined with lustrous blue-black outwardly and heavily scaled with red between the veins inwardly; outer transparent area barely apparent, basal area very narrow; discal mark blue-black around a rather large bright red center; a bright red mark also at the wing base. Hindwing transparent, narrowly bordered with lustrous black, fringes brownish. Beneath, wings slightly tinged with orange and the discal mark lacking the red center.

Expanse: Female, 17 mm.

Distribution.—Huachuca Mountains, 7,000 feet, Cochise County, Ariz.

Type.—Female. Collected by Charles Schaeffer on the Brooklyn Museum Expedition to Arizona in 1905. In the United States National Museum.

Remarks.—The female type still remains the sole representative of the species. The specimen was obtained by sweeping on meadows in the Huachuca Mountains at an elevation of about 7,000 feet. The range of the species most probably extends across the Arizona border into Mexico. The type specimen is in poor condition, and inclusion of the species in the genus *Ramosia* is provisional.

RAMOSIA BIBIONIPENNIS (Boisduval)

PLATE 1, FIGURE 4; PLATE 5, FIGURES 31, 31a; PLATE 13, FIGURE 61; PLATE 19, FIGURE 104

Sesia bibionipennis BOISDUVAL, Ann. Soc. Ent. Belgique, vol. 12, p. 64, 1869.
Albuna rutilans HY. EDWARDS, Papilio, vol. 1, p. 186, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.
Aegeria aureola HY. EDWARDS, Papilio, vol. 1, p. 194, 1881.
Aegeria neglecta HY. EDWARDS, Papilio, vol. 1, p. 197, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.
Aegeria hemizoniae HY. EDWARDS, Papilio, vol. 1, p. 198, 1881.—RIVERS, Papilio, vol. 3, p. 26, 1883.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.
Aegeria lupini HY. EDWARDS, Papilio, vol. 1, p. 192, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892; vol. 5, p. 24, 1893; vol. 6, p. 91, 1894.
Aegeria perplexa HY. EDWARDS, Papilio, vol. 1, p. 192, 1881.
Aegeria impropria HY. EDWARDS, Papilio, vol. 1, p. 193, 1881.—RILEY, Proc. Ent. Soc. Washington, vol. 1, p. 85, 1888.—RIVERS, Ent. Amer., vol. 4, p. 99, 1888.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.
Aegeria washingtonia HY. EDWARDS, Papilio, vol. 1, p. 197, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.
Aegeria madariae HY. EDWARDS, Papilio, vol. 1, p. 201, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.
Aegeria rutilans BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 94, 1894.
Sesia rutilans BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 130, 1896; vol. 9, p. 219, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 281, pl. 32, figs. 22, 23, 1901.
Sesia neglecta BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 132, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 283, pl. 33, fig. 16, 1901.
Sesia madariae BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 132, 1896.
Synanthedon bibionipennis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8697, 1939.

Male.—Antennae black. Labial palpi deep yellow, the sides covered with dense black hair, tips black. Head black, roughly scaled on top. Collar deep yellow. Thorax purplish black above, patagia broadly edged with yellow, yellow beneath at the sides. Abdomen black, segments 2 and 4 broadly banded with yellow above, segment 6 sometimes also with a narrow yellow band; anal tuft fan-shaped, black above, deep yellow at the sides and in the middle beneath. Legs yellow, shaded with black and a blue-black band between the spurs of posterior tibiae, tarsi yellow, dusted black. Forewing broadly bordered with dull black with coppery rays between the veins at outer margin; discal mark large, square, black; inner transparent area narrowly triangular; outer area small, roundish. Hindwing transparent, borders brown-black, tinged with yellow near base. Underside of wings heavily shaded lustrous yellow between the veins, hindwing with a well-defined narrow line along inner margin.

Female.—Differs from the male. Palpi wholly yellow. Metathorax well banded with yellow above. Abdomen with segments 2, 4, and 6 broadly banded with yellow and segments 3 and 5 usually, but not always,

sparsely banded or mixed with yellow. Posterior tibiae blue-black between the spurs, otherwise more yellow than those of the male. Forewing heavily shaded with orange, especially between the black veins, nearly obscuring the transparent areas before and behind the discal mark, which remains black; a thin, well-defined orange line running between the black border and the fringes on both the forewings and hindwings; beneath, wings heavily shaded with golden yellow.

Expanse: Male and female, 15 to 22 mm.

Distribution.—Throughout Rocky Mountains and westward to the Pacific coast from California to British Columbia. Not east of Rocky Mountains.

Type.—Male. In the United States National Museum. Types and cotypes of the synonyms are distributed as follows: In the United States National Museum: One male, *Aegeria madariae* Hy. Edwards, Sausalito, Calif.; one female, *Aegeria aureola* Hy. Edwards, Nevada; one male, *Aegeria impropria* Hy. Edwards, Washington Territory; one male, *Aegeria perplexa* Hy. Edwards (Texas, J. Bol?); one female, *Aegeria hemizoniae* Hy. Edwards, Nevada.

In the American Museum of Natural History: One female, *Albuna rutilans* Hy. Edwards, Virginia City, Nev.; three females, *Aegeria hemizoniae* Hy. Edwards, Nevada; three males and three females, *Aegeria lupini* Hy. Edwards, Marin and Mendocino Counties, Calif.; one male, *Aegeria impropria* Hy. Edwards, Marin County, Calif.; one male, *Aegeria washingtonia* Hy. Edwards, Washington Territory; one male, one female, *Aegeria madariae* Hy. Edwards, Sausalito, Calif.

Remarks.—The strawberry crown moth, best known in the past as *Sesia rutilans* Hy. Edwards, has been the subject of numerous publications on the part of professional entomologists dealing with the insect as an economic species injurious to strawberries and other related plants under cultivation, but neglecting its original status as an indigenous North American species with wild food plants from which its attacks spread to plants under cultivation. The problem, after prolonged investigation, has been solved only in part.

The moths are strong, swift fliers, most frequently encountered and captured on flowers, perhaps flowering dogbane (Apocynaceae), but visiting many other plants also. Flowers do not serve as a dependable guide to the food plant, as evidently assumed by earlier authors, who gave botanical names to species now listed as synonyms under *bibionipennis*.

Long series of specimens at the United States National Museum adequately cover the wide range of the species along the Pacific coast from California to British Columbia and inland to, but not east of, the Rocky Mountains. More eastern records are based on misidentifications. Attacks on cultivated strawberries are more severe on the Pacific coast than elsewhere. Wild strawberries do not appear to be affected, and injury to

raspberries and blackberries is of minor importance. Adaptability to new food plants is shown by the rearing of examples from the roots of roses, submitted by a Palo Alto, Calif., nursery. Actual breeding records from wild food plants as yet are limited and confined to the plant genus *Potentilla*. From the strong rootstocks of a species of this genus, growing on hillsides adjacent to agricultural fields at Pullman, Wash., 2,500 feet, 1933 (Engelhardt and Clarke), a number of specimens were reared, the moths emerging in May and June 1934, one or rarely two from each root. The experiment was repeated by R. D. Shenefelt, of Washington State College, in 1930. His breeding material included the root of wild *Geranium*, collected in association with the *Potentilla* roots; it also produced a specimen of *bibionipennis*. This host association is probably accidental. Heavier infestations were noted in open woodlands, Modoc County, Calif., 5,000 feet, July 1928. Here, from patches of the massive, interlocking roots of a low-growing species of *Potentilla* the moths had emerged in large numbers, and several were captured at this source. The season had advanced too far for breeding. A similar observation has been reported by Crumb and Wilcox, of Puyallup, Wash.

The great numbers of specimens received from inland States, Nevada, Utah, New Mexico, Colorado, Wyoming, Idaho, and Montana, record elevations up to 8,000 feet and dates of capture from June to August but lack records on food plants. All specimens agree perfectly on structures, both external and genitalic. Color variations in the males are slight, but in the females they are considerable and present an array of confusing intergradations which defy naming. Figure 104 (pl. 19) illustrates the extreme color variation of a female selected from a series of otherwise normal examples reared at Pullman, Wash. The specific name *bibionipennis* Boisduval, 1869, has not been used in earlier check lists because of insufficient description and the supposed loss of the type. This type, however, has been found in a part of the Oberthür collection, acquired by William Barnes, and is now at the United States National Museum. It bears the label in Boisduval's handwriting, "taken in flight in woods, Calif.," without exact locality or date. The specimen is a male in a condition leaving no doubt as to its identity and hence must head the list of names applied to the strawberry crown moth.

RAMOSIA RESPLENDENS (Hy. Edwards)

PLATE 19, FIGURES 105, 106

Albuna resplendens HY. EDWARDS, Papilio, vol. 1, p. 186, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Sesia mellinipennis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 279, 1901.

Synanthedon mellinipennis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8694, 1939.

Male.—Antennae blue-black, pectinations fine, ferruginous. Labial palpi smooth, lemon yellow, black at tips. Head black-violaceous. Collar lemon yellow. Thorax black-violaceous; patagia and posterior base well marked with lemon yellow. Abdomen blue-black, segments 2, 4, and 6 broadly banded with yellow, segments 3 and 5 sometimes slightly dusted or narrowly banded with yellow, beneath segments 2 and 3 blue-black, 4 to 6 yellow; anal tuft broad, fan-shaped, black, yellow in center, at the sides and beneath. Legs yellow, femora shaded with dark purplish and posterior tibiae purplish above and between the spurs; tarsi purplish, banded with yellow at the joints. Forewing transparent, costa and outer margin moderately broad, violaceous-black, intermixed heavily with yellow between the veins; discal mark prominent, oblong, lustrous purple; fringes dull black; underside with costa and inner veins yellow. Hindwing transparent, narrowly bordered with black and yellow, fringes sordid black; discal mark small, black.

Female.—Larger than the male; forewing with broader violaceous margins and a heavier shading of bright yellow on and between the veins. Hindwing brightly bordered in thin lines purple and yellow, fringes dull black. Abdomen with segments 1 and 3 blue-black, all other segments bright yellow above and beneath; anal tuft a short blunt yellow brush, touched with black in center and at the sides.

Expanse: Male 20 to 22 mm., female 22 to 24 mm.

Distribution.—Southern to central California, New Mexico.

Type.—Female. Collected in Siskiyou County, Calif. In the United States National Museum.

Remarks.—This is a bark borer on sycamore and to a lesser extent on live oak. The presence of the insect is revealed by numerous brown or red pellets in crevices of the bark or in accumulations at the base of the tree trunks. The tortuous galleries of the voracious larvae are within the bark, rarely through the cambium layer into the solid wood. The trunks of large, old trees are attacked in preference to young trees. My personal records limit the range of this species to the California coastal regions from San Diego to Santa Barbara. It has not been reported or observed in northern California. Infestations, particularly heavy on sycamore, were noted at Laguna Beach and in Arroyo Seco at Los Angeles, extending to shade trees on adjacent streets and in gardens. Attacks on live oak in the same region were less serious. The insect is single-brooded, the larva wintering and pupating in spring in an oblong cocoon of chips at the exit to the burrow. From bark sections obtained early in the season the moths can be reared easily; they emerge from May to July. Examples reared from both sycamore and live oak in low coastal regions unquestionably are one species. Sycamores at 2,000 feet and over appear to be free from attack. Live oaks, on the other hand, were found heavily infested at Buckman Springs, San Diego County,

4,000 feet, by an aegeriid bark borer with identical larval habits, but late in July I was unable to secure material for breeding or to capture moths. From the Jacinto Mountains, San Bernardino County, Calif., 4,000 to 6,000 feet, I have a small series of specimens collected, not reared, by Timberlake, Beamer, Oman, and Anderson, in June and July. These average smaller in size and are slightly more suffused on the forewings of both sexes. Structures of the male genitalia assign them very close to the sycamore borer, and they have been placed tentatively in this species pending further investigations.

A single New Mexico specimen, a male, is labeled Santa Fe (Jackson).

RAMOSIA MELLINIPENNIS (Boisduval)

Sesia mellinipennis Boisduval, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1 (plates), pl. 14, fig. 12, 1836; vol. 1, p. 402, 1874.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 96, 1894; vol. 8, p. 129, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 279, pl. 31, figs. 2 (male), 26 and 27 (females), pl. 33, fig. 22 (female), 1901.—Williams, Ent. News, vol. 20, p. 58, 1909.—McDunnough, Check list of Lepidoptera of Canada and the United States of America, pt. 2, No. 8694, 1939.

Albuna artemisiae Hy. Edwards, Papilio, vol. 1, p. 187, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Aegeria senecioides Hy. Edwards, Papilio, vol. 1, p. 198, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.

We regard as typical of the species described and figured by Boisduval a series consisting of specimens reared and collected by F. X. Williams and deposited in the California Academy of Sciences. Examples from this series have been placed in the United States National Museum. The original types, two males, were destroyed in an explosion at the Luxemburg Museum.

Male.—Antennae blue-black, pectinations and underside ferruginous. Labial palpi smooth, yellow. Head black; collar yellow. Thorax blue-black; patagia, a posterior transverse stripe, and the underside yellow. Abdomen metallic black, violaceous; segments 2, 4, 6, and 7 broadly banded, segments 3 and 5 slightly touched with yellow; beneath same as above; anal tuft long, narrow, black at sides, yellow in center and beneath. Legs yellow, posterior tibiae well marked with blue-black at the lower spurs. Forewing transparent, borders and veins dull black or brown, broad apical margin coppery red between the veins, discal mark conspicuous, red, margined with black inwardly; basal transparent area elongate triangular, outer area reduced and rounded; beneath more brightly colored, yellow or orange. Hindwing transparent, narrowly bordered with bronzy black, fringes dull black, beneath as above, but with the costa yellow.

Female.—Differs from the male by the more suffused forewing, coppery red or golden yellow, including discal mark, which is entirely red on red

examples and black and yellow on pale specimens. The marginal border of the hindwing narrowly lined, red and black or yellow and black; the fringes sordid black. Abdominal segments 2, 4, 5, and 6 broadly banded, 1 and 3 narrowly orange or yellow; the short, blunt, anal tuft yellow with a black central mark on top.

Expanse: Male and female, 22 to 26 mm.

Distribution.—Coastal and mountain regions, California.

Cotypes.—*R. mellinipennis,* two males, lost but figured by Boisduval. Types of *Albuna artemisiae,* male, and *Aegeria senecioides,* male, in the American Museum of Natural History.

Remarks.—With only the types and few old specimens available for examination, I am doubtful about Beutenmüller's conclusions in placing *artemisiae* and *senecioides* as synonyms *of mellinipennis* but have not ventured to change them. Structurally these forms certainly are congeneric. Additional material and information will be necessary before it can be determined if they are entitled to specific or subspecific rank.

Hy. Edwards's type of *Albuna resplendens* is a female, not a male, figured by Beutenmüller as a color form of *mellinipennis* (Monograph of the Sesiidae of America north of Mexico, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, pl. 31, fig. 27, 1901). The specimen is contrastingly lemon yellow on the forewings instead of bright orange, expressing perhaps a color phase in the northern range of the species at Soda Springs, Siskiyou County, Calif. Hy. Edwards also included two females from Sierra Nevada, Calif. (S. Brannon), in his type series of *Albuna resplendens,* American Museum of Natural History. The two examples are females of *bibionipennis.*

The names *senecioides* and *artemisiae* do not imply actual food plants, merely plants on which specimens were collected, as do so many of the names used by Hy. Edwards. The latter differs from *mellinipennis* in the main by the broader and greenish-black costa and the darker scaling between the veins on the outer margin. The only available male example of *senecioides,* from Durango, Colo., is labeled "compared with type, Wm. Barnes." It lacks antennae; otherwise it agrees better with *arizonensis* Beutenmüller, which has red-brown antennae, black at the tips. The antennae of *mellinipennis* are black throughout.

The food plant and larval habits of *mellinipennis* are recorded by F. X. Williams (Ent. News, vol. 20, p. 58, 1909). He found the larvae boring in the solid wood and pupae in silk-lined cocoons under bark on the large, decumbent trunk of *Ceanothus thyrsiflorus* in a canyon south of Carmel, Monterey County, Calif. From a sawed-off section of the tree three moths emerged during August 1909. To this record I can add the occurrence of the insect under similar conditions attacking old, decadent trees of *Ceanothus thyrsiflorus* in suburban regions of San Francisco. The lack of proper cutting implements prevented securing tree sections suitable for

rearing. Other species of *Ceanothus* growing as many-branched, hard-wooded shrubs in hilly sections throughout California showed no evidence of the borer's attacks. Williams considers *mellinipennis* a common species. I do not. It is poorly represented in collections. Examples in the United States National Museum are as follows: One male, one female, Castella, Shasta County, Calif., August 19, 1907 (Williams); one male, Santa Cruz, Santa Cruz County, Calif., July 1904 (Williams); one male, Lompoc, Santa Barbara County, Calif. (R. H. Beamer); one female, California (Barnes collection); one male, *artemisiae*, Los Angeles County, Calif. (Coquillett).

RAMOSIA ARIZONENSIS (Beutenmüller)

PLATE 19, FIGURE 107

Gaëa arizonensis BEUTENMÜLLER, Can. Ent., vol. 48, p. 372, 1916.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8773, 1939.

Male.—Antennae strongly clavate, posterior three-fourths orange-red, terminal quarter blue-black, pectinations pale brown. Labial palpi orange, black at the sides and tips. Head black, stiff-haired on top, black and orange mixed. Collar yellow. Thorax black, patagia narrowly striped with yellow and a posterior transverse band yellow, beneath a large yellow patch in front of the wing base. Abdomen shiny black, all segments, except the third, ringed with yellow, most broadly so on the last three segments; anal tuft flat, moderately fan-shaped, yellow, intermixed with black in center on top. Legs with femora blue-black, posterior tibiae yellow, black on inner side and broadly ringed at the lower spurs, tarsi orange. Forewing opaque, except for small areas before and behind the large, square discal mark, which is black edged with red outwardly; costa and veins blue-black with scattered red scales; a heavy shading of red between the veins of the outer and inner margins extending to the wing base; fringes sordid black; beneath preeminently orange-red. Hindwing transparent, veins black; discal mark, wing base and narrow margins red, fringes sordid black.

Female.—Much like the male. Labial palpi wholly yellow; forewing with discal mark wholly red or only slightly touched with black, the transparent areas heavily suffused with red and a heavy red line along the inner margin to the wing base. The short, blunt anal tuft wholly yellow.

Expanse: Male 24 to 26 mm., female 26 to 30 mm.

Distribution.—Arizona; Durango, Colo.

Type.—Female, in the United States National Museum.

Remarks.—The available series of 16 examples, all captured and more or less imperfect, suggests a close relationship to *mellinipennis*. Obvious differences, confined to coloration, are the more opaque forewings and the orange-red antennae, except for three specimens from Durango, Colo.,

which have the antennae nearly black on the upper surface. Thirteen specimens from Arizona are exactly alike.

In addition to the type, a female from Pinal Mountains, Gila County, Ariz., there is a male from the same region, dated June 10, 1936 (F. H. Parker). Other Arizona records are Fort Valley, Flagstaff, two males, one female, June 10, 1924 (S. A. Rohwer); Palmerlee, one male; Chiricahua Mountains, Cochise County, one male, six females, June 8-15.

RAMOSIA ARIZONAE (Beutenmüller)

Sesia arizonae Beutenmüller, Journ. Ent. Soc. New York, vol. 6, p. 240, 1898; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 288, pl. 32, fig. 31 (female), 1901.
Synanthedon arizonae McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8709, 1939.

Female.—Antennae black. Labial palpi yellow. Head black. Collar yellow. Thorax black; patagia with a yellow stripe; a yellow lateral mark at the posterior end and a yellow patch beneath on each side. Abdomen black, segments 2, 4, and 6 broadly banded, 3 and 5 narrowly edged with yellow; anal tuft yellow, black at the sides above and beneath. Legs yellow, tibiae black at the spurs. Forewing with costa, veins, outer margins, and fringes black; outer and inner parts between the veins heavily suffused with bright orange; discal mark bright orange, narrowly edged with black inwardly; basal transparent area elongate, outer one small, suffused; underside orange, except for black outer veins and yellow costa. Hindwing transparent, veins black, discal mark black, edged outwardly with yellow, narrow outer margin black sparsely mixed with coppery scales, fringes dull black, yellow at wing base; underside with costa, veins, and margins tinted with orange.

Expanse: 23 mm.

Distribution.—Arizona and (doubtfully) Texas.

Type.—Female in the American Museum of Natural History.

Remarks.—Two females, both imperfect, served Beutenmüller for the description of this species. The type in the American Museum of Natural History is labeled "Summit Rock, 9,000 ft., Mt. Union, Yavapai Co., Ariz., July 3, 1884"; the second specimen, in the United States National Museum, also labeled type by Beutenmüller, is marked "Tex." without further locality or date. If from Texas, which seems somewhat doubtful, the most likely locality would be Davis Mountains in the southwestern part of the State. No additional examples of either sex satisfactorily matching the types have been discovered since description of the species in 1898. A near relationship to *arizonensis* is suggested, but until substantiated by more material and information on food plants and habits conclusions must be reserved. Dimorphism of the sexes in this group often has led to confusion.

RAMOSIA TIPULIFORMIS (Clerck)

Sphinx tipuliformis CLERCK, Icones insectorum rariorum cum nominibus eorum trivialibus, pl. 4, fig. 1, 1759.—LINNAEUS, Fauna Suecica, ed. 2, p. 289, 1761; Systema naturae, ed. 12, vol. 1, p. 804, 1766.

Sesia tipuliformis FABRICIUS, Systema entomologiae, p. 549, 1775.

Trochilium tipuliformis LEACH, Edinburgh encyclopedia, vol. 9, p. 131, 1815.

Bembecia tipuliformis HÜBNER, Verzeichniss bekannter Schmetterlinge, p. 129, 1819.

Aegeria tipuliformis STEPHENS, Illustrations of British entomology: Haustellata, vol. 1, p. 142, 1828.—HY. EDWARDS, Papilio, vol. 2, p. 56, 1882; Ent. Amer., vol. 3, p. 224, 1888.

Setia tipuliformis MEIGEN, Systematische Beschreibung der europäischen Schmetterlinge, vol. 2, p. 119, pl. 42, figs. 2, b, 1830.

Trochilium tipuliforme FITCH, Third report on the noxious and other insects of the State of New York, 1856, p. 423, 1857.—PACKARD, Amer. Nat., vol. 2, p. 219, 1869.—SPULER, Die Schmetterlinge Europas, vol. 2, p. 310, 1910; vol. 3, pl. 20, fig. 19, pl. 79, fig. 6, 1910.

Sesia tipuliformis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 285, pl. 31, fig. 19, 1901.

Synanthedon tipuliformis BARTEL, *in* Seitz, The Macrolepidoptera of the World. Palearctic Aegeriidae, vol. 2, p. 384, pl. 51d, 1912.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8708, 1939.

Male.—Antennae black, rufous beneath. Labial palpi yellow, black above and at the sides. Head lustrous black, orbits white. Collar yellow. Thorax black-violaceous, patagia narrowly edged with yellow inwardly; metathorax without a transverse yellow mark; a large yellow patch on each side beneath. Abdomen lustrous black; segments 2, 4, 6, and 7 narrowly banded with yellow above and at the sides, very faintly beneath; anal tuft fan-shaped, lustrous black above, sparsely mixed with yellow beneath. Legs purplish black, posterior tibia yellow beneath and on inner side and with a yellow tuft at the lower spurs; tarsi purplish black above, yellow beneath. Forewing transparent, costa, veins, and large discal mark black-violaceous; the broad, marginal border in a straight proximal edge heavily shaded with golden yellow or coppery between the veins; fringes pale, sordid black; beneath as above, the costa more yellowish. Hindwing transparent, narrowly margined with shiny black, above and beneath.

Female.—Similar to the male in color but with abdominal segments 2, 4, and 6 more narrowly banded with yellow; anal tuft short, blunt, depressed in the middle, blue-black.

Expanse: Male and female, 16 to 20 mm.

Distribution.—Europe, Asia, North America, Australia, New Zealand.

Remarks.—Since its introduction into North America this insect has become established through the continent wherever currants and, to a lesser extent, gooseberries and raspberries are cultivated. Wild species of the plant genus *Ribes* do not appear to be affected. The moths vary very little in size and coloration. The eggs are laid in crevices of the

bark, and the larvae, feeding largely on the inner pith, excavate long tunnels in the canes and branches. The moths emerge late in May and in June. In the New England and Atlantic Coast States and in Washington, Oregon, and northern California all plantings of currants are subject to attack. Specimens from scattered points over the Rocky Mountain region and the Midwestern States are included in the United States National Museum collection.

RAMOSIA RHODODENDRI (Beutenmüller)

PLATE 19, FIGURE 108

Sesia rhododendri BEUTENMÜLLER, Ent. News, vol. 20, p. 82, 1909.
Synanthedon rhododendri McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8730, 1939.

Male.—Antennae black-violaceous. Labial palpi black above, yellow beneath. Head black, frons lustrous green, face well marked with white. Collar black on top, white at the sides and beneath. Thorax black with steel-blue reflections and a broad patch of shiny white or pale yellow on each side beneath. Abdomen lustrous steel blue or coppery black; segments 2, 4, and 5 narrowly edged with yellow, at each side a narrow yellow stripe from the base to the band on segment 2; on the underside segments 3, 4, 5, and 6 whitish yellow; anal tuft broadly fan-shaped, lustrous black, touched with yellow at the sides and yellow in the middle beneath. Legs with anterior coxae shiny white or pale yellow, femora steel blue or purple-blue, posterior tibiae pale yellow at the spurs, violaceous-black between the spurs; tarsi pale yellow, shaded with black above. Forewing transparent, costa, narrow margin, discal mark and inner veins violaceous-black; outer margin between the veins golden yellow, fringes rusty black; beneath costa heavily scaled with yellow, otherwise as above. Hindwing transparent, narrowly margined with shiny black, fringes paler, a mixture of black and yellow.

Female.—Like the male, but with abdominal segments 2, 4, and 5 more broadly banded with yellow and the short, rounded anal tuft heavily mixed with pale yellow inwardly from the sides.

Expanse: Both sexes, 10 to 15 mm.

Distribution.—Atlantic Coast States, Pennsylvania to Rhode Island.

Type.—In the American Museum of Natural History. From Cheltenham, Pa.

Remarks.—The rhododendron borer, one of the smallest of North American Aegeriidae, is capable of inflicting serious injury to *Rhododendron* and occasionally also to mountain-laurel (*Kalmia latifolia*) when the latter grows in association with *Rhododendron.* The species was not recognized as of economic importance until after its description in 1909 based on examples received from Cheltenham, Pa. While pre-

sumably also at home along the Appalachian regions where *Rhododendron* grows so profusely, no records from south of Pennsylvania are available.

Twigs and small branches are preferably attacked, the larvae subsisting chiefly on the soft pith, digging long tunnels, which are filled with small, reddish pellets and serve for wintering and for pupation in spring. On larger and older parts of the shrubs the larvae bore under the bark, which peels off, exposing shallow grooves on the hard wood. A heavy infestation observed in the Botanic Garden of Brooklyn, N. Y., in 1918, killed many shrubs in new plantings and furnished ample material for rearing. Moths, exceeded in numbers by ichneumonoid parasites, emerged late in May and during June. Woodpeckers, drilling for the insects, added to the injury, although with ultimately beneficial results. The borer is far less common at present. Complaints of abundance in parks and nurseries in and about New York City ceased some time ago. The northernmost record for the species is Kingston, R. I.

RAMOSIA RILEYANA (Hy. Edwards)

Albuna rileyana Hy. Edwards, Papilio, vol. 1, p. 187, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Aegeria hyperici Hy. Edwards, Papilio, vol. 1, p. 195, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Aegeria brunneipennis Hy. Edwards, Papilio, vol. 1, p. 191, 1881.

Sesia rileyana Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 129, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 280, pl. 31, fig. 9 (male), pl. 32, fig. 25 (female), 1901.

Sesia brunneipennis Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 129, 1896.

Synanthedon rileyana McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8696, 1939.

Male.—Antennae robust, only slightly dilated toward tips, black, fuscous beneath, pectinations strong and even. Labial palpus with a rough brush, bright yellow, black at the sides. Head black, face pale yellow. Collar yellow. Thorax black, patagia with long yellow tufts posteriorly and metathorax edged transversely with golden yellow; a yellow mark at base of forewing and a yellow patch beneath at the sides. Abdomen shiny black, with the six posterior segments evenly banded with lemon yellow, the bands encircling the body; anal tuft yellow and black mixed, with spatulate tufts laterally. Legs yellow, rough; posterior tibiae with black patches at the sides at posterior spurs; tarsi with first joint slightly thickened, yellow touched with purple, and remaining joints shaded darker than the first. Forewing transparent, with narrow brownish borders, very slightly edged inwardly with violaceous scales between the veins; costa and veins violaceous-black; dorsum reddish brown to wing base; discal mark moderately large, oblong, bright red, narrowly edged with black inwardly; beneath, a heavy, yellow shading on costa and dorsum. Hindwings transparent, margins very

narrow, violaceous-black, discal mark small, orange, fringes sordid black, above and beneath.

Female.—Differs from the male by the broader costa and wider margin of the forewings. Only five yellow bands encircle the abdomen. The anal tuft is narrower, black, slightly intermixed with yellow and the posterior tibiae are broadly marked with black at the lower spurs.

Expanse: Male 18 to 24 mm., female 20 to 30 mm.

Distribution.—General from the Mississippi Valley regions to New England and the Midwestern States.

Type.—Female. In the United States National Museum.

Remarks.—A very common species usually found in association with its food plant, horsenettle (*Solanum carolinense* L.), in sandy regions and neglected farmlands. Large numbers of the moths were collected by A. E. Brower in such a combination at Willard, Mo., in 1919, and on his suggestion a thorough search for the early stages of the insect was made at Tottenville, Staten Island, N. Y., during August 1920 (G. P. Engelhardt and W. T. Davis). The moths at that time were abundant, mostly freshly emerged. A number of pupal exuviae were exposed on the surface near the bases of *Solanum* plants, connected with flimsy silk-lined tubes 3 to 10 inches deep in the soil. Living pupae in some of the tubes quickly descended to the very bottom when disturbed. Stems, annual sprouting from deeply embedded main roots, showed no evidence of the borer's work. Only the main roots from a foot or two under ground appeared to be attacked; this explains the construction of the long tubes to facilitate emergence of the moths. The eggs, normally roundish and brown, are laid in small clusters of three or more, on leaves and stems or dropped on the ground. Underground main roots contained larvae in various stages of growth during August. The principal season of emergence is August to September, with occasional records as late as October. No spring or early-summer records are at hand.

United States National Museum records: Cadet, Mo., female type, August 25, 1877? (Riley); Willard, Mo., long series, August 4–20, 1920 (A. E. Brower); Manhattan, Kans., one male, October 19, 1924; McKinney, Collin County, Tex., one female, October 16, 1908 (E. S. Tucker); Jackson, Miss., one male, September (E. S. Tucker); Red Level, Covington County, Ala., one male, August 12, 1923; Mobile (Chickasaw), Ala., one female, October 12, 1930 (Van ?); Rabun, Ga., one male (dwarfed), July 1910 (W. T. Davis); Southern Pines, N. C., two males, one female, August 8–15; Clarksville, Tenn., two males, August 21 (G. E. Painter); Norfolk, Va., male and female, September 6, 1901 (C. H. Popenoe); Nelson County, Va., male and female, August 10 (W. Robinson); Plummers Island, Potomac River, Md., male and female, August 10, 1907 (W. L. McAtee); Tottenville, Staten Island, N. Y., long series, August 11–14,

1926 (Engelhardt); Decatur, Ill., long series, August 8–23 (Barnes collection).

In addition a few odd specimens from Texas and New Mexico suggest subspecies or geographical races, which is to be expected considering the abundant representation of *Solanum* throughout the Western States, Field investigations of this kind are laborious, and, not being of economic importance, they have been neglected.

Genus CARMENTA Hy. Edwards

Carmenta Hy. Edwards, Papilio, vol. 1, p. 184, 1881. (Genotype, *Aegeria pyralidiformis* Walker.)

Male antennae with short cilia; female antennae simple. Tongue long, spiraled. Labial palpus with a short, nearly smooth brush on second joint; terminal joint smooth, somewhat porrect. Head and thorax smooth. Forewing with 12 veins (11 veins in a few species as the result of coalescence of veins 10 and 11); 7 and 8 stalked, 7 to costa; 10 and 11 confluent before the edge of the wing or united throughout their length. Hindwing with 8 veins; 3 and 4 stalked; 7 and 8 concealed in costal fold. Posterior tibiae nearly smooth, sometimes slightly roughened with stiff hairs at spurs; first tarsal joint not thickened, smooth. Anal tuft of the male rather small, halberd- or fan-shaped. Male genitalia of the *Synanthedon* type; vinculum long; sacculus ridge with a curved row of flat, forked, black scales, terminating in characteristic and diagnostic, sharply curved row of yellow scales to the edge. Aedeagus long, straight, bulbous at base. Female genitalia with terminal part of ductus sclerotized; bursa oval, with signum.

CARMENTA PYRALIDIFORMIS (Walker)

Plate 1, Figure 5; Plate 5, Figures 32, 32a; Plate 13, Figure 62

Aegeria pyralidiformis Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 44, 1856.—Hy. Edwards, Papilio, vol. 1, p. 207, 1881.

Trochilium pyralidiformis Morris, Synopsis of the described Lepidoptera of North America, pt. 1, p. 333, 1862.

Sesia pyralidiformis Boisduval, Histoire naturelle des insects: Spécies général des lépidoptères hétérocères, vol. 1, p. 439, 1874.—Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 310, pl. 32, fig. 18, 1901.

Carmenta pyralidiformis Hy. Edwards, Papilio, vol. 1, p. 184, 1881.—Kellicott, Can. Ent., vol. 24, p. 46, 1892.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 147, 1896.

Sesia nigella Hulst, Bull. Brooklyn Ent. Soc., vol. 3, p. 75, 1881.

Carmenta nigella Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892.

Synanthedon pyralidiformis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8755, 1939.

Male.—Antennae stout, purplish black. Labial palpus with a rough, even brush, golden yellow, tip black. Head purplish black. Collar golden

yellow. Thorax black, with purple or blue luster; patagia with a narrow yellow stripe and a yellow patch beneath at wing base. Abdomen lustrous violaceous or bronzy black; segment 4 broadly banded and segment 7 narrowly banded with yellow above only; anal tuft short, halberd- or wedge-shaped, entirely black. Posterior tibiae rough throughout, black, mixed with yellow at and between the spurs; tarsi with first joints slightly thickened, black; posterior joints sordid yellow. Forewing usually opaque, lustrous violaceous-black, sometimes with a very small vitreous or suffused yellowish area between the veins before, and a very narrow area behind, the discal mark. Fringes broad, sordid black. Hindwing transparent, narrowly margined and broadly fringed with brownish black; vein 1c heavily scaled and thickened toward apex. Beneath, forewing heavily shaded with yellow inwardly and less so outwardly from the discal mark.

Female.—Very similar to the male but averaging larger in size and with a heavier body. Only the fourth abdominal segment is broadly banded with yellow above, and the black anal tuft is rounded with a short brush projecting on each side.

Expanse: Male 12 to 18 mm.; female 13 to 23 mm.

Distribution.—Eastern and Midwestern States, eastern Canada, Southern States, and Gulf of Mexico coastal regions.

Remarks.—*C. pyralidiformis* is a root borer in *Eupatorium,* confining its attacks, however, to species of the so-called bonesets and thoroughworts—*E. perfoliatum, sessilifolium,* and *album.* It has not been found in the common joe-pye-weed, *E. purpureum.* The larvae tunnel in the upper rootstock and before pupating in July or later work up into the bases of the stems to prepare the pupal chambers and the usual circular apertures for exit.

Hulst's *nigella* represents dwarfed forms of this species, which have been traced to impoverished food plants growing in sterile, sandy soil on hillsides. A majority of the several hundred specimens contained in the United States National Museum collection are from Long Island, the vicinity of New York City, New Jersey, and Pennsylvania in long, reared series. Inland, inclusive of the Allegheny Mountains, the species runs true in Virginia, the Carolinas, Ohio, Tennessee, to eastern central Texas. At Myrtle Beach, Horry County, S. C., both typical *pyralidiformis* and the color form *aurantis* were collected September 20, 1937 (Engelhardt), indicating a transition zone. In addition to numerous records from Mobile, Ala., September-October (Van Aller and Engelhardt), the form *aurantis* has been collected at Merrill, George County, Miss., October 2, 1930 (Henry Dietrich), and there are several very old examples in the United States National Museum labeled merely "Texas."

Type.—Female in the British Museum.

CARMENTA PYRALIDIFORMIS AURANTIS, new variety

PLATE 19, FIGURE 109

This is a color form with abdominal bands and markings deep orange or red in place of the lemon yellow characteristic of typical *pyralidiformis*. It represents the southern extension of *pyralidiformis*, beginning in South Carolina and northern Florida and becoming fixed in the coastal regions of the Gulf of Mexico into Texas.

This form, which occurs in a warm, more humid climate, has the same food plants and habits as the typical *pyralidiformis*, but its period of emergence is September and October instead of August and September as in the northern range of the species.

Type.—U.S.N.M. No. 56827, male. Also female allotype, 32 male and 28 female paratypes. Collected at Mobile, Ala. In the United States National Museum.

CARMENTA ANTHRACIPENNIS (Boisduval)

PLATE 19, FIGURE 110

Sesia anthracipennis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 392, 1874.

Synanthedon anthracipennis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8707, 1939.

Male.—Antennae stout, finely ciliate, black. Labial palpus rough, deep tawny-yellow, third joint black above, tawny beneath. Head black. Collar deep tawny-yellow. Thorax violaceous-black, yellow-striped laterally; beneath shiny metallic black with a few scattered yellow scales. Abdomen deep black, shiny; segments 2, 4, and 6 well marked with narrow yellow bands above; segments 3, 5, and 7 sometimes, but not always, slightly edged with yellow. Anal tuft broadly wedge-shaped, black. Coxae of front legs lustrous deep yellow; posterior tibiae rough, black, deep yellow between the spurs. First tarsal joint slightly thickened, black; posterior joints dark tawny. Forewing nearly opaque, lustrous bronze and violaceous-black; usually a well-marked vitreous area before and a very narrow vitreous dash behind the discal mark; these vitreous areas sometimes greatly reduced or nearly absent; beneath forewing heavily shaded deep yellow along the costa and on the basal half. Hindwing transparent, margin narrow, even, deep black, fringes broad, dull black; vein 1c broadening to apex.

Female.—Differs from male by its entirely opaque, lustrous-black forewings with very occasionally a tawny dot before the discal mark. Hindwing transparent, widely and irregularly margined with black, with suffusions between the veins about half the distance to the cell. Abdominal segments 2 and 4 conspicuously banded with deep yellow; segments 5 and 6 thinly banded or barely touched with yellow. Posterior

tibiae mostly black, a few tawny-yellow scales at and between the spurs. Otherwise like the male.

Expanse: Male 17 to 20 mm., female 18 to 22 mm.

Distribution.—Savannah, Ga.; Georgiana, Palm Beach County, Fla.; Mobile, Ala.

Type.—One female in the Oberthür collection, acquired by William Barnes and now in the United States National Museum, labeled *"Sesia anthracipennis* Bdv., type, a/c Hofer." Also attached are labels: "ex Musaeo Boisduval, Oberthur collection," and a handwritten label: "Received Sept. 1882 from Mr. Edwards, Ch. Ob." The example conforms to Boisduval's description.

Remarks.—This insect is recorded first by a hand-painted water-color figure in John Abbot's "Insects of Georgia," published in 17 volumes beginning in 1792 and preserved in the library of the British Museum of Natural History. Fourteen species of Aegeriidae are illustrated in this work, 13 in volume 7, and 1 in volume 17. All can be easily determined. The text supplies dates and place of capture but does not name the species. A good figure is given of a male *anthracipennis* named and described by Boisduval, 1875, in volume 7, page 34. The text states that it "lives on a species of *Salix.*" This signifies merely a capture, not the food plant, which is not willow. Abbot collected at or near Savannah.

A second female from the Oberthür collection is labeled "Georgiana." This should be in Palm Beach County, Fla., where W. Witfeld, the collector, resided about 1880. No additional specimens are recorded until September and October 1927, when the species was collected in numbers near Mobile, Ala., by Thos. S. Van Aller. Other collections have been recorded subsequently. The obvious resemblance and kinship of *anthracipennis* to *sanborni* and *morula* was confirmed by finding that it shares the same food plants and habits as a root borer in species of *Lacinaria* (blazing-star) growing in dry, sandy soil, not in swampy places. The moths frequent flowers, showing preference for late-blooming Compositae. The principal time of emergence in the South is September and October. *C. a. sanborni* in temperate and northern zones emerges in July and August.

Rules of priority in nomenclature dictate the rank of a species for *anthracipennis,* a form restricted to a narrow coastal belt in the South, while *sanborni,* widely distributed over temperate and boreal zones, must be relegated to the rank of race.

CARMENTA ANTHRACIPENNIS race SANBORNI Hy. Edwards

PLATE 19, FIGURE 111

Carmenta sanborni HY. EDWARDS, Papilio, vol. 1, p. 185, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 147, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 311, pl. 32, fig. 17, 1901.

Aegeria morula Hy. Edwards, Papilio, vol. 1, p. 196, 1881.
Sesia morula Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 142, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 288, pl. 31, fig. 18, 1901.
Synanthedon morula McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8712, 1939.
Synanthedon sanborni McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8756, 1939.

Male.—Antennae violaceous-black above, tawny beneath. Labial palpus sordid white, third joint black. Head black. Collar dull yellow. Thorax lustrous bronze-black; patagia laterally striped with pale yellow; metathorax with long, sordid-white lateral tufts; beneath, small clusters of shiny silvery scales. Abdomen lustrous coppery black; segments 2, 4, and 7 narrowly banded with pale yellow or sordid white above, not beneath, anal tuft short, broadly wedge-shaped, black, slightly edged with white. Posterior tibiae very rough throughout, lustrous bronzy and tawny on inner side, spurs sordid white, tarsi with first joint thickened, blackish; posterior joints pale tawny. Forewing with costa and margins broad, black; vitreous spaces much reduced and more or less flushed sordid white; fringes broad, brown black; beneath heavily flushed with tawny-yellow, except for veins, discal mark, and outer margin, which are black. Hindwing transparent, with margin bronzy black, clearly defined; nearly as broad as cilia, which are brown-black.

Female.—Forewing opaque, lustrous black, except a small nearly circular area before the discal mark, which is sordid white or tawny-yellow. The abdominal segments 2 and 4 and sometimes 6 narrowly banded with pale yellow above, not beneath; anal tuft short, rounded, black. Posterior tibiae rough, metallic black throughout. Otherwise like the male.

Expanse: Male 17 to 20 mm., female 18 to 22 mm.

Distribution.—Eastern and Midwestern States, Texas, Colorado; Saskatchewan, Manitoba.

Types.—Female. In the Boston Society of Natural History.

Remarks.—The original description of *sanborni,* said to be based on two females and one male, applies to the female alone. It is doubtful whether Hy. Edwards had male examples of the species, as sexual dissimilarities would have made their recognition unavoidable. The types are two females. The specimens were collected by F. G. Sanborn, at Andover, Mass., on September 7, 1867, on flowers of *Lacinaria scariosa,* which since has been proved to be the food plant. Examples of both sexes have been reared from the bulbous roots. Hy. Edwards described *Aegeria morula* from a single male, labeled "Texas, J. Ball," in the Neumoegen collection now in the United States National Museum. The antennae must have been missing, as female antennae have been substituted. J. Ball, the collector, lived at Dallas, Tex., the probable type locality.

Beutenmüller's illustration of *morula* is not of a female, as stated, but of a male and probably based on the type, as it is shown with male antennae of the subspecies *sanborni.* The males of *anthracipennis* differ

from *sanborni* in the more opaque forewings and the very narrow bands on the abdominal segments 3 and 5, which are not present in *sanborni*. The females differ in the broader margin of the hindwing with irregular extension inwardly about halfway to the cell.

Records of *sanborni* in the United States National Museum: Two males and one female, dunes at Waukegan, Ill., August 27, 1933, bred from roots of *Lacinaria scariosa* (A. K. Wyatt and Engelhardt); one male, East Chicago, Ind., September 6, 1920 (W. J. Gerhard); one female, Beach Station, Lake County, Ill., August 15, 1930 (B. Benish); male and female, Aweme, Manitoba, male, August 20, 1910, female, July 20, 1910 (N. Criddle); one male, Colorado Springs, Colo., bred from roots of *Lacinaria punctata* (Engelhardt); one female, Dickinson County, Iowa, August 1915 (H. M. Clark); one female, Lake Okoboji, Dickinson County, Iowa, June 23, 1922 (R. A. Leusler).

CARMENTA HELENIS, new species

PLATE 20, FIGURE 112

Male.—Antennae ferruginous-black. Labial palpi pale yellow, black on the sides and at tips. Head metallic black. Collar black above, whitish beneath. Thorax black with bluish luster, metathorax transversely edged with pale yellow, a small pale-yellow patch beneath wing base. Abdomen shiny black, segment 4 narrowly banded with pale yellow or whitish, segments 2, 6, and 7 with bands faintly indicated; abdomen beneath pale yellow on posterior half; anal tuft broad at base, bluntly pointed at tip, black above, pale yellow in center beneath. Legs pale yellow or white, posterior tibiae violaceous on upper and outer surfaces, black and white mixed inwardly and beneath; tarsi glossy whitish. Forewing transparent, costa and veins purplish black, outer margin broadened by golden-yellow rays between the veins; discal mark prominent, square, black intermixed with yellow, fringes brownish black. Hindwing transparent, margins narrow, black-violaceous; beneath a heavy yellow shading on costa and margins, discal mark black and orange.

Female.—Similar to male. Antennae rusty black, touched with white on apical half. Abdominal segments 2, 4, and 6 with narrow white bands, only band 4 encircling the body. Outer and inner transparent areas on forewing smaller than in male.

Expanse: Male and female, 16 to 18 mm.

Distribution.—Prairies of Saskatchewan, Manitoba, and British Columbia.

Type.—U.S.N.M. No. 56828, male. Collected at Earl Grey, Saskatchewan. Also allotype female, one male paratype, and one female paratype. In the United States National Museum.

Remarks.—This species, most confusing in its resemblance to *Carmenta ithacae,* is represented by insufficient examples but must be recognized as

distinct on structural differences in the male genitalia. Veins 10 and 11 of the forewings are coincident, as in *ithacae*. The male genitalia differ by the shorter vinculum and by the arrangement of narrower scales on the sacculus ridge, terminating at a shallow pocket without scales before the margin of harpe. The female genitalia are much like those of *C. ithacae*.

The species presumably is a root borer in Compositae in midwestern and Canadian prairie regions.

Records in United States National Museum: Two males, Earl Grey, Saskatchewan, July 4, 1906? (J. D. Ritchie); one female, Glen Souris, Manitoba, July 8, 1925 (N. Criddle); one female, Fernie, British Columbia, June 3, 1934 (H. B. Leach).

CARMENTA PHORADENDRI, new species

PLATE 20, FIGURE 113

Sexes similar.

Male.—Antennae black with steel-blue and coppery reflections. Labial palpi white beneath, black above. Head black, frons blue-black. Collar pale yellow on top, white at the sides and beneath. Thorax black, lustrous steel blue or coppery; patagia striped narrowly with pale yellow; pale-yellow patches below the wing base at the sides; abdomen black with metallic reflections, segments 2, 3, 4, 5, and 6 narrowly banded with pale yellow, segment 4 with the broadest band; segments 4, 5, and 6 more broadly banded beneath than above. Anal tuft well developed, broad, fan-shaped, black, thinly edged with white at the sides. Legs black, posterior tibiae tufted with white at the spurs, tarsi white at the joints above and mixed white and black beneath. Forewing transparent, costa, veins, and narrow vertical discal mark black-violaceous, outer margin black, with dull-yellow suffusions between the veins extending to near the discal mark along costa; beneath, costa and discal mark edged with yellow. Hindwing transparent, veins and narrow margin black, fringes sordid black.

Female.—Similar to the male. Forewing shaded bright yellow between the veins at outer margin; the discal mark yellow, slightly mixed with black; a thin yellow streak between the veins dorsally extending from the discal mark to the wing base. Abdominal segments 2, 4, and 6 narrowly banded with yellow, the broadest band on segment 4 and this alone encircling the body; segment 5 with a broad yellow patch beneath; anal tuft short, rounded and black, sordid white on the upturned edges at the sides.

Expanse: Male and female, 18 to 20 mm.

Distribution.—Bexar and Victoria Counties, Tex.

Type.—U.S.N.M. No. 56829, male. Collected at San Antonio, Tex. Female allotype, five male and six female paratypes also in the United States National Museum.

Remarks.—While in outward appearance closely approaching the tree borers *Thamnosphecia scitula* and *T. pyri,* structures of the genitalia indicate a nearer relationship with *Carmenta querci,* a western species feeding on spongy galls on oak. The sacculus ridge of *phoradendri* bears flat, brown scales ending in a pocket of yellow scales at the margin. This structure prevails in the majority of species boring in herbaceous plants. *C. phoradendri* confines its attacks to the mistletoe, *Phoradendron flavescens,* growing in strong clusters on trees of mesquite, *Prosopis glandulosa,* in Texas. Rearing records thus far are limited to Bexar and Victoria Counties. The larvae tunnel in the heavy, lower parts of the stems and the basal swellings on the branches. From stem cuttings secured in March, moths emerged in April, May, and June. A long series of examples received from H. B. Parks were collected on flowering *Baccharis* at the Apicultural Station near San Antonio during September 1931. This may signify a double-brooded species; however, no material for rearing could be obtained at that time. Infestations are easily detected by the wilted, discolored appearance of the plants. The larvae winter in long galleries, pupating in firmly attached, smoothly silk-lined cocoons at the burrow's exit in the spring. The pupae are normal, light brown.

Sacculus ridge of male genitalia flat-scaled in a thin, curved line, hooked at the margin. Vinculum long and slender.

CARMENTA TECTA (Hy. Edwards)

Aegeria tecta Hy. Edwards, Papilio, vol. 2, p. 56, 1882.

Sesia tecta Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 142, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 302, pl. 31, fig. 7 (male), pl. 33, fig. 2 (male), fig. 3 (female), 1901.

Synanthedon tecta McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8738, 1939.

Male.—Antennae black, strongly dilated and ferruginous. Labial palpi pale yellow or sordid white beneath, black above. Head black. Collar pale yellow above, white at the sides and beneath. Thorax violaceous-black, patagia with a pale-yellow stripe and metathorax tufted with sordid white at the sides; a posterior, transverse, pale-yellow mark; anterior wing base and the sides beneath with patches of pale yellow or sordid white. Abdomen black with steel-blue or violaceous reflections and with five narrow yellow bands on segments 1, 2, 4, 6, and 7, the band on segment 4 broadest and encircling the body; some of the bands not always discernible on abraded examples; segments 5, 6, and 7 each with a pale-yellow patch beneath; anal tuft black, narrowly fan-shaped, faintly fringed with white at the sides and pale yellow in the middle beneath. Legs blue-black, anterior coxae pale yellow, posterior tibiae tufted with sordid white at the spurs, and tarsi banded with white at the joints. Forewing transparent, veins, costa, and narrow margin black, discal mark narrow, straight, and marked with orange outwardly; beneath dusted with golden yellow on costa, discal

mark, and, very slightly, between the veins at outer margin. Hindwing transparent, margined with a thin black line; fringes short, grayish black.

Female.—Larger and with a heavier body than the male. Margin of the forewing considerably broadened by a mixture of violaceous and golden-yellow scales on and between the veins; discal mark also broader, heavily edged with golden yellow outwardly; beneath, costa and veins yellow from wing base to beyond discal mark and violaceous-black at outer margin; fringes broad, dull black. Hindwing transparent, with margins violaceous-black and fringes broad, dull black. Abdomen clearly banded on segments 2, 4, and 6 with pale yellow or sordid white and in some examples also with indications of a band on segment 1; the band on segment 4 encircling the body; worn examples showing a scattering of pale scales on abdomen beneath, insufficient to define the band; the short, blunt anal tuft in some examples yellow, slightly mixed with black in the middle and more heavily at the sides, and in other examples mostly black mixed with sordid white.

Expanse: Male 18 mm., female 20 to 24 mm.

Distribution.—Mountains of Arizona.

Type.—Male. In the United States National Museum.

Remarks.—*C. tecta* is a mistletoe stem borer; it attacks *Phoradendron orbiculatum,* occurring on live oak, in Arizona. In appearance, structure, and habits it is associated closely with *C. phoradendri,* the mistletoe borer in Texas. Its favorite habitat is groves of old live oaks supporting well-established colonies of the mistletoe, usually at considerable elevations in mountainous regions. In such situations the mistletoe attains a large size, growing in dense clusters with thick, brittle stems, firmly anchored on branches, usually too high to reach. Aside from the aegeriid borer, many other kinds of insects are attracted to the plants. Old stems are riddled with the larval galleries of cerambycid and rhynchophorous beetles, subsequently serving wasps and bees for rearing their broods and various other insects which prey upon the inhabitants or utilize the galleries as places of refuge.

The collecting of material for rearing proved arduous. Clusters of mistletoe on high branches were brought down by shots from a rifle. From cuttings containing larvae and pupae of the aegeriid borer, one to three in a stem, taken in the Santa Rita Mountains, March and April 1937, no moths emerged. On a previous visit to the same region, July 26, 1925, a freshly emerged female, still near its exit on a stem was captured. Mistletoe on *Celtis* in the Santa Rita Mountains also contained larvae of an aegeriid borer, which has not yet been reared to the adult stage.

To the 2 male types of *C. tecta* from Prescott, Ariz., collected in 1882, 13 more examples have been added in the course of years, all captured, not reared, specimens from widely separated regions. The collection records probably indicate a much prolonged season rather than a 2-brooded species. The data for these specimens are as follows: One male, Jerome, Yavapai

County, May 12, 1902 (Oslar); two males, Oak Creek Canyon, Coconino County, 6,000 feet (F. H. Snow); one male, Gila County, June 1902 (Poling); one male, Pinal Mountains, Gila County, September 7, 1936 (Parker); two males, Santa Catalina Mountains, Pima County, September; one female, Santa Rita Mountains, Pima County, 4,000 feet, July 26, 1925 (Engelhardt); one female, Santa Rita Mountains, Pima County, 5,000 feet, September 6, 1936 (Parker); one male, Palmerly, Cochise County, August; one female, Hereford, Cochise County, April 9, 1937 (H. Hereford); one female, Chiricahua Mountains, Cochise County, 7,600 feet, August 6, 1933 (Owen Bryant).

CARMENTA APACHE, new species

PLATE 20, FIGURE 114

Female (holotype).—Antennae lustrous blue-black. Labial palpi buff-yellow, tips black above. Head purplish black. Collar dull yellow. Thorax violaceous-black, patagia broadly striped with dull yellow and a broad, brighter yellow, transverse band on metathorax posteriorly; a dull-yellow patch at the sides beneath wing base. Abdomen violaceous-black, segments 2, 4, 5, and 6 broadly banded with yellow, the last three bands encircling the body; anal tuft rounded, black. Legs dull yellow, posterior tibiae purplish black between the spurs and tarsi touched with purplish black below the joints. Forewing heavily scaled, violaceous-black, intermixed with yellow; costa and outer and inner margins broad, transparent areas reduced before and behind the discal mark, which is square, mostly black, touched with yellow outwardly; beneath predominantly yellow. Hindwing transparent, narrowly margined violaceous, fringes brownish black; underside as upper side.

Male.—Description based on two rather worn specimens. Antennae black and fuscous owing to abrasion. Labial palpi pale yellow, black above and at tips. Collar pale yellow. Thorax coppery black, patagia striped with yellow and metathorax well edged with yellow transversely; a yellow patch at the sides beneath. Abdomen coppery black, segments 2, 4, and 6 with encircling yellow bands, the band on segment 4 broadest and that on segment 2 widening at the sides and beneath; anal tuft fan-shaped, black, mixed with yellow at the sides. Legs black, violaceous, posterior tibiae tufted with yellow at the spurs; tarsi dusted with yellow. Forewing transparent, costa, veins, large vertical discal mark, and outer margin purplish black; outer margin inwardly between the veins filled with a mixture of black and yellow scales; beneath yellower than above from discal mark to wing base, otherwise as above. Hindwing transparent, outer margin narrow, purplish black, fringes sordid black; beneath mixed with yellow, most heavily so toward the base.

Expanse: Female holotype 20 mm., male 20 mm.

Distribution.—Arizona.

Types.—U.S.N.M. No. 56830, female.

Remarks.—Described from three specimens, a perfect female and two imperfect males, the latter, not designated as paratypes, in all probability representing the same species, but without knowledge of the food plant and habits the evidence is not conclusive. The three specimens are from Prescott, Ariz., the males collected by H. Dyar, August 20, 1917, and the female from the Barnes collection, dated July 1-7.

Venation and structures of the genitalia indicate a relationship nearest to *C. tecta,* from which the male is readily distinguished by the much broader margins on the primaries and the female by the wide, yellow edge on metathorax and the broad, yellow bands on abdominal segments 2, 4, and 6.

CARMENTA QUERCI (Hy. Edwards)

PLATE 20, FIGURES 115, 116

Aegeria querci HY. EDWARDS, Papilio, vol. 2, p. 98, 1882.

Aegeria quercus HY. EDWARDS, Ent. Amer., vol. 3, p. 224, 1888.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Sesia querci PACKARD, 5th Rep. U. S. Ent. Comm., p. 217, 1890.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 141, 1896; vol. 9, p. 220, 1897; Mem. Amer. Mus. Nat. Hist. vol. 1, pt. 6, p. 301, pl. 31, fig. 15 (male), 1901.

Podosesia comes HEINRICH, Proc. U. S. Nat. Mus., vol. 57, p. 79, 1920.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8770, 1939.

Synanthedon querci MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8736, 1939.

Male.—Antennae black, short, strongly clavate to tips, pectinations arising from brown bases. Labial palpus with a rough brush, black and white mixed. Head black, shiny blue-black on top, face white. Collar pale yellow or white above, black at the sides and beneath. Thorax black with steel-blue or coppery reflections; patagia tipped with pale yellow at posterior end and metathorax tufted at the sides and transversely edged with very pale yellow; a pale-yellow patch at wing base on the side. Abdomen black, lustrous steel blue, or coppery, with a very narrow band on segments 2 and 3, a very broad one on segment 4 encircling the body, and very narrow ones on the last two segments; anal tuft black, edged with pale yellow above. Legs black, femora white beneath, posterior tibiae tufted at the spurs, white; tarsi sordid white, first joint dusted with black. Forewing transparent, costa and very narrow margin violaceous-black, slightly shaded with golden yellow inwardly; a very slight yellow suffusion between the veins at outer margin; discal mark straight, very narrow, golden yellow, edged with black at inner junction with costa; underside mostly yellow. Hindwing transparent with very narrow violaceous margins and yellow costa, above and beneath; fringes short, sordid black.

Female.—Larger and stouter than the male; forewing with slightly broader yellow suffusions between the veins at outer margin; abdominal

segments 2, 3, and 6 narrowly banded with pale yellow above and at the sides, segment 6 broadly banded, the band encircling the abdomen; anal tuft short, rounded, lemon yellow, black at the sides and beneath or black in the middle between yellow and, laterally, black tufts. Otherwise like the male.

Expanse: Male 15 to 17 mm., female 18 to 20 mm.

Distribution.—Arizona.

Type.—Male. Collected at Fort Grant, Ariz. In the American Museum of Natural History.

Remarks.—Although represented sparsely only from Arizona, its range most likely extends through Mexico into Central America. It is congeneric with an unnamed species bred from very large, spongy oak galls in Guatemala (Engelhardt, 1934).

Records at the United States National Museum: One female, Arizona, August 3, 1882 (C. V. Riley); male type and one female paratype, *Podosesia comes,* Bush Corral, Santa Catalina Mountains, Ariz., bred May 11-15, 1920 (G. Hofer); two males, Sabina Canyon, Pima County, Ariz., bred from spongy galls on *Quercus oblongifolia,* collected February 8, 1921 (G. Hofer), reared Brooklyn, N. Y., March 8-10, 1921 (Engelhardt); one female, Oracle, Pinal County, Ariz., reared from gall on *Quercus arizonica;* one male, two females, Baboquivari Mountains, Pima County, Ariz., August 15-20, 1921 (O. C. Poling); one female, Mohave County, Ariz., July 8-14.

CARMENTA TORRANCIA, new species

PLATE 20, FIGURE 117

Male.—Not known.

Female.—Antennae strongly dilated to tips, basal two-thirds lustrous orange, anterior one-third black-violaceous. Labial palpi rough, pale yellow at bases and deep yellow on upper parts and above. Head black; face shiny white; a posterior fringe of stiff hairs, black and yellow mixed, on top, white at the sides and beneath. Collar broad, golden yellow. Thorax black, patagia pale yellow on lower half and metathorax edged with yellow transversely; wing base of primaries above and at the sides white, beneath shiny yellow. Abdomen black, broadly banded on segments 2, 4, 5, and 6, the bands encircling the body; segment 3 black, slightly mixed with yellow; anal tuft a short, rounded brush, light orange, slightly mixed with black at the base. Legs with femora orange and black, posterior tibia rough, orange, black at the proximal end; tarsi orange. Forewing with transparent areas much suffused and reduced, rusty brown with coppery reflections; discal mark prominent, bright red, and costa and inner margin shaded with red; outer margin narrow but densely suffused by coppery rays between darker veins; wing base tipped with blue-black; beneath deep yellow and orange, discal mark red; fringes rusty black. Hindwing transparent; veins, outer and inner margins rusty black, shading to orange

basally; costa and discal mark deep orange, fringes rusty black; beneath dull yellow outwardly, orange inwardly.

Expanse: Females 16 to 22 mm.

Distribution.—New Mexico, Arizona.

Type.—U.S.N.M. No. 56831. Female. Collected in Torrance County, N. Mex.

Remarks.—Only the type and three female paratypes in the United States National Museum and three females in the Engelhardt collection now included in the National collection are known. Six of the specimens were collected in Torrance County, N. Mex., 6,000 feet, June 23, 1929 (R. H. Painter), and to these a seventh specimen has been added, collected at Hereford, Cochise County, Ariz., September 17, 1935 (F. H. Parker).

The species strongly suggests a kinship to *rileyana,* and with this in mind I visited the New Mexico type locality in midsummer, 1934. It is in open country of pasture and agricultural lands. A day was spent in digging out an abundant blue-flowered and deep-rooted species of *Solanum,* as well as many other kinds of herbaceous plants, without results.

CARMENTA AUSTINI, new species

PLATE 20, FIGURE 118

Male.—Antennae strongly pectinate, black above, fuscous beneath. Labial palpus with a rough brush, yellow, heavily mixed with black at the sides and above. Head black; face violaceous, edged with yellow at the sides. Collar dull yellow. Thorax black, spotted with golden yellow on each side below the collar, patagia long, tufted with sordid yellow on posterior part and a yellow patch at and beneath the wing base. Abdomen black with greenish luster, each segment with a yellow band, which is broader beneath than above; anal tuft short, spatulate, yellow with black center and sides. Legs yellow, posterior tibiae rough, slightly shaded with black at and between the spurs. Tarsi yellow, with a few black, short spines at the sides. Forewing transparent, costa and narrow outer margin violaceous-black, broadly rayed with deep orange between the veins; discal mark conspicuous, bright red; inner margin violaceous at tornus, becoming orange before the wing base; fringes dull black; beneath costa and veins heavily shaded with orange, discal mark red. Hindwing transparent, narrowly edged with black and orange mixed and broadly fringed with dull black; discal mark conspicuous, triangular, bright red; beneath, veins and margin dull yellow.

Female.—Like the male, orange and red shadings on primaries intensified; anal tuft short, rounded, yellow.

Expanse: Male and female, 30 mm.

Distribution.—Texas, Utah.

Type.—U.S.N.M. No. 56832.

