

THE SATURNIIDAE
(LEPIDOPTERA)
OF THE
WESTERN HEMISPHERE

MORPHOLOGY, PHYLOGENY, AND
CLASSIFICATION

CHARLES D. MICHENER

BULLETIN
OF THE

AMERICAN MUSEUM OF NATURAL HISTORY
VOLUME 98 : ARTICLE 5 NEW YORK · 1952

THE SATURNIIDAE (LEPIDOPTERA) OF THE
WESTERN HEMISPHERE

THE SATURNIIDAE (LEPIDOPTERA) OF THE WESTERN HEMISPHERE



MORPHOLOGY PHYLOGENY, AND CLASSIFICATION

CHARLES D. MICHENER

University of Kansas, Lawrence

BULLETIN

OF THE

AMERICAN MUSEUM OF NATURAL HISTORY

VOLUME 98 : ARTICLE 5

NEW YORK : 1952

BULLETIN OF THE AMERICAN MUSEUM OF NATURAL HISTORY

Volume 98, article 5, pages 335-502, text figures 1-420,
plate 5, diagram 1, tables 1-19

Issued March 3, 1952

Price: \$2.25 a copy

CONTENTS

INTRODUCTION	341
Note on the Illustrations	341
Descriptions of New and Little-known Species	341
Acknowledgments	343
MORPHOLOGY OF <i>Eacles imperialis</i> (DRURY)	344
COMPARATIVE MORPHOLOGY	355
PARALLELISMS	365
PHYLOGENY AND DISTRIBUTION	369
CLASSIFICATION	372
Key to the Seven Subfamilies of Saturniidae.	372
List of Genera and Subgenera of the Western Hemisphere.	372
Subfamily Rhescyntinae	374
Subfamily Citheroniinae	382
Subfamily Agliinae	409
Subfamily Hemileucinae	410
Subfamily Ludiinae	473
Subfamily Salassinae	473
Subfamily Saturniinae	475
LITERATURE CITED	500

INTRODUCTION

THIS IS THE FIRST of a proposed series of publications on the Saturniidae (including Citheroniidae) of the Western Hemisphere. It is hoped that the subsequent parts, the revisions of the genera by various authors, can be published within a reasonable period of time as separate monographic works.

The purpose of this paper is not only to give unity to subsequent parts by providing a phylogenetic and systematic basis on which they can be built, but also to contribute to the store of general information on the skeletal morphology of insects. In order to accomplish this, the morphology of one species, *Eacles imperialis* (Drury), has been studied and illustrated in some detail. In this section a terminology has been devised which is used throughout this work and which, it is hoped, will be useful to other lepidopterists.

In a subsequent section on Comparative Morphology the structural characters which have been observed to vary within the Saturniidae are discussed, and evidence is thus assembled for the study of the phylogeny of the group. In a separate section on Phylogeny and Distribution the principal morphological changes which have occurred during the history of the group are discussed, together with what little can be deduced about the distributional history of the Saturniidae.

The bulk of this paper consists of the systematic section, in which the subfamilies of the world and the genera and subgenera of the Western Hemisphere are discussed and described.

The generic descriptions in particular have been made quite full and include statements as to the range of variation of certain structures. Usually such intragenerically variable features are actually specific or subgeneric characters. It is hoped that the indication of variability in such cases will lead students of these moths to investigate such structures as possible specific characters. The rather numerous structural specific characters (other than those of the male genitalia) have been extensively ignored by other authors, although some of them are obviously convenient to use and of great importance in establishing relationships.

Because of unavoidable delay in the ap-

pearance of the present paper, numerous generic and subgeneric names which should have appeared first in this paper were actually first used in another (Michener, 1949a). From this latter paper it is possible to deduce some of the characters of the new genera and subgenera by reference to discussions and phylogenetic trees. However, as no species were listed, the names are properly *nomina nuda* under Article 25 of the International Rules of Zoological Nomenclature. Because of this, each name was later validated by a brief description and type designation (Michener, 1949b, 1950), but full descriptions and lists of included species first appear in the following pages.

NOTE ON THE ILLUSTRATIONS

Figures 97 to 420 are semidiagrammatic drawings of the male genitalia. Because of the great variability in the size of the structures, not all are drawn to the same scale. Except as otherwise explained, the genitalia, with aedeagus removed, are shown in ventral and lateral aspect, while the aedeagus is shown in lateral aspect. The abbreviations on these drawings are: a, annellus; g, gnathos; u, uncus. To permit correlation between ventral and lateral views of any one species, the clasper lobes are numbered. These numbers do not necessarily indicate homologies between different genera; thus the lobe numbered 2 for one genus may be homologous to the one numbered 3 in another.

A photograph of *Ormiscodes* (*Dirphiella*) *albofasciata* (Johnson and Michener) is given in plate 5, since the original figure was poorly reproduced.

DESCRIPTIONS OF NEW AND LITTLE-KNOWN SPECIES

Two new species are described below because it has seemed necessary or desirable to mention them by name in the following sections of this work. Comments on and illustrations of *Ceropoda johnsoni* Michener are also included to supplement the brief original description. Types of the new species are in the collection of the American Museum of Natural History (*ex* Frank Johnson collection). Paratypes, where enough exist, will be distributed to the United States National

Museum, the Museum of Comparative Zoölogy, the British Museum, and the Museu Nacional, Brazil.

***Psilopygida basalis*, new species**

This species is related to *P. apollinairei* (Dognin) which it resembles closely in size, wing shape, male genital structure, and in the pink and yellow coloration. It differs from *apollinairei*, however, in the dark brown fringes of the wings, in the presence in most specimens of minute scattered brown spots on the upper surfaces of the wings, and in the restriction of the pink coloration to the basal portions of the forewings in most individuals.

MALE: Length of body, 24 mm. (varying to 20 among the paratypes); of forewing, 23 mm. (varying to 21 mm. among the paratypes). Vestiture of body yellow, with pink intermixed on tegulae, pink replacing yellow on ventral surface of head, thorax, and abdomen; vestiture of legs pink except for that of tarsi and anterior and middle tibiae, which is gray. Wings yellow, basal half of forewing pink, pink extending towards apex of wing along costal margin; premedian line of forewing gray, arcuate outward in the middle; small gray spot present at apex of discal cell of forewing; postmedian line of forewing pink, only posterior portion present in holotype but entire line, which extends to wing apex, discernible in some paratypes; postmedian line of the forewing strongly bent at vein Cu_2 , portion of the line behind this vein transverse, that portion in front directed towards wing apex; some paratypes with narrow pink margin next to dark brown fringe. Posterior wings yellow, each with a narrow, pink, postmedian line arising near anterior apical angle of wing and curving inward towards center of wing where it disappears, in some paratypes area between this line and dark brown fringe of wing pale pink. Upper surfaces of both forewings and hind wings with scattered brown dots, much more numerous in some of the paratypes than in holotype. Under surface of forewing completely yellow in holotype but with pink margins in some paratypes; under surface of hind wing yellow, with pink margins and pink postmedian line similar to that of upper surface, pink margins considerably expanded to occupy much of the wing area in some para-

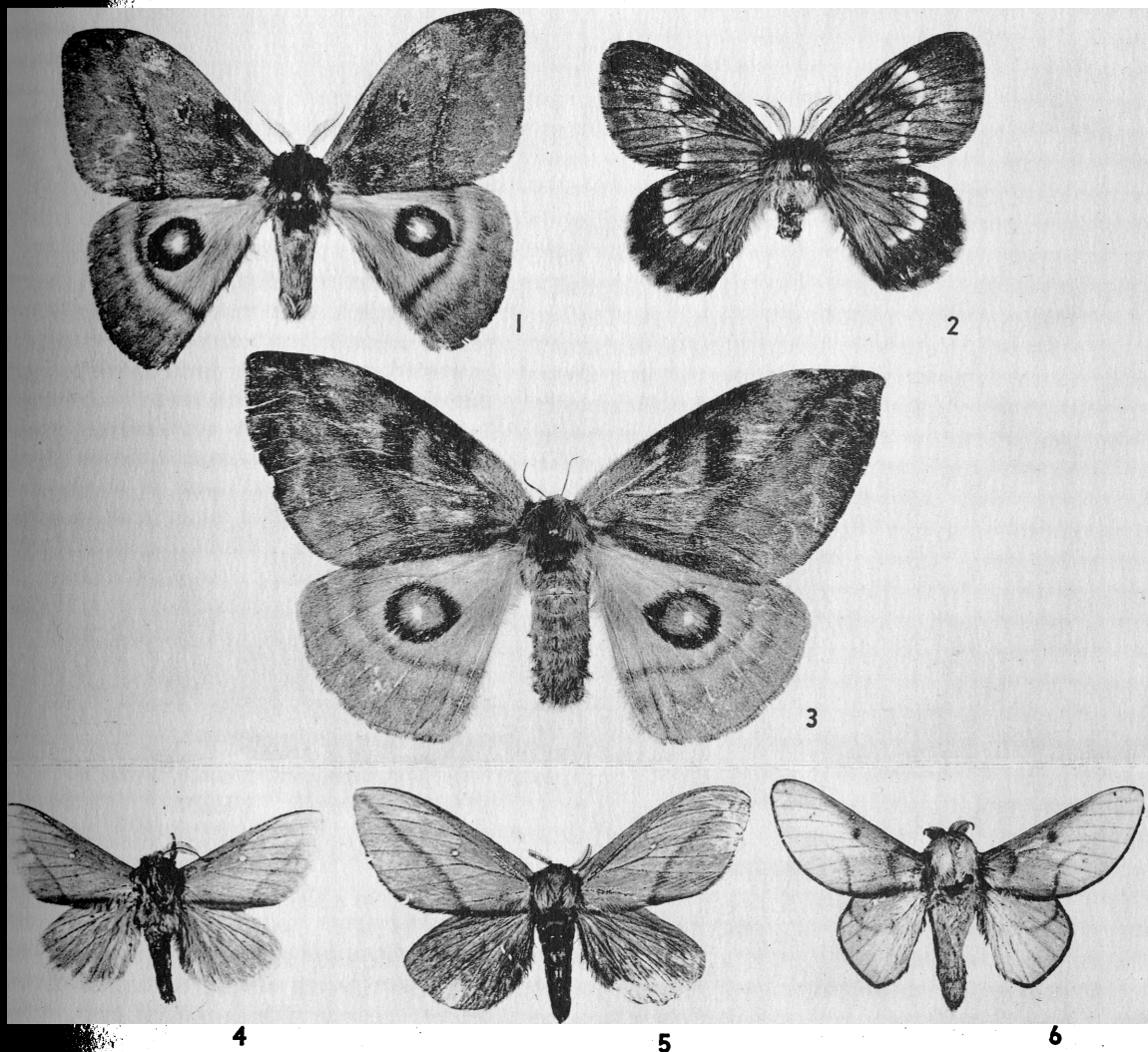
types; male genitalia similar to those of *P. apollinairei*, but convexity of ninth tergum more uniform in profile and median apical process of this tergum, which projects over base of uncus, smaller than in *apollinairei*, a little over one-fourth of length of uncus.

TYPE MATERIAL: Holotype male and six male paratypes from Paraná, Brazil. One additional male paratype from north Paraná, Brazil. All these specimens are from the collection of Mr. Frank Johnson, now in the American Museum of Natural History.

***Hylesia gamelioides*, new species**

This is the largest and most brilliantly marked species of *Hylesia*. Superficially it looks like a member of the genus *Gamelia* because of the large eye spot of the hind wing, the iris of which is red. The male genitalia, however, are like those of typical *Hylesia*. The absence of very long terminal bristles on the basal rami of the male antennae and the relatively small size of the labial palpi also are characteristics of *Hylesia* not shared by *Gamelia*. This species has been confused with *Gamelia musta* Schaus in collections.

MALE: Length of body, 22 mm.; length of forewing, 32 mm. (varying from 30 to 34 among the paratypes). Antennae brown, about 8 mm. in length; vestiture of dorsum of head and thorax black (to dark gray in the paratypes), interspersed with reddish brown at posterior end of thorax (and sometimes in middorsal portion of thorax); vestiture of lower part of frons, sides and venter of thorax, and legs except for tarsi and fore tibiae black (to dark gray in some of the paratypes); forewings with ground color of upper side brownish gray, darker basally and gradually becoming paler towards the apex; premedian line strongly sinuous, very inconspicuous, slightly darker than ground color but indicated also by a scattering of yellowish white scales; apex of discal cell marked by small dark spot surrounded by scattered yellowish white scales; postmedian line nearly parallel to outer margin of wing, dark gray, emphasized by scattered yellowish white scales along outer margin of line; a sinuous line of gray shading present between postmedian line and outer margin of wing. Hind wing above with ground color gray, becoming browner towards the margin, eye spot with



1. *Ormiscodes (Dirphiella) albofasciata* Michener, male. 2. *Ormiscodes (Dirphiella) albofasciata* (Johnson and Michener). 3. *Ormiscodes (Dirphiella) albofasciata* Michener, female. 4. *Ceropoda johnsoni* Michener, male. 5. *Ceropoda johnsoni* Michener, female. 6. *Psilopygida basalis* Michener. All males shown in this plate are holotypes; all females, allotypes

outer margin black, iris red, center white; premedian line absent; postmedian and submarginal lines gray and arcuate, somewhat darker than the ground color. Under surfaces of wings red brown, with dusky shading towards apex of forewing and with a straight, gray, postmedian line across each wing and a large black spot at apex of discal cell of forewing.

FEMALE: Length of body, 27 mm.; length of forewing, 43 mm. Similar to male except for the usual sexual characters. Apex of forewing slightly more acute than in male. Under surfaces of wings gray instead of red-brown, with some red-brown along the outer margins of wings, particularly the hind wings and along the veins; abdominal pubescence long and shaggy as in many females of *Hylesia*, not appressed as usual in *Gamelia*.

TYPE MATERIAL: Holotype male, allotype female, and 18 male paratypes from Chiapas, Mexico. It is understood that these specimens were collected near the town of Comitán. They are from the collection of Mr. Frank Johnson, now in the American Museum of Natural History.

***Ceropoda johnsoni* Michener**

Plate 5

Ceropoda johnsoni MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 143.

The pink and yellow coloration of this species is superficially suggestive of that of some species of *Psilopygida*. The morphological characters indicated in the generic description show that this species is not related to *Psilopygida* but forms a distinctive group of

its own, possibly most nearly related to *Adelocephala* (*Giacomellia*). From *A. (Giacomellia) bilineata* (Burmeister), *C. johnsoni* differs not only in the generic characters but in the pink and yellow coloration and the direction of the lines on the forewings.

ACKNOWLEDGMENTS

Special acknowledgment for assistance is due to the late Frank Johnson of Griffin, Georgia, who not only gave freely of specimens from his very excellent collection of the Saturniidae but to a large degree made this work possible by his generous support of the project. Following his death his collection was given to the American Museum of Natural History. Thanks to his generosity the aid of technical assistants was made available not only at the American Museum of Natural History but at the University of Kansas. Mrs. John Hastings and Mrs. Jerome Rozen made most of the genitalic and wing preparations, as well as the outlines of most of the drawings of these structures, while Mrs. Rozen and Mrs. James Cunningham gave invaluable aid in inking the illustrations. Thanks are due to Mrs. Caroline Schramel for painstaking secretarial assistance.

This study was begun and to a large extent carried out at the American Museum of Natural History, where excellent facilities were provided, thanks to Dr. Mont A. Cazier.

I am indebted also to Mr. William D. Field and other authorities of the United States National Museum for the opportunity to study the fine saturniid collection of that institution.

MORPHOLOGY OF *EACLES IMPERIALIS* (DRURY)

THIS SECTION and the figures that accompany it are included to provide not only a basis for the understanding of the skeletal parts but a terminology for these parts for use in the succeeding papers of the work. Portions of sclerites referred to in systematic work have been provided with names in some instances, even though such names are unnecessary from the purely morphological viewpoint.

HEAD

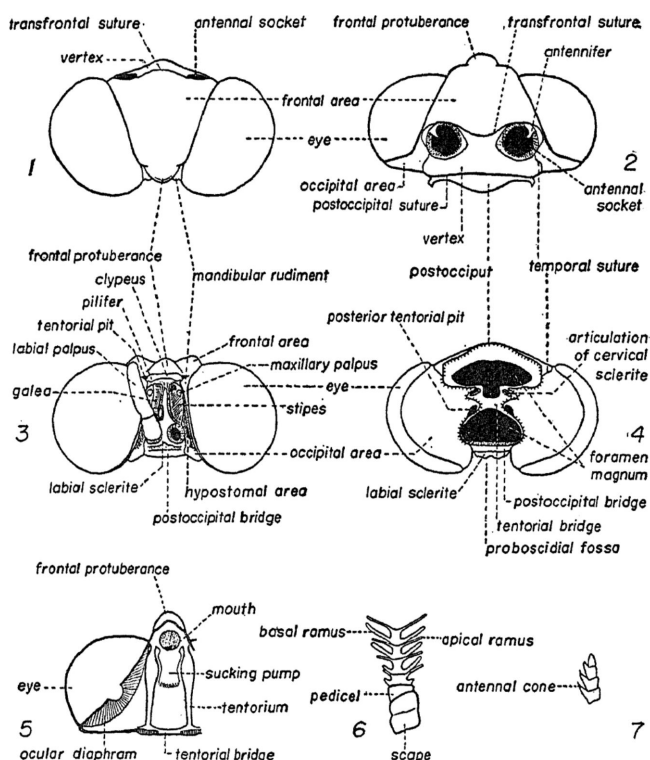
Figures 1-7

In comparison to the rest of the insect, the head is small. The greater part of the front of the head is the frons, the lower end of which is strongly protuberant and is termed the *frontal protuberance*. Although, according to DuPorte (1946), the short transverse sclerite usually called the labrum should be termed clypeus, Snodgrass (1947) indicates that the usual interpretation is correct. The *clypeus*, then, is the small transverse sclerite beneath the frons.¹ In most Lepidoptera there is at each side of the clypeus a projection called the pilifer. In *Eacles* the pilifers are represented by mere convexities. The labrum, while visible below the clypeus in many Lepidoptera, is absent or completely membranous and inflected into the mouth in *Eacles*. At each side of the clypeus is a pit, the *anterior tentorial pit*, and beneath each pit a small protuberance is the *mandibular rudiment*. For convenience in taxonomic usage, the entire front of the head below the antennal bases and above the clypeus is termed the *frontal area*. A pair of sutures (absent in *Eacles* and other Citheroniinae but present in many saturniids) running parallel to the inner orbits of the eyes from the anterior tentorial pits to the outer margins of the antennal sockets are the *laterofrontal sutures*, a term used in preference to frontogenal sutures because in insects such as Lepidoptera with enlarged eyes

the genae are so reduced that the sutures no longer lie between the frons and the genae but for the most part between the frons and those parts of the parietals that are in front of the eyes. The laterofrontal sutures, then, divide the frontal area into a large median frons and narrow lateral portions which are parts of the parietals. Dorsally the frontal area is limited by a weak transverse groove, the *transfrontal suture*, which is not indicated by a ridge on the inner surface of the head wall. The area behind this suture, between the eyes, and in front of the postoccipital suture is called the *vertex* for convenience, although it is recognized that it is the fusion product of the postfrons and portions of the parietals and occiput. The *temporal sutures* (Ferris, 1942) extend anteriorly from the postoccipital suture to the antennal bases. They are indicated internally, particularly posteriorly, by ridges. The narrow zone around the *foramen magnum* (the large opening on the posterior face of the cranium) is the *postocciput*. It is particularly broad above, where it is limited anteriorly by the *postoccipital suture*. The lower end of the foramen magnum is closed by a weakly sclerotic bridge which appears to be a *postoccipital bridge*. Across the middle of the foramen magnum is a broad transverse bar, the *tentorial bridge*. The *posterior tentorial pits* are located near the ends of this bridge. Shallow concavities for the articulation of the anterior ends of the cervical sclerites lie just above the posterior tentorial pits. In the absence of an occipital suture, the entire area on each side between the eye and the postocciput is termed the *occipital area*. It is delimited above by the temporal suture, and below it merges into the hypostomal area.

The entire ventral surface of the head, between the eyes, is occupied by a broad depression, the *proboscoidal fossa*. The lateral walls of the fossa are the *hypostomal areas*, while the roof is occupied by a longitudinally elongate, weakly sclerotized structure termed the *labial sclerite*. Posteriorly this sclerite is separated from the postoccipital bridge only by a narrow, slightly less sclerotic band. The anterior portion of the labial sclerite may well be secondary sclerotization, not of labial origin. Arising from membranous areas near the

¹ In apparent contradiction to this interpretation, Busk and Boving, and following them Snodgrass (1935), show a pilifer-like lobe on each side of the labrum of *Micropteryx*. However, in the species of *Micropteryx* examined by me no such lobe is present. Moreover, there is a small sclerotic projection on each side of the broad median portion of the clypeus immediately mesad of the anterior mandibular articulation. These small projections may be homologous to the pilifers.



FIGS. 1-7. *Eacles imperialis* (Drury). 1. Front view of head. 2. Dorsal view of head. 3. Ventral view of head. 4. Posterior view of head (the line marked by short cross lines represents attachment of cervical membrane to head). 5. Dorsal view of dissection of head to show tentorium. 6. Base of antenna of male seen in dorsal view. 7. Apex of antenna of male seen in lateral view.

posterior end of the labial sclerite are the two-segmented *labial palpi*. The *maxillae* are much reduced, each being represented by a *stipes* bearing near its apex a small tubercle, the *maxillary palpus*, and at its apex the short, curled *galea*. The cardo, greatly reduced in some related groups (as shown, for example, in a figure given by Melis, 1940) appears to be absent in *Eacles*.

The *tentorium* consists of the transverse bridge already described which divides the foramen magnum and the anterior arms which extend between the anterior and the posterior tentorial pits. Between the anterior ends of the tentorial arms, and attached to the cranial wall mesad of the anterior tentorial pits, is a flat sclerotic plate, the ventral wall of the *sucking pump*. The dorsal wall of the pump is membranous. The origin of the

sucking pump is not clear. According to Snodgrass (1935) it probably consists of the cibarium and a part of the stomodaeum. The *ocular diaphragm* (Ferris, 1940a) is very large, the opening in its center being small and dorsoventrally elongated.

The antennae consist of *scape*, *pedicel*, and *flagellum*. In the proximal portion of the flagellum of the male each segment bears a pair of *basal rami* and a pair of *apical rami*, the latter more slender than the former. This portion of the flagellum is therefore said to be quadripectinate, since each segment bears four rami.¹ In the distal portion of the flagellum the distal rami are entirely wanting and

¹ If the rami are reduced to tubercles or teeth, the antennae are quadridentate; if the distal rami are entirely absent but the basal are present, the antennae are bipectinate or bidentate.

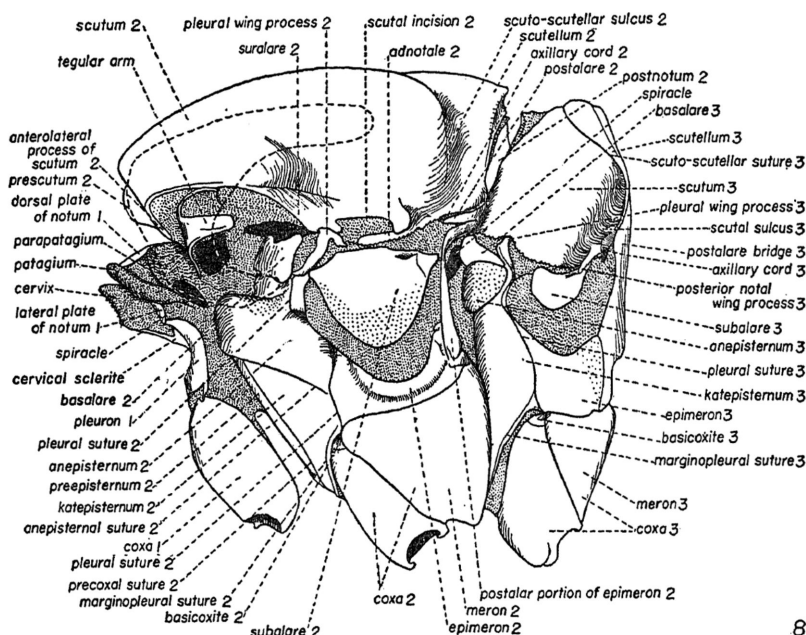


FIG. 8. *Eacles imperialis* (Drury). Lateral view of thorax. Broken line represents outline of tegula, removed to show structures beneath it.

the basal rami are represented merely by small hairy lobes. However, projecting ventrally, in a plane at right angles to the plane of the rami, are a series of projections, one per segment, termed the *antennal cones*. These are the sensory cones of Jordan (e.g., 1922).

THORAX

Figures 8-12

PROTHORAX: In comparison to the other thoracic segments, the prothorax is greatly reduced. There are three sclerotic parts of the *pronotum*: a *dorsal plate*, which is pointed posteriorly where it articulates in a deep pit with the prescutum of the mesothorax, and two *lateral plates*, which articulate above with the anterior end of the dorsal plate (their upper portions are hidden in fig. 8) and extend downward around the cervix to the upper ends of the propleura with which they are partially fused. The morphological identity of these lateral plates of the pronotum is in some doubt. However, after examining *Hepialus*, *Phassus*, and others in which they are fused dorsally and definitely appear to be notal structures, I agree with Berlese (1909), Schulz (1914), Madden (1944), and others in

so considering them. Other authors, however, have not concurred in this opinion (see Weber, 1924). The membranous dorsal portion of the prothorax is thrown into two pairs of large folds, the anterior pair being the *parapatagia*, the posterior the *parapatagia*. The *propleura* are fused midventrally (without discrimenal line or internal ridge), so that together they form a horseshoe around the lower portion of the *cervix*. There are two *cervical sclerites* which articulate with the inner or anterior margins of the propleura. Each has a process extending downward in the cervical membrane adjacent to the anterior margin of the propleuron and another extending forward to articulate with the head. Most of the anterior portion of the latter is hidden in figure 8. The lower posterior angle of each propleuron bears a process which articulates with the anterior coxa. Midventrally the fused propleura are continuous with a very narrow sclerotic ribbon which extends posteriorly between the anterior coxae and bears on its inner surface a weak longitudinal median ridge. Near its posterior end this ribbon expands slightly to form the *furcasternum*, a deep pit from which arises the internal prothoracic *furca*, the arms of which

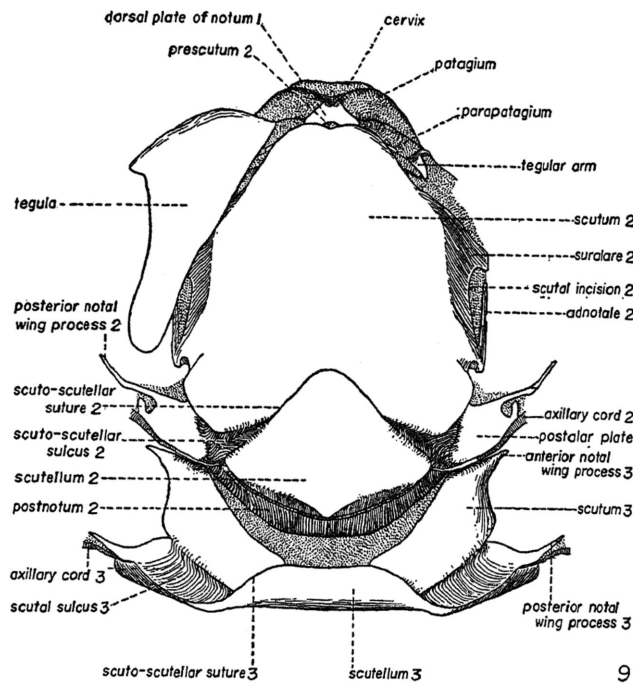


FIG. 9. *Eacles imperialis* (Drury). Dorsal view of thorax. Tegula removed on right side.

curve forward within the body and approach the inner walls of the propleura. Immediately behind the furcasternum in an exceedingly deep pit arises the internal prosternal spine, which projects upward and backward into the body. Behind this pit is the exposed portion of the *spinasternum*, which consists of a sclerotic ribbon ascending the posterior wall of the pit and dividing to form two arms whose posterior ends are fused with the anterior margins of the mesothoracic pre-episterna.

MESOTHORAX: The *mesonotum* occupies the greater part of the dorsum of the thorax. The anterior portion of the mesonotum is the *prescutum*, which is strongly convex above, deeply invaginated below where it articulates with the dorsal plate of the pronotum. From its anterior margin internally arises the thin, bilobed *first phragma*. Each lower lateral angle of the prescutum is produced as a long process or *prealare*, which extends downward in a fold in the membrane to a point behind the upper end of the first spiracle and mesad of the lower extremity of the tegular arm. The prealares are hidden from view in the figures. The suture between the prescutum

and the scutum is indicated internally by a strong ridge which is continued laterally along the inner surfaces of the prealares.

The *mesoscutum* is the largest dorsal plate of the thorax. Each anterolateral angle of the scutum is produced downward as a slender process, the *anterolateral process of the mesoscutum*. These processes and the conjunctiva supported by them hide the prealares as seen in lateral view. Behind each anterolateral process is a rather large sclerite known as the *tegular arm*. The connections of this structure are discussed with the pleura. The area of attachment of the *tegula* is between the median and ventral lobes of the tegular arm.

Behind the tegular arm each lateral margin of the scutum is produced as a sloping plate, the *suralare*. The entire scutal margin from the anterolateral process to the apex of the suralare is strongly inflected. The groove which marks the union of the suralare with the rest of the scutum is indicated internally by a strong ridge which becomes progressively higher anteriorly and fuses with the marginal inflection of the scutum. Behind each suralare is a deep incision in the scutal margin, the *scutal incision*, behind which is

the large *adnotale*. The suralare and adnotale both articulate with the first axillary sclerite and together constitute the *anterior notal wing process*.

The *scuto-scutellar suture* is continuous middorsally. Laterally the scutum and *meso-scutellum* are separated by the deep *scuto-scutellar sulci* which become progressively broader towards each side and terminate abruptly at the horizontal and somewhat elevated *postalar plate*. The distal margin of the postalar plate is produced to form the long, slender, *posterior notal wing process* which articulates with the lower or posterior extremity of the third axillar sclerite. The scuto-scutellar suture is marked internally by a strong ridge. A very strong internal ridge extends posteriorly from the adnotale to near the lateral extremity of the scutellum, where it abuts against an internal brace projecting anteriorly from the base of each side of the second phragma.

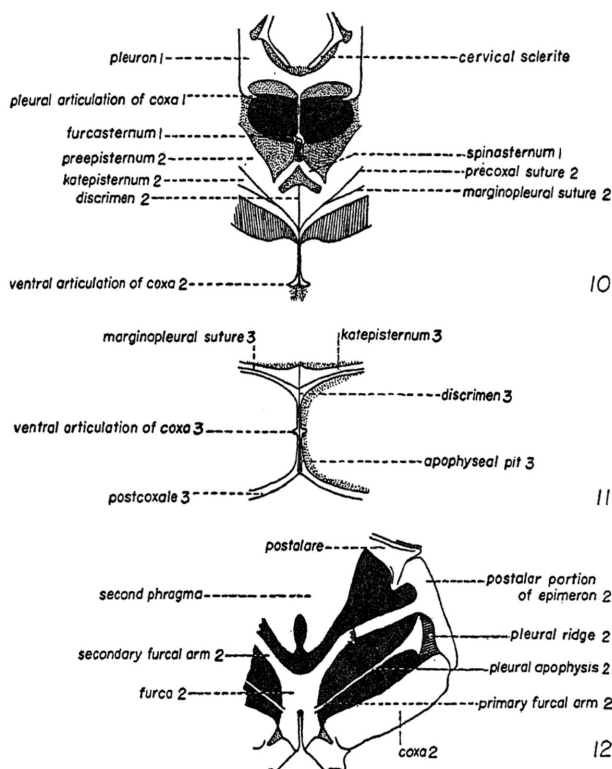
A narrow membranous zone separates the scutellum from the *postnotum*, the posterior margin of which is invaginated, with the anterior margin of the metanotum, to form the huge second *phragma*, which extends far to the rear and downward into the body cavity. Laterally the postnotum is produced to form a *postalare* on each side.

The pleural and sternal areas of the pterothorax are interpreted on the basis of the theory proposed by Ferris (1940b) and elaborated by Michener (1944a). The *meron* of the middle coxa is very large and the suture separating it from the rest of the coxa is marked internally by a high ridge. The *basicoxite* is separated from the rest of the coxa by a weak suture indicated internally by a fine ridge. The *mesopleural suture* is represented within by a strong ridge. From the outside the arcuate section of the pleural suture above the posterior end of the anapleural suture is very deeply impressed, although partly hidden in direct lateral view by the reflexed margin of the mesepimeron. The portion of the pleural ridge (which marks the pleural suture on the inner face of the pleuron) between the deeply impressed section and the coxa is expanded into a thin lamella which is produced inward and downward as a slender process, the *pleural apophysis*, which is fused with the primary arm of the

mesofurca. At the angle of the pleural suture where it is closest to the basalare an internal, rod-like invagination is attached. This extends anteriorly behind the basalare to the posterior lobe of the *tegular arm*. The latter is a trilobed structure, the dorsal lobe approaching the lateral margin of the mesoscutum, the median lobe approaching the anterior end of the wing base, and the ventral lobe approaching the lower end of the prealare.

The *mesepisternum* is divided horizontally by the *anepisternal suture*, which is an open cleft anteriorly. Elsewhere it is indicated internally by a weak ridge. The area above this suture is the *anepisternum*. The *basalare* is more or less rigidly attached to the summit of the anepisternum and bears within a short apodeme which is enlarged into a disc for muscle attachment. The portion of the episternum below the anepisternal suture is divided into an anterior *pre-episternum* and a posterior *katepisternum* by a suture here termed the *precoxal suture*. Shepard (1930) has indicated that only the lower portion of this suture is actually the precoxal suture, but for present purposes this name is used for the entire structure. Immediately in front of the coxa the katepisternum is marked by the *marginopleural suture*, which fuses with the precoxal suture on the venter. Both of these sutures are marked internally by ridges, the ridge of the marginopleural suture expanding upward and continuous with the lower portion of the pleural ridge. It is evident that the narrow area behind the marginopleural suture is not a trochantin, since a quite distinct though reduced trochantin is present in some families of Lepidoptera (see, for example, Weber, 1924). Incidentally, it is also clear that the basicoxite, regarded as the trochantin by some (e.g., Jordan, 1902), cannot be that structure. Midventrally the preepisterna and katepisterna are separated by a longitudinal suture, the *discrimen*. The katepisterna extend posteriorly in a very narrow space between the coxae to the *ventral articulations* of the coxae.

The discrimen is the line of invagination of a thin high lamella, which posteriorly merges into the mesothoracic *furca* which arises between the middle coxae. The furca bears two pairs of arms. As shown by Weber (1924,



FIGS. 10-12. *Eacles imperialis* (Drury). 10. Antero-ventral view of sternal regions of first two thoracic segments. 11. Ventral view of metathoracic sternal region. 12. Posterior view of mesofurca and associated structures.

1928) the *primary furcal arms* are weak, slender structures fused with the pleural apophyses. The *secondary furcal arms* are strong, tubular, and fused with the inflexed posterior margins of the postalar portions of the epimera. On the posterior surface of each secondary furcal arm, about midway of its length, a small, rounded lamella projects at right angles to the arm.

The *mesepimeron* is an arcuate sclerite extending from the pleural wing process to the postalar. The posterior *postalar portion* of it is incompletely separated by grooves from the rest of the epimeron, and its posterior margin is deeply inflected and joins the secondary arm of the furca. At its upper end the postalar portion of the epimeron abuts against the postalar, and together they form a flattened apodeme directed into the body.

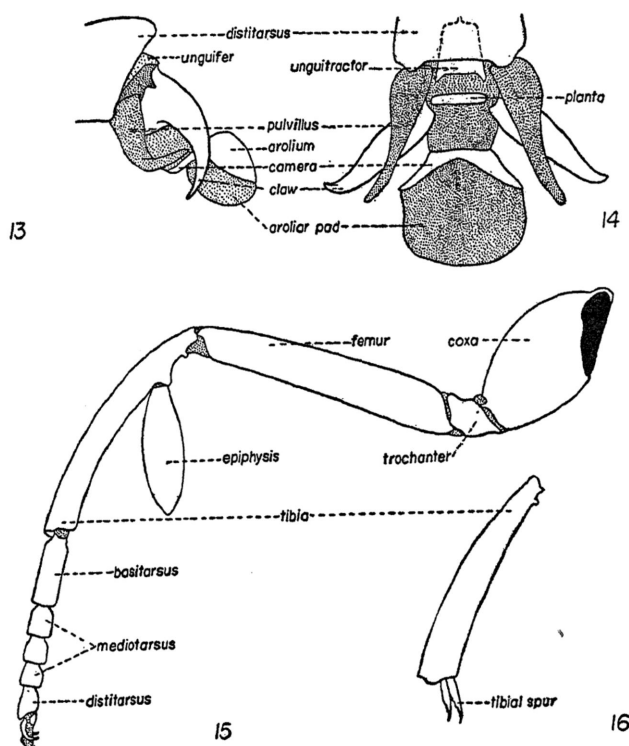
The *subalare* is very large and bears internally, near the posterior end, a lamella-

like apodeme for muscle attachment.

METATHORAX: In the *metanotum* the *metascutum* is divided into two lateral portions by the *metascutellum*. The *scutal sulci* are probably comparable to the scuto-scutellar sulci of the mesonotum. The *anterior notal wing processes* are simple projections, very unlike those of the mesothorax, but the *posterior notal wing processes* are elongate and slender, similar to those of the mesothorax.

Across the posterior margin of the *metascutellum* is a narrow band scarcely separable from the scutellum externally. Internally the line of separation is indicated by a strong ridge. This narrow band is probably the *postnotum*, since laterally it is continuous with the *postalar bridge*. As the metapostnotum is in an almost vertical position in the groove behind the metascutellum it is not visible in figure 9.

The metathoracic *coxa* is similar to that of



FIGS. 13-16. *Eacles imperialis* (Drury). 13. Lateral view of pretarsus. 14. Ventral view of pretarsus. 15. Anterior leg. 16. Posterior tibia.

the mesothorax. The *pleural suture* is also similar in many respects, but internally it lacks the apodeme connected with the tegular arm (which is absent in the metathorax) but bears lower down a long, slender, *pleural apophysis* similar to that of the mesothorax but apparently not fused with the *furca*. The pleural apophyses, however, nearly reach the lower part of the *furca*. The *secondary furcal* arms are short and horn-like, not reaching the sides of the thorax. The *basalare* lacks a large internal disc for muscle attachment. The weakly sclerotic *anepisternum* is the area sometimes called the basalare pad. The pre-coxal suture is absent. The *marginopleural suture* is present and extends to the *discrimen*. As shown in figure 8, a suture separates the *epimeron* into anterior and posterior parts, the latter continuous (as a *postcoxale*) with the *katepisternum* midventrally. The *furca* arises from a deep pit, the *sternal apophyseal pit*, between and behind the posterior coxae.