Remarks.—Represented only by the types; the male holotype captured inside a window, Biological Department, University of Texas, Austin, Tex., November 4, 1922 (H. B. Park), and the female allotype collected at Ephraim, Sanpete County, Utah, September 29, 1929 (H. B. Park). The larger size and brighter coloration set the examples apart as a distinct species.

CARMENTA GILIAE (Hy. Edwards)

PLATE 20, FIGURES 119, 120

Aegeria giliae HY. EDWARDS, Papilio, vol. 1, p. 200, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.

Sesia giliae BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 128, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 279, pl. 31, fig. 8 (male), pl. 33, fig. 1 (female), 1901.

Synanthedon giliae MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8695, 1939.

With this species have been united as forms a large number of specimens that differ greatly in coloration and in size but that cannot be separated specifically on structures, external or genitalic. All inhabit regions of the Rocky Mountains at considerable altitudes, bright-colored examples in general occurring at elevations from 6,000 to 8,000 feet and those of darker colors at elevations from 8,000 to 10,000 feet. Arizona and New Mexico specimens average smaller in size than those from Colorado and northward to Alberta.

Male.—Antennae strong, slightly dilated at tips, black above, brown beneath. Labial palpus with a heavy brush, yellow, edged with black at the sides. Head rusty black, face buff. Collar long-haired, yellow. Thorax coppery black; patagia with a narrow yellow stripe; metathorax with long, yellowish tufts at the sides and some flat yellow scales on posterior edge; a yellow spot anterior to wing base and a yellow patch beneath at the sides. Abdomen coppery black, segments 2, 4, 6, and 8 broadly banded, segments 1, 3, and 5 narrowly banded with yellow, the narrow bands sometimes very faint; beneath the bands uniting more or less; anal tuft flat, rounded, black, yellow in the middle. Legs hairy, yellow and black; posterior tibiae rough, black and yellow mixed and tufted with yellow at the spurs, tarsi yellow, slightly touched with black. Forewing transparent, costa and veins black; outer margin narrow, lustrous coppery black and a narrow suffusion of black and yellow scales between the veins; inner margin black, dusted with orange or red scales to wing base; discal mark orange or red, black on inner side. Hindwing transparent, narrowly margined with coppery black, fringes dull black. Undersides of wings more yellow than black.

Female.—Brighter in coloration. Antennae black, brown when abraded. Labial palpi golden yellow throughout, or barely touched with black at the sides. Thorax well marked with a yellow stripe on patagia

and transversely on posterior margin of metathorax. Abdomen broadly banded with golden yellow on segments 2, 4, and 6 and more narrowly banded on segments 3 and 5, subject to variation; the bands broadened or united beneath; anal tuft deep yellow, slightly mixed with black at base and sometimes at the sides. Posterior tibiae rough, yellow, blue-black at the lower spur; tarsi pale yellow. Forewing transparent, costa dark brown, edged with golden brown inwardly, narrow outer margin, fringes and veins golden brown and inner margin deep orange or red, discal mark also orange or red except for a very narrow black inner edge. Hindwing similar, inner veins darker and fringes turning yellow near wing base. Beneath wings shaded heavily with deep yellow, orange, or red.

Expanse: Male 26 to 28 mm., female 24 to 30 mm.

Distribution.—Rocky Mountains, Colorado, Utah.

Type.—Female. Collected in Colorado (Morrison). In the American Museum of Natural History.

Remarks.—An accumulation of over 50 specimens, assembled under the name of *giliae,* align themselves definitely with this species on structures, but in coloration and in size they vary greatly. This material comprises specimens collected singly or in small numbers, many in a worn condition, over a long period of years. The moths are active fliers, indiscriminate in visiting flowers. The first clue to the insect's food plant was furnished by a fine series of fresh specimens collected by A. B. Klotz during August 1932 on a species of wild geranium in New Mexico, 9,200 feet. Upon repetition of this experience (Klotz and Engelhardt) in the San Juan Mountains, San Miguel County, Colo., 10,000 feet, August 1937, a female was observed ovipositing on geranium, and after persistent search larvae were found in the roots. The borer shows preference for old, strongly rooted plants along exposed places rather than in dense woods, and it was found in colonies, often widely separated. Unfortunately none of the larvae survived the winter. More careful and extended field investigations are needed to support or to correct the foregoing conclusions.

As typical *giliae* I have selected a series that most nearly agrees with Hy. Edwards's original description and with the female type. The examples in this series, males and females, come from Jefferson County, Colo., 6,000 to 8,000 feet, as did the type. Added to this series is a female from Mount Timpanogos, Utah County, Utah, 8,000 feet, and another very old female, labeled *Albuna rileyana* Hy. Edwards, Type 2, evidently in Hy. Edwards's handwriting. This specimen clearly is *giliae,* not *rileyana.* Distinguishing features of typical *giliae* are the highly colored forewing with the costa and outer margin golden brown and the conspicuous discal mark bright red. The abdomen is banded with yellow, broadly or narrowly, on every segment. All dates of capture are during July.

CARMENTA GILIAE form VITRINA (Neumoegen)

Albuna vitrina NEUMOEGEN, Ent. News, vol. 2, p. 109, 1891.
Aegeria deceptiva BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 93, 1894.
Synanthedon giliae McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8695, 1939.

Male.—Antennae black. Labial palpus rough, yellow, heavily mixed with black on first and second joints, third joint black. Head black, buff or pale yellow between the eyes. Collar with long hair, which is mixed with black, although mostly pale yellow. Thorax lustrous blue-black, on fresh specimens densely clothed with yellowish hair above and beneath. Abdomen shiny black, segments 2, 4, 6, and 7 always with encircling yellow bands; segments 3 and 5 with traces of bands on some specimens; anal tuft narrowly fan-shaped, pale yellow in middle above and beneath and broadly edged with black at the sides. Legs hairy in a mixture of black and yellow; posterior tibiae mostly black between the spurs; tarsi black, dusted with yellow. Forewing transparent, costa and outer margin black with a slight mixture of orange scales, which are most pronounced between the veins at the margin; inner margin shaded with yellow toward wing base; discal mark black, spotted with red; underside pale yellow, discal mark red and black. Hindwings transparent, narrowly margined with metallic black; fringes broad, rusty black.

Female.—Similar to male. Outer margin of forewing with lustrous brownish scales between the veins and discal mark black and red or red edged with black inwardly; abdomen with segments 2, 4, and 6 broadly banded with yellow; sometimes a faint indication of yellow bands on segments 1, 3, and 5; beneath, the bands broadening or uniting; the short anal tuft bluntly pointed, black and yellow mixed, mostly black in the middle. Posterior tibiae more evenly mixed with black and yellow than in the male.

Expanse: Male 20 to 24 mm., female 24 to 28 mm.

Distribution.—Rocky Mountains, Arizona to Alberta, Canada.

Type.—Male. Collected at Fort Calgary, Alberta. In the United States National Museum.

Remarks.—For this form, prevailing in Rocky Mountain regions at altitudes from 8,000 to 10,000 feet (less in the northern limits of its range), the name *vitrina* Neumoegen, considered by Beutenmüller a synonym of *giliae,* has been resurrected. From typical *giliae* this form differs strikingly in its darker coloration, in the fewer abdominal bands, and in the average smaller size. The effect of higher altitudes is registered by greater hairiness.

United States National Museum records: Four males, Paradise Creek, White Mountains, Ariz., 9,000 feet, July 15, 1932 (A. Duncan); three males, two females, Little Tesugue Canyon, Santa Fe, N. Mex., 9,200 feet, July 27-August 10, 1932 (A. B. Klotz); one male, Beulah, N. Mex., July 21 (Cockerell); three males, one female, San Juan Mountains, San Miguel County, Colo., 10,000 feet, July 1937 (Engelhardt); one female, Rock

Creek, Teller County, Colo., 8,200 feet, August 19, 1937 (Engelhardt); one male, two females, Middle Piney Lake Range, Wyo., 8,000 feet, August 9-12, 1935 (A. B. Klotz); female type, Fort Calgary, Alberta (Barnes collection, now in the United States National Museum).

CARMENTA GILIAE WOODGATEI, new race

Male.—Antennae black or brown when abraded, pectinations strong. Labial palpi rough, pale yellow or buff, mixed with black at the sides and on third joint above. Head black, face buff. Collar pale yellow mixed with black above, buff at the sides and beneath. Thorax black, heavily clothed with yellow and black hair; metathorax with long tufts overlapping from the sides to the center; a pale-yellow spot at anterior base of the primaries connecting with patches of the same color at the sides and beneath. Abdomen black, with pale-yellow, broad, encircling bands on segments 2 and 4, the bands uniting on segments 5, 6, and 7; segment 3 barely edged with yellow and otherwise deep black; anal tuft narrow and more pointed than flat; the central tuft yellow, the lateral tufts black. Legs hairy, black and yellow; posterior tibiae rough, broadly banded with violaceous-black between the spurs; tarsi yellow, dusted with black above. Forewing transparent, costa violaceous-black with a thin orange inner line; outer margin narrow, with black and orange scales between the veins, all veins dusted more or less with orange, most heavily on the inner margin; discal mark black and orange, in some specimens largely black, in others largely orange; underside heavily dusted with yellow, orange on the discal mark; fringes brownish black. Hindwing transparent, narrowly margined with violaceous-black; underside dusted with yellow and orange on discal mark; fringes pale yellow at wing base.

Female.—Similar to male; costa of forewing golden brown, outer margin broader, lustrous deep yellow, discal mark orange or red, margined with black inwardly. Thorax with a yellow stripe at the sides. Abdominal bands pale yellow or buff, separated above, united on posterior half beneath; anal tuft yellow, slightly mixed with black.

Expanse: Male 18 to 24 mm., female 20 to 24 mm.

Distribution.—Rocky Mountains, New Mexico and Arizona.

Type.—U.S.N.M. No. 56833, male. Collected at Fort Wingate, N. Mex. Female allotype, nine male and three female paratypes also in the United States National Museum.

Remarks.—The relationship of this form to typical *giliae* is recognized on evidence of the male genitalia. Without this evidence the status or relationship would be in doubt. The material on hand, while extensive, consists largely of old, worn examples, some obtained from John Woodgate, a pioneer collector and former postmaster at Fort Wingate and Jemez Springs, N. Mex., for whom this form has been named. Other examples were collected by F. H. Snow in Oak Creek Canyon, Yavapai County,

Ariz., early in this century. A few specimens of more recent date come from Oak Creek Canyon and from the White Mountains, Arizona.

In coloration the form *woodgatei* closely resembles the typical form of *giliae,* but it averages much smaller in size. Examples from Fort Wingate, N. Mex. (Woodgate), are dated August 1-7, year and altitude not being shown. Hairiness of the examples indicates an elevation of 9,000 to 10,000 feet, regions favored by Woodgate when collecting. The specimens collected by Snow, Oak Creek Canyon, Ariz., August, 6,000 feet, are not so hairy, thus reflecting the lower elevation. A pair collected in copulation, Oak Creek Canyon, Ariz., August 9, 1932 (R. H. Beamer), duplicates the Snow specimens. Both *vitrina* and *woodgatei* are represented in material from the White Mountains of Arizona collected at elevations of 8,000 to 10,000 feet. Along the highway from Springerville to Harrigan Meadows, Apache County, Ariz., 8,500 feet, aegeriid larvae were found in the big, spongy roots of *Geranium caespitosum* growing on a steep embankment. These again failed to survive the winter. It is hoped that these investigations will be continued more successfully by western collectors.

CARMENTA BASSIFORMIS (Walker)

Aegeria bassiformis WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 39, 1856.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 24, 1893.

Trochilium bassiformis MORRIS, Synopsis of the described Lepidoptera of North America, p. 331, 1862.

Sesia bassiformis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 434, 1874.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 133, 1896; vol. 9, p. 219, 1897.

Trochilium lustrans GROTE, Can. Ent., vol. 12, p. 213, 1880.

Aegeria consimilis HY. EDWARDS, Papilio, vol. 1, p. 194, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Aegeria corusca HY. EDWARDS, Papilio, vol. 1, p. 193, 1881.

Aegeria eupatori HY. EDWARDS, Papilio, vol. 1, p. 195, 1881.—BEUTENMÜLLER, Ann. New York Acad. Sci., vol. 5, p. 205, 1890; Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Aegeria sexfasciata HY. EDWARDS, Papilio, vol. 1, p. 193, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Aegeria imitata HY. EDWARDS, Papilio, vol. 1, p. 196, 1881.

Aegeria lustrans GROTE, New check list of North American moths, p. 12, 1882.—WEED, Amer. Nat., vol. 23, p. 1108, pl. 43, fig. 6, 1889.—KELLICOTT, Can. Ent., vol. 24, p. 46, 1892.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892; vol. 5, p. 25, 1893; vol. 6, p. 92, 1894.

Sesia corusca BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 140, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 299, pl. 31, fig. 21, 1901.

Sesia imitata BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 133, 1896.

Sesia bassiformis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 284, pl. 31, fig. 3, pl. 33, fig. 4, 1901.

Sesia bassiformis HY. EDWARDS, Ent. News, vol. 19, p. 164, 1908.

Synanthedon bassiformis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8704, 1939.

Male.—Antennae only slightly dilated toward apices, pectinations short and fine, black with bluish reflections, sometimes with a short, buff shading above on outer half. Labial palpi smooth, pale yellow, tips black. Head violaceous-black. Collar yellow. Thorax black, lustrous blue-black or coppery; a long, thin, yellow stripe on patagia; metathorax with yellow tufts at the sides and a few flat yellow scales transversely; a yellow, narrow patch at the sides before the wings and an irregular patch below the wings. Abdomen long, slender, violaceous-black, all segments narrowly banded with yellow above, the bands broadening at the sides and uniting beneath; bands on segments 3 and 5 fainter or sometimes wanting, owing usually to abrasion or discoloration; anal tuft large, fan-shaped, lustrous black, edged with yellow at the sides and yellow in the center beneath. Legs yellow, violaceous-black on outer side, except at tibial spurs; tarsi yellow, touched with blackish between the joints. Forewing transparent, with narrow metallic bronzy borders, the outer margin broader and rounded inwardly, with yellow rays between the veins; discal mark straight, oblong, purplish black; underside washed with yellow. Hindwing transparent, margin narrow, black, dusted with yellow, fringes dull black, above and beneath.

Female.—Similar to the male, but with a stouter body. Antennae always buff or yellow before the tips. Margins and discal mark of the forewing bronzy brown rather than bronzy black. Abdominal segments 4 and 6 conspicuously banded with yellow, twice as broad as the bands on segments 1, 2, and 4; segment 5 not banded above, but broadly so beneath, this band uniting with that on segment 4; the short, blunt anal tuft black at the base and orange at the tip, above and beneath.

Expanse: Male 18 to 21, female 18 to 26 mm.

Distribution.—Eastern, Southern, and Midwestern States.

Type.—In the British Museum of Natural History.

Remarks.—Critical studies of long series of well-preserved specimens in the United States National Museum collection confirm Beutenmüller's conclusion in considering as synonyms the species listed under *bassiformis.* Captured specimens of the moths, which are strong, active fliers, often are worn and in the cabinet become discolored by grease. Judged by the condition of types such imperfections have caused confusion in the past. For accurate determination the venation and structures of the genitalia are more dependable. Veins 10 and 11 of the forewing are confluent from or before middle to costa. The sacculus ridge of the genitalia is densely clothed with strong, bifurcated scales and connects before the margin of the harpe with a recurving pocket filled with smaller lighter colored scales. This structure, shared by other species of the genus, differs sufficiently in details to afford specific alignment.

C. bassiformis is a root borer in ironweed, *Vernonia noveboracensis,* and in near-related species of this plant. I have failed to find it in joe-

pye-weed, *Eupatorium purpureum,* recorded by H. Edwards as a host. The insect is locally common and appears to live in colonies, often widely separated, regardless of an abundance of the food plant. The moths in visiting flowers fly long distances, but in the morning and late in the afternoon they can be found resting on foliage about their breeding places. They emerge from late in July through August and September. The eggs are laid singly or in small numbers attached to leaves or dropped at the base of the food plant. The young larvae enter growing stems, bore down to the roots, where they winter in various stages of development, and resume feeding during spring and early summer. Before pupation stems of the previous year's growth again are entered, girdled, and caused to break off several inches above ground. For purposes of rearing, these stem stumps containing pupae in midsummer can be collected easily, compared to the labor of digging out the deep-rooted plants. Many of the aegeriid species that are root borers in herbaceous plants have similar habits.

Fine series of *bassiformis* have been obtained by rearing on Long Island, Staten Island, and in the vicinity of New York City; also near Pittsburgh, Pa., by Henry Engel. Records of captures in general cover the Atlantic Coast and Midwestern States, the specimens showing no variation, with one striking exception, a form with opaque or nearly opaque forewings that is represented only by the female. In Illinois this form occurs in mixed association, but in Kansas, Missouri, and Texas it replaces typical females of *bassiformis.* All the males run true to type and the females differ only in coloration, not in structure. Good series, definitely connecting the sexes, have been collected in the region of Manhattan, Kans. (R. P. Painter). In Ellsworth County, Kans., a heavy infestation was noted in *Vernonia crinita,* indicating an earlier season of emergence, June and July. Records from Austin and College Station, Tex., are dated as early as April and May. Beutenmüller doubtfully considered this form as the female of *aureopurpurea* Hy. Edwards, a species from Texas, congeneric but much smaller and specifically distinct, which is still known only from two male types described in 1880. Available males associated with such females perfectly match the type of *bolli* Hy. Edwards, from Texas, described from a single male (which is in the United States National Museum) and placed by Beutenmüller as a synonym of *bassiformis.* Accordingly, the name *bolli* is here restored and applied to this female color form of *bassiformis.*

Records in United States National Museum: Old specimens without locality and date from New York, New Jersey, Ohio, North Carolina, Texas. Dated records, Long Island, N. Y. (Jamaica, Newton, Flushing), reared males and females, August-September 1924 (Engelhardt); Staten Island, reared males and females, August 1926 (W. T. Davis and Engelhardt); Bronx River, N. Y., Botanical Garden, males and females, July,

August, September 1937 (H. J. Dietz); Delaware Water Gap, Pa., males and females, July (A. T. Slosson); Pittsburgh, Pa., reared males and females, August-September 1906 (Hy. Engel); Clearfield, Clearfield County, Pa., reared males and females, July-August 1922 (Nell McMurray); Cincinnati, Ohio, males and females, May 1902 (A. F. Braun); Palos Park, Chicago, Ill., male and female, August 8, 1915 (A. K. Wyatt); Washington, D. C., one male, August 1925 (A. Busck); Nelson County, Va., males and females, August 2, 1927 (W. Robinson); Black Mountains, N. C., female, September 11, 1906 (Beutenmüller); Putnam County, Ill., one female, August 4, 1940 (M. O. Glenn).

CARMENTA BASSIFORMIS form BOLLI (Hy. Edwards)

Aegeria bolli Hy. Edwards, Papilio, vol. 1, p. 191, 1881.

Synanthedon bassiformis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8704, 1939.

Male.—Like the male of *bassiformis*.

Female.—Differs from the female of typical *bassiformis* by the heavier scaling on the forewings, which in extreme examples are entirely opaque and in others show a reduction of the clear areas to a small, circular space before and a narrow, short space behind the discal mark. The wings have a purplish rather than a violaceous luster. The bands on abdominal segments 1, 2, 4, and 6 are pale yellow or sordid white and do not broaden or unite beneath. The anal tuft is black throughout, not orange at the tip.

Expanse: Male 17 to 20 mm., female 20 to 22 mm.

Distribution.—Illinois, Kansas, Missouri, and Texas.

Type.—Male, from Texas. In the United States National Museum.

Remarks.—What has been considered as the female of *aureopurpurea* Hy. Edwards, a species known only by two male types from Texas, proves to be a color variation restricted to females of *bassiformis* in the midwestern and western range of the species. Good series of specimens of both sexes from Illinois, Kansas, Missouri, and Texas definitely establish this relationship.

Records in the United States National Museum: Decatur, Ill., males and females, July 16, 1923 (Barnes collection); River Grove, Cook County, Ill., August 5, 1934, male and female (A. K. Wyatt); Pottawatomie and Riley Counties, Kans., males and females, June-July 1929 (R. B. Painter and G. P. Engelhardt); Willard, Greene County, Mo., one female, July 27, 1929 (A. E. Brower); Austin, Tex., one female, April 3, 1921 (R. B. Painter); College Station, Tex., two males, May 20, 1935 (H. J. Reinhard).

CARMENTA TEXANA (Hy. Edwards)

Pyrrhotoenia texana Hy. Edwards, Papilio, vol. 1, p. 204, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 26, 1893; vol. 8, p. 145, 1896.

Pyrrhotaenia wittfeldii Hy. Edwards, Papilio, vol. 3, p. 156, 1883; Ent. Amer., vol. 3, p. 224, 1888.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892.

Sesia texana Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 304, pl. 31, fig. 4 (female, not male), 1901.

Synanthedon texana McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8742, 1939.

Male.—Antennae strong, black, with a bluish luster, pectinations short. Labial palpus orange, third joint black toward the tip. Head metallic black. Collar orange. Thorax lustrous blue or green-black; patagia conspicuously striped and metathorax transversely edged with orange or red; orange or red patches on the sides and underside. Abdomen shiny blue-black; segments 2, 4, 6, and 7 evenly banded above with deep orange or red, band on segment 2 not extending beneath, but bands on segments 4, 6, and 7 uniting with that on segment 5 into one deep orange or red patch; anal tuft fan-shaped, angular at base, rounded at tip, violet-black, orange at the edges and in center beneath. Legs lustrous purplish black, posterior tibiae golden yellow on the inner side and ringed at the spurs with the same color; tarsi ringed with yellow at the joints. Forewing with veins 10 and 11 coincident, heavily scaled, violaceous-black, transparent areas much reduced, the outer one more or less suffused with orange, the inner one clear, narrowly triangular, extending to wing base; discal mark large, square, lustrous purple; fringes dark brownish black; underside heavily shaded with orange from discal mark to wing base. Hindwing transparent, with black margin and brownish-black fringes above and beneath.

Female.—Similar to the male but with forewing more opaque, the outer clear area being obscured with orange and purplish scales and the inner one reduced to a short, narrow slit, not reaching the wing base; an orange streak between the veins before the inner margin on basal half. Abdomen with an orange or red band on segments 2, 4, and 6 and sometimes a fainter band indicated on segment 5 above; beneath the bands broadening and nearly uniting on segments 4, 5, and 6; anal tuft glossy black, short, rounded, indented centrally.

Expanse: Male and female 18 to 22 mm.

Distribution.—Florida, coastal regions of Gulf of Mexico to Texas.

Type.—Female, from Texas. In the United States National Museum.

Remarks.—This species, contrastingly marked with orange or red and lustrous black, does not readily suggest its near kinship to *bassiformis,* but this affinity is evident from its structure and habits. Its resemblance to *floridensis* has caused confusion, though the two species are not closely related.

The principal food plant of *texana* is *Eupatorium serotinum,* a composite that grows luxuriously in moist places throughout Florida and in the coastal areas along the Gulf of Mexico to Texas. The larvae bore in the roots and stalks, numbers of them in large plants. Rearings from *Arte-*

misia and *Grindelia* also produced the same species. In Florida the moths emerge from March to June, issuing from larval galleries packed with frass in the crown roots and in the stalks.

Records from specimens in United States National Museum: Royal Palm State Park, Dade County, Fla., reared from *Eupatorium*, males and females, May 5-16, 1930 (Engelhardt); Biscayne Bay, Dade County, Fla., male and female (A. T. Slosson); Lake Okeechobee, Glades County, Fla., reared male and female, May 6, 1929 (Engelhardt); St. Petersburg, Fla., May 12, 1914, two males (R. Ludwig); Dunedin, Pinellas County, Fla., reared from *Grindelia*, male, March 20, 1929 (Engelhardt); Palm Beach, Fla., male and female, June 1900 (P. C. Truman); Florida City Beach, Fla., one male reared from *Eupatorium serotinum*, May 6, 1941 (F. M. Jones); Lower Matacumbe Key, Fla., one female reared from *Melanthera deltoidea*, May 2, 1941 (F. M. Jones).

CARMENTA ITHACAE (Beutenmüller)

PLATE 21, FIGURES 121, 122

Sesia ithacae BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 25, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 299, pl. 31, fig. 22 (female), 1901.
Synanthedon ithacae McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8732, 1939.

Male.—Antennae metallic black, white before the tips. Labial palpi whitish or pale yellow, black above. Head lustrous blue-black. Collar pale yellow. Thorax shiny black, patagia with a thin yellow stripe and metathorax tufted with sordid yellow at the sides and pale yellow patches on thorax beneath the wing base. Legs with forecoxae shiny white, posterior tibiae and tarsi violaceous-black, the former white at the spurs, the latter white at the joints. Abdomen shiny black with violaceous or coppery reflections; segments 2, 4, 6, and 7 with thin whitish bands above, the bands narrowly uniting at the sides, the one on segment 4 encircling the body; whitish scales scattered along the middle of the abdomen beneath; anal tuft broadly fan-shaped, shiny black, edged with whitish at the sides and in the center beneath. Forewing with veins 10 and 11 coincident, transparent, costa and margins black, outer margin much broadened by golden-yellow rays between the veins; outer clear area small, square; basal area triangular to wing base; discal mark subquadrate, purplish black; underside pale yellow on costa and inner margin; fringes grayish black. Hindwings transparent, narrowly margined with black above and beneath.

Female.—Very similar to the male, but the body stouter. Antenna more contrastingly marked with whitish before the tip. Abdominal segments 2, 4, and 6 narrowly banded with whitish or pale yellow above and broad, whitish patches at the sides, absent beneath.

Expanse: Male 15 to 17 mm., female 16 to 18 mm.

Distribution.—Eastern and Midwestern States, Appalachian Mountains in the South.

Type.—Male from Ithaca, N. Y. In the American Museum of Natural History.

Remarks.—Cabinet specimens invariably become greasy and the color markings obscured. Even immersion in benzene or other chemical agents does not always restore the natural colors. This may explain the inaccuracy of Beutenmüller's description and colored illustration.

C. ithacae easily can be, and frequently has been, confused with *Thamnosphecia pyri* and *T. scitula* because of superficial resemblance. For definite determination, differences in venation and in the genitalia are more dependable. Veins 10 and 11 in the forewing of *T. pyri* are separate, the sacculus ridge of the male genitalia is armed with strong spines in a row not reaching the margin of harpe, and the vinculum is short; whereas in *C. ithacae* veins 10 and 11 are coincident, the sacculus ridge bears flat, bifurcated scales connecting near the margin of harpe with a pocket of smaller, paler scales, and the vinculum is slender and long. The food plant of *C. ithacae* is oxeye, *Heliopsis helianthoides,* the larvae boring in the crown roots and lower parts of the stems, where they pupate early in the summer, having previously filled the galleries with frass and constructed a silk-lined case behind a thinly covered circular exit. The moths are at large from late June to August. One female is labeled: Chicago, Ill., August 18, 1907, bred from sneezeweed, *Helenium autumnale* by Hy. Bird.

Records in United States National Museum: Reared series, Ithaca, N. Y. (type locality), males and females, July 29-August 5, 1930 (A. E. Brower and Engelhardt); Clearfield, Pa., males and females, July 14-August 20, 1923 (N. McMurray). Captured specimens, Falls Church, Va., one male, July 20, 1914 (C. Heinrich); Montgomery County, Md., June 20, 1914, one female (W. T. Davis); Glencarlyn, Va., one female, June 6, 1910 (F. Knap); Onaga, Kans., one male, June 27, 1922 (Creveceur); La Fayette, Ind., July 3; Balsam, N. C., one male, July 20, 1911 (A. F. Braun); Forest Park, Chicago, Ill., one female, July 11, 1915 (E. Beer).

CARMENTA AUREOPURPUREA (Hy. Edwards)

Aegeria (?) *aureopurpura* Hy. Edwards, Bull. Brooklyn Ent. Soc., vol. 3, p. 72, 1880.

Sesia aureopurpurea Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 137, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 296, pl. 32, fig. 33 (male), 1901.

Synanthedon aureopurpurea McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8728, 1939.

Male.—Antennae black, broadly white near the tips. Labial palpi yellow. Head black. Collar yellow. Thorax brownish black, patagia striped with bright yellow. Abdomen lustrous blue and coppery black, segments 1, 2, 4, 6, and 7 narrowly edged with pale yellow. Anal tuft fan-shaped,

brownish black. Legs yellow, posterior tibiae and tarsi purplish brown. Forewing opaque, purplish black and lustrous golden between the veins before outer margin; fringes brownish; underside streaked with golden yellow. Hindwing transparent, margins narrow, violaceous-brown.

Female.—Not known.

Expanse: 14 mm.

Distribution.—Eastern Texas.

Type.—Male. In the Museum of Comparative Zoology, Cambridge, Mass. Paratype in the American Museum of Natural History.

Remarks.—This species is known by two males only, labeled Texas, locality and date omitted. They were collected by J. Ball, 1880, most likely in the vicinity of Dallas, eastern Texas, his home city. The genitalia have not been examined. The insect should prove to be a root borer in composite plants.

CARMENTA ALBOCILIATA (Engelhardt)

PLATE 21, FIGURES 123, 124

Synanthedon albociliata ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 215, 1925.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8710, 1939.

Male.—Antennae strong, glossy black. Labial palpus white, black above and on third joint. Head black, a strong brush on top mixed black and white. Collar narrow, sordid white. Thorax purplish black, patagia inwardly edged with white, metathorax with white tufts at the sides, and some white scales at the wing base beneath. Abdomen slender, purplish black, segments 2, 4, 6, and 7 very faintly edged with white, these markings not always recognizable; segments 4, 5, and 6 beneath wholly shiny white; anal tuft long, narrowly fan-shaped, black above, white at base beneath. Coxae and trochanters of forelegs shiny white, black on inner sides; posterior tibiae rough-haired, black and white, tarsi black and white mixed. Forewing transparent, clear areas with a white sheen; broad costa, narrow outer and inner margins, and larger discal mark, deep black; a suffusion of dark scales between veins 7, 8, and 9 at apex and costa; fringes dark at apex, white at termen; underside heavily shaded white. Hindwing transparent with fainter shiny white reflections, discal mark and inner veins white, outer margin narrow, dull black, fringes contrastingly white.

Female.—More robust. Thorax contrastingly marked with white on patagia. Abdomen with posterior half of segment 4 yellowish white, the band extending to the side and partly beneath; anal tuft short, rounded at tip, wholly violaceous-black. Posterior legs wholly purplish and bronzy black. Forewing heavily and broadly scaled at costa and margins, violaceous-black; much reduced clear areas with a white sheen. Hindwing transparent, more broadly margined with black; fringes on both forewings and hindwings brownish or dull black. Otherwise like the male.

Expanse: Male 16 to 18 mm., female 16 to 20 mm.

Distribution.—Kerrville, Kerr County, Tex.

Type.—Male. In the United States National Museum.

Remarks.—Known only from the type locality at Kerrville, Tex. H. Lacey, the collector, reported the moths confined to weedy places on his ranch, which supports my suspicion that the insect is a root borer in herbaceous plants. The examples collected by Mr. Lacey are dated October 1916. One male from the same locality, collected by F. C. Pratt, is dated April 11, 1907. This record, considered doubtful, would indicate a 2-brooded species.

CARMENTA AURITINCTA (Engelhardt)

PLATE 21, FIGURES 125, 126

Synanthedon auritincta ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 216, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8711, 1939.

Male.—Antennae black, with small white area on upper surface near tips. Labial palpus pale yellow, black above on second and third joints. Head black, front glossy whitish, a coarse brush on top black and pale yellow mixed. Collar yellow above, white at the sides and beneath. Thorax above black-violaceous, with two lateral stripes and posterior margin golden yellow; beneath, the wing base laterally with yellow patches. Abdomen slender, violaceous-black, segments 2, 3, 4, 6, and 7 narrowly banded with yellow above and at the sides, not beneath; anal tuft fan-shaped, violaceous-black, touched with pale yellow at the sides. Coxae and trochanters of forelegs shiny white; hindlegs with tibiae violaceous-black, tufted with pale yellow at the spurs; tarsi ringed with pale yellow at the joints. Forewing transparent, costa and broad outer margin violaceous-black, with coppery rays between the veins; rectangular discal mark and narrow inner margin metallic black; fringes dark, bronzy black; underside shaded more strongly with yellow on basal half. Hindwings transparent, narrowly margined, black with coppery reflections above and beneath.

Female.—Antennae lustrous black, usually, but not always, marked with white before the tips. Labial palpi bright yellow, tips black. Head violaceous-black, face black and white. Collar golden yellow above, pale yellow at the sides and beneath. Thorax shiny blue-black, deep golden yellow at the sides and at anterior and posterior margins; ventral parts with pale-yellow or whitish patches. Abdomen bluish black, all segments narrowly banded with deep yellow, except segments 4 and 6, which are nearly or entirely deep yellow; beneath, only segment 3 remaining black, all other segments much suffused with yellow; anal tuft golden yellow, mixed with black at base.

Expanse: Male 16 mm., female 16 to 21 mm.

Distribution.—Arizona (Baboquivari and Santa Catalina Mountains).

Type.—Male. In the United States National Museum. The allotype female and two male and five female paratypes are also in the United States National Museum.

Remarks.—The food plant of this beautiful species is not known. However, the insect appears so well aligned with the group of species that bore in the roots of herbaceous plants that its habits should prove similar; it is rather likely a root borer in one of the Compositae so abundantly represented in the Midwest. With one exception, a male from Sabino Canyon, Santa Catalina Mountains, August 13, 1924 (E. P. Van Duzee), all the known examples have been collected in the Baboquivari Mountains, Pima County, August 15-30, 1923, by O. C. Poling, an experienced collector, who vouches for the identity of the dimorphic sexes.

CARMENTA CORNI (Hy. Edwards)

PLATE 21, FIGURES 127, 128

Aegeria corni HY. EDWARDS, Papilio, vol. 1, p. 190, 1881.
Aegeria infirma HY. EDWARDS, Papilio, vol. 1, p. 195, 1881.
Synanthedon corni MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8705, 1939.

Examination of the type of *infirma,* American Museum of Natural History, shows it to be a worn female, not a male, of *corni* collected on Long Island, N. Y., by S. L. Elliot. Additional bibliographical citations have been placed under *Conopia acerrubri,* as they involve confusion with that species.

Male.—Antennae black, apical third buff or sordid white. Labial palpus orange, third joint black above. Head tufted black and orange on top, face white. Collar orange. Thorax bluish black, densely clothed laterally and at posterior margin with dull-yellow hair; beneath also dull yellow. Abdomen black above, not banded, but dusted with pale yellow or grayish scales, which are heaviest on segments 4, 5, 6, and 7, but are often lost; underside of abdomen yellow; anal tuft fan-shaped, orange in the center, black slightly mixed with orange at the sides and orange beneath. Legs yellow, posterior tibiae marked with purplish black at lower spurs and tarsi purplish black, pale yellow at the joints. Forewing transparent, costa and broad outer margin black, with a few yellow scales sprinkled on costa and a faint yellowish shading between the veins at outer margin; the discal mark conspicuous, nearly square and deep black; the outer clear area with a yellowish stain not present in the inner area; fringes grayish black; underside shaded with yellow, most heavily so toward wing base. Hindwing transparent, discal mark and narrow border black, fringes grayish black, above and beneath.

Female.—Very similar to the male, larger, with a stouter body. The yellowish stain over the outer clear area of forewing more pronounced and

the costa showing a denser scattering of yellowish scales. The anal tuft short, deep orange. Color patterns, so contrasting on freshly emerged specimens, unavoidably become blurred or lost in the cabinet. A confusion with *Conopia acerrubri* can always be avoided by comparison of the male genitalia.

Expanse: Male 15 to 18 mm., female 18 to 24 mm.

Distribution.—Eastern Atlantic Coast States.

Type.—Male. In the American Museum of Natural History.

Remarks.—Reared from the roots and basal parts of stalks of *Doellingeria umbellata* (tall, flat-topped white aster) late in May and early in June 1921. The insect is a fairly common species along the borders of a swampy region at Woodhaven, Long Island, N. Y. The males fly about actively on bright, sunny days, while the more sluggish females, resting on or near the food plant, can be taken with a killing bottle. The eggs are laid singly on the lower stems of the food plant, and the young larvae work downward through the pith to the root, attaining full growth late in fall. At this time also preparations are made for the change to pupae early in May by enlarging the larval gallery from the root upward for 2 or 3 inches, where the stalk is weakened by inner, circular incisions and the gallery capped with frass. Just below the weakened part of the stem a round hole thinly capped with plant tissue provides an easy exit for the moth, which emerges two or three weeks after pupation. Stems weakened by incisions invariably break off during winter storms, leaving clean-cut, short, upstanding stumps, easily recognized by the collector when looking for pupae. Quick action is needed, though, for the pupa is capable of moving up or down and will descend well into the root upon disturbance. This provision no doubt also is of advantage to the larva and pupa at times when the swamps are flooded. It is a habit characteristic of many of the root borers in herbaceous plants. Larvae that have not transformed to pupae by the end of May usually are found to be parasitized.

At Woodhaven, Long Island, more than a hundred specimens were obtained by rearing or collecting. The species in general follows the distribution of its food plant in Eastern and Midwestern States.

The name *corni* was suggested by the capture of the type on *Cornus sericea* in Purgatory Swamp near Boston, Mass. Subsequent to the description in 1881 this borer in the roots of asters was confused with another species *(acerrubri)* bearing some external resemblance but a wood borer in maple, principally red maple. Under the misapplied name of *corni* this form has received considerable attention as an economic species, while the true *corni* has been ignored. Worn and greasy examples of the two species in mixed collections are confusing. For accurate determinations it is necessary to compare the male genitalia. In *corni* the vinculum is long and slender and the sacculus ridge of harpe is densely and broadly scaled to a recurving pocket at the margin; in *acerrubri* the vinculum is shorter and

broader and the sacculus ridge bears a straight, narrow line of scales, ending before the margin, which lacks a pocket. Other structural differences are present, but these serve best.

CARMENTA OGALALA, new species

PLATE 22, FIGURE 129

Male.—Antennae black. Labial palpi sordid white, black on the sides and at tips. Head black, with a strong brush, which is mixed black and pale yellow, face sordid white. Collar sordid white. Thorax black, broadly marked with golden ochreous laterally, anteriorly, and beneath, this color becoming whitish at posterior margin. Abdomen brownish black with bright-blue reflections, segment 4 with a narrow, white, encircling band, last segment edged with white and segments 5, 6, and 7 beneath with white suffusions; anal tuft fan-shaped, brownish black, edged with white at the sides and white centrally beneath, iridescent at base above. Coxae and trochanters of forelegs glossy white; posterior tibiae slightly rough, mostly white with blue-black reflections anterior to spurs, which are white; tarsi white, slightly shaded with black. Forewing opaque, costa to cell and narrow outer margin bluish black, also to wing base in an otherwise golden-ochreous inner field; the discal mark, not clearly defined, of a deeper ochreous shade; the fringes grayish brown, a bright blue metallic mark at the wing base; underside brownish black, with light-gray rays between the veins. Hindwing transparent, margins narrowly brown-black, between the veins inwardly a suffusion of brownish gray for about half the distance to the cell, and between veins 2 and 3 to beyond the cell with golden reflections.

Female.—Very similar to the male. Hindwing more suffused, only the areas between veins 1c to 5 from the cell to wing base remaining transparent.

Expanse: Male and female, 20 mm.

Distribution.—Prairie regions of Colorado and Kansas.

Type.—U.S.N.M. No. 56834. Described from male holotype from Durango, Colo. (Oslar), female allotype, Jewell County, Kans., August 7, 1925 (H. J. Grady), and paratype male, Graham County, Kans., 2,130 feet, August 16, 1912 (F. F. Williams); all in the United States National Museum.

Remarks.—A little-known but very distinct species. Of two examples observed among herbaceous plants on open, hilly pasture lands, near Plainview, Jefferson County, Colo., 6,000 feet, only one, a male, was captured (Engelhardt and E. L. Bell). None of the plants examined gave evidence of the borer's work.

CARMENTA SUFFUSATA, new species

PLATE 22, FIGURE 130

Male.—Antennae brown-black. Labial palpus sordid white, third joint black. Head brown-black, a strong tuft on top black and white mixed. Collar black and white. Thorax brown-black, glossy, the sides tufted with black and white mixed. Abdomen deep brown, glossy; segment 4 with a white band encircling the body, segments 5, 6, 7 white beneath, not above; anal tuft narrowly fan-shaped, brownish black. Coxae and trochanters of forelegs shiny white, posterior tibiae and tarsi brown-black, with a violaceous sheen and a white tuft at anterior spurs of tibiae. Forewing opaque, brownish, outer half sprinkled with ash-gray scales; discal mark in a concolorous blending; underside grayish brown. Hindwing opaque, brown-black, except for a small clear basal area between veins 1c and 2; fringes pale brown; underside similar.

Female.—Like the male except forewing with a denser sprinkling of ash-gray scales on outer half and hindwing entirely opaque.

Expanse: Male 16 mm., female 18 mm.

Distribution.—Oklahoma and Kansas.

Type.—U.S.N.M. No. 56835, male.

Remarks.—While quite distinct in general appearance, the venation and the structure of the male genitalia closely associate this species with *C. ogalala*. Only three rather worn examples are at hand. The type from McAlester, Pittsburg County, Okla., is labeled "bred from root," April 19 (C. E. Hood). The name of the plant is lacking. The paratypes, two females, come from Wichita National Forest, Comanche, Okla., July 14, 1931 (R. H. Painter), and from Sharon Springs, Wallace County, Kans. (A. B. Klots).

CARMENTA VERECUNDA (Hy. Edwards)

PLATE 22, FIGURES 131, 132

Aegeria verecunda HY. EDWARDS, Papilio, vol. 1, p. 190, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Sesia verecunda BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 142, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 312, pl. 32, fig. 26, 1901.

Carmenta nigra BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 95, 1894; vol. 8, p. 147, 1896.

Sesia florissantella COCKERELL, Can. Ent., vol. 40, p. 330, 1908.

Synanthedon verecunda MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8760, 1939.

Synanthedon florissantella MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8700, 1939.

Synanthedon nigra MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8759, 1939.

Male.—Antennae rather stout, black, tuft at tips white. Labial palpus white, with long, black hair at outer side, third joint white and black mixed. Head black with a strong brush, which is black slightly mixed with orange,

face white. Collar above with an erect orange brush, white at the sides and beneath. Thorax metallic black, with an ill-defined whitish stripe anteriorly and a long, sordid-white brush posteriorly at the sides; beneath shiny white. Abdomen black, segments 2, 4, 6, and 7 narrowly banded with clear white; beneath segment 4 entirely white, the other segments shaded with white; anal tuft short, rounded, black, slightly mixed with buff at base above and at the sides, medially beneath sordid white. Legs hairy, mostly white; posterior tibiae slightly rough, anterior half mixed black and white, black between the spurs, which are white; tarsi sordid white. Forewing semitransparent, clear areas with a white sheen between the veins; costa heavily and broadly scaled with black, narrow outer margin and fringes sordid black; discal mark conspicuous, nearly square, black; underside with costa white and a white sheen over the wing more pronounced than above. Hindwing transparent, a white sheen only suggested; outer margin narrow, violaceous-black; the fringes, sordid white at apex, blend into pure white at the wing base.

Female.—Collar with an erect, orange brush above, which is more pronounced than in the male. Thorax laterally striped with sordid white or buff. Abdominal segments 2, 4, and 6 narrowly banded with white above and beneath; segment 5 banded with white beneath only. Posterior tibiae black, sordid white at anterior spurs; tarsi black, white at the joints. Forewing nearly or quite opaque, brownish black with areas before and behind discal mark, usually but not always, streaked with sordid white. Hindwing scaled with brown-black between the veins inwardly from outer margin to near the cell and along the inner margin to wing base. Fringes on both wings brownish black.

Expanse: Male 18 to 20 mm., female 18 to 22 mm.

Distribution.—Colorado, Utah, Washington.

Type.—Female. In the American Museum of Natural History.

Remarks.—Hy. Edwards's description of *verecunda,* based on three examples, one male and two females from Colorado (Morrison), does not discriminate between the sexes, which are dissimilar. The male type, if existing, cannot be located. Two females, labeled type, are at the American Museum of Natural History. Additional material, doubtfully assigned to this species, consists of a small number of specimens from Colorado and various Rocky Mountain regions northward to Canada. These specimens, collected at random over a long period of years, are mostly in a worn condition and lack information on food plants and habits. They are mostly females and superficially similar, but structural differences of the male genitalia indicate at least two distinct species. For conclusive determination, more adequate and reared series from Rocky Mountain regions are needed.

Two long series of specimens are available, which were reared from the roots of *Lithospermum ruderale* (Boraginaceae) in the State of Wash-

ington. From roots collected at Sawmill Flat, Mount Rainier National Park, 3,000 feet, July 4, 1933, the moths emerged from July 25 to August 25, six or more from large roots (Engelhardt and J. Wilcox). From roots collected at Kamiack Butte, Whitman County, late in the season and winter, the moths emerged during April and May 1935 (J. F. Gates Clarke).

The males of these series differ in the extent of the white shadings over the otherwise vitreous areas of the forewings, and the females vary in the amount of dark suffusions on both wings, which in extreme cases become entirely opaque. This is the form of Hy. Edwards's female types from Colorado, also illustrated in Beutenmüller's "Monograph of the North American Sesiidae." *Sesia nigra* Beutenmüller is considered another extreme form of *verecunda.* The unique female type from Colorado differs from the female type of *verecunda* only by lacking the whitish suffusions on the fore and hind wings. Both wings of *nigra* are opaque, brownish black. Again final conclusions must be withheld, pending the acquisition of adequate material.

An unusual problem in taxonomy is presented in the aberrant venation of the series of reared specimens from Washington. Veins 10 and 11 are present, confluent at tip, or coincident. This is upsetting in a key to a classification largely based on venation. All specimens of the series dissected agree perfectly in structures of the genitalia.

Individual records provisionally assigned to *verecunda* are: One male, Sioux County, Nev., July 16, 1917 (R. A. Leussler); one male, La Junta, Colo. (Oslar); one female, Chimney Gulch, Golden, Colo., June (Oslar); one male, Plainview, Jefferson County, Colo., July 10, 1927 (E. L. Bell).

Sesia florissantella Cockerell, known only by the male type, is apparently a dwarfed specimen of *verecunda,* with which it conforms in all respects except size.

The American Museum of Natural History collection contains the following determined as *verecunda:* One female, Meeker, Colo., 6,200 feet; one female, Easton, Wash.; one male, Fort Douglas, Utah, June 26, 1904 (Wickham); Medicine Bow, Wyo., 6,000 feet, June 23, 1920.

CARMENTA PROSOPIS (Hy. Edwards)

PLATE 5, FIGURES 33, 33a; PLATE 13, FIGURE 63

Aegeria prosopis HY. EDWARDS, Papilio, vol. 2, p. 99, 1882; Ent. Amer., vol. 3, p. 224, 1888.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Aegeria candescens HY. EDWARDS, Papilio, vol. 2, p. 123, 1882.

Sesia prosopis SMITH, List of Lepidoptera of Boreal America, p. 21, No. 833, 1891.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 142, 1896; vol. 9, p. 220, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 302, pl. 31, fig. 6, male, 1901.

Sesia candescens BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 303, pl. 31, fig. 12, female, 1901.

Synanthedon prosopis McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8737, 1939.

Synanthedon candescens McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8739, 1939.

Male.—Labial palpi with second joint pure white; terminal joint black. Antennae stout with short pectination, black. Head, collar, and thorax black. Abdomen all black, or commonly with a narrow, white, transverse band on second joint; sometimes with white transverse bands also on other segments, especially the last; underside all black; anal tuft black, fan-shaped, slightly edged with white. Forewing transparent with costal edge, veins and discal mark black. Hindwing transparent, costal edge and veins black, cilia black with tips narrowly white. Legs black with white annulations.

Female.—With broader black borders on both wings; otherwise like the male.

Reared from small woody galls of the encyrtid genus *Tanaostigmodes* Ashmead on mesquite, kindly determined by A. B. Gahan, of the United States Bureau of Entomology and Plant Quarantine.

Expanse: 13 to 16 mm.

Distribution.—Arizona and Brewster County, Tex.

Food plant.—Mesquite (*Prosopis glandulosa*).

Type.—In United States National Museum.

SYLVORA, new genus

Genotype, *Trochilium acerni* Clemens.

Tongue long, spiraled. Antennae of male long, slender, slightly dilated toward tips, with short fine pectinations; female antennae simple. Labial palpus with second joint erect, thickened with a nearly smooth, short brush, but slightly ruffled in front; third joint short, blunt. Forewing with 12 veins, 7 and 8 stalked to costa, 10 and 11 stalked; hindwing with veins 3 and 4 stalked. Posterior tibiae with rough scaling above; first tarsal joint not thickened with scales. Anal tuft of male fan-shaped, subject to spreading or folding. Male genitalia with aedeagus deeply forked at tip; penis finely granulated; sacculus ridge unscaled. Female genitalia with ductus sclerotized only at extreme end; ostium cup-shaped.

The genus is based mainly on the stalked veins 10 and 11 in the forewing, a small but unusual character in this group where the tendency is for these veins to become confluent at the edge of the wing rather than at the cell. This genus comprises the maple bark borers. The North American representatives are *acerni* and its races *buscki* and *tepperi*.

SYLVORA ACERNI (Clemens)

PLATE 1, FIGURE 6; PLATE 5, FIGURE 34; PLATE 13, FIGURE 64

Trochilium acerni CLEMENS, Proc. Acad. Nat. Sci. Philadelphia, 1860, p. 14.—MORRIS, Synopsis of the described Lepidoptera of North America, pt. 1, p. 330, 1862.

Aegeria acerni RILEY, Sixth annual report on the noxious and other insects of the State of Missouri, p. 107, 1874.—THOMAS, Sixth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, pt. 1, 1876, p. 40, 1877; Seventh report (l. c.), 1877, p. 173, 1878.—KELLICOTT, Can. Ent., vol. 13, p. 7, 1881.—PACKARD, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. No. 7, p. 106, 1881.—SAUNDERS, Can. Ent., vol. 13, p. 69, 1881.—RILEY, Amer. Nat., vol. 8, p. 124, 1874.—WEED, Amer. Nat., vol. 23, p. 1108, pl. 43, fig. 5, 1889.—RILEY and HOWARD, Insect Life, vol. 3, 1890, p. 161, 1891.—BEUTENMÜLLER, Ann. New York Acad. Sci., vol. 5, p. 205, 1890.—BRUNER, Rep. Nebraska Hort. Soc., p. 197, 1891.

Trochilium acericolum GERMADIUS, Amer. Nat., vol. 8, p. 57, 1874.

Sesia acerni HULST, Bull. Brooklyn Ent. Soc., vol. 6, p. 10, 1883.—LUGGER, Bull. Minnesota Agr. Exp. Stat., No. 43, p. 188, 1896.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 138, 1896; vol. 9, p. 220, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 294, pl. 31, fig. 24, 1901.

Synanthedon acerni MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8727, 1939.

Male.—Antennae long, slender, slightly dilated toward tips, shiny black or brown-black, pectinations short and very fine. Palpi nearly smooth, orange. Head black, tufted with orange at base, orbits white. Collar orange. Thorax dark orange above, pale orange beneath. Abdomen covered with orange and blackish scales that are more or less mixed, wholly pale yellow beneath; anal tuft broadly fan-shaped, bright orange, touched with black at the base. Legs yellow, tibiae of hindlegs blue-black between the spurs or sometimes wholly blue-black above. Forewing narrow, costa, veins, narrow marginal border, and large discal mark black; a small transparent area before and a long transparent area behind the discal mark; apex of wing shaded with pale yellow between the veins, mixed inwardly with blackish scales, suggesting a broken cross band; the fringes broad, grayish black; the pale-yellow scaling heavier on the underside of the wings. Hindwing transparent, lightly scaled with pale yellow between the veins at apex, borders narrow, dull black, fringes broad grayish black, discal mark conspicuous, black.

Female.—Very similar to the male, with wings more contrastingly black and pale yellow; abdomen blackish above and at the sides in an irregular pattern, due to an admixture of gray scales; the segments narrowly edged with gray posteriorly; abdomen beneath wholly pale yellow; anal tuft short, depressed in center, orange or red.

Examples of this species very often are discolored by grease; clean, well-marked specimens are scarce in collections. Submergence in a cleaning medium (benzol or gasoline) for a day or two may be necessary to restore natural color markings before determinations are attempted.

Expanse: Male and female, 20 to 25 mm.

Distribution.—Canada, New England, Eastern and Midwestern States, and Mississippi Valley, in general following the distribution of the white maple *(Acer saccharinum)* and red maple *(Acer rubrum)*.

Type.—Lost.

Remarks.—A common, well-known bark borer in shade trees, destructive to white and red maples. The larvae feed upon the inner bark and the sapwood and once established continue their attacks year after year, resulting in the gradual weakening and final death of the trees. The white maple, formerly so popular as a shade tree in cities and towns, now is being replaced largely by Norway and other maples less subject to attacks by this insect. Maples in native environments, woodland, etc., suffer far less than those planted in streets and gardens. The moths appear late in May and during June, emerging early in the morning, and can be collected easily while still resting or mating on the tree trunks. Their flight on sunny days is swift and erratic. In habits they are strictly diurnal. Not infrequent records of night capture under city lights are accidental. The larvae winter within their galleries, constructing oblong cocoons of chips and frass before pupation in the spring, and the moths emerge through circular holes in the bark, leaving the pupal exuvia protruding, usually in places showing injury and blistered bark on the tree trunks, rarely on the branches. Within the more temperate part of its range the species varies slightly only in coloration, but along the coastal regions in the South two color phases occur which are so striking as to demand recognition as geographical races. Both of these races have been obtained by rearing, establishing beyond doubt that they are conspecific with *acerni*.

Records of this species from New England and the Eastern and Midwestern States are well represented in the United States National Museum collection. There are also records from Monteagle, Tenn., St. Louis, Mo., and Texarkana, Tex.

SYLVORA ACERNI BUSCKI, new race

PLATE 22, FIGURE 133

Male.—Antennae blue-black. Palpi deep orange, slightly black at the tips. Head tufted with orange above, face violaceous-black, orbits white. Collar orange. Thorax brownish red, tinged with blackish centrally and shiny black at the sides to the wing base, brownish red beneath. Abdomen orange, segment 3 scaled with blue-black, except for the center, which remains orange; segments 4, 5, 6, and 8 with blue-black scales, which are heaviest on the last segments; abdomen beneath wholly orange; anal tuft fan-shaped, orange above and beneath. Hindlegs with femora orange, tibiae outward shaded with blue-black scales, thin above, but dense between the spurs, otherwise orange; the tarsi showing a sprinkling of blue-black scales. Forewing broadly shaded with bright orange or golden yellow be-

tween the black veins at outer margin to a much-reduced clear space before the large, black discal mark and below the heavily black-scaled costa; inward from the discal mark a narrow clear space extending to the wing base; fringes broad, brownish black, the orange shading heavier on underside than above. Hindwing transparent, with a slight shading of black and orange scales between the veins at apex.

Female.—Forewing only slightly shaded with orange at the outer margin; abdomen orange, with segments 3, 4, 5, and 6 blue-black above; anal tuft short, orange. Otherwise like the male.

Expanse: Male and female 18 to 22 mm.

Distribution.—Florida, Georgia.

Types.—U.S.N.M. No. 56836, male, from Gainesville, Fla. Also allotype female, Gainesville, Fla.; two male and two female paratypes, Florida and Georgia, in the United States National Museum.

Remarks.—Records of this beautiful race are confined to Florida with one exception, a reared female from Cordele, Ga., May 7, 1906 (Georgia State coll.). The Florida examples, males and females, were obtained on the campus of the University of Florida, at Gainesville, by rearing from heavily infested young white maples near the agricultural building. The trees subsequently died. An additional specimen was reared from the bark of a red maple near a swamp. The moths emerged in March, April, and May.

This race has been named in honor of my friend and collaborator August Busck.

SYLVORA ACERNI race TEPPERI (Hy. Edwards)

PLATE 22, FIGURE 134

Pyrrhotaenia tepperi HY. EDWARDS, Papilio, vol. 1, p. 203, 1881.

Sesia tepperi BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 137, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 294, pl. 32, fig. 24 (male), 1901.

Synanthedon tepperi MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8726, 1939.

Male.—Antennae blue-black. Labial palpus orange, third joint black. Head orange above, face blue-black, orbits white. Collar orange. Thorax orange above and beneath, blue-black at the sides before the wing base. Abdomen slender, violaceous or blue-black above and at the sides, except the first segment, which shows a mixture with orange and brownish scales; venter orange; anal tuft fan-shaped, touched with blue-black at the base, otherwise wholly orange. Legs orange and blue-black, the femora a mixture of these colors, the tibiae of hindlegs blue-black on upper surfaces, mixed with orange beneath, a short tuft of yellow hair at the posterior spurs; tarsi violaceous. Forewing nearly opaque, metallic black; a small clear area before and a long, narrow one behind the large discal mark, the clear areas somewhat blurred by scales. Hindwing transparent, broadly

margined and fringed with black and brownish and a scattering of scales between the veins at outer margin.

Female.—Like the male, but stouter and with scaling and color intensified. Thorax darker, the first abdominal segment barely touched with orange anteriorly and the blue-black scaling on all segments above, extending more or less beneath the abdomen; the short, blunt anal tuft bright red; tibiae and tarsi of hindlegs blue-black, slightly tinged with orange beneath; a small, yellow, hair tuft at the posterior spurs of tibia.

Expanse: Male 20 to 23 mm., female 20 to 25 mm.

Distribution.—Known only from Alabama and Mississippi.

Type.—Male. In the Tepper collection, Michigan Agricultural College.

Remarks.—The long series in the United States National Museum, with the exception of one specimen from Mississippi, came from Mobile, Ala., the result of rearing from young white-maple shade trees. F. M. Jones, of Wilmington, Del., first reported the food plant and habits on a visit to Mobile in 1920. The infestation at that time was serious and the trees were in a much weakened condition, with sores and swellings on trunks and branches. On subsequent visits in 1928 and 1930 (Engelhardt) most of the trees had died and had been removed. Credit for rearing many examples belongs to Thomas S. Van Auer, W. C. Dukes, and H. P. Loeding, sterling entomologists and friends, who have contributed so much information on Alabama insects.

S. acerni tepperi, with the food plant and habits unknown, has been regarded as a distinct, valid species. Now that this information is available and is supported by structural conformities, *tepperi* has been established indisputably as conspecific with the common eastern maple bark borer, *acerni,* of which *buscki* from Florida is the intermediary and *tepperi* from Alabama the third link in a chain of geographical races. This serves as an illustration of the chief aim of the present revision of the family, a classification based on a combined study of taxonomy and biology.

Emergence records from Mobile, Ala., are dated from March to June. A single example from Hattiesburg, Miss., is labeled "Bred from maple, Aug. 27, 1917."

Genus CONOPIA Hübner

Conopia HÜBNER, Verzeichniss bekannter Schmetterlinge, p. 129, 1819. (Genotype, *Sphinx myopiformis* Borkhausen.)

Male antennae ciliate; female antennae simple. Tongue long, spiraled. Second joint of labial palpus with a short, nearly even brush; terminal joint, short, blunt. Head and thorax smooth. Forewing with 12 veins; 7 and 8 stalked; 7 to costa or apex; 10 and 11 separate. Hindwing with eight veins, 3 and 4 stalked. Posterior tibiae roughly hairy. Posterior first tarsal joint smooth. Male anal tuft wedge- or fan-shaped. Male genitalia of the *Synanthedon* type; vinculum rather short, blunt; aedeagus straight,

slightly bulbous at base; sacculus ridge with a thin, slightly curved row of flat, biforked scales. Female genitalia with ductus sclerotized posteriorly, ending in a vase-shaped ostium; no signum or at most a small, slightly granulated, oval spot.

The genotype is figured on plate 1, figure 7, and plate 3, figures 26, 27.

CONOPIA ALBICORNIS (Hy. Edwards)

Aegeria albicornis Hy. Edwards, Papilio, vol. 1, p. 201, 1881.—Beutenmüller. Ann. New York Acad. Sci., vol. 5, p. 205, 1890; Bull. Amer. Mus. Nat. Hist., vol. 4, p. 174, 1892.

Sesia albicornis Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 292, pl. 31, fig. 23, pl. 33, fig. 15, 1901.

Synanthedon albicornis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8723, 1939.

Male.—Antennae black, moderately dilated toward tips, finely pectinated and narrowly but plainly marked with white before the tips. Labial palpi rough, pale yellow beneath, black above. Head, thorax, and abdomen bluish or purplish black. Abdomen sometimes, though usually not, edged very narrowly and faintly with white on segment 2 above and along the sides; anal tuft wedge-shaped, white in the middle beneath. Wings transparent; veins, discal marks, costae, and outer margins metallic black. Forewing beneath shaded with bright yellow along costa from discal mark to wing base. Veins 3 and 4 on hindwings on a short stalk. Legs steel blue, forecoxae white, tibiae tufted, white at the spurs, which also are white. Tarsi whitish at the joints and at tips.

Female.—Similar to the male. Labial palpi not so rough or so white as those of the male. Antennae marked with white for one-third of their length before the tips. Anal tuft narrow, rounded at end, and black throughout.

Expanse: Male 18 to 20 mm., female 16 to 22 mm.

Distribution.—Rocky Mountains, Colorado, Idaho, Sierra Nevada, Sierra Madre, California to Washington.

Type.—Female (Nevada, Morrison). In collection F. Tepper, Michigan Agricultural College.

Remarks.—Check lists synonymize *proxima* (Hy. Edwards) and *modesta* Kellicott with *albicornis,* but on critical examination of ample material it is found that western examples differ specifically from eastern specimens. Conclusive evidence of this is furnished by the male genitalia. The sacculus of *albicornis* shows a curved line of flat scales ending in a point; in *proxima* the line of scales terminates distinctly in a hook. Furthermore, there are external differences. The labial palpi of *albicornis* in both sexes are pale yellow; in *proxima* only the male palpi are pale yellow, the female palpi are black. *C. albicornis* lacks the narrow, pale yellow lateral stripes present on the thorax of *proxima.* The antennae of *albicornis* are plainly

marked with white before the tips in both sexes; in *proxima* only the females are thus marked.

C. albicornis was described by Hy. Edwards from a female, not a male as he states, labeled Nevada (Morrison). That is a vague designation, but most likely applies to the mountainous western part of the State. Available records include: San Juan Mountains, Colo., 1 male (Oslar); Coolin, Priest Lake, Idaho, July 24, 1927, 1 female; Snoqualmie Pass, Wash. (V. Argo), July 25, 1925, 1 male; Mount Rainier, White River Camp, Wash. (James Wilcox), August 7, 1935, 5 males, 1 female; Plumas County, Calif. (F. M. Jones), July 20, 1918, 1 female; Meadow, Plumas County, Calif., 4,000 feet (Van Dyke), June 21, 1924; Los Angeles County, Calif. (Coquillett), 1 female reared in March, 1 female reared in April, 1 male reared in October.

This species is well distributed from the Pacific coast to the Rocky Mountains and northward into British Columbia. At Madeline, Lassen County, Calif., a heavy infestation was evidenced by masses of brown pellets and pupal exuviae from larval burrows in exposed roots of low-growing willows, too late in the season to obtain adults. Otherwise moderate swellings on willow canes and branches indicate attacks. At Riverside, Calif., C. M. Dammers reared examples found boring in the bark of fairly large tree willows. As in the East, the species in the West also often enters abnormal growth or wounds caused by coleopterous larvae.

CONOPIA PROXIMA (Hy. Edwards)

Aegeria proxima Hy. Edwards, Papilio, vol. 1, p. 201, 1881.
Albuna modesta Kellicott, Can. Ent., vol. 24, p. 46, 1892.
Synanthedon albicornis McDunnough (in part), Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8723, 1939.