LEGS

Figures 13-16

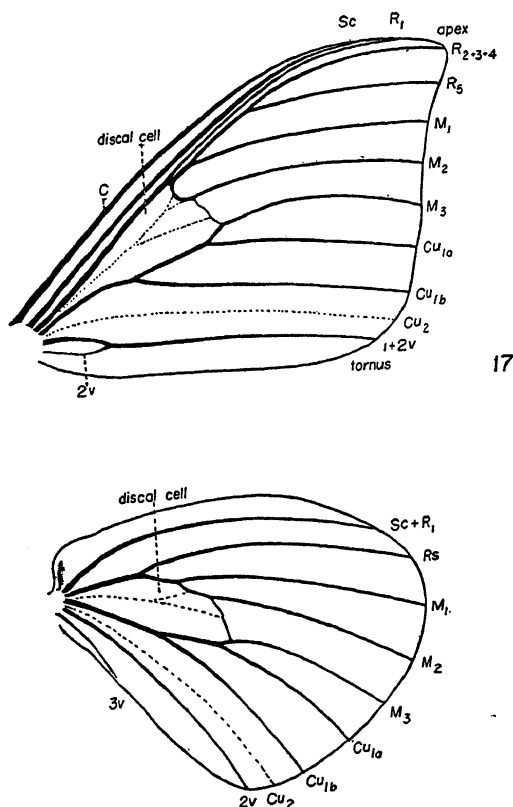
The salient features of the coxae, as they are so closely associated with the thorax, are discussed above. The tibiae of the forelegs each bears near its base a large articulated process, the *epiphysis*. It is probable that this represents a much enlarged tibial spur which has migrated towards the base of the tibia. The tibiae of the other legs each has a pair of *apical spurs*. In many Saturniidae the tibiae also bear *subapical spurs*, but these are absent in *Eacles*.

In the *pretarsus*, the *unguifer* is feebly sclerotic and the plate of the *planta* but little more heavily so; the camera is heavily sclerotic, uninterrupted ventrally, and united to the heavily sclerotic *arolium*, beneath which is the membranous *aroliar pad*. The *pulvilli* are elongate and submembranous.

WINGS

Figures 17, 18

The nomenclature of the wing veins shown in the figures is modified somewhat from that in use by most lepidopterists in order to utilize morphologically acceptable terms. Justification for these changes is to be found in the works of Tillyard (1919), Lameere



FIGS. 17-18. *Eacles imperialis* (Drury). 17. Forewing. 18. Hind wing.

(1922), Snodgrass (1935), and others. The nomenclature used for the veins labeled R_5 , M_1 , and M_2 in the forewing is subject to some question. According to Turner (1947), the trachea representing vein M of the forewing in *Antheraea* is only two-branched. Turner assumes that this means that vein M_2 is absent. Since in many saturniids, including *Eacles* (fig. 15), the basal remnant of M in the discal cell is clearly three-branched, this evidence should be rechecked. For the present it is assumed that there are three median veins.

ABDOMEN

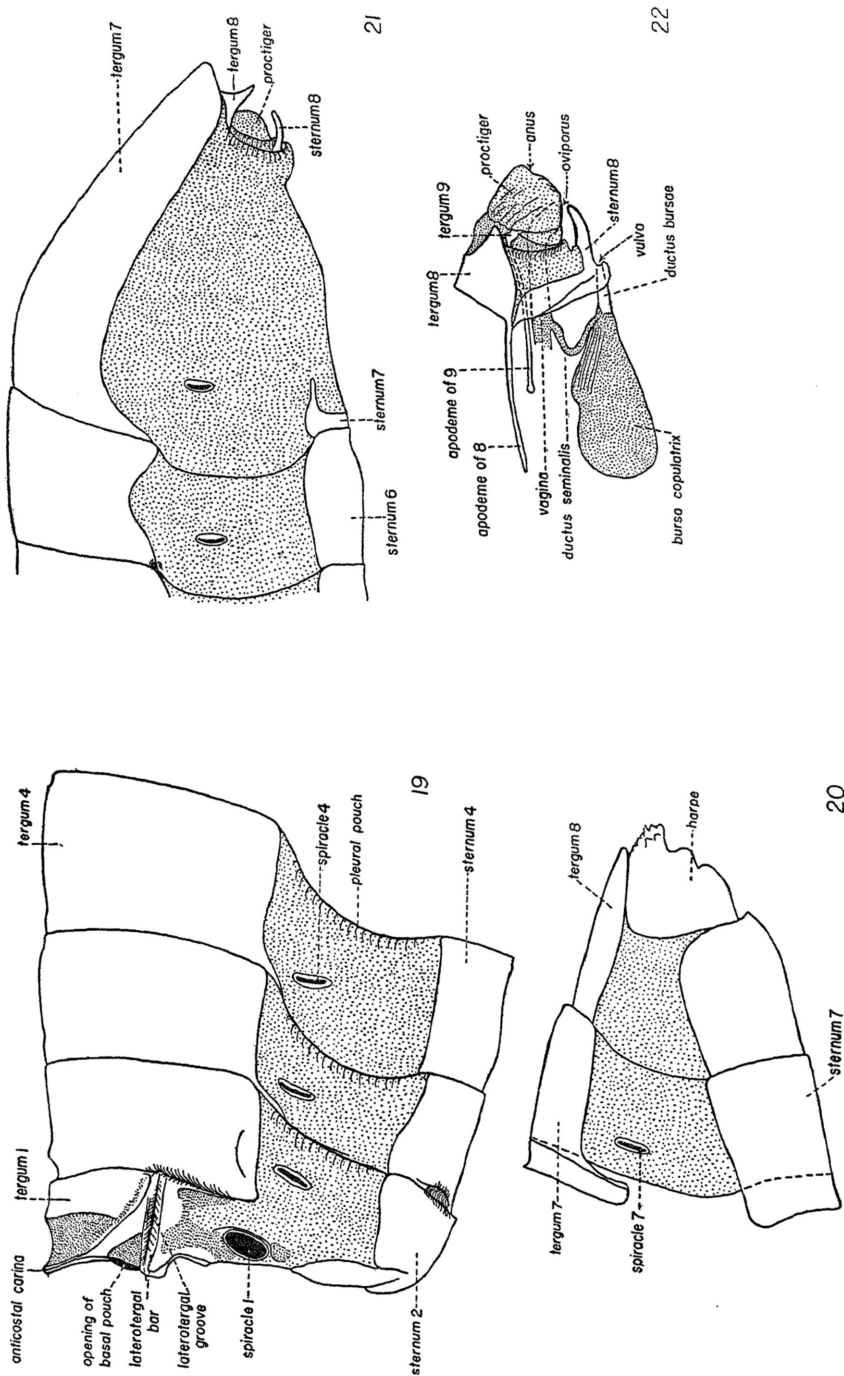
Figures 19-24

PREGENITAL SEGMENTS: The first abdominal tergum is partly membranous, and the first sternum either entirely so or fused to the second so as to be unrecognizable. The ant costa of the first tergum is large and arises from strongly sclerotic *anticostal carina*, rather than from an impressed line or suture. This carina is in contact with the acrotergite, or postnotum, of the metathorax. On each side beneath the lower extremity of the anticostal carina is a large opening into the *basal pouch* of the abdomen. This pouch is a sclerotic invagination between the postalare bridge of the metathorax and the first abdominal tergum. Beneath the opening of the pouch is a horizontal, bar-like portion of the tergum, the *laterotergal bar*, strengthened by an internal ridge represented externally by the *laterotergal groove*. Anteriorly this bar is directed inward. The posterior end reaches the second tergum, to which this portion of the first tergum is fused. The laterotergal bar is very widespread in the Lepidoptera. Its groove is not a tergo-pleural groove as indicated by some authors.

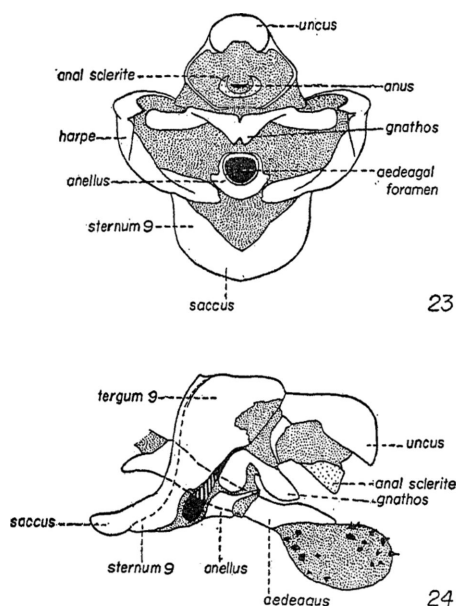
There are *spiracles* on the first seven abdominal segments, those of the first being much larger than the others. The intersegmented grooves in the membranous pleural regions are deep and form the *pleural pouches*.

FEMALE GENITAL SEGMENTS: The *eighth tergum* is small and heavily sclerotic, produced posteriorly at each side to a free point. Basally it is produced to two slender *apodemes*. The *eighth sternum* is also connected with these apodemes. Midventrally it is produced posteriorly as a strong median process. Anterior to this process a transverse slit in the sternum is the *vulva*, which divides the sternum into prevulvar and postvulvar portions. The sclerotization of the sternum is continuous through the vulva into the broad, dorso-ventrally compressed *ductus bursae*. Behind the more or less sclerotic ductus bursae is the larger, membranous *bursa copulatrix*. From a point to the right of the midline, near the posterior end of the bursa, the slender *ductus seminalis* extends upward to the *vagina*.

The *ninth tergum* is represented by a small plate on each side which is produced an-



Figs. 19-22. *Eacles imperialis* (Drury). 19. Base of abdomen. 20. Apex of abdomen of male. 21. Apex of abdomen of female. 22. Female genital structures seen in lateral view.



FIGS. 23-24. *Eacles imperialis* (Drury). 23. Ventral view of male genitalia, aedeagus removed. 24. Lateral view of male genitalia, harpes removed.

teriorly as a slender *apodeme*. Below each of the small plates the ninth segment is represented by a slightly sclerotic area which extends downward to the membranous ridges surrounding the *oviporus*, or opening of the vagina. These ridges are regarded as the sternal portion of the ninth tergum. That portion of the abdomen behind the ninth tergum, and containing the *anus*, is wholly membranous and is termed the *proctiger*. It presumably consists largely of the tenth segment, but remnants of the eleventh and even twelfth segments are perhaps included.

MALE GENITAL AND POSTGENITAL SEGMENTS: The *ninth tergum*, or tegumen, is fused at each side with the *ninth sternum*, or vinculum, to form a complete ring. The ninth sternum is produced anteriorly midventrally to form the invaginated *saccus*. The broad gonocoxites, or *harpes*, are articulated along the posterior lateral margins of the ninth sternum. Each gonocoxite is heavily sclerotic externally, but the inner surfaces are membranous except marginally. As has been indicated elsewhere (Michener, 1944b) the gonostyli are considered to be absent. The ar-

ticulated process arising on the inner surface of each gonocoxite and homologized with the gonostylus by Forbes (1939) appears to be absent in more primitive Lepidoptera (see Eyer, 1924). For this reason it is suspected that it is a derived structure, a fragmentum of the coxopodite, and homologous to neither the stylus nor the volsella of other orders.

There appears to be no good evidence concerning the fate in the Lepidoptera of the volsellae and penis valves of other orders of insects. The terms *anellus* and *aedeagus* are here used, therefore, in a morphologically noncommittal sense, it being recognized that either or both may be derived from the volsellae or from the penis valves. The *anellus* is a sclerotic ring, broken dorsally, in which the *aedeagus* lies.

The principal sclerotic portion of the tenth tergum is the *uncus*. It has been indicated by some authors (e.g., Zander, 1903) that the *uncus* is a posterior portion or "appendage" of the tenth tergum. If this is the case, the more anterior portion of the tergum is either wholly membranous and nearly wanting or is indistinguishably fused to the *uncus*. In *Eacles* the basal portion of the *uncus* is produced laterally and ventrally to form an almost complete sclerotic ring, apparently of tergal origin, beneath the anus.

The proper name for the structure here called the *gnathos* is in doubt. It is the heavily sclerotic median structure, connected at each side to a slender arm which is part of the *harpe*. Such a structure should be called a

TABLE 1

THE PRINCIPAL STRUCTURES OF THE
MALE TERMINALIA

Tegumen	Ninth tergum
Vinculum	Ninth sternum
Saccus	Midventral cephalad invagination of ninth sternum
Harpes	Gonocoxites
Uncus	Sclerotic portion of the tenth tergum
Gnathos	Sclerotic portion of the tenth sternum
Transtilla	A sclerotic gonocoxal bridge between the upper basal angles of the gonocoxites, passing above the aedeagus and below the gnathos
Anellus or juxta	Sclerotized wall of the pouch in which the aedeagus lies
Aedeagus	Sclerotic and membranous intromittent organ

transtilla (see Busck and Heinrich, 1921) because of its connection to the harpes. There is, moreover, in *Eacles* and others a narrow sclerotic ribbon above the gnathos and connected at its ends to the base of the uncus. This is more likely to be the gnathos proper. However, in many saturniids the structure here called the gnathos is connected to the base of the uncus or to the ninth tergum in addition, or instead of, to the harpes. For this reason the whole subject of what should be called gnathos and what transtilla is in doubt. The most recent discussion of the male genitalia of Lepidoptera (Viette, 1948) does not clarify the matter. The word gnathos

has tentatively been utilized throughout the Saturniidae. The *anus* is on a small projection below the uncus. The ventral and lateral walls of this projection are slightly sclerotic and have been called the anal sclerite. Since no such sclerite is present in the majority of Lepidoptera, it is considered a secondary sclerotization.

In table 1 the morphological equivalents, where known, of the principal parts of the male terminalia are shown. The terms in the left-hand column are those used by Busck and Heinrich (1921), which have been widely accepted among lepidopterists.

COMPARATIVE MORPHOLOGY

THE SATURNIID MOTHS appear to be most closely related to the small South American families Oxytenidae and Cercophanidae which were the subject of an excellent study by Jordan (1924). From an examination of these moths, particularly the Oxytenidae, it has been possible to learn a great deal as to which characters of the various saturniids are primitive and which are derived. For example, in the Oxytenidae the galeae are large and curled, forming an apparently functional proboscis, and bear large carinate papillae. In certain of the Rhescyntinae (Saturniidae), which on other grounds also are considered the most primitive of the saturniids, the galeae, although reduced to evidently functionless rudiments, are provided with carinate papillae. The presence of these papillae in the Rhescyntinae is therefore considered a primitive character so far as the saturniids are concerned. Similarly, the presence of three-segmented labial palpi is characteristic of most Lepidoptera, including many saturniids; a reduced number of segments is obviously to be regarded as a modification, or a derived character. By reasoning such as this, numerous characters have been judged as to degree of specialization so far as the Saturniidae are concerned and in table 2 have been placed accordingly. Table 2 thus consists of a list of evolutionary trends noted in the Saturniidae. Of course some characters listed under "primitive" are highly specialized when considered in connection with the Lepidoptera as a whole, and are primitive only in relation to the Saturniidae.

There are no saturniids possessing all the characters listed in table 2 under "primitive." However, certain Rhescyntinae agree with most of them, as do also some Oxytenidae. Indeed the most primitive members of each of the seven subfamilies of Saturniidae here recognized agree with the majority of the characters in the "primitive" column of the table, while there are derived representatives in several of the subfamilies which agree with many of the characters in the "specialized" column of table 2. Many of the conditions described in the "specialized" column have been attained independently within the

different subfamilies, or even several times within a single subfamily.

In the following pages most of the characters in table 2, and in addition certain others that do not lend themselves to such tabulation, are discussed in some detail and the evidence that they shed on relationships is indicated. Although the subfamilies are not defined until later, their names are utilized in this section in order to avoid the cumbersome listing of numerous generic names.

In most of the subfamilies of Saturniidae, and also in the Oxytenidae, the frons is flat or nearly so along the inner margins of the eyes, and the laterofrontal sutures (figs. 25, 26) are visible running parallel to these margins and often very close to them. Usually the areas between these sutures and the eye margins are smoother and more shining than the main portion of the frons between the laterofrontal sutures. Because of this difference in sculpturing the location of the sutures can usually be determined even when they are exceedingly faint. In the Citheroniinae (fig. 1), however, the main portion of the frons is convex at the sides, the convexities overhanging the laterofrontal sutures and completely hiding them as well as the areas between them and the eye margins except at their upper and lower extremities. The same is true to nearly the same degree in the tribe Attacini of the Saturniinae, and some convexity is evident in the genus *Hirpida* of the Hemileucinae.

In most of the groups of saturniids the lower end of the frons is produced to form a distinct and dorsoventrally flattened projection termed the frontal protuberance. In the Oxytenidae and Cercophanidae the frontal protuberance is either absent or represented by a thickened projection quite different from that characteristic of most saturniids. In the Saturniidae, however, the presence of a projection is apparently a primitive character, for there is a distinct though blunt and transverse protuberance present in the Rhescyntinae as well as in many members of other subfamilies. In the Citheroniinae the protuberance is often very strong though sometimes low and transverse. The same is true of the Hemileucinae, although in *Polythysana*, in brachypterous females of *Ormis-*

TABLE 2

PRIMITIVE AND SPECIALIZED CHARACTERS IN THE SATURNIIDAE

Primitive	Specialized
Frons flat at side, next to eyes	Frons convex at sides, next to eyes
Laterofrontal sutures visible	Laterofrontal sutures obscured by convexity of sides of frons
Frontal protuberance broad, transverse	Frontal protuberance elongated
	Frontal protuberance absent
Shortest distance between eyes one-third to one-half length of an eye	Shortest distance between eyes one-fifth length of an eye
	Shortest distance between eyes one and one-half times length of an eye
Eyes large, upper ends extending above lower margins of antennal sockets, lower ends extending below lower end of frons	Eyes smaller, not reaching lower margins of antennal sockets or lower end of frons
Antennae many segmented, longer than thorax	Antennae fewer segmented, shorter than thorax
Flagellum scaled above	Flagellum not scaled
Rami arising laterally from antennal segments	Rami arising dorsolaterally from antennal segments
Flagellum of male narrowly quadripectinate to apex	Flagellum of male broadly quadripectinate to apex
	Flagellum of male quadripectinate only basally
Flagellum without bristles	Flagellum of male bipectinate
	Rami and shaft of flagellum with certain setae enlarged into bristles
Apical rami arising adjacent to basal rami of following segment	Bases of rami well separated
Antennal shaft not carinate beneath	Antennal shaft carinate beneath
Antennal cones simple	Antennal cones multiple
Antennal cones limited to apical portion of flagellum	Antennal cones recognizable to base of flagellum
Pilifers conspicuous, bearing bristles	Pilifers small and bare or even absent
Clypeus separated from frons by distinct groove	Clypeus indistinguishably fused to frons
Proboscival fossa deep, with vertical walls	Proboscival fossa absent, walls absent
Galeae rather long and curled	Galeae absent
Galeae with carinate papillae	Galeae without papillae
Labial palpi arising near posterior end of proboscival fossa	Labial palpi arising in front of middle of fossa
Labial palpi three-segmented, reaching in front of frons	Labial palpi one-segmented, not reaching clypeus
Anepisternum large, anepisternal suture slanting strongly downward posteriorly	Anepisternum small, anepisternal suture slanting upward posteriorly
Anterior and middle tibiae subequal to tarsi in length, not armed with spines	Anterior and middle tibiae shorter than tarsi, armed with spines
Epiphyses large, reaching nearly to apices of tibiae	Epiphyses absent
Tibial spurs twice as long as diameter of tibia	Tibial spurs as long as diameter of tibia
Only apices of tibial spurs flat or concave on one side, with serrate margins	Tibial spurs flat or concave on one side, with serrate margins nearly to base
Posterior tibiae with a pair of subapical spurs	Posterior tibiae without subapical spurs
Tarsal spines numerous	Tarsal spines absent
Penultimate fore tarsal segment of female with apical lobes, each bearing a spine	Penultimate fore tarsal segment of female without apical lobes or spines
Last fore tarsal segment of female scaled beneath	Last fore tarsal segment of female bare beneath
Arolium and pulvilli well developed	Arolium and pulvilli absent
Wings large and broad	Wings small, giving the insect a sphingid-like aspect
Vein R ₁ of forewing present	Vein R ₁ of forewing absent
Vein R ₂ of forewing present	Vein R ₂ of forewing absent

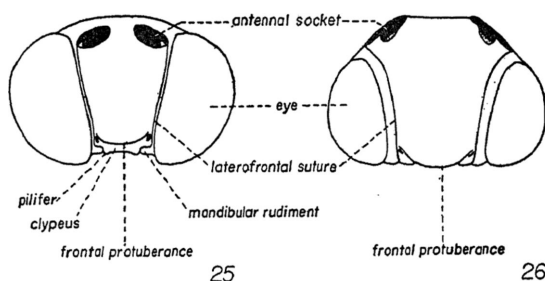
TABLE 2—Continued

Primitive	Specialized
Vein M_2 of forewing arising near middle of apex of discal cell	Vein M_2 of forewing arising from anterior apical angle of cell and stalked with M_1
Vein 2V of forewing present	Vein 2V of forewing absent
Vein 3V of hind wing present	Vein 3V of hind wing absent
Discal cell closed	Discal cell open
Anellus free from harpes and ninth sternum	Anellus fused to harpes or ninth sternum, or absent
Harpes freely articulated to ninth segment	Harpes fused to ninth segment
Harpes cleft, the portion below the cleft often curved up mesad to upper portion	Harpes with homologue of portion below cleft modified into large spine arising from inner surface
Nocturnal	Diurnal

codes subgenus *Meroleuca*, and in certain species of *Hylesia* the protuberance is entirely absent. The protuberance is present and strong in the Salassinae, but is apparently invariably absent in the Agliinae, the Ludiinae, and the Saturniinae, although in some groups of the last subfamily it is replaced by a projection of the clypeus, which is superficially very similar to that found on the frons in other subfamilies.

The size of the eyes has varied independently within different groups of saturniids. In most groups which on the basis of other characters must be classified as primitive the shortest distance between the eyes is about one-third of the length of an eye or slightly more. In these groups also the upper ends of the eyes extend above the lower margin of the antennal sockets, and the lower ends of the eyes extend below the lower end of the face. In various groups scattered through the subfamilies, the eyes are much closer together, the shortest distance between the eyes sometimes being as little as one-fifth of the length of an eye. More radical changes occur, however, in other groups, also scattered through the subfamilies. In these the size of the eyes has been markedly reduced, so that in some cases the distance between the eyes is as great as one and one-half times the length of an eye, and the upper ends of the eyes do not reach the lower margins of the antennal sockets, and the lower ends do not reach the lower end of the face. In such groups also the frontal protuberance is usually very low and transverse, and very commonly the labial palpi are reduced, one-segmented, and the proboscis fossa is very shallow or almost

completely absent. It is not evident why a correlation should exist between these different and apparently unrelated structures of the head. Examples of such reduction in eye size and associated structures are found in certain species of *Anisota*, in the subgenus *Heliconisa* of the genus *Dirphia*, in the genus *Calcedirphia*, in the genus *Hemileuca* (fig. 26), and in others.



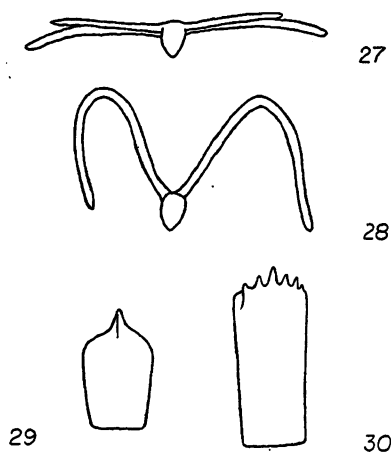
FIGS. 25-26. Anterior view of head. 25. *Rhescynthis* (*Arsenura*) *xanthopus* (Walker). 26. *Hemileuca* (*Pseudohazis*) *eglanterina* (Boisduval).

The antennae are primitively longer than the thorax and many segmented. However, in most Citheroniinae they are shorter than the thorax, and the same is true in a few Hemileucinae, notably the genus *Automerina*, in certain species of which they are extraordinarily short, being only about one-half of the length of the thorax. Although the lack of scales on the flagellum is often given as one of the characteristics of the Saturniidae, it is by no means a constant one. The flagellum is densely scaled above in certain saturniids as well as in the related family Oxytenidae. In the subgenus *Periga* of the genus *Lonomia*

(Hemileucinae) the axis of the flagellum is densely scaled to the apex in both sexes. This is unique among male saturniids so far as known, but dense scaling to the apex or nearly so is fairly common among females of certain genera. The presence of such scales on the antennae of females appears to be of little or no phylogenetic significance, for it occurs in occasional genera scattered through the entire family. The dense scaling in *Lonomia* may, however, be a primitive character, for the antennae, again of the subgenus *Periga*, exhibit another clearly primitive character. The rami of the flagellum arise not from the upper portions of the sides of the segments as in all other true saturniids but from lower down on the sides, more as in the oxytenids which *Lonomia* resembles to some extent in general appearance. It is not clear whether these primitive antennal characters of *Periga* indicate a close relationship to the oxytenids or are merely a reversion of some sort from forms having the typical saturniid antennal structure. The small anepisternum, the absence of subapical spurs on the posterior tibiae, and the absence of tarsal spines in *Lonomia* all indicate high specialization.

It is with some hesitation that I have listed "flagellum of male narrowly quadripectinate to apex" under "primitive" in table 2, for in

the Oxytenidae and the Cercophanidae the flagellum of the male is in every case rather broadly bipectinate. However, from a study of the saturniids it is evident that, at least for the majority of them, the quadripectinate condition is the primitive one within the family. There has been reduction, the various steps of which can very easily be studied, from quadripectinate to bipectinate in numerous genera of Saturniidae. The only genus of saturniid in which the bipectinate condition appears to be possibly primitive is *Lonomia* which, as already indicated, exhibits other primitive features in antennal structure. In the Rhescyntinae and the most primitive of the Citheroniinae the flagellum of the male is narrowly quadripectinate to the apex. In the majority of Citheroniinae the distal portion of the antenna has lost its pectination, so that the flagellum is quadripectinate only in its basal portion. In the Hemileucinae the antennae are bipectinate in the genus *Hemileuca*, in *Lonomia* as already indicated, in certain subgenera of *Ormiscodes*, *Dirphia*, *Catacantha*, and others. Throughout the saturniids, when the antennae are quadripectinate the rami are not strongly bent downward (fig. 27), and the setae that they bear are arranged so that those of the basal rami are directed towards the apex of the antenna and those of the apical rami are directed towards the base of the antennae. On the other hand, when the antennae are bipectinate the remaining rami, which are the basal ones, are elongated and usually bent more or less strongly downward medially (fig. 28), so that their basal portions are directed upward but the distal portions are directed downward. The setae arising from such rami are directed principally downward. Every intergradation between these two conditions can be found in certain genera of saturniids, particularly in the subfamily Hemileucinae. For example, in *Dirphia*, in the subgenus *Dirphia*, the antennae of the male are quadripectinate, with the distal rami usually almost as long as the basal ones and the setae directed as usual in quadripectinate antennae. In the subgenus *Periphoba*, however, the distal rami are greatly reduced, being mere stubs on the outer side of the antenna. Correspondingly the basal rami are elongated and bent downward and their



FIGS. 27-30. Diagrams of antennal structures of males. 27. Apical view of median flagellar segment of *Automeris io* (Fabricius). 28. The same of *Hemileuca maia* (Drury). 29. Ventral aspect of a subapical antennal segment of *Automeris io* (Fabricius). 30. The same of *Hyalophora promethea* (Drury).

setae tend to be directed downward. The extreme of this development appears in *Dirphiopsis* in which the antennae are typically bipectinate. Again in the genus *Dirphia* the same series can be traced through the subgenera *Eudyaria*, *Ithomisa*, and *Heliconisa*, although in the last the antennae are not quite bipectinate, for the distal rami are represented by stubs on the inner side.

Although bristles are present on the antennal rami of the Oxytenidae, it seems probable that in the Saturniidae the absence of bristles is a primitive character, for there are no bristles on the antennae of the males in the Rhescyntinae and Citheroniinae, nor are there in the Agliinae, Ludiinae, or most genera of Saturniinae. They are very common, however, though by no means of invariable occurrence, in the Hemileucinae, reaching their maximum development in the genus *Cerodirphia*.

In most of the groups of saturniids having quadripectinate antennae the apical rami arise adjacent to the basal rami of the following segment, so that if the segmentation is ignored the rami appear to arise in pairs. Only in the Saturniinae, the Salassinae, and in the genus *Goodia* of the Ludiinae are the bases of the rami well separated in forms having quadripectinate antennae.

In the saturniids that on the basis of other characters appear to be most primitive the flagellum lacks a ventral carina. However, in the genus *Ceropoda* of the Citheroniinae and in many of the genera of Hemileucinae there is a more or less strong longitudinal carina on the under side of the shaft of the flagellum.

The antennal cones when present in the Oxytenidae are simple, laterally compressed projections arising from the apices of the under surfaces of the distal antennal segments. These cones are acutely pointed. They are essentially similar in structure in most of the Rhescyntinae, in the Citheroniinae, in the Ludiinae except for *Goodia*, in the Agliinae, and in the Hemileucinae (fig. 29). In the Saturniinae (fig. 30), however, and also in the genus *Goodia* in the Ludiinae and in two subgenera of *Rhescyntis* and in the genus *Copiopteryx* (Rhescyntinae) the antennal cones are multiple, that is, at the apex of each distal segment of the antenna there is, instead of a single cone, a more

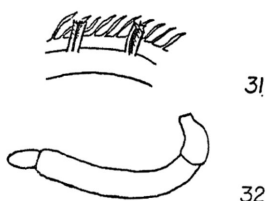
or less broadly produced region which is divided to form numerous spicules or separate projections. A somewhat intermediate condition exists in *Polythysana* (a Chilean genus tentatively included in the Hemileucinae) in which there are no laterally compressed antennal cones such as are characteristic of other Hemileucinae, but there are dorsoventrally compressed, slightly eroded projections suggestive of the projections that bear the cones in those forms having multiple cones. Similar reduction of the cones occurs in the genus *Saturnia*, in some members of which cones are altogether absent. In others they are represented by weak eroded projections. In some (for example, the subgenus *Calosaturmia*) there are simple blunt projections suggestive of those of some of the groups that typically have simple cones. The antennal cones are absent in the Salassinae.

The pilifers in a great many moths are provided with tufts of bristles. Such bristles are present in *Janiodes* of the Cercophanidae, although they are absent in other cercophanids and in the oxytenids. They are also present in all members of the subfamily Rhescyntinae, except for one species in which the pilifers lack bristles although bristles are present along the clypeal margin between the pilifers. Otherwise, bristles are absent from the pilifers in the Saturniidae.

In Lepidoptera in which the proboscis is functional, this organ is ordinarily curled between the labial palpi and fits into a groove termed the proboscidial fossa on the under surface of the head. This groove is large and conspicuous in the majority of saturniids in spite of the great reduction in the proboscis. However, scattered throughout the subfamilies of the Saturniidae there are genera or subgenera in which the depth of the fossa is greatly reduced so that its walls become sloping or disappear completely. As indicated above, this reduction is commonly associated with reduction in the size of the eyes and the size of the labial palpi.

The galeae in the Oxytenidae are curled and bear numerous carinate papillae of very large size. Such papillae are present in almost all genera of the Rhescyntinae in which the galeae are at all well developed. They are of course absent in the genera in which the galeae are greatly reduced or absent. In spe-

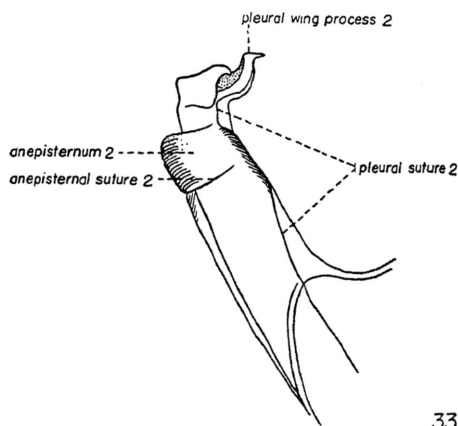
cies having well-developed galeae and a large proboscival fossa, the labial palpi are usually large and three-segmented and arise from near the posterior end of the proboscival fossa. This is the condition found in the Rhescyntinae, in the Agliinae, and in some members of all the other subfamilies except the Ludiinae. In the Ludiinae and many of the Citheroniinae, Saturniinae, and Hemileucinae the labial palpi are much reduced in size to two segments or even to one. Correlated with this reduction their bases frequently move forward so that the palpi may arise in the middle of the proboscival fossa instead of at its posterior end. In American forms the extremes of reduction are found in *Hemileuca* in the Hemileucinae, in which the



FIGS. 31-32. 31. Portion of galea of *Oxytenis*. 32. Maxillary palpus of *Asthenidia*.

labial palpi are not only reduced to unsegmented structures but are fused together to form a single structure which is sometimes bilobed at its apex, and in *Saturnia* in the Saturniinae in which the palpi are likewise reduced to very short, almost globular structures and are sometimes fused together.

In the mesothoracic pleuron the size of the anepisternum and the direction of the anepisternal suture provide characters of considerable importance in judging the relationships of the saturniids. In a great many moths, including the oxytenids and many saturniids, the anepisternal suture is directed somewhat downward posteriorly, reaching the pleural suture at or below the lower end of the deeply impressed portion of the latter so that the anepisternum is large. This is the situation in the Rhescyntinae, Citheroniinae (fig. 8), Agliinae, and Ludiinae. In the Salasinae and Saturniinae the anepisternum is relatively small, because the anepisternal suture is horizontal or slants upward posteriorly as shown in figure 33. In the Hemileucinae both conditions exist, most genera



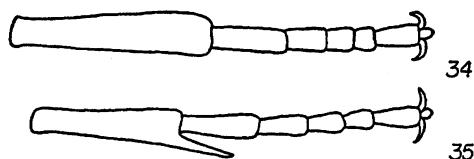
33

FIG. 33. Anterior part of mesothoracic pleuron of *Actias luna* (Linnaeus).

having the anepisternum small, but in *Automeris* there is very great variability in its size and shape and sometimes it is large as in many of the Citheroniinae. In *Hirpida* also the anepisternum is large, with the anepisternal suture slanting downward posteriorly.

The fore and middle tibiae are ordinarily subequal to the tarsi in length and without apical spines (fig. 34). However, in certain genera of the Citheroniinae, certain Old World Saturniinae, and a number of genera of the Hemileucinae the fore tibiae or in some instances also the middle tibiae are considerably shorter than the tarsi and provided with one or more long apical spines (fig. 35). These spines are not at all similar to the tibial spurs but are heavy, immovable projections from the apices of the tibiae. They seem to be of little or no phylogenetic significance, as they occur in unrelated groups of the family. They may be correlated with some habit of the adult. For example, they may be useful in digging out of the ground, if pupation in such genera occurs beneath the surface.

In the Oxytenidae and indeed in the majority of moths the middle and hind tibiae



FIGS. 34-35. Diagrams of anterior tibiae and tarsi. 34. *Automeris io* (Fabricius). 35. *Hemileuca maia* (Drury).

bear tibial spurs which are much longer than the diameter of the tibiae and are scaled to their apices. The posterior tibiae bear a pair of subapical spurs as well as the apical pair. In the Saturniidae these spurs have bare apices which are ordinarily flat or concave on one side, the resulting margins being toothed or serrated in most cases. Throughout the saturniids there is a tendency for the spurs to become shorter, for the subapical spurs of the posterior tibiae to disappear, and for a progressively greater portion of the spur to become concave on one side, with serrated margins. Thus in the Rhescyntinae the spurs are usually considerably longer than the tibial diameter, with only the extreme apices curved and horny and bare. In the Citheroniinae the spurs are usually shorter, the subapical ones of the posterior tibiae are absent, and the horny serrated portion is usually short. The same is true in the Ludiinae, Agliinae, and Saturniinae. In the Salassinae there is one subapical spur on each posterior tibia. In the Hemileucinae the tibial spurs are extremely variable, sometimes being quite long and the posterior tibiae sometimes having a subapical pair of spurs. In other groups, however, the tibial spurs are nearly as short as in the Saturniinae, and the subapical spurs of the posterior tibiae may be reduced to one or be completely absent. The reduction in the number of subapical spurs of the posterior tibiae has occurred independently in the different groups. For example, in the genus *Ormiscodes* every intergradation can be found from species with two distinct subapical tibial spurs to species with none whatever. Among the genera related to *Automeris*, *Adetomeris* has two subapical spurs, the others but one. In the Hemileucinae there is a strong tendency for the concave portion of the tibial spurs to become greatly elongated towards the base of the spur, so that this portion of the spur occupies three-fourths or more of the total length of the spur. This condition is by no means universal in the subfamily, but it is very common as can be seen from the descriptions of the genera presented below.

In many moths there are spine-like setae widely scattered on the tarsal segments. In all the saturniids and their relatives these setae if present are confined to the under surfaces of the segments. Although such setae are ab-

sent in the Oxytenidae, they are present in Cercophanidae and in many of the groups of the Saturniidae. They are present in most Rhescyntinae, many Saturniinae, in many Ludiinae, and in the Agliinae. They are rare in the Hemileucinae, although they do occur in some groups, for example, *Hirpida*, *Callo-dirphia*, and *Adetomeris*. They appear to be absent in all Citheroniinae. Two of these spine-like setae are of nearly constant occurrence in the Saturniidae and their relatives. They are usually larger than the other spine-like setae, when others are present, and they arise from the apical lobes of the penultimate fore tarsal segment of the female. These structures, which for the sake of simplicity have been called spines elsewhere in this paper, occur in the Oxytenidae, Cercophanidae, and Saturniidae. So far as known, in the last family they are absent only in two small subgenera of *Dirphia*, in brachypterous females of *Ormiscodes* (subgenus *Meroleuca*), and in the genus *Coloradia*, although in the latter genus the lobes of the penultimate segment bear several spines which are not in any way differentiated from spines occurring elsewhere on the tarsi. The spine-bearing lobes of the penultimate fore tarsal segment of the female are bare or largely bare in the Saturniidae. The spine projecting from each lobe overlies a bare area on the following tarsal segment. In this area is an oval or crescentic structure slightly suggestive of a spiracle in general appearance. It appears that by movement of the last tarsal segment the spines of the preceding segment can be rubbed on these areas. The bare areas of the last fore tarsal segments of the female often extend as more or less broad bands to the apex of the segment, and in some genera, particularly in the Saturniinae, the entire under surface or sole of the segment is bare.

The arolium and pulvilli are well developed in almost all the saturniids. Among forms occurring in the Western Hemisphere they are absent in *Hemileuca* and *Coloradia* of the Hemileucinae and reduced in some *Saturnia* (Saturniinae).

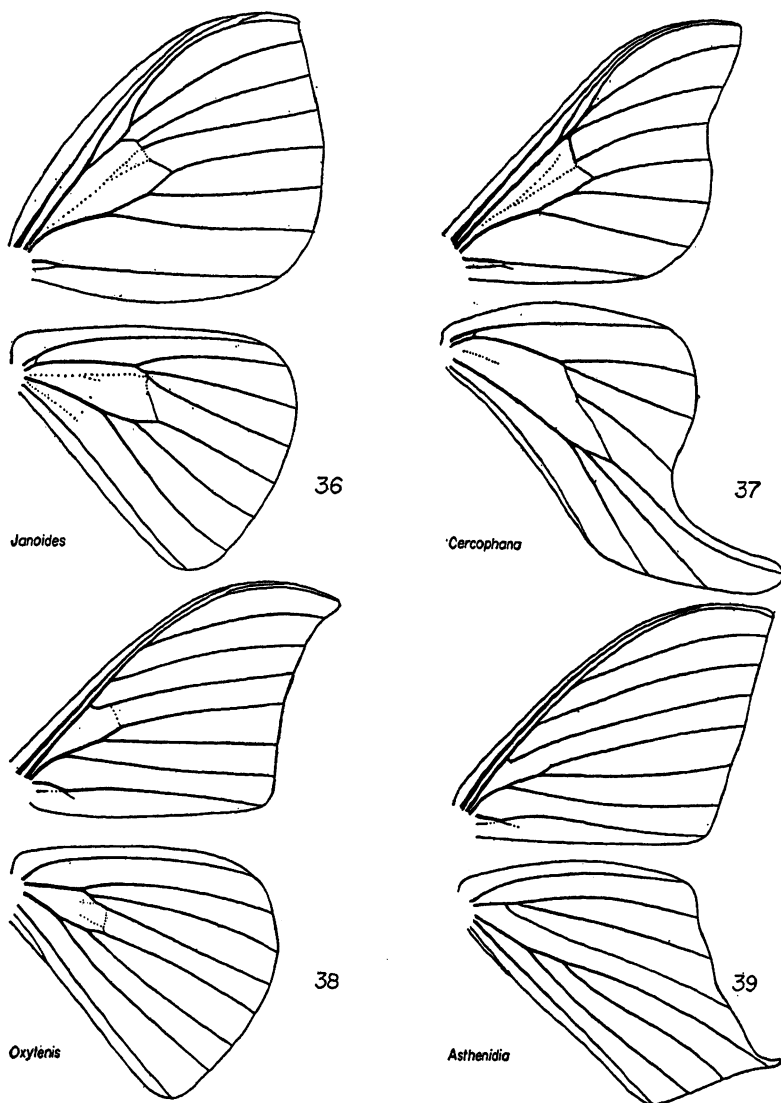
There are numerous characters of phylogenetic significance in the wing venation. For example, the discal cell of both wings is open in certain Saturniinae, closed in other members of the family. This is an obvious special-

ization of the groups of Saturniinae involved. The position of the base of vein M_2 of the forewing has received much attention in the study of these moths. In the Rhescyntinae the base of this vein is but little in front of the middle of the apex of the discal cell. The same is true of *Hylesia* (most species), *Lonomia*, *Travassosula*, and a number of other genera of Hemileucinae as well as of the Ludiinae. In most other groups, however, the base of M_2 has moved forward, so that sometimes it arises from the anterior apical angle of the discal cell. This is particularly characteristic of the Saturniinae and Salassinae in which there is a distinct notch between the apex of the discal cell and the $R_{1+2+3+4}$ stem. Such a notch occurs also in many Ludiinae and in the genus *Hemileuca* of the Hemileucinae. In other groups the base of M_1 is very close to the base of the $R_{1+2+3+4}$ stem, so that there is little or no notch between the two. Indeed in many, the base of M_1 is stalked with the base of the radial stem. In almost all Citheroniinae there is a particularly strong connection between the base of M_2 and the radial veins. In the Cercophanidae the base of vein R of the hind wing persists, forming a short transverse vein between Sc and R. This is absent in the Oxytenidae and Saturniidae except for a faint indication in at least some *Lonomia* (Hemileucinae). In most saturniids there is a small cell at the base of the forewing between the bases of veins 1V and 2V. This cell is open in most Citheroniinae but is closed in other groups. In the oxytenids and in the genus *Cercophana* of the Cercophanidae and in the genera *Antheraea* and *Actias* of the Saturniinae, this small vannal cell bears an appendage arising from its posterior apical portion. In the Oxytenidae, Cercophanidae, and the very great majority of the Saturniidae vein 3V of the hind wing is either absent or short, being less than half as long as vein 2V. In the latter case it is always weak, being considerably thinner than vein 2V. Only in the genera *Coloradia* and *Hemileuca* is vein 3V thick and about three-fourths as long as vein 2V. This has been regarded as a primitive character and it may be one, but it is difficult to see how such a structure, which does not occur in other saturniids or in any of their close relatives, could be inherited by these otherwise highly specialized members of

the subfamily Hemileucinae. It seems more likely that the large 3V is a reversion to a primitive type which occurred in an ancestor of *Hemileuca* and *Coloradia*, but that these genera arose from saturniids in which 3V was a small vein. In females of certain species of the subgenus *Meroleuca* of the genus *Ormiscodes* (Hemileucinae) the wings are reduced to small, hairy pads.

The male genitalia have been very widely used as indicators of relationships in the Saturniidae. They offer excellent specific as well as generic characters. There is little point in discussing here the many modifications that result in the characters used to separate the various genera, for these characters are figured for each genus, and the more important ones are described as well. There are, however, certain important trends in the modifications. Some of these are discussed below. Primitively the annellus is free from the harpes and from the ninth sternum and consists of a rather large sclerite, often extending upward on either side of the aedeagus. Independently in different groups of Citheroniinae and Hemileucinae the annellus becomes fused to the bases of the harpes and to the ninth sternum or is reduced in size to the point where it sometimes disappears completely. Not infrequently it is divided medially into two parts, each of which is fused to the base of a harpe (see for example, *Ceropoda*). This condition can sometimes be recognized only by the presence of a projection from the lower margin of each harpe near the base. These projections are homologous to the processes of the undivided annellus that extend upward on either side of the aedeagus. Another line of development which can be seen to have occurred independently in different groups of Citheroniinae and Hemileucinae is the fusion of the harpes to the ninth segment. This begins at the lower extremities of the harpes, but in its extreme form, as in *Dirphia*, the harpes are completely fused to the ninth segment and are apparently completely immovable.

In the Oxytenidae and the more primitive members of each of the subfamilies of the Saturniidae, the harpes are cleft by a distinct notch in the outer margin which is often prolonged as a membranous line part way or almost all the way across the harpe. The por-



FIGS. 36-39. Wings of Cercophanidae (36, 37) and of Oxytenidae (38, 39). 36. *Janoides ecuadorensis* (Dognin). 37. *Cercophana venusta* (Walker). 38. *Oxytenis modesta* (Cramer). 39. *Asthenidia* sp.?

tion of the harpe below this cleft is often thickened at its apex and bent upward mesad of the portion above the cleft. Harpes of this general nature can be seen in most of the Rhescyntinae, in some of the Citheroniinae, for example *Schausiella*, in a few of the Hemileucinae, for example *Hirpida*, and in many of the Saturniinae. Modification from this general type is principally in the direction of reduction of that portion of the harpe below the cleft and increase in size of the

portion above, the latter being the main broad portion of the harpe of many genera. In those Citheroniinae in which the genitalia are considerably modified, it can be seen that the portion below the cleft has been bent upward to form a large inner spine which may bend towards the base of the harpe and finally emerge as a free spine from the base of the upper portion of the harpe. This condition can easily be observed in several groups of the genus *Adelowalkeria*. The inner spine of

the harpe that is frequently observed in the Hemileucinae is also a derivative of that portion of the harpe below the cleft, although the cleft is evident in but few members of this subfamily.

There are also characters of considerable phylogenetic importance to be found in the larvae of the Saturniidae, a great many of which have been figured by Packard and others. In the young larvae of the Rhescyntinae and the Agliinae there are two or more pairs of large thoracic horns which are forked at their apices. In the mature larvae, however, these horns are absent, and there are not even tubercles on the body surface. In the Citheroniinae one or more pairs of such horns are present. They are usually forked at their apices in the early stages, but in the mature larvae they are unforked. In the Hemileucinae the larva is provided with tubercles which are often elongated and which are covered with numerous coarse, sharply pointed spines. In some genera, and particularly in young larvae, some of the tubercles of the thorax which correspond to the horns of the subfamilies mentioned above are more elongated than the other tubercles of the body, but they are covered with the coarse,

pointed spines as usual in this subfamily. In the Ludiinae the tubercles are short and bear a mixture of sharply pointed spines and long hairs. In the Saturniinae there are tubercles that are sometimes elongated into cones. They are often spiculate and sometimes provided with hairs or short spines, or, in other groups, the tubercles are virtually absent. In some the thoracic tubercles corresponding to the horns of the Citheroniinae are longer than the others, but they are not forked apically even in young larvae.

In the Oxytenidae the pupa is not enclosed in a cocoon. The same is true of the Rhescyntinae and the Citheroniinae. In all the other subfamilies the pupa is ordinarily enclosed in a cocoon, but in certain African groups of the Saturniinae and in a few Hemileucinae no cocoon is formed.

Although this work is primarily on the Saturniidae of the Western Hemisphere, figures of the wing venation and genitalia of certain cercophanids and oxytenids are included because of their close relationship to the saturniids, and of the Old World *Aglia* because of its relationship to the New World subfamilies.

PARALLELISMS

IN THE PRECEDING SECTION repeated references are made to structures that are independently lost or to new structures independently gained in various saturniids. Although these parallelisms have been more fully treated in a separate paper (Michener, 1949a), a discussion of them here seems necessary.

As already indicated, the posterior tibiae of most moths bear a pair of subapical spurs in addition to the apical pair. The subapical pair is retained in many members of the large genus *Rhescyntis* (Rhescyntinae) and is retained, or perhaps regained, in *Adetomeris* and some *Ormiscodes*, members of the subfamily Hemileucinae. In all other saturniids one or both of the subapical spurs are wanting. Both are absent in all members of some of the large groups such as the Citheroniinae and Saturniinae. In the Hemileucinae one is absent in most groups, and all stages in the reduction of the remaining one can be found in several genera. The loss of this remaining subapical spur seems to have occurred independently 14 times in the Hemileucinae, if the phylogeny indicated in diagram 1 (p. 370) is correct. Even if some misinterpretations of phylogeny be allowed, the spur must have been lost at least 10 times.

The epiphyses, or anterior tibial spurs, are frequently lost in the Saturniidae. They are more stable in males than in females, having disappeared in males of American forms only four times. All groups lacking epiphyses in males also lack them in females. In addition, they are wanting in females of 12 other groups. If the possibility of errors in the phylogenetic tree of the subgenera of *Ormiscodes* be assumed, this means that the epiphyses of the female were independently lost at least 10 times during the evolution of the Saturniidae.

The labial palpi in the Saturniidae vary from large, three-segmented structures projecting far in front of the head, as in most Lepidoptera, to small, one-segmented globules, which may become fused together. Labial palpi are considered "reduced" in groups in which they extend but little beyond the clypeus and are one-segmented, or incompletely two-segmented. This degree of reduc-

tion was apparently reached 11 times among saturniids. If, as seems quite possible, the "Old World" portion of the tree (diagram 1) is inaccurate in detail, there nonetheless must have been such reduction in at least eight different groups.

In most groups of Saturniidae the male genital harpes are freely articulated to the ninth abdominal sternum. In the Hemileucinae, however, there is a tendency for the harpes to lose the articulation and become fused to this sternum; they may be partially fused as in *Automeris* and its allies or completely fused as in *Dirphia* and *Hemileuca*. Some degree of fusion has arisen independently in seven different groups of the Hemileucinae.

The occurrence of parallel evolution in genital structures is noteworthy, since they are hidden from the outside and hence presumably are relatively little affected by direct selection from the outside environment.

In the more primitive Saturniidae the antennae of the male are quadripectinate; that is, each segment bears four projecting processes, or rami, a basal pair and an apical pair. In the Hemileucinae there are a number of groups in which the apical rami are reduced or lost. In some groups, especially in certain subgenera of *Dirphia*, every stage in reduction can be observed in different species. The apical rami were lost, that is, the antennae became bipectinate, eight times independently in the Hemileucinae.

Curiously enough, the reduction in the apical rami is correlated with certain characteristics of the basal rami. In forms with quadripectinate antennae the rami are relatively short and straight (fig. 27), and the setae of the distal rami are directed basad, while those of the basal rami are directed distad. When the antennae are bipectinate, however, the rami (basal) are long and strongly curved downward (fig. 28) and their setae are directed downward. When the distal rami are represented by short stubs, an intermediate condition also prevails as to the length and curvature of the basal rami and the direction taken by their setae.

The eyes of saturniids are large in relation to the head, but their size is variable (figs. 25,

26). As a measure of the eye size, the relation between the length of an eye and the length of the shortest line that can be drawn between the eyes has been used. If the distance between the eyes is one-fifth of the length of an eye, as in some of the Citheroniinae, the eyes are considered very large, while if it is one and one-half times the length of an eye, the eyes are very small. The eyes are considered small if the distance between them is one-half of the length of an eye or more. This degree of reduction in eye size seems to have been achieved 18 times. Even if several of these apparent reductions result from phylogenetic misinterpretations, such reduction must have occurred at least 14 times.

Small eye size is usually correlated with changes in other structures of the head capsule. For example, the ordinarily very small distance between the laterofrontal sutures and the eyes is greatly increased as the eyes are reduced. Moreover, the proboscoidal fossa and the frontal protuberance are reduced in all forms with small eyes and in but few others. It is as if the entire head capsule were less fully developed than in ordinary saturniids.

A relationship exists between reduced eye size and diurnal habits. Like most moths, most saturniids are nocturnal, but most, if not all, of those with reduced eyes are diurnal or crepuscular. Perhaps in daylight smaller eyes can perform the functions for which large eyes are necessary at night. Hence small eyes, which would be selectively disadvantageous in most saturniids, are at least not seriously disadvantageous in diurnal forms.

Reduction in eye size is correlated, as already stated, with reduction of other parts of the head capsule; the indication is that this is an example of disharmonic or allometric growth (see Huxley, 1932), the head capsule growing more slowly in relation to the rest of the body than in most saturniids.

The examples of parallel evolution in the Saturniidae described above all involve reduction or loss of certain structures. But the following example involves the acquisition of a structure found neither in the Oxytenidae and Cercophanidae nor in the more primitive Saturniidae such as the Rhescyntinae. In these groups the front tibiae are approximately as long as the tarsi and are unarmed (fig. 34), but there are scattered groups, nine

in all, in the Citheroniinae and Hemileucinae in which each front tibia bears a horny spine arising from its outer apical angle (fig. 35). Some of those groups also have a spine arising from the inner apical angle and even from the apex of the middle tibia. In every case, tibiae bearing such spines are markedly shorter than unarmed tibiae and shorter than the tarsi. Similarly spined tibiae are found in some Old World Saturniinae.

Although the preceding paragraphs give examples of the loss and gain of structures, they give no numerical information on the frequency of loss of old structure or of acquisition of new.

In table 2 are listed 46 evolutionary trends, each of which can be observed in one or more parts of the phylogenetic tree of the Saturniidae. From table 3, which is a numerical summary of table 2, it can be noted that there are nearly 3.5 times as many trends towards reduction as towards increase in size of a structure and nearly 10 times as many trends towards reduction as acquisition of new structures. Many of these trends occur as parallelisms in different groups of the saturniids, but each is counted but once for the upper row of figures in table 3.

The lower row of figures in table 3 indicates the number of times that such trends have occurred in the Saturniidae of the Western Hemisphere. The differences between the lower numbers and the upper are an indication of the frequency of parallelisms. From the lower figures, it will be seen that trends towards reduction occurred over 5.4 times as frequently as trends towards increase in size of a structure. Trends towards reduction occurred over 8.2 times as frequently as acquisition of a new structure. The figure 147, for the number of times that trends towards reduction or loss have occurred, might have been considerably larger. This is because some judgment is involved in determining when a structure is "reduced." For example, labial palpi range from rather long, three-segmented structures to minute, unsegmented, spherical bodies hidden under the vestiture. For purposes of this count they were considered reduced when they were two-segmented, but there are some forms with short, three-segmented palpi which might well have been called reduced.

TABLE 3
FREQUENCY OF FORTY-SIX DIFFERENT EVOLUTIONARY TRENDS IN THE SATURNIIDAE

	Reduction or Loss of a Structure	Increase in Size of a Preëxisting Structure	Acquisition of New Structure	Not Classifiable
Number of trends	29	9	3	5
Number of times trends have occurred	147	27	18	25

Several examples of reduction or loss of structures are given above. An example of the increase in size of a preëxisting structure can be seen in the changes in the frontal protuberance. In primitive groups this structure is present as a conspicuous transverse ridge. In scattered groups it becomes a strong snout, so that this trend is counted as one in the second column of table 3. Incidentally it is also sometimes reduced or absent (e.g., subfamily Saturniinae) so that the same structure is involved in a trend counted in the first column of table 3.

Under acquisition of new structures are included the tibial spines (not spurs) mentioned above. These might have been interpreted as more than one trend, since inner apical spines are not always present, and since the middle tibiae as well as the front ones sometimes have spines. Another structure which seems to be newly acquired is the multiple antennal cone. Apparently each of the distal antennal segments bears, primitively, a single sharp conical projection on its under surface near the apex. In certain groups, instead of a single projection, there is a broad lobe bearing a group of small points. Another minor new structure is a sharp ridge or carina along the under surface of the antenna. This ridge is often produced at the apex of each segment so that simple antennal cones extend nearly to the base of each antenna.

Under "not classifiable" in table 3 are included such a trend as that from a large to a small anepisternum. At first sight this would seem to be a reduction, but actually it is merely a change in the course of the anepisternal suture, for as the anepisternum is reduced in size the katepisternum is correspondingly enlarged. In the same category falls the change from nocturnal to diurnal habits. This involves not only the gain of

diurnal flight habits, but also the loss of nocturnal ones.

The potentiality for similar changes, resulting in parallel characters, no doubt results from the fact that related animals have homologous chromosomes and genes (see Sturtevant and Novitski, 1941). It is evident that certain characters have changed repeatedly in the same manner, while others are relatively stable or changed but once so that the altered feature is regarded as of phylogenetic significance.

Why should certain characters change repeatedly in this fashion? It is well known that in those animals which have been studied genetically mutations occur or at least survive at certain loci more frequently than at others. Mayr and Vaurie (1948) give examples of the occurrence of parallel changes in birds comparable to those here described for the Saturniidae. In these groups, perhaps in all groups, there are much greater potentialities for changes of certain sorts than for those of other sorts. The independent acquisition of, for example, tibial spines in various saturniids may indicate such a predisposition to spined tibiae because of high mutability of a gene locus controlling such spines.

However, as Simpson (1944) has emphasized, there is no necessary relationship between mutation rate and rate of evolution. A high mutation rate at a certain locus might be completely unexpressed in evolution because of the inviability of the mutants. Moreover, there is no certain way of judging whether the presence of spines in various unrelated saturniids is due to separate mutations or is due to alleles common to all or most saturniids but unexpressed in most because of the action of modifiers. Mather (1943) has pointed out that an organism's response to natural selection must depend

largely upon stored variability such as this and not upon new mutations.

The significant point is that tibial spines have arisen at least 10 times during the course of saturniid evolution. It is certain that selection has played the principal role in determining what variants survive. Simpson (1944) has ably discussed its importance. Both Rensch (1939) and Muller (1939) have pointed out that parallel evolution occurs in animals having similar genetic makeups and subject to similar conditions of selection. In connection with this last point, it is interesting that all American forms having such spines occur in the more or less temperate regions of the United States and Canada or in temperate or nearly temperate areas of southern Brazil, Paraguay, Uruguay, and Argentina. None of the numerous tropical saturniids have such spines. So far as known, forms with these spines pupate below the surface of the ground, and the spines are thought to be important to the adult in digging its way to the surface. Pupation in the

soil is probably one of the ways in which these insects are able to protect themselves from cool winters, although many other northern types survive cold by means of other sorts of adaptations, for they pass the winter as pupae in cocoons hanging in trees.

The remarks already made concerning mutation rates and selection apply equally to the reduction or loss of structures. As Wright (1929) and Muller (1939) have pointed out, there is considerable mutation pressure against most structures, so that unless they are preserved by selection, they tend to disappear. We must conclude that in at least some groups the selection pressure has relaxed for such structures as the epiphyses, which have been lost at least 10 times (in females) in saturniid evolution. It is obviously much easier for an organism to lose a previously established character in this way than to acquire a new one. The extent to which this is true is indicated by the numerical data already presented.

PHYLOGENY AND DISTRIBUTION

ON THE BASIS of the information presented in the section on Comparative Morphology, it is concluded that the Oxytenidae, Cercophanidae, and Saturniidae had a common origin, and that the classification of the Saturniidae can best be expressed by recognizing seven subfamilies: the Rhescyntinae, Citheroniinae, Agliinae, Hemileucinae, Ludiinae, Salassinae, and Saturniinae. A phylogenetic tree for the saturnioid moths has been devised, and it is believed that this tree (diagram 1) indicates the relationships with reasonable accuracy. Since there are no known saturniid fossils of any significance, the construction of such a tree is possible only because of the existence of unspecialized or primitive genera or species in which for some reason evolution of the principal characters ceased. Such forms provide the intermediate or annectent links necessary to establish the relationships of other genera. If certain specialized characters are ignored, these primitive living groups closely resemble the putative ancestral forms. Thus the tree is actually only a scheme of relationships based on living forms, not a phylogeny in time.

Although all of the subfamilies contain primitive genera, it seems probable that certain Rhescyntinae, such as *Rhescyntis*, are more similar to the ancestral saturniid type than are any others. It is a relatively minor step from *Rhescyntis* to the primitive members of the Citheroniinae, such as *Bathyphebia*. The principal characters by which *Bathyphebia* differs from the more primitive Rhescyntinae are the convex lateral portions of the frons, the absence of bristles on the pilifers, the shorter tibial spurs, the absence of the subapical spurs of posterior tibiae, and the absence of tarsal spines. From the large, broad-winged *Bathyphebia* the principal direction of evolution in the Citheroniinae has been reduction in size, especially in wing size, so that the more characteristic members of the subfamily are small, with the thorax very robust, and the wings, or at least the forewings, are slender and powerful so that the shape is similar to that of certain Sphingidae. Another line of evolution in the Citheroniinae as in other subfamilies, has been reduction in the size and segmentation of the labial palpi.

They are three-segmented in *Citheronia*, *Schausiella*, and most *Eacles*. They are one- or two-segmented and relatively short in the other genera, the reduction reaching its extreme in *Neocarnegia*. As indicated in the section on Comparative Morphology, another noteworthy line of development in the Citheroniinae is the conversion of that portion of the male harpe below the cleft into an inner spine of the harpe, with resulting disappearance of the cleft.

The remaining subfamilies of the Saturniidae are probably not quite so closely related to the Rhescyntinae as are the Citheroniinae, although in the Agliinae the larval characters are very similar to those of the Rhescyntinae. The adults of the Old World Agliinae, however, are similar to those of the New World Hemileucinae. The possibility that the Hemileucinae arose from the same ancestral stock as the Citheroniinae is indicated by the genus *Hirpida* which shows some characters intermediate between those typical of the two subfamilies. It seems more likely, however, that the characters of *Hirpida* that suggest a relationship with the Citheroniinae, for example, the convex lateral areas of the frons, are actually parallel developments rather than indications of close relationship. It seems more reasonable to suppose that the various subfamilies arose from a common ancestor, now extinct. Within the Hemileucinae there are several genera, mostly primitive in various respects, which cannot well be placed in relation to other genera. Such groups are *Lonomia* and *Hirpida*. As indicated in the phylogenetic tree (diagram 1) the relationships of several groups can be determined. For example, *Cerodirphia* and *Molippa* [through such species as *M. lulesa* (Schaus)] are related to *Ormiscodes*, and several genera are obviously related to *Automeris*. The complete fusion of the harpes to the ninth segment in *Ormiscodes* subgenus *Xanthodirphia* is apparently an expression of the tendency which has gone farther in the reduction and fusion of the harpes in *Hemileuca* and *Travassosula* and reached its climax in *Dirphia*.

The Ludiinae, Salassinae, and Saturniinae are rather closely related. In spite of certain

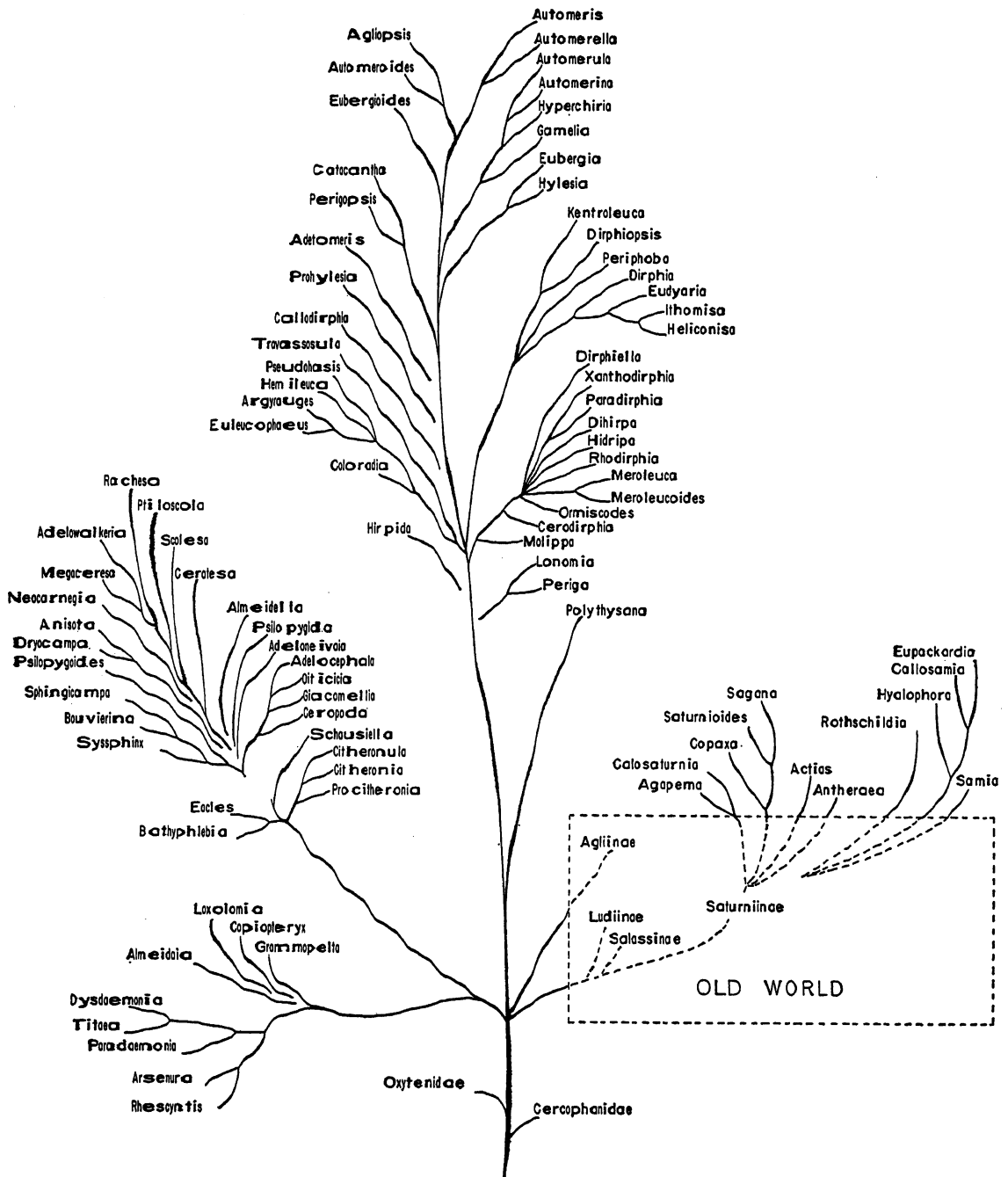


DIAGRAM 1. Phylogenetic scheme showing the probable relationships of the groups of saturnioid moths.

specialized characters, most features of the Ludiinae and Salassinae are more primitive than those of the Saturniinae.

The genus *Polythysana* is so different from other Hemileucinae that it has been placed in a tribe by itself and perhaps should be placed in a separate subfamily. While most of its characteristics can be matched within the rest of the Hemileucinae, the combination of characters is suggestive of certain Saturniinae except for the wing venation, which is not at all like that of the Saturniinae. Probably *Polythysana*, which occurs in Chile, is a relict type, like *Aglaia* (Agliinae) and *Salassa* (Salassinae). Such a probability is indicated in the phylogenetic tree.

The greater part of the evolutionary history of the Saturniinae seems to have taken place in the Old World and hence, because of lack of material, is not indicated on the accompanying phylogenetic tree. New World genera are the scattered representatives that were able to migrate from Asia to America after the subfamily characters were established.

The distributional pattern shown by the various groups of saturniids is extremely interesting. The Oxytenidae and Cercophanidae are entirely Neotropical, all but one genus of the latter family being Chilean in distribution. Although the family Saturniidae is almost world-wide, except for far northern and far southern regions, its most primitive groups are Neotropical. The Rhescyntinae are entirely Neotropical. The Citheroniinae are principally Neotropical, although a few genera and species extend well north into the Nearctic region. The same is true of the Hemileucinae, although there are more Nearctic genera and species than in the Citheroniinae. This great diversity of entirely American groups in the Saturniidae, together with the occurrence in the Neotropics of the only families that appear to be very closely related to Saturniidae, suggests that the group as a whole arose in the Western Hemisphere and no doubt in the American tropics.

There are, however, very numerous genera

and species of Saturniidae in the Old World, particularly in the Old World tropics. The bulk of these belong to the subfamily Saturniinae which is more richly represented in the Old World than in the New World. The small subfamily Ludiinae, however, is confined to Africa, and the Salassinae to Asia. If one ignores some of the highly specialized features of the Ludiinae such as the reduced size and the reduced labial palpi, the characters of this subfamily might well be regarded as ancestral to those of the Saturniinae. The Salassinae also exhibit primitive characters, such as the frontal protuberance. It therefore seems not unlikely that a common ancestor of the Ludiinae, Salassinae, and Saturniinae reached the Old World not long after the saturniids became widespread in the New World and that in the Old World it gave rise to the Saturniinae as well as to the modern Ludiinae and the relict Salassinae. The Saturniinae became widespread and eventually, on several different occasions as indicated in diagram 1, migrated back into the Western Hemisphere. There are, in fact, three genera of Saturniinae that occur in both hemispheres. All are far better represented in Asia than in America, and they can be regarded as having arisen in the Old World and spread to the New World relatively recently. These genera are *Antheraea*, *Actias*, and *Saturnia*.

An interesting feature of distribution of the Saturniidae is their almost complete absence from the West Indies, although the group is extremely well represented around the coasts of the Caribbean, and there are a number of species in the southern United States. It is evident that these American forms are poor colonizers of islands. Perhaps this is because the females are relatively sluggish and do not fly much, in spite of their large wings, for there are certainly suitable host plants and climatic conditions in the West Indies. In view of this situation it is interesting that in the Old World the Saturniinae have spread through the East Indies to New Guinea and to Australia.

CLASSIFICATION

ACCORDING TO MANY CLASSIFICATIONS of the Lepidoptera (e.g., Jordan, 1923; Forbes, 1920), the Saturniidae (with the Oxytenidae and Cercophanidae) fall in a superfamily of their own. The chief differences between this "superfamily" and its near relatives in the Eupterotidae and Bombycidae are the complete loss of the frenulum and of one of the branches of the radius of the forewing in the "Saturnioidea." Since these are rather minor characters, which vary within families elsewhere in the order, and since there are so few families involved, it seems that a more satisfactory classification and one that better indicates the relationships between families results if the Saturniidae, Oxytenidae, and Cercophanidae are included in the Bombycoidea. The most recent general classification of the Lepidoptera (Turner, 1947) uses this system.

The Saturniidae are here considered to include the Citheroniidae (or Syssphingidae or Ceratocampidae) and the Hemileucidae of various authors, but to exclude the Cercophanidae and Oxytenidae.

Among the larger moths the Saturniidae can be recognized by the absence of tympana, the complete absence of the frenulum, the absence in the hind wing of a transverse basal portion of R_1 between veins Sc and R, the absence of one or more branches of the radius of the forewing, the hard, bare, slightly hooked apices of the tibial spurs, and the absence of scales on the antennal rami and usually also on the shaft.

Jordan (1922) has indicated several of the important characters of the major subdivisions of the Saturniidae and has recognized two families. Bouvier (1931, 1932, 1935, 1936a, 1936b) has provided the most recent revision of the group, and has recognized three families. The use of a single family seems to express more satisfactorily the relationship of these moths to the Cercophanidae and Oxytenidae. As indicated previously there appear to be seven, not two or three, primary divisions of the Saturniidae. These divisions are here recognized as subfamilies. As already indicated they are the Rhescyntinae, Citheroniinae, Agliinae, Hemileucinae, Ludiinae, Salassinae, and Saturniinae. The difficulty involved in the subfamily groupings

results from the existence of primitive forms which to some degree link the subfamilies. While such forms aid greatly in determining the phylogenetic relationships of the groups, they make the definition of the groups difficult.

KEY TO THE SEVEN SUBFAMILIES OF SATURNIIDAE, BASED ON ADULTS

1. Pilifers with strong bristles, or, if absent, bristles are present on clypeal margin between pilifers (America) Rhescyntinae
Pilifers and clypeal margin without bristles 2
2. Frons convex at sides so that laterofrontal sutures are completely hidden from front view; antennal cones simple (America) Citheroniinae
Frons flat at sides, or, if convex, the antennal cones are multiple 3
3. Frontal protuberance present, though often a mere transverse ridge (absent in *Polythysana* and a few *Hylesia*); tarsal spines usually absent except those of penultimate fore tarsal segment of female; anepisternal suture usually not slanting downward posteriorly 6
Frontal protuberance absent (sometimes there is a superficially similar clypeal protuberance); tarsal spines usually present; anepisternal suture variable 4
4. Anepisternal suture slanting down posteriorly; R_s of forewing usually arising from anterior apical angle of discal cell 5
Anepisternal suture horizontal or slanting upward posteriorly; R_s of forewing leaving discal cell well before apex of latter (world-wide) Saturniinae
5. Vein M_2 of forewing arising in front of middle of apex of discal cell; antennal cones simple (Eurasia) Agliinae
Vein M_2 of forewing arising near middle of apex of discal cell; antennal cones sometimes multiple (Africa) Ludiinae
6. Antennal cones present, simple, rarely (*Polythysana*) reduced to blunt projections; R_s of forewing usually arising from anterior apical angle of discal cell (America) . Hemileucinae
Antennal cones absent; forewing with R_s leaving discal cell well before apex of latter (Asia) Salassinae

LIST OF GENERA AND SUBGENERA OF THE WESTERN HEMISPHERE

SUBFAMILY RHESCYNTINAE

Grammopelta Rothschild
Rhescyntis Hübner

Arsenura Duncan (*Aricia* Herrich-Schäffer)
 Rhescyntis Hübner (*Machaerosema* Rothschild,
Machaerosoma Bouvier)
 Paradaemonia Bouvier
 Dysdaemonia Hübner
 Titaea Hübner
 Almeidaia Travassos
 Loxolomia Maassen
 Copiopteryx Duncan

SUBFAMILY CITHERONIINAE

Bathyphebia Felder
 Eacles Hübner (*Cerocampa* Kirby and Spence,
Basilona Boisduval, *Crenudia* Burmeister)
 Citheronia Hübner
 Procitheronia Michener
 Citheronia Hübner (*Ceratocampa* Harris, *Dory-*
campa Duncan)
 Citheronula Michener
 Schausiella Bouvier
 Syssphinx Hübner
 Bouvierina Michener
 Sphingicampa Walsh
 Syssphinx Hübner (*Psephopaectes* Grote and
 Robinson, *Ceroderes* Boisduval)
 Adelocephala Herrich-Schäffer
 Adelocephala Herrich-Schäffer (*Othorene* Bois-
 duval)
 Oiticicia Michener
 Giacomellia Bouvier
 Ceropoda Michener
 Psilopygoides Michener
 Adeloneivaia Travassos
 Almeidaia Oiticicia
 Psilopygida Michener
 Adelowalkeria Travassos
 Ceratesa Michener
 Scolesia Michener
 Ptiloscola Michener
 Rachesa Michener
 Adelowalkeria Travassos
 Megaceresa Michener
 Neocarnegia Draudt
 Anisota Hübner
 Dryocampa Harris
 Anisota Hübner

SUBFAMILY HEMILEUCINAE
TRIBE HEMILEUCINI

Lonomia Walker
 Lonomia Walker
 Periga Walker
 Hirpida Draudt
 Callodirphia Michener
 Coloradia Blake
 Hemileuca Walker
 Euleucophaeus Packard
 Argyrauges Grote
 Hemileuca Walker (*Euchronia* Packard)

Pseudohazis Grote and Robinson
 Travassosula Michener
 Cinommata Butler
 Adetomeris Michener (*Io* Blanchard, not Lea)
 Catacantha Bouvier
 Catacantha Bouvier
 Perigopsis Bouvier
 Parancistrota Bouvier
 Automeris Hübner
 Automeris Hübner (*Protautomeris* Packard)
 Automerella Michener
 Automeroides Michener
 Agliopsis Bouvier
 Eubergioides Michener
 Gamelia Hübner
 Automerina Michener
 Automerina Michener
 Automerula Michener
 Hyperchiria Hübner (*Jo* Herrich-Schäffer)
 Hylesia Hübner
 Hylesia Hübner (*Micrattacus* Walker, *Hyllosia*
 Herrich-Schäffer)
 Eubergia Bouvier
 Prohylesia Draudt
 Prohylesia Draudt
 Hylesiopsis Bouvier
 Ormiscodes Blanchard
 Ormiscodes Blanchard (*Catocephala* Blanchard,
Thauma Edwards)
 Hidripa Draudt
 Dihirpa Draudt
 Rhodirphia Michener
 Paradirphia Michener
 Xanthodirphia Michener
 Dirphiella Michener
 Meroleucoides Michener
 Meroleuca Packard (*Mesoleuca* Packard, not
 Hübner)
 Cerodirphia Michener
 Molippa Walker (*Rhodormiscodes* Packard, *Pro-*
dirphia Bouvier)
 Dirphia Hübner
 Dirphia Hübner (*Phricodia* Hübner, *Plateia*
 Hübner, *Hyperdirphia* Packard, *Phidira*
 Draudt)
 Periphoba Hübner
 Dirphiopsis Bouvier (*Pseudodirphia* Bouvier)
 Kentroleuca Draudt
 Eudyaria Grote
 Ithomisa Oberthuer
 Heliconisa Walker
 Catharisa Jordan

TRIBE POLYTHYSANINI

Polythysana Walker

SUBFAMILY SATURNIINAE
TRIBE SATURNIINI

Saturnia Schrank
 Calosaturnia Smith

Agapema Neumoegen and Dyar
 Copaxa Walker
 Copaxa Walker
 Saturnioides Jordan
 Sagana Walker
 Antheraea Hübner (*Telea* Hübner, *Metosamia*
 Druce)
 Actias Leach (*Echidna* Hübner, not Forster;
Tropaea Hübner; *Plectropteron* Hutton)

TRIBE ATTACINI

Samia Hübner (*Philosamia* Grote)
 Rothschildia Grote
 Hyalophora Duncan
 Hyalophora Duncan (*Platysamia* Grote)
 Callosamia Packard
 Eupackardia Cockerell

Reference should be made to certain works other than those already mentioned which have been found extremely useful in this study. Although containing errors, Schüssler's catalogue (1933, 1934, 1936) has been most useful. Also valuable are the lists of genera and genotype designations published by Oiticica (1941) and d'Almeida (1943a, 1943b).

SUBFAMILY RHESCYNTINAE

Frons flat at sides, adjacent to eyes; latero-frontal sutures visible; frontal protuberance present (low and broad); antennae quadripennate to apices, apical rami arising adjacent to basal rami of following segment; antennal cones simple or multiple; pilifers each bearing a tuft of bristles or [in *Rhescynthis tamerlan* (Maassen)] without bristles but clypeal margin between pilifers with bristles. Anepisternum large, anepisternal suture directed at least slightly downward posteriorly. Vein M_1 of forewing not or only briefly stalked with radials, M_2 arising near middle of apex of discal cell. Tibial spurs long, often twice as long as tibial diameter; posterior tibiae usually with subapical spurs; tarsi usually with ventral spine-like setae in addition to those of penultimate fore tarsal segment of female.