Male.—Antennae black, rarely marked faintly white before the tips, pectinations short and fine. Labial palpi white beneath, black above. Head, thorax, and abdomen blue or bronzy black, collar mixed with pale yellow and thorax laterally striped with pale yellow; anal tuft wedge-shaped, edged with white at the sides and white in the middle beneath. Wings transparent, veins, discal marks, costae and outer margins metallic black. Forewing beneath shaded with pale yellow on costa and from discal mark to base of wing. Veins 3 and 4 of hindwing on a long stalk. Legs blue or coppery black, anterior coxae marked with white, tibiae tufted with white at the black spurs, tarsi banded with white at the joints and at tips.

Female.—Similar to male. The simple antennae broadly marked with pale yellow before the tips. Labial palpi black, above and beneath. Anal tuft straight, narrow, black throughout.

Expanse: Male 16 to 20 mm., female 18 to 24 mm.

Distribution.—Atlantic Coast States, Maine to Pennsylvania; Midwestern States. Canada, Ontario to Alberta.

Type.—Female. In collection of F. Tepper, Michigan Agricultural College.

Remarks.—Hy. Edwards's very brief original descriptions of *albicornis* and *proxima* on the same page (Papilio, vol. 1, p. 201, 1881) are insufficient to separate clearly two species that superficially resemble each other so closely. With imperfect specimens it is difficult to avoid confusion. For precise determination the genitalia are dependable.

C. proxima in general may be stated to inhabit the eastern half of the North American Continent, whereas *albicornis* is indigenous to the western half. The female type came from the White Mountains, N. H. (Morrison), from which locality I also have examples. Locally it is a common species in the vicinity of New York City and on Long Island, most easily obtained by rearing from cuttings of canes, branches, and exposed roots of low-growing willows in moist or swampy situations late in spring and early in summer. Numerous records from New York and New Jersey show a period of emergence from late in May to July; for the Catskill Mountains, July 3 and 20, 1913 (Pearsal); White Mountains, N. H., July (Mrs. Slosson); Williston, N. Dak., June 13, 1923 (H. Notman); Aweme, Manitoba, June 28, 1921 (N. Criddle). The species is annual, wintering as larvae and pupating within the burrow during spring.

CONOPIA BOLTERI (Hy. Edwards)

Aegeria bolteri Hy. Edwards, Papilio, vol. 3, p. 155, 1883; Ent. Amer., vol. 3, p. 224, 1888.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Sesia bolteri Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 290, pl. 32, fig. 32, 1901.

Synanthedon bolteri McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8716, 1939.

Male.—Antennae black, apical third yellowish white above; pectinations short and fine. Labial palpi above black, beneath roughly scaled with orange. Head, collar, and thorax lustrous black, orbits white. Abdomen steel or coppery black, segments 4 and 5 encircled with deep orange or scarlet, the band on segment 5 extending over segment 6 beneath; anal tuft wedge-shaped, edged with white at the sides and yellow in the middle beneath. Legs bluish black, tibiae rusty yellow at the sides and beneath, white-tufted at the spurs. Tarsi rusty yellow and black, a pale narrow band at first joint; northward within the range of the species the leg increasingly brighter with a corresponding reduction in black. Forewing transparent; veins, discal mark, and broad costal margins lustrous black, sparsely intermixed with orange scales, denser at posterior wing base; distal area very broadly coppery red or deep orange between the veins; cilia brownish. Hindwing transparent, costa dull yellow. Wings paler beneath than above.

Female.—Same as the male. Anal tuft straight, rounded.

Expanse: Male 15 to 18 mm., female 18 to 20 mm.

Distribution.—Temperate North America, Canadian and Hudsonian to Arctic Zone.

Type.—Female, in the American Museum of Natural History.

Remarks.—Rearing records associate this species invariably with abnormal growths on low-growing willows caused by the boring larvae of the beetles *Cryptorhynchus lapathi* (Linnaeus) and *Saperda concolor* LeConte and by fungi. *C. bolteri* has not been reported in heavy infestations throughout its wide range. It is scantily represented, if at all, in most collections. The larvae winter in their burrows and construct oblong cocoons in spring, and the moths emerge from late in May to July. *Conopia formicaeformis* (Esper), of Europe, is a close relative, very similar in appearance and identical in habits. It has the antennae entirely black, not marked with white on the apical third as in *bolteri*. Records for *bolteri*: Moshulu, New York, N. Y., 3 females; Ivoryton, Conn., 3 males, 2 females, bred May 19, 1914 (H. Tuschka); Ute Trail, Colo., 1 male, 2 females, bred June 19–23, 1914 (H. B. Kirk); Brookings, S. Dak., 1 female, June 17, 1914; Yakima Indian Reservation, Wash., 3,000 feet, 1 female, June 30, 1925 (E. C. Van Dyke); Cheboygan County, Mich., 1 male, July 30, 1931; Earl Grey, Saskatchewan, 6 males, 4 females, bred July 7–11, 1925 (J. D. Ritchie); Hasavich, Manitoba, 1 female, July 5, 1910 (J. B. Wallis); Lethbridge, Alberta, 1 male, July 28, 1912 (H. L. Seaman); Fort Yukon, Alaska, 1 male, 1 female, June 16, 1916; Rampart, Alaska, 1 female, July 1916; Dawson, Yukon, 1 male, June 1916.

Examples from British Columbia and from Alaska average darker in coloration.

CONOPIA ACERRUBRI (Engelhardt)

Synanthedon acerrubri ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 64, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8706, 1939.

The following bibliographical citations under the specific name of *"corni* Hy. Edwards," as far as can be ascertained, refer to the present species, which invariably has been confused with the true *"corni,"* a borer in the roots of asters.

Aegeria corni HY. EDWARDS, KELLICOTT, Can. Ent., vol. 24, pp. 46, 210, 1892; Insect Life, vol. 5, p. 83, 1892.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Sesia corni HY. EDWARDS, BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 138, 1896; vol. 9, p. 220, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 296, pl. 31, fig. 17, 1901.

Male.—Antennae black, more or less tinged with white or pale yellow before the tips, pectinations short and fine. Palpi orange, mixed with

black behind, tips black. Head black, orbits silvery white. Collar orange. Thorax violaceous-black, with yellow scales on patagia in a broken arrangement; thorax beneath pale yellow. Abdomen above steel blue or violaceous, segments 2, 4, 5, and 6 edged with pale yellow; beneath segments 1 and 2 sprinkled with whitish scales and segments 4, 5, 6, and 7 wholly sordid white shading to pale yellow laterally; anal tuft fan-shaped, bluish black, mixed with red at the sides and end, beneath bright red, black at the sides on upper part, and claspers yellow. Outer side of femora, anterior part of tibiae and tarsi blue-black mixed with yellow scales and tarsi banded with yellow at the joints; posterior part of tibiae between the spurs solid blue-black; inner side of femora, tibiae, and tarsi yellow, except for a blue-black area between the spurs, which are yellow. Wings transparent; costa, veins, rather broad apical margin, and large discal mark of primaries metallic black; hindwings with narrow black outer margins and brownish fringes; underside of wings shaded slightly with yellow scales on costa and veins.

Female.—Apical third of antenna contrastingly shaded with sordid white or pale yellow on upper surface. Abdominal segments often, but not always, dusted with pale-yellow scales in addition to having narrow, pale-yellow bands on segments 2, 4, and 6; segments 4, 5, and 6 beneath sordid white; anal tuft short, rounded, wholly bright red. Otherwise like the male.

Expanse: Male 16 to 18 mm., female 18 to 22 mm.

Distribution.—Eastern half of the North American Continent from the Atlantic coast to Canada.

Type.—Male, in the United States National Museum.

Remarks.—Red and sugar maples are the native food plants of *acerrubri,* but other maples, especially when planted as shade trees, also are attacked. The larvae bore under the bark, preferring branches to tree trunks. When a larva is working singly it causes a slight swelling or a roughening on the branch. Quite often advantage is taken of wounds and scars caused by the borings of other insects, beetles of the family Cerambycidae and Buprestidae and of the leopard moth, *Zeuzera pyrina* (Linnaeus), which has become a serious pest to various shade trees in the neighborhood of New York City and on Long Island. Such scars may harbor six or more larvae of the aegeriid borer, thereby contributing to the injury. *C. acerrubri* is an annual species; the larva, wintering in its burrow, resumes feeding in spring before changing to a pupa within an oblong cocoon of castings and chips in a cell just under the bark, with a thin, circular shell remaining to be broken by the pupa upon emergence of the moth during late May and June.

C. acerrubri is not so common a species as the other maple-infesting aegeriid, *Sylvora acerni.* Serious outbreaks usually are local. While somewhat resembling *acerni* in appearance, it is structurally quite distinct.

CONOPIA RICHARDSI, new species

PLATE 22, FIGURE 135

Male.—Antennae violaceous black-buff before the tips. Labial palpus buff at base, second joint dull yellow, terminal joint yellow mixed with black. Head black with metallic reflections, face glossy white. Collar pale yellow, slightly mixed with black above. Thorax black-violaceous, patagia narrowly touched with pale yellow inwardly; underside of thorax very pale, glossy yellow. Abdomen slender, lustrous blue-black, segments not banded above; beneath segments 2, 3, 4, and 5 glossy buff, segments 1, 6, and 7 black; anal tuft long, narrow, the center a thin pencil extending beyond the sides, blue-black slightly intermixed with orange at base beneath. Legs pale yellow, sparsely shaded with violaceous; posterior tibiae very rough, golden yellow; tarsi smooth, yellow, shaded with black. Forewing transparent; costa, veins, and large oblong discal mark glossy black; outer margin broadly shaded, black on the veins and orange between the veins, as wide as the transparent area before the discal mark; fringes dull black; underside with costa and veins touched with orange and the discal mark narrowly orange at the sides. Hindwing transparent, narrowly margined with violaceous-black; fringes sordid black above and beneath.

Female.—Similar to male. Antennae with basal half violaceous-black, outer half buff or pale yellow before the black tips. Forewing with outer margin broader and brighter orange. Abdomen more robust, segment 4 with a conspicuous yellow band, venter of all segments shiny buff or pale yellow; anal tuft short, rounded, orange.

Expanse: Male 18 mm., female 20 mm.

Distribution.—Georgia, Virginia, Ohio.

Type.—U.S.N.M. No. 56837, male. Allotype female and two male and two female paratypes also in the United States National Museum.

Remarks.—Holotype, allotype, and one male and one female paratype were collected on flowers in moist meadows along a river in Clarke County, Ga., June 15, 1938 (A. Glenn Richards). One paratype male, Cincinnati, Ohio, June 20, 1909 (Annette Braun). One paratype female, Falls Church, Va., June 28 (Nathan Banks).

The food plant is not known.

Genus SYNANTHEDON Hübner

Synanthedon HÜBNER, Verzeichniss bekannter Schmetterlinge, p. 129, 1819. (Genotype, *Sphinx ocstriformis* Esper, synonym of *Sphinx vespiformis* Linnaeus.)

Tongue long, spiraled. Antennae of male robust, bipectinate; pectination longest at bases, shortening toward the strongly dilated, tufted tips. Female antennae simple. Labial palpus with second joint thickened with rough scales, terminal joint short, smooth. Forewing with 12 veins, 10 and 11 separate, 7 and 8 stalked, 7 to apex; hindwing with veins 3 and 4

stalked. Posterior tibiae roughly scaled above; first tarsal joint thickened with rough scales above. Male genitalia with short, stout (often paired) cornuti, sacculus ridge with flat scales in a dense, obliquely curved line. Female genitalia with outer end of ductus bursae sclerotized. Anal tuft in male wedge-shaped.

The American species placed in this genus, aside from structural similarities, have much in common with the biological characteristics of the genotype, *vespiformis,* of Europe. The sacculus ridge of the male genitalia in the American species shows flat scales in a less dense arrangement, curved outwardly, differing in this respect from *vespiformis.* Most of the American species, as here limited, are borers in oak, normally attacking the bark, but specimens found in greatest abundance in abnormal swellings due to cankerous growth and, in particular, in woody galls of cynipid origin, which they occupy as commensals. There are other generically distinct species sharing such habits; from these the species of *Synanthedon* are distinguished by the thickened posterior first tarsal joint and by the wedge-shaped male anal tuft.

The genotype is figured on plate 1, figure 8; plate 6, figures 35, 35a; and plate 13, figure 65.

SYNANTHEDON SAPYGAEFORMIS SAPYGAEFORMIS (Walker)

Aegeria sapygaeformis WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 45, 1856.—HY. EDWARDS, Papilio, vol. 1, p. 207, 1881.

Trochilium sapygaeformis MORRIS, Synopsis of the described Lepidoptera of North America, p. 333, 1862.

Sesia sapygaeformis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 440, 1874.

Pyrrhotaenia sapygaeformis GROTE, New check list of North American moths, p. 12, 1882.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 146, 1896.

Sesia sapygaeformis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 310, 1901.

Synanthedon sapygaeformis McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America. pt. 2, No. 8753, 1939.

Male.—Antennae robust, strongly dilated, bipectinate. Labial palpi long, ascending, curved, deep orange, bases and sides black. Head black, covered with strong violaceous scales. Collar red. Thorax densely hairy, black, conspicuously bordered with red posteriorly above; beneath marked with red before the wing base. Abdomen lustrous black, segments 4, 5, 6, and 7 red above and beneath; anal tuft wedge-shaped, black. Legs violaceous, marked with orange; hindtibiae twice broadly banded with orange; first tarsal joint thickly scaled, black and orange. Forewing very narrow, widening at outer third, which is blackish violaceous; the narrow portion of the wing medially orange-red, with radiations beyond the deep red cell; clear spaces reduced to an intervenular short streak from the wing base; underside largely shaded with orange, radiating into the outer margin.

Hindwing pellucid, with a narrow orange costal border, the broad margins violaceous, the fringes dull black.

Female.—Very similar to the male. Abdomen with only the three last segments red, instead of four as in the male; anal tuft short and blunt with a central indentation, black.

Expanse: Male 13 to 20 mm., female 18 to 22 mm.

Distribution.—Florida.

Type.—Male. In the British Museum of Natural History.

Remarks.—Priority in nomenclature dictates the elevation of a color variety to specific rank and reduces the actual species to the status of a variety. Collecting records of *sapygaeformis* have been few and far apart since its description in 1856. Its food plant and habits remained unknown until extensive rearing experiments with *floridensis* proved this to be conspecific and only a color variety of *sapygaeformis*. From identical lots of breeding material, consisting of cynipid oak galls, 4 *sapygaeformis* were obtained as against 96 *floridensis* per hundred. There are only color differences between the two, and these are restricted to the banding of the abdominal segments. In *sapygaeformis* segments 4, 5, and 6 are concolorous, whereas in *floridensis* segments 4 and 6 are red and segment 5 is black. Intermediate color forms are not lacking.

Records: Daytona Beach, Fla., males and females, April 14, 1929 (Engelhardt); Jacksonville, Fla. (Ashmead).

One unique female example, labeled East Florida (Ashmead), lacks all the red abdominal bands above but has segment 4 banded with red beneath and segments 2 and 3 red at the sides. If not substantiated by additional specimens, it may be regarded as a freak.

SYNANTHEDON SAPYGAEFORMIS variety FLORIDENSIS (Grote)

Pyrrhotaenia floridensis Grote, Can. Ent., vol. 7, p. 174, 1875.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 145, 1896; vol. 9, p. 220, 1897.

Sesia floridensis Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 309, 1901.

Synanthedon floridensis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8751, 1939.

Differs from typical *sapygaeformis* only in the banding of the abdominal segments. Male with segment 4 red, 5 black, 6 and 7 red; female with segment 4 red, 5 black, and 6 red.

Expanse: Male 16 to 21 mm., female 18 to 22 mm.

Distribution.—Florida.

Type.—Male. In the American Museum of Natural History. From Enterprise, Fla.

Remarks.—Long series of *floridensis* have been reared from woody cynipid galls on various species of oaks in Florida. Material from the following sources is available: Royal Palm State Park, galls on live oak,

April 23, 1927, July 1926 (F. M. Jones), February 25, 1919 (H. S. Barber), Biscayne Bay (Mrs. A. T. Slosson), Coronado Beach, March 1929, Daytona Beach, October 1938; galls on spiny-leaved scrub oak, Monticello, June 1928; on scrub oak, Gainesville, April 15, 1930; on water oak, Longwood, April 10, 1930 (Engelhardt).

The prolonged season of emergence does not prove that there are two broods annually. Larvae in various stages of growth have been noted throughout the year. Only galls well along in development, but with the tissue still alive, serve for occupancy. The presence of larvae is indicated by frass and by spots that are soft under pressure. The borers are abundant locally and are easily reared in numbers. Coinhabitants in the galls very often are ants. This association appears to be harmonious as long as the silk-lined galleries and pupal cases of the lepidopterous borers remain intact.

SYNANTHEDON DECIPIENS DECIPIENS (Hy. Edwards)

PLATE 22, FIGURES 136, 137

Aegeria decipiens HY. EDWARDS, Papilio, vol. 1, p. 197, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 367, 1894.

Aegeria imperfecta HY. EDWARDS, Papilio, vol. 1, p. 198, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Aegeria nicotianae HY. EDWARDS, Papilio, vol. 1, p. 202, 1881.

Sesia decipiens BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 141, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 300, 1901.

Synanthedon decipiens MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8734, 1939.

Male.—Labial palpi golden yellow, black on the inner sides. Head black, collar yellow. Thorax black with a posterior, yellow, transverse band and a yellow patch on each side beneath. Abdomen coppery black, somewhat swollen centrally and with segments 2, 6, and 7 narrowly banded with yellow above, segment 4 broadly banded with yellow above and beneath; anal tuft wedge-shaped, edged with whitish at tip. Legs broadly banded with yellow and blue-black. Forewing narrow, costa heavily scaled, black and orange scales being intermixed; veins black, interspaces from outer margin streaked with orange, leaving a small vitreous area before, and another narrow long one beyond, the red, black-edged discal mark; fringes lustrous brown; underside heavily shaded with golden yellow. Hindwing transparent, narrowly margined; discal mark very small, orange.

Female.—Differs from the male in having broader wing margins and denser orange shading between the veins, with a corresponding reduction in the vitreous areas before and beyond the discal mark, which is bright red, only barely edged with black. Abdomen with segments 2 and 6 narrowly banded with yellow above, band on segment 4 above and beneath twice as broad as those on segments 2 and 6; anal tuft short, rounded,

centrally indented, black, edged with yellow. Otherwise like the male.

Expanse: Male 15 to 17 mm., female 15 to 18 mm.

Distribution.—Rocky Mountains, Colorado, New Mexico, Texas, Gulf Coast States.

Type.—Male. Collected in Colorado by Morrison. In the American Museum of Natural History.

Remarks.—Records from specimens in the United States National Museum: North Cheyenne Canyon, Colo., reared from cynipid galls on scrub oak, 2 females, June 15, 1915 (A. B. Champlain); Manitou, Colo., from galls on white scrub oak, June 15, 1915, 2 males, 2 females (B. J. Narney); Little Tesugne Canyon, Santa Fe, N. Mex., 9,200 feet, sweeping on *Quercus gambeli,* July 27, 1932, 1 female (dwarfed specimen, 11 mm.) (A. B. Klots); 4 males, Texas, without date and locality; 1 male labeled reared from gall on *Quercus nigra,* Mobile, Ala., April (J. Ball); long series of both sexes from galls on scrub oak in Alabama and Mississippi, May-June, 1922-1932 (Engelhardt); Baton Rouge, La., both sexes, from oak galls, July 1932 (C. O. Hopkins); Crowley, La., May 27, 1922 (W. W. Porter); Cedar Bluff, Miss., from gall on black oak; Pensacola, Fla., May 1928, from woody round galls on small-leaved scrub oak (Engelhardt).

SYNANTHEDON DECIPIENS race RUBRISTIGMA (Kellicott)

Aegeria rubristigma Kellicott, Can. Ent., vol. 24, p. 211, 1892; Insect Life, vol. 5, p. 84, 1892.

Sesia rubristigma Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 141, 1896; vol. 9, p. 220, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 301, 1901.

Synanthedon rubristigma McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8735, 1939.

Male.—Labial palpus with basal and second joints black, except the tip of the latter, which is yellow like the third joint. Forewing transparent with costa and outer margin very narrow and orange streaks between the veins much shortened or absent.

Female.—Labial palpus yellow, black at the base. Forewing with costa and outer margin broader and with the orange streaks more pronounced than in the males.

Expanse: Male 13-18 mm., female 13-18 mm.

Distribution.—Eastern and Midwestern States, Canada (Ontario), Appalachian system, in general following the red and black oak belts.

Type.—In the American Museum of Natural History. Type specimens reared from cynipid galls on *Quercus palustris,* Central College and Sugar Grove, Ohio.

Remarks.—Records for specimens in the United States National Museum: Three males, 2 females, Long Island, N. Y., both from galls of *Andricus cornigerus* (Osten Sacken) on *Quercus palustris,* June-July (Engelhardt); 1 male, Falls Church, Va., from oak gall, June 1, 1914

(C. Heinrich); 3 females, Cleveland, Ohio, from galls of *Andricus cornigerus,* May 6, 1931 (F. DeGant); 3 females, Chickamauga, Tenn., from gall of *A. cornigerus;* 1 male, Iowa (C. P. Gillette); 1 male, Hope, Ark., July, caught in light trap; 1 male from galls of *Andricus seminator,* June 10, 1893 (Zabriskie).

Like the typical form, *decipiens decipiens,* the race *rubristigma* is a borer in oak, attacking the bark but by preference living in cynipid galls, which must be hard and woody in substance, not soft or spongy. Such galls are occupied only after they have grown to near or full maturity but still retain sufficient living tissue to support the borers through their 1-year cycle of life. Rearing from galls, collected during spring and early in summer, is the easiest method of obtaining the adults. In the eastern and midwestern States the favorite gall is *Andricus cornigerus* on black oak. This gall is inhabited also by the far more common smaller species, *Thamnosphecia scitula,* and as emergence proceeds there is usually a great preponderance of *scitula* and only an occasional specimen of *decipiens.* This ratio is reversed along the coastal regions of the Southern States and in the type habitat of *decipiens* in Colorado, where different species of woody galls on different kinds of oaks are occupied. Cynipid galls on live oak and on scrub oak at Pensacola, Fla., and Mobile, Ala., produced examples of *decipiens* only. There are no records of *scitula* from Colorado.

The recognition of *rubristigma* as a race of *decipiens* stands on color differences alone. Intergradations along the range of the species interfere with a clear-cut geographical division. In general the race *rubristigma* represents the eastern and northern part of the range, differing from typical *decipiens* by the nearly complete transparency of the forewings in the male and by the only narrowly suffused tips of the forewings in the female. Westward and southward there is a gradual intensification of the scaling on the forewings, this reaching its greatest development along the coastal regions of northern Florida and Alabama, where transparent areas become nearly obscured. A narrow belt across Florida from Jacksonville to the northern State line remains untouched by field investigations. Within this belt lies the meeting place of *decipiens* and *floridensis.* The question is, Do these two forms remain apart or do they blend? We are inclined to suspect a blending.

SYNANTHEDON SAXIFRAGAE (Hy. Edwards)

Aegeria saxifragae Hy. Edwards, Papilio, vol. 1, p. 190, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 91, 1894.

Aegeria henshawii Hy. Edwards, Papilio, vol. 2, p. 56, 1882.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 173, 1892.

Sesia saxifragae Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 135, 1896.

Synanthedon saxifragae McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8719, 1939.

Male.—Antennae metallic black. Labial palpi heavily brushed with orange beneath, above orange and black mixed and tips black. Head black, frons with a stiff brush, blue-black. Collar blue-black. Thorax black, a small orange patch at the sides; metathorax tufted with long black hair. Abdomen black with steel-blue reflections above and beneath; anal tuft short, fan-shaped, black. Legs orange, femora black outside, tibiae rough throughout, tarsi smooth. Forewing transparent, costa, outer margin, veins, and large discal mark shiny blue-black, very sparsely intermixed with orange, a suffusion of rusty black scales between the veins at outer margin, limbus and wing base shaded a deep orange; fringes sordid black. Hindwings transparent, narrowly margined with black. Forewings and hindwings shaded with orange beneath.

Female.—Same as the male. Anal tuft narrow, straight with thin hair pencils, two on each side (this condition possibly due to abrasion); none of the few available examples is in perfect condition.

Expanse: Of *saxifragae,* male 22 mm., female 22 to 24 mm.; of *henshawii,* male 18 mm.

Distribution.—Of *saxifragae,* Rocky Mountains, Colorado and Utah, 8,000 to 12,000 feet, and Alaska; of *henshawii,* Labrador, Hudson Bay.

Type.—Male. In the American Museum of Natural History.

Remarks.—It is difficult to align this species satisfactorily. The few worn specimens available have been collected singly over a long period of years in widely separated sections of the continent, but all at high elevation, 8,000 to 12,000 feet, or in Arctic regions. If allowance is made for excessive hairiness and roughness as due to a life in frigid zones, the species fits best into the present genus. Structures of the male genitalia, especially the strong, flat-scaled, outwardly recurved sacculus ridge, set it apart from the other species. Nothing is known of the food plant, except that it is not saxifrage.

Of the species described by Hy. Edwards as *henshawii* only two examples are known, the male type (American Museum of Natural History) from Mingen Island, Labrador, 1882, and one male (U. S. National Museum), Piquitenay River, Mile 214, Hudson Bay Railroad, July 16–23. The two examples are smaller in expanse than *saxifragae,* 18 mm. against 22 mm., and they are dusted slightly more heavily with orange on the primaries. The male genitalia are alike. For the present it seems best to continue *henshawii* as a synonym of *saxifragae.*

The following records of *saxifragae* are contained in the United States National Museum collection: One male, South Park, Colo., 12,000 feet, June 25, 1917 (Oslar); one male, San Miguel, Colo., (Oslar); one male, Silverton, San Juan Mountains, Colo., 12,000 feet, July 19, 1903 (C. P. Gillette); one female, Rico, southwestern Colorado, 10,000 feet (Oslar); one female, Uinta Mountains, Utah, June 26 (Truman Swallow); one female, Fort Yukon, Alaska.

SYNANTHEDON PICTIPES (Grote and Robinson)

PLATE 23, FIGURES 138, 139

Aegeria pictipes GROTE and ROBINSON, Trans. Amer. Ent. Soc., vol. 2, p. 182, pl. 2, fig. 64, 1868.

Aegeria insitata HY. EDWARDS, Papilio, vol. 1, p. 201, 1881.

Synanthedon pictipes McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8720, 1939.

Male.—Antennae long, black, scarcely dilated toward tips; pectinations fine. Palpi beneath pale yellow, above black. Head, thorax, abdomen, and legs black, with metallic reflections more often coppery than blue. Head sprinkled with pale-yellow scales at the base. Collar black above, pale yellow at the sides. Thorax with yellowish borders to the tegulae and a yellowish spot at the side beneath and before the base of the wing. Wings hyaline, sometimes stained yellowish. Forewing with costa, transverse mark, and outer margins very narrowly scaled with black. Fringes short, brown-black. Hindwing wholly pellucid, with only a very narrow terminal border continued to the base. Wings beneath with inner and costal margins and discal mark scaled and edged pale yellow. Tibiae with two pale yellow or whitish tufts at the spurs. Tarsi banded with whitish at the joints. Abdomen with the second segment bordered with whitish above and beneath and the fourth segment whitish beneath only (color markings on abdominal segments of imperfect or old specimens often obscured); anal tuft distinctly hastate, sparsely edged with whitish at the sides.

Female.—Very similar to the male. Antennae simple, anal tuft long, narrow, not hastate.

Expanse: Male 18 to 23 mm., female 20 to 25 mm.

Distribution.—Chiefly eastern half of Canada and the United States to the Mississippi and eastern Texas. Rocky Mountain and Pacific coast records doubtful.

Type.—Lost. Type of *Aegeria insitata,* female, in the American Museum of Natural History.

Remarks.—Specimens of the two sexes of *pictipes* are very similar and bear a striking resemblance to the male of *Sanninoidea exitiosa,* except for their smaller size. Swellings and distortions caused by the black-knot fungus on branches of wild black cherry often are inhabited by the larvae. *S. pictipes* is usually known as the "lesser peach borer," while *exitiosa* is called the "peachtree borer." As a pest of peach trees and other kinds of stone fruits under cultivation, *pictipes* is far less important than *exitiosa.*

Wild cherry and wild plum are the principal native food plants. The species has been reported from Juneberry, *Amelanchier canadensis,* probably erroneously, as my specimens reared from this plant turned out to be *Thamnosphecia pyri.* The chestnut bark borer, often confused

with *pictipes,* is a distinct species. It is of interest to note that *pictipes,* like *exitiosa,* exhibits the same tendency toward a gradual broadening of the wing margins in specimens from the northeast to the south and from the south to the west.

SYNANTHEDON CASTANEAE (Busck)

PLATE 23, FIGURES 140, 141

Sesia castaneae BUSCK, Proc. Ent. Soc. Washington, vol. 15, p. 102, 1913.
Synanthedon castaneae MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8722, 1939.

Male.—Antennae long, black, scarcely dilated toward tips, pectinations fine, curved inward, shorter near the tips. Labial palpi beneath yellow or whitish yellow; above black, sparsely sprinkled with yellow scales; apical half of third joint all black. Face bluish black, broadly white before the eyes. Head black, sparsely mixed with yellow scales at base. General body color black. Thorax bluish or coppery black, with two narrow, yellow, lateral stripes above and two broader, yellow marks on the underside, before the wing base. Wings hyaline; veins and costa scaled with bluish black, as are also the very narrow transverse mark and the other margins on the forewings; underside of wings yellower on veins, costa, and margins; fringes purplish or rusty black. Abdomen black, with blue or coppery reflections and with segments 2, 3, and 4 very narrowly banded with pale yellow above; the band on segment 4 continuing onto the venter where it becomes broader (cabinet specimens quickly become greasy; only thoroughly cleaned individuals reveal the exact body markings); anal tuft wedge-shaped, with the inner side of the claspers dark ochreous. Legs blue or coppery black; tibia with only one whitish band or tuft at the posterior spurs, an important character for separating *castaneae* from *pictipes,* which has two pale yellow bands, one each at the anterior and posterior spurs.

Female.—Very similar to the male. Average size larger. Antennae simple. Transverse mark and outer wing margins slightly broader. The banding on abdominal segments as in the male, but more pronounced; tuft straight, narrow.

Expanse: Male 17 to 20 mm., female 22 to 28 mm.

Distribution.—In general following the distribution of the American chestnut, *Castanea dentata,* from Maine to Ontario and southward to the Mississippi.

Type.—In the United States National Museum.

Remarks.—This species was confused with *pictipes* until recognized by Busck as distinct and described as *castaneae* in 1913. Superficially the two species may be easily confused, but closer study reveals differences calling for specific separation. In *pictipes* the collar is yellow and the tibia is tufted with yellow at both the anterior and posterior spurs, whereas

in *castaneae* the collar is black and the tibia is tufted with yellow only at the posterior spurs.

The United States National Museum has a fine representation of *castaneae,* in large part obtained by rearing. This is fortunate, as the species is threatened with early extinction following the extermination of its food plant, the American chestnut, by the chestnut blight. Only comparatively few diseased and struggling trees remain.

S. castaneae is a borer in the tree trunks, preferably attacking bruised places. The life cycle is annual. Wintering in its burrow, the larva constructs a rough, oblong cocoon of chips in spring. The moths emerge late in May or in June or July. At the beginning of the twentieth century the insect was fairly common in the eastern Atlantic Coast States, in the Southern States, and inland, ranging north to Canada, wherever the chestnut occurred. No records have been received in recent years. Quite likely there are stray specimens in collections unrecognized and confused with *pictipes.*

SYNANTHEDON VIBURNI Engelhardt

PLATE 23, FIGURE 142

Synanthedon viburni ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 65, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States, pt. 2, No. 8721, 1939.

Male.—Antennae blue-black, slightly dilated apically and with a few pale scales before the tips, pectinations very short and fine. Tongue well developed, spiral. Labial palpus with a smooth, even, pale-yellow brush; third joint pointed, black. Face black. Head black, with long hair, which is yellow and black mixed on top. Collar pale yellow. Thorax blue-black, narrowly banded with pale yellow laterally above and with a broad patch of the same color beneath before base of wing. Wings lustrous hyaline; forewing with costa, transverse mark, and narrow outer margins blue-black, underside shaded with pale yellow; hindwing with margins and cilia very narrow, rusty black. Legs steel blue, tibia smooth, with a whitish, short tuft at the spurs; tarsi white at the joints. Abdomen bright steel blue, second segment narrowly banded with white above, fourth segment broadly marked with white at the sides, no bands beneath; anal tuft clearly wedge- or halberd-shaped, edged with white at the sides.

Female.—Similar to male. Antennae simple, broadly banded with pale yellow or whitish before the tip; outer wing margins broader than in the male; anal tuft straight, narrow.

Expanse: Male 16 to 18 mm., female 18 to 22 mm.

Distribution.—Recorded only from Long Island, N. Y.

Type.—Male, from Woodhaven, N. Y. In the United States National Museum.

Remarks.—Biologically *viburni* is not closely related to any of the several species to which it bears a close superficial resemblance. When

specimens are rubbed and discolored it is difficult to avoid confusion, but in doubtful cases the genitalia always will serve for definite conclusions. Thus, *pictipes,* which most nearly resembles *viburni,* has the tip of the aedeagus distinctly forked while in *viburni* it is much swollen and triangular; the antennae of *pictipes* are black in both sexes, whereas in the female of *viburni* they are well marked with white before the tips; in *pictipes* the body colors are black with bluish or coppery reflections, but in *viburni* they are bright steel blue. The rather recent discovery and recognition of *viburni* as a distinct species was made in an area where there had been much entomological collection for generations. No examples were captured in flight; all were reared from the cones and branches of *Viburnum dentatum* obtained in swampy thickets of *Viburnum* in the Brooklyn Botanic Garden, Brooklyn, N. Y. *S. viburni* is an annual species, the larva living under the bark and not in the solid wood, preferably in such parts where abrasions or gall growths have caused distortions and swellings. Pupation takes place early in May in an oblong cocoon constructed within the larval gallery under the bark. The moth emerges late in May and early in June. While locally not uncommon, the larvae are much subjected to the attacks of a hymenopterous parasite, and rearing experiments thus far have resulted in more parasites than moths.

The occurrence of *viburni* on horticultural varieties of *Viburnum* as well as native shrubs gave rise to a consideration of the possibility of an introduced species, but this appears to be excluded as this form bears no resemblance to *Synanthedon andrenaeformis* (Laspeyres) of Europe, the only other aegeriid recorded as boring in *Viburnum.* Further investigations should prove it an indigenous species of wider distribution than present records indicate.

Genus PALMIA Beutenmüller

Palmia Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 123, 1896. (Genotype, *Sciapteron praecedens* Hy. Edwards.)

Female antenna simple, thickened toward apex and with the usual apical tuft. Tongue well developed, spiraled. Labial pulpus rather short, porrect; second joint with a short, uneven brush; terminal joint shorter, smooth. Head and thorax smooth. Wings long, narrow, bluntly pointed; forewing with 12 veins, 7 and 8 stalked to costa; hindwing with 8 veins, 3 and 4 stalked. Posterior tibiae smooth with stiff scales at spurs; posterior first tarsal joint slightly thickened with rough scales above. Anal tuft small.

The genus is known only from a single female specimen. It is for this reason not included in the synoptic table of the genera, in which it would fall with *Synanthedon.* Pending rediscovery and the acquisition of better material, including males, the genus is treated as distinct.

PALMIA PRAECEDENS (Hy. Edwards)

Sciapteron praecedens Hy. Edwards, Papilio, vol. 3, p. 155, 1883; Ent. Amer., vol. 3, p. 223, 1888.

Palmia praecedens Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 123, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 255, 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8767, 1939.

Female.—Antennae orange, black at the tips. Labial palpi orange, with bases sprinkled with black. Head and thorax dark brown, the latter with a red stripe on each side. Abdomen dark brown, with the three last segments and anal tuft light lemon yellow. Posterior tibia red, with a broad, black band at tip; posterior tarsus light yellow. Forewing dark bronzy brown, with only a narrow longitudinal streak from base to middle of cell translucent; base of internal margin stained with red. Hindwing bronzy brown with translucent base. Underside of both pairs of wings mottled with red.

Expanse: 30 mm.

Type.—Female. In the United States National Museum. From North Carolina.

Known only from the unique female type specimen.

HYMENOCLEA, new genus

Genotype, *Sesia palmii* Beutenmüller.

Sexes very dissimilar in size and coloration. Male antennae strongly pectinate; female antennae simple. Tongue long, spiraled. Labial palpi porrect, second joint with a short, uneven brush on the underside, smaller in the female than in the male, terminal joint smooth, shorter than second. Head and thorax smoothly scaled. Forewing with 11 veins; veins 10 and 11 coalescent; 7 and 8 stalked, 7 to apex; 4, 5, and 6 equidistant, parallel; 2 and 3 also parallel but farther apart from 4. Hindwing with 8 veins; 3 and 4 connate or short-stalked; 7 and 8 obscured in the costal fold. Posterior tibiae roughly scaled above; first joint of posterior tarsus slightly thickened with scales. Anal tuft of male large, fan-shaped; of female, short. Male genitalia of the *Synanthedon* type; harpe with cucullus rounded; sacculus ridge nearly straight, covered with black bifurcate scales on the upper (inner) half, outer half devoid of scales; aedeagus long, straight, bulbous at base; cornuti numerous, short, sharp thorns; vinculum long, slightly bifurcate at tip. Female genitalia with end of ductus strongly sclerotized; bursa oval, without signum.

HYMENOCLEA PALMI (Beutenmüller)

Plate 1, Figure 9; Plate 6, Figures 36, 36a; Plate 14, Figure 66; Plate 23, Figures 143, 144

Sesia palmii Beutenmüller, Journ. New York Ent. Soc., vol. 10, p. 126, 1902.

Gaea palmi McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8774, 1939.

Male.—Antennae bluish black, brown beneath, stout, strongly pectinate. Labial palpus with a heavy brush in a tawny or sordid-white mixture, third joint smooth, grayish black. Head tufted, blackish brown and white mixed, eyes brown. Collar tawny, sordid white at the sides. Thorax brown-black, thinly clothed with whitish hair; anterior edge with black and tawny scales, a short, tawny stripe in the center and two lateral stripes of the same color ending in a broader tuft at metathorax, which is long-tufted at the sides and hairy centrally, tawny or sordid white; underside of thorax shiny black shingled with sordid-white scales; the bases of the primaries similarly shingled. Abdomen lustrous bronzy brown, with grayish suffusions; segments not banded; anal tuft large, fan-shaped, dull black, tawny at the sides and beneath. Forelegs with coxae shiny buff and sordid white; posterior tibiae very rough throughout, in color a grayish mixture; tarsi concolorous, black, spined beneath. Forewing opaque, streaked with brownish and sordid black, except for a small, more or less suffused buff-colored area before the large sordid black discal mark; costa, outer and inner margins of a darker shade, fringes brownish black; underside more pronounced tawny in color than upper surface. Hindwing opaque, bright tawny, sprinkled with darker scales outwardly, above and beneath; veins and discal mark rusty black.

Female.—Antennae black, above and beneath. Labial palpus with short brush, black throughout. Head black, face lustrous tawny. Collar black with a few whitish hairs intermixed. Thorax violet-black, sometimes with a faint central stripe and always with two broad, lateral stripes sordid white; underside black. Abdomen shiny black, segment 2 banded with white above; anal tuft short, black, with two white streaks, not reaching to the end. Posterior tibiae rough, violaceous-black. Forewing opaque, purplish black, thinly sprinkled with grayish scales on inner half to the wing base and in a dense cluster before the black discal mark; fringes dull black; underside streaked with sordid white below the costa and between the veins to inner margin. Hindwing opaque, wholly brownish black, above and beneath.

Expanse: Male 20 to 28 mm., female 27 to 36 mm.

Distribution.—Arid regions of western Texas, New Mexico, Arizona.

Type.—Lectotype female from Phoenix, Ariz. (Kuntze). In the United States National Museum.

Remarks.—Beutenmüller's description of this remarkable species is not based on the male, as stated, but on the female. The identity of the very dissimilar sexes was established many years after the description of the female in 1902. The type specimens were collected by Kuntze, a well-known botanist and collector of insects, of Phoenix, Ariz., and subsequently acquired by Charles Palm, of New York, for whom the species was named. Favorite haunts of the insect are arid regions along river embankments and irrigation ditches, where the food plants, species of *Hymenoclea* (burro-brush), attain a heavy rank growth, sometimes 10 feet tall and with

enormous, tough-fibered roots penetrating the ground equally deep. The larval galleries in the roots go down several feet. Excavating them is most difficult. A fortunate opportunity to study the habits of the borer was afforded on a visit to southern Arizona in the spring of 1935. One of the so-called "dry washes," caused by a cloudburst, had recently cut off vertically large parts of an embankment, exposing plants of *Hymenoclea* in their entirety. Many of the roots showed the extensive tunnels of the larvae and their places of pupation nearer to the crown of the root. The moths emerged during August and September. Whether this insect is an annual or a biannual species could not be determined. There are long periods of estivation. Of the three known female types from the original lot collected by Kuntze at Phoenix, Ariz., one is in the collection of the United States National Museum, bearing Beutenmüller's label and designation as "type." It has been made the lectotype. Additional records in the United States National Museum: 26 males, 7 females, Mohave County, Ariz., September 1, 1930; 5 males, 3 females, Kingman, Mohave County, Ariz., October 1-7; 3 males, 6 females, Marfa, Presidio County, Tex., October 1926 (O. C. Poling); 1 male, 2 females, Alpine, Brewster County, Tex., 5,000 feet, September 5, 1926 (Engelhardt).

Genus ALCATHOE Hy. Edwards

Alcathoe Hy. Edwards, Papilio, vol. 2, p. 53, 1882. (Genotype, *Aegeria caudata* Harris.)

Tongue long, spiraled. Male antenna long, only slightly dilated before tip, finely and shortly bipectinate; female antennae simple. Labial palpi ascending, projecting beyond the head; second joint slightly thickened with nearly smooth scales, third joint about half the length of second, bluntly pointed. Posterior tibia rough-scaled to the middle spurs, smooth to the last spur, where it is again tufted; first tarsal joint heavily tufted above. Eighth abdominal segment of the male with two short lateral tufts and one central very long, soft, hairy appendage as long as, or longer than, the abdomen. Forewing with 11 veins, veins 10 and 11 coalescent; hindwing with veins 3 and 4 on short stalk. Male genitalia of the *Synanthedon* type, sacculus ridge curved, densely covered with furcate scales and terminating in a recurved, convoluted, unscaled fold; aedeagus slightly bent, with a somewhat bulbous base; cornuti prominent, stout, paired spines; vinculum stout, blunt, moderately long. Female genitalia with ductus rather short, strongly sclerotized on outer half; bursa oval, finely granulated, without signum.

The species of this genus form a singular unit, distinguished by the long, delicate caudal appendage of the male and by the remarkable resemblance of both sexes to members of the Psammocharidae, and in particular to species of *Pepsis*, the so-called tarantula-killer wasps. The resemblance between western species of the moths and wasps during flight is so decep-

tive as to leave their identity doubtful until cautiously transferred from net to cyanide jar. I refrain from speculating on the advantage of the mimicking moths in escaping enemy attacks, but it is a fact that moths of some species have never, or very rarely, been captured by entomologists; the fine, long series in the United States National Museum has been obtained by rearing. The species are root and stem borers in *Clematis,* practically confining their attacks to native, small, white-flowering plants known as virgins-bower, as *Clematis virginiana* and *C. ligusticifolia.* Cultivated varieties seem to be avoided. *A. caudata,* ranging east from the Mississippi to to Maine and Canada along the distribution of its food plant, appears to be the only distinctly North American species. The several species and forms west of the Mississippi to California suggest a Mexican and Central American origin. Tropical Central America as yet is represented by only a few captured specimens, specifically in confusion. However, as has been noted by the larval work on vines of *Clematis,* the insects are not uncommon, but even abundant, and should be easily obtained by rearing.

The life cycle of all the species is annual. The young larvae, emerging from characteristically spherical, somewhat compressed, light-brown eggs laid at the crown roots or on the vines, tunnel into the living plants, causing scars and gall-like swelling of considerable size after wintering and resuming feeding in spring. The change from larva to pupa takes place within the swelling in a roughly constructed case of chips and frass. Large roots may house a number of larvae in close proximity. On vines the swellings usually are well separated, in temperate regions not far above the ground, but in the Tropics they may extend well upward toward the tops of the trees. Rearing the moths is easy from infested plant cuttings, obtained in advance and near the time of emergence. Immature stages in such cuttings do not survive. The moths upon emerging in a rearing cage must be handled with care, as they will injure themselves by dropping quickly, trying to escape or to hide.

COLOR KEY TO NORTH AMERICAN SPECIES, RACES, AND VARIETIES OF THE GENUS ALCATHOE

Forewing opaque, violaceous, except vitreous basal half; hindwing transparent; antennae and caudal appendage orange.....**caudata caudata** (Harris)

Hindwing transparent, broadly margined, suffused between veins 5 and 6 to cell and between veins 1b and 1c irregularly inward.....**caudata annettella,** new race

Forewing black, hindwing transparent, margin narrow; antennae, legs, and caudal appendage black.....caudata **walkeri** Neumoegen

Wings opaque, orange with a small clear area on hindwing at base between veins 1a and 1b; male antennae and caudal appendage black; female antennae orange. **pepsioides** Engelhardt

Body, wings, antennae, legs, and male caudal appendage ferruginous. **pepsioides ferrugata,** new race

Wings, legs, male antennae, and caudal appendage deep black or rusty black; female antennae orange or rusty black.....**pepsioides atra** Engelhardt

Wings deep orange; forewing black at base and on costa, streaked with black veins; hindwing with 3 hyaline areas at wing base, divided by black veins; legs black; male antennae and caudal appendage black; female antennae orange.
autumnalis, new species

Wings opaque, bluish black; female antennae orange.....**carolinensis** Engelhardt

Wings opaque, dark orange; hindwing lacking hyaline area at base; antennae, legs, and male caudal appendage black.....**verrugo verrugo** (Druce)

Wings opaque, lustrous black in both sexes.....**verrugo corvinus,** new variety

ALCATHOE CAUDATA CAUDATA (Harris)

PLATE 2, FIGURE 10; PLATE 6, FIGURES 37, 37a; PLATE 14, FIGURE 67

Aegeria caudata HARRIS, Amer. Journ. Arts and Sci., vol. 36, p. 311, 1839.—WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 42, 1856.—PACKARD, Guide to the study of insects . . ., p. 278, 1869.—LINTNER, 23d Ann. Rep. New York State Cabinet Nat. Hist., 1869, p. 192, 1873.—THOMAS, Seventh report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1877, p. 172, 1878.—MARTEN, *in* Thomas, Tenth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, p. 108, 1881.

Trochilium caudatum FITCH, Third report on the noxious, beneficial, and other insects of the State of New York, 1856, p. 424, 1857.—MORRIS, Synopsis of the described Lepidoptera of North America, p. 139, 1862.—BETHUNE, Can. Ent., 1868, vol. 1, p. 18, 1869.—HY. EDWARDS, Papilio, vol. 2, p. 53, 1882.

Sesia caudata BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 437, 1874.

Alcathoë caudatum HY. EDWARDS, Papilio, vol. 2, p. 53, 1882.—BEUTENMÜLLER, Ann. New York Acad. Sci., vol. 5, p. 204, 1890; Bull. Amer. Mus. Nat. Hist., vol. 8, p. 116, 1896; vol. 9, p. 217, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 240, pl. 29, figs. 7, 8, 1901.—JACK, Garden and Forest, vol. 4, p. 496, fig. 77, 1891.—RILEY and HOWARD, Insect Life, vol. 4, p. 219, 1891.—KELLICOTT, Can. Ent., vol. 24, p. 44, 1892.—ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 156, 1925.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8685, 1939.

Male.—Antennae long, very slightly dilated; pectinations short and fine, yellow or orange. Labial palpus nearly smooth; second joint slightly thickened, deep yellow. Head black, slightly mixed with brown on top and on face. Collar black. Thorax black, shiny, patagia slightly touched with reddish, metathorax with lateral light-brown tufts. Abdomen black, violaceous or coppery, beneath reddish brown; anal tuft black at base and with a soft, hairy, yellow appendage as long as, or longer than, the abdomen. Forelegs with coxae brownish red; posterior tibiae rough, red-brown to the last spurs; first tarsal joints heavily tufted with yellow and orange, posterior joints yellow. Forewing opaque black on outer half, vitreous on basal half, streaked with black veins; underside somewhat rusty black. Hindwing transparent, narrowly margined black.

Female.—Antennae pale yellow. Labial palpi yellow beneath, black above. Head black. Collar orange. Thorax and abdomen purplish black; anal tuft long, narrow, black. Forelegs orange, shaded with black out-

wardly, posterior tibia and first tarsal joint black, last tarsal joints yellow. Forewings opaque, black throughout. Hindwings transparent.

Type.—Male. In the Boston Society of Natural History.

ALCATHOE CAUDATA WALKERI Neumoegen

Alcathoe caudatum var. *walkeri* NEUMOEGEN, Ent. News, vol. 5, p. 331, 1894.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 116, 1896.—ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 156, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8685, 1939.

This male color variety differs from the normal form in having labial palpi, collar, legs, and anal appendage black. The antennae are black above, rufous beneath. It has been recorded only very occasionally and at long intervals. It shares the distribution of the normal species.

Expanse: Male 22 to 30 mm., female 23 to 33 mm.

Distribution.—General throughout eastern Atlantic and Midwestern States to Nova Scotia and eastern Canada and through the Appalachian regions to the South.

Type.—Male. In the United States National Museum.

Remarks.—Records in the United States National Museum: Richmond Hill, Long Island, N. Y., males and females, July 5, 1914 (Engelhardt); New Jersey, males and females (J. Doll); Bronx Park, New York City, males and females (L. Jontel); Greenville, N. Y., August 22, 1922, female (Engelhardt); Monterey, Mass., August 11, 1927, male (Engelhardt); Washington, D. C., male and female (H. G. Dyar); Hartsdale, Westchester County, N. Y., August 12, 1939 (Engelhardt); Black Mountains, N. C., 2,000 feet, August 21, 1929, males and females normal and male *walkeri* (Engelhardt).

ALCATHOE CAUDATA ANNETTELLA, new race

PLATE 24, FIGURE 145

Forewing of male opaque, black, except for a very narrow space between the veins at wing base. Hindwing, in both male and female, broadly margined with irregular extensions between the veins inwardly.

Type.—U.S.N.M. No. 56838, male.

Remarks.—Represented in the United States National Museum by the type, one male and two female paratypes collected and reared on *Clematis* vines in the garden of Annette E. Braun, Cincinnati, Ohio, July 1, 1916. In range it is expected this race should extend to regions in Tennessee and Arkansas from where as yet no records of *Clematis* borers have been obtained.

ALCATHOE PEPSIOIDES Engelhardt

PLATE 24, FIGURE 146

Alcathoe pepsioides ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 157, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8687, 1939.

Male.—Antennae bluish black when perfect, rufous when abraded, pectinations dense but short. Labial palpi black, slightly touched with brown. Head black, a coarse brush on top. Collar, thorax, abdomen, anal appendage, and legs black with metallic reflections. Forewing opaque, dull orange; costa, vein 10, and cubitus shaded with dull black; discal mark and inner margin with reddish scales; fringes brownish black. Hindwing opaque, dull orange; cubitus and veins 2, 3, and 4 shaded with dull black. A vitreous, round or slightly oval area confined between veins 1a and 1b at base of wing. Wings similar above and beneath.

Female.—Antennae simple, orange. Labial palpi black, slightly mixed with orange. Head black, a coarse brush on top, mixed black and orange in color. Anal tuft black, narrow, centrally inverted and with a shorter hair pencil at each side. Otherwise like the male.

Expanse: Male 30 to 32 mm., female 34 to 36 mm.

Distribution.—Rocky Mountain regions, 4,000 to 8,000 feet, Colorado, Utah, Nevada, New Mexico, Arizona.

Type.—Male, in the United States National Museum.

Remarks.—This species, aside from its predominating normal orange form, is subject to color variations in both sexes varying from orange to deep black.

ALCATHOE PEPSIOIDES ATRA Engelhardt

PLATE 24, FIGURE 147

Alcathoe pepsioides atra ENGELHARDT, Bull. Brooklyn Ent. Soc., vol. 20, p. 158, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8687, 1939.

That the color variety *atra* is conspecific with *pepsioides* has been established from long series of specimens reared from material collected in the same locality and at the same time. One lot from Jemez Springs, Sandoval County, N. Mex., 6,000 feet, produced 50 or more examples of both sexes composed of the normal orange-winged form and numerous others displaying a gradual color transition from orange through brown and brown-black to deep black and lustrous blue-black. Other series with color variations of the same kind are from Fort Wingate, McKinley County, N. Mex., 7,000 feet, July 1922 (John Woodgate); Escalante, Carfield County, Utah, 4,000 feet, July 28, 1933 (Engelhardt); St. George, Washington County, Utah, July 20, 1941 (Engelhardt); Grand Junction, Mesa County, Colo., 5,000 feet, August 12, 1933 (Engelhardt); Trinidad, Las Animas County, Colo., 5,000 feet, July 10, 1929 (Engelhardt); Oak Creek Canyon, Coconino County, Ariz., 6,000 feet, August 1898 (Snow); Alpine, Brewster County, Tex., 5,000 feet, July 20, 1929, orange form only (Engelhardt).

ALCATHOE PEPSIOIDES FERRUGATA, new race

PLATE 24, FIGURE 148

Male.—Antennae ferruginous, pectinations blackish, tips lemon yellow, tufted. Labial palpi rusty brown. Head black mixed with rufous on top; face violaceous. Collar shiny, rufous. Thorax brown-black in center, roughly covered with rufous hairs on the sides, sordid black beneath. Abdomen bright chestnut, each segment thinly annulated with black posteriorly; anal tuft and a shorter hairy pencil on each side black; anal male appendage long, dull brown. Legs rufous, posterior tibiae reddish brown between the spurs, shading into violaceous-black at lower spurs; much thickened first tarsal joint dark brown, terminal joints smooth, rufous. Wings opaque, golden brown; forewing metallic black at base and hindwing with the characteristic vitreous roundish area between veins 1a and 1b at the base.

Female.—Antennae simple. Anal tuft long, narrow, dark brown. No anal appendage, otherwise like the male.

Distribution.—Western slopes of Rocky Mountains only, Colorado, New Mexico.

Types.—U.S.N.M. No. 56839. From Rifle, Colo.

Remarks.—Described from the male type and 13 male and 15 female paratypes.

This distinctive race of *pepsioides* has been reared in long, pure series of both sexes at Rifle and Glenwood, Garfield County, Colo., 5,000 feet, August 4, 1927, and July 22, 1931 (Engelhardt). A small number from the canyon above Glenwood, 6,000 feet, included examples of typical *pepsioides* and of the race *ferrugata*. One female of *ferrugata* is labeled Taos, Taos County, N. Mex., 7,000 feet, July 29, 1929 (Engelhardt).

ALCATHOE AUTUMNALIS, new species

PLATE 25, FIGURE 149

Male.—Antennae black, orange between the pectinations and at tips. Labial palpi all black. Head lustrous black, with a coarse brush on top. Collar, thorax, abdomen, anal tuft, anal appendage, and legs all black with metallic reflections. Forewing opaque, deep orange; costa, submedian and median veins, and inner margin heavily scaled with black from wing base to beyond the cell, fringes brownish black; on the underside the black shading reduced to near the wing base. Hindwing opaque, deep orange, streaked with black veins; three hyaline areas, divided by black veins at wing base, the posterior one oval and largest, the others narrow, straight.

Female.—Antennae bright orange, simple; anal appendage lacking; otherwise like the male.

Expanse: Male 32 to 36 mm., female 34 to 38 mm.

Distribution.—Southeastern Texas, Mexico.

Types.—U.S.N.M. No. 56840. From San Antonio, Tex.

Remarks.—Described from the male type and 31 male and 27 female paratypes all from San Antonio, Tex.

This species escaped notice and capture on the part of collectors until reared in long series from cuttings of *Clematis ligusticifolia* in southeastern Texas. Rearing material obtained in June and July repeatedly resulted in failure until after the emergence of one dwarfed specimen late in September. This solved the problem. *A. autumnalis* is a fall species with the principal time of emergence in September and October as against June, July, and August for other species in the genus. The three hyaline areas at the base of the hindwing readily separate this species from *pepsioides,* which has only one hyaline basal area. Long series of fine specimens of both sexes as yet are contained only in the United States National Museum. Locality records are: Austin, San Antonio, Del Rio, and Brownsville, Tex. The range of *autumnalis* follows the food plant into Mexico and very likely into Central America, where it is expected to prove conspecific with *A. korites* (Druce), when more and better material becomes available. The examples from Texas run true to type. There are no color variations.

ALCATHOE CAROLINENSIS Engelhardt

Alcathoe carolinensis Engelhardt, Bull. Brooklyn Ent. Soc., vol. 20, p. 156, 1925.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8686, 1939.

The description of this form as a Nearctic species seems likely to have been incorrect. Erected on a single example, without locality label and date, and contained in a miscellaneous lot of Lepidoptera at the American Museum of Natural History, the specimen was recognized, at first doubtfully, then positively, by Beutenmüller as having been collected by him on flowers of *Clematis* in the Black Mountains of North Carolina, a surprising record inasmuch as the moth exhibits much closer affinities to western species than to the eastern *A. caudata.* Subsequent field investigations in the Black Mountains of North Carolina have proved Beutenmüller's plant identification erroneous. Long series of reared examples consisted of typical *A. caudata,* including several of the black male variety, *walkeri.*

The collection of North American clematis borers has been extended greatly in recent years, affording a clearer conception of the species and their races and color varieties. The type of *carolinensis* lacks antennae and the long anal appendage of the male. Reexamination shows it not to be a male, as described, but a female with a short antennal stub which is orange, characteristic of that sex. The male antennae are black. On structure *carolinensis* could readily be placed as a black color variety of *autumnalis,* but 100 or more reared specimens of *autumnalis* from Texas show absolutely no color variations. This apparent uniformity

may yet be upset as it has been for other western species. However, at present it would seem that the type of *carolinensis* was from Mexico or Central America and is a black color variety of *A. korites* (Druce). The tropical species still are much confused.

Type.—In the American Museum of Natural History.

ALCATHOE VERRUGO VERRUGO (Druce)

PLATE 25, FIGURE 150

Sannina verrugo DRUCE, Biologia Centrali-Americana, Lepidoptera, vol. 1, p. 34, pl. 5, fig. 21, 1884.

Male.—Antennae black, brown at the tips and beneath the pectinations, which are short and fine. Labial palpi, head, thorax, abdomen, anal appendage, and legs shiny black with steel-blue reflections. Forewing opaque, orange or orange-red, finely streaked with black veins; costa black, outer margins with broad dull-black fringes; wing base black; discal mark usually not prominent, sometimes with black scales. Hindwing opaque, orange or orange-red; margins with broad dull-black fringes; no hyaline areas at the wing base.

Female.—Antennae simple. Anal appendage lacking. Otherwise like the male.

Distribution.—Mexico, California.

Type.—Female. In the British Museum of Natural History. From Esperanza, Pueblo, Mexico.

ALCATHOE VERRUGO CORVINUS, new variety

PLATE 25, FIGURE 151

Male and female.—Entirely black, with steel-blue reflections; otherwise like the typical form.

Expanse: Male 24 to 26 mm., female 26 to 30 mm.

Distribution.—Central America to southern and central California.

Type.—U.S.N.M. No. 56841. From Arroyo Seco, Los Angeles, Calif.

Remarks—Described from male type, 6 male and 5 female paratypes from the type locality, and 2 female paratypes from San Juan Capistrano, Calif.

Central American records of *verrugo* Druce are scattered and too few for a comprehensive survey of distribution in tropical and subtropical countries. In the United States the species is confined to coastal regions of southern and central California at elevations not above 2,000 feet. Santa Barbara is still the northernmost record. In northern California, Oregon, and Washington the abundantly present food plant has been found free from attacks. The absence of hyaline areas at the base of the hindwing readily separates *verrugo* from western species, which it otherwise resembles.

Reared in long series from Arroyo Seco, Los Angeles, July 1927 and 1928 (Engelhardt), the insect attracted other collectors and is now amply represented by reared specimens, not captures. All the series exhibit two distinctly separate color phases, approximately 75 percent being the normal orange and 25 percent a lustrous black. The lack of transitions caused speculation. Could the dark form be accepted as evidence of a new species or subspecies in the making? The answer has been supplied by Theodore W. Hower, of Orange, Calif., whose rearings of several hundred specimens from San Juan Capistrano have furnished the missing intergarding color variations, although in only a few examples.

Along wooded river bottoms and gorges in California the food plant, *Clematis ligusticifolia,* attains maximum growth, huge vines, often displaying the swollen infested parts, reaching the tree tops. Smaller, sprawling vines, usually sufficiently well represented, are more convenient for collecting. Invariably such vines grow in a mixture of poison oak, which calls for precaution.

The larvae pupate in the swollen part of their burrows late in June. From plant cuttings obtained at that time the moths can be reared easily during July. C. M. Dammers, of Riverside, Theodore W. Hower, of Orange, and E. Henne, of South Pasadena, have contributed reared specimens to the United States national collection.

Genus PODOSESIA Möschler

Podosesia Möschler, Ent. Zeit., Stettin, vol. 40, p. 246, 1879. (Genotype, *Aegeria syringae* Harris = *Grotea longipes* (Möschler).)

Grotea Möschler (not Harris), Ent. Zeit., Stettin, vol. 37, p. 312, 1876. (Genotype, *Grotea longipes* Möschler.)

Antennae of male bipectinate, of female simple. Tongue long, spiraled. Labial palpus with a well-developed brush on second joint; terminal joint shorter, smooth, blunt. Head and thorax smooth. Forewing with 12 veins; 7 and 8 stalked to costa, 10 and 11 separate, 2 and 3 short-stalked. Hindwing with 8 veins; 3 and 4 short-stalked, 7 and 8 obscured in costal fold. Abdomen slightly constricted at base. Posterior tibiae and first tarsal joint much prolonged with rough scales above. Male genitalia of the *Synanthedon* type; vinculum short, blunt; sacculus ridge with a rather short slightly curved row of heavy, black, flat scales near the edge of the harpe; aedeagus terminating in three prongs. Female genitalia with an unsclerotized ductus; bursa without signum.

PODOSESIA SYRINGAE SYRINGAE (Harris)

Plate 2, Figure 11; Plate 7, Figures 38-38b; Plate 14, Figure 68

Aegeria syringae Harris, Amer. Journ. Arts and Sci., vol. 36, p. 311, 1839.—Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 41, 1856.—Thomas, Seventh report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1877, p. 174, 1878.—

MARTEN, *in* Thomas, Tenth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1880, p. 109, 1881.—FRENCH, Papilio, vol. 1, p. 106, 1881.

Trochilium syringae MORRIS, Synopsis of the described Lepidoptera of North America, p. 139, 1862.—RILEY, Insect Life, vol. 6, p. 206, 1894.

Sesia syringae BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 436, 1874.—HULST, Bull. Brooklyn Ent. Soc., vol. 5, p. 17, figs., 1882.—LUGGER, 2d Ann. Rep. Ent. State Exp. Stat. Univ. Minnesota, 1896, p. 38, 1897.

Grotea longipes MÖSCHLER, Ent. Zeit., Stettin, vol. 37, p. 313, 1876.

Podesesia syringae MÖSCHLER, Ent. Zeit., Stettin, vol. 40, p. 246, 1879.—BEUTENMÜLLER, Ann. New York Acad. Sci., vol. 5, p. 204, 1890; Bull. Amer. Mus. Nat. Hist., vol. 8, p. 125, 1896; vol. 9, p. 219, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 244, pl. 30, fig. 14, pl. 33, fig. 10, 1901.—PACKARD, 5th Rep. U. S. Ent. Comm., p. 542, 1890.—KELLICOTT, Can. Ent., vol. 23, p. 250, 1891; Journ. Columbus Hort. Soc., vol. 6, p. 62, 1891.—OSBORN, Rep. Iowa State Hort. Soc., Proc., 1892, p. 102, 1893.—WEBSTER, Journ. New York Ent. Soc., vol. 5, p. 71, 1896.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8768, 1939.