Larvae with large thoracic horns, forked apically in early stadia, but hornless and without even large tubercles in last stadium. Pupa not enclosed in a cocoon.

In addition to the characters given above all members of the subfamily that have been examined exhibit the following features:

Upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending well below lower end of face. Antennae without bristles, antennal shaft compressed but not carinate ventrally, antennal cones limited to distal half of antenna. Clypeus separated from frons by a distinct line or groove. Mandibular rudiments large and protuberant. Proboscical fossa longer than broad, very deep, walls vertical; maxillary stipites free from walls, standing up as erect lamellae, posterior ends reaching to anterior margins of palpal sockets; labial palpi arising near posterior end of proboscical fossa, extending forward to a point much in front of face, three-segmented, the second segment longer than either of the others. Anterior tibiae about as long as tarsi, epiphysis reaching to apical third of tibia, without long hairs; tibial spines absent; tibial spurs, at least the longer one, distinctly longer than tibial diameter, sometimes twice as long (see Oiticica, 1940), only extreme apices of spurs curved and bare; spine-bearing lobes of penultimate fore tarsal segment of female bare, adjacent bare areas of following segment rather large and extending to apex of segment but sole scaled; arolium and pulvilli well developed. Vestiture of wings consisting of scales, overlain at bases of wings and particularly on hind wings with hairs; forewing with vein M_2 arising near middle of apex of discal cell or slightly in front of middle, M_1 arising near anterior apical angle of cell, R_1 arising before apex of cell, cell 1V closed and without a spur; hind wing with vein 3V absent or small. Abdomen rather small, covered with appressed, hair-like scales; gnathos not strongly sclerotic in most species, somewhat produced posteriorly in the middle, usually divided longitudinally in the middle by a membranous area, median portion of gnathos finely spiculate, gnathos connected laterally to upper basal angles of harpes and without free lateral arms; anellus rather small and free; harpes freely articulated to the ninth segment. Female with ductus seminalis arising from right-hand side of base of bursa.

As indicated in the section on Comparative Morphology, the carinate galeal papilli, found in most Rhescynntinae in which the galeae are not too much reduced, indicate a close relation between this group and the Oxytenidae.

This is corroborated by the fundamental similarity in genitalia. In the Rhescyntini, *Grammopelta* seems to be most primitive in view of the characters listed in the discussion of that genus. *Rhescyntis* is apparently related to *Grammopelta*. The relationships of the remaining genera remain in doubt, although they are more specialized than the above named (see diagram 1).

KEY TO THE GENERA OF RHESCYNTINAE

1. Hind wings with veins Cu_1 and Cu_2 stalked with M_3 ; projection or tail from margin of hind wing including vein Cu_1 2
 Hind wings with veins Cu_1 and Cu_2 arising from discal cell, or Cu_1 and M_3 forming a short stalk; projection or tail from margin of hind wing, if present, in front of vein Cu_1 3
2. Hind wings with very long tails; antennal rami long, curved downward, not flattened *Copiopteryx*
 Hind wings with only short projections; antennal rami short, straight, flattened *Loxolomia*
3. Forewing three times as long as broad, pointed at apex, outer margin nearly parallel with costal margin. *Almeidaia*
 Forewing less than two and one-half times as long as broad, not pointed at apex, outer margin not parallel to costal margin. 4
4. Third segment of labial palpus about one-third as long as second; tarsal spines absent except for pair on penultimate fore tarsal segment of female; harpes of male not cleft *Grammopelta*
 Third segment of labial palpus much less than one-third as long as second; tarsal spines, in addition to pair on penultimate fore tarsal segment of female, usually present; harpes each with a cleft *Rhescyntis*

GENUS GRAMMOPELTA ROTHSCILD

Figures 127-129

Grammopelta ROTHSCILD, 1907, Novitates Zool., vol. 14, p. 419. Type: *Grammopelta cervina* Rothschild = *Copaxa lineata* Schaus (monobasic).

This is possibly the most primitive genus of the Rhescyntinae, to judge by the large third segment of the labial palpus, the long clypeus, and the very ordinary-looking wing shape and pattern. These characters serve to distinguish the genus from other Rhescyntinae. However, certain of its characters appear to

be specializations. For example, the tarsal spines are reduced to slender setae, except for the apical pair on the penultimate fore tarsal segment of the female, and the harpes of the male are not cleft.

Shortest distance between eyes less than one-half of the length of an eye.

Antennae about one and one-half times as long as thorax, flagellum not scaled, quadridentate to apex in both sexes, the teeth or short rami of female smaller than in male and nearly absent apically, teeth or rami flattened; antennal cones very small, simple.

Tentorial pits rather small and nearly round; clypeus only two or three times as wide as long, being considerably produced medially. Galeae much longer than the head, curled, with slender carinate papillae among numerous bristles. Third segment of labial palpus much larger than in any of the related genera, being about one-third of the length of the second segment.

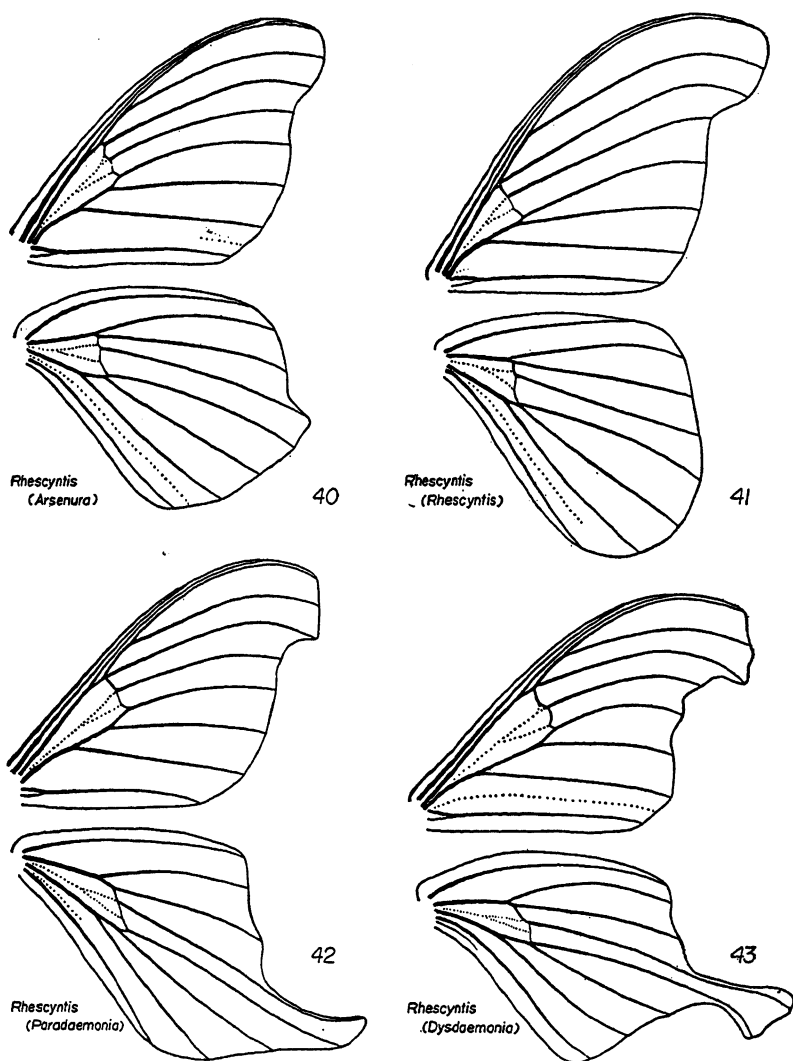
Thorax covered with long recumbent hairs; patagia narrow and nearly lamelliform; parapatagia lamelliform; tegulae reaching nearly as far back as anterior median angle of scutellum; anepisternum rather large, anepisternal suture directed downward posteriorly towards a point near lower end of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture at an angle of about 170 degrees to straight lower portion of pleural suture, these two main portions separated by a curved region.

Posterior tibiae without subapical spurs; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female; claws serrate.

Forewings with outer margins slightly concave, not angulate; torni distinct; posterior wings without tails.

Ninth tergum of male shorter than the uncus, the latter somewhat down-curved at apex, not bilobed; harpes simple as seen from the outside, rather elongate, apices broadly rounded.

Eighth tergum of female produced to form two broadly rounded sublateral lobes; eighth sternum with rather broad, weakly sclerotic, prevulvar band and large, weakly sclerotic, postvulvar area; ductus bursae sclerotic posteriorly, membranous anteriorly; bursa nearly spherical, rather small.



FIGS. 40-43. Wings of Rhescyntinae. 40. *Rhescyntis* (*Arsenura*) *richardsoni* (Druce). 41. *Rhescyntis* (*Rhescyntis*) *martii* (Perty). 42. *Rhescyntis* (*Paradaemonia*) *pluto* (Westwood). 43. *Rhescyntis* (*Dysdaemonia*) *boreas* (Cramer).

This genus contains a single species, *G. lineata* (Schaus), which ranges from the Guianas to Colombia and Peru.

GENUS *RHESCYNNTIS* HÜBNER

This is by far the largest genus of the Rhescyntinae, and is here used in a much broader sense than by previous authors, who have recognized as genera most of the groups here called subgenera. These groups are similar in genitalia and other structures, and it

hardly seems necessary to separate them as genera.

Although the distinctions between the *Dysdaemonia-Titaea* group and the *Rhescyntis-Paradaemonia* group are rather conspicuous, they tend to break down. Thus *R. timur* (Fassl) has a simple uncus, while *R. orsinome* (Hübner) lacks the clear spots in the wings, and even the shape of the hind wings is more like that of a *Paradaemonia* or tailed *Rhescyntis* than of other *Titaea*.

Shortest distance between eyes one-third to more than one-half of the length of an eye.

Antennae slightly longer than thorax to over one and one-half times as long as thorax, flagellum without scales or with a few scales on dorsum of basal segments, flagellum of male narrowly quadripectinate to broadly quadridentate to apex, flagellum of female commonly simple or quadridentate, sometimes bipectinate and sometimes as broadly quadripectinate as in the male; rami short, straight or somewhat curved, usually flat; antennal cones small, simple or multiple.

Tentorial pits large and oval to small and round; clypeus about four times as broad as long; galeae very short and rudimentary to considerably longer than the head and curled, in the latter case with bristles and carinate papillae; third segment of labial palpus small. Postoccipital bridge narrow, sclerotic.

Thorax covered with long, recumbent hairs or hair-like scales; patagia lamelliform or somewhat broadened; parapatagia lamelliform; tegulae reaching or nearly reaching anterior median angle of scutellum; anepisternum of moderate size, anepisternal suture slanting slightly downward posteriorly, curved downward at extreme posterior end, directed towards a point near or below lower end of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in approximately the same direction as straight lower portion of this suture, these two main portions separated by a conspicuous curved region.

Posterior tibiae with only an apical pair of spurs or with a subapical pair in addition; tarsal spines occasionally absent but usually one to several apical or subapical pairs on segments one to three or four or in some with such spines even on basal portions of segments; penultimate segment of fore tarsus of female with a pair of apical spines; claws finely serrate to apparently simple.

Forewings with outer margins convex to concave, tornus distinct though sometimes broadly rounded; hind wings without tails or with short tails containing apices of veins M_2 and M_3 .

Ninth tergum of male subequal to the uncus or shorter; harpes rather short, each divided by an inconspicuous cleft into upper and lower portions, lower portion often

thickened apically or subapically, commonly curved upward mesad to the upper portion.

Eighth tergum of female largely membranous or consisting of a sclerotic band which bears a pair of broad, weak, sublateral lobes; eighth sternum almost entirely membranous or with a weakly or heavily sclerotic prevulvar band and large weakly or heavily sclerotic postvulvar area; ductus bursae longer than broad, sometimes sclerotic posteriorly; bursa with an elongate posterior portion slightly enlarged to a subspherical anterior portion.

The five subgenera of *Rhescyntis* can be differentiated by the characters shown in table 4.

SUBGENUS ARSENURA DUNCAN

Figure 40

Arsenura DUNCAN, 1841, in Jardine, Naturalist's library, vol. 32, p. 125. Type: *Bombyx erythrinae* Fabricius = *Phalaena armida* Cramer (monobasic).

Aricia HERRICH-SCHÄFFER, 1858, Sammlung ausseropäischer Schmetterlinge, vol. 1, p. 78. Type: *Aricia aspasia* Herrich-Schäffer (monobasic).

The characters of this subgenus are indicated in table 4. Twenty-one species are listed by Bouvier (1931), who incorrectly places them in *Rhescyntis*, using the name *Machaerosoma* for *Rhescyntis* proper. The subgenus ranges from Mexico to Argentina.

Rhescyntis (*Arsenura*) *romulus* (Maassen) is intermediate in appearance between *Arsenura* and *Rhescyntis*, while *R. (A.) xanthopus* (Walker), although belonging obviously to *Arsenura*, in which the antennae of the females are usually simple, has antennae as broadly pectinate as in the male, thus resembling *Rhescyntis*.

SUBGENUS RHESCYNTIS HÜBNER

Figures 41, 119-121

Rhescyntis HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 156. Type: *Phalaena hippodamia* Cramer, by designation of Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 745.

Machaerosoma ROTHCHILD, 1907, Novitates Zool., vol. 14, p. 418. Type: *Phalaena hippodamia* Cramer, by original designation.

Machaerosoma BOUVIER, 1929, Ann. Sci. Nat., Zool., ser. 10, vol. 12, p. 251 (emendation of *Machaerosoma*).

TABLE 4
THE SUBGENERA OF *Rhescyntis*

<i>Arsenura</i>	<i>Rhescyntis, Sensu Stricko</i>	<i>Paradaemonia</i>	<i>Dysdaemonia</i>	<i>Titaea</i>
Antennal cones simple	Antennal cones multiple	Antennal cones simple	Antennal cones simple	Antennal cones multiple
Antennae of male quadri- pectinate or quadriden- tate	Antennae of male quadri- pectinate	Antennae of male quadri- dentate	Antennae of male quadri- dentate	Antennae of male nar- rowly quadripectinate
Antennae of female usually simple, sometimes bipec- tinate or, if quadripec- tinate, distal rami mere stubs	Antennae of female quad- ripectinate, distal rami two-thirds to three- fourths as long as basal rami	Antennae of female quad- ridentate, distal rami equal to, or somewhat shorter than, basal rami	Antennae of female quad- ridentate, distal rami equal to basal rami	Antennae of female quad- ridentate, distal rami equal to basal rami
Antennal rami flattened, nearly straight	Antennal rami scarcely flattened except basally, curved downward	Antennal rami flattened, nearly straight	Antennal rami flattened, nearly straight	Antennal rami flattened, nearly straight
Forewing not angulate at apex of M ₁	Forewing not angulate at apex of M ₁	Forewing angulate at M ₁	Forewing angulate at M ₁	Forewing angulate at M ₁
Hind wing without tail or, if tail is present, wing margin is straight or con- vex from apex of tail to anal angle	Hind wing without tail	Hind wing with tail, wing margin straight or con- vex from apex of tail to anal angle	Hind wing with tail, wing margin concave from apex of tail to anal angle	Hind wing with tail, wing margin concave from apex of tail to anal angle (not or scarcely concave in <i>orsinome</i>)
Uncus usually dentate, with lower teeth usually paired	Uncus usually dentate, with lower teeth usually paired	Uncus enlarged apically, untoothed, usually with longitudinal depression	Apex of male uncus com- pressed, bidentate	Apex of male uncus com- pressed, three- or four- toothed (except in <i>ti- mur</i> , in which it is sim- ple)
Wings without transparent spots	Wings without transpar- ent spots	Wings without transpar- ent spots	Forewings and hind wings each with one or more clear spots	Forewings only with a transparent spot (ab- sent or virtually so in <i>orsinome</i>)

This subgenus, which includes four species with numerous subspecies, is characterized in table 4. The species occur from Central America to Argentina. Characteristic features are the elongate forewings and the broadly arcuate postmedian lines of these wings.

SUBGENUS *PARADAEMONIA* BOUVIER
Figures 42, 116-118

Paradaemonia BOUVIER, 1924, Ann. Soc. Ent. France, vol. 94, p. 69. Type: *Saturnia pluto* Westwood, designated by Draudt, 1930, in Seitz, Macrolepidoptera of the world, vol. 6, p. 795.

This subgenus has the wing shape and appearance of *Dysdaemonia*, from which it differs by the absence of transparent spots in the wings, the straight or convex margin of the hind wing between the apex of the tail (which is always present) and the anal angle, the edentate male uncus, and other characters.

Paradaemonia includes about a dozen species which range from Costa Rica to Argentina.

SUBGENUS *DYSDAEMONIA* HÜBNER
Figures 43, 122-124

Dysdaemonia HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 151. Type: *Phalaena boreas* Cramer (monobasic).

As here restricted, this subgenus contains *Rhescyntis* (*Dysdaemonia*) *boreas* (Cramer) and *fosteri* (Rothschild). The former ranges from Mexico to Argentina; the latter occurs chiefly in Argentina.

SUBGENUS *TITAEA* HÜBNER
Figures 125, 126

Titaea HÜBNER, [1823], Sammlung Exotischer Schmetterlinge, vol. 2, pl. [176]. Type: *Titaea orsinome* Hübner (monobasic).

Although *Titaea* has commonly been used in a generic sense to include only its type species, there seems to be no justification for this procedure, for *D. orsinome* agrees closely in structure with the bulk of the species usually placed in *Dysdaemonia*. The following are therefore included in this subgenus: *Rhescyntis* (*Titaea*) *andicola* (Bouvier),¹ *lemoulti* (Schaus), *nobilis* (Schaus), *orsinome* (Hübner), *raveni* (Johnson and Michener), *tamerlan* (Maassen), and *timur* (Fassl). These species

¹ Not studied by me but placed by the description alone.

occur from Central America to Peru and southern Brazil.

GENUS *ALMEIDAIA* TRAVASSOS

Almeidaia TRAVASSOS, 1937, Rodriguezia, vol. 3, p. 199. Type: *Almeidaia romualdoi* Travassos, by original designation.

As this peculiar genus is not available to me, being apparently known from a single specimen from the state of São Paulo, Brazil, I cannot give a full description of it. However, it is obviously a very distinct genus, as shown by the following characters:

Antennae of male (female unknown) longer than thorax, flagellum very narrowly quadripectinate to apex, apical rami arising adjacent to basal rami of following segment (rami almost certainly of the short, flat, straight type common in this group). Epiphysis large, in the form of a spine; tibiae without spines; claws simple. Forewings much elongated, the outer margin slightly concave subapically, much longer than posterior margin and nearly parallel with costal margin; torni distinct; wing apices produced, acute; hind wings rounded, neither angulate nor tailed; upper surfaces of wings without distinct lines.

GENUS *LOXOLOMIA* MAASEN

Figures 45, 130-132

Loxolomia MAASEN, 1869, in Maassen and Weymer, Beiträge zur Schmetterlingskunde, Heterocera, no. 1, p. [1], fig. 8. Type: *Loxolomia serpentina* Maassen (monobasic).

In wing shape this genus is somewhat suggestive of *Almeidaia*, but the hind wing venation indicates a possible relationship to *Copiopteryx*. The short, flattened antennal rami, however, are more like those of other *Rhescyntinae*.

Shortest distance between eyes more than one-third of the length of an eye.

Antennae longer than thorax, flagellum not scaled; flagellum of both sexes narrowly quadripectinate to apex, that of female more narrowly so than that of male, perhaps better termed quadridentate; rami short, flattened, straight, basal and apical rami about equal in length; antennal cones very small, simple.

Tentorial pits large and obliquely elongated; clypeus about four times as broad as long, separated from the frons only inconspicuously. Galeae longer than the face, with-

out papillae. Third segment of labial palpus small. Postoccipital bridge narrow but heavily sclerotic.

Thorax covered with elongated suberect scales; patagia rather broad; parapatagia lamelliform; tegulae reaching almost as far back as anterior median angle of scutellum; anepisternum rather large, anepisternal suture slanting downward posteriorly, directed towards a point on pleural suture well below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture directed more forward above than straight lower portion of this suture, these two main portions separated by a conspicuous curved region.

Posterior tibiae without subapical spurs but at least frequently with a small bulge indicating the position of one of the subapical spurs present in related forms; tarsal spines rather numerous at or near apices of under surfaces of segments one to four; claws simple.

Forewings much elongated, the outer margins slightly undulate, almost parallel with costal margin and longer than posterior margin, torni distinct; hind wings with margins undulate, produced at apices of veins M_3 and Cu_1 .

Ninth abdominal tergum of male very short, much shorter than the small simple uncus; harpes rather short and very broad, rounded apically, divided by an inconspicuous line into upper and lower portions.

Eighth tergum of female heavily sclerotic, produced sublaterally into broadly truncated lobes which are separated from one another by a rather narrow, deep emargination; eighth sternum with prevulvar and postvulvar sclerotic bands neither produced nor very heavily sclerotized; ductus bursae about three times as long as broad and slightly sclerotic; bursa with an anterior more or less spherical portion and a posterodorsal pocket containing a large, strongly curved, sclerotic rod.

This genus contains two species, *L. johnsoni* Schaus from Peru and *L. serpentina* Maassen from Brazil.

GENUS COPIOPTERYX DUNCAN

Figures 44, 133-136

Copiopteryx DUNCAN, 1841, in Jardine, Natural-

ist's library, vol. 32, p. 125. Type: *Phalaena semiramis* Cramer (monobasic).

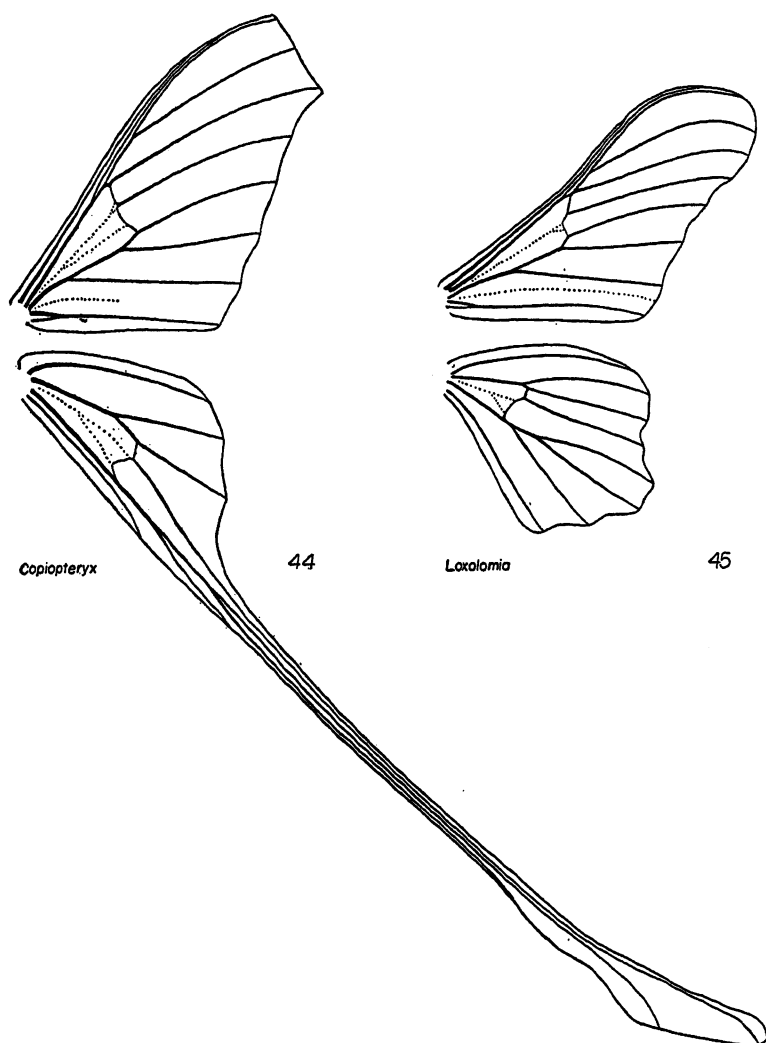
This is a genus of large moths, differing from all other Rhescyntinae by the extremely long tails of the hind wings.

The use of *Copiopteryx* Duncan (1841) remains in some doubt because of *Eudaemonia* Hübner [1819], which was proposed to include *semiramis* Cramer and *uroarge* Hübner [= *argus* Stoll¹ (= *argus* Fabricius)], the latter an African form unrelated to *Copiopteryx*. Kirby (1892) in his catalogue indicates that the type of *Eudaemonia* is *brachyura* Drury. Although the name *brachyura* does not appear with *Eudaemonia* in Hübner's work, Kirby shows clearly in his synonymy that *brachyura* and *argus* are synonymous. If this designation is upheld, *Copiopteryx* can be retained for the Neotropical group for which it is well established. If, as seems probable, this is not a valid designation, the next possibly valid one is by Bouvier (1931) who states that Hübner indicated the type of *Eudaemonia* as *semiramis* by citing that species first in his list of species. Since this statement is based on a false premise, it is doubtful if it constitutes type designation. However, if this is regarded as a type selection, and if Kirby's designation is invalid, *Eudaemonia* will replace *Copiopteryx*.

The first apparently valid genotype designation for *Eudaemonia* Hübner is that of d'Almeida (1943a) who cites the type as "*Phalaena brachyura* Drury, 1780 = *Bombyx argus* Fabr., 1781." As Hübner considered that the proper name for this species was *uroarge* Hübner, indicating that *argus* was a synonym, and not mentioning *brachyura*, there is even some doubt as to the validity of this designation. Since there has been no type designation which is not subject to some doubt, the type of *Eudaemonia* Hübner is here designated as *Eudaemonia uroarge* Hübner [1819] [= *Attacus argus* Stoll (1787) = *Bombyx argus* Fabricius (1781)]. Actually this specific name has priority over *brachyura* Drury which was not published until 1783, although the plate was presumably published in 1780.

Since Hübner's *Eudaemonia* was originally proposed with two species, it might be

¹ The synonymy of *uroarge* and *argus* was indicated by Hübner.



FIGS. 44-45. Wings of Rhescyntinae. 44. *Copiopteryx semiramis* (Cramer). 45. *Loxolomia serpentina* Maassen.

thought that an author who named a new genus for one of these two would, as indicated in Opinion 6 of the International Commission of Zoological Nomenclature, automatically designate the other as type for *Eudaemonia*. Unfortunately this is not the case, since Duncan on the same page named new genera (*Eustera* and *Copiopteryx*) for not one but both of the species which Hübner included in *Eudaemonia*. Fuller discussion of these matters is given by Oiticica (1941) and d'Almeida (1943a).

Shortest distance between eyes about one-half of the length of an eye.

Antennae nearly one and one-half times as long as thorax; flagellum not scaled or with scales on dorsal surface of first two or three segments, flagellum pectinate to apex, about as broadly so in female as in male; rami slender and rather long, apical rami one-third to nearly two-thirds as long as basal rami, the latter strongly curved downward; antennal cones small, slender, multiple, and arising from ventral projections on the segments which are large in distal third of the antenna and under low or moderate power look like large, simple, antennal cones.

Tentorial pits large and nearly round; clyp-

eus between three and four times as broad as long, separated from the frons by a rather distinct line. Galeae about as long as face to more than twice as long as face, curled, with numerous long, cylindrical, carinate papillae; third segment of labial palpus small.

Thorax covered with long, recumbent hair; patagia rather broad; parapatagia lamelliform; tegulae reaching behind anterior median angle of scutellum; anepisternum rather large, anepisternal suture sloping downward to the rear or sometimes, as in *C. sonthonnaxi*, sloping downward but little towards lower end of deeply impressed portion of pleural suture, the latter at an angle of about 170 degrees to the straight lower portion of the pleural suture, a curved region intervening between these two main portions.

Posterior tibiae without subapical spurs; tarsal segments one to three usually with a few apical spines, penultimate fore tarsal segment of female with the usual pair of apical spines; claws finely serrate.

Forewings with outer margin angulate at apex of vein M_1 , torni distinct; hind wings with exceedingly long tails containing apical portions of veins M_2 , M_3 , and Cu_1 ; wings with transparent spots beyond apices of discal cells and often with others beyond postmedian line.

Ninth abdominal tergum of male slightly shorter than uncus or subequal to it, the latter strongly downcurved at apex; harpes with a subapical projecting spine on ventral margin.

Eighth tergum of female with distinct sub-lateral sclerotic lobes projecting posteriorly; eighth sternum with prevulvar and postvulvar parts not heavily sclerotic, the former more heavily than the latter, neither projecting posteriorly nor conspicuously modified; ductus bursae almost twice as long as broad, weakly sclerotic; bursa rather narrow posteriorly but enlarged and subspherical anteriorly, posterior portion of bursa with longitudinal folds.

This genus contains about six species which occur from Central America to Argentina.

SUBFAMILY CITHERONINAE

Frons strongly convex laterally, adjacent to the eyes; laterofrontal sutures not visible; frontal protuberance present; antennae of male quadripectinate basally, sometimes to

apices, apical rami arising adjacent to basal rami of following segment; antennal cones simple; pilifers without bristles. Thorax robust, anepisternum large, anepisternal suture directed downward posteriorly. Vein M_1 of forewing stalked with the radials; vein at apex of discal cell of forewing between base of M_2 and radials very strong and usually directed basally, M_2 usually arising in front of middle of apex of cell. Tibial spurs usually longer than tibial diameter, posterior tibiae without subapical spurs; tarsi without spine-like setae except for apical pair on penultimate fore tarsal segment of female.

Larva with one or more pairs of large thoracic horns which are usually forked at their apices in the first instar; subventral abdominal spines present on segments 1, 2, and usually 7 to 9 (see Munroe, 1949). Pupa not enclosed in a cocoon.

In addition to the characters listed in the above diagnosis, all members of the subfamily that have been examined agree in the following respects:

Antennal rami without bristles or bristles present on rudimentary rami of some females. Thorax robust, its vestiture long, dense, and recumbent; patagia broad; parapatagia narrow and lamelliform; tegulae not reaching anterior angle of scutellum or only rarely reaching it; spine-bearing lobes of penultimate fore tarsal segment of female bare, adjacent bare areas of following segment large and each continued as a narrow band to apex of segment; arolium and pulvilli well developed. Abdomen robust and tapering apically, covered with dense and recumbent hairs; harpes of male freely articulated to the ninth segment.

In this subfamily the heavy-bodied, rather slender-winged form suggestive of the Sphingidae is developed more than in any other saturnioids. Perhaps the most primitive representatives of the family are the subgenus *Procitheronia* of *Citheronia* and the genus *Bathyphlebia*. These groups agree in having the antennae narrowly pectinate, but unlike other Citheroniinae, pectinate to the apices. This is a primitive character, shared with the Rhescyntinae. They are also large, broad-winged forms suggestive in that respect also of the Rhescyntinae. They share with *Eacles*, *Schausiella*, and other subgenera of *Citheronia* large and usually three-segmented labial

palpi, another primitive character. Except for *Eacles* and perhaps *Bathyphlebia* these genera have a longitudinal cleft or depressed line in the male harpe, a character shared with most Rhescyntinae and with the Oxytenidae and therefore presumably primitive. Such a cleft occurs also in a number of the more specialized genera. No doubt the bulk of *Citheronia* arose from *Procitheronia*-like forms, but *Bathyphlebia* cannot have given rise to any other groups, because it is highly specialized in certain respects, notably the absence of a gnathos in the male.

The remaining groups of the Citheroniinae are those in which evolution seems often to have led towards reduction in size. The great bulk of these genera have been placed in *Syssphinx* by most authors, but they are no more closely related to one another than are *Eacles* and *Citheronia*, and if more than one or two genera are to be recognized in the Citheroniinae, it will be necessary to recognize most of these. Their relationships to one another are not at all obvious, except that *Adelocephala*, *Syssphinx*, and *Ceropoda* appear to be rather closely related. These genera, together with *Anisota* and *Neocarnegia*, have relatively little-modified male genitalia. *Almeidella* and *Psilopygida* have somewhat modified genitalia, while *Adeloneivaia* and *Adelowalkeria* have highly modified, though very different, genitalia.

The proper name for this subfamily has been questioned. Numerous authors (for example, Bouvier, 1931; Oiticica, 1941; and d'Almeida, 1943c) use names based on the genera *Syssphinx* or *Adelocephala*. The first higher category based on a genus now included in the Citheroniinae was the Ceratocampidae, used by Harris in 1841, and based on the name *Ceratocampa*. I believe that in order to maintain continuity in meaning of names of higher categories, they should always be nomenclatorially attached to the genus upon which they were originally based. Since *Ceratocampa* is a synonym of *Citheronia*, it follows that the proper name for the category including this genus should be based upon *Citheronia*. Hence the name Citheroniinae is here used. This conclusion is not altered by the fact that names based on *Syssphinx* and *Adelocephala* were proposed before any based on *Citheronia*, although after the one based on *Ceratocampa*.

KEY TO THE GENERA OF CITHERONIINAE

1. Labial palpi three-segmented, extending well in front of frons, the second segment much longer than first, rarely (*Eacles imperialis*) second and third segments fused and palpi not extending in front of frons, but the second segment much longer than first; cell 1V of forewing closed. 2
 Labial palpi one- or two-segmented, not or scarcely reaching frons, if two-segmented first segment at least nearly as long as second (except in *Psilopygoides*); cell 1V of forewing open (except in *Neocarnegia*) 5
2. Epiphysis with numerous long hairs; gnathos of male with free lateral arms; harpe not divided into upper and lower lobes (although often with an inflexed projection along lower margin) *Eacles*
 Epiphysis without long hairs (with a few in *Citheronia* subgenus *Citheronula*); gnathos without lateral arms; harpe divided into upper and lower lobes, the latter sometimes reduced. 3
3. Wings with eye spots; gnathos absent; harpe with lower lobe much smaller than upper and blunt. *Bathyphlebia*
 Wings without eye spots; gnathos large; harpe with lower lobe large and usually acutely pointed. 4
4. Female antennae simple to strongly dentate; antennal cones of male small and but little projecting from shaft. Wing pattern usually consisting of numerous lobed bands or lines or separate spots. *Citheronia*
 Female antennae quadripennate basally; antennal cones of male large, the larger ones projecting from the shaft to a distance equal to fully two-thirds of the diameter of the shaft; wings lacking numerous spots or lobed lines, with more or less straight lines *Schausiella*
5. Only apical sixth of male antenna simple; under surface of antenna in both sexes with strong carina; fore and middle tibiae each bearing one long spine on outer apical angles, inner apical angles not produced *Ceropoda*
 Apical fifth or more, usually much more, of antenna simple; antennae not or scarcely carinate beneath; tibiae without spines or, if spined, with a different arrangement of spines, the inner apical angles being produced or spined 6
6. Clypeus a mere narrow rim beneath the frontal projection; anterior tibiae usually with apical spine; larva with only a single pair of large thoracic horns, these on the mesothorax (small North American forms) *Anisota*

- Clypeus usually at least one-fifth as long as broad; anterior tibiae usually without spines; larva in known forms with more than a single pair of large thoracic horns . . . 7
7. Eyes separated by a distance equal to well over one-third of the length of an eye; wings with numerous irregular transparent areas . . . *Neocarnegia*
- Eyes separated by a distance equal to much less than one-third of the length of an eye; wings without transparent areas . . . 8
8. Females . . . 9
- Males . . . 13
9. Antennae quadripectinate basally, distal rami about as long as basal rami . . . 10
- Antennae simple or dentate, sometimes (*Syssphinx* subgenus *Sphingicampa*) bipectinate or even with short stubs (much shorter than basal rami) representing apical rami . . . 11
10. Sides of eighth tergum narrow bands strongly arcuate anteriorly; antennal pectination more than three times as long as broad . . . *Adeloneivaia*
- Sides of eighth tergum extending downward from dorsal portion, not arcuate anteriorly (see note on *Syssphinx mexicana*, p. 393) . . . *Adelocephala*
11. Outer and posterior margins of forewing forming together a broad curve so that there is no tornus . . . 12
- Outer and posterior margins of forewing separated by a more or less distinct tornus . . . *Syssphinx*, *Adelowalkeria*, *Adelocephala* subgenus *Giacomellia*
12. Anterior apical angle of hind wing broadly rounded . . . *Psilopygida*
- Anterior apical angle of hind wing distinct . . . *Almeidella*
13. Outer and posterior margins of forewing consisting of a single broad curve so that there is no tornus . . . 14
- Outer and posterior margins of forewing separated by a tornus which may be very broadly rounded but is at least more strongly convex than the posterior margin . . . 16
14. Labial palpi one- or two-segmented, in the latter case segments subequal in length; ninth tergum of male more than one-fourth of the length of uncus . . . 15
- Labial palpi three-segmented (division between first and second segments inconspicuous), last segment much shorter than second; ninth tergum of male only one-fourth as long as uncus . . . *Psilopygoides*
15. Anterior apical angle of hind wing broadly rounded; gnathos scarcely produced medially; annellus absent or nearly so; ninth tergum much longer than uncus . . . *Psilopygida*
- Anterior apical angle of hind wing distinct; gnathos much produced medially; annellus large; ninth tergum shorter than uncus . . . *Almeidella*
16. Harpes large but inconspicuous and wholly membranous; ninth tergum much longer than the bifid but otherwise unarmed uncus . . . *Adeloneivaia*
- Harpes conspicuous and sclerotic; ninth tergum variable; uncus often ornamented with lobes or spines . . . 17
17. Harpes each with a huge inner spine or process, usually arising near lower basal portion of harpe but frequently becoming free from harpe near upper basal angle, this spine extending above or beyond remainder of harpe; ninth tergum of male usually longer than uncus . . . *Adelowalkeria*
- Harpes without inner spines or each with a spine of moderate size, not extending above or beyond rest of harpe (spine large and extending above harpe only in *jacca* group of *Syssphinx*); ninth tergum of male not or but little longer than uncus . . . 18
18. Gnathos of male divided longitudinally in the middle by a membranous zone, or rarely by a mere groove which ends at a median apical notch in gnathos . . . *Adelocephala*
- Gnathos of male undivided, apex of median projection usually unnotched . . . *Syssphinx*

GENUS BATHYPHLEBIA FELDER

Figures 137-139

Bathyphebia FELDER, 1874, Reise der Österreichischen Fregatte Novara, Zool., vol. 2, Lepidoptera, Atlas; Erklärung der Tafeln, Heterocera, p. 2. Type: *Bathyphebia aglia* Felder (monobasic).

This genus is similar to *Eacles*, and its species have often been included in that genus. The outstanding differences are indicated in table 5.

Frontal protuberance distinct, though often rather low and broadly rounded. Shortest distance between eyes about one-third of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae about as long as thorax; flagellum without scales, rather narrowly quadripectinate to the apex in both sexes, more narrowly so in female than in male; rami short, nearly straight, basal rami distinctly longer

TABLE 5
GENERIC CHARACTERS OF *Bathyphebia* AND *Eacles*

<i>Bathyphebia</i>	<i>Eacles</i>
Antennae of both sexes pectinate to apices	Antennae of male pectinate only about to middle, of female simple or dentate
Epiphysis without long hairs	Epiphysis with long hairs
Vein R ₁ usually stalked with other radials	Vein R ₁ arising from discal cell
Gnathos absent	Gnathos present
Harpe with separate lower lobe	Harpe without such a lobe
Eighth tergum of female scarcely bilobed	Eighth tergum of female clearly bilobed

than apical rami, rami of male with the usual fine curved setae, those of female with setae much shorter and sparser; basal rami of female each with an inconspicuous terminal bristle and sometimes one or two similar bristles on ventral side; shaft of flagellum somewhat compressed proximally, more strongly so distally, not carinate ventrally, with small simple cones in distal third or half, basal portion of each segment in proximal third or half of antenna somewhat swollen so that under surface is undulate viewed from side; female with one to three small bristles on under surface of most of segments of flagellum and with a rather large dorsal bristle on each segment of flagellum.