Trochilium denudatum OSBORN, Trans. Iowa Hist. Soc., vol. 15, 1880, pp. 107-110, 1881; College Quart., vol. 2, p. 10, 1879; vol. 3, pp. 14-33, 1880.

Sciapteron syringae HY. EDWARDS, Papilio, vol. 1, p. 184, 1881.—PACKARD, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. No. 7, p. 261, 1881.

Male.—Antennae strongly bipectinate, rufous, black above. Labial palpus with a heavy brush, dark brown on second joint, terminal joint short, blunt. Head dark brown, posteriorly with a rufous fringe. Collar brown-black. Thorax brown-black marked with chestnut-red laterally and posteriorly. Abdomen somewhat constricted at base, black or brownish black, not banded, but sometimes with a yellow lateral spot on segment 4; anal tuft short and pointed. Coxae of forelegs black, edged with red, femora black, tibiae hairy, orange, tarsi yellow; posterior tibiae smooth, orange and black; first tarsal joint very long, deep yellow, terminal joints smooth, pale yellow. Forewing nearly opaque, hyaline between the veins at base, dull black, more or less shaded with chestnut-red, paler beneath. Hindwing transparent, yellowish opalescent, and with scale suffusions between the veins, heaviest between veins 1b and 1c, the veins black and the fringes brown-black.

Female.—Antennae simple, reddish brown at base, at tip, and beneath, black in the middle above. Posterior tarsus with first joint constrastingly orange and black, terminal joints bright yellow. Otherwise like the male.

Color variations are increasingly conspicuous toward the southward limits of the species' range. The thorax and abdominal segments 2 and 3 may become almost entirely chestnut-red, only narrowly edged with black.

Expanse: Male 26 to 32 mm., female 32 to 38.

Distribution.—Eastern half of United States and Canada. For detailed distribution and host records see under the race *fraxini*.

Type.—Female. In the Boston Society of Natural History (T. W. Harris, collector).

PODOSESIA SYRINGAE race FRAXINI (Lugger)

Trochilium fraxini LUGGER, Psyche, vol. 6, p. 109, pl. 3, fig. 4, 1891; 1st Ann. Rep. Ent. State Exp. Stat. Univ. Minnesota, 1895, p. 94 (1895).—ALDRICH, Insect Life, vol. 4, p. 68, 1891.

Aegeria fraxini ORCUTT and ALDRICH, South Dakota Agr. Coll. and Exp. Stat. Bull. 22, pp. 80-83, fig. 1, 1891.

Podosesia fraxini BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 88, 1894; vol. 8, p. 125, 1896; vol. 9, p. 219, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 245, pl. 30, fig. 15 (female), 1901.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8769, 1939.

Male.—Antennae pale rufous, with narrow black annulations above. Labial palpus with a heavy brush, rufous slightly mixed with black. Head grizzly black on top, base fringed with orange. Collar brown and yellow. Thorax brown-black, tufted with yellow at wing base and black and yellow on metathorax laterally. Abdomen contracted at base, segment 1 black; segments 2 and 3 black, narrowly edged with yellow; segment 4 black, broadly banded with yellow; segments 5, 6, and 7 and the short, pointed anal tuft chestnut mixed with yellow. Coxae black, posterior tibiae deep yellow or orange, black between the spurs. Tarsi with first joint very long, sordid yellow. Forewing opaque, coppery brown to discal mark, hyaline streaks between the veins to wing base; costa and inner margin dull black, red on basal parts; fringes dark brown. Hindwing transparent; veins yellowish brown; narrow margin edged with red; fringes sordid brown, darkening toward base.

Female.—Very similar to male. Abdomen less constricted at base. Hindwing more broadly margined and with reddish suffusions between veins 1b and 1c.

Expanse: Male 28-32 mm., female 30-34 mm.

Distribution.—Northern Midwestern States to Manitoba, and Kansas, Colorado, Rocky Mountain regions to Montana. Not recorded from the Pacific coast.

Type.—Location not indicated.

Remarks.—In its western distribution the ash tree borer, *Podosesia syringae*, is replaced by the pale ochreous color form *fraxini*. Heretofore *fraxini* has been given specific rank, but it is conspecific with *syringae* as shown in a series of examples from St. Paul, Minn., a transition zone in which the two color forms occur intermixed. In arid regions west of the Mississippi *fraxini* runs true to type.

As examples of mimicry the Aegeriidae furnish many excellent illustrations. It is of interest to note the similar response to climatic differences in the insects which are mimicked. In the humid Atlantic coast regions, *Podosesia syringae* resembles deceptively a common, black and chestnut colored wasp of the genus *Polistes;* in the arid West, the race *fraxini* mingles with a different *Polistes* of the same pale ochreous coloration.

Among insects injurious to forest and shade trees, the ash tree borer has called for considerable attention. Young trees planted along streets,

in parks, and in gardens are attacked with preference and at times heavily, sometimes causing death. Trees in wild woodlands suffer less seriously. The larvae bore in the living wood, excavating galleries several inches long. After wintering in its burrow, the larva prepares a thin cocoon giving access to an exit covered thinly by the outer bark. The moths emerge in June and July or in the South as early as March and April. Besides ash, the borer is partial as well to other trees and shrubs of the family Oleaceae, including European introductions, although *Ligustrum* appears to be the exception. In the Botanical Garden, Brooklyn, N. Y., 1910-1915, the insect interfered seriously with the development of an extensive plantation of *Syringa,* and fringetrees (*Chionanthus*) also were attacked. Parasites very largely are responsible for checking heavy infestations. Woodpeckers also take a heavy toll. In recent years it appears the insect has become far less abundant.

Records of *syringae* in the United States National Museum: Male and females, Columbus, Ohio (W. N. Tallant); Decatur, Ill. (Barnes); Washington, D. C. (H. G. Dyar); Botanical Garden, Brooklyn, N. Y., June 5, 1914 (Engelhardt); Delchamps, Mobile, Ala., April 7, 1933 (Engelhardt); Staten Island, N. Y., June 25, 1927 (W. T. Davis); College Station, Tex., March 31, 1928 (Engelhardt); Willard, Mo., June 1914 (A. E. Brower); State College, Pa., May 16 (Geo. C. Butz); Pittsburgh, Pa., June 12; Biltmore, S. C., from European ash, May 15, 1915 (F. E. Brooks); Agricultural Experiment Station, St. Paul, Minn., May 1, 1890, and forced emergence, March 23, 1877.

The race *fraxini* has been reported as causing serious injury in Texas, Colorado, South Dakota, Montana, and Manitoba, Canada, attacking with preference young ash trees planted in public squares and parks. In severe cases a tree may contain 50 or more of the borers, and the chance of its survival is small.

Records of *fraxini* in the United States National Museum: Males and females, Experiment Station, St. Paul, Minn., May 17, 1887; Ramsey County, Minn.; North Dakota from ash twigs (J. A. Munroe); Bozeman, Mont. (Allen Mail); Denver, Colo. (Oslar); Miles City, Mont., on ash, May 19, 1891 (Ch. A. Wiley); Akrow, Colo., on ash, July 17, 1916 (H. L. Shantz).

Kellicott (1891) reports rearing *P. syringae* from the trunks of mountain-ash, *Sorbus americana,* on the university campus, Columbus, Ohio. I am unable to confirm this record. The only aegeriids I have found partial to mountain-ash are *Thamnosphecia scitula* and *pyri.*

Genus THAMNOSPHECIA Spuler

Thamnosphecia SPULER, Die Schmetterlinge Europas, vol. 2, p. 308, 1910. (Genotype, *Sphinx culiciformis* Linnaeus.)

Tongue long, spiraled. Labial palpus with second joint having a strong, uneven brush; third joint short, blunt. Antennae of male with

short, fine pectinations; of female, simple. Forewing with 12 veins, 7 and 8 stalked to costa, 10 and 11 separate. Hindwing with veins 3 and 4 stalked, 5 nearer to 6 than to 4. Posterior tibiae nearly smooth, tufted at spurs; first tarsal joint not thickened. Male genitalia having sacculus ridge with stiff spines, not bifid scales, in a slightly curved longitudinal group ending before the margin of sacculus; aedeagus straight, bulbous at base; cornuti short spined.

THAMNOSPHECIA CULICIFORMIS (Linnaeus)

PLATE 2, FIGURE 12; PLATE 7, FIGURES 39, 39a; PLATE 14, FIGURE 69

Sphinx culiciformis LINNAEUS, Systema naturae, ed. 10, p. 493, 1758.—CLERCK, Icones insectorum rariorium cum nominibus eorum trivialibus, pl. 9, fig. 3, 1759.

Sesia culiciformis FABRICIUS, Systema entomologiae, p. 549 (in part), 1775.—BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 294, 1901.

Aegeria culiciformis STEPHENS, Illustrations of British entomology: Haustellata, vol. 1, p. 143, pl. 10, fig. 3, 1828.

Synanthedon culiciformis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8725, 1939.

This European species is included on the basis of one male example recorded from Kukak Bay, Alaskan Peninsula, July 1, 1899 (Harriman Expedition, T. Kincaid, collector), in the United States National Museum collection. The specimen is not perfect but conforms precisely with *culiciformis* on structures of the genitalia. Additional evidence of *culiciformis* in Alaska is furnished by larvae and pupal cases obtained in and under the bark of white birch at Anchorage and at Palmer (July 1938, Engelhardt). The infested trees had been abused, showing bruises and healing wounds; at Anchorage they were near a baseball field and at Palmer adjacent to the administration buildings for the Matanusca agricultural developments. The borers had concentrated on the injured places of the tree trunks. None could be found on the abundant birches, or on alder, growing under natural, undisturbed conditions.

In Europe *culiciformis* ranges to Lapland, Finland, and along the northern borders into Siberia. There is good reason for accepting it as a circumpolar species. There are no structural, and only slight color, differences between *culiciformis* and *americana*. The forewings of *culiciformis* have orange scales at the bases and are almost entirely golden yellow beneath, and the tibiae and tarsi are prominently marked yellowish brown, whereas the forewings of *americana* are entirely black, with orange scales only at the bases beneath, and the tibiae and tarsi are only slightly marked with yellowish brown. Rearing records of *americana* are all from alder; there are none from birch.

THAMNOSPHECIA AMERICANA (Beutenmüller)

Aegeria culiciformis BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 93, 1894.

Sesia culiciformis var. *americana* BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 136, 1896; vol. 9, p. 219, 1897.

Sesia americana BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, p. 6, p. 293, 1901.

Synanthedon americana McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8724, 1939.

Male.—Antennae black, moderately dilated, pectinations short and fine. Labial palpi blue-black above, orange beneath. Head blue-black, orbits silvery white. Thorax blue-black, with an orange patch on each side beneath. Abdomen blue-black, the fourth segment entirely orange, the sides orange from the base to segment 4 and sometimes segment 2 narrowly edged with orange above; anal tuft wedge-shaped, black. Legs metallic black, posterior tibia shaded with brown on upper half and at the union with tarsus. Forewing transparent opalescent; veins, strong costa and discal mark, and broad outer margin shiny black; fringes lustrous brown; underside pale orange at the base. Hindwing with narrow margin and small discal mark.

Female.—Like the male except: antennae simple; anal tuft narrow, blunt at tip.

Expanse: Male 23 to 26 mm., female 24 to 27 mm.

Distribution.—Nevada, northern California, Oregon, Utah, Idaho, Montana, Washington, British Columbia.

Type.—Male. In the American Museum of Natural History.

Remarks.—Trees rather than shrubs of alders are attacked. The larvae bore under the bark in shallow, winding channels of the wood, causing the bark to blister and die. Such places may have as many as a dozen orifices from which moths have escaped. Alders exposed along roadsides and stream beds are preferred. The injury to alder trees very much resembles that caused to maples by *Sylvora acerni*. The moths recorded from White River Camp, Mount Rainier, Wash., were captured on the flowers of pearly-everlasting, *Anaphalis margaritacea*.

A long series of reared specimens of both sexes is labeled Riggins, Idaho (*Alnus rhombifolia*), June 4, 1914 (Hopkins U. S. 11590). Other records are Burns, Oreg., June 1926 (B. G. Thompson); Almata, Wash., May 11, 1901, one male (C. V. Piper); Uinta Mountains, Utah, one male (D. E. Beck); White River Camp, Mount Rainier, Wash., August 8, 1935, 2 males (Joseph Wilcox).

THAMNOSPHECIA FULVIPES (Harris)

Aegeria fulvipes HARRIS, Amer. Journ. Arts and Sci., vol. 36, p. 312, 1839.

Sesia fulvipes BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 439, 1874.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 135, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 290, pl. 31, fig. 28, 1901.

Synanthedon fulvipes McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8718, 1939.

Male.—Antennae slender, pectinations short, whitish before tips. Labial palpi orange beneath, black above. Head and thorax coppery black, the

latter with an orange lateral patch beneath the wing bases. Abdomen slender, lustrous coppery, segments 2 and 3 orange at the sides, segment 4 orange above and beneath; anal tuft wedge-shaped, narrow and long, light brown at tip beneath. Legs with coxae black; tibiae bright orange throughout; first joint of posterior tarsus orange, the other joints black. Forewing hyaline; veins, costa, and very narrow outer margin black, discal mark narrow, outwardly edged with orange, wing base and costa dusted with orange; underside pale yellow along costa to wing base. Hindwing with very small black discal mark, costa pale yellow to wing base, above and beneath, fringes brownish black.

Female.—Similar to male. Antenna simple, apical one-third pale yellow. Anal tuft straight, blunt.

Expanse: Male 23 to 24 mm., female 18 to 24 mm.

Distribution.—Northern New Jersey; New York, in the Catskill and Adirondack Mountains; New Hampshire; Massachusetts; Vermont; Maine; Ontario and Quebec, Canada.

Type.—Female. In the Boston Society of Natural History. From Massachusetts (May 25, 1826).

Remarks.—All records for this species, the only one indigenous to eastern North America with the food plant still unknown, are captured specimens taken one at a time, usually on flowers or herbage. The genitalia unite it so closely with *americana,* the western bark borer on alder, that it would not be surprising if *fulvipes* should prove to be a bark borer on alder in the East.

THAMNOSPHECIA SCITULA SCITULA (Harris)

PLATE 8, FIGURES 41, 41a; PLATE 14, FIGURE 71; PLATE 25, FIGURE 152

Aegeria scitula HARRIS, Amer. Journ. Arts and Sci., vol. 36, p. 313, 1839.—WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 45, 1856.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 94, 1894.

Trochilium gallivorum WESTWOOD, Gard. Chron., vol. —, p. 757, 1854; Proc. Ent. Soc. London, ser. 2, vol. 3, p. 21, 1854.—HY. EDWARDS, Papilio, vol. 2, p. 96, 1882.

Trochilium scitula MORRIS, Synopsis of the described Lepidoptera of North America, p. 141, 1862.

Trochilium hospes WALSH, Proc. Ent. Soc. Philadelphia, vol. 6, p. 270, 1866.

Sesia scitula BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 439, 1874.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 139, 1896; vol. 9, p. 200, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 298, 1901.

Aegeria gallivora GROTE, New check list of North American moths, p. 12, 1882.—KELLICOTT, Can. Ent., vol. 24, p. 45, 1892.

Aegeria aemula HY. EDWARDS, Papilio, vol. 3, p. 155, 1883; Ent. Amer., vol. 3, p. 224, 1888.

Sesia hospes PACKARD, 5th Rep. U. S. Ent. Comm., pp. 217, 328, 596, 1890.

Synanthedon scitula MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8731, 1939.

Male.—Antennae steel-blue-black, with a golden spot at the base beneath. Palpus yellow, the third joint often, but not always, tipped black. Head black, orbits shining white. Collar yellow above, white at the sides and beneath. Thorax black, lustrous steel blue or coppery, with a narrow, long, yellow stripe on the patagia and a small yellow transverse patch posteriorly. Abdomen steel blue or violaceous-black, segment 2 narrowly banded with yellow above; segment 4 above also with a narrow yellow band, which broadens on underside; segments 5, 6, and 7 yellow beneath; a thin yellow stripe below on the side from base of abdomen to segment 2; anal tuft nicely fan-shaped, black, edged with yellow at the sides. Anterior coxae bright golden yellow; femora blue-black; tibiae yellow, banded with purplish black between the spurs; tarsi yellow, with narrow blackish bands at the joints. Forewing transparent, veins, discal spot and narrow, outer border blue-black; golden-yellow rays between the veins from the margin inward; costa blue-black, intermixed with yellow; underside yellower than upper. Hindwing transparent, margins very narrowly blue-black. Genitalia having sacculus with strong spines in a straight line.

Female.—Like the male but larger and stouter; the yellow shading on forewings heavier; abdominal segment 2 edged with yellow posteriorly, sometimes with a yellow stripe on the side to the base of abdomen; segment 4 broadly banded with yellow above and beneath; segments 5 and 6 yellow beneath; anal tuft short, inverted from the sides, center black, edged broadly with yellow.

Expanse: Male 14 to 18 mm., female 16 to 20 mm.

Distribution.—Southeastern Canada and New England, westward to Ohio, Illinois, and Minnesota and southward to the Mississippi Valley and into Texas. Not known from the Rocky Mountain regions and the Pacific coast.

Type.—Female (T. W. Harris). In Boston Society of Natural History.

Remarks.—No other species in the family Aegeriidae exhibits so great an adaptability to different unrelated food plants as *scitula*. Normally a bark borer on oaks, it has been found to attack all sorts of deciduous trees and shrubs and even pine, provided there are physiological conditions to attract the insects. These are abnormal growths such as woody galls, excrescences due to fungi, rusts, and blights, bruises, and healing wounds. Under favorable conditions extremely heavy infestations result. The cynipid gall, *Andricus cornigerus,* often occurring in thousands on single trees of black and pin oaks, may be heavily attacked, nearly every gall serving the clearwing borer as a habitation. A similar condition has been observed in the case of hickory trees in Texas that were laden with hard, woody galls. A larger, bulging growth on the trunk of a beach near Mobile, Ala., produced hundreds of the moths, judged by the protruding pupal exuviae. Likewise in pecan groves in northern Florida and in Alabama distortions at the bases of tree trunks due to a fungus were

honeycombed by larval galleries, and higher up on the tree trunks the larvae were boring under the bark to an extent calling for control measures.

The young saplings of the American chestnut, periodically produced as sprouts from underground roots and representing about all that remains of a formerly magnificent forest tree, invariably succumb in a few years to the fatal attacks of the chestnut blight. From cuttings of parts distorted by this disease I have reared *scitula* but never any of the original chestnut bark borer, *Synanthedon castaneae* (Busck). On dogwood, *Cornus florida, scitula* is common on scarred tree trunks. From cherry, apple, mountain-ash, hickory, willow, and birch there are occasional records, usually associated with injured or diseased places on the tree trunks. Wounds and scars started by other insects also serve as abodes, regardless of the kind of tree or shrub on which they occur.

Rearings have been obtained from bayberry (*Myrica carolinensis*) and from Japanese dwarf pine at Mobile, Ala.; from hazelnut in Connecticut; from white oak, Brooklyn, N. Y.; from bark of *Physocarpa,* Chicago, Ill., and from rattan-vines (*Berchemia scandens*), Jacksonville, Fla. This should suffice to indicate the variety of trees and shrubs subjected to attacks when suitable ecological conditions are present. As may be expected, *scitula* is the commonest of the North American species of Aegeriidae. Economically the most serious damage is caused to pecan in the Southern States. Otherwise the species is not of great importance.

The principal time of emergence is spring and early in summer, as early as March in the South, but occasional adults issue through July and August, and even as late as September. Whether this signifies two broods in one year is difficult to prove. The change from larva to pupa takes place in an oblong cocoon within the larval gallery.

THAMNOSPHECIA SCITULA race CORUSCA (Hy. Edwards)

PLATE 25, FIGURE 153

Aegeria corusca HY. EDWARDS, Papilio, vol. 1, p. 193, 1881.

Sesia corusca BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 140, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 299, 1901.

Synanthedon corusca McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8733, 1939.

Field investigations over a number of years have established beyond doubt that *corusca* represents the southern extension in the range of *scitula,* and hence it can be recognized only as a race. In structure and in habits it agrees perfectly with typical *scitula.* It differs in having coppery rays on the wing margins and orange abdominal bands instead of yellow as in *scitula.* The change in coloration is gradual from the coastal regions of Virginia southward into Texas. Inland, in hilly and mountainous country, the color changes are less pronounced.

Type.—Male. In the American Museum of Natural History.

THAMNOSPHECIA GELIFORMIS (Walker)

Aegeria geliformis WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 46, 1856.—HY. EDWARDS, Papilio, vol. 1, pp. 208, 244, pl. 4, fig. 7, 1881.—DRUCE, Biologia Centrali-Americana, Lepidoptera, vol. 1, p. 32, pl. 5, figs. 12, 17, 1883.

Trochilium geliformis MORRIS, Synopsis of the described Lepidoptera of North America, p. 333, 1862.

Sesia geliformis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 441, 1874.—BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 309, 1901.

Pyrrhotaenia geliformis HY. EDWARDS, Papilio, vol. 3, p. 157, 1883.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 145, 1896.

Sciapteron geliformis HAMPSON, Ann. Mag. Nat. Hist., vol. 16, p. 349, 1895.

Synanthedon geliformis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8752, 1939.

Male.—Antennae, palpi, head, and thorax wholly black with a greenish or bluish metallic luster. Abdomen with first segment above blue-black, red beneath; all other segments red above and beneath; anal tuft fan-shaped, red, broadly edged with black. Legs shiny blue-black, tibial spurs tawny. Forewing opaque, blue-black above and beneath. Hindwing transparent, broadly margined with dull black; cilia dull black. Genitalia, sacculus ridge strongly spined in a straight line.

Female.—Slightly larger, anal tuft inverted, rounded, all red or red edged with black. Otherwise like the male.

Expanse: Male 15 to 16 mm., female 16 to 20 mm.

Distribution.—Florida and Gulf coast regions, West Indies, Mexico.

Type.—Male. In the British Museum of Natural History.

Remarks.—Druce (Biologia Centrali-Americana, vol. 1, p. 32, pl. 5, color fig. 12 [male] and fig. 17 [female], 1883) corrects the illustration by Hy. Edwards as having the forewings too opaque in contrast to his examples from Jalapa, Mexico, which show distinct transparent areas before and behind the discal mark. This is not true of a long series of specimens from Florida, which have the forewings wholly opaque; in fact, even denser than illustrated by Hy. Edwards. A specimen in the United States National Museum from Orizaba, Mexico, conforms exactly with Florida examples. Hence, the figures by Druce must apply to a race, if not a different species.

The male type in the British Museum, said to be in very poor condition, is labeled U. S. A. (E. Doubleday) and is most likely a Florida specimen. *T. geliformis* is a species of tropical and subtropical origin, ranging from Mexico through the West Indies into Florida, reaching the northern sections of the State. So strikingly different in coloration, it is surprising to find that structurally it is closely related to the preceding species, *scitula,* with which also it agrees in habits and a propensity to attack various kinds of unrelated food plants. As a bark borer on pecan it is establishing itself increasingly in central and southern Florida. Dog-

wood, adjacent to the university campus at Gainesville, badly infested by a bark borer, produced only *geliformis* instead of *scitula* which had been expected. The much-abused tree trunk of a hickory gave the same results. From *Andricus* galls on oak at Monticello both *geliformis* and *scitula* emerged. Several examples in the United States National Museum collection bear this label: "Cocoa, Fla., April 28, 1939. Larvae in callus tissue formed where rabbits had gnawed the bark of Australian pine, *Casuarina equisetifolia,* A. S. Rhoads, collector."

The moths are most numerous in March and April but continue to issue until July.

THAMNOSPHECIA PYRI (Harris)

PLATE 26, FIGURE 154

Aegeria pyri HARRIS, New England Farmer, vol. 9, p. 2, 1830; Amer. Journ. Arts and Sci., vol. 36, p. 313, 1839; A report on the insects of Massachusetts injurious to vegetation . . ., p. 235, 1842; ed. 2, p. 256, 1852; ed. 3, p. 335, 1863; Entomological correspondence of Thaddeus William Harris, M. D., edited by Samuel H. Scudder, p. 361, 1869.—WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 45, 1856.—PACKARD, Guide to the study of insects . . ., p. 278, 1869.—THOMAS, Sixth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1876, p. 40, 1877; Seventh report (l. c.), 1877, p. 170, 1878.—STOUT, Kansas Hort. Soc. Rep., vol. 9, 1879, p. 89, 1880.—MARTEN, *in* Thomas, Tenth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1880, p. 107, 1881.—KELLICOTT, Can. Ent., vol. 13, p. 8, 1881.—SAUNDERS, Insects injurious to fruits, p. 140, fig. 146, 1883; ed. 2, p. 140, 1889.—RILEY, Proc. Ent. Soc. Washington, vol. 1, p. 85, 1888.—WEED, Amer. Nat., vol. 23, p. 1108, pl. 43, fig. 3, 1889; Insect Life, vol. 4, p. 34, 1892.—BEUTENMÜLLER, Ann. New York Acad. Sci., vol. 5, p. 204, 1890.

Trochilium pyri FITCH, Third report on the noxious, beneficial, and other insects of the State of New York, 1856, p. 349, 1857.—MORRIS, Synopsis of the described Lepidoptera of North America, p. 141, 1862.

Sesia pyri BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 440, 1874.—SMITH, Catalogue of insects found in New Jersey, vol. 2, pt. 2, p. 289, 1890.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 139, 1896; vol. 9, p. 220, 1897; Mem. Amer. Mus. Nat. Hist. vol. 1, pt. 6, p. 297, 1901.

Aegeria koebelei HY. EDWARDS, Papilio, vol. 1, p. 196, 1881.

Synanthedon pyri MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8729, 1939.

Male.—Antennae black, sometimes slightly marked whitish before the tips; palpi yellow beneath, black above. Head violaceous-black, strongly hairy, orbits narrowly white. Collar black, mixed with white at the sides and white beneath. Thorax lustrous blue-black above and with yellow patches beneath at the sides. Abdomen lustrous blue-black, with a very narrow yellow band on segment 2 above and also one on segment 4, the latter broadening at the sides, covering the whole segment in the middle beneath; segments 5 and 6 also yellow in the middle and segments 2

and 3 with yellow scales mixed with the darker scales on the underside; the anal tuft fan-shaped, rarely expanded, black above, yellow beneath and at the sides. Coxa, trochanter, and femur pale yellow; tibia yellow beneath, broadly banded with blue-black above, tarsus yellow beneath, black above, narrowly ringed with yellow at the joints. Forewing transparent, veins, narrow border, and oblong discal mark black; outer margin broad, dull cupreous between the veins; underside golden yellow at the outer margin and along the veins. Hindwing transparent, discal mark faint; border narrow, black; cilia dull black. Genitalia with sacculus spined in a straight line curved at the tip.

Female.—Antennae clear pale yellow on the outside for nearly half their length. Abdomen with segment 4 more broadly banded with yellow above than in the male, on underside the band broadening over the whole segment, connecting with segment 5, which also is yellow beneath; segments 1 and 2 striped with yellow at the sides, the stripe continuing in a thin band posteriorly on dorsum of segment 2; anal tuft short and blunt, black with yellow edges.

Expanse: Male 15 to 18 mm., female 16 to 20 mm.

Distribution.—Canada to Mississippi. Western records doubtful.

Types.—Male. In the Boston Society of Natural History. The type of *Aegeria koebelei,* a male, is in the American Museum of Natural History. A specimen in the United States National Museum labeled "*Aegeria koebelei* Hy. Edwards, male, type, Arizona," is a female and not *pyri.* There are no records of *pyri* from Arizona. The specimen is in very poor condition.

Remarks.—*T. pyri* and *scitula* are easily confused when not in good condition or if discolored by grease. The outstanding differences are as follows: *pyri* with thorax wholly black above, tibiae black, tufted with yellow at the spurs, tarsi black, narrowly banded with yellow at the joints, antennae of the female well marked with white before the tips; *scitula* with antennae black in both sexes, thorax with a yellow stripe on the patagia, tibiae yellow, black between the spurs, tarsi yellow.

As a bark borer on apple, *pyri* has received considerable attention from orchardists and economic entomologists. Healthy, well-cared-for trees, however, are fairly immune to attack. Trees suffering from neglect, injured by storms, and weakened by disease are subjected to heavy infestations, the borer hastening the decline of the tree. Aside from apple, hawthorn (*Crataegus*) is another food plant, presumably the original one. The borer also has been reported from mountain-ash (*Sorbus*) and from Juneberry (*Amelanchier*), but there are no records from pear. The larvae live in shallow, tortuous channels in and beneath the bark, which they cause to blister and peel. The moths emerge from late in May to July.

THAMNOSPHECIA REFULGENS REFULGENS (Hy. Edwards)

PLATE 7, FIGURES 40, 40a; PLATE 14, FIGURE 72

Aegeria refulgens HY. EDWARDS, Papilio, vol. 1, p. 199, 1881.
Sesia refulgens BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 132, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 283, fig. 21, pl. 32, 1901.
Synanthedon refulgens McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8703, 1939.

Male.—Antennae metallic black, strongly pectinate. Labial palpi yellow. Head black, striped with white at the eyes inwardly. Collar, a yellow circle. Thorax shiny black, the patagia with a yellow stripe and a transverse yellow band at the base; beneath banded with yellow at the sides. Abdomen shiny black, with segments 2, 4, 6, and 7 contrastingly banded posteriorly with yellow above and beneath; segments 3 and 5 also sometimes banded, but only faintly; anal tuft short, rounded, not wedge-shaped, black above, yellow beneath at the tip. Legs yellow and black; femora black; posterior tibia black before the anterior spurs, then yellow to a black band at the posterior spurs; spurs and tarsi yellow. Forewing transparent, lustrous black marked with orange between the veins at outer margin, discal mark black toward base, red toward apex, lower costa streaked with orange, fringes coppery; underside with orange shadings more pronounced. Hindwing transparent, narrowly margined and fringed with coppery black.

Female.—Similar to the male but much more heavily shaded with orange along the costa and between the veins at outer margin, giving a deep golden luster to all shaded portions of the wing, above and beneath; abdominal segments 2, 4, and 6 with yellow bands posteriorly, the anal tuft short, inverted, black, yellow at the sides.

Expanse: Male 20 to 24 mm., female 20 to 22 mm.

Distribution.—Coastal regions of the Southern States, South Carolina to Mississippi.

Type.—Female. In Michigan Agricultural College. From Georgia (Morrison).

Remarks.—Represented in the United States National Museum collection by only a small series of captured specimens, all more or less worn. A precise definition of the species on external characteristics has been difficult.

Records in the United States National Museum: Spring Creek, Decatur County, Ga., July 16–29, 1912, 1 male, 1 female; Chickasaw (Mobile), Ala., April 13, 1930, 2 males, 1 female; September 13, 1931, 4 females (Engelhardt); Southern Pines, N. C., August 24, 1930, 1 female.

The habitat, as observed at Mobile, Ala., was open woodland on a sandy ridge. Specimens were captured in a low, hovering flight or resting on foliage.

THAMNOSPHECIA REFULGENS race SEMINOLE (Beutenmüller)

Sesia seminole BEUTENMÜLLER, Journ. New York Ent. Soc., vol. 7, p. 255, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 305, pl. 33, figs. 18, 20, 1901.

Synanthedon seminole MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8743, 1939.

Male.—The unique type was figured by Beutenmüller. Through the courtesy of the American Museum of Natural History it was possible to prepare a slide of the genitalia of the type. On the evidence offered by these structures *seminole* is conspecific with *refulgens*. It appears to differ only in its smaller average size and in the slightly heavier scaling on the forewings. Until the food plant is known and a sufficient number of examples have been obtained by rearing, the name *seminole* is retained to designate a race of *refulgens*. Forewing narrow, transparent areas inside and outside discal mark reduced, smaller than in *refulgens*. Costa, veins, and narrow border dull black; dull-orange rays between the veins from outer margin to near discal mark, which is a conspicuous orange-red and only narrowly edged with black inside; fringes brown-black; underside of forewing shaded with golden yellow. Hindwing transparent, crossvein on upper part scaled with orange. The color markings and their arrangement on the body and on the appendages agree exactly with those of *refulgens*.

The United States National Museum collection contains two Florida examples, which may be considered authentic. One from Lake Worth bears the label "type"; the other from De Funiak Springs, May 20, 1921, is an exact replica. Two female types are at the American Museum of Natural History. In addition, two females occur in my representation of *refulgens,* one from Spring Creek, Ga., July 16, 1929, and the other from Chickasaw, Ala., April 7, 1930, which, if labeled from Florida, would be designated as *seminole* without hesitation. This further supports the view that the two names apply to a single variable species.

Female.—Forewing heavily scaled, suffusing the clear space before and greatly reducing the clear space behind the discal mark, which is orange outwardly and well marked with black inwardly. In general the colors are a blending of orange and dull black, less contrasting than in *refulgens*. The thorax and abdomen are dull black with coppery rather than bluish reflections. Otherwise like *refulgens*.

Expanse: Male 17 mm., female 15 to 18 mm.

Distribution.—Central and northern Florida.

Type.—Male. In the American Museum of Natural History. From Lake Worth, Fla.

The type and paratypes were collected by Mrs. A. T. Slosson and are not dated, but according to Beutenmüller they were taken in February.

THAMNOSPHECIA MARICA (Beutenmüller)

Sesia marica Beutenmüller, Journ. New York Ent. Soc., vol. 7, p. 254, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 305, 1901.

Synanthedon marcia McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8744, 1939.

Male.—Antennae black, with fine pectinations. Labial palpi smooth, orange. Head black, eyes narrowly edged with white inwardly. Collar orange. Thorax lustrous blue-black, patagia striped with orange to a transverse basal band of the same color; beneath a large orange patch at the sides. Abdomen blue-black, narrowly banded with orange on segments 2, 4, 6, and 7 above and beneath; anal tuft short, rounded, black above, orange beneath. Femora of middle legs and hindlegs blue-black; tibiae of hindlegs orange, banded with black at posterior spurs; tarsi orange. Forewing transparent, costa heavily scaled with black and with a thin orange edge on inner margin; apex narrowly bordered and fringed with brownish black; orange rays between veins 7 and 8 to stalk and veins 8 and 9 to discal mark, which is red; orange rays between veins 7 and 4, or thin orange streaks on inner, lower wing margin to near the wing base; underside similar, more heavily shaded with orange on basal half of the wing. Hindwing transparent, narrowly bordered and fringed with brownish black.

Female.—Only one fragmentary specimen, lacking left forewing, abdomen, and hindlegs, is available. Nevertheless its identity is hardly in doubt. Antennae, palpi, and thorax agree with those of the male.

The main sexual difference is in the forewing, which is nearly opaque, blue-black at the costa and violaceous at the margin and the inner space; only two narrow, clear streaks, extending from the wing base between the veins to near the discal mark, remain. The discal mark is lustrous black above and on the underside bears an orange spot. Beneath, the forewing is shaded more heavily with orange on the costa and at the base. The borders of the hindwings are violaceous, the fringes brown-black, and both are broader than those of the male.

Expanse: Male 22 to 24 mm., female 28 mm.

Distribution.—Central and northern Florida.

Type.—Male (Jacksonville, Fla.). In American Museum of Natural History.

Remarks.—Judged by its greater size and the opaque forewing of the female, *marica* should prove to be a valid species when its food plant and habits become known. At present it is very rare in collections.

The United States National Museum collection contains three males, all from Jacksonville, Fla., but not dated. These were collected by Mrs. A. T. Slosson during her winter and spring sojourns in Florida years ago. Hence, the dates should be in the spring. The female example at the United States National Museum came from Gainesville, Fla., September 13, 1914, captured in flat, open woods.

THAMNOSPHECIA SUBAEREA (Hy. Edwards)

Pyrrhotaenia subaerea Hy. Edwards, Papilio, vol. 3, p. 156, 1883; Ent. Amer., vol. 3, p. 224, 1888; Bull. Amer. Mus. Nat. Hist., vol. 8, p. 146, 1896.
Sesia subaerea Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 312, pl. 32, fig. 3 (male), 1901.
Synanthedon subaerea McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8758, 1939.

Male.—Antennae black, marked with whitish on apical third. Labial palpi sordid white, third joint black. Head and thorax lustrous deep brown. Abdomen of the same color, annulations, if any, not discernible; anal tuft narrowly fan-shaped, brown, edged with sordid white at the sides and beneath. Legs deep brown. Forewing with veins 10 and 11 very close together, parallel; opaque brown sprinkled with pale-yellow scales. Hindwing brown, transparent between the veins at base. Underside of wings shaded more pale yellow.

Female.—Not known.

Expanse: Male 14 mm.

Distribution.—Arizona.

Type.—Male. In the United States National Museum.

Remarks.—A very distinct species of which only the type and another male, labeled Cochise County, Ariz., both in faulty condition, are available for description. The food plant and habits are unknown.

THAMNOSPHECIA RUBROFASCIA (Hy. Edwards)

Plate 8, Figures 42, 42a; Plate 14, Figure 70; Plate 26, Figures 155, 156

Aegeria rubrofascia Hy. Edwards, Papilio, vol. 1, p. 191, 1881.
Sesia rubrofascia F. M. Jones, Ent. News, vol. 23, p. 122, 1912.
Synanthedon rubrofascia McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8715, 1939.

Male.—Labial palpi, antennae, head and thorax black, slightly metallic lustrous. Abdomen purplish black with segments 4 and 5 deep orange above and beneath, the orange scales sometimes extending over part of segment 6; anal tuft wedge shaped, black, edged with whitish to the tip. Legs black, except for the tibial spurs and posterior tarsi, which are straw-colored; posterior tibia roughly scaled above; first tarsal joint thickened with scales. Forewing transparent with veins, costa, and very broad outer margin purplish black, the discal mark long, narrow, nearly straight-edged; the outer transparent area reduced, subquadrate; basal transparent area broad and long; underside of forewing slightly shaded with straw color. Hindwing narrowly margined and fringed with dull black.

Female.—Forewings opaque, violaceous-black; hindwings more broadly margined than in the male. Tibial spurs and tarsi black. Otherwise like the male.

Expanse: Male 26 to 34 mm., female 28 to 36 mm.

Distribution.—Georgia, Florida, Alabama, Virginia, and Maryland coastal regions.

Type.—Male. In the American Museum of Natural History. From Georgia.

Remarks.—Nearly a hundred years before Hy. Edwards's description was published this species was well illustrated by an original water-color drawing, accompanied by field notes, in John Abbot's "Georgia Insects" (vol. 7, p. 34, 1792), but it was not named. The figure is that of a male. The dissimilarity of the sexes was not recognized until the capture of a pair in coitus by Frank M. Jones, at Summerville, Ga., in April 1907. Since then the following specimens have been obtained: Jacksonville, Fla., 1 female, Mrs. A. T. Slosson (no date); vicinity of Mobile, Ala., males and females, March 25, 1925, May 15, 1934, June 19, 1928, September 29, 1929 (Thomas Van Allen and G. P. Engelhardt). These records show a long period of emergence. The moths are attracted to flowers, particularly those of chinquapin, along the edges of swamps. The food plant of the larva is sour-gum (*Nyssa*). The task of collecting larvae and pupae has proved difficult, for the species, although widely distributed, does not occur in heavy infestations. Large, well-matured trees having places of injury and healing wounds are preferred for attack. Otherwise there is little outside evidence of the larval work under the thick bark. The tunnels are long and sinuous, moist with sap, scraping the surface of the solid wood but not entering it. The pupa is within an oblong cocoon of chips, very much like those of the peach borer, *Sanninoidea exitiosa,* with the exit facing a crevice in the bark. Rearing efforts produced only three examples, two females and one male. The females, collected as larvae in woodlands near Bolling Field, D. C., early in May, transformed successfully, the adults emerging on June 5 and 6. The male, collected as a pupa in the bark of a huge sour-gum at Solomons Island, Md., on June 15, emerged on June 18; several pupal exuviae observed on this tree indicate that emergence normally occurs earlier.

THAMNOSPHECIA ALLERI, new species

PLATE 26, FIGURE 157

Male.—Antennae long, slender, moderately dilated toward the tips, rusty black. Labial palpi golden yellow throughout. Head black, coarsely tufted on top. Collar golden yellow. Thorax rusty black, striped with yellow at the sides above and beneath and with broad yellow patches anterior to wing base. Abdomen dull black, slightly lustrous; fourth segment on posterior half above deep yellow and fifth segment with a mixture of yellow and black scales; segments 4, 5, 6, and 7 deep yellow beneath; the wedge-shaped anal tuft black, edged with white to the tip. Legs golden yellow; tibiae broadly banded with black above posterior spurs. Forewing nearly opaque, rusty black with a partly obscured,

small, transparent quadrangle before the discal mark and a long, narrow clear space between the veins near the wing base; underside shaded with yellow scales. Hindwing transparent, narrowly edged with dull black above and beneath.

Female.—Same as the male except anal tuft narrow, blunt; antennae simple.

Expanse: Male 20 to 23 mm., female 22 to 24 mm.

Distribution.—Alabama, coastal regions.

Type.—U.S.N.M. No. 56842, male. Also female allotype and 5 male and 3 female paratypes in the United States National Museum. From Chickasaw, Ala.

Remarks.—External structures and genitalia associate this species most closely with *T. americana.* Its food plant and early stages are not known. I have a series of 10 specimens, 7 males and 3 females, all collected by Thomas S. Van Aller at Chickasaw and other localities in the vicinity of Mobile, Ala., late in August, September, and October 1931–1932. The habitat is open woodlands bordering on swamps. The moths are attracted to flowers such as *Eupatorium* and other late-blooming composites, but none of these is the food plant of the larva. No clue to the early stages of the insect could be found.

My good friend Thomas S. Van Aller has been of great assistance on field investigations in regions near his home at Mobile, Ala. His contributions to the United States National Museum collection have been large and important. It is a pleasure to name the present species for him.

THAMNOSPHECIA SIGMOIDEA (Beutenmüller)

PLATE 8, FIGURES 43, 43a; PLATE 14, FIGURE 73

Aegeria asiliformis HY. EDWARDS (not Rottemburg), Papilio, vol. 2, p. 56, 1882.
Sesia sigmoidea BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 9, pp. 214, 220, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 303, pl. 31, fig. 20, 1901.
Synanthedon sigmoidea McDUNNOUGH, Check list of the Lepidoptera of Canada and United States of America, pt. 2, No. 8740, 1939.

Male.—Antennae black, dilated to tips, pectinations short and fine. Labial palpi yellow, scales appressed. Head black. Collar yellow. Thorax black, with a narrow, yellow mark at each side, continuing and broadening beneath; posterior edge above yellow. Forewing transparent, costa and veins black, intermixed slightly with orange; discal mark orange, edged with black on inner side; outer margins broad; underside shaded heavily with yellow to wing base and light orange on outer margins. Hindwing with narrow margins and fringes black above and beneath. Tibia lustrous black, spurs and a band at anterior spurs yellow; first tarsal joint yellow. Abdomen steel or cupreous black, segments 2, 4, 6, and 7 narrowly banded with yellow, the band on fourth segment broader beneath than above; anal tuft broadly wedge-shaped, edged with yellow to tip.

Female.—Same as the male, but with only three yellow abdominal bands on segments 2, 4, and 6; anal tuft blunt, black, yellow in the middle above.

Expanse: Male 18 to 24 mm., female 22 to 26 mm.

Distribution.—Eastern Atlantic Coast States, Maine to Maryland, the Appalachian region of Virginia and the Carolinas, the Midwestern States northward to Canada, New Mexico, and the Rocky Mountains.

Type.—Male. In the American Museum of Natural History.

Remarks.—*T. sigmoidea* is a borer in low-growing willows in bays, along streams, and in depressions among sand dunes of coastal or lake regions. The species is rather local, but when found infestations are apt to be very heavy, swellings being produced on branches and canes, with a number of larvae often in one branch. The moths, emerging late in August and during September, do not visit flowers, and captures of adults have been few. However, a good series can be obtained easily by rearing from sections of branches collected in August, when the larvae have pupated or are about to pupate in their galleries. Many examples in the United States National Museum collection were reared from sage willow, *Salix tristis,* growing in low places among sand dunes at Amaganset, Long Island, N. Y., August and September 1913. Lake Waccabuc, Conn., also furnished numerous rearing records. Another good series has been reared from willow cuttings obtained along springs in an open canyon near Estancia, N. Mex. The moths emerged late in July and during August 1929. They are shaded a deeper orange on the costa and outer wing margins but otherwise run true to the eastern type. Captured moths are recorded from Manassas, Va., August 9, 1936 (Guerney); Black Mountains, N. C., August 25, 1929 (Engelhardt); West Point, N. Y., September 11, 1926 (Col. Robinson). Hy. Edwards confused this species with *Synanthedon asiliformis* Rottemburg from Europe, based on specimens from Walpole, Winchester, and Cambridge, Mass., in the collection of the Boston Society of Natural History. *S. asiliformis* is a borer in oak.

THAMNOSPHECIA ARCTICA (Beutenmüller)

Sesia arctica Beutenmüller, Can. Ent., vol. 32, p. 208, 1900; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 283, 1901.

Synanthedon arctica McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8699, 1939.

Male.—Antennae, palpi, head, and thorax entirely black. Abdomen black, segments 2 and 4 narrowly banded with white posteriorly; anal tuft black. Legs black, hind tarsi whitish. Forewing transparent, borders and discal mark very broad, black; underside shaded a golden yellow basally. Hindwing transparent with a narrow black margin.

Expanse: Male 20 mm.

Distribution.—Kodiak, Alaska.

Type.—Male. In the United States National Museum. This is the only known specimen.

Genus VESPAMIMA Beutenmüller

Vespamima Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 87, 1894. (Genotype, *Bembecia sequoiae* Hy. Edwards.)

Tongue long, spiraled. Antennae of male bipectinate; of female, simple. Labial palpi nearly erect, reaching vertex; second joint thickened, rough; third joint shorter with scaling protruding beyond apex. Forewing with 12 veins, 7 and 8 stalked to costa; 10 and 11 narrowly separated. Hindwing with veins 3 and 4 short-stalked. Posterior tibiae roughly scaled above; first tarsal joint smooth, not thickened. Anal tuft fan-shaped. Male genitalia very similar to those of *Carmenta,* but harpes and vinculum shorter and blunter and the cornuti with fine granulations, no stout thorns as in *Carmenta.* The sacculus ridge terminates, as in that genus, in a curved pocketlike flap on the edge of the harpe, clothed with light-colored flat scales and connected with the basal costal area by a broad oblique streak of black, furcate scales. Female genitalia with ductus bursae strongly sclerotized below ostium.

KEY TO NORTH AMERICAN SPECIES OF VESPAMIMA

Wings transparent, abdomen yellow banded.....**sequoiae** (Hy. Edwards)
Wings transparent, abdomen orange banded.....**novaroensis** (Hy. Edwards)
Wings translucent, abdomen black and orange.....**pini** (Kellicott)

In this genus have been assembled the three North American species confined in host association to coniferous trees. In coloration they appear quite distinct, but in structure they conform so closely as to permit this natural biological grouping. A description of the habits of one of the species serves as well for the other two.

VESPAMIMA SEQUOIAE (Hy. Edwards)

Plate 2, Figure 13; Plate 9, Figures 44–44a; Plate 15, Figure 74

Bembecia sequoiae Hy. Edwards, Papilio, vol. 1, p. 181, 1881.—Packard, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. No. 7, pp. 258, 261, 1881; 5th Rep. U. S. Ent. Comm., pp. 733, 922, 1890.

Bembecia superba Hy. Edwards, Papilio, vol. 1, p. 181, 1881.

Aegeria pinorum Behrens, *in* French, Can. Ent., vol. 21, p. 163, 1889.—Packard, 5th Rep. U. S. Ent. Comm., p. 731, 1890.

Vespamima sequoiae Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 87, 1894; vol. 8, p. 119, 1896; vol. 9, p. 218, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 263, pl. 30, fig. 23 (male), 1901.—Williams, Ent. News, vol. 20, p. 58, 1909.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8766, 1939.

Male.—Antennae black, pectinations strong. Labial palpus with a rough brush, yellow, black at the sides, terminal joint short, blackish. Head black, posteriorly with a yellow fringe. Collar black, yellow at the

sides. Thorax black, a narrow yellow line at the sides, yellow at the wing base and beneath; metathorax with grizzly tufts at the sides and a transverse yellow line. Abdomen black and all segments except 1 and 3 bordered with bright yellow above and beneath; anal tuft short, semicircular, black above, yellow beneath. Coxae of forelegs bright yellow; posterior tibiae rough, bright yellow, black at lower spurs; tarsi smooth, black above, touched with yellow beneath. Forewing transparent; costa and narrowly bordered outer and inner margins lustrous blue-black; veins and discal mark black. Hindwings transparent, narrowly margined with black, touched with yellow on costa. Both wings beneath yellowish at bases.

Female.—More robust than male. Antennae simple, black. Abdominal segments more broadly banded with bright yellow, 4, 5, and 6 nearly all yellow; anal tuft short, blunt, yellow, mixed with a little black.

Expanse: Male 26 to 28 mm., female 26 to 32 mm.

Distribution.—California, Oregon, Washington, Idaho, Montana.

Type.—Male. In the American Museum of Natural History.

Remarks.—This species is charged with serious injury to pine and to redwood (*Sequoia sempervirens*). However, we have failed to find evidence that redwood is attacked. Favorites among many pines on the Pacific cost and northwestern Rockies are *Pinus ponderosa, contorta, radiata,* and *lambertiana.* The moths have an extended season, emerging from March to September, but principally during June. Indications of the presence of larvae are resinous nodules, small and soft at first, but growing in size and becoming firmer in substance on exposure. In their moist tunnels in the cambium and solid wood the larvae can move unmolested. Removed and exposed to air they do not survive. For purposes of rearing, pupae serve best. These are found in silk-lined chambers within the growing nodules, the exits well concealed under thin covers of the harder crust. Collecting calls for utmost caution, as a slight prick or direct contact with the gum is fatal. Even at best the percentage of moths emerging from collections of pupae is frequently disappointing. The life cycle, not definitely known, most likely covers two years. Only well-set seasoned nodules appear to be suitable for pupation. Young trees are stunted in growth or killed; large trees may be scarred badly, but not injured seriously.

Heavy infestations have been reported by F. X. Williams on Monterey pine at Carmel, Monterey County, Calif. At Walpole, on the coastal border of Oregon and Washington, B. G. Thompson and I collected 60 or more pupae on *Pinus contorta* after hard, grimy work, when one of those cold, wet coastal fogs drove us to seek shelter in a cabin. The box of pupae was placed on the stove and forgotten when a fire was lighted. When next examined, the pupae were baked hard. Long series of reared examples in the United States National Museum have been supplied by the Bureau of Entomology and Plant Quarantine from American River,

Calif., on *Pinus ponderosa;* Pacific Grove, Calif., from *P. radiata;* Rogue River, Oreg., Scookmuchuck Creek, Idaho, and Missoula, Mont., from *P. ponderosa;* Clear Water, Mont., from *P. contorta;* and Butte Falls, Oreg., from Douglas fir.

VESPAMIMA NOVAROENSIS (Hy. Edwards)

Aegeria novaroensis Hy. Edwards, Papilio, vol. 1, p. 199, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892; vol. 8, p. 133, 1896.

Sesia novaroënsis Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 289, pl. 31, fig. 14 (female), 1901.

Parharmonia piceae Dyar, Proc. Ent. Soc. Washington, vol. 6, p. 106, 1904.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8764, 1939.

Sesia brunneri Busck, Proc. Ent. Soc. Washington, vol. 16, p. 143, 1914.

Synanthedon novaroensis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8713, 1939.

Synanthedon brunneri McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8714, 1939.

Male.—Antennae black, pectinations fine. Labial palpus with a short brush, orange, black at the upper sides and on tip. Head black, face and posterior fringe orange. Collar blue-black. Thorax black, patagia and a large spot on the posterior edge orange-red, at wing base and beneath orange. Abdomen lustrous blue-black, segment 1 orange at the sides, segments 2, 4, 5, 6, and 7 contrastingly banded with orange posteriorly and abdomen beneath wholly orange; anal tuft broad, fan-shaped, black above, orange beneath. Forelegs with coxae orange, femora yellow, tibiae yellow and black; posterior tibiae rough, orange, black at lower spurs; tarsi smooth, sordid yellow. Forewing transparent, costa, conspicuous discal mark, veins, and margins lustrous blue-black; fringes dull black; underside with costa and margins flushed with orange. Hindwing transparent, margins narrowly black, mixed with orange at base.

Female.—Antennae simple, black, between middle and terminal part orange. Abdomen black, but broadly banded with deep orange on segments 1, 2, 4, 5, and 6, wholly deep orange beneath; anal tuft short, blunt, black at base above, orange at tip and beneath.

Expanse: Male 24 to 30 mm., female 30 to 34 mm.

Distribution.—Northern California, Oregon, Washington, Idaho, Montana, British Columbia.

Type.—Female, in the American Museum of Natural History.

Remarks.—Parharmonia piceae Dyar and *Sesia brunneri* Busck fall as synonyms under *Vespamima novaroensis. S. brunneri* proves conspecific in all details and Dyar's type of *piceae,* described as having the abdomen black, has been restored to its original coloration through immersion in benzol and exhibits the normal orange annulations. *V. novaroensis* is primarily a borer in spruce, but pines also are attacked, especially when they occur in association with spruce. Its habits are like those of

sequoiae. When the two species dwell in one tree their resinous nodules cannot be distinguished until the moths emerge. Adults are rarely captured. The numerous examples in the collection at the United States National Museum, with few exceptions, were obtained by rearing. The collection data for this material are as follows: Ashland and Rogue River, Oreg., on Douglas spruce, *Pseudotsuga taxifolia,* May-June, 1914 (Miller and Brunner); Butte Falls, Oreg., and Riggins, Idaho, on *Pinus ponderosa,* May-June 1914 (L. O. Swartz and Brunner); Corvallis, Oreg., on pine and spruce, July 15, 1924 (B. G. Thompson); Hoquiam, Wash., on *Picea sitchensis* (Burke); Big Hole County, Mont., on *Pinus contorta* (Brunner); Missoula, Mont., on *Pinus ponderosa* and *Picea engelmannii,* May-June 1914 (Brunner); and Victoria, British Columbia, on spruce (E. H. Blackmore).

VESPAMIMA PINI (Kellicott)

Aegeria pini Kellicott, Can. Ent., vol. 13, pp. 5, 157, 1881.—Packard, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. No. 7, p. 180, 1881.

Harmonia pini Hy. Edwards, Papilio, vol. 2, p. 54, 1882.—Packard, 5th Rep. U. S. Ent. Comm., p. 727, 1890.—Comstock, Manual for the study of insects, p. 261, 1895.

Parharmonia pini Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 124, 1896; vol. 9, p. 219, 1897; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 264, pl. 30, fig. 13, 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8763, 1939.

Male.—Antennae long, nearly filiform, black above, rusty black beneath, pectinations short and fine. Labial palpus with a short brush, black, orange at base. Head black, a brush on top and an encircling posterior fringe, orange. Collar blue-black. Thorax blue-black, slightly touched with orange at wing base beneath. Abdomen blue-black, segment 4 broadly banded with orange, sides and venter wholly orange; anal tuft long, slender, black above, orange at the sides and beneath. Legs wholly blue or violaceous-black. Forewing densely suffused between the veins, nearly opaque, smoky black. Hindwing semitransparent, less densely suffused between the veins; narrow margins, conspicuous discal mark and veins dull black.

Expanse: Male 28 to 32 mm., female 32 to 34 mm.

Distribution.—Atlantic Coast and New England States; Midwestern States and eastern Canada; Appalachian regions southward.

Type.—Male. In the collection of D. S. Kellicott.

Remarks.—In general this species follows the distribution of its principal food plant, white pine, *Pinus strobus.* Because of the hemispherical masses of resin formed over the larval burrows on tree trunks, the abundance or scarcity of the insect can be readily estimated. Heavy infestations resulting in ugly scars no doubt reduce the timber value. Well-grown trees are attacked with preference, and as these usually survive the actual loss is not great. The moths are very poorly represented in most collections.

They seem to elude capture. D. S. Kellicott, author of the species, gives an excellent account of the habits and the difficulties in rearing the insect. Briefly, it is an aggravating and dirty job. In the vicinity of New York City well-established colonies are found in parks, cemeteries, gardens, and lanes in suburban districts. Aside from white pine the insect is partial to Norway spruce, *Picea abies,* the nodules of resin often being most numerous on such trees. A thriving colonization followed the planting of white pine along the shores of the reservoir at Pensico and Croton, N. Y., 20 to 25 years ago. The trees now are of a size to be attractive. Hundreds of the resinous masses have been noted here in recent years, many within reach and others beyond. Small and soft, year-old masses and those three years old or older, which are large and hardened, can be disregarded. Immature larvae removed from their burrows invariably perish. Only 2-year old masses of firm, but still sticky, consistency hold promise of containing pupae late in June or early in July. The exact location of the pupal chamber is well concealed. Cautious probing is necessary, and losses are unavoidable as the slightest prick or contact with the sticky resin is fatal to the pupa. My method has been to prepare tubes of soft paper to receive the pupae upon uncovering the chambers. Ten healthy pupae from 100 selected masses is a fair average. Parasites of the hymenopterous family Eulophidae and a species of larvaevorid fly take a very large toll.

Records in the United States National Museum: Hudson, N. Y., July 1902, male and female (Engelhardt); Hartsdale, Westchester County, N. Y., July 12, 1935, males and females (Engelhardt); Sunbury, Pa., July 1912, female (Hopkins U. S. No. 9410); Buffalo, N. Y., 1880, male (D. S. Kellicott).

THE SIGNAPHORA GROUP

SIGNAPHORA, new genus

Genotype, *Carmenta ruficornis* Hy. Edwards.

Tongue well developed, spiraled. Antenna strong, dilated; tufted at apex; smooth in both sexes; in the male with minute ciliae between the joints, no pectinations. Labial palpus upcurved, nearly reaching vertex; second joint with a well-developed, short, rough brush; terminal joint roughly scaled beyond apex. Thorax smooth. Anal tuft short, rounded. Hindtibia loosely scaled above with projecting, stiff scales at spurs; first tarsal joint not thickened. Forewing with veins 2 and 3 approximate, 3 and 5 connate or short-stalked; 7 and 8 long-stalked to costa; 10 and 11 separate, 11 not reaching costa. Hindwing with veins 3 and 4 stalked. Male genitalia with uncus elongate, spoon-shaped, clothed laterally with simple undivided hairs; extreme tip furcate; gnathos long, thin, bluntly pointed, slightly deflected, supporting the alimentary canal, as the ventral plate does in other aegeriid genera; annellus with

long lateral processes, supporting aedeagus; harpe hairy, rather narrow elongate with cucullus upturned; sacculus without special armed ridge; vinculum short, broad, bluntly rounded at tip; aedeagus slightly curved, bulbous on basal half. Female genitalia with ductus short, sclerotized only around the heart-shaped ostium; bursa very long, elongate ovate with a strong, sharp, thornlike signum, a very unusual character in the family.

Only the type species is known.

SIGNAPHORA RUFICORNIS (Hy. Edwards)

PLATE 2, FIGURE 14; PLATE 9, FIGURES 45, 45a; PLATE 15, FIGURE 75

Carmenta ruficornis HY. EDWARDS, Papilio, vol. 1, p. 184, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 147, 1896.

Carmenta minuta HY. EDWARDS, Papilio, vol. 1, p. 185, 1881.

Sesia ruficornis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 311, pl. 32, fig. 35, 1901.

Synanthedon ruficornis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8757, 1939.

Male.—Antennae coppery black above, rufous beneath. Labial palpi yellow, dusky above. Head black, with a rough brush, black and yellow on top; occipital fringe yellow. Thorax rusty black, smooth; a yellow dash on posterior half at the sides and a yellow mark anterior to wing base and beneath; prescutum with appressed golden metallic scales; abdomen violaceous-black, segments 2, 4, 6, and 7 banded with yellow, 7 above and beneath; anal tuft short, rounded, black above, black and yellow beneath. Forelegs with coxae yellow; tibiae of hindlegs black, broadly banded with yellow at anterior spurs; tarsi annulated with black and yellow. Forewing opaque, lustrous violaceous brown-black, streaked with red before and behind the discal mark. Hindwing transparent; margins narrow, lustrous coppery; fringe broad, sordid black. Wings beneath same as above.

Female.—Very similar to male.

Expanse: Male 12 to 14 mm., female 14 to 16 mm.

Distribution.—Atlantic Coast States, Virginia to Gulf of Mexico.

Type.—Female. In the United States National Museum.

Remarks.—One of the smallest and structurally most distinct species in the North American fauna. The moths frequent flowers and during late summer and early in fall may be collected in numbers in dry, open or wooded regions from Virginia southward to the Gulf of Mexico. Thomas S. Van Aller and the author captured hundreds of specimens near Mobile, Ala., yet persistent search for the food plant and early stages failed completely. It should prove to be a borer in an herbaceous plant, but this problem remains unsolved.

Records in the United States National Museum: Long series of both sexes, vicinity of Mobile, Ala., August-September 1927-1929 (Aller and Engelhardt); males and females, Raleigh, N. C., August 16, 1906; Southern Pines, N. C., August 1-7; Falls Church, Va., July 1901.

THE CALASESIA GROUP

Genus CALASESIA Beutenmüller

Calasesia Beutenmüller, Journ. New York Ent. Soc., vol. 7, p. 256, 1899. (Genotype, *Pyrrhotaenia coccinea* Beutenmüller.)

Tongue well developed, spiraled. Antenna strong, thickened toward apex, with apical tuft smooth in both sexes. Labial palpus curved upward, reaching vertex, second joint with a short, rough, even brush, terminal joint thickened with scales which protrude beyond apex. Thorax smooth. Anal tuft short, blunt; hindtibia smooth with few spinelike scales above spurs; first tarsal joint not thickened. Forewing with 11 veins. 7 and 8 coincident to costa; rest separate; 9, 10, and 11 parallel. Hindwing with veins 3 and 4 closely approximate; 5 parallel to 4 and nearer to 4 than to 6. Male genitalia with uncus hood-shaped; gnathos well developed, strong; harpe short, nearly rectangular, cucullus armed with heavy spines; vinculum with medium anterior process; aedeagus stout, straight. Female genitalia with very long ductus, greatly enlarged, bulgy on posterior third, then sclerotized for a short space and continued as a narrow tube to the elongate ovate bursa, which contains a small narrow sclerotization at the entrance of the ductus.

Only the type species is known.

CALASESIA COCCINEA (Beutenmüller)

Plate 2, Figure 15; Plate 9, Figures 46, 46a; Plate 15, Figure 76

Pyrrhotaenia coccinea Beutenmüller, Journ. New York Ent. Soc., vol. 6, p. 241, 1898.

Calasesia coccinea Beutenmüller, Journ. New York Ent. Soc., vol. 7, p. 256, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 314, pl. 32, fig. 20, 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8788, 1939.

Male.—Antennae dusky black, strongly dilated, not pectinate. Labial palpus sordid pale yellow, terminal joint black. Head black with stiff black and white mixed hair on top; occipital fringe sordid white. Thorax lustrous blue-black, bright orange or red at the sides, anterior to wing base and beneath; metathorax laterally tufted with sordid white. Abdomen lustrous blue-black above and beneath; anal tuft a fringe of short, stiff black hairs. Legs violaceous-black. Forewing opaque, scarlet; discal mark conspicuous, round, blue-black; outer part of costa and broad margin dull black, fringes sordid white; underside dull orange, margin shaded with black scales. Hindwing reddish brown, profusely sprinkled with blackish scales above and beneath, fringes sordid white.