Tentorial pits round; clypeus four or five times as wide as long, with numerous erect scales, separated from frons by a distinct line; pilifers rather distinctly convex. Mandibular rudiments large and protuberant. Proboscical fossa longer than broad, walls subvertical; maxillary stipites in contact with walls of fossa, extending backward to or slightly behind anterior margins of palpal sockets, galeae very short and not curled; labial sclerite rather large and strongly sclerotic; labial palpi arising behind middle of fossa, rather long and extending well in front of frontal protuberance, three-segmented, third segment small, second segment much longer than either of the others.

Prescutum strongly convex above medially; anepisternal suture curved strongly downward near its posterior end, directed towards a point on pleural suture well below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture at an angle of about 160 degrees to

straight lower portion, curved portion intervening between these two main portions inconspicuous.

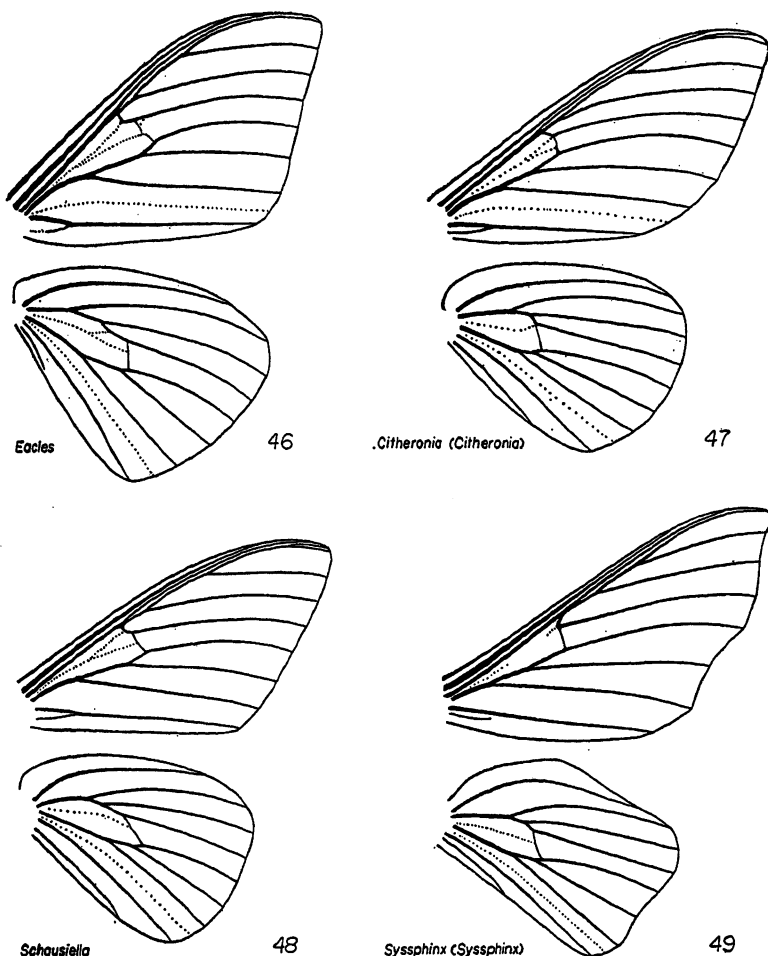
Anterior tibiae equal to tarsi in length; epiphysis large, reaching well beyond middle of tibia, without long hairs; tibial spines absent; tibial spurs not completely hidden in vestiture, their apical halves concave on one side and minutely serrate; spurs slightly longer than diameter of tibiae; claws not noticeably serrate.

Forewings with outer margins slightly concave to slightly convex, torni clearly defined; hind wings with anal angles rounded, not produced; forewings and hind wings usually each with a small discal eye spot; vestiture consisting of scales, overlain on the hind wings by hair in many areas; vein R₁ usually stalked with the other radials.

Ninth tergum of male shorter than or equal to uncus, the latter broad, blunt, more or less bilobed; gnathos entirely absent; annellus free from harpes; harpes bilobed, lower lobe much smaller than upper.

Eighth tergum of female scarcely bilobed; eighth sternum with prevulvar part consisting of transverse sclerotic band, postvulvar part heavily sclerotic and produced medially to form a median posterior projection; ductus bursae sclerotic, broader than long; bursa membranous and short; ductus seminalis arising on right-hand side of base of bursa.

This genus includes *B. aglia* Felder, *eminentens* (Dognin), *johnsoni* Oiticica and Michener, *rufescens* Oiticica and Michener, *tyrannus* (Draudt), and presumably *peruvianus* (Bouvier) and *gschwandneri* (Schawerda). These species occur in Colombia, Ecuador, and Peru.



FIGS. 46-49. Wings of Citheroniinae. 46. *Eacles imperialis* (Drury). 47. *Citheronia (Citheronia) regalis* (Fabricius). 48. *Schausiella polybia* (Stoll). 49. *Syssphinx (Syssphinx) molina* (Cramer).

GENUS *EACLES* HÜBNER

Figures 46, 140-143

Eacles HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 153. Type: *Phalaena imperialis* Drury, designated by Grote and Robinson, 1866, Ann. Lyc. Nat. Hist. New York, vol. 7, p. 379.

Cerocampa KIRBY AND SPENCE, 1826, Introduction to entomology, vol. 3, p. 251. Type: *Phalaena imperialis* Drury, designated by Oiticica, 1941, Arq. Zool. Estado São Paulo, vol. 2, p. 328.

Basilona BOISDUVAL, 1868, Ann. Ent. Soc. France, vol. 8, p. 317. Type: *Basilona cacticus* Boisduval, designated by Barnes and Lindsey, 1922, Ann. Ent. Soc. Amer., vol. 15, p. 97.

Crenudia BURMEISTER, 1879, Description physique de la République Argentine, Lépidoptera

Atlas, p. 46. Type: *Basilona opaca* Burmeister (monobasic).

This genus and *Bathyphlebia* are unique in the Citheroniinae in having eye spots on the forewings and hind wings. The principal differences between *Eacles* and *Bathyphlebia* are indicated in table 5. *Eacles* differs from *Citheronia* by the presence of numerous long hairs on the epiphysis, the presence of free lateral arms of the gnathos, the transverse vulva of the female, and by other characters.

Frontal protuberance distinct and strongly produced. Shortest distance between eyes about one-fourth of length of an eye, upper

ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae two-thirds as long as thorax; flagellum without scales in male, usually with a few scales on dorsal surface basally in female; male with proximal half to three-fifths of flagellum quadripectinate, rami relatively short, nearly straight, basal and apical rami subequal, or the apical rami considerably shorter than the basal ones on one or both sides, shaft of proximal half of antenna slightly to considerably compressed, not carinate ventrally, without cones or bristles, basal portion of each segment somewhat swollen so that the shaft appears undulate beneath viewed from the side; non-pectinate portion of antenna strongly compressed, not carinate ventrally, each segment with large, basal, and usually also smaller apical lateral tubercles representing the rami and bearing setae similar to those of rami, each segment also with one large ventral cone; ventral margin of each segment nearly straight in profile. Antennae of female simple or nearly so; if simple (as in *imperialis*) there are basal tubercles representing basal rami on the sides of segments of proximal half of flagellum, each of these tubercles bearing a weak bristle, comparable bristles present to apex of antenna on less conspicuous tubercles. In many species tubercles (which may bear bristles) are present both apically and basally so that proximal half of antenna is quadridentate. Distal half of antenna with segments each bearing a single ventral cone which may be small to large, these segments also usually with a dorsal bristle, these bristles sometimes present also on basal half of flagellum.

Tentorial pits oval; clypeus four or five times as wide as long, separated from the frons by a distinct line; pilifers but little convex. Mandibular rudiments large and protuberant. Proboscis fossa longer than broad to over twice as long as broad (as in *imperialis*), rather deep, the walls steeply sloping or subvertical; maxillary stipites in contact with wall of fossa, extending backward to or behind anterior margins of palpal sockets; galeae very short and uncurled to considerably longer than labial palpi and curled, without papillae or conspicuous hairs;

labial sclerite rather strongly sclerotic; labial palpi arising behind middle of fossa or nearly at its posterior end, rather long and usually extending well in front of frontal protuberance, usually three-segmented, though sometimes (as in *imperialis*) with the small third segment fused to the second and their apices only reaching the base of the frontal protuberance. Postoccipital bridge moderately broad and sclerotic.

Prescutum strongly convex above; anepisternal suture directed towards a point on pleural suture below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture at an angle of about 160 degrees to straight lower portion, an oblique, slightly curved region intervening between the two main portions.

Anterior tibiae subequal to tarsi; epiphysis large, not reaching apex of tibia, with some long hairs; tibial spines absent; tibial spurs not completely hidden in vestiture, apical one-half to one-fourth of each concave on one side and minutely serrate; spurs slightly longer than diameter of tibiae; claws not noticeably serrate.

Forewings with outer margins slightly concave to straight, torni clearly defined; hind wings with anal angles rounded, not produced; forewings and hind wings usually each with small distal eye spot, the centers of these eye spots occasionally transparent; scales of wings in most species overlain and hidden by dense covering of hairs. Vein R_1 arising from apex of discal cell.

Gnathos of male heavily sclerotic and produced medially, connected laterally to upper part of base of harpe and with a free lateral arm on each side; ninth tergum shorter than or equal to uncus, the latter robust, blunt, more or less bilobed; anellus free from harpes; aedeagus more or less cylindrical, with an apical sac usually bearing heavily sclerotized spicules.

Eighth tergum of female with sublateral sclerotic lobes, often considerably produced; eighth sternum with a prevulvar transverse, sclerotic band, postvulvar part heavily sclerotic, produced medially to form an often quite narrow, median, strongly sclerotized projection; ductus bursae sclerotic, broader than long to considerably longer than broad, bursa membranous and usually short; ductus

seminalis arising on right-hand side of base of bursa.

Eacles ranges from Canada to Argentina. It contains about 16 species, all of those commonly placed in the genus except those transferred to *Bathyphebia*.

GENUS CITHERONIA HÜBNER

This is a genus of large moths with a pattern consisting of numerous spots and lobed lines. It is most closely related to *Eacles* and *Bathyphebia*, from which it differs by the absence of eye spots on the wings. From *Eacles* it differs further by the absence (except in the subgenus *Citheronula*) of long hairs on the epiphyses, by the absence of the lateral arms of the gnathos, by the cleft claspers, the lower arms being usually incurved and sharp, and by the round or longitudinal vulva of the female. (It is transverse in other genera.) It differs further from *Bathyphebia* by the shape of the vulva, by the presence of a gnathos, and by the longer and more produced lower portion of the harpe.

Frontal protuberance rather short but distinct, broader than long, rounded apically. Shortest distance between eyes about one-third of length of an eye, upper ends of eyes extending somewhat above lower margins of antennal sockets, lower ends of eyes extending well below lower end of frons.

Antennae two-thirds to three-fourths as long as thorax, flagellum not scaled or with a few scales on proximal segments in female; male with proximal half of flagellum quadripectinate or pectination tapering gradually almost to apex of antenna; rami rather short, robust, nearly straight, basal and apical rami subequal; shaft of proximal half of antenna but little compressed, not carinate ventrally, without cones or bristles, each segment swollen basally on ventral side as seen in profile, shaft of distal half of antenna more compressed, very conspicuously so if not pectinate, not carinate ventrally, each segment with small ventral cone; ventral margin of each segment straight or convex seen in profile; if distal portion of antenna is not pectinate, each segment bears a small, basal and apical tubercle on each side, representing the rami and bearing setae similar to those of rami. Antennae of female simple, some species with basal and apical projec-

tions representing the rami on each segment, others with only weak basal projections and many with no projections at all, antennae not carinate, without bristles, or with weak bristles on basal projections of segments and on dorsal surfaces of distal segments; distal portion of antenna compressed, with small ventral cones similar to those of the male.

Tentorial pits round to oval; clypeus four or five times as wide as long, with erect scales; pilifers often indicated by distinct convexities. Mandibular rudiments rather large, strongly projecting. Proboscis considerably longer than broad, with vertical walls; maxillary stipites in contact with walls of fossa, extending backward to anterior margins of palpal sockets; galeae as long as the fossa or longer, curled, without conspicuous hairs or papillae; labial sclerite rather large and strongly sclerotic; labial palpi arising well behind middle of fossa, large, three-segmented, second segment much longer than either of the others, the palpi reaching well in front of the frontal protuberance. Postoccipital bridge rather weakly sclerotic.

Prescutum slightly convex above; anepisternal suture directed downward near posterior end towards a point on pleural suture well below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture directed in about the same direction as lower straight portion, a conspicuous curved region intervening between these two main portions.

Fore tibiae subequal to or shorter than tarsi, epiphysis reaching to apical third of tibia or beyond, usually without long hairs; tibial spines absent, or the fore tibia with a single spine; tibial spurs not completely hidden in vestiture, longer than diameter of tibiae, extreme apices to apical halves concave on one side and minutely serrated; claws not noticeably serrate.

Forewings with outer margins convex or straight, torni distinct; hind wings with anal angles not produced; vestiture consisting of scales covered in most species by hairs.

Ninth tergum of male equal to or somewhat longer than uncus, the latter downcurved, usually bilobed apically; gnathos strongly sclerotized and somewhat produced medially, laterally connected to upper parts of bases of harpes, without free lateral arms; anellus

TABLE 6
SUBGENERA OF *Citheronia*

<i>Procitheronia</i>	<i>Citheronia</i> , <i>Sensu Stricto</i>	<i>Citheronula</i>
Male antennal pectination tapering nearly to apex of antenna	Male antennae pectinate in proximal half only	Male antennae pectinate in proximal half only
Female antennae strongly quadridentate	Female antennae simple or feebly dentate	Female antennae simple
Wings broad, fenestrate, postmedian line continuous, not lobate	Wings narrower, not fenestrate, postmedian line broken or lobate	Wings narrower, not fenestrate, postmedian line lobate and broken
Fore tibiae equal to tarsi, unarmed	Fore tibiae equal to tarsi, unarmed	Fore tibiae shorter than tarsi, each with an apical spine
Epiphysis without long hairs	Epiphysis without long hairs	Epiphysis with a few long hairs
Aedeagus simple, tapering	Aedeagus strongly compressed, blade-like, bifurcate	Aedeagus simple, tapering
Vulva of female circular	Vulva of female a longitudinal slit	Vulva of female circular

distinct and free from harpes; harpes cleft, the produced lower lobe commonly acute.

Eighth tergum of female with two large, sublateral, heavily sclerotic lobes; eighth sternum consisting of a heavily sclerotic plate produced posteriorly in the middle and containing the vulva which is either a round hole or longitudinal slit, not a transverse slit as in most other groups; ductus bursae variously shaped, often much enlarged and partially sclerotic; bursa consisting of a slender neck posteriorly, greatly enlarged anteriorly to form a highly membranous sac; ductus seminalis arising from right-hand side near base of neck of bursa.

The subgenera of *Citheronia* can be separated by the characters given in table 6.

SUBGENUS *CITHERONIA* HÜBNER

Figures 47, 144-146

Citheronia HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 153. Type: *Bombyx regalis* Fabricius, designated by Grote and Robinson, 1866, Ann. Lyc. Nat. Hist. New York, vol. 8, p. 379.

Ceratocampa HARRIS, 1833, in Hitchcock, Report on geology, mineralogy, botany, and zoology of Massachusetts, p. 519. Type: *Bombyx regalis* Fabricius, designated by Oiticica, 1941, Arq. Zool. Estado São Paulo, vol. 2, p. 328.

Dorycampa DUNCAN, 1841, in Jardine, Naturalist's library, vol. 32, p. 161. Type: *Bombyx regalis* Fabricius (monobasic).

This subgenus contains about 20 species and ranges from Canada to Argentina.

SUBGENUS *PROCITHERONIA* MICHENER

Procitheronia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 142. Type: *Citheronia fenestrata* Rothschild, by original designation.

The characters of this subgenus are indicated in table 6. The broad wings and completely pectinate male antennae, as well as the wing markings and genitalia, suggest that this is the most primitive group of *Citheronia*, if not of the Citheroniinae.

The subgenus includes *C. fenestrata* Rothschild and *C. principalis* Walker, which occur from Honduras to southern Brazil.

SUBGENUS *CITHERONULA* MICHENER

Citheronula MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 143. Type: *Citheronia armata* Rothschild, by original designation.

This subgenus is characterized in table 6. It contains only the type species, found in southern Brazil, Paraguay, and northern Argentina.

GENUS *SCHAUSIELLA* BOUVIER

Figures 48, 147-150

Schausiella BOUVIER, 1930, Compt. Rendus Acad. Sci., Paris, vol. 191, p. 505. Type: *Orthorene arpi* Schaus, designated by Oiticica, 1941, Arq. Zool. Estado São Paulo, vol. 2, p. 332.

This genus contains a group of species that have been widely included in *Syssphinx*, but, as pointed out by Bouvier, are probably more closely related to *Citheronia*. At least they

have the large labial palpi and almost bare epiphyses of *Citheronia*. *Schausiella* differs from *Citheronia* by the completely different wing pattern, lacking the streaks, blotches, and lobed lines which characterize that genus, by the female antennae which are quadripectinate proximally, and by the very large ventral cones of the distal part of the antenna of the male. The genitalia are usually somewhat asymmetrical.

Frontal protuberance low but distinct, rounded. Shortest distance between eyes less than one-fourth of length of an eye, upper ends of eyes extending well above lower margins of antennal sockets, lower ends of eyes extending below lower end of frons.

Antennae two-thirds to three-fourths as long as thorax, flagellum not scaled; male with proximal one-half to three-quarters of flagellum quadripectinate, rami rather long and slender, slightly curved, especially those of inner side; apical rami slightly shorter than basal ones, especially so in distal portion of pectinate part of antenna; shaft of pectinate part of antenna scarcely compressed, not carinate ventrally, without cones or bristles, but each segment somewhat swollen at base; nonpectinate portion of antenna compressed, not carinate ventrally, each segment with basal tubercles laterally, representing basal rami, these tubercles bearing setae similar to those of rami; each segment also with a very large, produced, ventral cone. Antennae of female quadripectinate in basal three-fifths to three-quarters, distal rami very short, less than one-fourth as long as basal rami, basal rami conspicuously curved, each with a few weak terminal bristles, setae of rami much shorter and less numerous than in male; shaft of this portion of antenna similar to that of male; nonpectinate portion of antenna similar to that of male, but basal tubercles (representing basal rami) each bearing a bristle, many of the segments also with a dorsal apical bristle and antennal cones frequently with a few small bristles, subapical antennal segments less than twice as long as broad.

Tentorial pits slightly elongated; clypeus about three times as wide as long, separated from frons by a mere line; pilifers not projecting, inconspicuous. Mandibular rudi-

ments large and protuberant. Proboscidial fossa more than twice as long as broad, deep, its walls vertical; maxillary stipites free from walls of fossa, lamella-like, posterior ends not reaching palpal sockets; galeae about as long as fossa, curled, without conspicuous hairs or papillae; labial sclerite distinct and somewhat elevated in region of bases of palpi; labial palpi arising near posterior end of the fossa, three-segmented, directed forward, reaching well beyond the frontal protuberance. Postoccipital bridge moderately broad and sclerotic.

Prescutum rather conspicuously convex above seen in profile; anepisternal suture slightly curved near its posterior end, reaching pleural suture a very short distance below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture continued in almost same direction as straight lower portion of this suture, but a short curved section intervening between these two portions of pleural suture.

Fore tibiae about as long as tarsi; epiphysis in both sexes reaching well beyond middle of tibia, without long hairs; tibial spines absent; tibial spurs almost completely hidden in the vestiture, apical one-half to two-thirds concave on one side, slightly serrate; claws not noticeably serrate.

Forewings with apices acute but not at all produced, torni clearly marked, especially in male; outer margins of forewings convex; hind wings with anal angles rounded, not produced; vestiture consisting of broad scales, overlain but not entirely concealed by long, hair-like scales.

Eighth sternum of male unarmed; ninth tergum about as long as uncus, the latter usually with a bilobed apex and often with a very large asymmetrical dorsal projection; gnathos strongly produced and heavily sclerotic medially, connected laterally to upper parts of bases of harpes, without free lateral lobes; anellus distinct, free from harpes; harpes divided longitudinally by an impressed and dark line into an upper, often rounded lobe and a lower lobe which is usually acute or bears an apical spine.

Eighth tergum of female with sublateral heavily sclerotic lobes; eighth sternum with prevulvar part membranous, postvulvar part

large and heavily sclerotic, produced medially to form an often irregularly or complexly shaped projection; ductus bursae broader than long, heavily sclerotic, no appreciable constriction between it and the very elongate, almost tube-like bursa which sometimes bears one or two sclerotic spots near its slightly expanded anterior extremity; ductus seminalis arising from right-hand side of base of bursa.

Bouvier includes *S. adocima* (Druce), *arpi* (Schaus), *carabaya* (Rothschild), *janeira* (Schaus), *klagesi* (Rothschild), *polybia* (Stoll), *polybioides* (Bouvier), *schausi* Bouvier, and *subochreata* (Schaus) in this genus. An undescribed species before me raises to 10 the known species of this genus. All are found in South and Central America.

GENUS SYSSPHINX HÜBNER

This is a large genus, even as here restricted. It can be distinguished from its close relative, *Adelocephala*, by the simple or bipectinate female antennae (they are simple also in the subgenus *Giacomellia* of *Adelocephala*) and by the medially produced and undivided gnathos of the male. Superficially many of the species are similar to those of *Adeloneivaia*, which has very peculiar genitalia in both sexes and quadripectinate female antennae.

Frontal protuberance distinct, directed forward, rounded at apex. Shortest distance between eyes one-fourth to one-fifth of length of an eye, upper ends of eyes usually extending well above lower margins of antennal sockets, lower ends of eyes usually extending below lower end of face.

Antennae two-thirds to three-fourths as long as thorax, flagellum not scaled; male with basal one-half to two-thirds of flagellum quadripectinate, rami nearly straight and rather slender, basal and apical rami subequal; shaft of pectinate part of antenna not or only slightly compressed, not carinate ventrally, without bristles, sometimes with weak indications of antennal cones at apices of segments; nonpectinate portion of antenna somewhat compressed, not carinate ventrally, each segment with basal lateral tubercles representing basal rami and bearing setae similar to those of rami; each segment also

with a ventral cone of small to moderate size; ventral margin of each segment nearly straight to distinctly convex seen from the side, segments of this portion of antenna broader than long seen from the side, except for apical segments in certain species. Antennae of female simple or bipectinate proximally, rarely with abbreviated apical rami so that it approaches the quadripectinate condition; antennae virtually without bristles or, if bipectinate, with a terminal bristle on each ramus and also with dorsal and lateral bristles on nonpectinate portion of antenna, antennal cones similar to those of male.

Tentorial pits oval; clypeus four or five times as wide as long, bearing a tuft of elongated scales medially, separated from frons by a weak line; pilifers low, broad, and inconspicuous. Mandibular rudiments low and inconspicuous. Proboscis fossa much longer than broad, walls nearly vertical; maxillary stipites included in walls or adjacent to them, extending backward to the anterior margins of palpal sockets; galeae usually short and curled, sometimes very short and not curled; galeae without conspicuous hairs or papillae; labial sclerite rather large and elevated near bases of palpi; labial palpi arising behind middle of fossa, reaching forward to clypeus, usually two-segmented but often with the two segments partially or completely fused so that they appear to be one-segmented. Postoccipital bridge broad and sclerotic.

Prescutum slightly convex above. Anepisternal suture straight or nearly so, reaching pleural suture below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture directed in about the same direction as straight lower portion of this suture, a conspicuously curved region intervening between these two main portions.

Fore tibiae subequal to tarsi; epiphysis usually reaching to apical third of tibia in female, and nearly to apex of tibia in male, without elongate hairs; tibial spines absent; tibial spurs hidden in the vestiture or partially exposed, apical halves or less concave on one side, feebly serrate; claws not noticeably serrate.

Forewings with outer margins convex, torni fairly conspicuous, postmedian line

usually not at all parallel to costal margin of wing; hind wings with anal angles not or but little produced, rounded; vestiture consisting of broad scales, overlain in some species by elongate, hair-like scales.

Ninth tergum of male rather short, though usually longer than uncus, the latter variously modified but almost always bilobed or with a series of tubercles or processes at apex; gnathos connected laterally to upper parts of bases of harpes, without free lateral

In an otherwise apparently normal female of *S. albolineata* (Grote and Robinson) the antennae are bipectinate to their apices.

Syssphinx can be divided into three subgenera, as indicated in table 7.

SUBGENUS SYSSPHING HÜBNER

Figures 49, 155-157

Syssphinx HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 143. Type: *Phalaena molina* Cramer (monobasic).

TABLE 7
SUBGENERA OF *Syssphinx*

<i>Syssphinx</i> , <i>Sensu Stricto</i>	<i>Bouvierina</i>	<i>Sphingicampa</i>
Antennae of female simple, without conspicuous bristles	Antennae of female simple, without conspicuous bristles	Antennae of female bipectinate, each ramus with a terminal bristle
Harpe of male over three times as long as broad, without inner spine	Harpe of male under three times as long as broad, almost always with inner spine	Harpe of male under three times as long as broad, without inner spine
Uncus of male longer than ninth tergum	Uncus of male shorter than ninth tergum	Uncus of male equal to ninth tergum

lobes, medially strongly produced, heavily sclerotic, not divided; anellus free from harpes; harpes not divided by a cleft or line of weakness into upper and lower lobes, each harpe usually with an internal spine arising near the lower margin medially or subbasally and often with one to three marginal teeth or spines.

Eighth tergum of female with two sub-lateral sclerotic lobes which do not project posteriorly, are only feebly sclerotized, and are only narrowly or even not at all connected with each other medially by a sclerotic band; eighth sternum with prevulvar band sometimes heavily sclerotic, more often weakly so, postvulvar part broad, truncate or emarginate, not much produced, usually heavily sclerotic; ductus bursae short, thick, sclerotic; bursa short to elongate, with a spherical swelling at the anterior end, sometimes containing a small sclerotic area; elongate neck-like portion sometimes with slightly sclerotic ribs; ductus seminalis arising from right-hand side of base of bursa. [In *S. isias* (Boisduval) the lower lateral portions of the eighth tergum bear a number of teeth and projections. This portion of the tergum is unusually heavily sclerotized in *Syssphinx*.]

Syssidphinx WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 6, p. 1503 (emendation of *Syssphinx*).

Psephopaectes GROTE AND ROBINSON, 1867, Trans. Amer. Ent. Soc., vol. 1, p. 5. Type: *Psephopaectes simulatilis* Grote and Robinson = *Phalaena molina* Cramer (monobasic).

Ceroderes BOISDUVAL, 1871-1872, Ann. Soc. Ent. Belgique, vol. 15, p. 81. Type: *Phalaena molina* Cramer (monobasic).

In addition to the characters given in table 7, this subgenus is distinct by the biconcave outer margin of the forewing in the male, the somewhat produced anal angle of the hind wing in the male, the several pairs of tubercles on the apex of the uncus of the male, and the presence of a distinct postmedian band in the hind wing.

This subgenus is represented by a single species, *S. molina* Cramer, ranging from Mexico to Argentina.

SUBGENUS BOUVIERINA MICHENER

Figures 151-153

Bouvierina MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 143. Type: *Adelocephala högei* Druce, by original designation.

This subgenus includes the bulk of the species of *Syssphinx*. It is characterized in table 7. The outer margins of the forewings are not biconcave, and the anal angle of the hind wing is rounded, or in some species slightly produced.

Included species are *Syssphinx* (*Bouvierina*) *albolineata* (Grote and Robinson), *andrea* (Dognin), *bisecta* (Lintner), *colloida* (Dyar), *heiligbrodti* (Harvey), *högei* (Druce), *isias* (Boisduval), *kuschei* (Dyar), *marginata* (Bouvier), *mexicana* (Boisduval),¹ *modena* (Dyar), *ocellata* (Rothschild), *quadrilineata* (Grote and Robinson), and *sinaloana* (Schaus).

The following group of species is included in *Bouvierina* but has unusually large male genitalia, with the inner spine of the harpe large and reaching to the apex of harpe and often above harpe: *colla* Dyar, *jacca* (Schaus), *pollens* (Schaus), *talmanca* (Schaus), and *vilderi* (Schaus). It may be from such forms that *Adelowalkeria* arose.

The majority of the species of this subgenus occur in Mexico and central America, but one occurs in eastern North America and a few in South America, one reaching southern Brazil.

SUBGENUS SPHINGICAMPA WALSH

Figure 154

Sphingicampa WALSH, 1864, Proc. Boston Soc. Nat. Hist., vol. 9, p. 290. Type: *Sphingicampa distigma* Walsh = *Dryocampa bicolor* Harris (monobasic).

Adelocampa PACKARD, 1905, Mem. Natl. Acad. Sci., vol. 9, p. 11. Type: *Dryocampa bicolor* Harris (monobasic).

This subgenus contains species in which the antennae of the female are bipectinate, the rami clavate, each terminating in one or more bristles. In certain species the distal rami are represented by short stubs, so that the antennae approach the quadripectinate

condition. The outer margins of the forewings are convex, and the anal angles of the hind wings are rounded.

This subgenus contains *S. bicolor* (Harris) from eastern North America and *paranensis* Bouvier from southern Brazil, as well as an unidentified Brazilian species.

GENUS ADELOCEPHALA HERRICH-SCHÄFFER

This is a large genus, closely related to *Syssphinx*, from which it differs principally by the quadripectinate rather than simple antennae of the female (except in the subgenus *Giacomellia*) and by the male gnathos, which is divided, in most instances by a longitudinal median membranous band, in a few species (e.g., *A. cadmus* Herrich-Schäffer) merely by a groove which terminates in a notch at the apex of the gnathos.

Frontal protuberance distinct, narrow, thick, and projecting forward. Shortest distance between eyes slightly more than one-fourth to less than one-fifth of length of eye, upper ends of eyes extending well above lower margins of antennal sockets, lower ends of eyes extending to or below lower end of face.

Antennae two-thirds as long to nearly as long as thorax, flagellum not scaled; proximal one-half to three-quarters or even more quadripectinate in both sexes (flagellum of subgenus *Giacomellia* simple in female), the rami rather long and slender, nearly straight, proximal and distal rami subequal or the distal slightly shorter; rami of male with the usual long setae, rami of female frequently with some similar setae, though setae usually shorter than in male, both basal and apical rami with one or two terminal bristles in females of most species; shaft of pectinate part of antenna somewhat compressed, not or only slightly carinate ventrally, apical margins of segments frequently with a produced angle suggesting a rudiment of an antennal cone; nonpectinate portion of antenna compressed, slightly carinate ventrally, each segment with a small to rather large ventral cone; each segment also with a lateral swelling representing a basal ramus on each side, this swelling in male bearing curved setae similar to those of the rami, in female bearing short setae and usually one or two bristles.

Tentorial pits oval; clypeus about four to

¹ *Syssphinx mexicana* is placed here with some hesitation. In the male the inner spine of the harpe is more reduced than is usual in *Bouvierina*. Moreover, females associated, seemingly correctly, with *mexicana* in the collection of the United States National Museum have the bases of the antennae quadripectinate and would be placed in the genus *Adelocephala*. It seems likely that the genera *Adelocephala* and *Syssphinx* should be united. In this case *Oiticicia*, *Adelocephala*, and *Giacomellia* would be considered as subgenera of *Syssphinx*, along with *Bouvierina* and *Sphingicampa*.

five or even more times as wide as long, separated from frons by a rather distinct line; pilifers inconspicuous. Mandibular rudiments small. Proboscis longer than broad, often considerably so, usually deep, with walls nearly vertical; maxillary stipites included in the walls of the fossa, extending backward to about the middle of sockets of labial palpi; galeae very small and not at all curled or about as long as palpi and curled, without conspicuous hairs or papillae; labial

in vestiture, only apical third or less hooked and concave on one side, slightly serrate; claws not noticeably serrate or minutely serrate in *Giacomellia*.

Forewings with apices rather acute; outer margins straight or convex; torni much rounded to moderately angulate; postmedian line usually parallel to costal margin of wing, at least in distal portion of wing; vestiture of wings consisting of rather broad scales, overlain by hair-like scales at wing bases.

TABLE 8

SUBGENERA OF *Adelocephala*

<i>Oiticicia</i>	<i>Adelocephala</i> , <i>Sensu Stricto</i>	<i>Giacomellia</i>
Pectination of male antenna over three times as long as broad	Pectination of male antenna very broad, about twice as long as broad	Pectination of male antenna over three times as long as broad
Antennae of female quadripectinate basally, with some bristles	Antennae of female quadripectinate basally, virtually without bristles	Antennae of female simple, flagellum slightly thickened near base
Antennae shorter than thorax	Antennae shorter than thorax	Antennae about as long as thorax
Fore and middle tibiae subequal to tarsi, without spines	Fore and middle tibiae subequal to tarsi, without spines	Fore and middle tibiae shorter than tarsi, bearing apical spines
Gnathos of male divided by a membranous band	Gnathos of male divided by a mere groove	Gnathos of male divided by a membranous band
Harpe under three times as long as broad	Harpe over three times as long as broad	Harpe under three times as long as broad

sclerite rather large and usually conspicuously sclerotic; labial palpi arising near posterior end of fossa or a short distance behind middle, extending forward approximately to clypeus, one- or two-segmented, often showing a faint indication of a line between the two segments in species in which they are fused. Postoccipital bridge broad and sclerotic.

Prescutum scarcely convex seen in profile; anepisternal suture slightly curved near posterior end, reaching pleural suture slightly to considerably below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture about parallel to lower straight portion, but with a conspicuous and rather long curved section intervening between these two portions.

Fore tibiae, except in *Giacomellia*, about as long as tarsi; epiphysis in both sexes reaching to apical third or nearly to apex of tibia, provided with long hairs; tibial spines usually absent (see *Giacomellia*); tibial spurs hidden

Ninth abdominal tergum of male subequal to uncus in length, the latter commonly bilobed at apex; gnathos produced medially but divided by a membranous band, so that it is a paired structure, or in *Adelocephala* proper divided merely by a groove; gnathos connected laterally to upper parts of bases of harpes, without free lateral lobes; anellus present and distinct from harpes; harpes rather simple, without internal spine, but often ornamented along lower margin basally with spines or with a small basal process.

Eighth tergum of female bilobed, the lobes broad and separated only by a wide, shallow emargination or completely separated by a scarcely sclerotic middorsal part of the tergum; eighth sternum with prevulvar as well as postvulvar sclerotization, prevulvar sclerotization consisting of a narrow or broad sclerotic band, postvulvar sclerotization broad and bilobed or truncate, not much produced medially; ductus bursae short and broad, partially sclerotic; bursa considerably

elongated and swollen anteriorly; ductus seminalis arising from right-hand side of base of bursa.

The three subgenera of *Adelocephala* can be recognized by the characters given in table 8.

SUBGENUS OITICICIA MICHENER

Oiticia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 143. Type: *Adelocephala purpurascens* Schaus, by original designation.

The tibiae are of normal length and lack spines, the claws are apparently not serrate, and the antennae are shorter than the thorax and not so fully pectinate as in *Giacomellia*. In many of the species, the labial palpi are two-segmented, or at least show indications of the division between the two segments. It is in the small species, such as *citrina*, *pamala*, and *invalida*, that the palpi are short, with segments completely fused, as in *Giacomellia*.

This subgenus contains most of the species of the genus. Included species which have been available for study are *A. bellardi* Schaus, *citrina* Schaus, *crocata* Boisdual, *intensiva* (Draudt), *intermedia* (Rothschild), *invalida* Schaus, *jucunda* Walker, *jucundoides* (Draudt), *nettia* Schaus, *pamala* Schaus, *pelota* Schaus, *pollens* (Schaus), *purpurascens* Schaus, *tibialis* Rothschild, and *verana* Schaus.

Although this subgenus is represented as far north as Mexico, the majority of its species occur in southern South America (southern Brazil, northern Argentina).

Oiticia was named (with intentional modification of the spelling for the sake of euphony) for Dr. José Oiticica Filho, in recognition of his excellent work on the saturniid moths.

SUBGENUS ADELOCEPHALA HERRICH-SCHÄFFER

Figures 162-165

Adelocephala HERRICH-SCHÄFFER, 1854, Sammlung aussereuropäischer Schmetterlinge, vol. 1, Heterocera, figs. 77, 78. Type: *Adelocephala cadmus* Herrich-Schäffer, designation of Kirby, 1892, Systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 741.

Oithorene BOISDUVAL, 1871-1872, Ann. Soc. Ent. Belgique, vol. 15, p. 82. Type: *Adelocephala cadmus* Herrich-Schäffer, designation of Kirby, 1872, Zool. Rec., vol. 9, p. 363.

Orthorene DYAR, 1900, Proc. Ent. Soc. Washington, vol. 4, p. 427 (error for *Oithorene*).

Adelocephala includes *A. cadmus* Herrich-Schäffer and its close relative, *A. hodeva* Druce, which occur from Mexico to southern Brazil. Their large size together with the characters indicated in table 8 differentiates them from their nearest relatives, members of the subgenus *Oiticia*.

SUBGENUS GIACOMELLIA BOUVIER

Figures 166-168

Giacomellia BOUVIER, 1930, Compt. Rendus Acad. Sci., Paris, vol. 190, p. 152. Type: *Ceratocampa bilineata* Burmeister, designated by Oiticica, 1941, Arq. Zool. Estado São Paulo, vol. 2, p. 331.

In this subgenus the anterior tibiae are markedly shorter than the tarsi and bear two short apical spines, the middle tibiae are very short and bear three long apical spines, two from the outer apical angle and one from the inner apical angle. The claws are finely serrated. In this subgenus also the face is relatively broad, and the antennae are pectinate far out towards their apices. The labial palpi are short and the segments completely fused, so that they appear to be but one-segmented, a feature shared with certain species of *Oiticia*.

This subgenus contains only *A. bilineata* (Burmeister) and *inversa* (Giacomelli) and their subspecies or forms. Members of the subgenus occur in Uruguay and Argentina.

GENUS CEROPODA MICHENER

Figures 169-171

Ceropoda MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 143. Type: *Ceropoda johnsoni* Michener, by original designation.

Although related to *Giacomellia*, this is one of the most distinctive of the small genera resembling *Syssphinx* in the old broad sense. Its remarkable characters include the long spines on the apices of the fore and middle tibiae (thus resembling *Adelowalkeria* subgenus *Ceratesa*), the antennae which are quadripectinate nearly to their apices (apparently in both sexes, although the antennae of the only known female are broken apically), and the very strong, undulate, lamella-like carina on the under side of the pectinate part of the antenna. The yellow and pink coloration is suggestive of some *Psilopygida*, but the lines and wing shape are different

and the sexes are more nearly the same in coloration and wing shape. The much reduced clypeus is suggestive of *Anisota*. The subgenus *Giacomellia* of *Adelocephala* also has short and spined fore and middle tibiae, distinctly serrated claws, much pectinate antennae (in the male only), and a divided gnathos. *Giacomellia*, however, has a free anellus, non-carinate antennae, more tibial spines, and simple antennae in the female.

Frontal protuberance distinct, broad, bilobed at apex, its under surface bare and slightly convex. Shortest distance between eyes less than one-third of length of an eye, upper ends of eyes not reaching the lower margins of antennal sockets, lower ends of eyes reaching below lower end of face.

Antennae slightly longer than thorax, flagellum not scaled; male with basal five-sixths of flagellum quadripectinate; rami slender, slightly curved, particularly those of inner side; apical rami slightly shorter than basal ones, particularly so on outer side, shaft of pectinate part of antenna very strongly compressed, strongly carinate or even almost lamellate beneath, the carina with a strong, rounded elevation at base of each segment and produced to a cone-like projection at the apex of each segment, adjacent to the rounded projection of the following segment, so that seen in profile the under surface of the shaft of this portion of the antenna is strongly undulate; nonpectinate portion of antenna also strongly compressed, each segment with a large ventral cone; each segment also with a dorsal apical bristle and with a bristle arising from each side. Antennae of female apparently similar to those of male and equally broadly pectinate, although with setae of rami shorter and less numerous (apical portion of antenna missing in only female available).

Tentorial pits oval. Clypeus about six times as broad as long, scarcely separated from the frons by a line, with erect scales; pilifers not recognizable. Mandibular rudiments strongly protuberant but thin and lamella-like. Proboscis fossa longer than broad, rather deep, walls vertical; maxillary stipites free from walls, extending back behind posterior margins of palpal sockets; galeae extremely short and uncurled; labial sclerite feebly sclerotic, labial palpi arising

at middle of fossa, short and apparently one-segmented, although there is an inconspicuous median constriction; palpi reaching forward to clypeus. Postoccipital bridge rather broad and sclerotic.

Prescutum scarcely convex above; anepisternal suture unusually strong, straight except at the extreme posterior end, reaching pleural suture well below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture directed in approximately same direction as straight lower portion, a conspicuous curved region intervening between these two main portions.

For and middle tibiae much shorter than their tarsi, each terminating in a large robust spine arising from the outer apical angle; epiphysis of male reaching to apex of tibia, of female to apical fifth, epiphyses with some long hairs; tibial spurs not hidden in the vestiture, the longest distinctly longer than diameter of tibia, apical halves of tibial spurs concave on one side and minutely serrated; claws finely serrated.

Forewings with outer margins convex, torni rounded; hind wings with anal angles rounded; vestiture consisting of scales, overlain but not hidden by elongate scales or hairs.

Abdominal vestiture consisting of elongated recumbent scales and, especially towards bases of segments, broad scales beneath the usual recumbent hairs. Eighth sternum of male unarmed; ninth tergum slightly longer than uncus which is bilobed at apex; gnathos heavily sclerotic medially and strongly produced but divided longitudinally into two separate parts, laterally without free arms and connected to base of uncus; anellus absent as a single free structure but represented by a pair of large spines attached to lower basal angles of harpes; harpes otherwise simple, rounded at apices, with a blunt tooth on lower margin about three-quarters of the distance from base to apex.

This genus is known from a single species, *Ceropoda johnsoni* Michener, from Matto Grosso, Brazil.

GENUS *PSILOPYGOIDES* MICHENER

Figures 158-161

Psilopygoides MICHENER, 1949, Jour. Kansas

Ent. Soc., vol. 22, p. 144. Type: *Adelocephala oda* Schaus, by original designation.

This genus has the evenly rounded outer and posterior margins of the forewing in the male (female unknown) as in *Psilopygida* and *Almeidella*. It differs from these genera and from all others having cell 1V of the forewing open in having indications of three segments in the labial palpi, with the last segment much shorter than the preceding one. The male genitalia are also distinctive, for the ninth tergum is very much shortened, and the harpes bear a curious spiculate structure, adnate to their inner surfaces, near their lower margins.

Frontal protuberance distinct, very narrow and erect, about twice as long as basal width. Shortest distance between eyes between one-fifth and one-sixth of length of an eye; upper ends of eyes reaching upward to lower margins of antennal sockets, lower ends of eyes reaching below lower end of face.

Antennae nearly as long as thorax; flagellum, at least in male, not scaled; male with proximal two-thirds of flagellum quadripectinate; rami slender, nearly straight, apical rami slightly shorter than basal rami; shaft of pectinate part of antenna somewhat compressed but not carinate beneath, each segment with a basal rounded convexity or protuberance, so that, seen in profile, under surface of shaft of this portion of antenna is strongly undulate; nonpectinate portion of antenna compressed, each segment with a small ventral cone and with basal lateral setiferous swellings representing basal rami; clypeus less than four times as broad as long, separated from frons by a strong groove; pilifers absent; mandibular rudiments small; proboscis longer than broad, rather deep, very narrow anteriorly but broad posteriorly, walls subvertical; maxillary stipites extending back to anterior margins of palpal sockets; galeae about as long as fossa, curled, without conspicuous hairs or papillae; labial palpi arising behind middle of fossa, slender, reaching forward to clypeus, segments immovably fused together but lines of separation nonetheless visible between a short first segment, a long second, and a third segment which is about half as long as second and about twice as long as broad. Postoccipital bridge broad and sclerotic.

Anepisternal suture somewhat curved down posteriorly below the very large anepisternum, this suture reaching pleural suture slightly below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture extending in about same direction as lower straight portion, a conspicuous though rather short curved region intervening between the two main portions.

Fore tibiae subequal to tarsi; epiphysis of male reaching to apical fourth of tibia, with numerous long hairs; tibial spines absent; tibial spurs not entirely hidden in the vestiture, apical three-fifths of each spur concave on one side, margins serrated.

Forewings with apices subacute, outer and posterior margins forming a single broad curve, torni absent; hind wings rather elongated and extending posteriorly; vestiture consisting of scales overlain on much of hind wings by hair-like scales.

Ninth tergum of male very short, about one-fourth of length of uncus, the latter very deeply bilobed, each lobe with an outer spine; gnathos very strongly produced medially and not divided, apparently connected laterally to ninth tergum, without free lateral lobes or arms; anellus rather large, its lower surface deeply concave, its upper margin produced to a small median spine; laterally anellus fused to bases of harpes but the lines of separation remaining visible; harpes rather simple, without internal spines, spine probably represented by a large, black, denticulate structure lying near the lower margin of harpe but adnate throughout its entire length to inner surface of harpe.

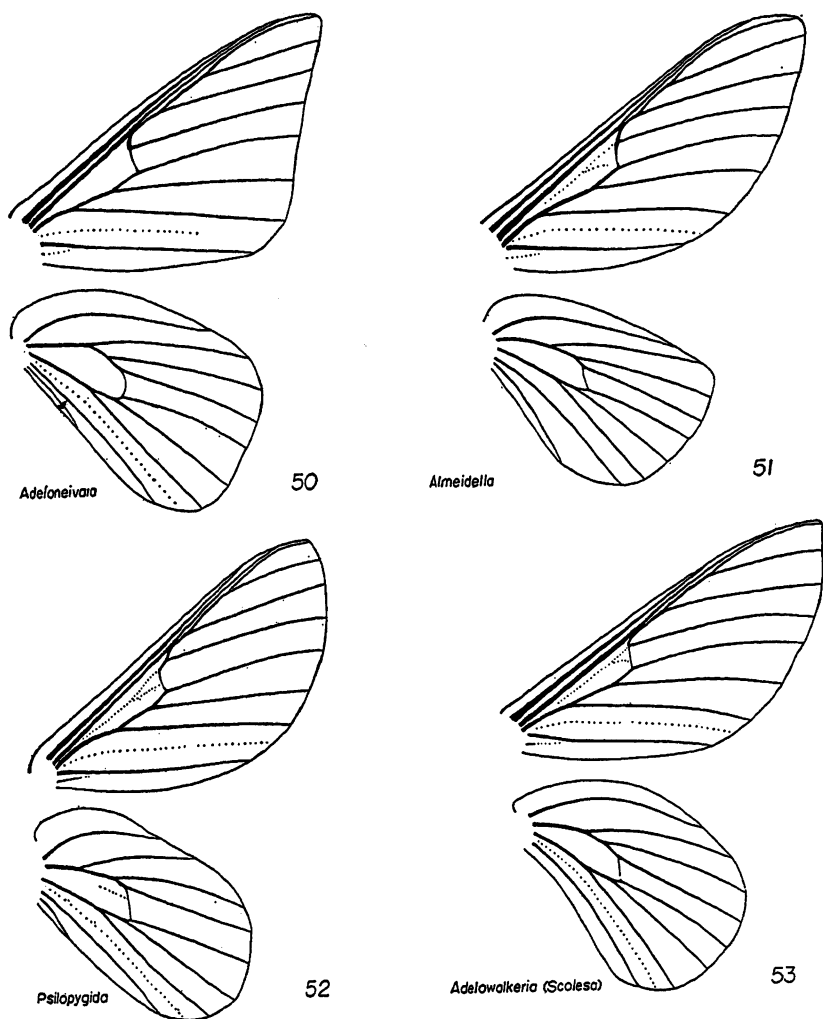
This genus, so far as known, contains only *Psilopygoides oda* (Schaus) from French Guiana.

GENUS *ADELONEIVAIA* TRAVASSOS

Figures 50, 175-177

Adeloneivaia TRAVASSOS, 1940, Rev. Ent., vol. 11, p. 683. Type: *Adelocephala subangulata* Herrich-Schäffer, by original designation.

Although superficially very similar to *Sysphinx*, this genus is very distinct by the unique genitalia of both sexes. The male harpes are reduced and completely membranous, while the ninth tergum is greatly elongated. In the female the sides of the eighth tergum are mere sclerotic bands,



FIGS. 50-53. Wings of Citheroniinae. 50. *Adeloneivaia subangulata* (Herrich-Schäffer). 51. *Almeidella approximans* (Schaus). 52. *Psilopygida crispula* (Dognin). 53. *Adelowalkeria (Scolesia) anthoniis* (Herrich-Schäffer).

strongly arcuate anteriorly, and the apodemes attached to these arcs are unusually short. Unlike *Syssphinx*, the proximal parts of the antennae of the female are quadripectinate.

Frontal protuberance distinct, though usually rather short. Shortest distance between eyes less than one-fifth of length of an eye, upper end of eye extending about as high as lower margin of antennal socket, lower ends of eyes extending well below lower end of face.

Antennae about two-thirds as long as thorax, flagellum not scaled; male with basal

two-fifths to one-half of flagellum quadripectinate, the rami nearly straight, basal and apical rami subequal, shaft of pectinate part of antenna compressed, almost carinate ventrally, without bristles but almost always with a ventral cone on each segment; non-pectinate portion of antenna strongly compressed, so that it is almost carinate ventrally, each segment with basal tubercles representing basal rami and bearing setae similar to those of rami, also with smaller apical tubercles representing apical rami and bearing small setae; each segment also with a moderate-sized ventral cone; ventral margin of

each segment nearly straight to somewhat convex seen in profile. Antennae of female quadripectinate in proximal two-fifths to three-fifths, similar to those of male but setae of rami often reduced; nonpectinate portion of antenna often with a weak bristle on dorsal surface of each segment.

Tentorial pits elongate oval; clypeus sometimes considerably produced, three to five times as wide as long, with numerous erect scales medially; pilifers broad and inconspicuous. Mandibular rudiments rather small. Proboscis fossa considerably longer than broad, rather deep, sides subvertical; maxillary stipites usually adjacent to walls of fossa, extending backward to about middle of palpal sockets; galeae very short to about as long as fossa, in the latter case curled, without conspicuous hairs or papillae; labial sclerite rather weakly sclerotized; labial palpi arising slightly behind middle of fossa or near posterior end of fossa, reaching forward to clypeus, two-segmented or the segments partially or completely fused. Postoccipital bridge rather broad and sclerotic.

Prescutum slightly convex above; anepisternal suture nearly straight, reaching pleural suture below lower end of deeply impressed portion; deeply impressed portion of pleural suture directed in same direction as straight lower portion, a conspicuous curved region intervening between these two portions.

Fore tibiae about as long as tarsi; epiphyses of female reaching to a point about three-fifths of distance from base to apex of tibia, of male reaching to apical third of tibia, epiphyses with numerous long hairs; tibial spines absent; tibial spurs not completely hidden in vestiture, tibial spurs with apical one-fifth to one-half broadly concave on one side and finely serrate; claws not noticeably serrate.

Forewings with apices acute in male, torni clearly marked in both sexes; outer margins of wings slightly concave to slightly convex in male, convex in female; hind wings with anal angles rounded or slightly produced; vestiture consisting of scales, overlain on hind wings and basal parts of forewings by hairs; remainder of forewings overlain, particularly in females, with elongated scales, which do not hide the broad scales.

Ninth abdominal tergum of male greatly

elongated, much longer than the deeply bifid uncus; gnathos not divided, strongly produced, sclerotic medially, connected laterally with sides of ninth tergum, without free lateral arms; anellus rather large and bifid or bilobed, usually fused to harpes; harpes membranous, large in size and bearing long hairs.

Eighth tergum of female with two sublateral, sclerotic lobes, partially projecting behind membranous posterior margin of tergal area; laterad of these lobes sclerotic portion of tergum very narrow and bent anteriorly in a broad arc, apodemes of this segment very much shorter than those of the following; eighth sternum without or with a much reduced prevulvar sclerotization, postvulvar sclerotization a mere band, not produced posteriorly and not very strongly sclerotic; ductus bursae short and broad, heavily sclerotic on dorsal surface; bursa small, short, about the same diameter as ductus bursae; ductus seminalis arising from right-hand side of base of bursa.

This genus contains numerous species. Those listed have been available for study: *Adeloneivaia acuta* (Schaus), *apicalis* (Bouvier), (?) *boisduvalii* (Doumet), *boliviana* (Bouvier), *carisma* (Schaus), *catharina* (Bouvier), *catoxantha* (Rothschild), *curvilinea* (Schaus), *diluta* (Rothschild), *fallax* (Boisduval), *guianensis* (Bouvier), *irrorata* (Schaus), *isara* (Dognin), *jason* (Boisduval), *lacrimata* (Dognin), *minuta* (Bouvier), *pacifica* (Schaus), *sabulosa* (Rothschild), *subangulata* (Herrich-Schäffer), *wagneri* (Bouvier), and *yucatana* (Druce).

These species occur from Mexico to Argentina.

GENUS ALMEIDELLA OITICICA

Figures 51, 182-184

Almeidella OITICICA, 1946, Livro de homenagem a R. F. d'Almeida, p. 263. Type: *Almeidella almeidai* Oitica (original designation).

In this genus the forewings of the male are shaped as in *Psilopygida*, but the antennae of the male are more narrowly pectinate and pectinate only to the middle, the ninth tergum of the male is shorter than the uncus, the latter down-curved and bidentate at apex, with a pair of posteriorly directed dorsal apical spines. The species are larger than those of *Psilopygida* and less brightly

colored, without lines on the wing. The extremely narrow face also characterizes *Almeidella*.

Frontal protuberance distinct, directed forward, rounded at apex. Shortest distance between eyes less than one-fifth of length of an eye; upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending well below lower end of face.

Antennae about two-thirds as long as thorax, flagellum not scaled; male with proximal half of flagellum quadripectinate, rami rather short and straight, basal and apical rami subequal; shaft of pectinate part of antenna little compressed, not carinate ventrally, without cones or bristles; basal portion of each segment with a ventral swelling; nonpectinate portion of antenna strongly compressed, not carinate ventrally, each segment with basal tubercle on each side representing basal rami, these tubercles or swellings bearing setae similar to those of rami; each segment also with a small, ventral cone; ventral margin of each segment straight or slightly convex seen from the side; segments of this portion of antenna tend to be elongated, in one species nearly all of them being longer than broad seen from the side. Antennae of female simple, flagellum slightly swollen near base in vicinity of its segments five, six, and seven. (In *A. approximans* there are basal and apical projections on the antennal segments, representing rami; these are absent in *corrupta*.) Distal two-fifths to one-half of antenna with small ventral cones similar to those of male, but more reduced, dorsal side of same portion of antenna usually with a small subapical bristle on each segment.

Tentorial pits oval; clypeus about four times as wide as long, separated from frons by a weak line; clypeus produced medially so that it extends nearly as far downward and forward as the frontal protuberance; pilifers unrecognizable. Mandibular rudiments small but strongly convex and high. Proboscoidal fossa much longer than broad, deep, the walls vertical; maxillary stipites free from walls of fossa, extending backward to middle of palpal sockets; galeae extremely short and not curled; labial palpi arising behind middle of fossa, reaching clypeus, two-segmented.

Prescutum somewhat convex above; anepisternal suture slightly curved posteriorly, reaching pleural suture below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture extending in approximately same direction as straight lower portion, a long curved region intervening between these two main portions.

Fore tibiae about equal to tarsi, epiphysis of female reaching to distal third, of male nearly to apex of tibia, with rather long hairs; tibial spines absent; tibial spurs not completely hidden in vestiture, apical third to half concave on one side, finely serrate; claws not noticeably serrate.

Forewings with outer margins convex, torni scarcely recognizable, the outer margin and posterior margin, especially in males, being a continuous curve; hind wings without produced anal angle; vestiture consisting of broad scales, overlain but not hidden on forewing by elongate scales, overlain and largely hidden on hind wing by hair-like scales.

Ninth tergum of male shorter than uncus, often much so, the latter produced to two slender, apically directed processes and two ventrally directed subapical processes; gnathos strongly sclerotized and produced medially, connected laterally to upper basal parts of harpes, without free lateral lobes; anellus distinct, free from harpes, with two long processes; harpes simple, not divided into upper and lower portions, without conspicuous spines or processes.

Eighth tergum of female with two broadly projecting truncated sclerotic lobes, broadly separated from one another by an unsclerotized area; eighth sternum with a broad, prevulvar sclerotic band, postvulvar portion considerably produced, heavily sclerotic, and deeply bilobed; ductus bursae short, broad, and heavily sclerotic; bursa with an elongate and rather slender neck and a swollen and subspherical anterior portion; ductus seminalis arising from right-hand side of base of bursa.

This genus includes *Almeidella almeidai* Oiticica, *approximans* (Schaus), and *corrupta* (Schaus), all species of southern Brazil.

GENUS *PSILOPYGIDA* MICHENER

Figures 52, 172-174

Psilopygida MICHENER, 1949, Jour. Kansas

Ent. Soc., vol. 22, p. 144. Type: *Adelocephala crispula* Dognin, by original designation.

This genus, like *Almeidella*, has the outer and posterior margins of the forewing of the male, and to a lesser extent of the female also, rounded to form together a single broad curve, without indications of a tornus. From *Almeidella* this genus differs in being of smaller size, in having the male antennae pectinate beyond the middle, in the long ninth tergum of the male, the short simple uncus, and the reduced gnathos and anellus.

Fontal protuberance rather small but distinct, extending forward and downward, rounded at apex. Shortest distance between eyes between one-fourth and one-fifth of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending about as low as lower end of face.

Antennae about two-thirds as long as thorax, flagellum not scaled; male with basal two-thirds of flagellum quadripectinate, rami nearly straight, basal and apical rami subequal; antennal shaft without bristles, that of pectinate part of antenna somewhat compressed, not carinate ventrally, each segment with a small, scarcely projecting, apical cone; nonpectinate portion of antenna compressed, not carinate ventrally, each segment with basal, lateral tubercles representing rami and bearing setae similar to those of rami; each segment also with a small, simple, ventral cone; ventral margin of each segment approximately straight seen from side, all but the most distal segment broader than long seen from side. Antennae of female simple, all but the last segment considerably broader than long, without setae or bristles and without a ventral carina; segments of apical half with small cones.

Clypeus about four times as wide as long, with some elongate erect scales medially, separated from frons only by a weak line; pilifers low and rounded. Mandibular rudiment low and inconspicuous. Proboscis fossa much longer than broad, rather deep, walls nearly vertical; maxillary stipites in contact with walls of fossa, extending backward to posterior margins of sockets of labial palpi; galeae extremely short and not curled; labial sclerite feebly sclerotized; labial palpi arising near middle of fossa, short, reaching

clypeus, one-segmented or with a faint indication of division into two segments. Post-occipital bridge broad and sclerotic.

Prescutum somewhat convex above; anepisternal suture straight, reaching pleural suture below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture directed in approximately the same direction as lower straight portion of this suture, but these two portions separated by rather long, curved region.

Fore tibiae subequal to tarsi; epiphysis reaching beyond middle of tibia in female, nearly to apex in male, with long hairs; tibial spines absent; tibial spurs not completely hidden in vestiture, these spurs longer than diameter of tibiae, their apical halves concave on one side, finely serrate; claws not visibly serrate.

Forewings with outer margin convex, torni broadly rounded in female and absent in male in which the entire outer and posterior margins of forewing form a single broad curve; hind wings elongated but without produced angles; vestiture consisting of broad scales, overlain but in most parts not hidden by elongate, almost hair-like scales.

Ninth abdominal tergum of male much longer than the uncus, the latter with a short, simple apex; gnathos strongly sclerotic but not much produced medially, laterally connected to base of uncus, not to harpes, although there are sclerotic projections extending towards harpes; gnathos not produced medially, without free lateral lobe; anellus absent or nearly so; harpes small and simple, without spines or projection.

Sclerotized portion of eighth abdominal tergum of female with widely separated, sublateral, posterior lobes; eighth sternum with sclerotized transverse prevulvar band, similar postvulvar band, which is produced posteriorly as a small lobe at each lateral extremity; ductus bursae much broader than long, its dorsal wall sclerotic; bursa elongate; ductus seminalis arising from a posteriorly produced pocket in right-hand side of base of bursa.

This genus contains *Psilopygida apollinairei* (Dognin), *basalis* Michener, and *crispula* (Dognin). All are from South America.

GENUS *ADELOWALKERIA* TRAVASSOS

This is a rather large genus of *Syssphinx*-like moths, characterized especially by the large and highly modified male genitalia. The ninth tergum of the male is usually much elongated, so that it is markedly longer than the uncus, and each harpe bears a huge inner spine, often spiculate or blunt tipped or otherwise modified, arising from the lower basal part of the harpe and often attached to the harpe to a point near its upper basal angle.

As originally proposed, *Adelowalkeria* was used only for the species here placed in the subgenera *Adelowalkeria* proper and *Megaceresa*. It is here regarded as the proper generic name for the much larger group of species included in the subgenera *Scolesa*, *Ptiloscola*, *Rachesa*, and *Ceratesa*. The recognition of each of these as a genus could well be justified.

Frontal protuberance distinct, often slender, rounded at apex. Shortest distance between eyes slightly less than one-fourth to about one-fifth length of eye, upper ends of eyes extending to or above lower margins of antennal sockets, lower ends extending below lower end of face.

Antennae two-thirds as long as thorax to as long as thorax, flagellum of male without scales, that of female with dorsal tufts of scales on first half dozen segments, male with proximal one-third to three-fourths of flagellum quadripectinate, rami nearly straight, basal and apical rami subequal; shaft of pectinate part of antenna slightly to distinctly compressed, not carinate ventrally, without or with very feeble cones, without bristles; nonpectinate part of antenna compressed, not carinate ventrally, each segment with basal lateral tubercles representing basal rami and bearing setae similar to those of rami; each segment also with a small to large ventral cone and sometimes with one or a few inconspicuous ventral bristles. Antennae of female simple, sometimes with lateral tubercles representing basal rami on first few flagellar segments, distal half of flagellum often compressed and with slight swellings representing basal and apical rami, these swellings without bristles, dorsal surface of each segment in distal half or two-thirds of antenna often with a weak median bristle, antennae otherwise without bristles; apical half or third of an-

tenna with a small ventral cone on each segment.

Tentorial pits elongated or round. Clypeus about four times, more rarely three times, as broad as long, with numerous erect scales medially, separated from frons by a distinct line; pilifers broadly convex and ill defined. Mandibular rudiments rather small and little projecting. Proboscical fossa about as broad as long and rather shallow to much longer than broad and deep, the walls vertical or nearly so; maxillary stipites appressed against the walls or free from them, extending backward almost to anterior margins of palpal socket or rarely to posterior margins; galeae short and not curled to at least as long as fossa and distinctly curled; labial sclerite feebly sclerotized; labial palpi arising near posterior end of fossa or but little behind middle, reaching to clypeus or base of frontal protuberance, two-segmented or the two segments partially fused. Postoccipital bridge slightly sclerotic and rather narrow to broad and sclerotic.

Prescutum convex above; anepisternal suture straight or curved near posterior end, almost reaching pleural suture at a point below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture directed in same direction as lower straight portion, a conspicuous curved region intervening between these two main portions.

Fore tibiae subequal to tarsi or slightly shorter; epiphyses of both sexes reaching at least to apical third of tibia; epiphyses with long hairs; tibial spines absent or an outer apical spine on fore and middle tibiae; tibial spurs not completely hidden in vestiture, apical one-fourth to one-half concave on one side and slightly serrate; tibial spurs about as long as or slightly longer than tibial diameter; claws not noticeably serrate.

Forewings with outer margins straight or convex; hind wings with anal angle usually distinct in male, broadly rounded in female; vestiture consisting of scales, overlain by hairs on much of hind wing.

Ninth tergum of male distinctly longer than uncus except in some species of *Adelowalkeria* proper; uncus often elevated basally or with a basal process or pair of processes; gnathos without free lateral lobes, harpes each with large basal inner spine or process

which is often dentate, often also with the upper basal angle produced into a process.

Female with dorsal portion of eighth tergum a mere sclerotic band, not or scarcely bilobed dorsolaterally, lower lateral portions usually greatly expanded, heavily sclerotic, sometimes scalloped; ductus bursae short; bursa with a slender membranous neck, enlarged anteriorly to an almost spherical body; ductus seminalis arising from right-hand side of base of bursa.

The species of *Adelowalkeria* are diverse both in appearance and in genital structure. They are placed in six subgenera (which might well be called genera), separated by the following key:

KEY TO THE SUBGENERA OF *Adelowalkeria*

1. Fore and middle tibiae each with a spine arising from outer apical angle *Ceratesa*
Tibiae without spines 2
2. Males 3
Females (*Rachesa* unknown) 7
3. Anellus distinct, free from harpes . . . *Scolesa*
Anellus absent or fused to harpes 4
4. Anellus entirely absent, represented if at all by inner basal processes of harpes, that of right-hand side produced into a long and sometimes dentate spine; uncus with a pair of dorsal processes *Philoscota*
Anellus present (sometimes small and only lightly sclerotic) and fused to harpes, not asymmetrical; uncus without such processes 5
5. Antennae as long as thorax; ninth tergum more than twice as long as uncus, the latter not elevated basally. *Rachesa*
Antennae shorter than thorax; ninth tergum not over one and one-half times length of uncus, with dorsal basal elevation or pedunculate process 6
6. Uncus elevated basally, simple at apex; flagellum with basal third to half pectinate *Adelowalkeria*
Uncus with pedunculate dorsal basal process and a pair of subapical, posterior spines; flagellum with basal three-fourths pectinate *Megaceresa*
7. Forewing less than twice as long as greatest breadth 8
Forewing twice or more than twice as long as greatest breadth 9
8. Antennae broad, broadest segments well over four times as wide as long . . . *Megaceresa*
Antennae not thickened, broadest segments much less than three times as wide as long *Adelowalkeria*

9. Abdominal terga banded, usually with apical bands of yellowish pubescence . . . *Philoscota*
Abdominal terga unbanded *Scolesa*

SUBGENUS *CERATESA* MICHENER

Figures 195-197

Ceratesa MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 144. Type: *Adelocephala hemirhoda* Schaus, by original designation.

This subgenus differs from all others by the presence of a strong spine arising from the outer apical angle of each anterior and middle tibia. In this respect it resembles *Ceropoda*, an otherwise very different moth. Genitally it resembles *Scolesa* in having a free anellus. Otherwise the genitalia are simpler, less enlarged and modified, than in any other *Adelowalkeria*. As in other members of the genus, except for some species of *Adelowalkeria* proper which have very complex genitalia, the ninth tergum is elongated, much longer than the uncus.

Frontal protuberance distinct, longer than broad, rounded at apex; antennae about two-thirds as long as thorax; male with slightly more than proximal half of flagellum quadripectinate, nonpectinate portion of flagellum compressed, without bristles; antennae of female simple, not thickened, distal half slightly compressed, antennal cones small, upper surfaces of segments of this portion of antenna with one or more inconspicuous bristles; anepisternal suture slightly curved downward posteriorly; forewings with outer margins rather broadly convex, hind wings with anal angles not at all produced. Uncus small, apex bilobed; gnathos heavily sclerotic medially and produced posteriorly, not divided; anellus free from harpes, bifid; harpes short, much broader than long, each bearing a rather large inner spine.

So far as known this subgenus contains only *Adelowalkeria* (*Ceratesa*) *hemirhoda* (Schaus) from Tucuman, Argentina.

SUBGENUS *SCOLESA* MICHENER

Figures 53, 189-194

Scolesa MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 144. Type: *Adelocephala totoma* Schaus, by original designation.

This subgenus differs from the others by having a large free anellus.

Frontal protuberance distinct though small, rounded apically; antennae two-thirds to three-fourths as long as thorax; male with proximal third to half of flagellum quadripectinate; nonpectinate portion of antenna compressed, without bristles; antennae of female simple, not thickened, distal half somewhat compressed, the segments with small to moderate-sized ventral cones; upper surfaces of segments of this portion of antenna often with one or more inconspicuous bristles and sometimes with other smaller scattered bristles in addition to the setae. Anepisternal suture nearly straight. Forewings with outer margins convex, torni rather broadly rounded; hind wings with anal angles not at all produced. Uncus usually bilobed at apex; gnathos heavily sclerotic medially and produced posteriorly, the produced portion sometimes bifid and often with at least an indication of division into two separate parts by a longitudinal median line of weakness, gnathos connected laterally to ninth tergum; anellus free from harpes and bifid; harpes short and broad, rather thinly sclerotic, each with a large internal spine which is sometimes truncate and denticulate apically, the spine of the left-hand harpe sometimes much larger than that of the right, lower basal angle of left harpe often with a long spine.

The genus *Scolesa*, which ranges from Central America to Argentina, consists of two closely related groups. One, having usually more pointed forewings, narrow dark premedian and postmedian lines on the forewings, a bilobed or even divided gnathos, and no large basal ventral spine on the left-hand harpe, contains *Adelowalkeria* (*Scolesa*) *analis* (Rothschild), *athonilis* (Herrick-Schäffer), *brevis* (Walker), *homoea* (Rothschild), *lanaris* (Rothschild), and *ocarona* (Schaus).

The other group, having only weak lines on the wings, entirely undivided gnathos, and a large spine arising from the lower basal part of the left-hand harpe, contains *Adelowalkeria* (*Scolesa*) *argyracaniha* (Boisduval), *erubescens* (Boisduval), *flavidorsata* (Dognin), *hypoxantha* (Rothschild), and *totoma* (Schaus). In view of their obviously close relationship, it does not seem desirable to accord these groups even subgeneric standing.

SUBGENUS ADELOWALKERIA TRAVASSOS

Figures 185-188

Adelowalkeria TRAVASSOS, 1941, Mem. Inst. Oswaldo Cruz, vol. 35, p. 579. Type: *Adeloccephala flavosignata* Walker, by original designation.

Male antennae with proximal one-third to one-half pectinate; nonpectinate part of antenna of male strongly compressed, without bristles. Antennae of female not thickened, segments much less than three times as broad as long; distal half of antenna compressed, with swellings on segments representing basal and apical rami; dorsal surface of each segment in apical one-half or two-thirds of antenna with weak median bristle. Anepisternal suture straight. Spine-bearing lobes on penultimate fore tarsal segment of female normal. Outer margin of forewing only slightly convex in male; tornus distinct in male; forewing with two or three silvery white discal spots in male; female much larger than male. Uncus of male elevated basally, simple at apex; upper basal angle of each harpe forming long, sometimes ornate process; lower margin of each harpe with a spine, or (in *plateada*) these spines free from harpes and together forming a slender and partially free anellus; gnathos not divided medially; anellus fused to harpes, bearing two processes which partially surround aedeagus; eighth sternum of female with heavily sclerotic and modified prevulvar part, but little produced postvulvar part; ductus bursae largely membranous.

This subgenus contains *Adelowalkeria* (*Adelowalkeria*) *comstocki* (Fleming), *flavosignata* (Walker), *plateada* (Schaus), and *tristygma* (Boisduval), all found in Central and South America.

SUBGENUS MEGACERESA MICHENER

Figures 198-200

Megaceresa MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 144. Type: *Adeloccephala pulchra* Bouvier, by original designation.

Antennae of male with basal three-fourths pectinate; nonpectinate part of antenna of male slightly compressed, with inconspicuous ventral bristles. Female with antennae broadened, broadest segments well over four times as wide as long; distal portion of antenna not

much compressed, without swellings; bristles absent. Anepisternal suture curved posteriorly. Spine-bearing lobes on penultimate fore tarsal segment of female exceedingly long and slender. Outer margin of forewing strongly convex and tornus broadly rounded in both sexes. Uncus of male with pedunculate dorsal basal process and a pair of subapical posteriorly directed spines; gnathos not divided medially, connected at sides to base of uncus; upper basal angle and lower margin of harpe simple; anellus fused to harpes, bearing two processes which partially surround aedeagus; eighth sternum of female with narrow prevulvar sclerotic band, postvulvar part much produced medially, thickened and heavily sclerotic; ductus bursae largely sclerotic.

So far as known this subgenus contains only the type species, *Adelowalkeria (Megaceresa) pulchra* (Bouvier), from Brazil.

SUBGENUS PTILOSCOLA MICHENER

Figures 54, 201-204

Ptiloscola MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 144; 1950, Jour. Kansas Ent. Soc., vol. 23, p. 26. Type: *Adelocephala lilacina* Schaus, by original designation.

This is a group of dull gray or brown species with the abdomen paler in most species and segmentally banded. The highly modified male genitalia, with a lower basal process on the right harpe much larger than that on the left, are characteristic. There is no free anellus, the processes above mentioned being remnants of the anellus. The posterior wings are unusually small (except in *rorerae*), giving a very distinctive appearance, particularly in the male.

Frontal protuberance distinct but not large, rounded at apex. Antennae about two-thirds as long as thorax, male with basal third or half (or more than half in *rorerae*) of flagellum quadripectinate. Antennae of female simple, not thickened, distal half with small ventral cones, and with an inconspicuous bristle on dorsal surface of certain segments. Anepisternal suture curving somewhat near posterior end.

Forewings with outer margins convex, torni broadly rounded, especially in male; hind wings rather small and elongate, with

anal angles usually distinct, particularly in males. Uncus of male with the apex simple, but dorsal surface (except in *rorerae*) and in some species also dorsal surface of ninth tergum with a pair of tubercles or processes; gnathos heavily sclerotized, not much produced or considerably produced, connected laterally to ninth tergum, not to bases of harpes; anellus absent as a free structure; harpes rather small, a large, sometimes denticulate spine or a large, broad process arising from inner surface of each; basally lower margin of right-hand harpe provided with a long, arm-like process, left-hand one with a small projection, these evidently homologous to the anellus.

This subgenus includes *Adelowalkeria (Ptiloscola) affinis* (Rothschild), *cineria* (Schaus), *lilacina* (Schaus), *photophila* (Rothschild) (= ?subsp. of *affinis*), *picklei* (Schaus), and *surrotunda* (Dyar). *A. (Ptiloscola) rorerae* (Schaus) is an aberrant member of this subgenus, as indicated in the above description. In addition to the peculiarities there indicated, the abdominal coloration is different from the yellowish banding that otherwise characterized the subgenus. In *A. rorerae* the entire abdomen is yellowish, the terga having basal lateral black areas. This is suggestive of the pattern of *Megaceresa*.

The species of the subgenus occur from Mexico to southern Brazil.

SUBGENUS RACHESA MICHENER

Figures 205-207

Rachesa MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 146. Type: *Oithorene adusta* Rothschild, by original designation.

The species of this subgenus are superficially similar to the type species of the subgenus *Oiticicia* of *Adelocephala*. However, the male antennae (female unknown to me) are more broadly pectinate and about as long as the thorax. Moreover, the genitalia are completely different and very peculiar, the ninth tergum being elongated, the gnathos undivided, each harpe with two long, slender, dorsal spines from the upper basal angle and with a broad and intricately toothed basal ventral lobe, one of the long spines actually arising from this lobe but adnate to inner wall of harpe to upper basal angle.

Frontal protuberance distinct and very long, markedly longer than broad. Antennae as long as thorax, male with basal one-half to two-thirds of flagellum broadly quadripectinate; anepisternal suture very slightly curved. Forewings with outer margins straight, torni clearly defined; hind wings with anal angles moderately distinct; uncus of male with apex down-curved and relatively simple; gnathos rather heavily sclerotic medially and moderately produced, connected laterally to ninth tergum; anellus a small inconspicuous structure partially surrounding aedeagus, laterally fused to bases of harpes; harpes large, main portion weakly sclerotic and unornamented; two very long, slender processes arise from upper basal angle of harpe, one of which is the inner spine of other genera and actually originates from lower basal portion of harpe which is expanded to a broad multidenticulate lobe underlying base of main portion of harpe.

This subgenus includes *Adelowalkeria* (*Rachesa*) *adusta* (Rothschild), *colombiana* (Schaus) (identification?), and *nisa* (Druce), which occur from Colombia to Peru.

GENUS NEOCARNEGIA DRAUDT

Figures 55, 179-181

Neocarnegia DRAUDT, 1930, in Seitz, *Macrolepidoptera of the world*, vol. 6, p. 813. Type: *Syssphinx basirei* Schaus (monobasic).

This genus is readily recognized superficially by the numerous irregular clear areas on the wings. It differs morphologically from the other segregates of the old composite genus *Syssphinx* by the widely separated eyes, the extremely short labial palpi, the long, acutely pointed male uncus, and the closed cell 1V of the forewing.

Frontal protuberance distinct, rather broad and short, subtruncate. Shortest distance between eyes less than one-half of length of eye, upper ends of eyes extending well above lower margins of antennal sockets, lower ends of eyes slightly exceeded by lower ends of frons.

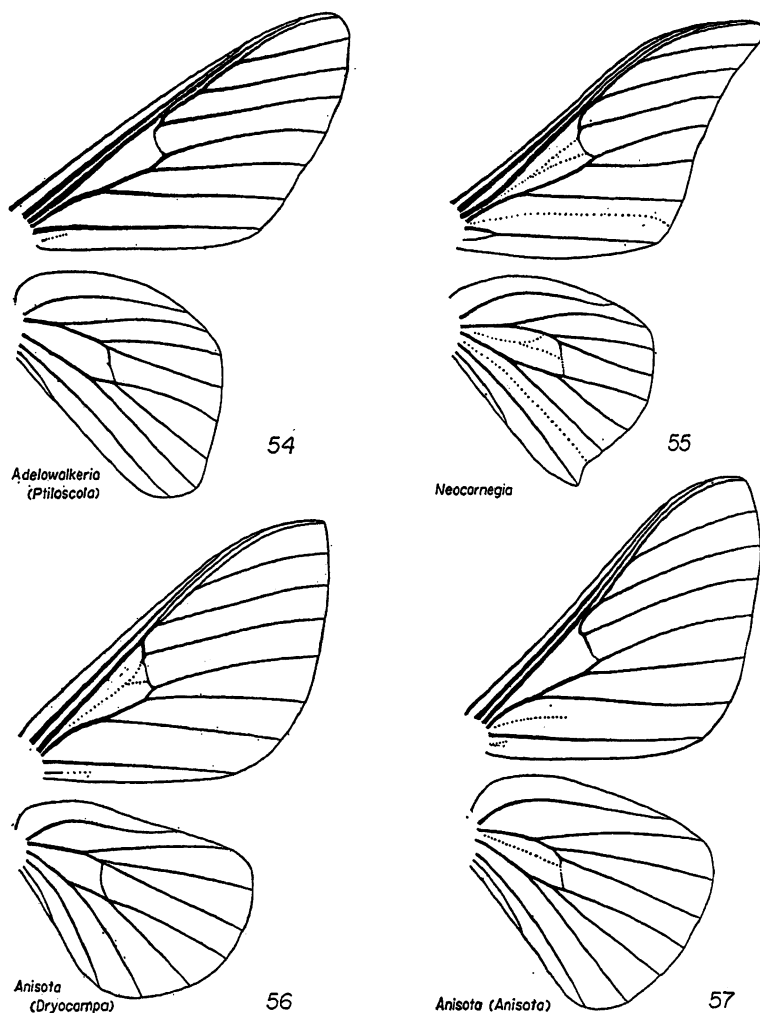
Antennae about two-thirds as long as thorax, flagellum not scaled; male with basal third of flagellum quadripectinate, rami rather short and robust, nearly straight, basal and apical rami subequal; shaft of pectinate part of antenna somewhat compressed, not

carinate ventrally, without cones or bristles; nonpectinate portion of antenna compressed, not carinate ventrally, each segment with basal and apical lateral tubercles representing rami and bearing setae similar to those of rami; each segment also with a small ventral cone; ventral margin of each segment nearly straight seen from side, basal segments of this portion of antenna broader than long seen from side, subapical ones nearly twice as long as broad. Antennae of female simple, basal two-fifths of flagellum dentate because of basal and apical projections representing the rami on each segment, these projections with short pubescence only and without, or with very inconspicuous, bristles, this portion of antenna without carina or cones; distal part of antenna similar to that of male but subapical segments not so elongated, slightly broader than long.