Female.—Very similar to the male and difficult to determine without dissection. The female appears to lack the sordid white lateral tufts which occur on the metathorax of the male, but more and better examples are needed to prove this difference.

Expanse: Male 14 to 16 mm., female 16 to 18 mm.

Distribution.—Kansas, Oklahoma, Texas, New Mexico.

Type.—Female. In the United States National Museum. From Albuquerque, N. Mex. (Cockerell).

Remarks.—Critical study confirms Beutenmüller's conclusions that this species must be placed in a genus by itself. It is unique among all North American species. Field notes of F. H. Snow connect the insect with the leguminous plant *Hoffmannseggia falcaria,* on which he captured numbers of the moths, Cimarron River, Clark County, Kans., 1,962 feet, June, but rearing was not attempted. Otherwise, only scattered records of the species are available. The type comes from Albuquerque, N. Mex. (Cockerell). Specimens other than the type are one male, Lucy, N. Mex., July 18, 1932 (C. W. Sabrosky); and one male, Marfa, Tex., June 5, 1908 (Mitchell and Cushman).

THE CISSUVORA GROUP

CISSUVORA, new genus

Genotype, *Cissuvora ampelopsis,* new species.

Tongue developed, spiraled. Antenna stout, with an apical tuft, strongly dilated; that of the male broadly pectinate, of the female simple. Labial palpus reaching vertex, second joint rough, terminal joint bluntly pointed. Hindtibia smooth, tufted at distal end; first tarsal joint slightly thickened, coarsely hairy. Forewing with 12 veins, 7 and 8 stalked, 9 from the stalk of 7 and 8, 7 to termen; 4, 5, and 6 slightly bent downward. Hindwing with veins 3 and 4 connate. Male genitalia with socii erect; alimentary canal supported ventrally by a slightly sclerotized plate; gnathos stout, straight, ending in small triangular, flattened apex. Aedeagus straight with a downward pointed hook at tip. Harpes elongate-ovate with pointed apices; costal area covered with palmate scales, dorsal area without scales; vinculum long, tip rounded, central part compressed. Female genitalia with ductus bursae long; bursa elongate-ovate, finely wrinkled transversely.

Represented only by the type species.

CISSUVORA AMPELOPSIS, new species

PLATE 2, FIGURE 16; PLATE 9, FIGURES 47, 47a; PLATE 15, FIGURE 77; PLATE 26, FIGURE 158

Male.—Antennae robust, pectinate, fuscous-brown, suffused with black scales above. Labial palpi rough, pale yellow, edged with orange at the sides. Head chestnut-red on top, face pale yellow, occipital fringe pale yellow, mixed with brown. Collar prominent, pale yellow, anterior parts touched with chestnut-brown. Thorax smooth, chestnut-red, with two dorsal yellow stripes broadening posteriorly; between the stripes a sprinkling of round, pearly scales; metathorax fringed and tufted at the sides

with yellow; ventral parts with patches of yellow scales. Abdomen chestnut-red; segment 1 yellow; segments 2 and 3 chestnut-red with posterior edge black; segment 4 yellow, posterior edge chestnut; segments 5, 6, and 7 chestnut-red with anterior edge yellow, narrowly so on 6 and 7; beneath as above; anal tuft short, blunt, chestnut-red dorsally and ventrally, yellow at the sides. Front legs with coxae bright yellow; femora, tibiae, and tarsi mixed chestnut and yellow; posterior tibiae chestnut and yellow, tuft at discal end mixed with black; tarsi stout, deep yellow, chestnut at the joints. Forewing semitransparent, brownish; costa and discal mark dark brown; between the veins on anterior parts a heavy suffusion of brownish scales; posterior part distad to discal mark vitreous and narrow, vitreous streaks between the veins to a yellow patch on wing base; narrow margins and fringes pale brown; beneath as above. Hindwing transparent, narrow margins and broad fringes pale brown.

Female.—Very similar to the male. Vitreous spaces on forewing reduced. Antennae simple, heavily shaded with black centrally.

Expanse: Male 28 to 32 mm., female 34 to 40 mm.

Distribution.—Southeastern Texas.

Type.—U.S.N.M., No. 56843. From Victoria, Tex.

Remarks.—Described from male type, female allotype, 3 male and 3 female paratypes from the type locality; 4 male and 10 female paratypes from San Antonio, Tex.

Credit for the discovery of this very aberrant species is due the late J. C. Mitchell, Southern Field Crop Investigations, U. S. Bureau of Entomology, San Antonio, Tex., who submitted to the United States National Museum three males and three females in 1920 together with notes on the food plant and habits. Subsequent field investigations by H. B. Parks, State apiculturist, and the author have added biological information and have considerably extended the series of specimens. Records as yet are confined to San Antonio, Tex., and its environs. The food plant is *Ampelopsis (Cissus) incisa,* a vine with thick, succulent foliage, climbing over fences and hedgerows and to considerable heights on trees. The vines are thickly barked and soft, except for a central brittle woody core, and rarely exceed 1 inch in diameter. Usually they are well exposed on fencerows, and it is readily observed that they are subject to peculiar swellings which are more or less separated and vary in number. These gall-like swellings, always on the vines, not on the roots, are caused by the larvae of *Cissuvora ampelopsis.* Examination will show many of the swellings to be old or to have been deserted by the larvae, which are voracious feeders and leave weakened plants to start fresh burrows in healthier parts of the same or other plants. Cuttings of the vine collected for purposes of rearing, if containing immature larvae, are abandoned shortly by the caterpillars. If placed in one box the larvae will become cannibalistic or if the container is of cardboard or soft wood they bore

through and escape. On maturity they drop out of their burrows and construct tough, leathery, oval cocoons in the soil, 1 or 2 inches below the surface. The principal season for the moths is May and June. In rearing experiments emergence records are given for nearly every month of the year. Mitchell accepted late emergences, September and October, as indicating a double-brooded species. This is difficult to confirm. Larvae maturing late in the season spin their cocoons and the great majority winter as larvae, transforming to pupae during the following spring. As far as known moths have never been captured in the field, all having been obtained by rearing. They are perfect mimics of a species of *Polistes* common in the region. While records as yet are confined to San Antonio and vicinity, evidence of the larval work at various places from San Antonio to Del Rio indicates a distribution following the food plant, which is common across the border in Mexico.

A general resemblance of the moths to species in the genus *Paranthrene* is deceptive. The male antennae are pectinate, not bipectinate. Veins 7 and 8 of the forewings are stalked and vein 9 arises from this stalk. Most surprising and unique are the harpes of the male genitalia. They are elongate-ovate and have pointed apices, the costal area is covered with palmate scales, and the dorsal area is without scales. Such structural differences set the species apart from all others in the family. It stands alone, representing a distinct genus.

THE PARANTHRENE GROUP

Genus PARANTHRENE Hübner

Paranthrene Hübner, Verzeichniss bekannter Schmetterlinge, p. 128, 1819. (Genotype, *Sphinx asiliformis* Schiffermüller, synonym of *Sphinx tabaniformis* Rottemburg.)

Tongue long, spiraled. Antennae stout, dilated, with apices tufted, in the male bipectinate, in the female simple. Labial palpi erect, reaching vertex; second joint roughly scaled, terminal joint short, with scales projecting beyond apex. Forewing with 12 veins, 7 and 8 long-stalked to costa, 9 approximate to stalk of 7 and 8, 10 and 11 separate, parallel. Hindwing with 8 veins, 3 and 4 well separated, but 3 much closer to 4 than to 2. Posterior tibiae roughly scaled above; first joint of posterior tarsus smooth. Male genitalia with elongate, erect socii clothed with long, soft hairs, which are not bifurcate as in the *Synanthedon* group; a narrow, straight ventral plate supporting the anal tube; harpe elongate-ovate, clothed on the edges with inwardly directed hairs and scales, leaving a naked place in the middle; the scales on the costa trifurcate, not bifurcate, as in the *Synanthedon* group; the cucullus clothed with a row of long single hairs, terminating in the succulus ridge, which is clothed with strong spines; vinculum moderately long, slender; aedeagus bulbous at the base, slightly curved and with a downward-pointed hook just below apex.

Female genitalia with a rather long ductus; bursa elongate ovate, finely transversely wrinkled; signum a straight longitudinal row of dots, which are thickened spots of the tranverse wrinkles.

The genotype is figured on plate 2, figure 17; plate 10, figures 48, 48a; and plate 15, figure 78.

KEY TO NORTH AMERICAN SPECIES AND FORMS OF PARANTHRENE

Forewing opaque, violet-black; hindwing transparent; abdomen of male with 4, of female with 3, yellow bands..... ...**tricincta tricincta** (Harris)
Abdomen with 4 broad and 2 narrow yellow bands.
tricincta form **denotata** (Hy. Edwards)
Abdomen nearly all yellow.....**tricincta oslari**, new form
Hindwing opaque except at base; abdomen brown.....**dollii dollii** (Neumoegen)
Abdomen chestnut-brown.....**dollii** form **castanea** (Beutenmüller)
Abdomen brown, banded with yellow.....**dollii fasciventris**, new form
Forewing ochreous-yellow; abdomen yellow, 3 basal segments black.
robiniae robiniae (Hy. Edwards).
Forewing fuscous, abdomen deep ochreous.....**robiniae** form **perlucida** (Busck)
Forewing and abdomen pale yellow.....**robiniae** form **palescens**, new form
Forewing black, vitreous at base; abdomen yellow and black.
simulans simulans (Grote)
Abdomen yellow with narrow black annulations.
simulans form **luggeri** (Hy. Edwards)
Forewing and abdomen orange.....**palmii** (Hy. Edwards)
Forewing of male transparent, of female opaque, except for lower margin; abdomen brown with yellow bands.....**asilipennis** (Boisduval)
Forewing and hindwing orange; abdomen black..**fenestrata** Barnes and Lindsey

PARANTHRENE TRICINCTA (Harris)

Aegeria tricincta Harris, Amer. Journ. Arts and Sci., vol. 36, p. 310, 1839.—Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 41, 1856.—Kellicott, Bull. Buffalo Soc. Nat. Sci., vol. 4, p. 62, 1882.—Packard, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. 7, p. 121, 1881; 5th Rep. U. S. Ent. Comm., p. 444, 1890.—Kellicott, Can. Ent., vol. 13, p. 3, 1881.—Fyles, Can. Ent., vol. 16, p. 220, 1881; Rep. Ent. Soc. Ontario for 1884, p. 24, 1885.

Trochilium tricincta Morris, Synopsis of the described Lepidoptera of North America, p. 436, 1862.

Sesia tricincta Boisduval, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 436, 1874.

Sciapteron tricincta Grote, New check list of North American moths, p. 11, 1882.—Davis, Insect Life, vol. 4, p. 66, 1891.—Kellicott, Can. Ent., vol. 24, p. 209, 1892; Insect Life, vol. 5, p. 82, 1892.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 120, 1896; vol. 9, pp. 213, 218, 1897.

Memythrus tricinctus Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 247, pl. 33, fig. 9 (female), 1901.

Paranthrene tricincta McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8792, 1939.

Male.—Antennae strong, broadly bipectinate, violaceous-black above; ferruginous beneath and at the tips. Labial palpus very rough, yellow on the inner side toward tip, black on the outer side and at base; terminal

joint pointed, yellow beneath, black above. Head blue-black, roughened with coarse hairy scales on top; inner eyelashes white; occipital fringe bright yellow. Thorax smooth, black; collar of prothorax with broad scales, blue-black; a yellow spot at base of forewing; tegula spotted with yellow on posterior parts; prothorax at the sides and beneath and forewing at base beneath with yellow patches. Abdomen lustrous black, segment 2 broadly and segments 4, 6, and 7 narrowly, banded with yellow above; beneath, segments 2, 3, and 4 with yellow bands; anal tuft short, broadly rounded, black. Front legs black, coxae anteriorly at the sides yellow, tarsi sand color; hindlegs black, tibiae rough above, chestnut-red shading into orange; first tarsal joint orange, terminal joints mostly black. Forewing opaque, blue-black along costa, dull black inwardly, sparsely mixed with reddish scales, heaviest along inner margin; short, translucent streaks before wing base; discal mark not prominent; outer margin narrow, coppery brown, fringes dull brown; underside dull brown, discal mark reddish. Hindwing transparent, discal mark prominent, obliquely elongate, brown black; outer margin narrow, coppery brown, edged inwardly with dull brown scales; fringes dull brown; underside as above.

Female.—Antennae simple. Abdomen banded with yellow only on segments 2, 4, and 6; on the underside segments 3 and 6 narrowly edged and segment 4 broadly banded with yellow; anal tuft black, faintly streaked with yellow above. Otherwise like the male.

Expanse: Male 24 to 28 mm., female 26 to 32 mm.

Distribution.—Eastern and Midwestern States; Rocky Mountain States; Saskatchewan, Manitoba, Alberta, Canada; Alaska.

Type.—Male. In the Harrison collection, Boston Society of Natural History (type and female paratype caught in copulation, Massachusetts, June 20, 1829).

Remarks.—The principal food plants of this species are willows, preferably shrubby, low-growing kinds. The larvae excavate long tunnels in exposed roots, in canes and in branches, sometimes several occurring in one cane or branch, but in separate burrows. Another favorite breeding place is the galls and swellings produced by the larvae of cerambycid beetles of the genus *Saperda* on willow, poplar, and aspen. On maturing in the fall the larvae utilizes the upper part of its tunnel as a pupal chamber, which is capped above and below and gives access to a circular exit concealed under a flimsy cover of silk and bark. After wintering in such chambers the larvae transforms to pupae late in May and during June, and the adults emerge in June and July. The life cycle is two years. Immature larvae winter in their tunnels, only mature larvae in their second year construct pupal chambers before hibernation.

The European *tabaniformis* is identical practically with the North American *tricincta* and would be considered conspecific but for some slight structural differences in the male genitalia. Easily observable dif-

ferences are the more elongated harpe and the deeper excavation below the aedeagus hook in *tabaniformis* against the shorter harpe and shallower excavation below the aedeagus hook in *tricincta*. Nevertheless the Old and New World species are so closely related as to form a natural biological group with similar food plants and habits and a Holarctic distribution.

Beutenmüller's "Monograph of the North American Sesiidae" (Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, pl. 33, fig. 9, 1901), well illustrates a typical example of the female of *tricincta*. The sexes are easily separated by the heavily bipectinated antennae and the yellow banding of abdominal segments 2, 4, 6, and 7 in the male; the female has simple antennae, and only abdominal segments 2, 4, and 6 are banded with yellow.

Distribution records for specimens in the United States National Museum: Toronto, Ontario; Long Island, N. Y., Plainfield, N. J.; Virginia; Buffalo, N. Y.; Montana; Colorado.

PARANTHRENE TRICINCTA form DENOTATA (Hy. Edwards)

Albuna denotata Hy. Edwards, Papilio, vol. 2, p. 55, 1882.

Sciapteron denotata Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892; vol. 5, p. 24, 1893; vol. 8, p. 119, 1896.

Memythrus denotatus Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 248, pl. 30, fig. 1 (female), 1901.

Paranthrene denotata McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8793, 1939.

Male.—Forewing rusty dark brown, edged with reddish orange on costa and inner margin. Abdomen with segments 2, 4, 6, and 7 conspicuously banded with yellow and segments 3 and 5 narrowly edged with yellow; anal tuft black and yellow mixed. Otherwise like typical male of *tricincta*.

Female.—Like the male, but conspicuously banded with yellow only on abdominal segments 2, 4, and 6 and with faint indications of yellow bands on segments 3 and 5.

Distribution.—Rocky Mountain regions, Colorado to Montana; Alaska.

Type.—Male. In the American Museum of Natural History.

Remarks.—The form *denotata* can be considered only as a transition color phase connecting *tricincta* with the extreme color form *"oslari,"* hereafter described. It is found in mixed colonies in the Rocky Mountain regions of Colorado and Montana, and one male is recorded from Fort Yukon, Alaska. I question the accuracy of Beutenmüller's figure (loc. cit., pl. 30, fig. 1) illustrating a female with abdominal segments 2, 3, 4, 6, and 7 broadly banded with yellow. All the many female examples examined are conspicuously banded with yellow only on segments 2, 4, and 6, with a few scattered yellow scales on 3 and 5.

Records in the United States National Museum: Denver, Colo., males and females (Oslar); Williston, Williams County, N. Dak., male, June 9, 1923 (H. Notman); Montana, female; Fort Yukon, Alaska, male.

PARANTHRENE TRICINCTA OSLARI, new form

PLATE 26, FIGURE 159

Male.—Antennae ochreous, shaded with black on upper parts. Labial palpi pale yellow, black at bases and on sides. Thorax violaceous-black, contrastingly marked yellow at sides posteriorly. Abdomen shiny black with segments 2, 4, 6, and 7 broadly, and 3 and 5 narrowly, banded with yellow. Legs dull yellow, touched with orange. Forewing brown-black mixed with yellow and orange scales, densest on inner margin and basal half.

Female.—Antennae orange-red, with bluish-black scales above. Abdomen mostly yellow above and beneath; segments 1, 3, 4, and 5 black anteriorly, segments 2 and 6 all yellow; anal tuft yellow and black mixed, more yellow than black.

Type.—U.S.N.M. No. 26844. Described from female from Bear Creek, Morrison County, Colo. (Oslar); paratype female, San Juan Mountains, Colo. (Oslar); and two male paratypes, Chimney Gulch, Golden, Colo. (Oslar).

Remarks.—The similarity between the North American form *tricincta oslari* and the form of western Europe, *tabaniformis rhingiaeformis* Hübner, points to parallelism in response to comparable climatic conditions of two closely related species on widely separated continents.

The form *oslari* has been named for Ernest J. Oslar, of Denver, Colo., a pioneer collector who, during a long span of life, has made many contributions to our knowledge of the Rocky Mountain insect fauna.

PARANTHRENE DOLLII DOLLII (Neumoegen)

Sciapteron dollii NEUMOEGEN, Ent. News, vol. 5, p. 330, 1894.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 122, 1896; vol. 9, p. 218, 1897.

Memythrus dollii BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 252, pl. 30, fig. 4 (female), 1901.

Paranthrene dollii MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8802, 1939.

Male.—Antennae robust, broadly bipectinate and strongly dilated at tips, dark ochreous, shaded with black above. Labial palpi rough, rusty red, black at bases and on the sides. Head black, top reddish with a stiff brush black; face shiny sordid white; occipital fringe rusty red. Thorax black, prothorax with a collar of flat scales, black, edged with rusty red; tegula and sides dull brown; metathorax at the sides with buff and reddish tufts. Abdomen with segments 1, 2, and 3 black; 4, 5, 6, and 7 rufous; segments 2 and 4 narrowly ringed with pale yellow, segment 3 shaded with yellow at lower margin before a very narrow black edge; segments 5, 6, and 7 also narrowly edged with black; on the underside the banding of all segments more pronounced; anal tuft short, narrow, sordid brown. Legs pale rufous, femora black. Forewing opaque, dark brown with violaceous and coppery reflections; a short vitreous streak near wing base above inner margin, which is shaded with red; underside

dull orange-brown; costa, veins, and very narrow margin black, fringes brown-black. Hindwing semitransparent, reddish brown; discal mark conspicuous, with clear areas before and behind; an irregular suffusion between the veins from outer margin inward to and beyond the discal mark, basal parts of wing remaining transparent; underside lustrous reddish.

Female.—Like the male. Antennae simple, body heavier, anal tuft very short, blunt.

Expanse: Male 30 to 34 mm., female 30 to 40 mm.

Distribution.—Atlantic Coast States, Massachusetts to Appalachian regions of Virginia.

Type.—Male. In the United States National Museum.

Remarks.—*Paranthrene dollii* is a wood borer in poplars and willows. In natural, undisturbed regions along streams and the borders of swamps the species is found rather scatteringly, evidently held in check by parasites, woodpeckers, and other enemies. The best places for collecting are suburban districts of cities and towns where real-estate developments are interfering with plant growth, leaving trees and shrubs in a weakened and mutilated condition. Such struggling trees and shrubs are especially attractive to boring insects, as are also young poplars planted along roadsides. From a young poplar section several feet in length as many as 15 moths have been reared. On willows, preferably low-growing shrubby kinds, the larvae are found in the main trunks and in branches, not in the roots, and often in association with wood-boring Coleoptera, *Saperda* and *Cryptorhynchus,* which stuff their galleries with long, excelsiorlike shavings, whereas the burrows of the aegeriid larvae are filled with small, round, reddish pellets of frass and woody fragments. The larvae attain maturity in the fall of the second year. At that time, if in normal condition, they prepare pupal chambers, capped but without cocoons, in the upper part of their burrows. Here they winter and transform to pupae late in May and during June. The moths emerge two or three weeks later. Larvae affected with parasites generally fail to prepare pupal chambers. They linger through winter and spring, dying as the parasites issue to fill the burrow with their little white cocoons.

Heavy infestations, as have been recorded by very long series of moths, from Long Island and the vicinity of New York City 30 and more years ago, have not been encountered since. Recent records are of individuals or small numbers. This also is true of the color form *castanea* in its southern habitat, with one exception. A fine series was reared from willow cuttings obtained on the Tamiami Trail to Miami, Fla. (Engelhardt). Among material of the color form *fasciventris* are two long, reared series, one from Humboldt Park, Chicago, Ill., May 1897 (U. S. Bur. Ent. No. 6295); the other from Cicero, Chicago, Ill., June 1920 (A. Wyatt and E. Beer).

PARANTHRENE DOLLII form CASTANEA (Beutenmüller)

Sciapteron dollii var. *castaneum* Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 213, 1897.

Memythrus dollii var. *castaneus* Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 253, pl. 30, fig. 5 (male), fig. 6 (female), 1901.

Paranthrene castaneum McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8802a, 1939.

This is a color variation in both sexes, the black and brown on thorax and abdomen of typical *dollii* being replaced with bright chestnut and red-brown. The suffusions between the veins of the hindwings are denser and in most of the available specimens extend nearer to the wing base.

With Virginia as a transition zone the colors intensify southward to Florida and along the Gulf States into Texas and inland along the Mississippi Valley to Missouri.

Type.—Male. In the American Museum of Natural History.

PARANTHRENE DOLLII FASCIVENTRIS, new form

Plate 26, Figure 160

In contrast to the intensified coloration of the form *castanea,* which represents the southern extension in the range of *dollii,* the form *fasciventris,* in which the coloration is moderated, represents the northern extension in the range of the species. Wings of both sexes pale rufous. Collar black, edged with pale yellow. Thorax black, posterior half of tegula and the metathorax narrowly striped with yellow, the yellow mark being continuous and in the form of a semicircle. Abdomen pale brown, all segments ringed with pale yellow.

Distribution.—Midwestern States, Illinois, Wisconsin, Indiana, Michigan. Specimens comprising a long series from the dune regions of Lake Michigan in Illinois and Indiana are consistently of this form.

Type.—U.S.N.M. No. 56845.

Described from male type, female allotype, four male and three female paratypes from Chicago (May and June), and three male and three female paratypes from Cicero, Ill.

PARANTHRENE ROBINIAE ROBINIAE (Hy. Edwards)

Sciapteron robiniae Hy. Edwards, Bull. Brooklyn Ent. Soc., vol. 3, p. 72, 1880.—Packard, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. No. 7, pp. 103, 127, 261, 1881; Fifth Rep. U. S. Ent. Comm., p. 360, 1890.—Riley, Proc. Ent. Soc. Washington, vol. 1, p. 85, 1888; Insect Life, vol. 2, p. 18, 1889.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892; vol. 8, p. 120, 1896; vol. 9, p. 218, 1897.

Memythrus robiniae Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 248, pl. 29, fig. 15 (female), 1901.

Paranthrene robiniae McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8794, 1939.

Male.—Antennae strong, broadly bipectinate, ochreous. Labial palpi rough, yellow, slightly touched with black at the sides. Head black, a

brush on top black and yellow mixed, face yellow, occipital fringe yellow. Collar covered with depressed scales, black above and yellow below. Thorax metallic black; a yellow patch at wing base above and beneath; tegula yellow, posteriorly uniting with a transverse yellow band on metathorax to form a semicircular mark. Abdomen mostly yellow; segment 1 all black, segment 2 ringed with black and yellow; segment 3 banded with black and yellow above and entirely black beneath; segments 4, 5, 6, and 7 entirely yellow; the black on segments 2 and 3 sometimes blending into chestnut or red; anal tuft short, narrow, yellow. Legs with coxae and femora black; tibiae yellow, touched with black beneath; tarsi deeper yellow. Forewing suffused, ochreous or luteous, with or without vitreous streaks between the veins before and behind the more densely scaled discal mark; a yellow spot at wing base; the costa, veins, lower margin and fringes blackish brown; underside brighter and discal mark light yellow. Hindwing transparent, discal mark conspicuous, deep yellow; veins and narrow margin ochreous, fringes dark brown.

Female.—Considerably larger than the male in average size; antennae simple, deep yellow or orange, darkening before the tips. Forewing more reddish. Otherwise like the male.

Expanse: Male 26 to 30 mm., female 30 to 36 mm.

Distribution.—West of the Mississippi Valley; Rocky Mountain and Pacific Coast States.

Type.—Male. In the American Museum of Natural History.

Remarks.—In the western half of the United States and Canada, *Paranthrene robiniae* replaces *Paranthrene dollii*, which represents the eastern parts. The two species are closely related, structurally and biologically, sharing the same food plants and having similar habits. Their chief difference lies in the consistently transparent hindwings of *robiniae* and the equally consistently suffused hindwings of *dollii*. Transitions are not known. Both species respond to climatic changes in about the same degree. The color form *perlucida*, from Montana, Alberta, and British Columbia, expresses the northern range of *robiniae* and *palescens*, from extreme desert regions in California, the southern range. *P. robiniae* prevails throughout the Western States from the Rocky Mountains to the Pacific coast and from sea level to near timber line. The insect has proved injurious to shade trees, principally poplars and less so to willows. Many young poplars were reported killed at Sacramento, Calif. (B. G. Thompson, 1921). Long series have been obtained at San Bernardino and the Arroyo Seco, Los Angeles, reared from willow sections small enough to cut with a pocket knife. A series from the Grand Canyon, Ariz., is of interest because of the color variations displayed, specimens from the rim, at an elevation of 7,000 feet, being darker and having the abdomen banded with black, while specimens from the inner canyon, 4,000 feet above sea level, are lighter and have reddish-brown abdominal bands. Heavy infestations were encountered at Salt Lake City and Provo, Utah

(1917 and 1936, Engelhardt); on the Snake River near Pullman, Wash. (1935, J. F. G. Clarke). Specimens from Bowman, N. Dak., June 24, 1935 (Geiszler), and from Hamilton County, Kans., 3,350 feet (F. H. Snow), are typical examples.

PARANTHRENE ROBINIAE form PERLUCIDA (Busck)

PLATE 27, FIGURE 161

Memythrus perlucida BUSCK, Proc. Ent. Soc. Washington, vol. 17, p. 80, 1915.
Paranthrene perlucida McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8803, 1939.

Male.—Antennae reddish brown, bipectinations blackish. Labial palpi bright yellow, shaded with red at bases. Head on top, face, and occipital fringe reddish brown. Collar transversely banded with black and yellow. Thorax dark chestnut-brown, edged transversely with yellow posteriorly. Abdomen reddish brown, with narrow and broad yellow annulations, subject to variation; segment 2 narrowly edged with yellow above, broader beneath; segment 4 yellow, slightly reddish anteriorly; segments 5, 6, and 7 usually exhibiting a tendency to lighter colors and yellow edges; segments 3, 5, and 6 narrowly ringed with black at posterior edge; anal tuft short, narrow, yellowish. Legs chestnut-red, tarsi reddish yellow. Forewing brown, suffused with red; short vitreous streaks before reddish discal mark and toward apex; costa and veins bluish black, fringes dull black; underside of a lighter tone. Hindwing transparent, glassy blue; narrow margin reddish brown, fringes dull black; discal mark and veins red, touched with black.

Female.—Abdomen reddish brown, except segment 2, which is narrowly edged with yellow and segment 4, which is yellow, barely touched with reddish on anterior edge. Otherwise like the male.

Food plant.—*Populus trichocarpa.*

Distribution.—Northern Rocky Mountains, Montana, Alberta, British Columbia.

Type.—U.S.N.M. No. 19223. Female.

Remarks.—The color form *perlucida* is represented by a large series from Missoula, Mont., June 1914, reared from *Populus trichocarpa* (Joseph Brunner); a female from Seton Lake, Lillooet, British Columbia, June 30, 1906; a male and a female from Victoria, British Columbia (E. H. Blackmore); and a small series from Calgary, Alberta, June 1923 (George Salt).

PARANTHRENE ROBINIAE PALESCENS, new form

PLATE 27, FIGURE 162

Male and female very pale, straw colored. Thorax light reddish brown, transversely and at the sides posteriorly marked with pale yellow. Abdomen with segment 1 pale brown; segment 2 pale brown and yellow in

rings of equal width; segment 3 pale brown, narrowly edged with yellow, remaining segments entirely pale yellow. Forewing pale, straw colored, touched with red at base, along costa and inner margin.

Distribution.—Extreme desert regions of southern California.

Type.—U.S.N.M. No. 56846. From Palm Springs, Calif.

Described from female type and female paratype from the type locality.

PARANTHRENE SIMULANS SIMULANS (Grote)

PLATE 27, FIGURE 163

Trochilium (Sciapteron) simulans GROTE, Bull. Brooklyn Ent. Soc., vol. 3, p. 78, 1881, Bull. U. S. Geol. and Geogr. Surv. Terr., vol. 6, p. 257, 1881.

Sciapteron simulans GROTE, Rep. Ent. Soc. Ontario for 1887, p. 81, 1888.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 121, 1896; vol. 9, pp. 214, 218, 1897.

Paranthrene simulans MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8798, 1939.

Male.—Antennae strong, bipectinate, black, brown at apices. Labial palpi rough, yellow, black at bases and on the sides. Head black, eyes margined broadly with yellow in front. Collar yellow behind, black in front. Thorax deep black, a yellow spot on each side immediately below the collar and a yellow spot in front of and another beneath the forewings; tegulae prominently striped with yellow on lower half to a black-and-yellow tuft on metathorax, which is marked with yellow transversely. Abdomen yellow; segment 1 entirely black; segment 2 black with a short transverse yellow band; segment 3 slightly yellow on lower edge; segment 4 broadly black dorsally but the yellow band broadening on the sides below; segments 5, 6, and 7 yellow with a subobsolete row of black spots along the dorsum; beneath the segments more equally banded with yellow and black; anal tuft short, compact, yellow mixed with black. Coxae yellow, femora black, posterior tibiae yellow, shaded with rusty and black; tarsi orange. Forewing with brownish-black scales on and below the costa and on inner margin, pellucid at internal angle and with pellucid streaks to wing base; discal mark indicated by denser, brownish scales. Hindwing transparent, opalescent, narrow margin and fringes brown. Beneath, wings more yellow and lustrous.

Female.—Very much like the male. Larger in size. Forewings more heavily shaded. Antenna simple, touched with yellow at inner base.

Expanse: Male 27 to 30 mm., female 30 to 33 mm.

Distribution.—Atlantic coast from Maryland to Nova Scotia; Illinois; Wisconsin; Minnesota; eastern Canada.

Remarks.—This species occurs in mixed colonies, composed of the two named forms and in addition color variations ranging from yellow to orange. The predominating color is yellow, orange occasionally only. Orange narrowly banded examples very closely resemble the nearly related, southern species, *P. palmii*, and as the ranges of the two species overlap in New York and in New Jersey, confusion is likely. Normal

specimens differ chiefly in the stripe on the tegulae. In *simulans* it is short, confined to the lower half; in *palmii* it extends over the whole length from the collar to the metathorax. Intermediate phases suggest the possibility of hybridization, but this has not been proved. Numerous experiments in exposing virgin females to attract males have not been successful.

The capture of a moth is a rare and interesting experience. During flight the adults are almost indistinguishable from queens of species of *Vespa,* which they simulate, even when at rest on tree trunks, by nervous movements of the abdomen. One would hesitate to attempt capture one by hand. The fine, long series in the United States National Museum and in the writer's collection have been obtained by rearing. In a natural undisturbed habitat the larval burrows, easy to recognize, are scattered and oftener than not are empty, the larvae having been extracted by woodpeckers. For collecting in numbers favorable conditions have been provided by the clearing of woodlands near cities and towns, followed by the growth of young shoots and saplings, which are particularly attractive to the insect. The life cycle is two years, and curiously this has remained so fixed that in the Eastern States it is almost useless to hunt for wood cuttings containing mature larvae or pupae in years of uneven numbers; in the even years they are abundant. The young larva begins a shallow excavation under bulging bark, which it enlarges in the spring before tunneling into the solid wood to a depth of about 2 inches. In preparation for a pupal chamber the tunnel is capped at the outer end in the fall; the transformation to pupa does not take place until late in the spring of the second year.

In distribution the species may be said to follow its food plants, which are black, red, and pin oaks, north to Nova Scotia and eastern Canada, south to Virginia and west to Minnesota. Records of capture and rearing are most numerous from Long Island, the vicinity of New York City, and New Jersey. Several specimens in the collection of the Boston Society of Natural History are from Maine (Johnson).

The male type of *luggeri* was bred from red oak at St. Paul, Minn., by Professor Lugger, who states that the insect is injurious to the trees. His description and figure clearly apply to an example narrowly banded with black on the abdomen. In the Eastern States, this variation is replaced largely by a color form marked much more broadly with black on the anterior abdominal segments. Among hundreds of specimens examined four of the darker form occur to one of the paler. The former is regarded as *simulans.* Grote's description of the female type of *simulans* from Algonquin, Ill., indicates an example intermediate between the two. There is one rearing record from chestnut, *Castanea dentata,* a female from Brooklyn, N. Y., June 22, 1903 (Engelhardt). This specimen is normal for *simulans,* except that the body color is not yellow but deep orange.

PARANTHRENE SIMULANS form LUGGERI (Hy. Edwards)

PLATE 27, FIGURE 164

Trochilium luggeri HY. EDWARDS, Psyche, vol. 6, p. 108, pl. 3, fig. 3, 1891.
Paranthrene simulans McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8798, 1939.

Male and female.—Abdominal segments yellow, narrowly ringed black, excepting basal segment, which is all black.

Type.—Female. In the American Museum of Natural History.

PARANTHRENE PALMII (Hy. Edwards)

PLATE 27, FIGURE 165

Fatua palmii HY. EDWARDS, Can. Ent., vol. 19, p. 145, 1887; Ent. Amer., vol. 3, p. 224, 1888.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.
Sciapteron palmii BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 366, 1894; vol. 8, p. 122, 1896.
Paranthrene palmi McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8799, 1939.

Male.—Antennae black, orange at tips; bipectinations broad, dark brown. Labial palpus rough, bright yellow, black at base and slightly edged with black at the sides. Head above with stiff black-and-yellow hairs; face black; eyes with yellow lashes; occipital fringe black. Collar deep yellow, upper edge black. Thorax black, tegulae black, broadly and evenly striped with yellow from prothorax to metathorax, which has a lateral orange brush and a transverse orange patch; a deep yellow, nearly triangular patch just anterior to wing base and a small yellow patch beneath the wing. Abdomen orange; segment 1 black; all other segments each with a small black spot at lower edge centrally; a narrow posterior black edge on each segment visible when the abdomen is extended, obscured when abdomen is contracted, but always present on underside; anal tuft short, blunt, sordid orange. Legs orange, posterior tibia touched with brown on outer side; tarsi brownish orange. Forewing heavily scaled with black and brown-black, chestnut-brown at base; pellucid at internal angle and with pellucid streaks to wing base; underside dusted with orange basally. Hindwings transparent, opalescent, with narrow margins and fringes dull black.

Female.—Differs from the male only in its larger size, heavier body, and simple antennae. Both sexes consistently exhibit the same color pattern but differ slightly with respect to shades of orange and yellow.

Expanse: Male 34 to 36 mm., female 38 to 40 mm.

Distribution.—Coastal regions from Mississippi to New York.

Type.—Female. In the American Museum of Natural History. From Florida.

Remarks.—Known for many years only from the type, this species now has been proved to be widely distributed from the coastal regions of the Gulf of Mexico northward to New York State. In structure,

habits, and food plants it closely resembles *simulans*. The genitalia of the two species are much alike. Normal examples of *palmii* are orange, striped with yellow laterally the whole length of the thorax, whereas *simulans* normally is yellow with only a short, blunt, lateral stripe on the posterior part of the thorax. Intermediate specimens occur, and these may be placed with equal satisfaction in either of the two species. In general *palmii* develops in trees of the white-oak group and *simulans* in the black oaks. There is overlapping in this host association, but *palmii* has not been reared from black oak, nor has *simulans* been obtained from white oak. This discrimination has been observed even where the two species occur in mixed association as they do on Long Island.

Larval burrows on tree trunks are indicated by swollen places, covered with blistered bark. On small growths, saplings and branches, the injury is more serious, causing gall-like swellings and often the dying of the parts above the burrow. After emergence of the moths pupal skins protrude from the burrows, often remaining exposed for long periods. With experience the identity of the borer can be determined by the character of its work. Burrows characteristic of *palmii* have been found on white scrub oak in a canyon near Salt Lake City, Utah; at Jemez Springs, Sandoval County, N. Mex., and at Yosemite Park, Calif. However, this western distribution of the species still awaits substantiation through specimens of the moths.

Throughout Florida *palmii* is fairly common in areas of scrubby oak growth, both deciduous and evergreen species being attacked. Fine series were reared at Gainesville, Daytona, and Jacksonville. At Mobile, Ala., several females were captured in flight, but not nearly so many as of the queens of *Vespa carolinensis,* which are so deceptive in behavior and in appearance that they cannot be readily distinguished from the moths until they are collected. In its southern range *palmii* emerges from April to June; in its northern range in June and July, as does *simulans*.

Records in the United States National Museum: Woodhaven and other localities on Long Island, N. Y.; Washington, D. C. (Engelhardt).

PARANTHRENE ASILIPENNIS (Boisduval)

Sesia asilipennis Boisduval, *in* Guerin-Méneville, Cuvier's Iconographie du règne animal, vol. 3 (b) (Insects), p. 496, pl. 84, fig. 3 (male), 1829; Histoire naturelle des insectes: Spécies général des lépidoptères héterocères, vol. 1, p. 391, 1874.—Wilson, Encyclopedia Britannica, ed. 7, p. 244, pl. 236, 1835.

Trochilium denudatum Harris, Amer. Journ. Arts and Sci., vol. 36, p. 310 (female), 1839; A report on the insects of Massachusetts injurious to vegetation . . ., p. 232, 1842; ed. 2, p. 252, 1852; ed. 3, p. 330, 1863.—Kellicott, Can. Ent., vol. 13, p. 8, 1881.—Hy. Edwards, Papilio, vol. 2, p. 97, 1882.

Trochilium vespipenne Herrich-Schaffer, Sammlung neuer oder wenig bekannter aussereuropäischer Schmetterlinge, p. 57, fig. 217 (female), 1854.

Tarsa bombyciformis Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 61 (male), 1856.—Boisduval, Histoire

naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 463, 1874.

Sesia denudata Boisduval, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 435, 1874.

Aegeria asilipennis Marten, *in* Thomas, Tenth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1880, p. 109, 1881.—Hy. Edwards, Ent. Amer., vol. 3, p. 224, 1888.

Aegeria denudatum Packard, Insects injurious to forest and shade trees, U. S. Ent. Comm. Bull. No. 7, p. 138, 1881.

Fatua denudata Grote, New check list of North American moths, p. 11, 1882.—Beutenmüller, Ann. New York Acad. Sci., vol. 5, p. 204, 1890.—Smith, Catalogue of insects found in New Jersey, p. 288, 1890.—Packard, 5th Rep. U. S. Ent. Comm., p. 540, 1890.

Sphecia championi Druce, Biologia Centrali-Americana, Lepidoptera, vol. 1, p. 29, pl. 5, figs. 3, 5, 1883.—Zukowsky, *in* Seitz, The Macrolepidoptera of the world, vol. 6, p. 1245, pl. 178b, 1936.

Tarsa denudata Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 22, 1893; vol. 8, p. 124, 1896; vol. 9, p. 219, 1897.—Lugger, 1st Ann. Rep. Ent. State Agr. Exp Stat. Univ. Minnesota, 1895, p. 96, pl. 5, fig. 51, 1896.

Memythrus asilipennis Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 252, pl. 30, fig. 10 (male), fig. 11 (female), 1901.

Paranthrene asilipennis Zukowsky, *in* Seitz, The Macrolepidoptera of the world, vol. 6, p. 1255, pl. 180b (female), 180c (male), 1936.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8800, 1939.

Male.—Antennae strong, broadly bipectinate, rufous-brown, orange at tips. Labial palpus moderately rough, buff and sordid white, dark brown at base and the sides, rufous above. Head black, face rufous, occipital fringe rufous. Collar black, lower edge yellow or buff. Thorax brown-black; tegulae edged with yellow, shoulder chestnut-red, yellow at wing base; metathorax with a yellow transverse line curved upward. Abdomen blackish on upper and brownish on lower half; segment 1 black; segments 2, 3, and 4 black with pale yellow bands, the bands narrowing laterally; segments 5, 6, and 7 brownish, narrowly banded with pale yellow above and beneath; anal tuft short, blunt, brown. Legs rufous, touched with black and chestnut-red on femora and tibiae. Forewing transparent, costa and inner margin brownish black, shaded with red; discal mark irregularly oblique, mostly red with dark edges; outer margin narrow, dull black and red mixed, fringes brownish black. Hindwing transparent, margins and fringes narrow, brownish black; discal mark narrow, orange. Underneath, wings shaded with yellow and orange on opaque parts.

Female.—Antennae simple, rufous, darkening to tips. Thorax on shoulder mostly chestnut-brown. Abdomen chestnut-brown on lower half and with chestnut-brown shadings on upper half above the yellow bands. Forewing opaque, except a triangular area above the hind angle. Hindwing transparent, with costa and discal mark heavily suffused with brown and red; discal mark deep orange.

Expanse: Male 28 to 38 mm., female 36 to 46 mm.

Distribution.—United States; temperate and subtropical zones of Mexico and Central America.

Type.—Male. In the United States National Museum. From Oberthür collection.

Remarks.—This species is a borer in the solid wood of oaks. Apparently it does not discriminate as to the species of oak, and so it is found widely distributed in the United States, in Mexico, and in Central America. Color variations are insignificant. In warm or subtropical climates the average size is larger. Under normal conditions oaks are attacked at their bases and surface roots. The larvae in a 2-year life cycle produce ugly wounds, tunneling inches deep in the solid wood and causing serious injury to young trees, which are preferred. Until the habits and food plants of the species were known, only a few moths had been captured in widely separated regions and at long intervals. Now the species is represented abundantly in many collections, largely owing to concentrations of the insect in woodlands with recently cut and removed timber where the remaining oak stumps prove the attraction. Eggs are laid on the bark and outer edge of the raw wood, the young larvae boring downward to a depth of about 6 inches. The change to pupa in the spring of the second year occurs in a chamber capped below and above, the exit being well concealed by minute particles of wood. The moth, emerging in May or June, leaves an upstanding half of the pupal shell protruding from the stump's surface. On one stump as many as 50 of the shells were counted. No such heavy infestations are likely on growing trees. The stumps continue to serve as breeding places even when the upper part of the trees are dead, the larvae tunneling deeper and deeper to the still living tissue. Often the tunnels become partly filled with a white, spongy fungus, which is not, however, a serious obstacle to the larva. Parasitism is heavy. Virgin females attract males quickly after emergence and, enclosed in a screened cage, they have been used successfully in the collection of males.

Records in United States National Museum: Long Island, N. Y., long series, May-June 1908-1915 (G. P. Engelhardt); Framingham, Mass., female, May 23, 1934 (C. A. Frost); Laurel, Md., male, May 14, 1911 (E. B. Marshall); Washington, D. C., female (Bur. Ent.); Ice Mountain, W. Va., female, May 7, 1939 (Austin Clark); Hessville, Ind., long series, May-June 1915 (Alex. Wyatt and E. Beer); Southern Pines, N. C., males, females, April 1-7; Texas (Oberthür collection), males and females; Dento and Dallas, Tex., males and females, March-April 1909 (F. C. Bishopp); Jacksonville, Fla., female, March (A. T. Slosson); Tallahassee, Fla., male, February 28; Cincinnati, Ohio, male and female, May 2, 1902 (A. Braun).

PARANTHRENE FENESTRATA Barnes and Lindsey

PLATE 28, FIGURE 166

Paranthrene fenestratus BARNES and LINDSEY, Brooklyn Ent. Soc. Bull., vol. 17, p. 122, 1922.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8805, 1939.

Female.—Antennae, labial palpi, head, thorax, abdomen, and legs black. Apical portion of antenna orange. Forewing opaque, orange; costa to end of cell, base, radial and cubital stems, and inner margin to cell black; apical margin very narrowly black, fringes gray-brown. Hindwing orange, with transparent areas between veins 4, 3, and 2 to cell; between veins 2 and 1c, 1c to 1b, and 1b to 1a clear to base.

Male.—Not known.

Expanse: Female 40 to 45 mm.

Distribution.—Arizona.

Type.—Female. In the United States National Museum.

Remarks.—This species is represented by three known females, two in the United States Museum and one in the California Academy of Sciences, collected in Chiricahua Mountains, Cochise County, Ariz., June 8-15 and June 27, 1916 (V. Owen). The male is not yet known, and nothing is known of the food plant and habits. Presumably the species is Mexican, ranging across the border into Arizona.

VITACEA, new genus

Genotype, *Aegeria polistiformis* Harris.

This genus forms a natural group closely allied to *Paranthrene,* having the same venational, palpal, and genitalic characters, differing only as follows: Hindwing with vein 1c heavily scaled; male abdomen with four long anal appendages not found in *Paranthrene;* genitalia without the downward spine at apex of aedeagus, characteristic of *Paranthrene.* Biologically the two groups differ in that the larva of *Vitacea* constructs a cocoon before pupation, attached to the burrow or separate in the adjoining soil, whereas in species of *Paranthrene,* as now defined, the larvae transform to pupae in their galleries without making cocoons.

The Japanese species *Sciapteron regale* Butler belongs to this genus, and there are doubtless other Old World species to be added when better known. The larvae of the Japanese species, commonly called "gun work of grape," are in demand for feeding insectivorous cage birds. The larvae are common and can be extracted from root sections in numbers as needed for feeding. A lot of such root cuttings was brought to the United States but were fortunately confiscated by custom inspectors and referred to the State Commissioner of Horticulture at Sacramento, Calif. Moths reared from this material were identified as *Sciapteron regale* in the U. S. Bureau of Entomology. If established in California this insect might become a menace to grape culture there.

KEY TO NORTH AMERICAN SPECIES OF VITACEA

Forewings opaque, brown-black; hindwings transparent; abdomen with segments 2 and 4 narrowly banded with yellow.
polistiformis polistiformis (Harris)

Forewings and abdomen chestnut-brown.
polistiformis form **seminole** (Neumoegen)

Abdomen conspicuously banded with yellow, black, and brown.
polistiformis huron, new form

Forewings buff or light brown; abdomen posteriorly pale yellow.
cupressi (Hy. Edwards)

Abdomen with the segments red and yellow.....**admiranda** (Hy. Edwards)

Forewings brown-black, hindwings broadly margined and suffused between veins; antennae tipped with orange.....**scepsiformis** (Hy. Edwards)

VITACEA POLISTIFORMIS POLISTIFORMIS (Harris)

PLATE 2, FIGURE 18; PLATE 10, FIGURES 49, 49a; PLATE 15, FIGURE 79

Aegeria polistiformis HARRIS, Proc. Amer. Pomol. Soc., 1854, p. 216.—GLOVER, Rep. U. S. Comm. Pat., 1854, p. 80, pl. 6, figs., 1855; Rep. U. S. Comm. Agr., 1867, p. 72, figs., 1868; 1873, p. 59, 1874; Monthly Rep. [U. S.] Dept. Agr., Oct. 1873, p. 496.—WALSH, First report of the State entomologist on the noxious and beneficial insects of the State of Illinois, p. 24, 1868.—PACKARD, Guide to the study of insects . . ., p. 278, and other editions, 1869.—RILEY, Third report on the noxious and other insects of the State of Missouri, p. 75, figs., 1871.—BETHUNE, Can. Ent., vol. 5. p. 218, 1873.—THOMAS, Seventh report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1877, p. 171, 1878.—PERKINS, 5th Rep. Vermont Board Agr., p. 261, 1878.—STOUT, Rep. Kansas Hort. Soc., 1879, p. 88, 1880.—MARTEN, Tenth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1880, p. 108, 1881.—SAUNDERS, Insects injurious to fruits, p. 229, 1883; ed. 2, p. 229, 1889.

Trochilium polistiformis FITCH, Third report on the noxious insects of the State of New York, 1856, p. 387, 1857.

Aegeria polistaeformis GLOVER, Monthly Rep. [U. S.] Dept. Agr., Oct. 1867, p. 329.

Sciapteron polistiformis BEUTENMÜLLER, Ann. New York Acad. Sci., vol. 5, p. 204, 1890; vol. 8, p. 22, 1896; vol. 9, p. 218, 1897.—DAVIS, Proc. Michigan State Hort. Soc., 1894, p. 78, 1895.—LUGGER, 4th Ann. Rep. Ent. Agr. Exp. Stat. Minnesota, 1898, p. 55, figs., 1899.

Memythrus polistiformis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 249, pl. 30, figs. 7, 8, 1901.—BROOKS, Bull. West Virginia Agr. Exp. Stat., vol. 110, pp. 19–30, 1907.

Paranthrene polistiformis MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8796, 1939.

Male.—Antennae bipectinate, brown-black, fuscous at tips and beneath. Labial palpus rough, red-brown, black at base and at the sides, third joint pointed. Head brown, grizzly on top; face shiny whitish, occipital fringe deep orange. Collar black, pale yellow at the sides. Thorax brown-black, more or less touched with rufous before wing base, on lower tegulae and on metathorax. Abdomen black shaded with brown, segments 2 and 4 narrowly banded with pale yellow, very faintly so beneath; anal tuft short, blunt, brown-black, anteriorly with four orange-brown pencils, the dorsal two long, the two on sides shorter. Legs orange-brown,

femora black. Forewing opaque, brown-black, with vitreous streaks before wing base; underside shaded with orange. Hindwing transparent, opalescent; margin lustrous brown-black, broadened by scales between the veins; inner margin before and at base orange-red.

Female.—Antennae simple, blue-black, rufous at bases, at tips, and beneath. Thorax with yellow stripes laterally and transversely on metathorax. Abdomen dark chestnut-brown; much larger than that of the male. Otherwise like the male.

Expanse: Male 26 to 30 mm., female 36 to 42 mm.

Distribution.—Eastern half of United States and southeastern Canada, extending from Vermont to the Mississippi Valley.

Type.—Male. In the Boston Society of Natural History.

Remarks.—As a species of considerable economic importance the grapevine root borer has been the subject of numerous investigations and publications since reported by Thaddeus W. Harris in 1854. However, these investigations almost entirely were confined to vineyards and to grapes under cultivation. Outstanding among published accounts of this species is the one by Fred E. Brooks (West Virginia Agr. Exp. Stat. Bull. 110, Nov. 1907). My own attempts to associate the borer with native wild grapes have been successful in only one instance. An old well-established stand of fox grape, *Vitis labrusca,* sprawling over open, sandy soil near Stapleton at the southern end of Staten Island, N. Y., was found infested. Early in August 1927 moths of the borer, invariably males, were observed in rapid flight searching for the more sluggish females, mostly at rest on the foliage. As usual the moths in their flight were associated with a common wasp of the genus *Polistes,* to which they bear a striking resemblance in appearance and action. About 30 specimens of the moths, including both sexes, were netted on repeated visits to the locality. Examination of the main, central root showed no larval attacks, but on outgrowing, horizontal roots, the attacks were or had been serious. Fully grown larvae 1½ to 2 inches long were few, but half-grown larvae, 1 inch or less in length, were numerous during August. Tough-fibered, elongated, and outwardly soil-covered cocoons were found by sifting the surface sand near the roots. A few still contained living pupae, but from greater numbers the moths had emerged, in each case leaving half of the pupal shell protruding from the upper end. Persistent search on other native wild grapes growing in thickets or climbing trees has given no evidence of the borer's attack. Low-growing vines in open country are preferred. To obtain material suitable for rearing involves much labor. It is easier to collect the moths at known colonies on sunny days.

The life cycle is two years. A female lays 300 to 400 eggs, singly or in small numbers on foliage and stems, or on the ground. The eggs are oval, flattened at the sides, light brown and about 1 mm. long. The

larva hatches in 2 or 3 weeks, burrows down to the roots, and starts a gallery beneath the bark, which is gradually enlarged and serves as a domicile until maturity in early summer of the second year. The change to pupa takes place in a tough cocoon constructed in the soil and near the surface, apart from the gallery. The moths emerge three to four weeks after pupation, in temperate zones late in July or in August, in warmer climates late in May and in June. The insidious work of this borer often is not recognized as the cause of serious injury and loss in vineyards.

VITACEA POLISTIFORMIS form SEMINOLE (Neumoegen)

Sciapteron seminole NEUMOEGEN, Ent. News, vol. 5, p. 330, 1894.
Memythrus seminole BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 253, pl. 30, fig. 22 (female), 1901.
Paranthrene seminole MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8801, 1939.

Female.—A specimen from Florida (the type) differs from typical *polistiformis* only in the lighter brown on the forewings, the thorax, and abdomen. Another female, from Dallas, Tex. (March 24, 1909, F. C. Bishopp), is chestnut-red on head, thorax, abdomen, and posterior tibiae; the forewings are brown-black and the discal mark on the hindwing is broader. The early date of emergence, March 24, is unusual. The type from Florida is not dated, but the usual dates for *polistiformis* are late July and August.

The name *seminole* is recognized in this paper for an extreme color form within the range of *polistiformis,* as has been done in the case of *Paranthrene dollii* form *castanea.* It is not a well-defined segregate, however, intergradations connecting it with the typical form. The geo graphical limits of the two are elastic.

Type.—Female. In the United States National Museum. From Florida.

VITACEA POLISTIFORMIS HURON, new form

PLATE 28, FIGURE 167

Male and female.—Forewings opaque, pale rufous, streaked dark with brown and buff, beneath shaded with pale yellow. Hindwings transparent, margins rufous. Abdomen with conspicuous annulations, segment 2 narrowly and segment 4 broadly ringed with pale yellow posteriorly; all segments shaded transversely with black, chestnut-brown, and buff, this being most pronounced on the basal segments, at the sides and beneath. Posterior tibiae light brown.

Distribution.—Michigan, Wisconsin, Illinois, Indiana.

Type.—U.S.N.M. No. 56847. Described from male type from Pentwater, Mich., and female paratype from Miller, Ind.

Remarks.—This form has been collected in numbers by Alexander Wyatt and Emil Beer of Chicago, Ill., who generously have shared their

captures with the United States National Museum, the Chicago Natural History Museum, and other institutions. All specimens examined are uniform in appearance and were collected during August. It is of interest to mention the very similar color variety of the poplar borer, *Paranthrene dollii fasciventris,* apparently also restricted to the same habitat. The dates of capture of the form *huron* are all during August.[3]

VITACEA CUPRESSI (Hy. Edwards)

Sciapteron cupressi Hy. Edwards, Papilio, vol. 1, p. 183, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 121, 1896.

Memythrus cupressi Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 249, pl. 30, fig. 2 (male), 1901.

Paranthrene cupressi McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8795, 1939.

Male.—Antennae orange-brown, touched with black above. Labial palpi yellow, deep orange at bases. Head with vertex, face, and occipital fringe orange-brown. Collar deep yellow, orange at the sides. Thorax deep brown; tegulae marked with yellow on posterior half; a transverse, upward curved yellow band and a lateral tuft, yellow and orange mixed, on metathorax; shoulders to wing base chestnut-red. Abdomen with segment 1 black; segment 2 black and brown and posterior edge black; segments 3, 4, 5, 6, and 7 straw-colored, with paler annulations at posterior edges; anal tuft with orange-brown pencils. Legs yellow and orange, femora shaded with black. Forewing opaque, purplish brown, yellow and orange at the base and streaked with yellow and orange to and beyond the indistinct discal mark; underside shaded with golden yellow, darkening outward. Hindwing transparent, veins purplish brown, vein 1c thickened with scales, discal mark prominent, margin and fringe violet-brown with an orange line along the inner margin to the angle. Underside strongly shaded with deep yellow.

Female.—Allotype tawnier in color than the male type; antennae simple, abdomen without anal pencils.

Expanse: Male (type) 35 mm., female (allotype) 30 mm.

Distribution.—Colorado; Utah; Arizona; Long Island, N. Y.

Type.—Male. In the American Museum of Natural History. Female allotype in United States National Museum.

Remarks.—The statement by Beutenmüller regarding *cupressi,* "closely allied to *Memythrus robiniae,*" should be corrected to read, "closely resembling *robiniae,*" for the two species are not related biologically, *robiniae* being a borer in willow and poplar and *cupressi* a root borer in grape. The males of *cupressi* are distinguished by having four anal pencils, not found in *robiniae,* and both sexes have vein 1c of the hindwing twice as broadly scaled as it is in *robiniae.* These structures are

[3] The manuscript reads "August," but the type and paratype are labeled, respectively, "VII–20–20" and "VII–11–14." These are the only specimens of *huron* in the National Museum, and if they are correctly labeled the month should be July rather than August.—C. H.

characteristic of all the grapevine root borers I have examined from the United States, Mexico (*Tirista prasilla* Druce), and Japan (*Sciapteron regale* Butler). I regard *cupressi* as a western race of *polistiformis* but refrain from relegating it to subspecific rank until sufficient and better material has been obtained. The male type is in fine condition and well illustrated by Beutenmüller; the allotype is a dwarfed, imperfect specimen. One more imperfect female from the Grand Canyon of Arizona completes the available representation.

In the West, *cupressi* has not yet been reported injurious to cultivated grapes or otherwise. It occurs there, however, and as a possible menace to grape culture in the West it should be given serious attention.

VITACEA SCEPSIFORMIS (Hy. Edwards)

Sciapteron scepsiformis Hy. Edwards, Papilio, vol. 1, p. 183, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 121, 1896.

Memythrus scepsiformis Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 250, 1901.

Paranthrene scepsiformis McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8797, 1939.

Male.—Antennae broadly bipectinate, black, orange at tips and beneath. Labial palpus rough, chestnut-red, black mixed with brown at base and on the sides, mentum pale buff. Head purplish brown, occipital fringe chestnut-red. Collar black-brown, grizzly at lower edge and yellow beneath. Thorax purplish black-brown, tegulae touched with red-brown, metathorax marked transversely with pale yellow and a yellow spot at wing base above and one beneath. Abdomen shiny black on segments 1 and 2; reddish black on segments 3, 4, 5, 6, and 7; segment 2 narrowly banded with pale yellow above and at the sides; underside not banded; anal tuft with four pencils, the two lateral ones short, the two dorsal ones long, rusty black with brown edges. Coxae and femora black touched with red-brown, posterior tibiae black, yellow and red-brown mixed anteriorly, black edged with red-brown between the spurs; tarsi yellow. Forewing opaque, purplish black, yellow at base and streaked faintly with red-brown to the indistinct discal mark; fringes broad, brownish black; underside shaded with yellow on basal half. Hindwing transparent, veins, narrow discal mark, and broad margin brownish black; between veins 2 and 3 a heavy suffusion of scales to beyond the discal mark and vein 1c progressively broadening from base to outer margin; inner margin to wing base touched with yellow.

Female.—Differs only by its larger size, heavier body, and simple antennae. One female, the only available specimen from Florida (Alachua County), has the hindwings densely suffused from the outer margin to beyond the discal mark, leaving only the basal part transparent. Another female, a dwarfed specimen from Mobile, Ala., August 19, 1928, has the hindwings broadly margined, but otherwise transparent.

Expanse: Male 20 to 30 mm., female 22 to 36 mm.

Distribution.—Atlantic and Gulf Coast States, New York to Texas.

Type.—Female. In the United States National Museum. From Texas.

Remarks.—This species, since it was described in 1881, has been collected only rarely at long intervals and in widely separated regions until it was discovered in the writer's own garden at Hartsdale, Westchester County, N. Y., in 1936. Removal of vines of *Parthenocissus quinquefolia* and *P. tricuspidata veitchii* in poor weakened condition disclosed in the roots the larvae of an aegeriid borer, which subsequently proved to be *V. scepsiformis,* the first and only food plant and rearing record for the species and the first record of the occurrence of the insect in New York State.

Very closely related to the grape root borer, *V. polistiformis,* this species also has similar habits. Its life cycle is two years. The larvae attack the upper main and branching horizontal roots, which are not exposed but are near the surface, feeding under the bark on the soft, succulent fibers, rather than on the hard central core. For pupation, late in June and during July of the second year, they construct elongated cocoons of silk, chips, and earth, more often under bark at the upper end of the galleries than in the soil adjoining. The moths issue in from three to four weeks.

This species has been found established in gardens, but search on the common Virginia-creeper in nearby woodlands and many other places has shown no signs of attack. As with *V. polistiformis,* it is most difficult to trace this species to its original habitat. Thriving on plants under cultivation, it apparently has abandoned its original wild food plants. No moths were captured at Hartsdale until after the identity of the insect became established by rearing. Even with experience it is difficult for one to distinguish the moths in flight from the much commoner wasp, *Polistes fuscatus* (Fabricius). They are more easily recognized when resting. Not many adults have been captured in the writer's garden. Long series have been obtained by rearing.

Records of captures: Males and females, Cecil County, Md., June 29, 1921 (F. M. Jones); one male, Ogdensburg, N. J., July 10, 1922 (E. L. Bell); male, Holly Beach, N. J., August 2, 1908 (Haimbach); Biscayne Bay, Fla., female (A. T. Slosson); Mobile, Ala., August 19, 1928, female (T. Van Aller); North Carolina, female; Texas, two females (types).

VITACEA ADMIRANDA (Hy. Edwards)

Sciapteron admirandus Hy. Edwards, Papilio, vol. 2, p. 54, 1882.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.

Tirista admirandus Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 88, 1894.

Tirista admiranda Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 123, 1896.

Memythrus admirandus Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 254, 1901.

Paranthrene admiranda McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8804, 1939.

Male.—Antennae broadly bipectinate, fuscous, chestnut-red at bases. Head brown-black, vertex strongly tufted, light brown; face sordid white, occipital fringe yellow, reddish black beneath. Collar sordid black, lower edge yellow at the sides. Thorax brown-black, chestnut-brown at the sides above wing base, tegulae touched with yellow on posterior part, metathorax marked with yellow transversely; yellow patches at wing base beneath. Abdomen with basal segment brownish black; segment 2 narrowly banded with black and chestnut anteriorly, broadly banded with orange-yellow touched with blue-black posteriorly; segment 3 chestnut-red, narrowly edged with black and shiny blue-black; segment 4 orange-yellow above and beneath, edged with black and shiny blue-black above; segments 5, 6, and 7 in the male type orange-red, edged with yellow, in a second male brownish black; anal tuft with four short blackish pencils, the upper two twice as long as the lateral two. Legs orange-brown. Forewing opaque, dull brownish black, with a slight mixture of yellow, pale yellow at base; underside flushed with yellow toward apex, hindwing transparent, veins and margin dull brown-black; between veins 3 and 4 a partial suffusion of brown-black scales, vein 1c much thickened to apex; wing base and inner margin basally orange-red.

Female.—Very much like the male but larger. Antennae simple, orange dusted with black above. Anal tuft elongate, rounded, dull brown-black. Hindwing densely suffused between veins 2 and 3 beyond discal mark.

Expanse: Male 25 to 30 mm., female 34 mm.

Distribution.—Texas.

Type.—Male. In the American Museum of Natural History.