Tentorial pits obliquely elongated; clypeus about four times as wide as long, separated from frons by weak line; pilifers heavily sclerotic, rather broad and inconspicuous. Mandibular rudiments large and protuberant. Proboscis fossa scarcely longer than broad, rather shallow, walls nearly vertical; maxillary stipites free from walls of fossa, extending backward to middle of sockets of labial palpi, galeae longer than fossa, curled, without conspicuous hairs or papillae; labial sclerite rather large and elevated behind bases of palpi; labial palpi arising behind middle of fossa, very short, one-segmented, directed forward and downward, scarcely reaching mandibular rudiments. Postoccipital bridge rather broad and sclerotic.

Prescutum scarcely convex, anepisternal suture straight, reaching pleural suture at lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture at angle of about 160 degrees to straight lower portion, no conspicuous curved region between these two portions.

Fore tibiae slightly longer than tarsi; epiphysis reaching slightly beyond middle of tibia in male, not reaching middle in female, with some rather long hairs in both sexes; tibial spines absent; tibial spurs hidden in vestiture, the longest slightly longer than diameter of tibia, only extreme apices hooked and concave on one side, not noticeably serrate; claws not noticeably serrate.



FIGS. 54-57. Wings of Citheroniinae. 54. *Adelowalkeria (Ptiloscola) lilacina* (Schaus). 55. *Neocarnegia basirei* (Schaus). 56. *Anisota (Dryocampa) rubicunda* (Fabricius). 57. *Anisota (Anisota) stigma* (Fabricius).

Forewings with acute apices and clearly marked torni, especially in males; outer margins of forewings concave in male, slightly convex in female; hind wings with anal angles produced, especially in males; wings with numerous irregular transparent areas, principally between antemedian and postmedian lines; vestiture principally of rather broad scales, overlain or replaced by hair-like scales at wing bases.

Eighth sternum of male unarmed; ninth tergum distinctly shorter than uncus, the latter produced to a slender sharp point; gnathos connected laterally to upper parts

of bases of harpes, without free lateral lobes, medially band-like, neither broken nor produced, although rather heavily sclerotic; anellus distinct, free from harpes, largely surrounding aedeagus; harpes divided by a cleft into large upper and lower lobes, without spines or other ornamentation; aedeagus with many fine teeth at sides subapically, sac with two small multidentate sclerotizations.

Eighth tergum of female with two sub-lateral sclerotic lobes which do not project behind the membranous posterior margin of the tergal area; eighth sternum with pre-

vulvar part membranous, postvulvar part large, heavily sclerotic, produced to form a pair of irregularly shaped lobes; ductus bursae short, thick, sclerotic, no appreciable constriction between it and the small bursa; dorsal wall of bursa also largely sclerotic; ductus seminalis arising on the right side ventrally.

This genus contains only a single species, *Neocarnegia basirei* (Schaus), from southern Brazil.

GENUS ANISOTA HÜBNER

This is a North American genus of small moths, characterized especially by the extremely reduced clypeus of the adult and the reduced number of thoracic horns of the larva, as indicated in the key. Bouvier (1931) has removed *A. rubicunda* (Fabricius) to *Syssphinx* because of the narrow face and absence of tibial spines. There is no doubt, however, of its correct placement in *Anisota*, although it seems to be the most primitive member of the genus and, therefore, shares a number of characters with *Syssphinx*.

Frons convex laterally, near the eyes but areas between the convexities not depressed so that convexities are less conspicuous than in most genera; frontal protuberance low and transverse, usually four or more times as broad as long. Shortest distance between eyes less than one-third to nearly one and one-half times length of eye, upper ends of eyes extending but little above or not reaching lower margins of antennal sockets, lower ends of eyes extending slightly below lower end of face or not so far downward as lower end of face.

Antennae about two-thirds as long as thorax, flagellum not scaled in male, with scales on dorsal side of basal segment in female; male with proximal three-fifths or two-thirds of flagellum quadripectinate, rami rather short, nearly straight, basal and apical rami subequal or the apical ones slightly shorter; shaft of pectinate portion of antenna strongly compressed, not carinate ventrally, without cones or bristles, basal portion of each segment somewhat swollen so that profile of ventral surface of shaft appears undulate; nonpectinate portion of antenna strongly compressed, not carinate ventrally, each segment with basal lateral tubercles

representing the rami and bearing setae similar to those of rami; each segment also with a small ventral cone. Antennae of female simple, each flagellar segment usually with lateral protuberances representing basal rami, each of which bears an inconspicuous terminal bristle, distal third of antenna somewhat compressed but not carinate ventrally, each segment bearing one or occasionally more inconspicuous dorsal bristles, and each also bearing a small ventral cone.

Tentorial pits oval to nearly round. Clypeus a mere rim beneath frontal protuberance, many times as broad as long seen from below; pilifers not recognizable. Mandibular rudiments small. Proboscis usually wider than long, very shallow, the walls slanting or even almost horizontal; maxillary stipites free from walls of fossa, extending backward to about middle of palpal sockets or behind them, galeae very short, not curled; labial sclerite nearly membranous and very small, sometimes absent; labial palpi arising very close to one another, behind middle of fossa, usually one-segmented but sometimes with two clearly distinguishable segments, palpi reaching forward to a point slightly in front of frontal protuberance. Postoccipital bridge broad and sclerotic.

Prescutum conspicuously convex above medially; anepisternal suture directed towards a point on pleural suture well below lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture at an angle of about 160 degrees to 170 degrees to lower straight portion, a conspicuous curved region intervening between these two main portions.

Fore tibiae subequal to or slightly longer than tarsi; epiphysis in male reaching to middle or nearly to apex of tibia, with some long hairs, epiphysis of female absent, or in *rubicunda* long and slender, without long hairs; anterior tibia usually with a long spine on outer apical angle and a much shorter projection on inner apical angle, middle and posterior tibiae in most species each with a pair of small outer apical projections, one larger and more acutely pointed than the other; tibial spurs not hidden in vestiture, about equal to or considerably longer than diameter of tibia, their apical

halves or only extreme apices concave on one side and minutely serrated; claws not noticeably serrate.

Forewings with outer margins slightly concave to convex in males, convex in females, torni distinct and angulate; hind wings rounded or anal angles somewhat produced; vestiture consisting of scales overlain in most portions of hind wings and bases and occasionally elsewhere on forewings by elongate scales or hairs; vestiture reduced in males of some species so that the postdiscal portions of forewings are translucent.

Uncus of male short and robust, bilobed at apex; gnathos strongly sclerotic and medially produced, not divided, without free lateral arms, connected laterally to ninth tergum and base of uncus.

Eighth abdominal sternum of female with weakly sclerotic transverse prevulvar band, postvulvar portion more heavily sclerotic, consisting of only a simple band not much produced posteriorly and not ornamented; ductus bursae largely membranous to largely sclerotic; bursa slender posteriorly, somewhat enlarged anteriorly; ductus seminalis arising from right-hand side of base of bursa.

Anisota can be divided into two subgenera, as indicated in table 9.

SUBGENUS *DRYOCAMPA* HARRIS

Figures 56, 208–211

Dryocampa HARRIS, 1833, in Hitchcock, Report on the geology, mineralogy, botany, and zoology of Massachusetts, p. 591. Type: *Bombyx rubicunda* Fabricius, designated by Grote, 1874, Proc. Amer. Phil. Soc., vol. 14, p. 261.

This subgenus contains only a single very distinct species, *Anisota (Dryocampa) rubicunda* (Fabricius), which was incorrectly removed from *Anisota* and placed among the species of *Syssphinx* by Bouvier. It is pink and yellow, or completely white, without a white spot at the apex of the discal cell. It occurs in North America east of the Great Plains.

Adelocephala roseilinea Schaus, described from Costa Rica, is a synonym of *Anisota (Dryocampa) rubicunda alba* (Grote). It seems probable that the locality label on the single specimen is in error.

SUBGENUS *ANISOTA* HÜBNER

Figures 57, 212

Anisota HÜBNER, [1820], Verzeichniss bekannter Schmettlinge, p. 192. Type: *Bombyx stigma* Fabricius, designated by Grote, 1874, Proc. Amer. Phil. Soc., vol. 14, p. 260.

This subgenus includes most of the species of *Anisota*. They are brown, with a small white spot at the apex of the discal cell of the forewing. It includes two rather well-marked groups of species distinguished primarily by the size of the eyes. In *dissimilis* Boisduval and *oslari* Rothschild the eyes are reduced in size so that their upper ends do not reach the lower margins of the antennal sockets, and their lower ends do not reach the lower extremity of the frons. In this group, moreover, the frontal protuberance is more reduced and the proboscoidal fossa is even shallower than in the other group which contains the remainder of the species. In *dissimilis* and *oslari* also the labial palpi are more distinctly two-segmented than in the remaining species of the genus.

The species of this subgenus occur in eastern North America, westward to Arizona and south into Mexico.

SUBFAMILY *AGLIINAE*

Frons flat laterally, adjacent to eyes; laterofrontal sutures visible; frontal protuberance absent; antennae of male quadripectinate, distal rami arising adjacent to basal rami of following segment; antennal cones simple; pilifers without bristles. Anepisternum large, anepisternal suture directed strongly downward posteriorly. Vein M_1 and M_2 of forewing arising from apex of discal cell, the former at anterior angle, the latter in front of middle. Tibial spurs somewhat longer than tibial diameter; posterior tibiae without subapical spurs; tarsi with ventral, spine-like setae in addition to those of penultimate fore tarsal segment.

Larva with large thoracic horns, forked apically in early stadia but hornless in last stadium. Pupa enclosed in a cocoon.

This subfamily contains a single species, the Palearctic *Agria tau* (Linnaeus). This species exhibits such a mixture of subfamily characters that it cannot properly be placed in any of the other subfamilies, although it

TABLE 9
SUBGENERA OF *Anisota*

<i>Anisota</i> , <i>Sensu Stricto</i>	<i>Dryocampa</i>
Shortest distance between eyes one-half to nearly one and one-half times length of eye	Shortest distance between eyes less than one-third length of an eye
Epiphysis of female absent	Epiphysis of female long and slender, without long hairs
Anterior tibia with long spine on outer apical angle, much shorter projection on inner apical angle; middle and posterior tibiae each with a pair of small apical projections	Tibial spines absent
Anellus of male free from harpes	No free anellus, lower ends of bases of claspers being fused with one another and apparently with remnant of anellus
Uncus of male not protuberant above	Uncus of male with a dorsal protuberance
Eighth abdominal tergum of female with sub-lateral sclerotic lobes	Eighth abdominal tergum of female broadly sclerotic but scarcely lobed

may be nearest to Hemileucinae. It seems certain that it is a primitive type and that some of its characters are those of the ancestors of the following subfamilies. Perhaps its closest living relative is the Chilean *Polythysana*.

Although *Aglia* does not occur in the Western Hemisphere, figures of its male genitalia (figs. 213-217) and wing venation (fig. 85) are included for comparison with the similar Hemileucinae.

SUBFAMILY HEMILEUCINAE

Frons flat laterally, adjacent to eyes^s (slightly convex in *Hirpida*); laterofrontal suture visible, frontal protuberance present although often low, absent only in certain *Hylesia*, in *Polythysana*, and in brachypterous females of *Ormiscodes* subgenus *Mero-leuca*; antennae, when quadripectinate, with distal rami arising adjacent to basal rami of following segment; antennal cones simple; pilifers without bristles. Anepisternum and anepisternal suture variable. Vein M_1 of forewing usually arising near anterior apical angle of discal cell, occasionally stalked with the radials, only in *Hemileuca* and to a lesser degree in a few others are M_1 and M_2 stalked together but free from the radials; M_2 of forewing arising at least slightly in front of middle of apex of cell, sometimes at anterior apical angle of cell; tibial spurs somewhat longer than tibial diameter; posterior tibiae without, with one, or occasionally with two,

subapical spurs; tarsi with or without ventral, spine-like setae.

Larva with the tubercles large, often elongated, provided with numerous coarse, sharply pointed spines; some of thoracic tubercles often more elongated than other tubercles, especially in early stages, and forked at apices; subventral abdominal spines present on segments one, two, and usually seven to nine (see Munroe, 1949). Pupa usually enclosed in a cocoon.

This is a large, exclusively American subfamily.

In addition to the characters mentioned in the above diagnosis, members of this subfamily agree in the following features:

Labial palpi when three-segmented with second segment much longer than either of the others; labial sclerite feebly sclerotic, galeae virtually absent, represented by mere lobes or triangular projections, often provided with elongated scales, except in *Hylesia* and some *Dirphia* in which the galeae are somewhat elongated and curled. Thorax not unusually broad; tegulae almost always fail to reach anterior median angle of scutellum, although in *Hirpida* they reach this angle. Torni of forewings always distinct, though sometimes rounded.

KEY TO THE GENERA OF HEMILEUCINAE¹

1. Arolia and pulvilli absent; vein 3V of hind

¹ The genera *Catharisa* and *Parancistrota* are omitted from the key because they are poorly known and their

- wing well developed, as thick as 2V, about three-fourths as long as 2V 2
- Arolia and pulvilli well developed; vein 3V of hind wing absent or less than two-thirds as long as 2V and more slender than 2V 3
2. Labial palpi fused to one another to form a small, unsegmented, simple, or bilobed structure not reaching forward so far as mandibular rudiments; antennae of male bipectinate *Hemileuca*
- Labial palpi separate from one another, with at least traces of division into two segments, reaching forward to a point in front of face; antennae of male quadripectinate *Coloradia*
3. Frontal protuberance completely absent; forewings and hind wings each with large eye spot; antennal cones reduced to small, dorsoventrally flattened, irregularly rounded but unpointed projections *Polythysana*
- Frontal protuberance represented by at least a transverse ridge (except in a few *Hylesia*); forewings without eye spots; antennal cones not dorsoventrally flattened, often laterally compressed, pointed or narrowly rounded, at least as seen in ventral view 4
4. Frons slightly convex at sides, next to eyes; laterofrontal sutures visible but very close to eye margins; anepisternal suture largely horizontal but directed slightly downward posteriorly towards a point on pleural suture below deeply impressed portion of latter; tegulae reaching as far back as anterior median angle of scutellum *Hirpida*
- Fronts flat at sides next to eye; laterofrontal sutures usually well separated from eye margins; anepisternal suture reaching or directed towards pleural suture above lower end of deeply impressed portion of latter; tegulae not reaching so far back as anterior median angle of scutellum 5
5. First three tarsal segments of at least middle and hind legs with a few ventral apical spines (often hidden in vestiture); male harpes freely articulated, without inner spines, each with a conspicuous dorsal lobe; anellus conspicuous, free 6
- Tarsal segments without spines except for apical pair on penultimate fore tarsal segment of female; male harpes often fused to ninth abdominal segment; anellus usually absent, fused to harpes and ninth sternum, or small and inconspicuous (large and free only in *Lonomia*) 7
6. Labial palpi three-segmented, reaching in front of face; posterior tibiae with subapical spurs 20
- Labial palpi one-segmented, reaching only to clypeus; posterior tibiae without subapical spurs *Callodirphia*
7. Cell R_1 of hind wing much narrowed subapically but widened towards wing margin because vein $Sc+R_1$ curves forward at apex; anterior margin of hind wing with notch before apex of $Sc+R_1$, this notch very large in female *Travassosula*
- Cell R_1 of hind wing parallel sided or narrowest at apex; anterior margin of hind wing not notched 8
8. Flagellar segments of male each with a very large subapical dorsal bristle, those of female with a small bristle in same location; abdominal terga usually with narrow basal white bands contrasting with black or brown appressed vestiture of other portions of terga *Cerodirphia*
- Flagellar segments of male without dorsal bristles, those of female rarely with such bristles; abdomen variable, not as in *Cerodirphia* 9
9. Anellus of male large and free; antennal cones small but arising from large apical projections which would be blunt except for the cones *Lonomia*
- Anellus absent or fused to adjacent structures or rarely small, transverse, inconspicuous, and free; antennal cones variable but not arising from large and otherwise blunt projections 10
10. Uncus and gnathos of male weakly sclerotic or largely membranous or virtually absent, the former not or scarcely bent downward and strongly flattened dorsoventrally if at all strongly sclerotic; posterior wings each with conspicuous eye spot which has the iris orange or red, the pupil if present round or occasionally oval 11
- Uncus and gnathos well developed and heavily sclerotic, the former usually thickened, not dorsoventrally flattened; posterior wings with or without eye spots, these spots if present sometimes as above (some *Hylesia*) but usually with irides variously colored but not bright red or orange and with a streak or irregular spot in the pupil 13
11. Antennae slightly longer than thorax; basal rami of male antennae each terminating in a long bristle *Gamelia*

inclusion would weaken rather than strengthen the key. *Catharisa* can be distinguished from all other genera (except certain *Automerina*) by the strongly bipectinate female antennae. *Parancistrota* looks like *Catacantha*, but can be distinguished from all other genera by the two long processes of the gnathos which extend beyond the apices of the other genital structures.

- Antennae shorter than thorax; basal rami of male antennae without bristles or with inconspicuous bristles shorter than setae .12
12. Male genital harpes profoundly three-lobed, the lobes elongate and slender, median lobe representing inner spine of related genera *Hyperchiria*
Male harpes small and not deeply lobed, inner spine when present arising in the usual position on inner surface of harpe . *Automerina*
13. Lower basal angles of harpes produced to long, blade-like processes which are sometimes fused to one another basally.14
Lower basal angles of harpes not so produced15
14. Antennae of male bipectinate; uncus of male bifid apically, unspined dorsally
 *Prohylesia*
Antennae of male quadripectinate; uncus of male simple apically, usually with one or several dorsal spines, variously arranged *Molippa*
15. Harpes of male genitalia fused to ninth segment so that only a faint line, if any, can be seen separating the structures; harpes much reduced, the principal lobe being the dorsal one to which the gnathos is connected *Dirphia*
Harpes of male genitalia not fused to ninth segment or fused only ventrally [broadly fused in one species, *Ormiscodes* (*Xanthodirphia*) *amarilla* (Schaus)], their largest lobes not connected to gnathos.16
16. Harpes of male large, broadly and strongly three-lobed, there being upper and lower outer lobes and an inner upper lobe connected to the gnathos (in addition there is sometimes a large inner spine, sometimes blunt and scarcely spine-like) . *Ormiscodes*
Harpes of male not trilobed in the fashion described above17
17. Uncus large and inclined downward posteriorly, harpes much elevated so that the inner spine is mostly above level of uncus; gnathos low, immediately above aedeagus medially, but turned strongly upward to connect at each side with a small inner upper lobe of harpe *Hylesia*
Uncus variable in size but not so much inclined downward posteriorly so that harpes do not rise much above it; gnathos well above aedeagus medially, not curved so far upward at sides18
18. Harpes freely articulated to ninth segment; gnathos connected laterally to a small lobe of harpe; posterior wings without eye spot *Catacantha*
Lower basal portions of harpes fused to ninth abdominal segment; gnathos not connected to distinct lobe of harpe; posterior wings usually with eye spots19
19. Median portion of gnathos strongly bilobed; eye spot of posterior wing a mere black ring, its center being the ground color of wing; antennae of female broadest medially. *Eubergioides*
Median portion of gnathos rarely strongly bilobed; eye spot of posterior wings usually conspicuous and of a different color from the ground color; antennae of female tapering, rarely slightly broader medially than elsewhere *Automeris*
20. Posterior tibiae with two subapical spurs; posterior wings each with an eye spot *Adetomeris*
Posterior tibiae with one subapical spur; posterior wings without eye spots *Cinommata*

TRIBE HEMILEUCINI

This tribe includes all of the Hemileucinae except for the strange Chilean genus *Polythysana*. The tribe Hemileucini differs from the Polythysanini in having more or less distinct antennal cones which, if compressed, are compressed laterally. Its members also lack eye spots on the forewings, and, except for certain species of *Hylesia* and brachypterous females of *Ormiscodes*, have frontal protuberances.

GENUS LONOMIA WALKER

This is a genus of dull-colored moths remarkable for the combination of primitive and of specialized characters, particularly as seen in the subgenus *Periga*. The antennae of the male are bipectinate, and the antennal cones in both sexes arise from apical ventral projections of the segments. The male genitalia are distinctive, the harpes being rather elongated and narrow and freely articulated to the ninth tergum, the anellus being free.

Laterofrontal sutures widely separated from eye margins; frontal protuberance distinct and rounded. Shortest distance between eyes one-third to two-fifths of length of an eye, upper ends of eyes extending well above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae about four-fifths as long as thorax to slightly longer than thorax; flagellum of male scaled only on dorsum of

basal segments, these scales often broken off, or densely scaled to apex above, flagellum of female scaled dorsally on at least basal two-thirds; flagellum of male bipectinate nearly to apex, rami slender and strongly curved downward, each bearing a distinct terminal bristle, sometimes two or three subterminal ventral bristles, rami of inner side sometimes also each with a dorsal bristle about three-quarters of distance from base to apex and sometimes an additional dorsal bristle between this point and apex; antennal shaft not much compressed, not carinate beneath, antennal cones proper small, but arising from large projections which would be regarded as the cones unless the smaller true cones were present, these projections sometimes extremely long, cones and projections present in apical third or fourth of antenna, under surface of shaft with bristles which may be reduced to a pair on each of the apical ventral projections near the cones or may extend to base of antenna and number as high as six per segment.

Tentorial pits large, round or oval, lateral to and below frontal protuberance; clypeus only a narrow band many times as broad as long, separated from frontal protuberance by a distinct suture; pilifers represented by small but recognizable projections. Mandibular rudiments large, triangular, and somewhat protuberant. Proboscis fossa longer than broad, deep, walls vertical; maxillary stipites in contact with walls of fossa, extending backward to anterior margins of palpal sockets, galeae reduced to mere projections, bearing elongated, hair-like scales; labial palpi arising behind middle of fossa, large and three-segmented, extending forward to a point well in front of face. Postoccipital bridge rather broad.

Thorax covered with suberect, hair-like scales; patagia and parapatagia both narrow, the latter narrower than the former; tegulae not extending back so far as anterior median angle of scutellum; anepisternum small, anepisternal suture directed upward posteriorly towards middle or a point above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in same direction as straight lower portion of this suture, no curved region intervening between these two portions.

Fore tibiae slightly shorter than tarsi; epiphysis of male large and reaching almost to apex of tibia, epiphysis of female much smaller, those of both sexes without long hairs or scales; tibial spines absent; tibial spurs exceeding vestiture of tibiae, equal to, or somewhat longer than, diameter of tibiae, their distal halves or two-thirds concave on one side, with margins finely serrated; posterior tibiae without subapical spurs; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes of this segment bare, adjacent bare areas of following segments large but scarcely extending to apex of segment, sole scaled; claws small and slender, finely serrate; arolium and pulvilli present.

Forewings with apices acute, often somewhat produced, outer margins straight or slightly convex except near extreme apex where they are concave; hind wings with anal angles not or slightly produced; vestiture consisting of large scales overlain at least on hind wing with elongated scales; forewing with vein M_2 arising slightly in front of middle of apex of discal cell, M_1 and radial stem from anterior apical angle of cell, R_2 absent; hind wing with $3V$ very much reduced, vein R_4 arising slightly before apex of discal cell, basal free portion of R_1 (absent in other Saturniidae) sometimes represented by a feeble line between Sc and R near base of wing.

Abdomen covered with recumbent hairs which obscure a covering of broad scales; eighth sternum of male sometimes strongly bidentate; uncus variable, with or without a pair of dorsal or a pair of apical processes; gnathos complete, broken, or nearly absent; anellus very large, free; harpes elongated, free from ninth segment, to which they are movably articulated, sometimes with a small, subapical, inner spine.

Eighth tergum of female broadly or narrowly sclerotic, the sclerotization sometimes narrowed medially; eighth sternum with a prevulvar sclerotic band and a postvulvar, weakly sclerotic, produced lobe or flap which is itself bilobed or trilobed; ductus bursae short and largely sclerotic; bursa membranous and elongated, sometimes tubular; ductus seminalis arising from right-hand side of base of bursa.

TABLE 10
SUBGENERA OF *Lonomia*

<i>Lonomia</i> , <i>Sensu Stricto</i>	<i>Periga</i>
Antennal shaft of male not scaled, or scaled only in proximal third, of female scaled in proximal two-thirds	Antennal shaft (both sexes) densely scaled on dorsal surface to apex
Antennal rami arising from upper portions of sides of segments	Antennal rami arising medially from sides of segments
Antennal cones arising on moderate-sized projections	Antennal cones arising from exceedingly large projections which form a comb at apex of antenna in both sexes
Bristles of under surface of shaft conspicuous to base	Bristles of under surface of shaft of male conspicuous only on apical cone-bearing projections
Antenna slightly shorter than thorax	Antenna slightly longer than thorax
Antennal rami of male without dorsal bristles or occasionally a dorsal bristle on a few of inner rami	Inner rami each with a dorsal bristle about three-fourths of distance from base to apex, sometimes another bristle between this and apex
Uncus unarmed or with a pair of huge apical processes	Uncus with a pair of dorsal processes
Gnathos-like structure above proctiger present, often divided medially	Gnathos-like structure above proctiger absent or virtually so
Harpes usually each with an inner apical spine	Harpes without spines

The genus *Lonomia* can be divided into two subgenera, as indicated in table 10.

SUBGENUS *LONOMIA* WALKER

Figures 58, 221–226

Lonomia WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 5, p. 1191. Type: *Lonomia obliqua* Walker (= *Phalaena achelous* Cramer, present designation).¹

This and the next subgenus each contain but few species and range from Mexico to Brazil.

SUBGENUS *PERIGA* WALKER

Figures 218–220

Periga WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 5, p. 1197. Type: *Periga circumstans* Walker (monobasic).

GENUS *HIRPIDA* DRAUDT

Figures 59, 227–230

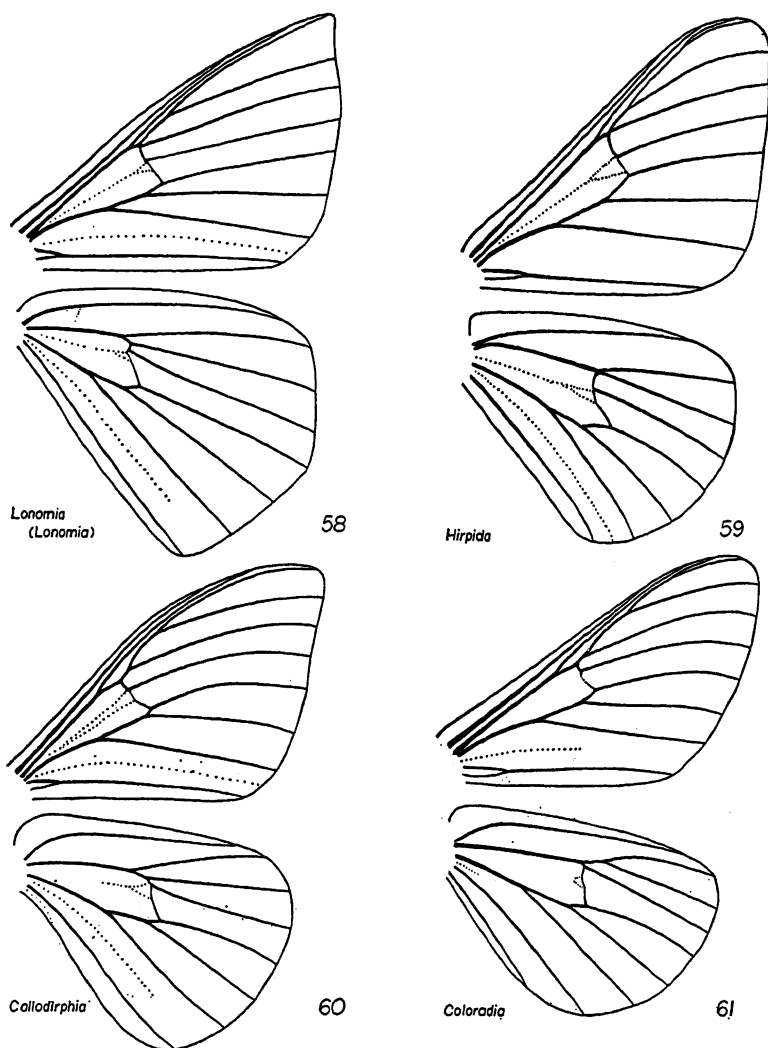
Hirpida DRAUDT, 1930, in Seitz, *Macrolepidoptera of the world*, vol. 6, p. 783. Type: *Dirphia gaujoni* Dognin, by original designation.

¹ The designation by Draudt (1929, in Seitz, *Macrolepidoptera of the world*, vol. 6, p. 763) of *achelous* as type is invalid since that name does not appear in the original publication of *Lonomia*.

Although members of this genus have usually been included in *Dirphia*, *Hirpida* is only distantly related to that genus. Among its distinctive characters are the slightly convex sides of the face, the presence of spines on the under surfaces of the tarsal segments, the large and freely articulated male harpes, and the free anellus.

Frons slightly convex at sides, next to eyes; laterofrontal sutures visible but very close to eye margins; frontal protuberance low, transverse. Shortest distance between eyes slightly more than one-third of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae about one and one-fourth times as long as thorax, flagellum not scaled, flagellum of male quadripectinate to apex, rami slender and but little curved, apical rami two-thirds to three-quarters as long as basal rami, rami without bristles; antennal shaft but little compressed, not carinate beneath, with one or two inconspicuous bristles or hairs on under surface of each segment, antennal cones extremely small and inconspicuous, recognizable only on last half dozen segments of antenna. Antennae of female strongly bidentate, each tooth with



FIGS. 58-61. Wings of Hemileucinae. 58. *Lonomia (Lonomia) submacula* Walker. 59. *Hirpida levis* (Johnson and Michener). 60. *Callodirphia arpi* (Schaus). 61. *Coloradia pandora* Blake.

one or two bristles; basal portion of shaft somewhat flattened dorsoventrally, apical portion laterally compressed; shaft without ventral carinae or bristles; antennal cones similar to those of male.

Tentorial pits small and oval, lateral to frontal protuberance; clypeus about eight times as broad as long, without recognizable pilifers. Proboscis fossa much longer than broad, with walls vertical; maxillary stipites in contact with walls of fossa, extending backward to middle of palpal sockets; labial palpi arising about the middle of fossa, ex-

tending forward to a point well in front of frons, three-segmented. Postoccipital bridge broad.

Thorax covered with long hairs which are more or less recumbent; patagia broad; parapatagia narrow and lamelliform; tegulae reaching slightly beyond anterior median angle of scutellum; anepisternum large, anepisternal suture horizontal, directed slightly downward at posterior end towards a point on pleural suture below lower end of deeply impressed portion of this suture; deeply impressed portion of pleural suture

directed in same direction as straight lower portion, a conspicuous curved region intervening between these two main portions.

Fore tibiae slightly longer than tarsi; epiphysis in both sexes reaching to or beyond apical fourth of tibia and without long hairs or scales; tibial spines absent; tibial spurs scarcely exceeding vestiture of tibiae, about as long as diameter of tibiae, only apical third or fourth concave on one side, with the margins finely serrated, posterior tibiae without subapical spurs; tarsal segments one to three with rather numerous spines on ventral surfaces; penultimate fore tarsal segment of female with the usual pair of apical spines, spine-bearing lobes bare, adjacent bare areas of following segment large and extended as broad bands to apex of segment but sole scaled; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins straight; hind wings with anal angles not produced; vestiture of wings consisting of scales, overlain by elongate scales or hairs; forewing with M_2 arising from middle of apex of discal cell, M_1 from anterior apical angle of cell, R_2 present; hind wing with 3V absent, R_4 and M_1 arising from anterior apical angle of cell.

Abdomen tapering posteriorly, covered with recumbent, hair-like scales, which do not form color bands; ninth tergum of male about as long as uncus, the latter down-curved, simple at apex but elevated, sometimes bilobed, dorsally; gnathos absent; anellus large, extending posteriorly; harpes large, free from ninth segment, divided by a cleft into upper and lower lobes.

Eighth tergum of female with a very broad sclerotic band; eighth sternum with very broad sclerotic areas both behind the vulva and in front of it, these continued into the mouth of the very large, funnel-shaped vulva and forming the ductus bursae which is completely sclerotic, somewhat longer than broad and tapering posteriorly; bursa membranous, apparently rather small; ductus seminalis arising middorsally at the extreme base of the bursa.

This genus includes *Hirpida gaujoni* (Dognin), *levis* (Johnson and Michener), and *rubella* (Dognin). It is Bouvier's (1935) group of *Dirphia gaujoni*. The species occur from Ecuador to Bolivia.

GENUS CALLODIRPHIA MICHENER

Figures 60, 234-236

Callodirphia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 145. Type: *Heliconisa arpi* Schaus, by original designation.

This is a monotypic but very distinct genus, exhibiting a number of primitive characters, such as spines on the under sides of the tarsal segments, freely articulated male harpes, and free anellus. The long, straight, male antennal rami, the quadripectinate female antennae, and the much reduced labial palpi are also distinctive. The genus is unique among the hemileucids in having the antennae of the female quadripectinate.

Frontal protuberance extremely low and transverse, not exceeding clypeus. Shortest distance between eyes over three-fourths of length of an eye, upper ends of eyes not quite reaching lower margins of antennal sockets, lower ends of eyes not reaching lower end of face.

Antennae about one and one-fourth times as long as thorax, flagellum not scaled; flagellum of male broadly quadripectinate to apex, rami long, slender, and nearly straight; apical rami, where longest, about four-fifths as long as basal rami, basal rami mostly with one or more terminal and one subterminal ventral inconspicuous bristle, shorter than the setae; antennal shaft not strongly compressed, inconspicuously carinate ventrally in distal half; antennal shaft without bristles; cones very small and inconspicuous, recognizable only on apical eight or 10 segments. Antennae of female rather narrowly quadripectinate, apical rami represented by rather short stubs, about one-third of length of basal rami, basal rami each with one or a few terminal bristles, the rami themselves tapering to points; shaft not compressed, feebly carinate in distal third, each segment bearing a pair of inconspicuous ventral bristles; antennal cones even more reduced than in male, virtually unrecognizable.

Tentorial pits rather large, short oval, lateral to and slightly below the rudimentary frontal protuberance; clypeus almost five times as broad as long, separated from frons by an interrupted groove, extending farther downward than frontal protuberance and not hidden by it; pilifers distinctly produced.

Mandibular rudiments large and protuberant, widely separated from eyes. Proboscival fossa nearly absent, without walls posteriorly and with inconspicuous sloping walls anteriorly; maxillary stipites extending backward to posterior margins of palpal sockets; labial palpi arising near posterior end of fossa, extending forward only to clypeus, one-segmented, although with a faint indication of a constriction between a very short first segment and a longer second segment. Postoccipital bridge broad and rather strongly sclerotic.

Thorax densely covered with hairs, among which are numerous longer, hair-like scales or hairs; patagia and parapatagia both rather broad, the latter slightly narrower than the former; tegulae not reaching back so far as anterior angle of scutellum; anepisternum rather small, anepisternal suture directed slightly upward posteriorly towards a point a little below middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture at an angle of about 170 degrees to straight lower portion, virtually no curved region intervening between these two main portions.

Fore tibiae slightly shorter than tarsi; epiphysis of male reaching to apex of tibia, with long hairs; epiphysis of female absent; tibial spines absent; tibial spurs exceeding vestiture of tibiae, slightly longer than diameter of tibia, their apical one-third broadly concave on one side, the margins finely serrated; posterior tibiae without subapical spurs; first three tarsal segments of middle and posterior legs with a few apical spines; penultimate fore tarsal segment of female with the usual spine-bearing lobes which are bare, adjacent bare areas of following segment large and continuous with the bare sole of this segment; claws very inconspicuously serrate; arolium and pulvilli well developed.

Forewings with outer margins slightly concave medially in male, convex in female; hind wings with anal angles rounded; vestiture consisting of scales, overlain by elongated scales or hair; forewing with base of M_2 well in front of middle of apex of discal cell, M_1 stalked with radial stem, R_s at apex of cell widely separated from R_1 but converging towards R_1 apically, R_1 arising

before apex of cell, R_2 absent; hind wing with 3V absent, R_s arising before apex of discal cell.

Abdomen robust, vestiture consisting of scales, overlain by long hairs and longer hair-like scales which do not form color bands; uncus of male down-curved and bilobed; gnathos connected laterally to base of uncus; anellus present, distinct from harpes and almost surrounding aedeagus; harpes free from ninth segment, with a rather long dorsal lobe and without inner spines.

So far as known this genus contains only one somewhat variable species, *Callodirphia arpi* (Schaus), from southern Brazil.

GENUS COLORADIA BLAKE

Figures 61, 231-233

Coloradia BLAKE, 1863, Proc. Ent. Soc. Philadelphia, vol. 2, p. 279. Type: *Coloradia pandora* Blake (monobasic).

This genus is closely related to *Hemileuca*, from which it differs by having quadripectinate antennae in the male, much larger labial palpi which are not fused with one another, and dull gray coloration of at least the forewings. *Coloradia* and *Hemileuca* form a very distinctive group characterized especially by the absence of arolia and pulvilli and the long, strong vein 3V of the hind wing.

The large size of vein 3V of the hind wing has been regarded by some as an important primitive character in *Coloradia* and *Hemileuca*. It seems more likely that it is a reversion to a primitive size of a vein which is variable in size and often absent in other saturnioids. (The vein is quite large, for example, in *Travassosula* and *Schausiella*.) In their numerous other characters *Coloradia* and *Hemileuca* show their relationship to the hemileucines of moderate specialization.

Laterofrontal sutures widely separated from eyes; frontal protuberance rather low and transverse, broadly rounded. Shortest distance between eyes more than one-half of length of an eye, upper ends of eyes not reaching to level of lower margins of antennal sockets, lower ends of eyes reaching to lower end of face.