Remarks.—Known from only three specimens, the male type collected by J. Ball, presumably near his home at Dallas, Tex., and a male and a female (United States National Museum) collected by H. B. Parks at San Antonio, Bexar County, Tex., July 3, 1931, and June 4, 1924, respectively. Mr. Parks captured his examples along open roadside hedges composed principally of wild grape and *Ampelopsis,* the most probable food plants. Search for larvae and their work by Mr. Parks and the writer has not been successful. Excavating in such hedgerows among cacti, poison-ivy, and other obnoxious plants is a hazardous job, especially since such thickets are notorious hiding places for the Texas diamondback rattlesnake. Structural characters definitely place *admiranda* in the genus *Vitacea.* It is apparently more closely related to *scepsiformis* than to *polistiformis.*

Genus GAËA Beutenmüller

Larunda HY. EDWARDS, Papilio, vol. 1, p. 182, 1881. (Preoccupied.) (Genotype, *Larunda solituda* Hy. Edwards.)

Gaëa Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 115, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 236, fig. 9, 1901.

Pterogostic and genitalic characters as in *Paranthrene*. Hindwing subtriangular, inner margin very long and oblique. Labial palpus more porrect, with a long, stiff brush. Tongue aborted, nonfunctional. Anal tuft short, spatulate. Harpe rounded at apex.

KEY TO NORTH AMERICAN SPECIES OF GAEA

Wings light brown and yellow.....**solituda** (Hy. Edwards)
Wings brown-black, streaked with orange and red.....**emphytiformis** (Walker)

GAËA SOLITUDA (Hy. Edwards)

Plate 2, Figure 19; Plate 10, Figures 50, 50a; Plate 16, Figure 81

Larunda solituda Hy. Edwards, Papilio, vol. 1, p. 182, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.

Gaëa solituda Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, pt. 115, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 238, pl. 29, fig. 6 (male), 1901. —McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8772, 1939.

Male.—Antennae reddish brown shaded with black scales, bipectinations long, somewhat appressed. Labial palpus with a long, stiff brush, orange and yellow mixed with black at the sides on basal and middle joint; third joint bare, yellow. Head with vertex black; face pale yellow; occipital fringe rough, yellow. Collar bluish black and reddish brown above, yellow beneath. Thorax brown-black, hairy; tegulae chestnut-red on anterior half and yellow on posterior half; shoulders chestnut-red and yellow at wing bases, above and beneath; metathorax broadly marked with yellow transversely. Abdomen with all segments banded with yellow, the bands touched with chestnut-red on upper edge and narrowly ringed with blue-black on lower edge; beneath the shading with chestnut-red more noticeable, except on segment 3, which is entirely yellow above and beneath; anal tuft short, compressed at the sides, black, red, and yellow mixed. Legs yellow; tibiae rough, chestnut-red on posterior half. Forewing opaque, brown, yellow, and red; costa, cubitus, and outer veins sordid black; between costa and outer veins sordid black; between costa and cubitus and inner margin to the red discal mark, pale yellow; pale yellow rays between the veins from discal mark to almost the outer reddish-brown margin; fringes broad, brown-black; underside with a heavy shading of yellow and orange, discal mark red. Hindwing transparent basally to discal mark from costa to vein 1c; beyond the discal mark to the outer margin a heavy suffusion of reddish brown between black veins, the inner margin broadly shaded with red basally; fringes brown black; underside yellow and orange, streaked with black veins.

Female.—Antennae simple, orange-red. Labial palpi orange. Head with a deep yellow brush on vertex, face shiny white. Thorax and ab-

domen more conspicuously marked with chestnut-red; segments 2, 3, 4, and 6 broadly banded with yellow, segment 5 chestnut-red; anal tuft, short, rounded, yellow, and red, black at the sides. Wings are flushed more brightly with yellow and red. Otherwise like the male.

Expanse: Male 24 to 26 mm., female 28 to 30 mm.

Distribution.—Colorado, New Mexico, Texas, Kansas.

Type.—Male. In the United States National Museum.

Remarks.—With the exception of one adequate series of both sexes, collected by E. J. Oslar, of Denver, Colo., at Turkey Creek, Jefferson County, Colo., 6,000 feet, August 2-6, 1923, only a few individual specimens of this species have been collected. The type specimens are simply labeled "Texas"; other specimens examined are one male, Pecos, N. Mex., July 22 (Cockerell); one male, Wilson County, Kans., 1916 (Beamer), and one female, Graham County, Kans., 2,130 feet, August 16, 1912 (F. F. Williams), in the University of Kansas collection. When its food plants and habits are better known, *solituda* should prove to be conspecific with *emphytiformis,* the only other species in the genus. The only difference between them appears to be in coloration, *solituda* being characteristically light colored in its dry western environment and *emphytiformis* dark colored in the humid climate of the South.

GAËA EMPHYTIFORMIS (Walker)

PLATE 28, FIGURE 168

Aegeria emphytiformis WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 43, 1856.—BUTLER, Ann. Mag. Nat. Hist., ser. 4, vol. 14, p. 408, 1874.—HY. EDWARDS, Papilio, vol. 1, p. 206, pl. 4, fig. 1 (male), 1881.

Trochilium emphytiformis MORRIS, Synopsis of the described Lepidoptera of North America, p. 332, 1862.

Sesia emphytiformis BOISDUVAL, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 438, 1874.

Bembecia emphytiformis BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 23, 1893.

Gaëa emphytiformis BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 115, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 237, pl. 31, fig. 31 (female), 1901.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8771, 1939.

Male.—Antennae bipectinate, broad, but appressed, orange-brown with black scales above. Labial palpus very rough, black at base, second and third joints orange. Head rusty, black and chestnut-brown mixed on vertex; face whitish; occipital fringe deep yellow. Collar black, yellow at sides below. Thorax grizzly, brown-black centrally, mixed with yellow and reddish hair laterally; tegulae red-brown, shading into deep yellow posteriorly; metathorax edged with yellow transversely; a chestnut-red and yellow spot at the base of the forewing. Abdomen brown-black, segments 2, 4, 6, and 7 banded with yellow, the band on segment 4 encircling

the body; a row of blue-black appressed scales at posterior edge of each of segments 3, 4, 5, 6, and 7 on dorsum and at the sides; anal tuft short, compressed at the sides, black mixed with orange and red. Coxae of front legs with a broad brush, orange and red; femora of middle legs and hind-legs clothed with long grayish-white hair; posterior tibiae rough, orange-brown, slightly mixed with black; tarsi sordid yellow. Wings purplish cupreous. Forewing opaque, streaked with red in the cell and between the veins beyond the black discal mark; a short red streak also at the base of inner margin; costa, veins, and broad outer margin violaceous-black; broad fringes of a lighter tint; underside with a heavier shading of red, and costa yellow on basal half. Hindwing slightly touched with red; inner margin red at base; vitreous on basal half between veins 1c and 2 and partly so in the cell.

Female.—Labial palpi yellow inwardly and orange outwardly. Head with an orange brush on vertex. Thorax more strongly edged with red and yellow than in the male. Abdomen banded with yellow on segments 2, 4, and 6, the band on 4 encircling segment 3 and segment 5 banded with chestnut-red; anal tuft short, blunt, orange, black at the sides. Posterior tibiae deep orange, yellow between the spurs. Wings streaked more conspicuously with orange and red than in the male; vitreous areas on basal half of hindwing larger and slightly indicated before the discal mark. Otherwise like the male.

Expanse: Male 20 to 26 mm., female 20 to 30 mm.

Distribution.—South Carolina, Florida, Alabama, Mississippi.

Type.—Male. In the British Museum of Natural History.

Remarks.—Described in England in 1856 from examples labeled "United States," this species remained practically unknown until F. M. Jones, of Wilmington, Del., collected a specimen at Freeport, Walton County, Fla., in 1921, and F. E. Watson, of the American Museum of Natural History, captured several in South Carolina. Two females were received from my good friend Thomas S. Van Aller, of Mobile, Ala., in 1927, and on subsequent visits to his southern home, 1930 and 1938, the species was collected in numbers. A favorable habitat proved a sandy ridge among pines and oaks at Chickasaw, a suburban district near Mobile. The moths were found in flight or resting on foliage during August and September and were easily captured. Search for the food plant proved far more difficult. Persistent observation connected the insect most intimately with a plant of the evening-primrose family, *Gaura michauxii.* After untold numbers of the flowering stalks of this plant were pulled up without evidence of larval work, a pupal shell protruding at the surface from a silk-lined tube 2 inches long disclosed a deeper, vertical tunnel leading down to the perennial, main root, with a larval burrow extending at least a foot underground. Efforts to connect *solituda* with a species of *Gaura* in Colorado have not been successful.

Genus ALBUNA Hy. Edwards

Albuna Hy. Edwards, Papilio, vol. 1, p. 186, 1881. (Genotype, *Aegeria hylotomiformis* Walker = *Albuna pyramidalis* (Walker).)

Harmonia Hy. Edwards, Papilio, vol. 2, p. 54, 1882. (Genotype, *Harmonia morrisoni* Hy. Edwards = *Albuna fraxini* (Hy. Edwards).)

Parharmonia Beutenmüller (new name for *Harmonia* Hy. Edwards, preoccupied), Bull. Amer. Mus. Nat. Hist., vol. 6, p. 89, 1894.

This genus has been maintained distinct from *Paranthrene* on the basis of the close proximity of veins 3 and 4 of the hindwing, which are nearly connate, and on the less conspicuous transverse wrinkling of the bursa without pronounced thickenings forming the signa of the bursa. Tongue well developed. Biologically also the species involved appear to be distinct from *Paranthrene*.

KEY TO NORTH AMERICAN SPECIES OF ALBUNA

Forewing transparent, broadly margined, slightly touched with red; legs black with yellow bands, abdomen yellow and black.....**pyramidalis pyramidalis** (Walker)

Red on forewing more pronounced.....**pyramidalis** form **montana** Hy. Edwards

Forewing with black margins, abdomen and legs black.

pyramidalis form **coloradensis** Hy. Edwards

Forewing and hindwing heavily touched with red.

pyramidalis form **rubescens** (Hulst)

Forewing and hindwing broadly marked and suffused with red, labial palpi black.

pyramidalis form **beutenmülleri** Skinner

Forewing opaque, black, discal mark red.....**fraxini fraxini** (Hy. Edwards)

Forewing transparent, margins and discal mark broadly black (male only).

fraxini vitriosa, new male form

ALBUNA PYRAMIDALIS (Walker)

Plate 2, Figure 20; Plate 11, Figures 51, 51a; Plate 15, Figure 80

Aegeria pyramidalis Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 40, 1856.—Hy. Edwards, Papilio, vol. 1, p. 206, 1881.

Aegeria hylotomiformis Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 43, 1856.—Hy. Edwards, Papilio, vol. 1, p. 207, 1881; Bull. Amer. Mus. Nat. Hist., vol. 5, p. 23, 1893.

Trochilium pyramidalis Morris, Synopsis of the described Lepidoptera of North America, p. 331, 1862.

Synanthedon nomadaepennis Boisduval, Ann. Soc. Ent. Belgique, vol. 12, p. 63, 1869; Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 399, 1874.

Sesia pyramidalis Boisduval, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 435, 1874.

Albuna vancouverensis Hy. Edwards, Papilio, vol. 1, p. 188, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Albuna pyramidalis Grote, New check list of North American moths, p. 12, 1882.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 89, 1894; vol. 8, p. 127, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 273, 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8789, 1939.

Male.—Antennae bipectinate, black above, rufous beneath. Labial palpus buff or pale yellow, black at the sides, orange on tip. Head black; face sordid white; occipital fringe pale yellow. Collar violaceous-black. Thorax black, with grizzly hair. Tegulae touched with yellow on posterior part; a sordid-white spot anterior to and below wing base and a whitish patch on anterior side. Abdomen black, segments narrowly ringed with yellowish white, the ring on segment 3 faint; anal tuft short, broad, black. Legs mostly black; posterior tibiae rough, black and grizzly, a yellow tuft at lower spurs; tarsi black, mixed with sordid white. Forewing transparent, outer margin very broadly sordid black; discal mark large, black, narrowly red on outer side; costa heavily scaled, blackish; inner margin edged with red basally; beneath heavily suffused with red. Hindwing transparent, margins and fringes narrow, dull black.

Female.—Larger and stouter. Antennae simple, entirely black. Abdominal segments more conspicuously ringed with pale yellow. Otherwise like the male.

Expanse: Male 18 to 26 mm., female 18 to 32 mm.

Distribution.—North America, transcontinental. Temperate to Arctic Zone.

Type.—Male. In the British Museum of Natural History. From St. Martins Falls, Albany River, Hudson Bay.

Remarks.—An abundant species, well represented in most collections, the food plant and early stages of *Albuna pyramidalis*, nevertheless, remained unknown for many years. The first clue leading to the discovery of the life history was furnished by Mrs. Hippiley of Terrace, British Columbia. During excavation of a tract of land for building, many plants of fireweed, or willow-herb, *Chamaenerion angustifolium,* were uprooted and found to contain in the deeply embedded, horizontal main roots numerous whitish, boring larvae. From such root cuttings transmitted to New York, Frank E. Watson, of the American Museum of Natural History, succeeded in rearing a male of *pyramidalis* var. *montana,* emerging under forced indoor breeding on March 5, 1928. With this evidence in mind the writer repeatedly failed to obtain additional material for rearing because of his unpreparedness to dig down to the main perennial roots among rocks in the usual environment. Pulling the annual flowering stalks proved useless. Success resulted during a visit to John D. Ritchie, at Earl Grey, near Regina, Saskatchewan, in July. A well-established, heavy growth of *C. angustifolium* in the clay soil of the plains region showed signs of a heavy infestation; numerous moths were in flight and pupal exuviae were protruding near the bases of the plants. The pupal shells were still attached to irregularly shaped oblong cocoons 1 to 2 inches long, which were just below the surface at the upper ends of vertical tunnels leading to main roots about a foot or even 2 feet deep. Small to half-grown larvae were in the main roots at that time. Investigation of the early stages has not

been attempted again, but F. M. Jones, of Wilmington, Del., succeeded in rearing adults from material collected on Marthas Vineyard, Mass., in the summer and fall of 1937. In this region the plants of *C. angustifolium* were less strong in growth and not so deeply rooted. Larvae were found in the main roots and also in the lower parts of the flowering stalks. In cuttings, packed in moist sphagnum in breeding jars, the larvae utilized their burrows as places for pupation by constructing rough pupal cases, either entirely within or extending outward from the burrows half an inch or more. The larvae wintered in the cocoon and pupation followed in the spring, moths emerging in May and June, all of them normal specimens of typical *pyramidalis*.

The increasing abundance of this species can be accounted for by the enormous spread of fireweed, *C. angustifolium*, and in the far North of *C. latifolium*, following in the wake of forest fires all over the North American Continent, except the coastal regions of the South and arid regions at low elevations in the West. Wherever the food plants have become well established the insect may be expected to occur. The moths are attracted to flowers, the rapidly flying males on bright sunny days hovering over blossoms like hawk moths without coming to rest, and the heavier, more sluggish females usually resting on foliage or flowers, preferably of umbiliferous plants. The principal time of emergence is from early in June through July. The very large representation of this species in the United States National Museum includes records from New York and the Midwestern States to Newfoundland, Labrador, Hudson Bay, British Columbia, and Yukon; and from the northwestern Pacific Coast States from near sea level through the Sierras to the Rocky Mountains up to or even above timberline. From boreal Europe and Asia, where the food plants are abundant, the insect has not been recorded.

ALBUNA PYRAMIDALIS form COLORADENSIS Hy. Edwards

Albuna coloradensis Hy. Edwards, Papilio, vol. 1, p. 189, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.

Albuna pyramidalis var. *coloradensis* Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 90, 1894; vol. 8, p. 127, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 274, pl. 33, fig. 12 (female), 1901.

Albuna torva Hy. Edwards, Papilio, vol. 1, p. 189, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 172, 1892.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8789, 1939.

Male and female.—Black, except antennae, which are brown beneath; abdomen with posterior borders edged with blue-black or steel blue; forewing sometimes with a very slight touch of red along the inner margin basally, oftener so in the male than in the female.

Distribution.—Same as the typical form and found intermixed; less common in the eastern than in the western part of the continent.

Type.—Male. In the American Museum of Natural History.

ALBUNA PYRAMIDALIS form MONTANA (Hy. Edwards)

Albuna montana Hy. Edwards, Papilio, vol. 1, p. 188, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 172, 1892.—Gillette, Colorado Agr. Coll. Bull. 43, p. 6, 1898.

Albuna tanaceti Hy. Edwards, Papilio, vol. 1, p. 188, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.

Albuna pyramidalis var. *montana* Beutenmüller, Bull., Amer. Mus. Nat. Hist., vol. 6, p. 90, 1894; vol. 8, p. 127, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 274, pl. 32, fig. 34 (male), 1901.

Males and females.—Hy. Edwards's description of *Albuna montana,* based on 21 examples from New Hampshire to California and British Columbia, applies to a color variation of *A. pyramidalis* having the forewing marked more conspicuously with red than in the typical form. It is not a sharply defined variety, the difference being rather one of degree and more pronounced in the females than in the males. It may be included in any lot of specimens of *pyramidalis* regardless of locality throughout the range of the species. Distinguishing features are the bright-red scaling between veins 1b and 2 on the inner margin and the red edge on the discal mark, which is broad outwardly and narrower or lacking inwardly. Beutenmüller states that the legs of *montana* are yellow, with the tibiae narrowly banded with black, which seems to be true as regards the females but does not apply to the males, which have the legs dull colored, pale yellow or whitish, heavily mixed with black. Moreover, the width of the bands of the abdominal segments is subject to individual variation and is not dependable for identification purposes. The recognition of the color variety *montana,* therefore, remains a matter of discriminating selection.

Distribution.—Same as that of *Albuna pyramidalis.*

Type.—Female. In the American Museum of Natural History.

ALBUNA PYRAMIDALIS form RUBESCENS (Hulst)

Sesia rubescens Hulst, Bull. Brooklyn Ent. Soc., vol. 3, p. 76, 1881.

Albuna rubescens Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.

Albuna pyramidalis var. *rubescens* Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 90, 1894; vol. 8, p. 127, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 274, pl. 33, fig. 19 (female), 1901.

Male.—Antennae bipectinate, black above, reddish brown beneath. Labial palpus rough, yellow, black at the sides and on tip above. Crown of head black, with a strong brush; face pale yellow; occipital fringe yellow. Collar steel blue, yellow at the sides and beneath. Thorax hairy, black mixed with yellow, densest at sides posteriorly and transversely on metathorax; a small cluster of yellow scales at base of forewing, anteriorly and beneath. Abdomen black, segments 2, 4, 5, 6, and 7 conspicuously banded with yellow above and beneath; a row of flat, shiny, pale-yellow scales edging the bands posteriorly above and at the sides; segment 2 black, with a small yellow spot dorsally and a yellow band beneath; anal tuft with two black spreading lateral pencils longer than the middle portion, which is yel-

low. Coxae and femora black, tibiae yellow touched with black between the spurs, tarsi sordid yellow. Forewing with opalescent areas before and behind the discal mark, which is black broadly faced with red on each side; costa, outer and inner margin, and veins black; outer opalescent area bordered with red between the veins at costa and before the broad black outer margin; inner margin lined broadly with bright red two-thirds of its length to a point before the black wing base; fringes cupreous-black; underside with a heavy shading of orange-red. Hindwing transparent; wing base, costa, and margin black; veins black, slightly touched with red; vein 1c entirely red, vein 1b and areas between the veins to vein 1a red; discal mark conspicuous, black, narrowly bordered with red. On the underside, veins and inside of margin orange-red.

Female.—Antennae simple, black above, brownish beneath. Labial palpi smoother than in the male, entirely yellow. Tongue well developed. Head crowned with a heavy brush, black and yellow mixed; face bright yellow. Thorax metallic black; tegulae with a yellow stripe broadening to an upcurved transverse line on metathorax; a yellow patch above and another beneath at wing base. Abdomen black, segments 2, 4, 5, and 6 broadly banded with bright yellow above and beneath; segment 3 dorsally spotted and beneath banded with yellow; anal tuft short and blunt, golden yellow, with smaller black tufts at the sides. Legs wholly deep yellow. Forewing mostly red, except costa, narrow margins, cubitus, and outer veins, which are black; small transparent areas before and behind the narrow black discal mark broadly encircled red; a broad, red streak between the cubitus and inner margin; underside orange, discal mark red. Hindwing transparent, with costa and margins broadly bordered with red to the black wing base; discal mark black at the center and red at the sides; vein 1b broad, red; underside mostly orange-red; fringes wide, dull black.

Expanse: Male 18 to 20 mm., female 20 to 24 mm.

Distribution.—Colorado, Utah.

Type.—Female. In the American Museum of Natural History.

This form has been considered another color variety of *pyramidalis,* displaying wing shadings of red to a more intensified degree than is found in the variety *montana.* Rearing experiments, as yet limited to one male and one female, throw some doubt on this conclusion. *A. p. rubescens* is a root borer in *Oenothera biennis* and not in *Chamaenerion,* the only food plant so far recorded for *pyramidalis*; it averages smaller in size and, aside from the more brilliant red coloration on the wings, differs in the arrangement of the abdominal bands, segments 4, 5, 6, and 7 in the male and segments 4, 5, and 6 in the female being nearly wholly yellow, except for a very narrow touch of black on the posterior edge of each. The posterior tibiae of the female are wholly deep yellow, those of the male more sordid, intermixed with black. Records of *rubescens,* accepted as authentic, are restricted to Rocky Mountain regions in Colorado and Utah. This form may be entitled to recognition as a geographical race.

ALBUNA PYRAMIDALIS form BEUTENMÜLLERI Skinner

Albuna beutenmülleri SKINNER, Ent. News, vol. 14, p. 126, 1903.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8791. 1939.

Male.—Antennae black, bipectinations from a rusty-brown base. Labial palpi, head, and collar black. Thorax black, rusty brown at bases of hindwings. Abdomen usually wholly black and all segments narrowly ringed with shiny steel blue, flat scales on posterior margin. In some examples abdomen banded with very pale yellow or whitish, the bands broad on segments 2 and 4 and narrow on posterior segments, above and beneath. Legs entirely black. Wings bright red, narrowly margined with black. Forewing with a narrow, elongated, translucent area before the discal mark, divided by red veins into four parts; behind the discal mark another translucent area, narrowly triangular, terminating before wing base; these translucent areas covered with beautiful, very light greenish or bluish opalescent scales; base of wing, costa, cubitus, and margins black; fringes dull black. Hindwing bright red on outer two-thirds to a broad, irregular translucent area before a black wing base; a small round, translucent spot, usually but not always present before the discal mark at costa; margins and fringes dull black; on the underside the bright red replaced by orange.

Female.—Antennae simple. Otherwise as described for the male.

Expanse: Male 22 to 24 mm., female 24 to 26 mm.

Distribution.—Rocky Mountains, Colorado, Utah.

Type.—Female. In the Academy of Natural Sciences of Philadelphia.

Remarks.—With the exception of one female captured in flight by the writer on the foothills of Beaver City, Beaver County, Utah, 7,000 feet, June 1904, the six or seven known examples all were collected by Tom Spaulding at Stockton and Provo, Utah, during April and May 1901-1913. Strikingly different in coloration, this form nevertheless shows no structural differences to warrant specific separation from *pyramidalis.* Field investigations along the mountains bordering the Great Basin of Utah have produced root-boring aegeriid larvae in species of evening-primrose (*Oenothera*) under conditions similar to those under which *rubescens* was obtained in Colorado. The difficult task of rearing the moths has not yet been accomplished. When represented by adequate series of reared examples transition forms will probably be found definitely connecting *rubescens* with *beutenmülleri,* the latter representing an extreme color variation confined to Utah.

ALBUNA FRAXINI (Hy. Edwards)

Carmenta fraxini HY. EDWARDS, Papilio, vol. 1, p. 185, 1881.—PACKARD, 5th Rep. U. S. Ent. Comm., p. 542, 1890.

Harmonia morrisoni HY. EDWARDS, Papilio, vol. 2, p. 55, 1882.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.

Parharmonia fraxini BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 6, p. 89, 1894; vol. 8, p. 124, 1896.

Albuna fraxini BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 275, pl. 30, fig. 12 (male), 1901.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8790, 1939.

Male.—Antennae pale yellow, shaded with black above on basal half and at apices; finely bipectinate and rufous between. Labial palpus smooth, pale yellow at base, black at the sides and toward the tip. Head and occipital fringe black. Collar black with a whitish patch at the sides. Thorax black; tegulae violaceous, a narrow pale-yellow strip at the sides from wing base to the collar; metathorax fringed with white at the sides and beneath. Abdomen wholly black above, dusted with white centrally beneath; anal tuft black, broadly fan-shaped or divided into two parts. Legs black; posterior tibiae with spurs pale yellow, posterior tarsus with first joint above black, posterior joints sordid pale yellow, above and beneath. Forewing nearly opaque, purplish black; two hyaline streaks before and behind cubitus to wing base; discal mark red of varying intensity; area beneath costa and the basal half touched with pale yellow; discal mark more conspicuously red. Hindwing transparent; discal mark, narrow margin, and broad fringes purplish black.

Female.—Body more robust. Antennae simple, basal half and apices black above and beneath, bright pale yellow on apical half before apices. Labial palpus wholly black. Thorax, legs, and abdomen all black. Segment 4 of abdomen, except above, sometimes edged with pale yellow, more broadly so at the sides than beneath; anal tuft short, blunt. Forewing wholly opaque or with a short hyaline streak basally; discal mark more conspicuously red than in the male. Hindwing transparent, margins and fringes broader, violaceous-black.

Expanse: Male 24 to 26 mm., female 25 to 27 mm.

Distribution.—Eastern and Central United States and Rocky Mountain regions of Colorado and Montana.

Type.—Male. In the American Museum of Natural History.

Remarks.—Structural similarity places this very distinct species with *pyramidalis* in the genus *Albuna.* It is a root borer in the Virginia-creeper, *Parthenocissus quinquefolia,* and was reared in numbers by Alexander K. Wyatt, Emil Beer, and V. G. Vasco, of Chicago, Ill., from material collected at Willow Springs, Ill., August 1919, and from Devils Lake, Wis., August 12, 1923. From root cuttings, submitted to the writer, additional specimens were obtained, all emerging during August. Other records of captured specimens from midwestern and Eastern States are: One female, Watkins Glen, N. Y. (Mrs. A. T. Slosson); one female, La Fayette, Ind., July 22, 1918; one female, Amherst, Ohio, July 1933 (H. G. Reinhard); one male, Ogdensburg, N. J., July 10, 1922 (E. L. Bell); one male, Squaw River, Allegheny County, Pa., August 9, 1923; one male, Riley County, Kans. (A. G. Dean); one male, Oconee, Ill., July 22, 1931. Another series in the United States National Museum was collected by E. J. Oslar, of Denver, Colo., in Turkey Creek Canyon, Colo., 8,000 feet,

August 10, 1920, and Platte Canyon, Colo., 8,000 feet, August 8, 1920. The Colorado specimens conform with Hy. Edwards's description of the male type. All the males from Midwestern and Eastern states differ from the type of *fraxini* in having two conspicuous vitreous areas, one before and one behind the discal mark. The name *fraxini* form *vitriosa* applies to these males. The females exhibit no such distinctions.

ALBUNA FRAXINI VITRIOSA, new male form

Male.—Forewing broadly margined with black; a hyaline area traversed by black veins between outer margin and discal mark, and a long hyaline area, crossed by the black cubitus, extending to wing base; discal mark broad, black, red spotted on outer edge. Thorax black, tegulae with a faint yellowish stripe inwardly and mixed with whitish hair laterally. Otherwise like the type of *fraxini*.

Female.—Like that of *fraxini*.

Expanse: Same as for *fraxini*.

Distribution.—Illinois, Indiana, Kansas, Missouri, Pennsylvania, New Jersey, New York.

Type.—U.S.N.M. No. 56848. From Chicago, Ill.

Remarks.—Described from male type, female allotype, and four female paratypes from the type locality; three male and two female paratypes from Willow Springs, Ill.; one male paratype from Oconee, Ill.; one male paratype from Riley County, Kans.; one male paratype from Onaga, Kans., one female paratype from Devils Lake, Wis.; one male paratype from Squaw Run, Allegheny County, Pa.; and one male paratype from Ogdensburg, N. J.; all in the United States National Museum.

Genus EUHAGENA Hy. Edwards

Euhagena Hy. Edwards, Papilio, vol. 1, p. 180, 1881. (Genotype, *Euhagena nebraskae* Hy. Edwards.)

Wing and genitalia characters as in *Paranthrene* except that veins 3 and 4 of hindwing are more closely approximate, nearly connate, than in that genus. Differs from *Paranthrene* also in the hair of the labial palpi being very long; in the strongly hairy, not scaled, head and thorax; in the male antennae having much longer appressed bipectinations; and in the aborted nonfunctioning tongue.

The excessive hairiness of the species of *Euhagena* seems explainable by the late season of emergence of the moths, principally during October and sometimes as late as November. At that time frosty nights prevail in their mountainous habitats. Ernest J. Oslar, of Denver, Colo., submitted over 100 specimens of *E. nebraskae* in 1922, collected in Turkey Creek Canyon and in Chimney Gulch near Golden, Colo., elevation about 6,000 feet, in the fall of that year and of the previous year. He reported the species locally common, the moths in flight or resting on foliage in weedy places. As to the food plant he utterly failed to find a clue. I also

am at a loss here, but suggest a search in a known habitat among deep-rooted herbaceous, perennial plants. Should a female moth be encountered, patient observation for ovipositing may lead to the food plant.

In distribution the genus *Euhagena* ranges much more widely than heretofore recorded. I have added as geographical races of *nebraskae, mormoni* from Utah and *intensa* from California; and I describe, as a valid species, *hirsuta* from Fort Davis, Davis Mountains, Tex. Another species represented by a single male in the United States National Museum comes from San Ángel, D. F., Mexico, collected by H. F. Wickham in 1933. It falls outside the geographical scope of the present paper and is not treated here.

The late season of emergence of the moths has been an obstacle in field investigations. The genus *Euhagena* is of outstanding interest, but it will remain inadequately known until supplemented by records of the food plants and information concerning early stages.

KEY TO NORTH AMERICAN SPECIES OF EUHAGENA

Wings opaque, red broadly bordered with black.
nebraskae nebraskae Hy. Edwards

Wings semitranslucent, whitish, sparsely touched with red.
nebraskae mormoni, new form

Wings brilliant red, stigma small, black.....**nebraskae intensa**, new form

Wings transparent, opalescent, body very hairy, grayish white.
hirsuta, new species

EUHAGENA NEBRASKAE NEBRASKAE Hy. Edwards

PLATE 2, FIGURE 21; PLATE 11, FIGURES 52, 52a; PLATE 16, FIGURE 82; PLATE 29, FIGURES 169, 170

Euhagena nebraskae HY. EDWARDS, Papilio, vol. 1, p. 181, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 116, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 239, pl. 31, fig. 32 (male), 1901.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8775, 1939.

Pyrrhotoenia coloradensis BEUTENMÜLLER, Amer. Mus. Nat. Hist. Bull., vol. 5, p. 25, 1893.—GILLETTE, Colorado Agr. Coll. Bull. 43, p. 6, 1898.

Male.—Antennae black; broadly bipectinate, pectinations appressed, black, tipped white. Labial palpus white, densely clothed with long black hair on basal and second joints beneath. Head black; vertex hairy, the black slightly intermixed with white; face white; occipital fringe black. Collar shiny black. Thorax hairy; velvety black, slightly mixed with white at the sides. Abdomen deep black; segments 2, 4, 6, and 7, narrowly banded with glossy white above and at the sides, not beneath; anal tuft black, flat, rounded at tip. Legs black; posterior tibiae hairy, black mixed with white; tarsi marked with white. Forewing opaque, subject to individual variations, red, deep orange, or rarely pinkish; black at base, along the costa, outer margin and narrowly so on inner margin; cubitus

and conspicuous, triangular discal mark black; fringes blackish brown; underside same as above. Hindwing of the same color, but increasingly more dusky toward the margins; inner margin basally broadly black; discal mark ovate, black; fringes blackish brown; underside same as above.

Female.—Antennae simple, black. Head and thorax less hairy, black, not mixed with white hair. Abdomen with segments 2, 4, and 6 banded with white, most broadly on segment 4; anal tuft short, blunt. Wings more uniformly colored, bright red or orange; black costa and margins narrower and clearly defined; discal mark reduced in size. Otherwise like the male.

Expanse: Male 20 to 26 mm., female 20 to 26 mm.

Distribution.—Nebraska, South Dakota, Colorado, Utah, New Mexico.

Type.—Male. In the Museum of Comparative Zoology. From Nebraska.

Remarks.—Records in the United States National Museum: Chimney Gulch and Turkey Creek Canyon, Colo., 6,000 feet, October 2–19, 1921–1922, long series both sexes (E. J. Oslar); Berkeley, Colo., October 16–23, males and females; Plains, Larimer County, Colo., two males (C. F. Baker); Loveland, Colo., males and females (Paul Schlarbaum); Buffalo Valley, Stanley County, S. Dak., 2 females (W. H. Over); Stockton, Utah, October 16–18, 1909, male and female (Tom Spaulding); Koehler Junction, N. Mex., October 6–15, 1913, two males (E. R. Kalmbach); Springer, N. Mex., one male (C. N. Ainslie); Las Vegas, N. Mex., October 5, one female (Cockerell).

EUHAGENA NEBRASKAE MORMONI, new form

PLATE 29, FIGURE 171

Male.—Forewing semitranslucent, with pearly-white scales, slightly mixed with orange; costa, outer margin, and cubitus black; inner margin thinly edged with orange; discal mark conspicuous black; fringes blackish brown; underside heavily dusted with cream white, except for black discal mark. Hindwing flushed with orange between and on the veins, most densely along inner margin; discal mark black, edged with orange on the sides; margins narrow, black; fringes black-brown, whitish basally. Abdomen black, segment 4 broadly banded with pale yellow above and beneath, segments 6 and 7 banded with pale yellow only above and at the sides. Otherwise like typical *nebraskae.*

Expanse: Male, 31 mm.

Distribution.—Logan, Utah.

Type.—U.S.N.M. No. 56849.

Remarks.—Only two male examples of this striking form of *nebraskae* are known. They are labeled "Logan, Utah, September 20, 1923, W. W. Henderson, collector."

EUHAGENA NEBRASKAE INTENSA, new form

PLATE 29, FIGURE 172

Female.—Wings brilliant red, narrowly banded with black costa and margins; the very small discal mark black and the fringes brown-black. Abdomen black with steel-blue reflections; segment 4 narrowly banded with pearly white above and beneath.

Expanse: Female 24 mm.

Distribution.—San Bernardino County, Calif.

Type.—U.S.N.M. No. 56850, female.

Remarks.—For this unique and strikingly colored example, I am indebted to my good friend C. M. Dammers, of Riverside, Calif., who collected the specimen in the mountains at Barnwell, San Bernardino County, on Otcober 12, 1936. It is the first record for the genus *Euhagena* in California.

EUHAGENA HIRSUTA, new species

PLATE 29, FIGURE 173

Male.—Antennae black, broadly bipectinate, the pectinations less appressed than in *nebraskae*. Labial palpus covered with long hair, which is mostly white but black at the sides; terminal joint pale yellow, touched with black. Head black, but obscured by long white hair with a slight mixture of black on vertex and in occipital fringe; face white. Collar black with a few yellowish-white scales at the sides. Thorax black, densely clothed with long white hair in a grizzly effect; at anterior wing base spotted, and underside largely patched with white. Abdomen black, segments 1, 2, and 3 diffused with white hair, posterior segments less so; segments 2, 4, 5, 6, and 7 encircled with white, the band on segment 4 the broadest; anal tuft short, rounded, compressed at the sides, sordid white centrally, black laterally. Legs hairy, whitish, except the tarsi, which are yellowish white and black; posterior tibiae with long hair, mostly sordid white, yellowish at lower spurs, above and outwardly, not inwardly. Forewing pearly translucent; costa, cubitus, outer margin, and inner margin to discal mark black; inner margin from discal mark to black wing base orange-yellow; discal mark orange-yellow, edged with black inwardly; fringes gray-white; underside mostly white and yellowish white, discal mark pale yellow. Hindwing pearly translucent, with a narrow black margin and grayish-white fringes; pure white basally; discal mark not conspicuous, pale yellow, edged with black.

Expanse: Male 20 mm.

Distribution.—Texas.

Type.—U.S.N.M. No. 56851.

Remarks.—The male type and only example is so distinctive as to warrant specific recognition. The specimen was captured by the late O. C. Poling, a well-known professional collector at Fort Davis, Davis

Mountains, Tex., 5,000 feet, October 17, 1928. No additional information could be obtained.

THE AEGERIA GROUP

Genus AEGERIA Fabricius

Aegeria Fabricius, *in* Illiger, Magazin für Insectenkunde, vol. 6, p. 238, 1807. (Genotype, *Sphinx apiformis* Clerck; Europe, North America.)

Sphecia Hübner, Verzeichniss bekannter Schmetterlinge, p. 127, 1819. (Genotype, *Sphinx crabroniformis* Denis and Schiffermüller.)

Poplar and willow wood borers. Tongue short, feeble. Antenna enlarged toward tip with an apical brush, in the male bipectinate, each pectination heavily ciliated; in the female pectinations very short. Labial palpus upright, strongly hairy, third joint pointed. Posterior tibiae heavily hairy above. Forewing with veins 3 and 4 connate or short-stalked. Male genitalia with socii short, stout, upright; harpes short, with costal and dorsal edges parallel, apices bluntly pointed with patches of heavy spines; penis finely spined. Female genitalia with a short ductus; bursa oblong, in some specimens with a minute signum, surrounded by a finely granulated area.

KEY TO NORTH AMERICAN SPECIES OF AEGERIA

Thorax dark brown, with a large yellow mark on each side anteriorly. **apiformis** (Clerck)

Thorax dark brown with a yellow line on tegula..... **tibialis** (Harris)

Thorax black; abdomen black narrowly banded with yellow. **tibialis melanoformis,** new variety

Thorax black; abdomen yellow, except the first segment and part of third black. **tibialis** variety **pacifica** (Hy. Edwards)

AEGERIA APIFORMIS (Clerck)

Plate 3, Figure 22; Plate 11, Figures 53, 53a; Plate 16, Figure 83

Sphinx apiformis Clerck, Icones insectorum rariorum cum nominibus eorum trivialibus, pl. 4, fig. 2, 1759.—Linnaeus, Systema naturae, ed. 12, vol. 1, pt. 2, p. 814, 1767.

Sesia apiformis Fabricius, Systema entomologiae, p. 549, 1775.

Sphinx crabroniformis Denis and Schiffermüller, Ankündigung eines Werkes von den Schmetterlingen der Wienergegend [Systematisches Verzeichniss der Schmetterlinge der Wienergegend], p. 305, 1775.

Aegeria apiformis Fabricius, *in* Illiger, Magazin für Insectenkunde, vol. 6. p. 288, 1807.—Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 256, pl. 29, fig. 13, 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8688, 1939.

Sphecia apiformis Hübner, Verzeichniss bekannter Schmetterlinge, p. 127, 1819.

Sesia crabroniformis Olivier, Encyclopédie méthodique, pl. 67, fig. 4, 1825.

Trochilium apiformis Stephens, Illustrations of British entomology, vol. 1, p. 137, 1828.—Beutenmüller, Ann. New York Acad. Sci., vol. 5, p. 204, 1890.—Duncan, The naturalist's library, Entomology, vol. 4, p. 171, pl. 13, fig. 1, 1836.—Smith, Catalogue of insects found in New Jersey, p. 288, 1890.—Beuten-

MÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 118, 1896; vol. 9, p. 218, 1897; vol. 12, p. 158, 1899.

Setia apiformis MEIGEN, Systematische Beschreibung der Europäischen Schmetterlinge, vol. 2, p. 103, 1830.

Trochilia apiformis HEINEMANN, Die Schmetterlinge Deutschlands und der Schweiz systematisch Bearbeitet, pt. 1, p. 120, 1859.

Male.—Antennae clavate, black, pectinations broad, ferruginous. Labial palpus with a strong brush, lemon yellow, touched with black on second joint above. Head with a rough brush on top yellow; eyes broadly edged with white on inner sides; face blackish brown; occipital fringe narrow and black above, broader and yellow at the sides. Collar broad, rusty black, anterior part at the sides yellow. Thorax brownish black; a large yellow, broadly triangular lateral patch on prothorax; another smaller, lateral patch on metathorax, deeper yellow or pale orange, sometimes connected with the patch on prothorax by a thin, yellowish line. Abdomen yellow; segment 1 black; segment 2 black, its anterior edge yellow; segment 3 yellow with posterior edge black; segment 4 orange-yellow and broadly brown-black on posterior part; segments 5, 6, and 7 yellow, narrowly edged with black; beneath same as above; anal tuft short, rounded, yellow, deepening into orange at tip. Legs brown and yellow; coxae of front legs with a broad brush, brown on inner side and yellow outwardly; femora of hindlegs pale yellow and whitish; posterior tibia rough, black at knee, brown on outer side and yellow on inner side; tarsi brownish yellow. Forewing transparent; costa, cubitus, and inner margin light brown; discal mark moderate, with purplish reflections; outer margin and fringes dark brown; wing base black with a yellow spot; underside more yellow basally. Hindwing transparent, narrowly margined with brown black; discal mark inconspicuous or absent.

Female.—Larger and stouter. Antennae clavate, finely ciliate. Abdomen with segment 4 entirely lustrous coppery black; anal tuft greatly reduced, tip of abdomen smooth, rounded. Otherwise like the male.

Expanse: Male 34 to 43 mm., female 40 to 44 mm.

Distribution.—Europe; New York, Connecticut, New Jersey, Pennsylvania.

Type.—Location unknown.

Remarks.—This European moth, popularly well known as the hornet moth, with reference to its deceptive resemblance to the large hornet *Vespa crabro,* appeared on this continent during the latter half of the nineteenth century. In Europe it has been the subject of innumerable reports and publications, beginning with an illustration in 1685. Of these only a few are cited to show the sequence in the nomenclature of the species.

Hoboken, N. J., is the probable port of entry into the United States. Collectors of Lepidoptera exhibited specimens captured there at meetings of the Brooklyn Entomological Society earlier than 1880. John B. Smith, in his "Catalogue of Insects Found in New Jersey," 1890, listed

the species from "Newark, N. J., rare, on poplars and willows." By 1900 it had spread and increased to such a degree that it was recognized as a menace to shade trees in the vicinity of New York City and on Long Island. Apparently the insect reached its greatest abundance between 1900 and 1920, attacking with preference Carolina and silver poplars, causing great injury or death to trees of those species. It became advisable to substitute maples and other trees for the faster-growing but shorter-lived poplars. The larvae burrow beneath the bark in the cambium and solid wood or in roots exposed or near the surface. During the fall of the second year they prepare for pupation by extending their galleries through the thick bark, leaving only fragile covers over the ultimate exits. Then they construct elongated cocoons 1 to 1½ inches long composed of rough chips on a silk inner lining in which they winter to change to pupae in the spring, the moths emerging in late May and in June. When living in roots the larvae often leave their burrows to construct cocoons in the surrounding soil. I have obtained as many as 50 cocoons by sifting along roots at one tree. Extracting the tight-fitting cocoons from bark is much more difficult and hazardous. The moths, upon emerging during morning hours, leave the pupal shells partly exposed at the base of the tree and crawl up the trunk to expand and dry their wings. Copulation may occur before this is completed, the strong flying males buzzing about like hornets in search of the heavy-bodied, sluggish females. This is the time when experienced collectors make their rounds to capture specimens.

Regarding the present distribution of *Aegeria apiformis* in North America, it seems that the species is still restricted to a narrow belt along the Atlantic coast, extending hardly beyond a hundred miles in either direction north and south from New York City. Reports from inland regions to midwestern states and eastern Canada are considered erroneous. In the vicinity of New York City the insect is far less common than it was 20 years ago. How far it has spread into areas outside of cultivation is difficult to determine.

Records in the United States National Museum: New York City (City Hall Park, larvae in silver poplar), female issued May 3, 1881; Englewood, N. J., males and females, June 2, 1924, Palisade Park, N. J., June 10, 1937, Bronx Park, New York City, June 9, 1937 (Henry J. Dietz); Prospect Park, Brooklyn, N. Y., June 29, 1915, Woodhaven, L. I., N. Y., May 29, 1921, Baldwin, L. I., N. Y., June 20, 1920, on Carolina poplar, males and females (Engelhardt); White Plains, Westchester County, N. Y., June 1938, on aspen (Engelhardt).

AEGERIA TIBIALIS (Harris)

Trochilium tibiale Harris, Amer. Journ. Arts and Sci., vol. 36, p. 309, 1839.—Lintner, 23d Ann. Rep. New York State Cabinet Nat. Hist., 1869, p. 192, 1873.—Hy. Edwards, Papilio, vol. 2, p. 53, 1882.—Beutenmüller, Bull. Amer. Mus.

Nat. Hist., vol. 6, p. 366, 1894; vol. 8, p. 118, 1896; vol. 9, p. 218, 1897; vol. 12, p. 159, 1899.

Melittia? flavitibia WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 67, 1856.

Aegeria tibialis BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 259, pl. 29, fig. 11 (male), fig. 12 (female), pl. 33, fig. 13 (female, variety), 1901.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8690, 1939.

Male (description based on an example from Monterey, Mass., selected as agreeing with the type from New Hampshire in the Boston Society of Natural History).—Antennae black, bipectinations strong, dark ferruginous. Labial palpus yellow, black at base and mixed with black at the sides. Head black on top and face; orbits yellow; occipital fringe black above, yellow at the sides. Collar black, touched with yellow at the sides. Thorax brownish black; a thin yellow line along inner side of tegula and a broader yellow, lateral line on prothorax, joining a yellow spot at inner wing base and anteriorly meeting the thin line on tegula in an acute angle; a yellow spot at wing base above; metathorax tufted with black, and with two separate yellow patches laterally. Abdomen with segments 1 and 2 brown-black; segment 3 yellow, narrowly edged with brown-black posteriorly; segment 4 brown-black sprinkled with yellow; segments 5, 6, and 7 yellow, with the narrow posterior margins brown-black and pale yellow and a row of brown-black spots at the sides; beneath same as above; anal tuft very short, blunt, brownish yellow. Legs yellow, shaded with brown. Forewing transparent with costa, veins, discal mark and margins orange-brown, darker on costa, wing base and fringes; same beneath. Hindwing transparent, very narrow margins and veins orange-brown.

Female.—Larger and more robust, marked more contrastingly on thorax and abdomen, yellow and black; old or faded specimens usually rusty brown or sordid yellow.

Original description by Harris: "Brownish; wings transparent; first pair with a narrow border and an abbreviated band beyond the middle pale brown; hind wings with a narrow brownish fringe; antennae black; orbits, two lines on the thorax, edges of the abdominal segments, and tibiae yellow; hindmost tibiae thickly covered with yellow hairs. Expands one inch and a half.

"Found in New Hampshire (Dublin) on the *Populus candicans,* and presented to me by the Rev. L. W. Leonard."

A female, Michigan, July 24, 1931, in the United States National Museum collection, matches this description.

Expanse: Male 30 to 32 mm., female 34 to 38 mm.

Distribution.—New York to Nova Scotia; Midwestern States; British Columbia; Pacific coast and intermountain regions from Washington to California; Rocky Mountain States.

Records in the "Catalogue of Insects Found in New Jersey," 1890 (John B. Smith), Riverton, September 9, and Browns Mills, September 15 (Daeke collector), are misidentifications and apply to *Bembecia emarginata.*

Type.—Female. In the Boston Society of Natural History.

Remarks.—Aegeria apiformis and *tibialis* are two closely related species with indentical food plants and habits, the first a European native, recently emigrated to the United States, and the second an indigenous American species. Overlapping in the distribution of the two species has not yet occurred. In the very large collection of *tibialis* at the United States National Museum it is notable that most of the moths are from western and Pacific coast regions, with no examples from the type locality in New Hampshire and only a few from Massachusetts and New York, none obtained by rearing. Typical specimens are one male, Monterey, Mass., July 15, 1923 (C. A. Frost), and one female, Ithaca, N. Y., July 9, 1937 (H. F. Scudder). Two, representing dark variations, male and female, are from Keene Valley, Adirondacks, N. Y., July 29, 1911 (Howard Natman).

While generally distributed along the north Atlantic coast, places of infestation are difficult to find until after the moths have emerged, leaving as evidence their pupal exuviae at the bases of the trees or on exposed surface roots. Such records have been furnished by William Procter from cottonwood, Bar Harbor, Maine, 1938, and by the writer from balsam poplar, Dublin Shore, Nova Scotia, 1919. In western and Pacific Coast States the insect is far commoner and at times a menace to poplars, mostly in settled rather than in wild undeveloped country. A serious outbreak on cottonwood in a park section of Sacramento, Calif., was reported by B. G. Thompson, of Corvallis, Oreg., in 1921. From wood and root sections of the stunted and dying trees he reared many of the moths during June, some emerging from sections several feet above ground. In extensive field examinations I always have found the larval burrows confined to the bases of trees or to roots. Heavy infestations on cottonwood also have been reported by Ralph Hopping, of Vernon, British Columbia, for the Vancouver region, and I found the borer extremely common in Arroyo Seco, Los Angeles, Calif., in 1928. Food plants rather than climatic conditions appear to influence distribution in the West. The insect occurs from sea level to near timber line, attacking quaking aspen with preference at high elevations. A female captured while emerging and confined in a screened box outdoors, Beaver County, Utah, July 1914, in two days attracted some 200 males during the morning hours and the early afternoon. The moths came buzzing like bees over a hive. J. H. Newton, State entomologist, reports a similar experience from Paonia, Colo., August 1917. A reared female, freshly emerged and stupefied with chloroform for photographing on a table out-

side the laboratory, attracted a male before the camera could be set and a dozen or more followed soon afterward. I have had no success in a similar experiment with *Aegeria apiformis*.

Critical examination of the ample material that is available shows no structural differences to warrant specific separation of *tibialis* and *pacifica*. Color variations are not restricted geographically but occur more or less throughout the transcontinental range of the species, the usual light colors darkening increasingly northward and at higher elevations.

Beutenmüller recognized two North American species under *Aegeria, tibialis* and *pacifica*. He treated *minimum* as a synonym of *tibialis* and *californicum* as a synonym of *pacifica*. His illustrations of *tibialis* do not conform with Harris's description, being much too dark. The male figure represents an almost black specimen marked narrowly with yellow on the thorax and abdomen. Probably it was discolored with grease. The female figure is a dark color variety, which is treated in the present paper under the name *melanoformis*. The typical form is predominantly yellow marked with black, and not predominantly black marked with yellow. In addition, Beutenmüller illustrated (pl. 33, fig. 13) as an unnamed variety a female from Colorado, an unusually fine, large, and well-marked example of *pacifica*, a name retained here for the form most representative of Rocky Mountain and Pacific coast regions. Cockerell refers to this illustration in his description of *Aegeria tibialis* var. *dyari*, and the variety *anonyma* Strand also is based on the same illustration.

Types of the following are in the United States National Museum: *Trochilium pacificum* Hy. Edwards, female, Washington Territory, 1881; *T. californicum* Neumoegen, female, California, 1891; *T. minimum* Neumoegen, male, Colorado, 1891; *Aegeria tibialis* var. *dyari* Cockerell, female, New Mexico, 1906. The type specimens are old, faded, and abraded, but there can be no doubt that all are conspecific. Color variations are not clean-cut or geographically restricted. In addition to the typical form two varieties are recognized.

AEGERIA TIBIALIS MELANOFORMIS, new variety

PLATE 30, FIGURE 174

Male.—Head with a yellow brush on top. Thorax deep brown-black, a thin yellow stripe on inner side of tegula and a broader yellow mark on prothorax extending obliquely to beneath wing base, which also is spotted with yellow above; metathorax tufted with yellow at the sides. Abdomen brown-black, all segments narrowly banded with a pale yellow, most broadly on segment 3, above and beneath; a row of black spots at the sides on segments 3, 4, 5, and 6; anal tuft a short, stiff brush, orange-yellow and brown. Wings with costa, discal mark, veins, and margins brown-black; beneath shaded with yellow basally.

Female.—Thorax brown-black, marked with yellow like the male, with the thin vertical stripe on the tegula not always extending beyond the prothorax; two yellow patches on each side posteriorly are separated by a transverse black area. Abdomen mostly black, segment 1 entirely black; segment 2 black with a narrow anterior yellow edge, broadening at the sides and beneath; segment 3 black with a broader anterior yellow edge; segment 4 black, touched with yellow only at the sides and beneath; segments 5 and 6 yellow, each with posterior half black, the black band narrowing laterad; last segment entirely yellow, its tip shaded with pale brown. Otherwise like the male.

Distribution.—Adirondack Mountains, N. Y., Michigan, Wisconsin, Montana, Colorado, Utah, Washington.

Type.—U.S.N.M. No. 56852. From Adirondack Mountains.

Remarks.—The male and female types and allotype were collected in copulation by Howard Natman in Keene Valley, Adirondacks, N. Y., July 29, 1911. The male is not quite so dark as Beutenmüller's illustration of a male *tibialis;* the female, however, perfectly matches his illustration of that sex. Field investigations still are insufficient to explain the melanism that occurs in this species. The New England States, which include the type locality, are least represented in available material. Examples from the Great Lakes regions of Michigan and Wisconsin average sufficiently dark to be placed with the variety *melanoformis.* In the West, dark-colored specimens occasionally may turn up in any series, but oftener they occur in lots from high elevations or the northern coastal regions. The series of the variety *melanoformis* studied includes, besides the types: One female, North Fox Island, Leelanau County, Mich., August 2, 1922 (S. Moore); one male, Beaver County, Utah, 8,000 feet, July 10, 1914 (Engelhardt); one female, Grand Park Creek, Colo., 10,000 feet on aspen, July 25, 1922 (Engelhardt); one male and one female, Missoula, Mont., reared from cottonwood, June 17, 1915 (J. Brunner); one female, Spanaway, Pierce County, Wash., July 27, 1935 (William H. Baker).

AEGERIA TIBIALIS variety PACIFICA (Hy. Edwards)

PLATE 30, FIGURES 175, 176

Trochilium pacificum HY. EDWARDS, Papilio, vol. 1, p. 180, 1881.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892; vol. 6, p. 365, 1894; vol. 8, p. 118, 1896; vol. 9, p. 218, 1897; vol. 12, p. 159, 1899.

Trochilium californicum NEUMOEGEN, Ent. News, vol. 2, p. 108, 1891.

Trochilium minimum NEUMOEGEN, Ent. News, vol. 2, p. 108, 1891.

Aegeria tibialis var. *dyari* COCKERELL, Can. Ent., vol. 40, p. 330, 1908.

Aegeria tibialis var. *anonyma* STRAND, Lepidopterorum catalogus, pt. 31, Aegeriidae, p. 124, 1925.

Aegeria pacifica McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8689, 1939.

Male.—Thorax deep brown-black, conspicuously marked with pale yellow in a broad lateral stripe on prothorax, a thin line edging the tegula and a large round mark laterally on metathorax, which also is shaded transversely with yellow. Abdomen mostly bright lemon yellow; segment 1 black; segment 2 black with the anterior edge yellow; segment 3 yellow, posteriorly edged with black, 4 olive-brown, 5, 6, and 7 lemon yellow, slightly or not touched with black on posterior edges. Wings with costa, nervules, and margins olive-brown. Otherwise like typical *tibialis.*

Female.—Stout and contrastingly marked with yellow and deep brown or black. Abdomen with segment 1 black; segment 2 black with a narrow anterior yellow edge; segment 3 yellow, posteriorly with a narrow even or sinuous black edge, which is broadest in the center; segment 4 entirely brown-black; segments 5 and 6 yellow with a narrow black posterior edge; last segment yellow and sordid yellow at tip. Beneath, all segments yellow, narrowly edged with black. Otherwise like the male.

Distribution.—Rocky Mountain States; western Kansas; Alberta; Pacific coast, southern California to British Columbia.

Type.—Female. In the United States National Museum.

Remarks.—Hy. Edwards's description of *Trochilium pacificum* is based on a female (Washington Territory). He had two specimens, stated to be male and female, but both are females, the one from California (Akhurst collection in United States National Museum) much faded and abraded. In long well-preserved series the variety *pacifica,* which predominates in the West, can be separated readily by its contrastingly yellow and black coloration from the more somber typical form of *tibialis* from the East and from the much darker variety *melanoformis.* The varieties overlap somewhat and examples which are old, faded and abraded are not always readily placed, as is indicated by the types of the earlier authors. Taxonomic studies establish conclusively that there is only one endemic species, *Aegeria tibialis,* in North America.

The western range of the species is covered by many records in the United States National Museum: Seward County, Kans., male, female, July 1910 (F. X. Williams); Hall Valley, Colo., 9,000 feet, July (Oslar); Cardiff, Colo., 8,000 feet, July 18, 1918, Veta Pass, Colo., 10,000 feet, male, July 28, LaPlata Mountains, Colo., 10,000 feet, 2 females, Aspen Forest, Colo., July 26, 1937 (Engelhardt); Colorado Springs, Colo., 4 males reared from *Populus deltoides,* June 7, 1915 (B. T. Harvey); Denver, Colo., male type of *minimum* Neumoegen (D. Bruce); Salt Lake City, Jordan River, Utah, June 1914, series reared from cottonwood, June 1914 (Engelhardt); Beaver County, Utah, 7,000 feet, long series, July 14, 1914 (Engelhardt); Deer Creek, Provo Canyon, Utah, female, July 21, 1916 (Tom Spaulding); Warner Ranch Sta., La Sal Mountains, Utah, 9,700 feet, male, July 27, 1936 (Klots), and female, 9,000 feet, July 22, 1936 (E. L. Chadwick); Pecos, N. Mex., female at light, June 23 (Cock-

erell) ; Las Vegas, N. Mex., female type of var. *dyari* Cockerell, July 3 (Cockerell) ; Sparks Ranch, Pecon Canyon, N. Mex., 7,500 feet, female, July 21 ; Jemez Springs, N. Mex., males and females, reared from cottonwood, July 29 (Engelhardt) ; Carrville, Trinity County, Calif., males and females, June 11, 1934 (E. C. Van Dyke) ; Madeline, Calif., female on willow, July 12, 1925 (Engelhardt) ; Arroyo Seco, Los Angeles, Calif., males and females, reared from cottonwood, July 1928 (Engelhardt) ; Riverside, Calif., males and females reared from cottonwood, July 1938 (C. M. Dammers) ; San Bernardino, Calif., males and females reared from cottonwood, June 1921 (Engelhardt) ; Sacramento, Calif., males and females, reared from cottonwood, June 1921 (B. G. Thompson) ; Medford, Oreg., male, July 12, 1922 (E. C. Van Dyke) ; Corvallis, Oreg., male, June 11, 1925 (B. G. Thompson) ; Ashland County, Oreg., female on *Populus alba,* August 1, 1913; Pendleton, Oreg., male, July 4, 1931 (Beamer) ; Hood River, Oreg., males and females on cottonwood, August 7, 1916 (Engelhardt) ; Mill Creek, Walla Walla, Wash., male, July 4, 1922 (A. L. Melander) ; Toppenish, Wash., male, June 28, 1925 (E. C. Van Dyke) ; Snake River, Pullman, Wash., males and females, July 1932 (Clarke and Engelhardt) ; University Campus, Seattle, Wash., June 1928 (Engelhardt) ; Mount Rainier, Wash., 6,000 feet, male and female, reared from willow, July 1927 (Engelhardt) ; Missoula, Mont., males and females, reared from *Populus trichocarpa,* June 17, 1913 (J. Brunner) ; Glacier Park, Mont., male, August 15, 1927 (Engelhardt) ; Yellowstone Park, Wyo., male and female, July 1922 (Engelhardt) ; Rexburg, Idaho, 5,000 feet, female, August 8, 1922; Earl Grey, Saskatchewan, male and female, on cottonwood, July 1928 (J. D. Ritchie) ; Banff, Alberta, males and females, on cottonwood, July 1928 (Engelhardt) ; Vancouver, British Columbia, males and females, from cottonwood (R. Hopping) ; Merritt, British Columbia, female, August 3, 1931; Victoria Island, British Columbia, males and females, from silver poplar, July 1928 (Engelhardt).

THE MELITTIA GROUP

Genus MELITTIA Hübner

Melittia HÜBNER, Verzeichniss bekannter Schmetterlinge, p. 128, 1819. (Genotype, *Sphinx bombyliformis* Cramer [India].)

Antennae broadly bipectinate, the pectinations shorter before apex; simple in female. Labial palpus upturned, the hair short. Abdomen cylindrical, pointed at apex; anal tuft very slender. Posterior tibiae and tarsi with very long hair on inner side. Forewing with 12 veins, 7 and 8 stalked to below apex, 10 and 11 narrowly separate. Hindwing with vein 3 nearer to 2 than to 4. Male genitalia with apices of harpes produced or angular. Uncus short, furcate; socii present; vinculum long; aedeagus nearly straight, swollen at base. Female genitalia with a short

rounded ovipositor; ostium plate weakly developed; ductus simple, not much longer than bursa, which is elongate-ovate with finely granulated walls.

A well-defined genus, world-wide in distribution, including some of the largest species in the family. All are borers in the vines or underground tubers of plants of the family Cucurbitaceae. The extreme hairiness of the posterior tibiae and tarsi is characteristic of all the species.

KEY TO NORTH AMERICAN SPECIES OF MELITTIA

Forewing dark olive-green, scales rough; abdomen red, spotted with black on dorsum ..... **cucurbitae** (Harris)

Forewing dark olive-green, scales rough, pearly; abdomen orange-red, banded with black; tibiae marked with black..... **grandis** (Strecker)

Forewing pale olive, scales rough, pearly; abdomen olive-green on back, red and black at sides..... **grandis hermosa**, new variety

Forewing grayish slate-colored, scales smooth; abdomen slate-colored on dorsum, size small..... **snowii** Hy. Edwards

Forewing blue-black and orange, abdomen blue-black... **magnifica** Beutenmüller

Forewing olive-green, scales smooth; hindwing of male transparent; hindwing of female orange-red; tibiae and tarsi marked with black.

gloriosa Hy. Edwards

Hindwing of female transparent, orange at base.

gloriosa race **lindseyi** Barnes and Benjamin

MELITTIA CUCURBITAE (Harris)

PLATE 3, FIGURE 23; PLATE 12, FIGURES 54, 54a; PLATE 16, FIGURE 84

Aegeria cucurbitae HARRIS, New England Farmer, vol. 7, p. 33, 1828.—RILEY, Second report on the noxious and other insects of the State of Missouri, p. 64, 1870.—REED, Rep. Ent. Soc. Ontario, 1871, pp. 89-90.—MARTEN, Tenth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1880, p. 107, 1881.—SAUNDERS, Insects injurious to fruits, p. 361, 1883.—KENT, Insect Life, vol. 1, p. 17, 1888.—PACKARD, 9th Ann. Rep. U. S. Geol. Geogr. Surv. Terr. (Hayden), 1875, p. 769, 1877.—FRENCH, *in* Thomas, Seventh report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1877, p. 173, 1878.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8777, 1939.

Trochilium ceto WESTWOOD, The cabinet of Oriental entomology, pl. 30, fig. 6, 1848.

Melittia ceto WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 66, 1856.—DRUCE, Biologia Centrali-Americana, Lepidoptera, vol. 1, p. 32, 1883.—HY. EDWARDS, Papilio, vol. 3, p. 157, 1883.—SMITH, Catalogue of insects found in New Jersey, p. 288, 1890; 13th Ann. Rep. New Jersey Agr. Exp. Stat., p. 499, 1892.—KELLICOTT, Insect Life, vol. 5, pp. 82, 85, 1892.—COMSTOCK, Manual for the study of insects, p. 262, 1895.—WEBSTER, Ohio Farmer, vol. —, p. 157, 1895.—SLINGERLAND, Rural New Yorker, vol. 54, p. 261, 1895.—QUAINTANCE, Florida Agr. Exp. Stat. Bull. 34, p. 293, 1896.

Melittia cucurbitae WALKER, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 66, 1856.—PACKARD, Guide to the study of insects . . ., p. 279, 1869.—LINTNER, Country Gentleman, vol. 43, p. 551, 1878.—FRENCH, Prairie Farmer, vol. 50, p. —, 1879.—COLEMAN, Papilio, vol. 2, p. 50, 1882.—HULST, Bull. Brooklyn Ent. Soc., vol. 6, p. 10, 1883.—DORAN, Bienn. Rep. Comm. Agr. Tennessee for 1885-86, p. 207, 1887.—SMITH, Insect

Life, vol. 4, p. 30, 1891; 22d Ann. Rep. Ent. Soc. Ontario, p. 55, 1891.—Osborn and Malley, Agr. Exp. Stat. Iowa Bull. 27, p. 142, 1895.—Webster, Ohio Farmer, vol. —, p. 291, 1895.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 113, 1896.

Trochilium cucurbitae Morris, Synopsis of the described Lepidoptera of North America, p. 139, 1862.

Melittia amoena Hy. Edwards, Papilio, vol. 2, p. 53, 1882.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 113, 1896.

Male.—Antennae black, broadly bipectinate, narrowing before apices. Tongue well developed, spiraled. Labial palpus extending above head, with short hair, tawny mixed with white. Head olive-black on top; face whitish; occipital fringe short and narrow, olive-black. Collar and thorax brown-green violaceous. Abdomen olive-green, suffused with red and black spotted with black on the dorsum; orange-yellow beneath; segments 1 and 2 greenish black, 3, 4, 5, and 6 shaded with red, more weakly so toward tip; segment 7 and short anal tuft green-black. Coxae of forelegs shiny white, femora tawny and black; posterior tibiae and tarsi red or deep orange, touched with white outwardly, with very long hair, black inwardly. Forewing opaque, lustrous blue or violaceous olive-green, except for a narrow, hyaline space basally between cubitus and inner margin; discal mark obscured; narrow outer margin and fringes black and brown-black; underside same as upper. Hindwing transparent, nervules and narrow margins greenish black.

Female.—Antennae simple, black. Abdomen with segments 1 and 2 black; all other segments red with a black spot and narrowly edged posteriorly with pale green above; beneath orange-yellow. Otherwise like the male.

Expanse: Male 28 to 30 mm., female 28 to 32 mm.

Distribution.—South and Central America, North America except Pacific Coast.

Type.—In the Boston Society of Natural History.

Remarks.—For this well-known and economically notorious squash borer the name *Melittia cucurbitae* (Harris) is retained, restricted to North America. It is closely related to *M. satyriformis* Hübner from Bogotá, Colombia, and identical with *M. ceto* (Westwood) and perhaps with others of the numerous closely related species and forms described from South and Central America. The original source of this species remains in doubt. Now widespread in North America, it seems to confine its attacks entirely to plants of the Cucurbitaceae under cultivation. Wild species, even when growing in close proximity to cultivated plants and apparently suitable as hosts, are ignored. Squash growers often suffer serious injury and find it difficult to control the pest. The usual remedy of cutting the larvae out of the vines is practical but too slow where squash is grown on a large scale. The insect has been successfully trapped. This is done by attracting the egg-laying moths to plants of rapid growth, such as

hardy summer squash. The fall squash, planted later in the season, is left practically uninfested.

The moths are active, rapid fliers, swarming over fields of squash in sunshine and resting exposed on the plants on cloudy days and at night. Flowers attract them. The brown, disklike eggs are laid on any part of the plant but preferably at the bases of the vines. The larvae tunnel in the more or less exposed, main portions of the vine, subsisting largely on the juices rather than the plant tissue. On maturity late in summer or early in fall they desert their burrows and spin tough parchmentlike cocoons a little below the surface of the ground; in these they rest until they change to pupae in the spring of the year following. A chisellike organ on the head of the pupa is used to cut a circular lid from the cocoon and to enable the pupa to wriggle to the surface before the moth emerges, which is usually in June or July. There are occasional records of moths collected as late as September in temperate regions and numerous records from Southern and Southwestern States as late as October and November. These suggest a 2-brooded species. However, as the larvae are dependent on living plants and cultivated squashes are annuals, a successful second brood seems unlikely, except under unusually propitious conditions.

Color variations are not sufficiently distinct to warrant recognition in the North American distribution of this species. Males sometimes lack the red shading on the abdominal segments. (Cabinet specimens quickly become greasy if not subjected to treatment.) *Melittia amoena* Hy. Edwards is a black-bodied, but otherwise normal, male from Kansas. Examples from southwestern Texas and from Mexico average slightly larger and have wing colors of a lighter olive-green than normal specimens from the United States. Entry into this country most likely occurred from that direction and not from Baja California, where records are still lacking from across the border.

Persistently confining its attacks only to cucurbits under cultivation, the common squash borer now has spread over the United States and into Canada, except on the Pacific coast. Serious injury has been reported from almost every region suitable for the cultivation of squash, and numerous papers covering the subject have been published.

MELITTIA GRANDIS (Strecker)

Trochilium grande Strecker, Can. Ent., vol. 13, p. 156, 1881.

Melittia grandis Grote, New check list of North American moths, p. 11, 1882.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 114, 1896; vol. 12, p. 151, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 235, pl. 29, fig. 4 (female), 1901.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8780, 1939.

Melittia beckeri Druce, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 276, 1892; Biologia Centrali-Americana, Lepidoptera, vol. 2, p. 325, pl. 69, fig. 18, 1896.

Male.—Antennae dark green-black, bipectinate and ciliate. Labial palpus orange-yellow. Head with top and occipital fringe dark olive; face white, tinged with yellow. Collar red. Thorax dark brown, with green and blue reflections and sprinkled with white-tipped scales, beneath marked with orange-red. Abdomen red, each segment with a broad, blue-black posterior band, which is narrowly edged with golden-yellow at the sides; anal tuft short, black above, orange beneath, like the abdomen. Fore and middle legs orange, tarsi black, banded with white; posterior legs very hairy, the hair long on the inner side and short outwardly, red and black above between the black, white tufted spurs and on tarsi. Forewing opaque, metallic dark olive-green, densely freckled with white-tipped scales, producing a pearly effect, which is a specific feature; wing base touched with orange. Hindwing transparent, veins, margins, and fringes dark olive-green, wing base touched with orange; underside of forewing orange at base, with a longer orange edge on costa, and metallic golden irrorations to outer margin.

Female.—Larger and stouter than the male. Antennae simple; abdomen cylindrical, bright red and more contrastingly banded with black; anal tuft small, pointed, black above, red beneath.

Expanse: Male 40 mm., female 44 mm.

Distribution.—Southwestern Texas, Mexico.

Type.—Male? In the Chicago Natural History Museum.

Remarks.—The rough white-tipped scales on the forewings and body of this species are dependable structures for separation from *M. gloriosa,* which is nearest in coloration and in size but has flat unicolored scales. A good series from Texas agrees perfectly with Strecker's description of *Trochilium grande* which was based on a specimen from Texas. Beutenmüller described and illustrated as *M. grandis* a female from Arizona, particularly emphasizing "abdomen brown above." The abdomen of typical *grandis* is red, banded transversely with black. Very few specimens of *grandis* have been collected in Arizona. Only two females from Arizona have been available for the present study, one from the Neumoegen collection and the other from the E. L. Graef collection. They are well preserved but old and probably faded. One of these apparently served Beutenmüller for his illustration. The Arizona specimens are conspecific but sufficiently different to warrant recognition as a variety, which I name *hermosa.*

Field investigations show a distribution for *M. grandis* in Texas from Austin and San Antonio to the Gulf coast and along the Rio Grande to the Big Bend; and probably the species extends westward into Arizona. Its native home is Mexico. *Melittia beckeri* Druce from Durango, Mexico, is this species.

A relationship with *M. cucurbitae* is shown by the male genitalia in the much produced apex of the harpe, which in the other species of the

genus is angular but not produced. *M. cucurbitae* also exhibits rough, white-tipped scales on the forewings and on body, although these are less conspicuous than in *M. grandis*.

The food plant is *Cucurbita foetidissima,* the wild gourd so common in western arid regions. The larvae bore in the underground tubers, which grow to enormous size. Guided by pupal shells above ground, I have found larval excavations but no living material for rearing. Apparently the insect congregates in colonies. H. B. Parks reported finding large tubers, laid bare in the course of road construction, fairly honeycombed with larval tunnels. I have not been so fortunate. My long series of moths was obtained by capture, the males usually in flight and the females resting on foliage of the food plant. A 2-year life cycle is expected. The available material is from Austin, Tex., male and female in copulation, April 29, 1930, and a female, June 9, 1933, H. Parks; San Antonio, Tex., males and females, May-June 1934, H. P. Parks and Engelhardt; Alpine, Tex., male and female, July 20, Barnes collection; female, Arizona, no definite locality or date.

MELITTIA GRANDIS HERMOSA, new variety

PLATE 31, FIGURE 177

Female.—Forewing opaque, pale olive-green. Hindwing transparent, veins orange, darker at margins. Abdomen broadly pale olive-green along back, banded with red and black at the sides only.

Expanse: 44 mm.

Distribution.—Arizona.

Type.—U.S.N.M. No. 56853, female. Described from two females from Arizona.

MELITTIA SNOWII Hy. Edwards

Melittia snowii HY. EDWARDS, Papilio, vol 2, p. 53, 1882.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892; vol. 8, p. 114, 1896; vol. 12, p. 150, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 234, pl. 29, fig. 2 (male), 1901.—F. X. WILLIAMS, Kansas Univ. Sci. Bull., vol. 8 (1913), p. 219, pl. 31 (egg, larvae, cocoon, pupa, and adult), 1914.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8778, 1939.

Male.—Antennae gray-black, bipectinate, dark brown beneath and rufous at tips. Labial palpus white, tinged with black above. Head gray, face glossy white, occipital fringe thin, gray and white at the sides. Collar lustrous blue-black. Thorax speckled gray, tawnier beneath. Abdomen gray on the back, orange-yellow at the sides, spotted sordid white and black in center beneath; anal tuft short and blunt, gray above, sordid white beneath. Fore and middle legs sordid white, edged with orange; tibiae and tarsi of hindlegs sordid white on outer side, densely covered with long, deep orange and bluish-black hair on inner side. Forewing

opaque, speckled with light gray scales; costa and narrow margins whitish gray; fringes brownish gray; underside paler, touched with yellowish basally. Hindwing transparent, narrowly margined with orange; fringes brown-gray.

Female.—Antennae simple. Abdomen deep gray on the back, red at the sides, bluish black beneath with segments more or less edged with tawny white; posterior tibiae red and lustrous blue-black.

Expanse: Male and female 24 to 26 mm.

Distribution.—Eastern Colorado, western Kansas and Oklahoma, eastern and southern Texas.

Type.—Male. In the American Museum of Natural History.

Remarks.—This, the smallest North American species of the genus, produces galls on its food plant, the common western gourd, *Cucurbita foetidissima.* Hatching from eggs laid on tender shoots of the vine or on the petioles of leaves, the young larvae enter the tissue, causing rapidly growing gall-like swellings, which are at first firm but which become hollow before full size of 2 or 3 inches in length and an inch or more in thickness is attained. The larvae, when mature, desert the galls, drop to the ground, and prepare tough, silk-lined cocoons below the surface. This habit was reported first by F. X. Williams, who found the insect in western Kansas in July 1912 wherever the food plant occurred. Each gall contains but one larva and remains entire until the larva has made its exit. Some of the cocoons obtained in July produced moths late in August, but in the majority the larvae hibernated, the moths emerging during the following May and June. The galls are conspicuous. We have found them numerous in western Kansas, eastern Colorado and New Mexico, Oklahoma, and the eastern half of Texas. For rearing purposes galls well grown and still intact should be gathered and placed in a cage with earth. When recently deserted by the larva, the cocoon usually can be located by scratching the soil beneath the gall. The principal time of emergence is May and June, occasionally only late in summer and in fall. It has not been observed whether the moths are attracted to flowers. They remain near the food plant, flying about and resting on the foliage. E. V. Walter captured many males near San Antonio, Tex., by exposing a virgin female, May 5, 1929. Examples reared by H. B. Parks, San Antonio, are labeled "Larva entered soil May 6, 1929; moth emerged June 24, 1929." The insect is not known to attack squash or other cucurbit plants under cultivation. The very long series of available examples shows no color variations. Scale reticulations on the forewings and on the body are present but are more appressed and less prominent than in *cucurbitae* and *grandis.* The tip of the harpe of the male genitalia is not produced but bluntly angular, similar to that in *gloriosa.*

MELITTIA GLORIOSA Hy. Edwards

PLATE 31, FIGURES 178, 179

Melittia gloriosa HY. EDWARDS, Bull. Brooklyn Ent. Soc., vol. 3, p. 71, 1880.—RILEY, Proc. Ent. Soc. Washington, vol. 1, p. 85, 1888.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892; vol. 8, p. 114, 1896; vol. 9, p. 217, 1897; vol. 12, p. 150, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 235, pl. 29, fig. 3 (female), 1901.—F. X. WILLIAMS, Kansas Univ. Sci. Bull., vol. 8 (1913), p. 217, 1914.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8779, 1939.

Male.—Antennae bipectinate, dark olive-green, rufous beneath and at apices. Labial palpus white, above and on its inner and outer sides pale dull yellow. Head greenish brown on the top; face white; occipital fringe pale yellow, white at the sides. Collar dark brown with bluish reflections. Thorax dark green-brown, a broad yellow patch laterally from collar to wing base; tegula with a posterior yellow tuft; metathorax transversely broadly edged with yellow and orange; underside lustrous blue-black. Abdomen with segments 1, 2, and 3 dark greenish brown on top, orange and red at the sides; segment 3 yellow, red at the sides and touched with black on posterior edge; segment 5 yellow; segments 6 and 7 and anal tuft lustrous pale blue; all segments with a posterior margin of appressed metallic black scales; beneath, the abdomen creamy white. Fore and middle legs with femora and tibiae pale yellow and white, tarsi blue-black, yellow at the joints; hindlegs with long orange-red hair on the inner side extending to second joint of tarsi; anterior half of tibia red above, yellow on outer side, posterior half of tibia and the tarsus velvety black on upper side, blotched with yellow on outer edge and beneath; apical joints of tarsus all black.

Forewing opaque, yellowish green, tinted with olivaceous on costa, inner margin, and basal parts; fringes broad, greenish brown, tipped with buff; underside orange-yellow. Hindwing transparent; veins, narrow margin and wing base orange-red above and beneath; fringes dark brown-black, not tipped with buff.

Female.—Antennae simple; body more robust, abdomen cylindrical. Forewing and thorax orange-green; underside orange. Hindwing opaque, orange-red; fringes brown-black; underside orange-red.

Expanse: Male 40 to 45 mm., female 40 to 50 mm.

Distribution.—Oregon and California and coastal islands of these States; Arizona, New Mexico, Utah, Colorado, western Texas.

Type.—Female. In the American Museum of Natural History.

MELITTIA GLORIOSA race LINDSEYI Barnes and Benjamin

Melittia lindseyi BARNES and BENJAMIN, Proc. Ent. Soc. Washington, vol. 27, p. 14, 1925.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United State of America, pt. 2, No. 8781, 1939.

Melittia superba BARNES and LINDSEY (not Rothschild), Bull. Brooklyn Ent. Soc., vol. 17, p. 122, 1922.

Melittia barnesi DALLA TORRE and STRAND, Lepidopterorum catalogus, pt. 31, Aegeriidae, p. 138, 1925.

Male.—Very similar to the male of *gloriosa.* Of larger average size. Abdomen with segments 3, 4, and 6 white, barely touched with yellow.

Female.—Differs from female of *gloriosa* by having the hindwings transparent and deep orange only at wing base. The abdominal bands, similar in arrangement, are more contrasting, pinkish white and bluish black. Females of this race attain the largest size found in North American Aegeriidae.

Expanse: Male 50 mm., female 52 to 62 mm.

Distribution.—Western Kansas, eastern Colorado, Texas.

Type.—Male. In the United States National Museum.

Remarks.—This, the largest and handsomest species of North American Aegeriidae, fittingly bearing the name *gloriosa,* is hardly exceeded in beauty and size by any other species in the entire family. Until collected in numbers and its food plant and habits reported by F. X. Williams in 1913, the few examples in collections were highly prized. Williams collected his specimens, a dozen or more, in Seward and Graham Counties of western Kansas, August 1911 and 1912. He traced moths to their food plant, *Cucurbita foetidissima,* found numerous pupal exuviae, and, upon digging down to the larger underground tubers, noted larval excavations but failed to find living material for rearing. This also has been my experience on many occasions, although better success was had in company with H. G. Thompson, of Oregon State College, during July 1924. Observing an insect in flight over pastureland and in doubt whether it was a cicada killer wasp or a moth, we watched its aerial gyrations until suddenly it dropped and to our delight proved to be a male of *gloriosa* already copulating with a freshly emerged female. The pupal shell of the latter protruded from near the base of the stem of *Echinocystis fabacea,* a sprawling or climbing cucurbit vine, better known as manroot, or bigroot, for its enormous underground tubers, sometimes actually as large as the body of a man. The vines above ground already had wilted at the time. A pickax was needed to uncover the top of the root a foot or deeper in the dry, almost stone-hard clay soil. We found several immature larvae and one fully grown in tortuous burrows. Above the tuber vertical tunnels led upward to a point an inch or two below the surface of the ground, the upper parts containing tough, elongated pupal cases, all vacated, except one that still contained a living pupa. This has been preserved and is an example of adaptation of unusual interest. Most pupae of boring Lepidoptera are provided with cutting structures on the head and roughened edges on the abdominal segments to facilitate emergence. In *gloriosa* such structures have developed to an extraordinary degree. The head armament consists of a 3-pronged drill in front, a sharp outcurving spine beneath, and an erect, knifelike

blade, more than a millimeter high, on top of the head. The thorax has a narrow knife-edged ridge all along the back and a stout, short spine on each shoulder. All abdominal segments are strongly spined, the spines being nearly erect above and at the sides; and the anal end bears a circle of broader, sharp-edged spines, which are slightly curved. It is an ingenious arrangement for drilling and is undoubtedly an indispensable provision in assuring the final exit of the moth from the hard soil. Following these investigations Dr. Thompson discovered manroot growing on a pasture adjoining his property at Corvallis, Oreg. In succeeding years during the flying season of late July and August he collected several hundred freshly emerged moths by making early-morning inspections.

In California the species is widely distributed from north to south and on the islands near the coast. B. G. Thompson captured numbers of the moths along farmlands at Sacramento, and C. O. Poling collected them on Santa Catalina Island; and there are many records of single specimens or small numbers collected throughout the state. F. E. Blaisdell took a specimen near San Diego on *Rhus laurina* and assumed it was a root borer in this plant, but that has proved erroneous. Successful rearing in California apparently has been accomplished only by C. M. Dammers, of Riverside, and C. Henne, of the Los Angeles Museum. These keen observers found pupal shells about the base of *Cucurbita palmata* in the desert near Blythe, Colorado River region, in September and October 1936; and in the underground tubers, about 2 inches thick and 2 feet long, there were immature and full-grown larvae. From these tubers, transported and replanted, moths emerged late in the summer of the following year and again in the second year, thus indicating a 2-year life cycle. These investigators also reported moths on the wing in September and as late as October. Retarded development is not unusual in extreme desert regions.

On the Pacific coast, in southwestern Arizona (Paradise), and in southwestern Utah, color variations in *gloriosa* are not apparent in either sex. The males appear to be typical wherever found. However, a change restricted to the females becomes obvious through the eastern range of the species. It consists in the gradual clearing of the hindwings from opaqueness to transparency; they become semiclear in central and northern Arizona and quite clear in western Kansas, the eastern limit in the range of the species. This is evidenced by prolonged and careful field investigations and long series of specimens in the United States National Museum. In central Arizona and in western Kansas the food plant was found to be *Cucurbita foetidissima*. Other wild gourds with sufficiently large underground tubers should serve equally well.

Records in the United States National Museum: Typical forms, Corvallis, Oreg., July-August 1926, male and females (Thompson and Engelhardt); Santa Catalina Island, Calif., June 1920, males and females

(O. C. Poling); San Diego, Calif., female (C. V. Riley); Los Angeles, Calif. (Coquillett); Phoenix, Ariz., female (J. Frank Meador); St. George, Washington County, Utah, female. Transition forms, Globe, Ariz., August 4, 1937, males and females (Engelhardt); Willcox, Ariz., September 14, 1935 (F. H. Parker); Cochise County, Ariz., 3,750 feet (F. H. Snow).

MELITTIA MAGNIFICA Beutenmüller

Melittia magnifica Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 12, p. 151, 1899; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 236, pl. 29, fig. 5 (female), 1901.—McDunnough, Check list of the Lepidoptera and the United States of America, pt. 2, No. 8782, 1939.

Female.—Antennae simple, blue-black, ferruginous toward the tips beneath. Labial palpus orange, extreme tip black. Thorax steel blue, tipped with orange on each side posteriorly. Abdomen metallic steel-blue-black, above and beneath. The anterior and middle legs steel-blue-black (hind pair lacking). Forewing bright steel-blue-black, with the inner part broadly light orange, the light area covering more than half the width of the wings to a little beyond the middle, where it curves downward to a point touching the hind angle; fringes light orange. Hindwing deep orange above and below; underside orange with outer fourth black; fringes orange.

Expanse: 42 mm.

Distribution.—Austin, Tex.

Type.—Female. In the American Museum of Natural History.

Remarks.—This species is represented by only the unique female type. Its indicated habitat, Austin, Tex., seems open to question. Especial attention has been given to this and other regions in Texas in a search for borers in cucurbit plants. Nothing approaching *magnifica* has been found in the State. Beutenmüller obtained the specimen from the late Josef Mattes, a collector of Lepidoptera and by vocation a painter and decorator, who loved bright, showy insects and freely exchanged for exotic species, but was careless about locality and date labels. Prior to coming to New York he had lived in Austin, Tex., and thought the type of *magnifica,* which bore no label, must have been collected there. This is probably erroneous. It does not fit in the North American fauna but displays a closer affiliation with species from South America. I have not attempted to determine it as a previously described South American species because of its imperfect condition.

THE BEMBECIA GROUP

Genus BEMBECIA Hübner

Plate 3, Figure 24; Plate 12, Figures 55, 55a; Plate 16, Figure 85

Bembecia Hübner, Verzeichniss bekannter Schmetterlinge, p. 128, 1819. (Genotype, *Sesia hylaeiformis* Laspeyres, Europe.)

Tongue well developed, spiraled. Antenna of male broadly but finely bipectinate; of female simple, thickened; tip without tuft. Labial palpus short, upcurved, loosely scaled, flattened; third joint blunt, with scales projecting above apex. Thorax with posterior tuft and with two hair pencils at the bases of the hindwings. Anal tuft short, rounded. Hind-tibiae above with long rough scales especially at the spurs; first tarsal joint thickened with scales. Forewing with 11 veins, vein 2 absent; 7 and 8 stalked, 7 to apex; 10 and 11 well separated, parallel. Hindwing with veins 3 and 4 long-stalked.

Male genitalia with short upright socii, harpes short rectangular, simple without specialized scales; ventral plate large; aedeagus long, straight; vinculum with a moderately long, anterior process.

Female genitalia with upper part of ductus bursae strongly sclerotized and looped on itself.

KEY TO NORTH AMERICAN SPECIES OF BEMBECIA

Thorax and abdomen marked with lemon yellow.....**marginata marginata** (Harris)
Thorax and abdomen marked with very pale yellow or white.
marginata var. **albicoma** Hulst

BEMBECIA MARGINATA (Harris)

Trochilium marginatum Harris, Amer. Journ. Arts and Sci., vol. 36, p. 309, 1839.—Morris, Synopsis of the described Lepidoptera of North America, p. 137, 1862.—Lintner, 23d Ann. Rep. New York State Cabinet Nat. Hist., 1869, p. 192, 1873.

Sphecia? marginata Walker, List of the specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 12, 1856.

Aegeria pleciaeformis Walker, List of specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 40, 1856.—Hy. Edwards, Papilio, vol. 1, p. 206, 1881.

Aegeria odyneripennis Walker, List of specimens of lepidopterous insects in the collection of the British Museum, pt. 8, p. 42, 1856.—Hy. Edwards, Papilio, vol. 1, p. 206, 1881.

Trochilium odyneripennis Morris, Synopsis of the described Lepidoptera of North America, p. 332, 1862.

Sesia odyneripennis Boisduval, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 437, 1874.

Sesia pleciaeformis Boisduval, Histoire naturelle des insectes: Spécies général des lépidoptères hétérocères, vol. 1, p. 436, 1874.

Aegeria rubi Riley, Sixth report on the noxious and other insects of the State of Missouri, p. 111, 1874.—Thomas, Sixth report of the State entomologist on the noxious and beneficial insects of the State of Illinois, 1876, p. 40, 1877.—Perkins, 4th Rep. Vermont Board Agr., p. 146, 1877.—Bruner, Rep. Nebraska Hort. Soc., 1891, p. 196.

Sesia flavipes Hulst, Bull. Brooklyn Ent. Soc., vol. 3, p. 76, 1881.

Albuna odyneripennis Grote, New check list of North American moths, p. 12, 1882.

Bembecia marginata Hy. Edwards, Papilio, vol. 2, p. 52, 1882.—Riley, Amer. Nat., vol. 17, p. 792, 1883.—Saunders, Insects injurious to fruits, p. 303, 1883.—Lintner, New England Homestead, vol. 20, p. 189, 1886.—Beutenmüller, Ann. New York Acad. Sci., vol. 5, p. 204, 1890; Bull. Amer. Mus. Nat. Hist., vol. 5, p. 22, 1893; vol. 8, p. 118, 1896; vol. 9, p. 218, 1897; Mem. Amer. Mus. Nat.

Hist., vol. 1, pt. 6, p. 260, pl. 29, fig. 14 (female), 1901.—Smith, 12th Ann. Rep. New Jersey Agr. Exp. Stat., 1891, pp. 378–381, figs., 1892; Insect Life, vol. 4, p. 29, 1892.—Kellicott, Journ. Columbus Hort. Soc., vol. 5, p. 27, 1890; Can. Ent., vol. 24, p. 44, 1892.—Fletcher, Ent. Rep. Canada Dept. Agr., 1895, p. 149, 1896.—Lugger, 4th Ann. Rep. Entomologist State Agr. Exp. Stat. Univ. Minnesota, 1898, pp. 54–55, 1899.—McDunnough, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8684, 1939.

Bembecia flavipes Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 171, 1892.

Bembecia pleciaeformis Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 23, 1893.

Male.—Antennae black, bipectinate, more or less appressed, not tufted at tips. Labial palpus rough, yellow. Head brown-black, orbits yellow; occipital fringe whitish. Collar black. Thorax brown-black marked with yellow; a small patch on the side, a thin lateral stripe below the collar, a subcircular ring from above forewing to metathorax, sometimes in a broken line, a spot at base of forewing above and another anteriorly beneath yellow. Metathorax laterally tufted with yellow and with yellow hair pencils at the sides beneath. Abdomen brown-black, broadly banded with yellow on posterior part of all segments above and beneath; segment 3 elevated on top with yellow and black hair mixed; anal tuft short, rounded, black and yellow mixed. Legs yellow, rough, femora and tibiae of hindlegs marked or not marked with black outwardly; first joint of posterior tarsus thickened with scales. Forewing transparent, broadly bordered and margined with brown, brighter inside; discal mark bright brown; fringes dark brown; beneath shaded with yellow basally; costa and discal mark black. Hindwing transparent, narrowly margined and fringed with brown-black.

Female.—Antennae simple, strong, not tufted at tips. Larger and stouter than the male. Last or two last abdominal segments usually entirely yellow or slightly mixed with black; anal tuft inconspicuous.

Expanse: Male 22 to 28 mm., female 24 to 34 mm.

Distribution.— United States, Canada, British Columbia.

Type.—Female. In the Boston Society of Natural History.

Remarks.—This insect is of considerable importance as a borer in species of *Rubus,* blackberries and raspberries, both wild and cultivated. Its distribution in North America north of Mexico is general wherever suitable food plants occur. The moths appear during August and September and are active fliers on sunny days about brambles, but they are difficult to distinguish from common yellow jackets, which they resemble closely. The roundish, brown eggs are laid singly on the canes of the food plant near the ground. The young larvae bore into the roots, wintering there in various stages of growth. Nearing full growth during the summer of the year following, they usually ascend into the canes, which they girdle a few inches above the surface of the ground, causing them to wilt or break. Pupation then takes place within the hollow stump. The pupa is provided with a triangular, sharp-pointed, chisellike process,

used in emerging by cutting through the bark. Except for the pale color variety *albicoma* of the Eastern States, the species runs true to type throughout its transcontinental range. Its depredations on cultivated blackberries and raspberries have been particularly serious in the coastal areas of the Northwestern States.

The European species, *Bembecia hylaeiformis* (Laspeyres), is a near relative, with similar food plants and habits. However, the European species is said to fly at night, but the North American species is not known to do so.

The color variety *albicoma* is found occasionally in the Atlantic Coast States associated with typical *marginata*. The only examples in the United States National Museum are males. They are from Pittsburgh, Pa., August 24, 1905 (Henry Engel), and Woodhaven, Long Island, N. Y., September 8, 1919 (Engelhardt).

BEMBECIA MARGINATA variety ALBICOMA Hulst

Bembecia marginata var. *albicoma* Hulst, Bull. Brooklyn Ent. Soc., vol. 6, p. 10, 1883.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 23, 1893; vol. 8, p. 119, 1896; Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 262, 1901.

Male.—Differs from typical *marginata* only in having the yellow markings replaced by pale straw color or white. This variation is more frequent in males than in females.

Distribution.—Eastern United States.

Type.—Male. In the American Museum of Natural History.

THE ZENODOXUS GROUP

Genus ZENODOXUS Grote and Robinson

Zenodoxus Grote and Robinson, Trans. Amer. Ent. Soc., vol. 2, p. 183, 1868. (Genotype, *Zenodoxus maculipes* Grote and Robinson.)

Antenna of the male thin, strongly biciliate, tapering toward apex, apex without hair tuft; female antenna shortly ciliate. Tongue rudmentary. Labial palpus short, porrect, somewhat flattened, roughly and heavily scaled, scales projecting above the tip. Head and thorax smooth. Forewing narrow, with 12 veins; veins 2 and 3 connate or stalked, the rest separate, 7 and 8 separate, 7 to costa just above apex, 8, 9, 10, and 11 well separated, parallel. Hindwing with 8 veins, all separate, vein 3 nearer to 2 than to 4, veins 7 and 8 obscured in the costal fold. Posterior tibia smooth with strong, rough tufts at spurs. First joint of posterior tarsus thickened with rough scaling. Anal tuft in both sexes short, rounded. Male genitalia very uniform in the species included in the genus, giving but slight help in specific differentiation; uncus (or uncus and socii united) short, upright, slightly divided at tip, with sparse single unspecialized hairs; ventral plate straight, narrow; harpe short, quadrangular with costal and dorsal edges parallel, terminal edge slightly curved and more or less oblique; vinculum with a short rounded anterior

process; aedeagus long, slender, straight or nearly so. Female genitalia with ductus short, slightly sclerotized below ostium and in most of the species with a circle of short, longitudinal rods of sclerotization before the small, round bursa.

A very distinct genus, not closely related to any other American genus, comprising a group of species with identical venation and very similar genitalia in both sexes. Because the species are exceedingly variable in color and size, their differentiation is difficult and some of the applied names may eventually prove to denote merely geographical races. All the North American species, of which the food plants are known, are borers in the roots and basal stalks of mallows.

ZENODOXUS MACULIPES Grote and Robinson

PLATE 3, FIGURE 25; PLATE 12, FIGURE 56; PLATE 16, FIGURE 86; PLATE 32, FIGURE 180

Zenodoxus maculipes GROTE and ROBINSON, Trans. Amer. Ent. Soc., vol. 2, p. 184. 1868.—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 148, 1896.—MCDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8783, 1939.

Paranthrene maculipes BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 315, 1901.

Male.—Antennae brown, slender, not dilated, finely and broadly bipectinate. Labial palpus rough, sordid white basally, buff on third joint and above. Head brownish, black on top, occipital fringe pale straw-colored. Thorax bronzy brown, with some yellow scales at and beneath base of forewing; brownish-yellow lateral tufts on posterior parts. Abdomen hairy, rusty grayish brown; first and fourth segments banded with buff above; apical segments grayer than anterior ones, all segments each with a narrow black posterior edge; anal tuft short, subcircular, gray and black mixed. Legs rusty dark brown, posterior tibiae buff between long, strong spurs; first tarsal joint thickened. Forewing opaque, bronzy, darker along costa and cubitus; costa beneath straw-colored. Hindwing opaque, bronzy brown, somewhat paler beneath.

Female.—Antennae simple, slender, brownish. Thorax and abdomen heavily covered with chestnut-brown scales; first and fourth segments banded with buff, segment 6 banded with buff and black mixed; anal tuft short, blunt, chestnut-brown. Otherwise like the male.

Expanse: Male and female 20 to 24 mm.

Distribution.—Kansas, Oklahoma, Texas.

Type.—Male, in the American Museum of Natural History.

ZENODOXUS WISSADULAE, new species

PLATE 32, FIGURE 181

Male.—Antennae brown with black ciliation. Labial palpus yellowish red. Head and thorax dark brown. Collar yellow. Forewing opaque,

dark bluish brown with base yellowish red. Hindwing opaque bluish brown, with yellowish base. Abdomen dark purplish brown, with narrow yellow bands on segments 1, 4, and 5 and with anal tuft yellow mixed with black scales. Hindlegs light yellow with brick red tufts at spurs. Male genitalia with terminal edge of harpes more nearly straight and more oblique than in the other described species.

Female.—Like the male except that it has one more abdominal segment, the sixth, banded with yellow.

Expanse: Male 18 to 20 mm., female 20 to 23 mm.

Distribution.—Brownsville, Tex.

Food plant.—Wissadula lozanii.

Type.—U.S.N.M. No. 56854. From Brownsville, Tex.

Remarks.—Described from male type, female allotype, 6 male and 5 female paratypes, reared by the late Emerson Liscum Diven, a promising young student of entomology who lost his life in the fall of an airplane near the Mexican border while he was on an official survey for the United States Department of Agriculture.

ZENODOXUS SIDALCEAE, new species

PLATE 32, FIGURES 182, 183

Male.—Antennae blackish with narrow yellow annulations. Labial palpi roughly tufted with white, black and yellow scales. Head bluish black. Collar yellow. Thorax bluish black, overlaid with thin, long, soft, yellow, hairlike scales protruding behind the thorax. Forewing bluish black, overlaid, especially on the cell and at termen, with brick-red and yellowish scales. Hindwing thinly scaled with red; veins black. Abdomen bluish black, thinly overlaid with reddish scales and with first, fourth, sixth, and seventh joints banded with yellow. Posterior tibiae light yellow, strongly tufted with black at spurs; first joint of posterior tarsus reddish yellow, tufted at tip with stiff, black scales; the other tarsal joints light yellow. Male genitalia typical of the genus; ventral plate proportionally slightly broader than in the allied species; terminal edge of harpe slightly rounded, nearly perpendicular to the parallel costal and sacculus edges.

Female.—With the yellow scaling of the male on thorax, abdomen, and especially on the legs largely supplanted by bright purplish red, with the exception of the abdominal bands, which are yellow as in the male.

Expanse: Male 13 to 14 mm., female 17 to 18 mm.

Distribution.—Washington, Oregon, Idaho, Wyoming.

Food plant.—Sidalcea nervata.

Type.—U.S.N.M. No. 56855.

Remarks.—Described from male type, female, allotype, 5 male and 4 female paratypes from Pullman, Wash., and reared by J. F. Gates Clarke;

1 male and 4 female reared paratypes from Bakersville, Oreg. (Engelhardt).

ZENODOXUS HEUCHERAE Hy. Edwards

Zenodoxus heucherae Hy. Edwards, Papilio, vol. 1, p. 205, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 148, 1896.—McDunnough, Check list of the Lepidoptera of Canada and of the United States of America, pt. 2, No. 8784, 1939.

Zenodoxus potentillae Hy. Edwards, Papilio, vol. 1, p. 205, 1881.—Beutenmüller, Bull. Amer. Mus. Nat. Hist. vol. 4, p. 175, 1892; vol. 8, p. 148, 1896.

Paranthrene heucherae Beutenmüller, Mem. Amer. Mus. Nat. Hist. vol. 1, pt. 6, p. 315, pl. 32, fig. 14, 1901.

Labial palpus yellow, with terminal joint mottled with black; head and thorax golden brown; collar pale yellow; abdomen with second and last four joints broadly pale yellow and the intermediate joints mottled with yellow scales. Forewing golden bronze, blackish at base. Hindwing opaque, bronzy brown; underside golden yellow. Legs black with yellow bands.

Expanse: 18 to 24 mm.

Distribution.—Lake Tahoe, Calif. Moths frequent flowers of *Heuchera rubescens.*

Type.—Known only from the types and paratypes of *Z. heucherae* and *Z. potentillae,* 2 males and 3 females, in the American Museum of Natural History.

ZENODOXUS PALMII (Neumoegen)

Plate 12, Figures 57, 57a; Plate 16, Figure 87

Larunda palmii Neumoegen, Ent. News, vol. 2, p. 108, 1891.

Zenodoxus palmii Beutenmüller, Bull. Amer. Mus. Nat. Hist., vol. 8, p. 148, 1896.

Paranthrene palmii Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 316, pl. 32, fig. 15, 1901.

Paranthrene palmiana Dalla Torre, Lepidopterorum catalogus, pt. 31, Aegeriidae, p. 160, 1925.

Zenodoxus palmi McDunnough, Check list of the Lepidoptera of Canada and of the United States of America, pt. 2, No. 8785, 1939.

Male.—Antennae slightly pectinate. Palpi light red. Head black, collar yellow. Thorax black, overcast with red. Abdomen yellow, with first and fourth segments black[4] and anal tuft red; venter of abdomen yellow, dusted with red. Legs brownish red; fringes black. Forewing slender, of a reddish tinge overcast with black, especially along costa, apical space and exterior margin. Hindwing about one-third broader than forewing, bright red; basal half hyaline; black shades at apex, exterior margin and anal angle. Underside of forewing black, shading into red at base, costa and exterior margin; of hindwing red, hyaline basally, nervures and fringes black.

[4] It is evident from the type specimens that Neumoegen had these two color words transposed in his manuscript.

Female.—Antennae slender, simple; much larger than the male and wings not so disproportionate in width. Forewing and hindwing both bright red; costa and exterior margins conspicuously black, with black areas at apex and anal angle of hindwing; underside of forewing with a large part of inner space black; costa and margins bright red; underside of hindwing with black nervures.

Alar expanse: Male 25 mm., female 27 mm.

Distribution.—South Arizona.

Type.—Male. In the United States National Museum, together with large series of both sexes reared from rootstocks of *Sphaeralcea ambigua* at Zion City, Utah (J. F. Gates Clarke), and Superior, Ariz. (G. P. Engelhardt).

ZENODOXUS PALMII SPHAERALCEAE, new race

PLATE 32, FIGURE 184

Very similar in size and coloration to typical *Zenodoxus palmii* but with the red coloration of the wings largely supplanted by yellow and with the blackish parts less conspicuous.

Distribution.—Eastern Washington. Reared from rootstalks of *Sphaeralcea munroana* (J. F. Gates Clarke, Aug. and Sept.).

Type.—U.S.N.M. No. 56856. From Snake River, Whitman County, Wash., opposite Clarkson.

Remarks.—Described from male type, allotype, and male paratype from the type locality; 4 male and 2 female paratypes from Pullman, Wash.; 2 male and 1 female paratypes from Hooper, Wash.; and 2 male and 1 female paratypes from Boardman, on the Columbia River, Wash.

ZENODOXUS PALMII INCANAE, new race

PLATE 32, FIGURE 185

Male.—Antennae yellowish, with black ciliation. Labial palpi reddish yellow. Face and head white. Collar yellow. Thorax bluish black, with posterior tip yellow and with two narrow, longitudinal yellow streaks. Abdomen light yellow, slightly overlaid with light reddish brown and with each joint margined posteriorly with a narrow bluish-black line. Forewing light yellow, heavily shaded with black on costal half. Hindwing translucent, sparsely speckled with black scales; basal half of dorsal edge brick red. Legs yellow, with reddish tufts at spurs.

Female.—Like male except thorax heavily overlaid with yellow; abdomen with black transverse lines still narrower and less conspicuous, and nearly absent in some specimens; hindwings not translucent, largely brick-red, except for the blackish costa and a small yellow spot at tornus.

Alar expanse: Male 22 to 25 mm., female 23 to 30 mm.

Type.—U.S.N.M. No. 56857. From Yuma, Ariz.

Food plant.—*Sphaeralcea incana.*

Remarks.—Described from male type, female allotype, 6 male and 13 female paratypes from the type locality (J. L. Lauderdale and G. P. Engelhardt).

ZENODOXUS CANESCENS CANESCENS Hy. Edwards

PLATE 32, FIGURE 186

Zenodoxus canescens HY. EDWARDS, Papilio, vol. 1, p. 205, 1881.—BEUTENMÜLLER, Bull Amer. Mus. Nat. Hist., vol. 4, p. 175, 1892; vol. 8, p. 148, 1896.—McDUNNOUGH, Check list of the Lepidoptera of Canada and the United States of America, pt. 2, No. 8786, 1939.

Paranthrene canescens BEUTENMÜLLER, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 316, 1901.

Male.—Antennae whitish, with dark-gray ciliation. Labial palpi white, sprinkled with black scales. Face white, mixed with black. Crown of head black. Collar whitish. Thorax black overlaid with long, hairlike, whitish scales, extending beyond the posterior edge. Abdomen yellowish gray, slightly sprinkled with single black scales; anal tuft yellowish gray. Forewing whitish gray, overlaid with blackish-brown scales, especially along the costa; cilia of dark gray, white-tipped scales. Hindwing translucent, except along costal and anal edges, which are dark gray, as are the veins and the cilia. Legs pepper-and-salt colored with tufts on posterior tibiae above the spurs light yellow.

Female.—Very different from the male and not hitherto described Labial palpi white. Head, thorax, and abdomen pepper-and-salt colored with a very slight sprinkling of small reddish scales. Forewing blackish brown, sprinkled with white scales; a small, nearly triangular area from end of cell to termen white, faintly tinged with rose; cilia dark brown, tipped with white. Hindwing vivid brick red with dark brown, white-tipped cilia. Posterior tibiae and tarsi tinged with red.

Alar expanse: Male 20 to 25 mm., female 17 to 21 mm.

Distribution.—Turkey Creek Canyon, Platte Canyon, Chimney Gulch, Colo. (Oslar); Buffalo Valley County, S. Dak. (W. H. Ouer); Snowden. Mont. (C. N. Ainsley); Kansas; Wyoming. September.

Type.—Male. In the American Museum of Natural History.

Remarks.—The relatively smaller size of the female in this and the following three races and species is very exceptional in the family.

ZENODOXUS CANESCENS SIDAE, new race

Male.—Labial palpi white sprinkled with black. Forewing darker than in typical *canescens* with the whitish, triangular area obscured with black scaling. Hindwing darker, deeper red; cilia black, white-tipped; anal cilia white.

Alar expanse: Male 18 to 23 mm., female 17 to 20 mm.

Foot plant.—*Sida hederacea* (alkali-mallow).

Type.—U.S.N.M. No. 56858. From Blythe, Riverside County, Calif. (C. Dammers).

Remarks.—Described from holotype male, allotype female, and a series of 35 male and 5 female paratypes, in United States National Museum, reared by Commander Dammers from the rootstocks of *Sida hederacea.*

ZENODOXUS CANESCENS BEXARI, new race

Male.—Antennae whitish, with ciliation nearly black. Labial palpi whitish sprinkled with black. Head, thorax, and abdomen blackish brown, sprinkled sparsely with red scales. Anal tuft reddish. Forewing blackish brown with a purple sheen, slightly lighter before apex. Hindwing translucent on cell; costa and apical and terminal borders broad, dark brown; anal edge brick red and veins touched with red; cilia dark brown, tipped with white. Legs brown mixed with red.

Female.—Like male except the hindwings not translucent but brick red, slightly dusted with black and the cilia blackish brown tipped with red.

Alar expanse: Male 17 to 20 mm., female 14 mm.

Distribution.—Bexar County and San Antonio, Tex., (H. B. Parks, collector).

Type.—Male. U.S.N.M. No. 56859. From Bexar County, Tex. Described from one female and two males in imperfect condition.

ZENODOXUS RUBENS, new species

PLATE 32, FIGURE 187

Male.—Antennae yellowish, with black annulations; ciliation and underside black. Labial palpi yellowish red, mottled with black. Face and head blackish brown, mottled with red. Collar red. Thorax blackish brown, with the long overlaid hair scales red. Abdomen reddish, mixed with black; and with narrow black annulations; anal tuft red. Forewing blackish brown sparsely sprinkled with yellow and red scales and with a triangular area along termen whitish strongly overlaid with red. Hindwing vivid dark brick red with the edges broadly blackish brown. Cilia dark brown tipped with white.

Female.—Like the male, except that the red hindwings are not bordered with blackish brown along the edges.

Alar expanse: Male 18 to 20 mm., female 14 to 19 mm.

Distribution.—Davis Mountains, Jeff Davis County, Tex. (O. C. Poling); Globe, Ariz. (Parker).

Type.—U.S.N.M. No. 56860.

Remarks.—Described from male holotype, female allotype, 4 male and 3 female paratypes from Davis Mountains, and one male paratype from Globe, Ariz. The only known species with red hindwings in both sexes.

ZENODOXUS MEXICANUS Beutenmüller

Zenodoxus mexicanus BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 9, p. 216, 1897.

Paranthrene mexicanus Beutenmüller, Mem. Amer. Mus. Nat. Hist., vol. 1, pt. 6, p. 316, pl. 32, fig. 12, 1901.

"*Male*.—Head black; palpus and collar white. Thorax black; patagia tipped with white. Abdomen black with a white band on the second and the last four segments. Anal tuft black. Legs black with white bands. Forewings brown-black, white between the veins on the outer part. Hindwings black. Underside of all wings same as upper." (Beutenmüller.)

Expanse: 12 mm.

Distribution.—New Mexico.

Type.—In the American Museum of Natural History. The species is known only from the unique type specimen.

EXPLANATION OF PLATES

Plate 1

Wing Venation

1. *Sannina uroceriformis* Walker. Genotype.
1a. Schematic cross section of the edges of the fore- and hindwings of an aegeriid, showing the locking device of the wings.
2. *Sanninoidea exitiosa exitiosa* (Say). Genotype.
3. *Penstemonia edwardsii* (Beutenmüller). Genotype.
4. *Ramosia bibionipennis* (Boisduval). Genotype.
5. *Carmenta pyralidiformis* (Walker). Genotype.
6. *Sylvora acerni* (Clemens). Genotype.
7. *Conopia myopiformis* (Borkhausen). Genotype.
8. *Synanthedon vespiformis* (Linnaeus). Genotype.
9. *Hymenoclea palmi* (Beutenmüller). Genotype.

Plate 2

Wing Venation

10. *Alcathoe caudata caudata* (Harris). Genotype.
11. *Podosesia syringae syringae* (Harris). Genotype.
12. *Thamnosphecia culiciformis* (Linnaeus). Genotype.
13. *Vespamima sequoiae* (Hy. Edwards). Genotype.
14. *Signaphora ruficornis* (Hy. Edwards). Genotype.
15. *Calasesia coccinea* (Beutenmüller). Genotype.
16. *Cissuvora ampelopsis,* new species. Genotype.
17. *Paranthrene tabaniformis* (Rottemburg). Genotype.
18. *Vitacea polistiformis polistiformis* (Harris). Genotype.
19. *Gaëa solituda* (Hy. Edwards). Genotype.
20. *Albuna pyramidalis* (Walker). Genotype.
21. *Euhagena nebraskae nebraskae* Hy. Edwards. Genotype.

Plate 3

Wing Venation and Genitalia

22. *Aegeria apiformis* (Clerck). Genotype.
23. *Melittia cucurbitae* (Harris).
24. *Bembecia hylaeiformis* (Laspeyres). Genotype.
25. *Zenodoxus maculipes* Grote and Robinson. Genotype.
26. *Conopia myopiformis* (Borkhausen): Male genitalia. Genotype.
27. *Conopia myopiformis* (Borkhausen): Female genitalia. Genotype.

Plate 4

Male Genitalia

28. *Sannina uroceriformis* Walker.
28a. *Sannina uroceriformis* Walker: Aedeagus.
29. *Sanninoidea exitiosa exitiosa* (Say).
29a. *Sanninoidea exitiosa exitiosa* (Say): Aedeagus.
30. *Penstemonia edwardsii* (Beutenmüller).
30a. *Penstemonia edwardsii* (Beutenmüller): Aedeagus.

PLATE 5

Male Genitalia

31. *Ramosia bibionipennis* (Boisduval).
31*a*. *Ramosia bibionipennis* (Boisduval): Aedeagus.
32. *Carmenta pyralidiformis* (Walker).
32*a*. *Carmenta pyralidiformis* (Walker): Aedeagus.
33. *Carmenta prosopis* (Hy. Edwards).
33*a*. *Carmenta prosopis* (Hy. Edwards): Aedeagus.
34. *Sylvora acerni* (Clemens).

PLATE 6

Male Genitalia

35. *Synanthedon vespiformis* (Linnaeus).
35*a*. *Synanthedon vespiformis* (Linnaeus): Aedeagus.
36. *Hymenoclea palmi* (Beutenmüller).
36*a*. *Hymenoclea palmi* (Beutenmüller): Aedeagus.
37. *Alcathoe caudata caudata* (Harris).
37*a*. *Alcathoe caudata caudata* (Harris): Side view.

PLATE 7

Male Genitalia

38. *Podosesia syringae syringae* (Harris).
38*a*. *Podosesia syringae syringae* (Harris): Aedeagus.
38*b*. *Podosesia syringae syringae* (Harris): Modification of tip of vinculum.
39. *Thamnosphecia culiciformis* (Linnaeus).
39*a*. *Thamnosphecia culiciformis* (Linnaeus): Aedeagus.
40. *Thamnosphecia refulgens refulgens* (Hy. Edwards).
40*a*. *Thamnosphecia refulgens refulgens* (Hy. Edwards): Aedeagus.

PLATE 8

Male Genitalia

41. *Thamnosphecia scitula scitula* (Harris).
41*a*. *Thamnosphecia scitula scitula* (Harris): Aedeagus.
42. *Thamnosphecia rubrofascia* (Hy. Edwards).
42*a*. *Thamnosphecia rubrofascia* (Hy. Edwards): Aedeagus.
43. *Thamnosphecia sigmoidea* (Beutenmüller).
43*a*. *Thamnosphecia sigmoidea* (Beutenmüller): Aedeagus.

PLATE 9

Male Genitalia

44. *Vespamima sequoiae* (Hy. Edwards).
44*a*. *Vespamima sequoiae* (Hy. Edwards): Aedeagus.
45. *Signaphora ruficornis* (Hy. Edwards).
45*a*. *Signaphora ruficornis* (Hy. Edwards): Aedeagus.
46. *Calasesia coccinea* (Beutenmüller).
46*a*. *Calasesia coccinea* (Beutenmüller): Aedeagus and anellus.
47. *Cissuvora ampelopsis*, new species.
47*a*. *Cissuvora ampelopsis*, new species: Aedeagus.

Plate 10

Male Genitalia

48. *Paranthrene tabaniformis* (Rottemburg).
48*a*. *Paranthrene tabaniformis* (Rottemburg): Aedeagus.
49. *Vitacea polistiformis polistiformis* (Harris).
49*a*. *Vitacea polistiformis polistiformis* (Harris): Aedeagus.
50. *Gaëa solituda* (Hy. Edwards).
50*a*. *Gaëa solituda* (Hy. Edwards): Aedeagus.

Plate 11

Male Genitalia

51. *Albuna pyramidalis* (Walker).
51*a*. *Albuna pyramidalis* (Walker): Aedeagus.
52. *Euhagena nebraskae nebraskae* Hy. Edwards.
52*a*. *Euhagena nebraskae nebraskae* Hy. Edwards: Side view.
53. *Aegeria apiformis* (Clerck).
53*a*. *Aegeria apiformis* (Clerck): Aedeagus.

Plate 12

Male Genitalia

54. *Melittia cucurbitae* (Harris).
54*a*. *Melittia cucurbitae* (Harris): Aedeagus.
55. *Bembecia hylaeiformis* (Laspeyres).
55*a*. *Bembecia hylaeiformis* (Laspeyres): Aedeagus.
56. *Zenodoxus maculipes* Grote and Robinson: Side view.
57. *Zenodoxus palmii* (Neumoegen).
57*a*. *Zenodoxus palmii* (Neumoegen): Side view.

Plate 13

Female Genitalia

58. *Sannina uroceriformis* Walker.
59. *Sanninoidea exitiosa exitiosa* (Say).
60. *Penstemonia edwardsii* (Beutenmüller).
61. *Ramosia bibionipennis* (Boisduval).
62. *Carmenta pyralidiformis* (Walker).
63. *Carmenta prosopis* (Hy. Edwards).
64. *Sylvora acerni* (Clemens).
65. *Synanthedon vespiformis* (Linnaeus).

Plate 14

Female Genitalia

66. *Hymenoclea palmi* (Beutenmüller).
67. *Alcathoe caudata caudata* (Harris).
68. *Podosesia syringae syringae* (Harris).
69. *Thamnosphecia culiciformis* (Linnaeus).
70. *Thamnosphecia rubrofascia* (Hy. Edwards).
71. *Thamnosphecia scitula scitula* (Harris).
72. *Thamnosphecia refulgens refulgens* (Hy. Edwards).
73. *Thamnosphecia sigmoidea* (Beutenmüller).

PLATE 15

Female Genitalia

74. *Vespamima sequoiae* (Hy. Edwards).
75. *Signaphora ruficornis* (Hy. Edwards).
76. *Calasesia coccinea* (Beutenmüller).
77. *Cissuvora ampelopsis,* new species.
78. *Paranthrene tabaniformis* (Rottemburg).
79. *Vitacea polistiformis polistiformis* (Harris).
80. *Albuna pyramidalis* (Walker).

PLATE 16

Female Genitalia

81. *Gaëa solituda* (Hy. Edwards).
82. *Euhagena nebraskae nebraskae* Hy. Edwards.
83. *Aegeria apiformis* (Clerck).
84. *Melittia cucurbitae* (Harris).
85. *Bembecia hylaeiformis* (Laspeyres).
86. *Zenodoxus maculipes* Grote and Robinson.
87. *Zenodoxus palmii* (Neumoegen).

PLATE 17

88. *Sanninoidea exitiosa* race *graefi* (Hy. Edwards).
89. *Penstemonia edwardsii* (Beutenmüller): Male.
90. *Penstemonia edwardsii* (Beutenmüller): Female.
91. *Penstemonia hennei,* new species: Male.
92. *Penstemonia hennei,* new species: Female.
93. *Penstemonia clarkei,* new species: Male.
94. *Penstemonia clarkei,* new species: Female.

PLATE 18

95. *Penstemonia dammersi,* new species: Male.
96. *Penstemonia dammersi,* new species: Female.
97. *Penstemonia brevifolia,* new species: Male.
98. *Penstemonia brevifolia,* new species: Female.
99. *Ramosia chrysidipennis wallowa,* new race: Male.
100. *Ramosia chrysidipennis wallowa,* new race: Female.
101. *Ramosia mariona* (Beutenmüller): Male.
102. *Ramosia mariona* (Beutenmüller): Female.

PLATE 19

103. *Ramosia rubricincta* (Beutenmüller): Female.
104. *Ramosia bibionipennis* (Boisduval): Male.
105. *Ramosia resplendens* (Hy. Edwards): Male.
106. *Ramosia resplendens* (Hy. Edwards): Female.
107. *Ramosia arizonensis* (Beutenmüller): Male.
108. *Ramosia rhododendri* (Beutenmüller): Female.
109. *Carmenta pyralidiformis aurantis,* new variety: Female.
110. *Carmenta anthracipennis* (Boisduval): Female.
111. *Carmenta anthracipennis* race *sanborni* Hy. Edwards: Male.

PLATE 20

112. *Carmenta helenis,* new species: Female.
113. *Carmenta phoradendri,* new species: Male.
114. *Carmenta apache,* new species: Female.
115. *Carmenta querci* (Hy. Edwards): Male.
116. *Carmenta querci* (Hy. Edwards): Female.
117. *Carmenta torrancia,* new species: Female.
118. *Carmenta austini,* new species: Male.
119. *Carmenta giliae* (Hy. Edwards): Male.
120. *Carmenta giliae* (Hy. Edwards): Female.

PLATE 21

121. *Carmenta ithacae* (Beutenmüller): Male.
122. *Carmenta ithacae* (Beutenmüller): Female.
123. *Carmenta albociliata* (Engelhardt): Male.
124. *Carmenta albociliata* (Engelhardt): Female.
125. *Carmenta auritincta* (Engelhardt): Male.
126. *Carmenta auritincta* (Engelhardt): Female.
127. *Carmenta corni* (Hy. Edwards): Male.
128. *Carmenta corni* (Hy. Edwards): Female.

PLATE 22

129. *Carmenta ogalala,* new species: Male.
130. *Carmenta suffusata,* new species: Male.
131. *Carmenta verecunda* (Hy. Edwards): Male.
132. *Carmenta verecunda* (Hy. Edwards): Female.
133. *Sylvora acerni buscki,* new race: Female.
134. *Sylvora acerni tepperi* (Hy. Edwards): Female.
135. *Conopia richardsi,* new species: Female.
136. *Synanthedon decipiens decipiens* (Hy. Edwards): Male.
137. *Synanthedon decipiens decipiens* (Hy. Edwards): Female.

PLATE 23

138. *Synanthedon pictipes* (Grote and Robinson): Male.
139. *Synanthedon pictipes* (Grote and Robinson): Female.
140. *Synanthedon castaneae* (Busck): Male. } [Specific name mis-
141. *Synanthedon castaneae* (Busck): Female. } spelled on plate.]
142. *Synanthedon viburni* Engelhardt: Female.
143. *Hymenoclea palmi* (Beutenmüller): Male.
144. *Hymenoclea palmi* (Beutenmüller): Female.

PLATE 24

145. *Alcathoe caudata annettella,* new race: Female.
146. *Alcathoe pepsioides* Engelhardt: Male.
147. *Alcathoe pepsioides atra* Engelhardt: Male.
148. *Alcathoe pepsioides ferrugata,* new race: Female.

PLATE 25

149. *Alcathoe autumnalis,* new species: Male.
150. *Alcathoe verrugo verrugo* (Druce): Male.
151. *Alcathoe verrugo corvinus,* new variety: Male.
152. *Thamnosphecia scitula scitula* (Harris): Female.
153. *Thamnosphecia scitula corusca* (Hy. Edwards): Male.

PLATE 26

154. *Thamnosphecia pyri* (Harris): Female.
155. *Thamnosphecia rubrofascia* (Hy. Edwards): Male.
156. *Thamnosphecia rubrofascia* (Hy. Edwards): Female.
157. *Thamnosphecia alleri,* new species: Male.
158. *Cissuvora ampelopsis,* new species: Female.
159. *Paranthrene tricincta oslari,* new form: Male.
160. *Paranthrene dollii fasciventris,* new form: Female.

PLATE 27

161. *Paranthrene robiniae perlucida* (Busck): Male.
162. *Paranthrene robiniae palescens,* new form: Male.
163. *Paranthrene simulans simulans* (Grote): Male.
164. *Paranthrene simulans luggeri* (Hy. Edwards): Male.
165. *Paranthrene palmii* (Hy. Edwards): Female.

PLATE 28

166. *Paranthrene fenestrata* Barnes and Lindsey: Female.
167. *Vitacea polistiformis huron,* new form: Male.
168. *Gaëa emphytiformis* (Walker): Female.

PLATE 29

169. *Euhagena nebraskae nebraskae* Hy. Edwards: Male.
170. *Euhagena nebraskae nebraskae* Hy. Edwards: Female.
171. *Euhagena nebraskae mormoni,* new form: Male.
172. *Euhagena nebraskae intensa,* new form: Female.
173. *Euhagena hirsuta,* new species: Male.

PLATE 30

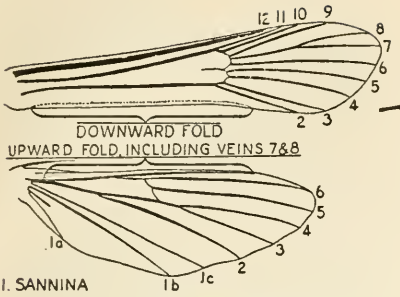
174. *Aegeria tibialis melanoformis,* new variety: Male.
175. *Aegeria tibialis pacifica* (Hy. Edwards): Male.
176. *Aegeria tibialis pacifica* (Hy. Edwards): Female.

PLATE 31

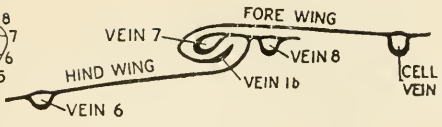
177. *Melittia grandis hermosa,* new variety: Female.
178. *Melittia gloriosa* Hy. Edwards: Male.
179. *Melittia gloriosa* Hy. Edwards: Female.

PLATE 32

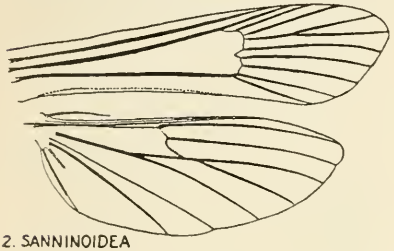
180. *Zenodoxus maculipes* Grote and Robinson: Female.
181. *Zenodoxus wissadulae,* new species: Male.
182. *Zenodoxus sidalceae,* new species: Male.
183. *Zenodoxus sidalceae,* new species: Female.
184. *Zenodoxus palmii sphaeralceae,* new race: Male.
185. *Zenodoxus palmii incanae,* new race: Female.
186. *Zenodoxus canescens canescens* Hy. Edwards: Female.
187. *Zenodoxus rubens,* new species: Male.



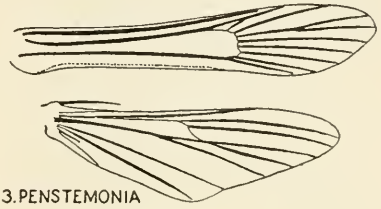
1. SANNINA



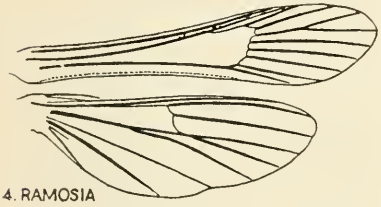
1a. SCHEMATIC CROSS SECTION OF THE EDGES OF FORE AND HIND WINGS OF AN AEGERIID, SHOWING THE LOCKING DEVISE OF THE WINGS.



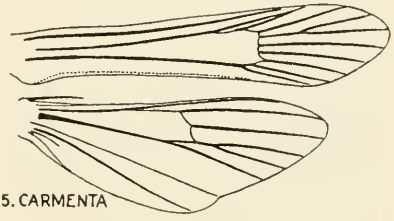
2. SANNINOIDEA



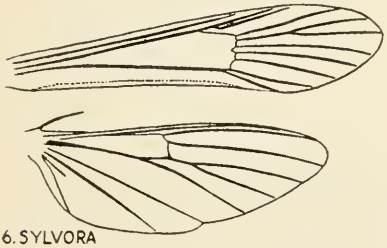
3. PENSTEMONIA



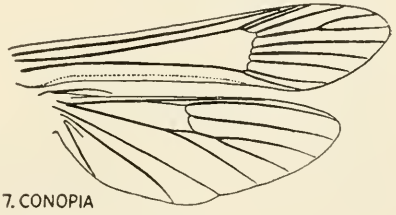
4. RAMOSIA



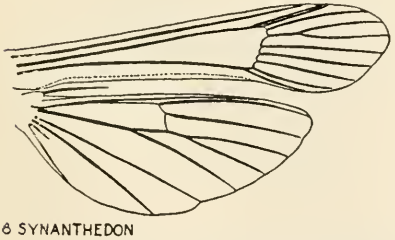
5. CARMENTA



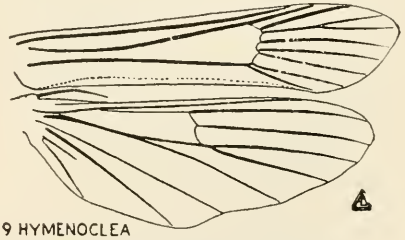
6. SYLVORA



7. CONOPIA



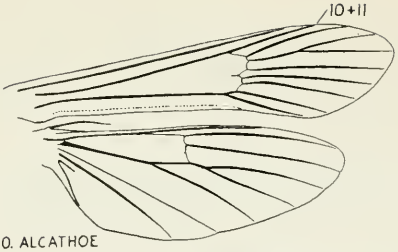
8 SYNANTHEDON



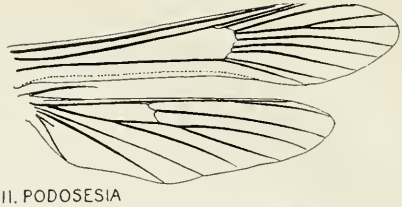
9 HYMENOCLEA

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: WING VENATION

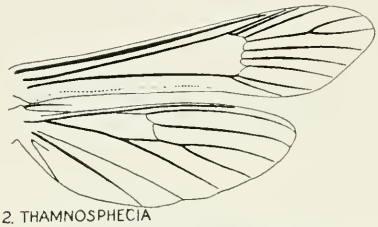
(SEE EXPLANATION OF PLATES)



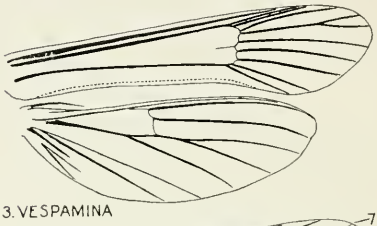
10. ALCATHOE



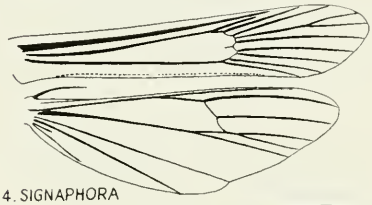
11. PODOSESIA



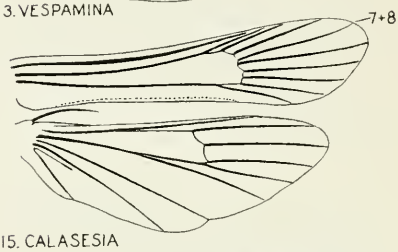
12. THAMNOSPHECIA



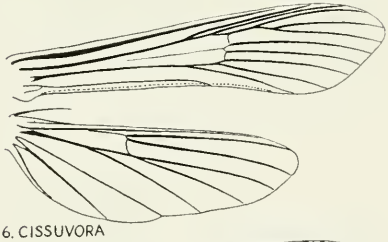
13. VESPAMINA



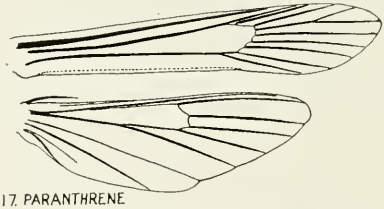
14. SIGNAPHORA



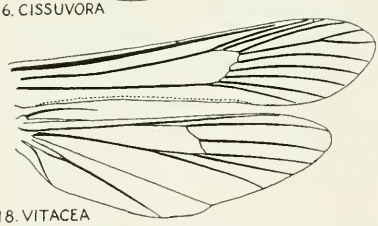
15. CALASESIA



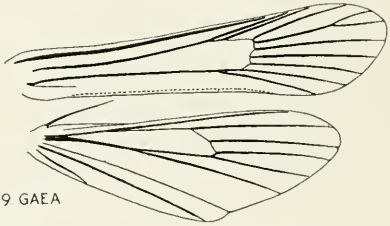
16. CISSUVORA



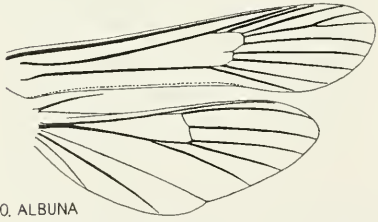
17. PARANTHRENE



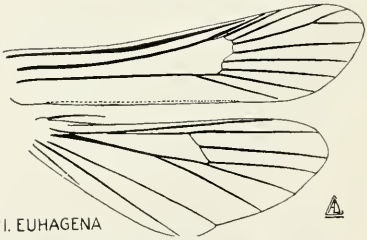
18. VITACEA



19. GAEA



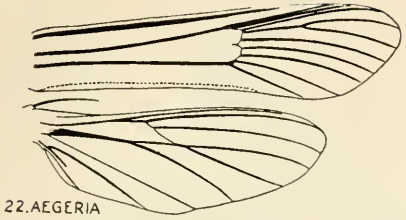
20. ALBUNA



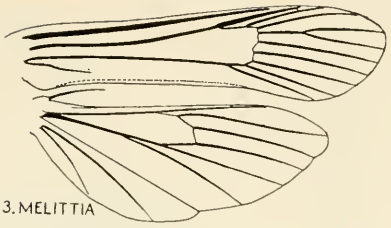
21. EUHAGENA

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: WING VENATION

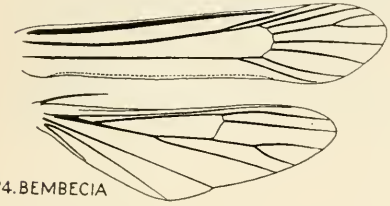
(SEE EXPLANATION OF PLATES)



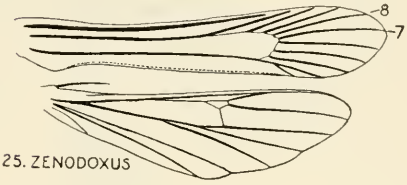
22. AEGERIA



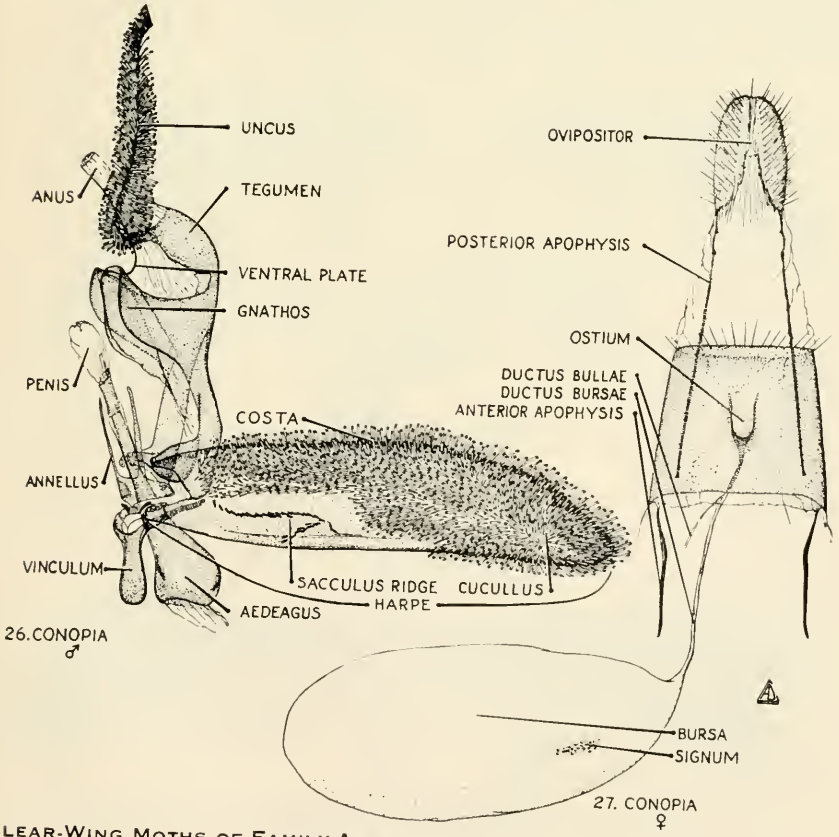
23. MELITTIA



24. BEMBECIA

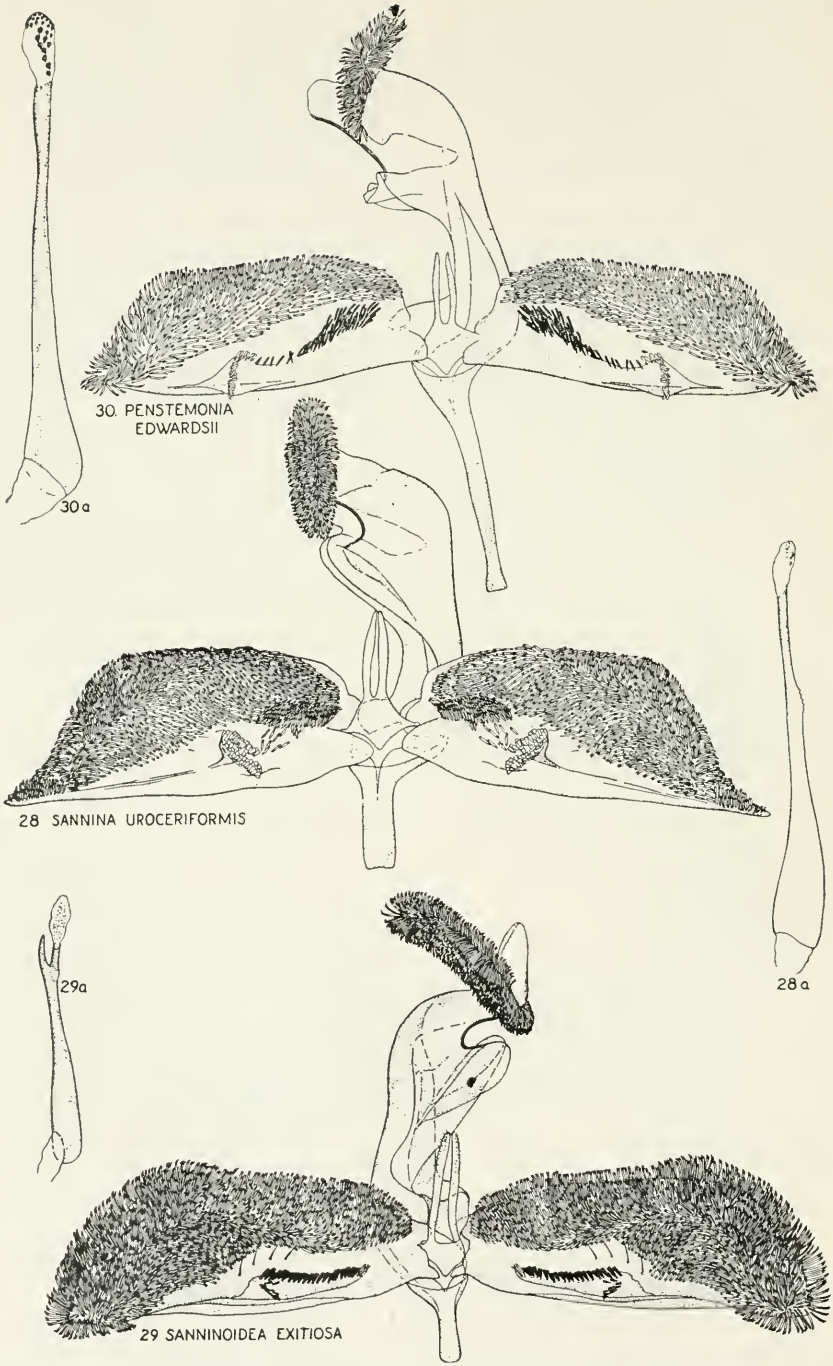


25. ZENODOXUS



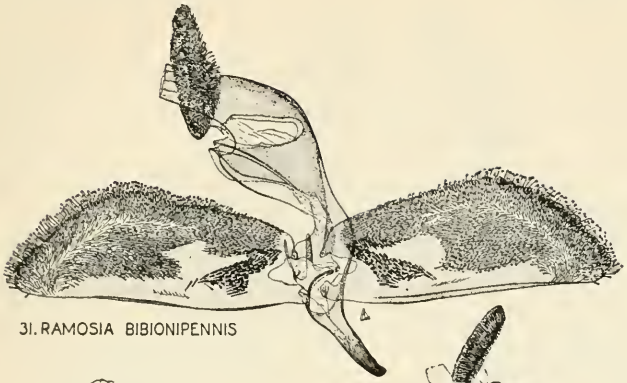
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: WING VENATION AND GENITALIA

(SEE EXPLANATION OF PLATES)



CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

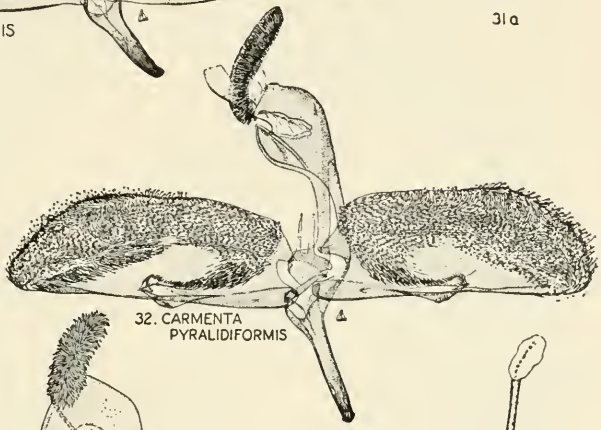
(SEE EXPLANATION OF PLATES)



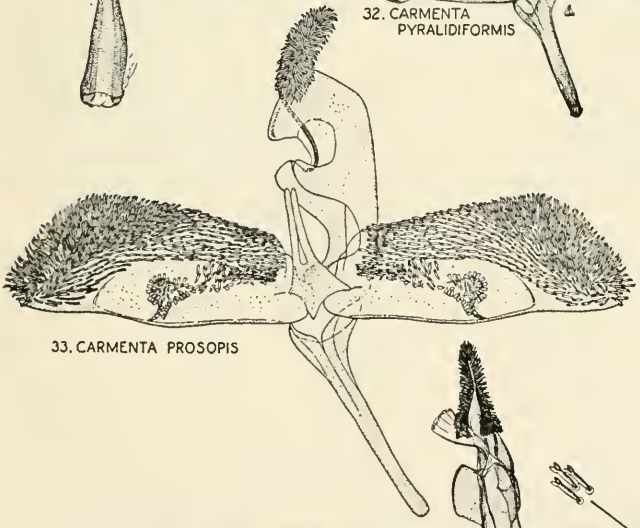
31. RAMOSIA BIBIONIPENNIS

31a

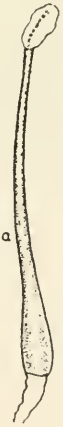
32a



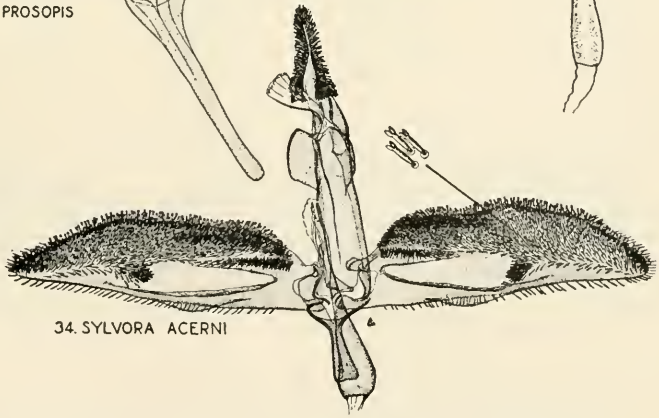
32. CARMENTA PYRALIDIFORMIS



33. CARMENTA PROSOPIS



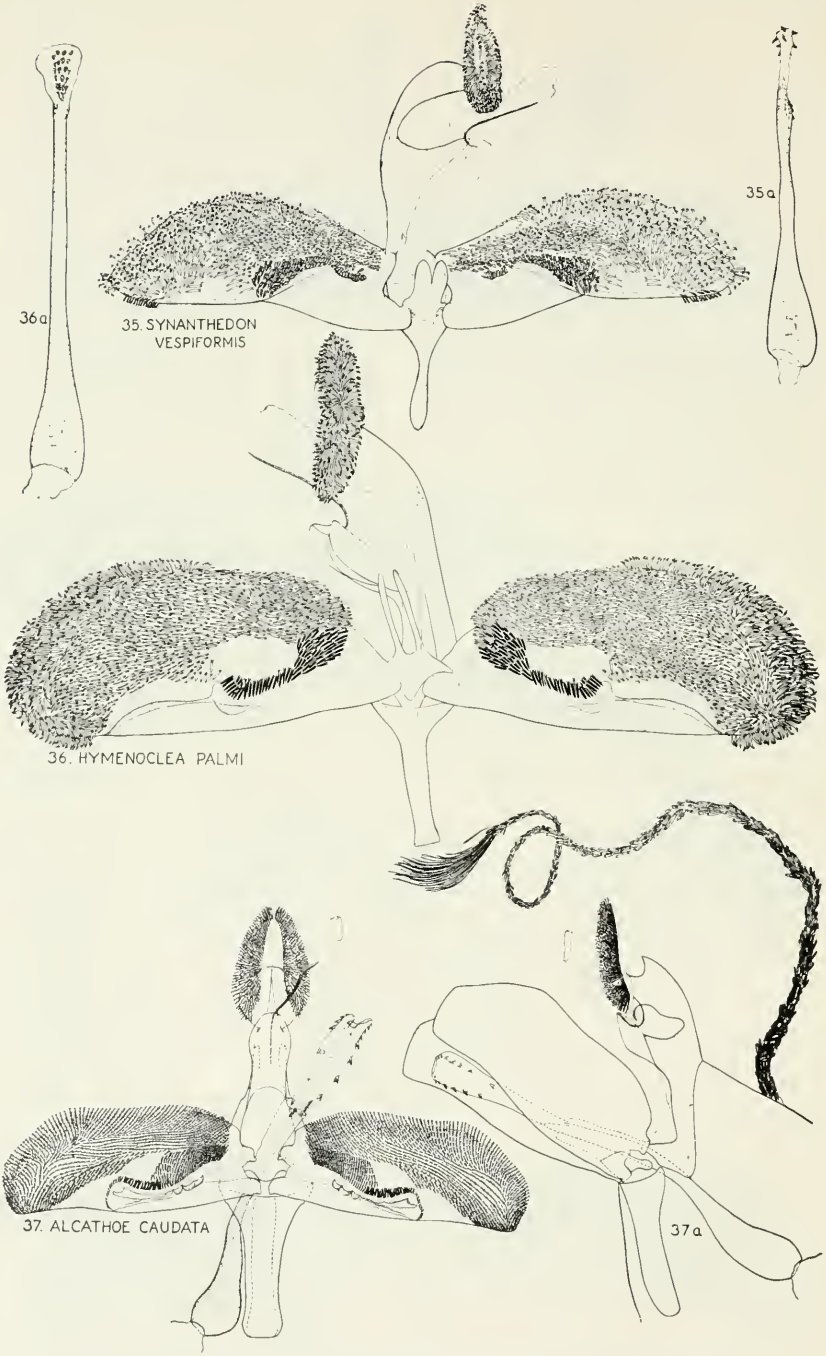
33a



34. SYLVORA ACERNI

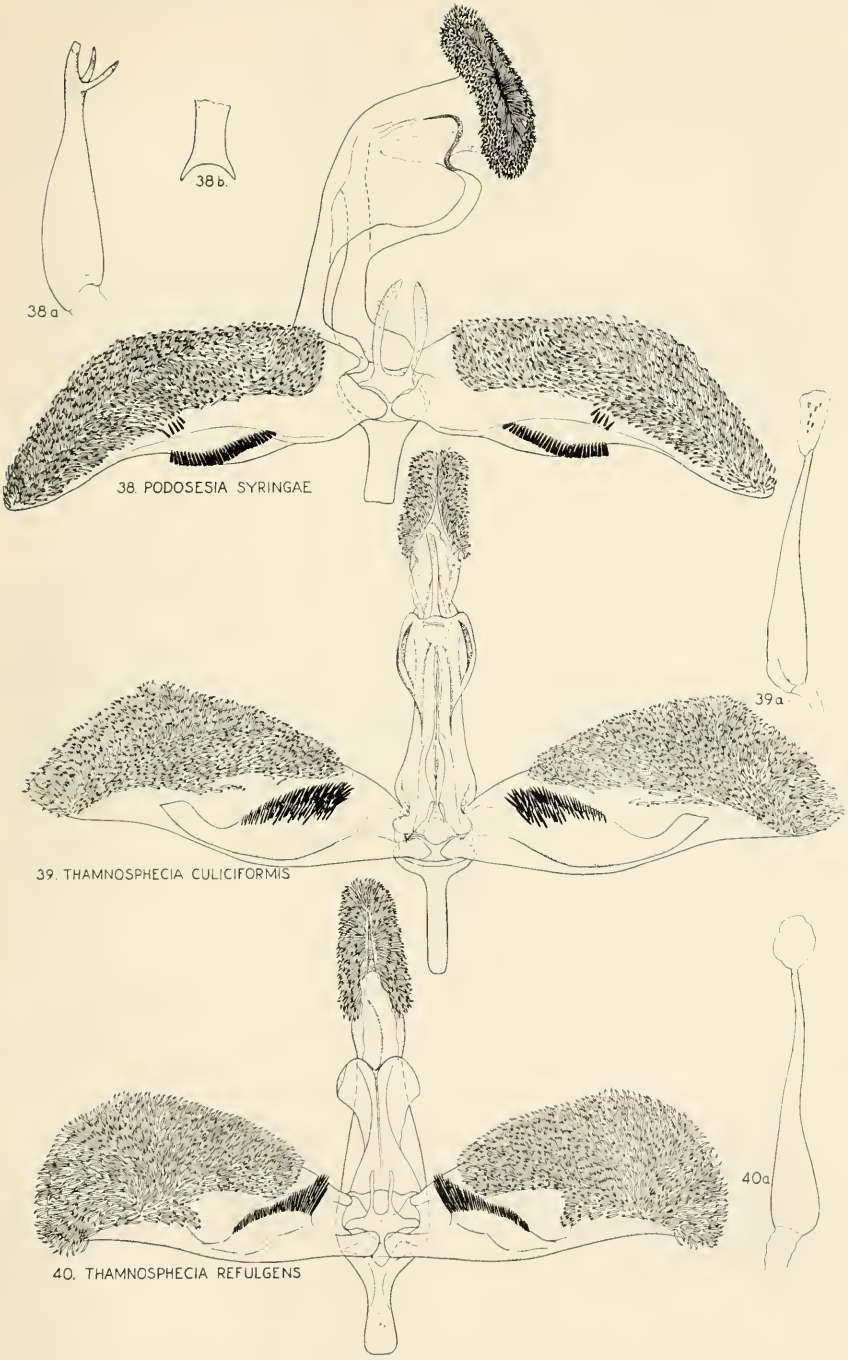
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

(SEE EXPLANATION OF PLATES)



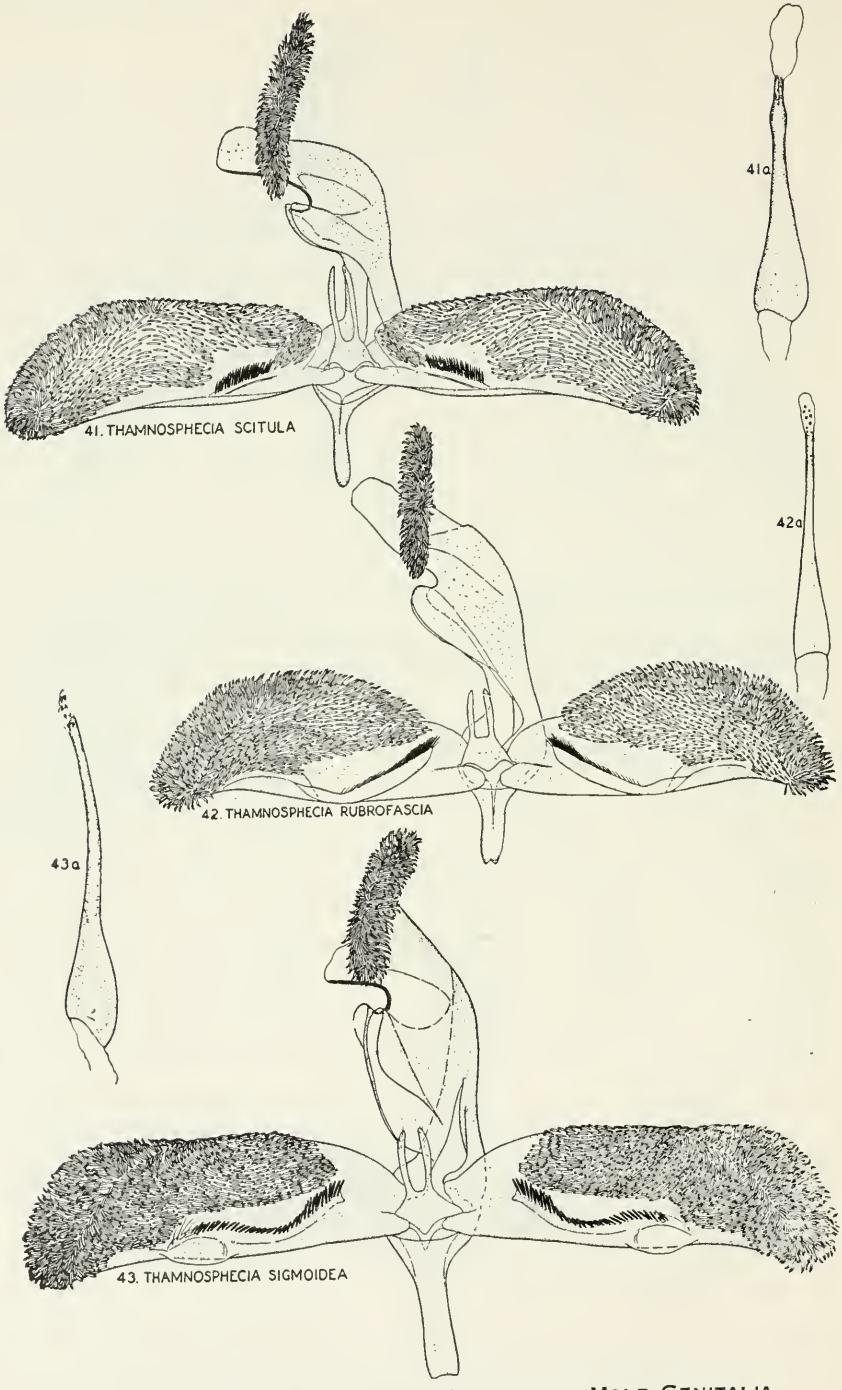
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

(SEE EXPLANATION OF PLATES)



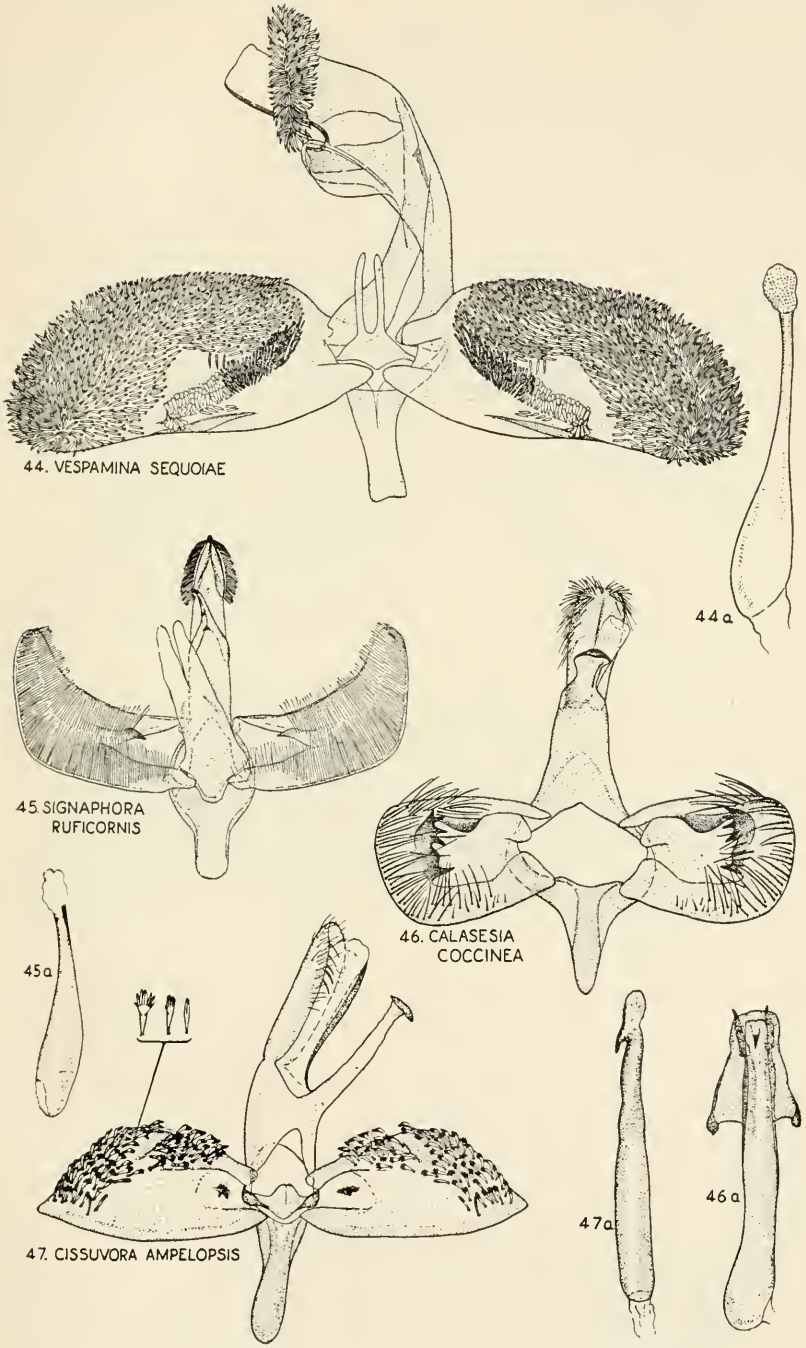
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

(SEE EXPLANATION OF PLATES)



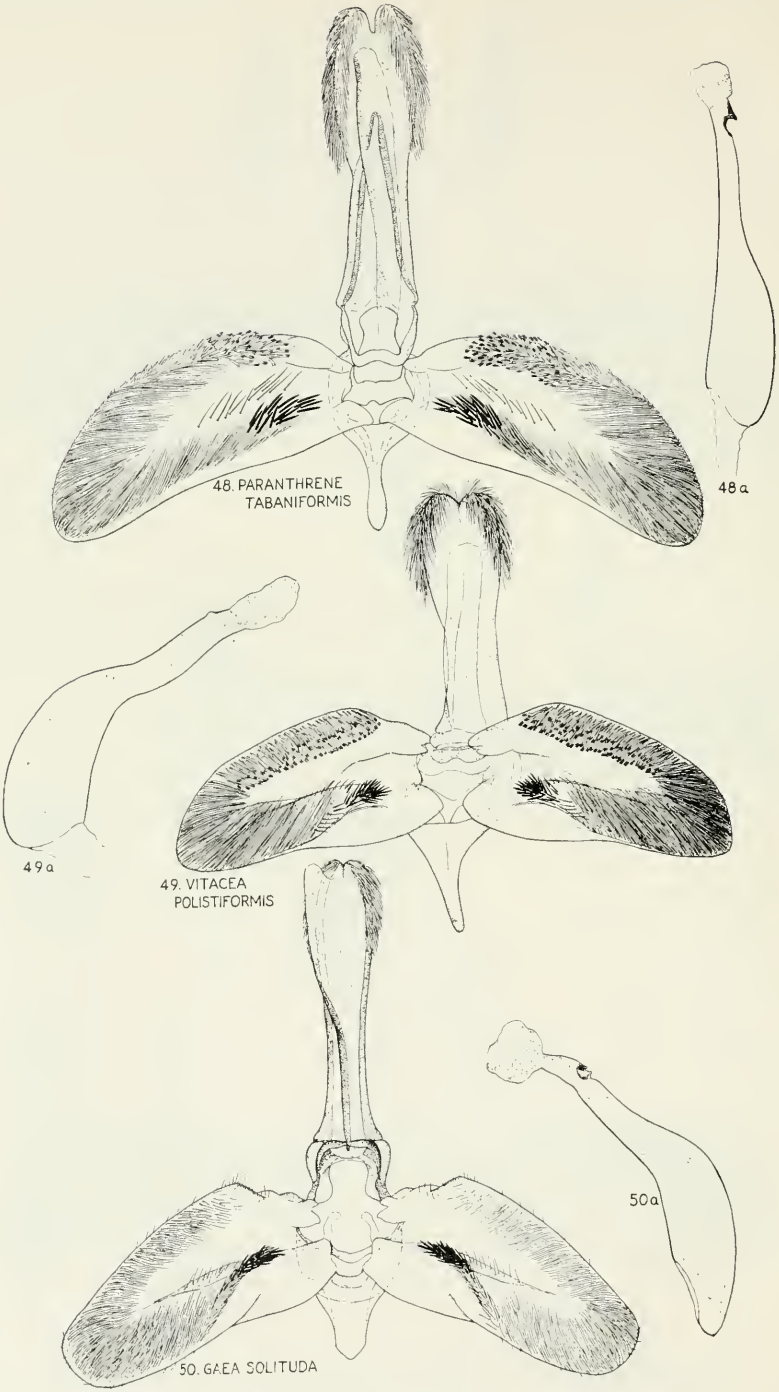
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

(SEE EXPLANATION OF PLATES)



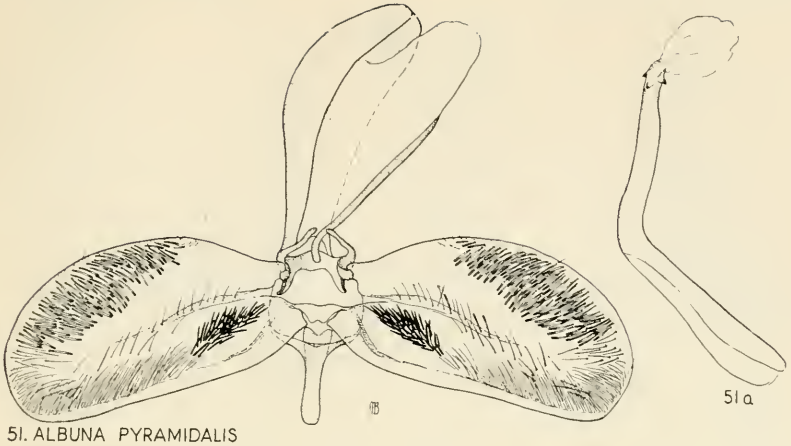
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

(SEE EXPLANATION OF PLATES)

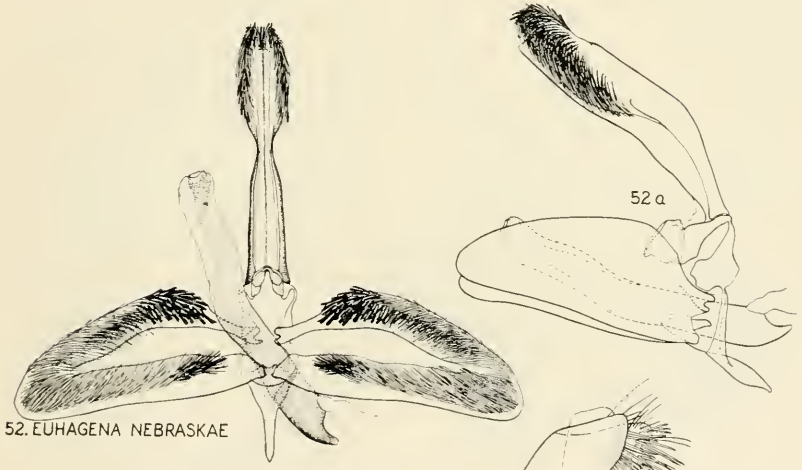


CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

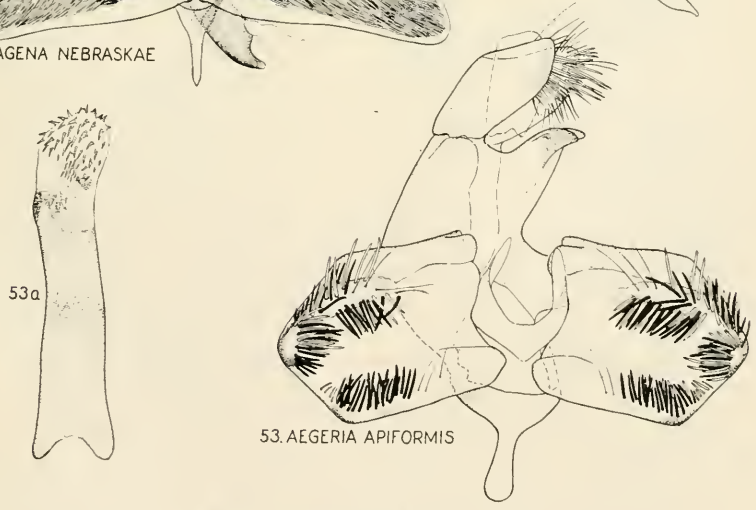
(SEE EXPLANATION OF PLATES)



51. ALBUNA PYRAMIDALIS



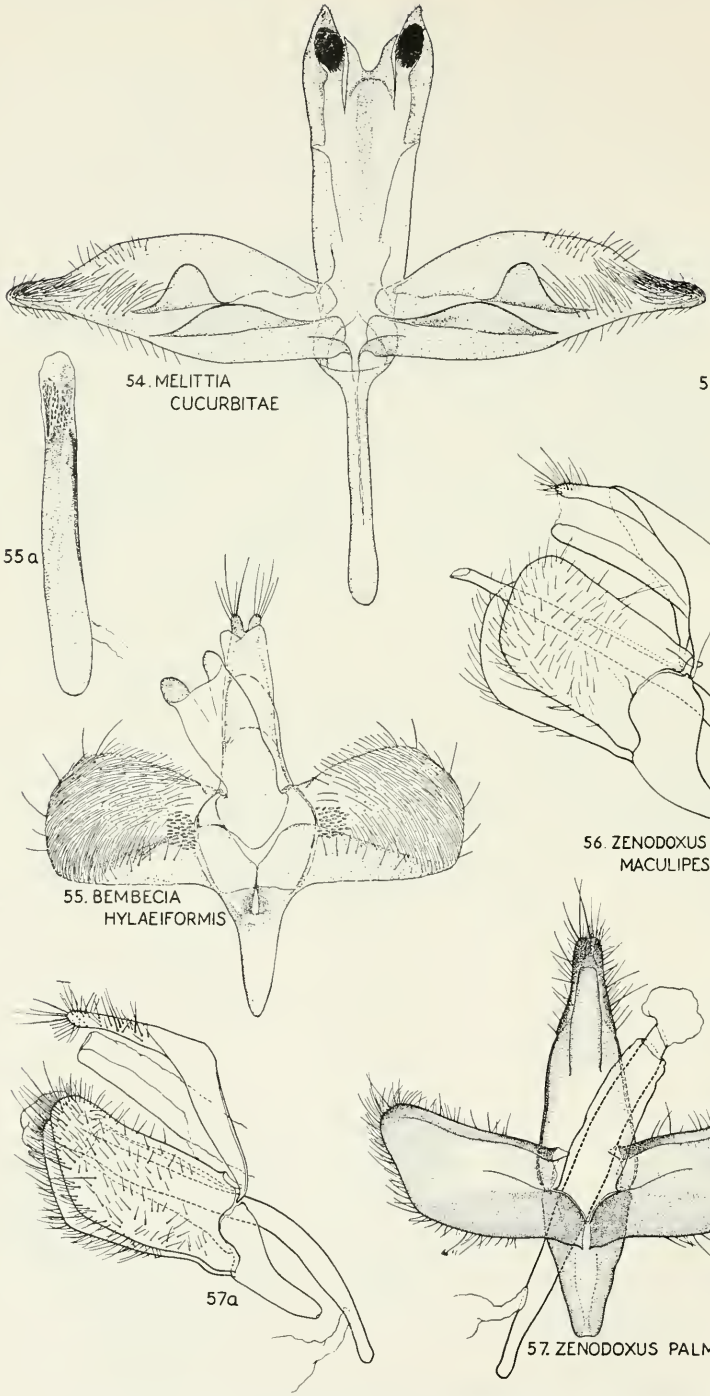
52. EUHAGENA NEBRASKAE



53. AEGERIA APIFORMIS

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

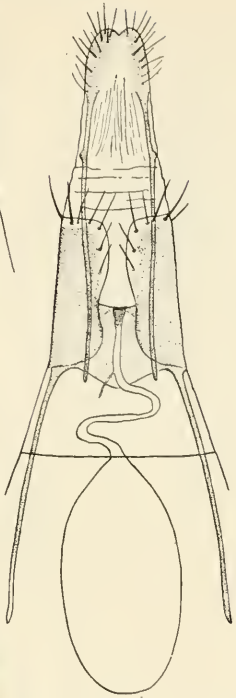
(SEE EXPLANATION OF PLATES)



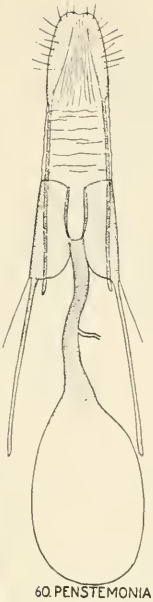
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: MALE GENITALIA

(SEE EXPLANATION OF PLATES)

58. SANNINA UROCERIFORMIS

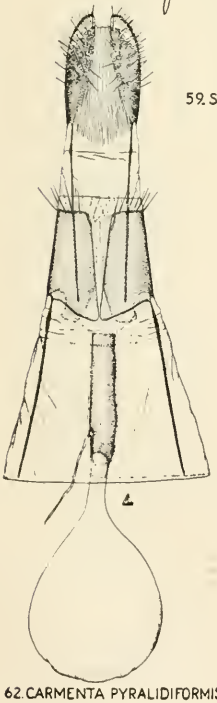


59. SANNINOIDEA EXITIOSA

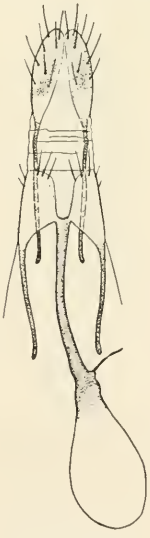


60. PENSTEMONIA EDWARDSII

61 RAMOSIA BIBIONIPENNIS

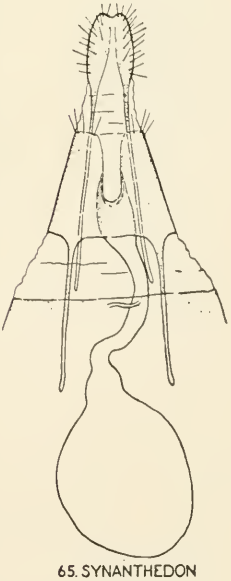


62. CARMENTA PYRALIDIFORMIS



63. CARMENTA PROSOPIS

64. SYLVORA ACERNI

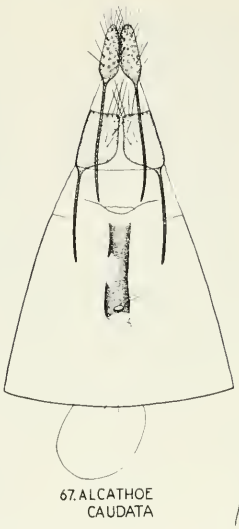


65. SYNANTHEDON VESPIFORMIS

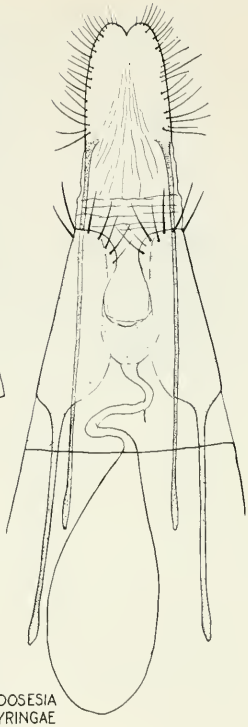
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: FEMALE GENITALIA

(SEE EXPLANATION OF PLATES)

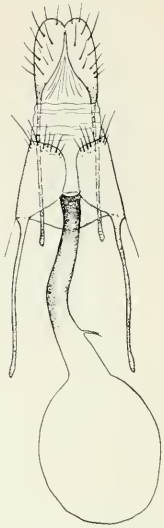
69. THAMNOSPHECIA CULICIFORMIS



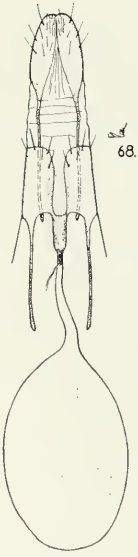
67. ALCATHOE CAUDATA



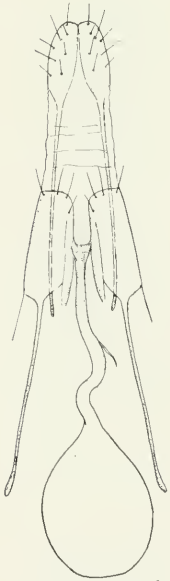
68. PODOSESIA SYRINGAE



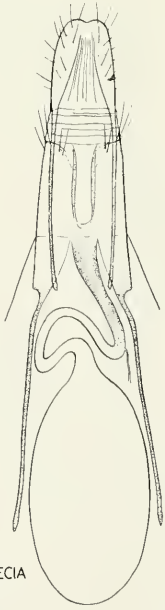
66. HYMENOCLEA PALMI



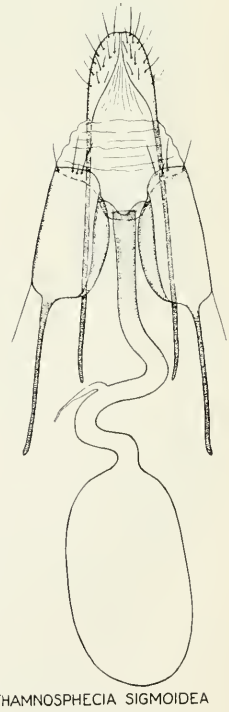
71. THAMNOSPHECIA SCITULA



70. THAMNOSPHECIA RUBROFASCIA



72. THAMNOSPHECIA REFULGENS

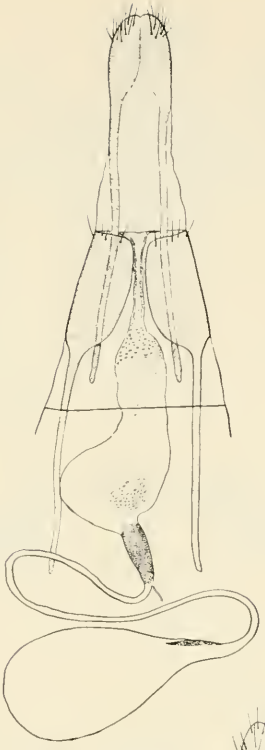


73. THAMNOSPHECIA SIGMOIDEA

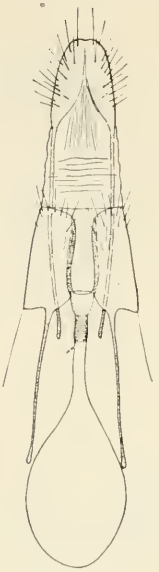
CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: FEMALE GENITALIA

(SEE EXPLANATION OF PLATES)

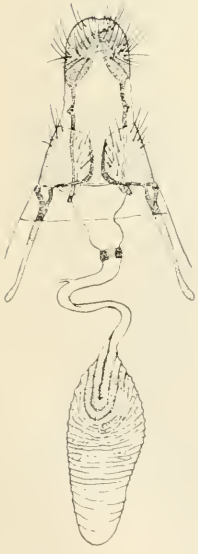
75. SIGNAPHORA RUFICORNIS



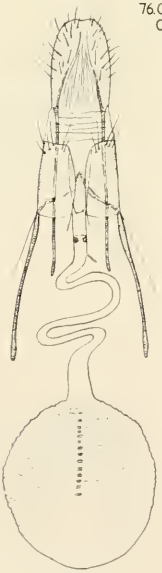
76. CALASESIA COCCINEA



74. VESPAMINA SEQUOIA



77. CISSUVORA AMPELOPSIS



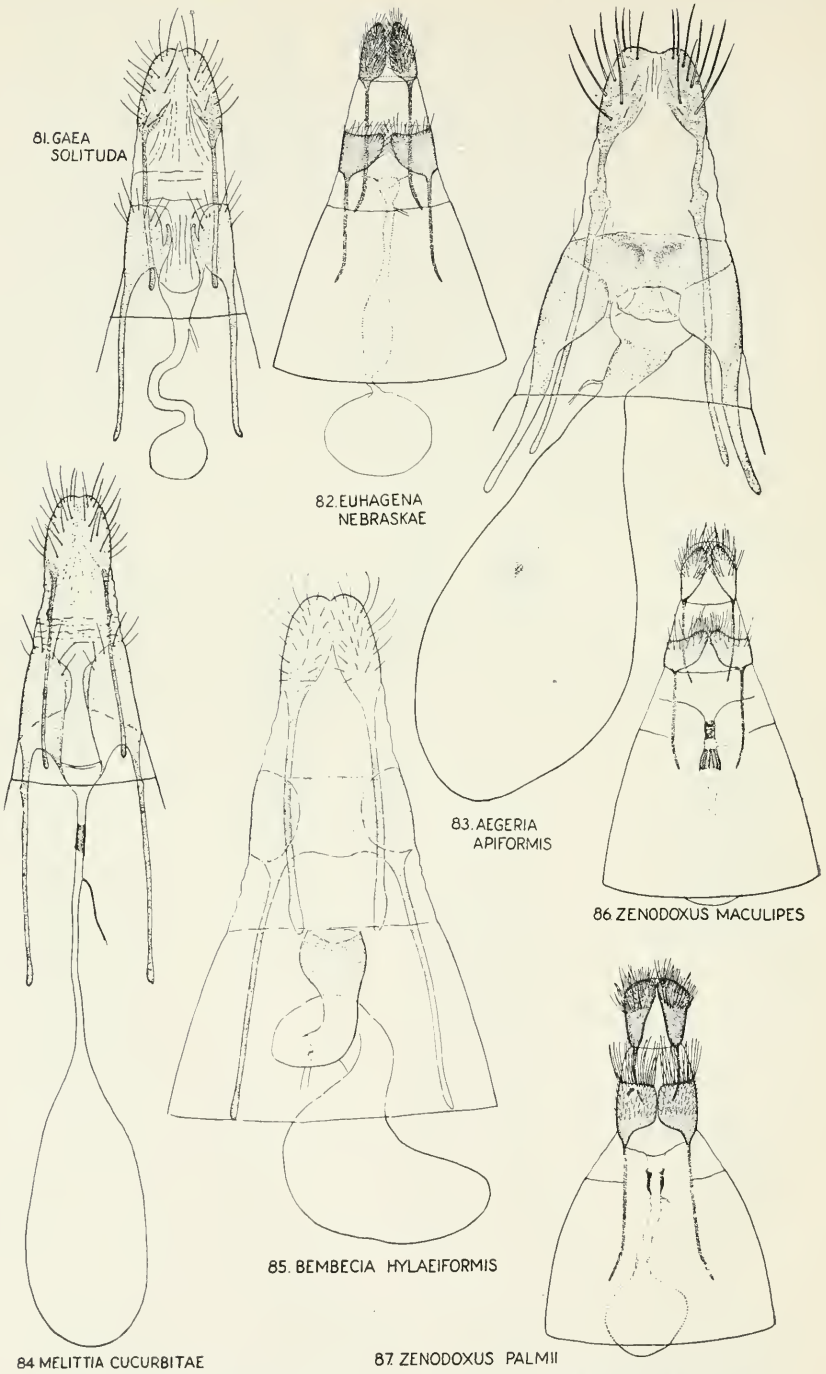
78. PARANTHRENE TABANIFORMIS

79 VITACEA POLISTIFORMIS

80. ALBUNA PYRAMIDALIS

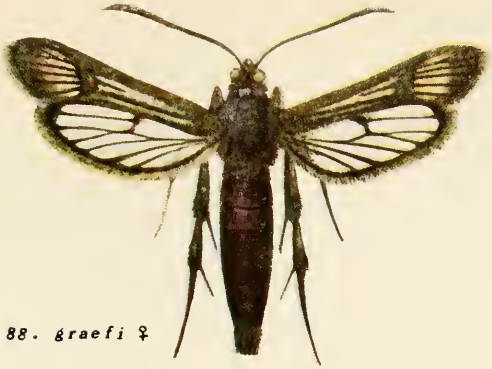
CLEAR-WING MOTHS OF GENUS AEGERIIDAE: FEMALE GENITALIA

(SEE EXPLANATION OF PLATES)



CLEAR-WING MOTHS OF FAMILY AEGERIIDAE: FEMALE GENITALIA

(SEE EXPLANATION OF PLATES)



88. *graefi* ♀

89. *edwardsii* ♂

90. *edwardsii* ♀

91. *hennei* ♂

92. *hennei* ♀

93. *clarkei* ♂

94. *clarkei* ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

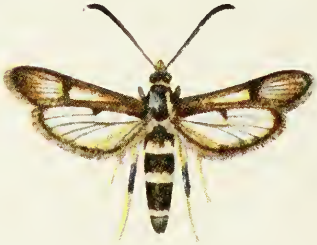
95. dammersi ♂

96. dammersi ♀

97. brevifolia ♂

98. brevifolia ♀

99. wallowa ♂



100. wallowa ♀

101. mariona ♂

102. mariona ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

103. rubricincta ♀

104. bibionipennis ♀

105. resplendens ♂

106. resplendens ♀

107. arizonensis ♂

108. rhododendri ♀

109. aurantis ♀

110. anthracipennis ♀

111. sanborni ♂

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

112. *helenis* ♀

113. *phoradendri* ♂

114. *apache* ♀

115. *querci* ♂

116. *querci* ♀

117. *torrancia* ♀

118. *austini* ♂

119. *giliae* ♂

120. *giliae* ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

121. ithacae ♂

122. ithacae ♀

123. albociliata ♂

124. albociliata ♀

125. auritincta ♂

126. auritincta ♀

127. corni ♂

128. corni ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

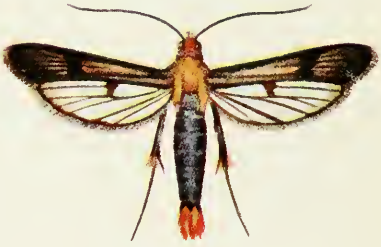
129. *ogalala* ♂

130. *suffusata* ♂

131. *verecunda* ♂

132. *verecunda* ♀

133. *buscki* ♀



134. *tepperi* ♀

135. *richardsi* ♀

136. *decipiens* ♂

137. *decipiens* ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

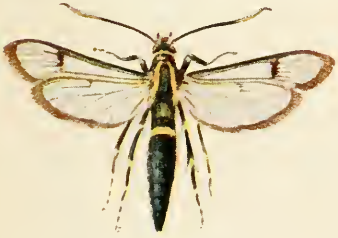
(SEE EXPLANATION OF PLATES)

138. pictipes ♂

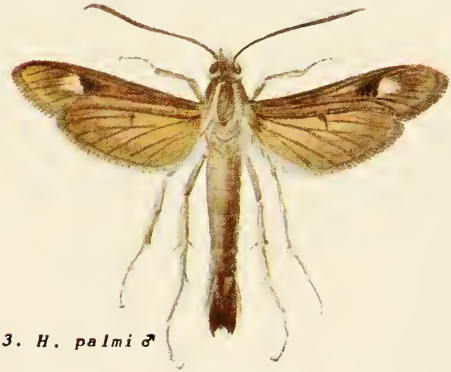
139. pictipes ♀

140. castaneneae ♂

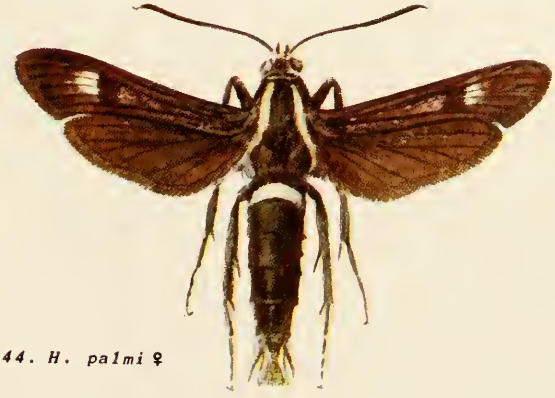
141. castaneneae ♀



142. viburni ♀



143. H. palmi ♂



144. H. palmi ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

145. annettella ♀

146. pepsioides ♂

147. atra ♂

148. ferrugata ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

149. *autumnalis* ♂

150. *verrugo* ♂

151. *corvinus* ♂

152. *scitula* ♀

153. *corusca* ♂

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

154. *pyri* ♀

156. *rubrofascia* ♀

155. *rubrofascia* ♂

158. *ampelopsis* ♀

157. *alleri* ♂

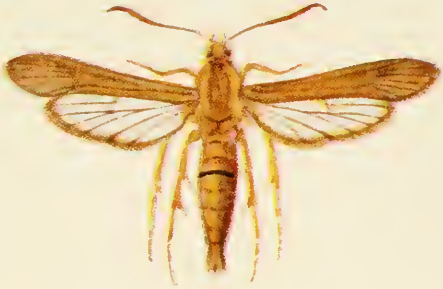
160. *fasciventris* ♀

159. *oslari* ♂

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

161. *perlucida* ♂



162. *pallescens* ♂

163. *simulans* ♂

164. *luggeri* ♂

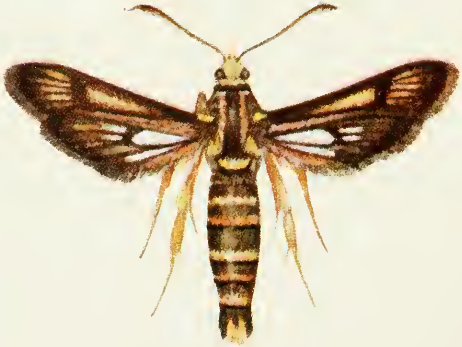
165. *P. palmii*♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

166. fenestrata ♀

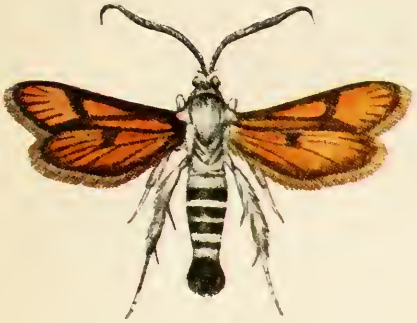
167. huron ♂



168. emphytiformis ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)



169. *nebraskae* ♂

170. *nebraskae* ♀

173. *hirsuta* ♂

171. *mormoni* ♂

172. *intensa* ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

174. melanoformis ♂

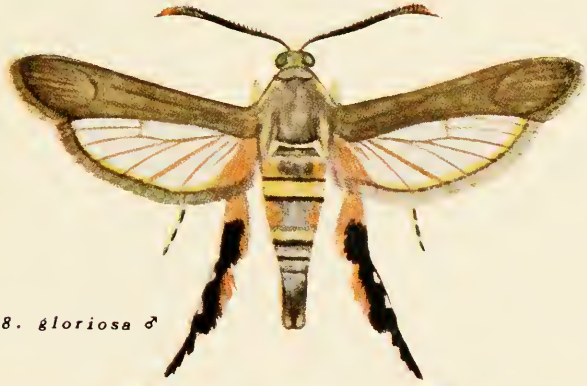
175. pacifica ♂

176. pacifica ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

177. *hermosa* ♀



178. *gloriosa* ♂

179. *gloriosa* ♀

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

180. *maculipes* ♀

181. *wissadulae* ♂

182. *sedalceae* ♂

183. *sedalceae* ♀

184. *sphaeralcea* ♂

185. *incana* ♀

186. *canescens* ♀

187. *rubens* ♂

CLEAR-WING MOTHS OF FAMILY AEGERIIDAE

(SEE EXPLANATION OF PLATES)

INDEX TO GENERA, SPECIES, AND LOWER CATEGORIES

(This index includes all the genera, species, and lower categories treated in this paper or discussed in the text. Valid names are in roman and synonyms are in italics.)

FOOD-PLANT INDEX

(Scientific plant names in *italics*.[1] Lepidopterous and common plant names in roman.)

[1] C. V. Morton, of the U. S. National Herbarium, kindly checked the spelling of the scientific botanical names.

Kalmia latifolia L.
Ramosia rhododendri (Beutenmüller), 42.
Knotweed. (See *Polygonum* spp.)
Lacinaria Hill = *Liatris* Schreb.
Carmenta anthracipennis (Boisduval), 47.
Lacinaria punctata (Hook.).
Carmenta anthracipennis sanborni Hy. Edwards, 48.
Lacinaria scariosa (L.) Hill = *Liatris scariosa* (L.) Willd.
Carmenta anthracipennis sanborni Hy. Edwards, 48.
Lilac. (See *Syringa.*)
Lithospermum ruderale Dougl.
Carmenta verecunda (Hy. Edwards), 74.
Mallow. (See *Malva.*)
Malus Miller.
Thamnosphecia scitula scitula (Harris), 114.
Thamnosphecia pyri (Harris), 118.
Malva L.
Zenodoxus Grote and Robinson, 194.
Manroot. (See *Echinocystis fabacea.*)
Maple. (See *Acer.*)
Maple, red. (See *Acer rubrum.*)
Maple, white. (See *Acer saccharinum.*)
Marine-ivy. (See *Ampelopsis* (*Cissus*) *incisa.*)
Melanthera deltoidea Michx.
Carmenta texana (Hy. Edwards), 65.
Melon, coyote. (See *Cucurbita palmata.*)
Mesquite. (See *Prosopis glandulosa.*)
Mistletoe. (See *Phoradendron.*)
Monkeyflower. (See *Diplacus aurantiacus.*)
Mountain-ash. (See *Sorbus.*)
Mountain-laurel. (See *Kalmia latifolia.*)
Myrica carolinensis Mill.
Thamnosphecia scitula scitula (Harris), 114.
Nightshade. (See *Solanum carolinense.*)
Ninebark. (See *Physocarpa.*)
Nyssa L.
Thamnosphecia rubrofascia (Hy. Edwards), 123.
Oak. (See *Quercus.*)
Oak, Arizona white. (See *Quercus arizonica.*)
Oak, black. (*Quercus* sp.)[2]
Paranthrene simulans luggeri (Hy. Edwards), 147.
Oak, blue. (See *Quercus oblongifolia.*)
Oak, coast live. (See *Quercus agrifolia.*)
Oak, pin. (See *Quercus palustris.*)
Oak, red. (*Quercus* sp.)[2]
Paranthrene simulans luggeri (Hy. Edwards), 147.
Oak, white. (*Quercus* sp.)[2]
Paranthrene palmii (Hy. Edwards), 147.
Oenothera L.
Albuna pyramidalis beutenmülleri Skinner ?, 167.
Oenothera biennis L.
Albuna pyramidalis rubescens (Hulst), 165.
Oxeye. (See *Heliopsis helianthoides.*)
Parthenocissus quinquefolia (L.) Planch.
Albuna fraxini (Hy. Edwards), 167.
Albuna fraxini vitriosa, new male form, 169.
Vitacea scepsiformis (Hy. Edwards), 156.
Parthenocissus tricuspidata var. *veitchii* Rehd. (Bailey, p. 2479).
Vitacea scepsiformis (Hy. Edwards), 156.
Peach. (See *Persica.*)
Pearly-everlasting. (See *Anaphalis margaritacea.*)
Pecan. (See *Carya pecan.*)

[2] Mr. Engelhardt did not give the Latin names for these oaks, and as the common names black, red, and white oaks apply to various species of *Quercus,* the exact species involved here remain uncertain.—Ed.

☆ U. S. Government Printing Office : 1946—665217