Antennae about one and one-half times as long as thorax in male, slightly shorter in female; flagellum not scaled, that of male

broadly quadripectinate to apex, basal rami long and slender, flattened, those of outer side slightly curved, those of inner side much more strongly so, apical rami much shorter than basal, those of outer side less than half as long as basal rami, those of inner side about two-thirds as long as basal rami; rami without bristles; antennal shaft compressed, strongly carinate beneath, carina produced on distal portion of each segment in apical two-fifths of antenna to form large but blunt antennal cones, basal three-fifths of antenna without distinct cones, but carina somewhat produced on each segment to form a convexity. Antennae of female strongly bidentate or even narrowly bipectinate, the teeth or rami each with one or few inconspicuous terminal bristles; shaft dorso-ventrally flattened, not carinate beneath, without bristles, with very small, simple, antennal cones, sometimes confined to distal fifth and other times extending nearly to or even basad of the middle of antenna.

Tentorial pits large and almost round, laterad of and slightly above frontal protuberance; clypeus little more than a mere rim beneath frontal protuberance, separated from it by only a weak line; pilifers scarcely recognizable. Mandibular rudiments small. Proboscis fossa wider than long, rather shallow, walls subvertical; maxillary stipites in contact with walls of fossa, extending backward nearly to posterior margins of palpal sockets; labial palpi arising at posterior end of fossa, extending forward to a point in front of frons, two-segmented, but segments immovably fused together, first segment somewhat shorter than second, a distinct small depression in apex of second segment. Postoccipital bridge narrow, rather lightly sclerotic.

Thorax with long, rather woolly, suberect hairs and hair-like scales; patagia and parapatagia both rather broad, the latter narrower than the former; tegulae not reaching back so far as anterior median angle of scutellum; anepisternum rather small, anepisternal suture directed slightly upward posteriorly except near its posterior end where it bends downward, reaching pleural suture near lower end of deeply impressed portion of latter; deeply impressed portion of pleural suture at an angle of about 170

degrees to straight lower portion of pleural suture, no curved region intervening between these two portions.

Fore tibiae shorter than basitarsi; epiphysis absent in female, very small to absent in male; fore tibia bearing a long spine on outer apical angle; tibial spurs slightly exceeding vestiture of tibiae, posterior tibiae without subapical spurs; tibial spurs with apical halves bare, concave on one side, margins serrated; tarsal spines numerous on under surfaces of segments one to four, apical segment of fore tarsus of female without the usual bare areas; penultimate segment without the usual bare, spine-bearing lobes but with several pairs of apical spines similar to those on the other tarsal segments; claws slender, simple or nearly so; arolia and pulvilli absent.

Forewings with outer margins slightly convex; hind wings with anal angles not produced but with two distinct anal veins; vestiture consisting of rather widely scattered, broad scales, overlain on wing bases and on hind wings or in female on entire wing surface with hair-like scales or hairs; vein M_1 of forewing stalked with radials; hind wing with 3V strong and about three-fourths as long as 2V, M_1 and R_s stalked beyond apex of cell.

Abdomen with suberect or recumbent hairs; ninth tergum of male longer than uncus, the latter with a large, submembranous, basal projection extending posteriorly beyond apex of uncus proper, the latter down-curved and bidentate at apex; harpes not or scarcely fused to ninth segment; gnathos sclerotic medially, with a small median posterior projection, laterally fused to upper basal portions of harpes; anellus absent.

Eighth tergum not sclerotic in female; eighth sternum with distinct transverse sclerotic band, in the middle of which is a short transverse slit, the vulva, behind which is a small posterior projection; ductus bursae membranous or nearly so; bursa cylindrical, several times as long as broad; ductus seminalis arising from right-hand side of base of bursa.

The genus *Coloradia* is restricted to the mountains of Mexico and the western United States where it appears to be represented by several species.

GENUS *HEMILEUCA* WALKER

This genus is unique among the hemileucines in having the labial palpi fused to one another to form a single structure. *Hemileuca* is related to *Coloradia*, from which it differs not only in the structure of the labial palpi but in the bipectinate male antennae and other characters. The inclusion in *Hemileuca* of long-recognized segregates such as *Pseudohazis* will be questioned by some. However, *Pseudohazis* is morphologically so similar to *Hemileuca*, both in the adult and in the larva, that it does not seem to warrant generic recognition, especially since it appears to contain only two valid species. Stages in the development of the *Pseudohazis* wing pattern can be seen in *H. (Hemileuca) electra* Wright and the species of *Argyrauges*. The resemblance between the latter and pale specimens of *H. (Pseudohazis) hera* Harris is very striking. Morphologically the subgenera *Euleucopheus* and *Argyrauges* are very similar and quite different from the subgenera *Hemileuca* and *Pseudohazis*, which exhibit many features in common as well as a number of differences.

Laterofrontal suture widely separated from eyes; frontal protuberance low, inconspicuous, broadly rounded, directed downward. Shortest distance between eyes less than one-half of length of an eye to more than length of an eye, upper ends of eyes below lower margins of antennal sockets, lower ends of eyes not reaching lower end of face or extending but little beyond it.

Antennae about one and one-half times as long as thorax, flagellum not scaled or with a few scales dorsally near base in female; flagellum of male broadly bipectinate to its apex, rami long and slender, each strongly bent downward medially, without bristles; antennal shaft compressed, carinate beneath distally and sometimes also proximally, without bristles; antennal cones rather large apically, smaller towards bases of antennae, completely absent in proximal half or third in many species. Antennae of female narrowly bipectinate or (in *H. oliviae* Cockerell) bidentate, the rami or teeth each tapering towards its apex, often with an inconspicuous terminal bristle, rami of inner side of antenna often shorter than those of outer; shaft dorsoventrally flattened, not carinate

beneath, without bristles or with one or two inconspicuous bristles on under surface of each segment, antennal cones usually small, inconspicuous, sometimes mere angles, limited to distal third or less of antennae.

Tentorial pits oval to round, lateral to and somewhat above frontal protuberance; clypeus unrecognizable or represented only by a mere rim beneath the margin of frontal protuberance; pilifers not recognizable as distinct structures; mandibular rudiments small. Proboscical fossa slightly longer than broad to broader than long, shallow so that in some groups walls do not exist; maxillary stipites in contact with walls of fossa if the latter are present, extending backward to or behind palpal sockets; labial palpi fused to form a small, bilobed or simple structure arising from posterior end or near posterior end of fossa and extending forward only a very short distance, not so far as mandibular rudiments, the fused palpi usually provided with a median apical pit. Postoccipital bridge narrow and rather weakly sclerotic.

Thorax covered with long, suberect hairs; patagia rather broad; parapatagia narrower; tegulae not reaching back so far as anterior median angle of scutellum; anepisternum small, anepisternal suture directed slightly upward posteriorly, reaching deeply impressed portion of pleural suture well above middle of the latter; deeply impressed portion of pleural suture directed at an angle of about 170 degrees to straight lower portion of this suture, curved region intervening between these two main portions of pleural suture.

Fore tibiae shorter than tarsi or equal to them; epiphysis absent; fore tibia in some species with an outer apical spine and a much smaller inner apical projection; tibial spurs but little exceeding vestiture of tibiae, apical half of tibial spurs concave on one side and minutely serrated, posterior tibiae without subapical spurs; tarsal spines numerous on segments one to four; penultimate fore tarsal segment of female with the usual spine-bearing lobes, spines at apices of these lobes being larger than other spines, these lobes partially bare, bare areas of following segment very small; claws simple or nearly so; arolia and pulvilli absent.

Forewings with outer margins convex;

TABLE 11
SUBGENERA OF *Hemileuca*

<i>Euleucopheus</i>	<i>Argyrauges</i>	<i>Hemileuca, Sensu Stricto</i>	<i>Pseudohazis</i>
Shortest distance between eyes less than half length of eye	Shortest distance between eyes less than half length of eye	Shortest distance between eyes more than length of eye	Shortest distance between eyes equal to or more than length of eye
Larger antennal cones of males long and overlapping following segments	Larger antennal cones of males long and overlapping following segments	Larger antennal cones of males long and overlapping following segments	Larger antennal cones of male shorter and not much overlapping following segments
Ventral antennal carina of male quite narrow and distinct to base	Ventral antennal carina of male quite narrow and distinct to base	Ventral antennal carina of male quite narrow and distinct to base or broad and inconspicuous basally	Ventral antennal carina of male broad and inconspicuous in basal half of antennae
Labial palpi fused to form an unlobed mass	Labial palpi fused to form an unlobed mass	Labial palpi incompletely fused apically, so that they form a bilobed mass	Labial palpi incompletely fused apically, so that they form a bilobed mass
Proboscoidal fossa longer than broad, with subvertical walls	Proboscoidal fossa longer than broad, with subvertical walls	Proboscoidal fossa broader than long, virtually without walls	Proboscoidal fossa broader than long, virtually without walls
Fore tibia subequal to tarsus, without a spine	Fore tibia shorter than tarsus, without a spine	Fore tibia much shorter than tarsus, with outer apical spine	Fore tibia much shorter than tarsus, with long outer apical spine and short inner apical spine
Wings whitish, gray-brown, or pink, with the premedian and postmedian lines usually paler	Wings white or nearly so, with premedian and postmedian lines black	Wings with apical and usually the basal regions black, intervening area, sometimes reduced to a few spots, pale	Wings orange to white, premedian and postmedian lines and streaks along the veins apically black
Uncus bilobed at apex	Uncus bilobed at apex	Uncus bilobed at apex	Uncus with a median subapical prominence in addition to the pair of apical lobes
Inner apical lobe of harpe short	Inner apical lobe of harpe short	Inner apical lobe of harpe short	Inner apical lobe of harpe much exceeding the others

hind wings with anal angles broadly rounded, two anal veins present; vestiture consisting of scales which are often widely separated so that the wings are translucent, these scales overlain in some cases by hair-like scales or hairs; veins M_2 and M_1 of forewing arising together from anterior apical angle of discal cell, R_s separating from cell before its apex; hind wing with 3V strong, about three-fourths as long as 2V; R_s arising from discal cell before apex.

Abdomen with recumbent or suberect hairs often forming color bands on sterna and frequently also on terga; ninth tergum of male subequal to uncus which is turned down and bilobed at its apex; gnathos heavily sclerotic and feebly bilobed, laterally connected to upper basal portions of harpes; anellus absent or incorporated into the harpes which are fused to one another as well as to the ninth sternum ventrally.

Eighth tergum of female with a rather

broad, transverse, sclerotic band which is divided by a weakly sclerotic median area; eighth sternum with a narrow sclerotic prevulvar band and a distinct small projection behind vulva; ductus bursae very small and slender, bursa small, elongated, and more or less cylindrical.

Hemileuca is divisible into four subgenera, the characters of which are indicated in table 11.

SUBGENUS EULEUCOPHAEUS PACKARD

Euleucophaeus PACKARD, 1872, 4th Ann. Rept. Peabody Acad. Sci., p. 88. Type: *Euleucophaeus tricolor* Packard (monobasic).

This subgenus contains about 11 species, most of which occur in Mexico. A few range north as far as Arizona and Kansas.

SUBGENUS ARGYRAUGES GROTE

Argyrauges GROTE, 1882, Canadian Ent., vol. 14, p. 215. Type: *Euleucophaeus neuwoegeni* Henry Edwards (monobasic).

This subgenus contains two species from the southwestern United States.

SUBGENUS HEMILEUCA WALKER

Figures 62, 237-239

Hemileuca WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 6, p. 1317. Type: *Phalaena maia* Drury, designated by Grote and Robinson, 1866, Ann. Lyc. Nat. Hist. New York, vol. 7, p. 376.

Euchronia PACKARD, 1864, Proc. Ent. Soc. Philadelphia, vol. 3, p. 382. Type: *Phalaena maia* Drury (monobasic).

This subgenus contains about six species, all from the United States and Canada.

SUBGENUS PSEUDOHASIS GROTE AND ROBINSON

Figures 63, 246, 247

Aglais PEALE (not Ranier), 1836, Lepidoptera Americana, vol. 1, p. [13] [doubtfully published].¹ Type: *Aglais nuttalli* Peale = *Pseudohasis nuttalli* Strecker (present designation).

Pseudohasis GROTE AND ROBINSON, 1866, Ann. Lyc. Nat. Hist. New York, vol. 8, p. 377. Type: *Saturnia eleganterina* Boisduval, by original designation.

¹ This name has already been published by Kirby (1869, Papilio, vol. 4, pp. 103-104). Hence there seems to be no reason for not repeating it here, even though this plate of Peale's work may never have been published.

Hera HARRIS, 1869, in Scudder, Entomological correspondence of Thaddeus William Harris, M.D., p. 149. Type: *Hera chrysocarena* Harris (= *Saturnia hera* Harris) (monobasic).

This subgenus, usually considered a distinct genus, includes but two species, *Hemileuca* (*Pseudohasis*) *eglanterina* (Boisduval) and *hera* (Harris) of western North America.

GENUS TRAVASSOSULA MICHENER

Figures 64, 240-242

Travassosula MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 145. Type: *Adelocephala subfumata* Schaus, by original designation.

This genus, based upon a species that has usually been placed in the Citheroniinae, is a very distinctive one, although not at all related to the Citheroniinae. The notch before the apex of vein Sc+R₁ of the hind wing is unique in the family. The genitalia are somewhat suggestive of those of *Hemileuca*, but this is probably owing to parallel reduction and fusion of parts rather than to close relationship. *Travassosula*, unlike *Hemileuca*, has vein 3V of the hind wings reduced and has well-developed arolia and pulvilli.

Frons flat at sides next to the eyes; latero-frontal sutures rather widely separated from eyes; frontal protuberance low, transverse. Shortest distance between eyes slightly less than one-half of length of an eye, upper ends of eyes extending well above lower margins of antennal sockets, lower ends of eyes extending well below lower end of face.

Antennae about three-quarters as long as thorax; flagellum of male not scaled, pectinate virtually to apex; pectination tapering, broadest near base, rami nearly straight, apical rami on inner side about three-fourths as long as basal rami except distally where apical rami become progressively shorter, apical rami of outer side mere stubs, where longest only one-third as long as accompanying basal rami, apical rami on both inner and outer sides of antennae reduced distally, so that antennae are merely bipectinate in their distal thirds; rami without bristles; antennal shaft not strongly compressed, not carinate ventrally, antennal cones small, limited to distal third of flagellum. Antennae of female simple, basal two-thirds of flagellum with numerous elongate scales on upper surface; flagellum bidentate, each tooth bearing a few bristles;

antennal cones slightly more elongated than those of male, limited to apical fourth of antenna; shaft not carinate ventrally.

Tentorial pits rather small, not greatly elongated; clypeus five or six times as wide as long, separated from frons only by weak line; pilifers not recognizable as distinct convexities. Proboscis less than twice as long as broad, rather shallow, walls nearly vertical; maxillary stipites connected with lower portions of walls of fossa, extending backward to a line tangent with anterior margins of palpal sockets; labial palpi arising behind middle of fossa, three-segmented, extending forward well in front of frontal protuberance, first and second segments robust, first but little curved, third segment less than twice as long as broad. Postoccipital bridge broad and sclerotic.

Thorax covered with long, hair-like scales, those of sides and venter curved and curled, mixed with broad and flat scales; patagia and parapatagia both moderately broad, the latter slightly narrower than the former; prescutum slightly convex above; tegulae reaching back almost as far as anterior angle of scutellum; anepisternum rather large, but anepisternal suture nearly straight and directed slightly upward posteriorly towards a point slightly below middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture continued in almost the same direction as the straight lower portion of pleural suture, a conspicuous curved region intervening between these portions.

Fore tibiae about as long as tarsi; epiphysis of male reaching nearly to apex of tibia, with some long hairs, that of female apparently completely absent; tibial spines absent; tibial spurs exceeding vestiture of tibiae, posterior tibiae with a single subapical spur as well as apical pair; apical two-thirds of spurs broadly concave on one side, the margins serrate; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment large and extending to apex of segment but sole scaled; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex; hind wings rather elongated, particularly in male, but without conspicuous angles, anterior

margin of hind wing in female with large circular notch before apex of $Sc+R_1$, male with small notch in same position; vestiture consisting of elongate, almost hair-like scales overlying and not completely hiding broad scales; vein M_2 of forewing arising from middle of apex of discal cell, M_1 and R_s from anterior apical angle of cell, R_1 before apex of cell, R_2 absent; hind wing with $3V$ weak but sometimes more than half length of $2V$, R_s arising before apex of cell, $Sc+R_1$ curved towards R_s subapically, especially in female.

Abdomen tapering apically, especially in male, covered with hair-like scales, overlapping and hiding a light covering of very broad scales. Ninth tergum of male distinctly shorter than uncus, the latter curved downward to a single blunt point; gnathos not much produced medially, though with a heavily sclerotized bilobed median portion connected laterally both to base of uncus and to base of upper portion of harpe; anellus absent as a free structure, though a pair of lobes attached to bases of lower margins of harpes may represent anellus; harpes rather small and fused, especially below, to ninth sternum.

Eighth tergum of female with sclerotic portion bilobed, the lobes not projecting nor heavily sclerotized; eighth sternum with a broad, prevulvar, sclerotic band, postvulvar sclerotization limited to a small, bilobed projection; ductus bursae broad, not or scarcely sclerotic.

So far as known this genus contains but one species, *Travassosula subfumata* (Schaus), from southern Brazil.

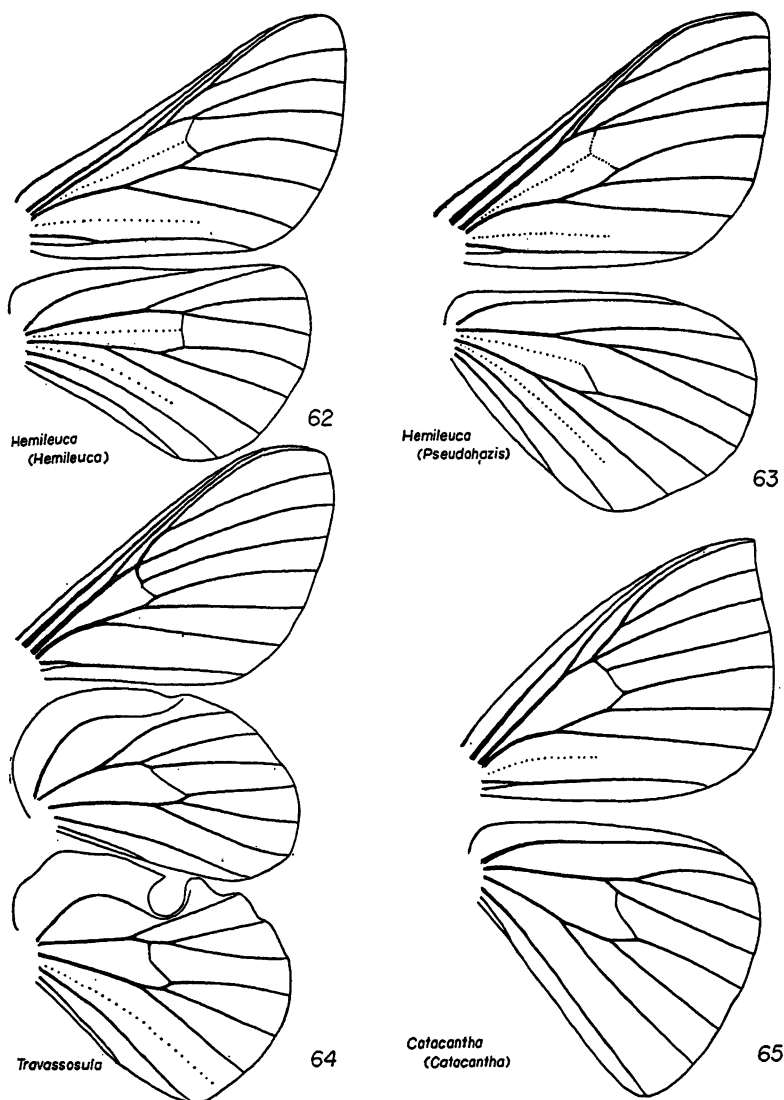
This genus was named for Dr. Lauro Travassos, who, with May (Travassos and May, 1943) first pointed out that *T. subfumata* was not properly placed in the Citheroniinae.

GENUS CINOMMATA BUTLER

Cinommata BUTLER, 1882, Trans. Ent. Soc. London, p. 16. Type: *Cinommata bistrigata* Butler (monobasic).

Cinommata DRAUDT, 1929, in Seitz, Macrolepidoptera of the world, vol. 6, p. 748 (error for *Cinommata*).

Since this genus is known to me only in the female, its relationships with other genera cannot be clearly determined. However, it is



FIGS. 62-65. Wings of Hemileucinae. 62. *Hemileuca (Hemileuca) maia* (Drury). 63. *Hemileuca (Pseudohazis) eglanterina* (Boisduval). 64. *Travassosula subfumata* (Schaus). 65. *Catacantha (Catacantha) plagia ferruginea* (Draut).

obviously a distinct genus, being one of the few genera of hemileucines with tarsal spines. Characters of males in the following description were obtained from the literature:

Frontal protuberance present, its apex broadly rounded. Shortest distance between eyes about one-half of the length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes reaching lower end of face.

Antennae about one and one-half times as long as thorax, flagellum of female with a few scales on dorsal side basally; flagellum of female strongly bidentate, each tooth bearing a strong terminal bristle; shaft with a ventral ridge or weak carina in distal three-fourths, each segment with a pair of ventral bristles; antennal cones small, rounded at apices, some of them bearing a bristle, cones largest subapically but recognizable in the entire distal

three-fourths of antenna.

Tentorial pits oval, lateral to and slightly below frontal protuberance; clypeus about four times as broad as long, separated from frons by a distinct groove, without pilifers. Mandibular rudiments rather large and protuberant; maxillary stipites extending backward to posterior margins of palpal sockets. Proboscoidal fossa very shallow, walls sloping, fossa scarcely longer than broad; labial sclerite feebly sclerotic; labial palpi arising at middle of fossa, three-segmented, extending forward to a point well in front of face, third segment at least three times as long as broad. Postoccipital bridge rather broad and sclerotic.

Thorax covered with long hairs; patagia and parapatagia subequal in width; tegulae not reaching anterior median angle of scutellum; anepisternum of moderate size, anepisternal suture horizontal posteriorly, sloping downward anteriorly, directed towards a point far below middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in same direction as straight lower portion of this suture, no curved region intervening between the two main portions.

Fore tibiae subequal to tarsi; epiphysis of female absent; tibial spines absent; tibial spurs much exceeding vestiture, more than twice as long as diameter of tibia, apical fourth or fifth of each spur concave on one side, the margins finely serrated; posterior tibiae with a single subapical spur in addition to apical pair; tarsal segments one to four with several apical spines each, spines on apical lobes of penultimate fore tarsal segment of female not larger than spines of other tarsal segments, spine-bearing lobes of this segment partially bare, adjacent bare areas of following segment rather large and contiguous with bare sole of segment; claws feebly serrated; arolium and pulvilli well developed.

Forewings with outer margins convex; hind wings with anal angles distinct but not produced; vestiture consisting of broad scales, overlain but not hidden by elongated scales or hairs.

Abdomen covered with scales, among which are interspersed short, appressed, hair-like scales which do not completely hide the broad scales beneath them.

This genus contains only a single species, which occurs in Chile.

GENUS *ADETOMERIS* MICHENER

Figures 248-250

Io BLANCHARD (not Lea), 1852, in Gay, *Historia de Chile, Zoologia*, vol. 7, p. 58.

Adetomeris MICHENER, 1949, *Jour. Kansas Ent. Soc.*, vol. 22, p. 145.¹ Type: *Io erythroptus* Blanchard, by original designation.

This is the most distinctive of the *Automeris*-like genera, having the iris of the eye spot of each hind wing orange or red as in *Gamelia*, *Hyperchiria*, and *Automerina*, but differing from these genera, as well as from *Automeris*, by having freely articulated harpes, a free anellus, and tarsal spines. These characters, together with the long antennae, are presumably primitive, and *Adetomeris* is undoubtedly the most primitive of the *Automeris*-like genera.

Frontal projection rather low, apex broadly rounded. Shortest distance between eyes less than half length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae one and one-third to one and one-half times as long as thorax, flagellum of male not scaled, that of female with scales on dorsal surface to a point well beyond middle; flagellum of male broadly quadripectinate to extreme apex, rami long, slender, but little curved, longest apical rami of outer side about three-quarters as long as basal rami, those of inner side nearly as long as basal rami; basal rami with rather short terminal and subterminal ventral bristles, these bristles not so long as setae; antennal shaft somewhat compressed and weakly carinate beneath, each segment with a median ventral pair of bristles; antennal cones small, conspicuous only in apical sixth or less of antenna, but represented by inconspicuous api-

¹ *Adetomeris* was proposed as a new genus, not a new name for *Io* Blanchard. *Io* was apparently first used for saturniid moths by Boisduval in manuscript. The name was later used in print for different groups similar to *Automeris* by various authors, including Herrich-Schäffer (who sometimes wrote *Jo*, see the synonymy of *Hyperchiria*) and Blanchard. In order to avoid any possible confusion, it seemed best to propose *Adetomeris* independently from *Io* Blanchard, although they are isogenotypic.

cal projections on segments nearly to base.

Tentorial pits rather small and oval, lateral to and slightly beneath frontal protuberance; clypeus separated from frons by an inconspicuous line, clypeus seven or more times as broad as long; pilifers scarcely recognizable. Proboscoidal fossa longer than broad, very shallow, walls subvertical; maxillary stipites free from wall of fossa, extending backward to anterior margins of palpal sockets; labial palpi arising near posterior end of fossa, three-segmented, extending forward to a point well in front of face. Postoccipital bridge narrow.

Thorax covered with long recumbent or suberect hair; patagia broad; parapatagia narrower, sometimes lamelliform; tegulae not reaching so far back as anterior median angle of scutellum; anepisternum rather large, anepisternal suture subhorizontal except at its posterior extremity where it is bent downward to meet lower end of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in same direction as straight lower portion, an inconspicuous curved region intervening between these two main portions.

Fore tibiae subequal to tarsi; epiphysis of male long, with long hairs; tibial spines absent; posterior tibiae each with a pair of subapical spurs; tibial spurs much exceeding vestiture, longer than tibial diameter, apical half of each spur concave on one side, with the margins finely serrate; tarsal segments one to three and often four with several pairs of apical and subapical spines; tarsal claws finely serrate; arolia and pulvilli well developed.

Forewings with outer margins slightly convex; hind wings with anal angles distinct but not produced, hind wings with an eye spot, the iris of which is red; postmedian line of hind wing bent around anterior end of eye spot; forewings with broad scales overlain by short slender scales, hind wings with similar broad scales largely overlain by hairs; wing venation similar to that of *Automeris*.

Abdomen densely covered with broad scales which are overlain but not hidden by recumbent hairs which do not form colored bands; uncus of male large and downcurved at apex; gnathos produced medially; anellus distinct and free from harpes and from ninth

sternum, harpes free from ninth segment, without an internal spine, with a long dorsal lobe separated by a very deep emargination from the remaining portions of harpe.

Eighth tergum of female with a transverse sclerotic band; eighth sternum with a broad sclerotic band in the middle, which is the transverse, slit-shaped vulva, postvulvar portion of this band elevated and slightly produced medially; ductus bursae membranous.

Adetomeris includes the species of Bouvier's (1936a) "groupe chilien" of *Automeris*. Species available to me are *Adetomeris erythraea* (Philippi), *erythroops* (Blanchard), *griseo-flava* (Philippi), and *microphthalma* (Izquierdo), all from Chile.

GENUS CATACANTHA BOUVIER

This genus, which has commonly but incorrectly gone under the name *Ancistrota* Hübner (see d'Almeida, 1943a), contains small, dull-colored moths structurally similar to the *Hylesia-Automeris* group of genera. Indeed the genitalia are quite similar to those of some species of *Automeris* except that the harpes are freely articulated to the ninth segment of the abdomen and the ends of the gnathos are each connected to a small inner lobe of the harpe. In the latter respect this genus resembles *Hylesia*.

Frontal protuberance distinct and rather strong, narrowly rounded at apex. Shortest distance between eyes slightly less than one-third of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending down about as far as lower end of face.

Antennae longer than thorax, flagellum of male not scaled, that of female with a band of scales on dorsal surface extending nearly to apex, flagellum of male bipectinate or quadripectinate to apex, rami slender, slightly curved downward, apical rami of inner side (when present) one-half to two-thirds of length of basal rami, apical rami of outer side (when present) one-third of length of basal rami or reduced to mere stubs; basal rami each with one long terminal bristle and usually one or several slightly shorter subterminal bristles; antennal shaft somewhat compressed, with a ventral ridge or weak carina, each segment bearing one to several rather strong apical or subapical bristles on under

side; antennal cones small or moderate sized, limited to apical third or fourth of antenna or sometimes represented by projections as far as middle of antenna. Antennae of female bidentate, each tooth terminating in a very long bristle and often one or more shorter bristles; antennal shaft slightly flattened dorsoventrally, many of the segments with an inconspicuous apical bristle on under surface, antennal cones similar to those of the male, limited to the apical eight or 10 segments.

Tentorial pits small and oval; clypeus continuous with under surface of frontal protuberance, so that its shape cannot be accurately determined; pilifers rather distinct; mandibular rudiments small, not protuberant. Proboscis longer than broad, the walls vertical; maxillary stipites free from walls of fossa, extending backward to or behind anterior margins of palpal sockets; labial palpi arising well behind middle of fossa, extending forward to a point in front of frontal protuberance, three-segmented, third segment cylindrical and longer than broad.

Thorax covered with suberect hairs which completely conceal scattered broad scales on surface of thorax; patagia rather narrow but broader than parapatagia which are lamelliform; tegulae not reaching back so far as anterior median angle of scutellum; anepisternum small, anepisternal suture directed slightly upward posteriorly, towards a point near middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture continued in same direction as straight lower portion of this suture, no curved region intervening between these two portions.

Fore tibiae about as long as tarsi; epiphysis of male reaching to or beyond apical third of

tibia, with long hairs, that of female absent or of moderate size, with long hairs; tibial spines absent; tibial spurs exceeding vestiture of tibiae; posterior tibiae each with a single subapical spur in addition to apical pair, longer tibial spurs much longer than the diameter of tibia, apical two-thirds, three-fourths, or even more broadly concave on one side, with margins minutely serrated; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment rather small and not extending to apex of segment, sole scaled; claws minutely serrated; arolium and pulvilli well developed.

Forewings with outer margins straight or convex; hind wings with anal angles distinct but rounded, rarely slightly produced; vestiture consisting of scales overlain but not hidden by a covering of hair-like scales or short hairs; forewings with vein M_2 arising in front of middle of apex of cell, M_1 arising with radial stem at anterior apical angle of cell, R_2 absent; hind wings with 3V much reduced, R_4 stalked with M_1 .

Abdomen rather small, its vestiture consisting of recumbent, hair-like scales which hide a covering of broad scales; uncus of male narrowed apically and downcurved, apex simple or slightly bilobed; gnathos medially produced and sometimes bidentate, usually rounded, laterally connected to short, arm-like lobes which are connected to upper basal angles of harpes; anellus absent; harpes not fused to ninth sternum, each bearing an inner spine.

Eighth tergum of female with a distinct, transverse, sclerotic band; eighth sternum with a narrow, transverse, sclerotic band in front of vulva, separated by a membranous area from a bilobed projection which is

TABLE 12

SUBGENERA OF *Catacantha*

<i>Catacantha</i> , <i>Sensu Stricto</i>	<i>Perigopsis</i>
Antennae of male quadripectinate, although distal rami of outer side may be reduced to stubs	Antennae of male bipectinate
Epiphysis of female absent	Epiphysis of female present
Upper surface of forewing with a pair of dots at apex of cell	Upper surface of forewing with a pupillated spot at apex of cell

sclerotic and is immediately in front of vulva; postvulvar sclerotization large but very weak; ductus bursae membranous and about as long as broad; bursa not constricted basally, long and rather cylindrical; ductus seminalis arising from the right-hand side of base of bursa.

The genus *Catacantha* is divisible into two subgenera, the nominate one and *Perigopsis*. These subgenera are clearly closely related, the chief differences being shown in table 12. Bouvier, however, placed the two groups in different subfamilies.

SUBGENUS CATACANTHA BOUVIER

Figure 65

Catacantha BOUVIER, 1930, Bull. Hill Mus., vol. 4, p. 47. Type: *Catacantha latifasciata* Bouvier, by original designation.

This subgenus contains three species which range from the Guianas to Bolivia.

SUBGENUS PERIGOPSIS BOUVIER

Figures 243-245

Perigopsis BOUVIER, 1932, Ann. Sci. Nat., Zool., ser. 10, vol. 15, p. 380. Type: *Periga oculata* Schaus, by original designation.

This subgenus contains one or two Brazilian species.

GENUS PARANCISTROTA BOUVIER

Parancistrota BOUVIER, 1933, Compt. Rendus Acad. Sci., Paris, vol. 196, p. 1944. Type: *Parancistrota geayi* Bouvier (monobasic).

This genus, based on a single specimen from northern Brazil, has not been available to me, but from Bouvier's figures it appears to be a distinct genus. In appearance it resembles *Catacantha*. The male antennae are bipectinate. The labial palpi are apparently three-segmented and reach well in front of the face. The male genitalia are distinctive, for the gnathos (sternite X of Bouvier) bears a pair of very long sharp processes. The harpes are large, and each bears a large inner spine. The uncus is narrow and downcurved.

GENUS AUTOMERIS HÜBNER

This is a very large genus of beautiful moths, almost all of which have a large eye spot in each posterior wing. Unlike the members of the genera *Adetomeris*, *Automerina*,

Hyperchiria, and *Gamelia*, which also have such eye spots, the irides of the eyes in *Automeris* are not light red or orange, only rarely dull red. Usually they are brown, gray, black, bluish, or pink. The central mark of each eye spot, in *Automeris*, is a streak or more complex pattern, only rarely (*hamata* Schaus) a more or less round spot, sometimes absent. In the other genera mentioned, there is usually a round central white area in the eye spot, occasionally centered with a black dot.

Structurally *Automeris* is variable but constitutes a monophyletic unit which is easily recognized among hemileucine genera. The male genitalia are quite distinct from those of any of the closely related genera. The thick, well-developed uncus and gnathos distinguish it from *Automerina*, *Hyperchiria*, and *Gamelia*, while the fusion of the harpes to the ninth tergum, as well as the absence of tarsal spines and of one of the subapical spurs of the hind tibia, separates it from *Adetomeris*.

Frontal projection distinct, usually strong, sometimes pointed or narrowly rounded at apex. Shortest distance between eyes less than one-half of length of an eye (or in male *A. janeira* Westwood almost two-thirds of length of an eye); upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face if frontal protuberance is ignored.

Antennae slightly longer than thorax to one and one-half times as long as thorax; antennal shaft of male without scales, that of female often with scales on dorsal surface, sometimes extending to apex; antenna of male quadripectinate to apex or nearly so (in some species, for example *A. convergens* Walker, apical rami are absent on last half dozen antennal segments and basal rami on last two or three), rami straight or but little curved, apical rami subequal to basal or very much shorter than basal, especially on outer side, rami without bristles or basal rami with one or a few terminal bristles which are usually inconspicuous and little if any longer than the setae (basal rami of inner side much thickened in *A. stuarti* Rothschild); antennal shaft not or but little compressed, not or feebly carinate beneath, without bristles or with as many as five or six bristles on under surface of each segment; antennal cones small, usually confined to apical half or less

of antenna, rarely [in *A. montezuma* (Boisduval)] which has an unusually strongly carinate antennal shaft] cones feebly indicated to the antennal base. Antenna of female bidentate, each tooth bearing one or a few apical bristles; under surface of antenna not carinate, sometimes with a few bristles on each segment; antennal cones similar to those of male, usually confined to apical fourth or less of antenna.

Tentorial pits round or oval, lateral to and usually slightly below frontal protuberance; clypeus separated from frons only by a weak line, clypeus usually about five times as broad as long; pilifers feebly indicated by weak convexities. Proboscoidal fossa distinct, walls subvertical; maxillary stipites rather small, extending backward only to anterior margins of palpal sockets and separated from walls of fossa; labial palpi arising well behind middle of fossa, three-segmented and extending in front of frons, rarely, for example in *janeira* Westwood, second and third segments almost or completely fused and palpi barely reaching front of head, more rarely, as in *irene* (Cramer), palpi unusually large, almost as in *Gamelia*. Postoccipital bridge rather broad and only weakly sclerotic.

Thorax covered with suberect hairs, among which are mixed in many species longer, hair-like scales which are occasionally (as in *flexuosa* Felder) broadened and lanceolate; patagia rather narrow but much broader than the lamelliform parapatagia; tegulae not reaching anterior median angle of scutellum; anepisternum usually rather large, anepisternal suture usually directed downward posteriorly towards a point near lower end of deeply impressed portion of pleural suture but sometimes (*surinamensis* Kirby and *modesta* Ménétries) directed towards middle of this portion of pleural suture or (*janeira* Westwood and *submacula* Walker) directed towards a point above middle so that anepisternum is small; deeply impressed portion of pleural suture directed in same direction as straight lower portion, usually only an inconspicuous curved region intervening between the two, but a distinct curved region present in *janeira* Westwood.

Fore tibiae subequal to tarsi; epiphysis of male large, usually reaching to apical third of tibia and bearing long hairs, epiphysis of fe-

male smaller, slender, and bare; tibial spines absent; spurs not hidden in vestiture, somewhat longer than diameter of tibia, their apical two-thirds or three-fourths broadly concave on one side, margins finely serrated; posterior tibiae with a single subapical spur in addition to apical pair [except in *janeira* Westwood, *nyctimene* (Latreille), and others which lack subapical spurs]; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female; spine-bearing lobes on this segment bare, adjacent bare areas of following segment of moderate size, sometimes extending to apex of segment, sole scaled; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex to concave, hind wings with anal angles distinct but not produced; vestiture consisting of scales overlain on much of the hind wing by hairs, and often overlain on forewing as well by hair-like scales or elongated scales; vein 3V of hind wing usually absent (as in fig. 66) but sometimes (*hamata* Schaus and *convergens* Walker) present although short as in *Gamelia*.

Abdomen covered with recumbent or suberect hairs which often form colored bands and often cover scattered broad scales; ninth tergum of male subequal to uncus which is distinct and usually curved downward at apex, sometimes bilobed or bidentate; gnathos distinct and strongly produced posteriorly in the middle; anellus present but fused to ninth sternum and to bases of harpes so that its margins are usually unrecognizable, not produced posteriorly or produced as a single median projection as shown in the figure of *grammivora* Jones; harpes rather large, lower portions fused to ninth segment; harpes frequently with an internal spine which, unless it is very short or very large and long, usually passes through a curled projection from the margin of harpe.

Eighth tergum of female with a transverse sclerotic band; eighth sternum highly variable, with either a prevulvar or a postvulvar sclerotic band, the latter if present sometimes medially produced; ductus bursae membranous or more often partially sclerotic; bursa elongate and membranous; ductus seminalis arising from right-hand side of base of bursa.

The genus *Automeris* is highly variable and contains a wide diversity of types, as shown

TABLE 13

SUBGENERA OF *Automeris*

<i>Agliopsis</i>	<i>Automeroides</i>	<i>Automeris, Sensu Stricto</i>	<i>Automerella</i>
Distance between eyes over two-thirds length of an eye	Distance between eyes less than two-thirds to over three-fourths length of an eye	Distance between eyes usually less than one-half, rarely nearly two-thirds, length of an eye	Distance between eyes less than one-half length of an eye
Frontal protuberance a mere ridge	Frontal protuberance a mere ridge	Frontal protuberance distinct	Frontal protuberance distinct
Proboscoidal fossa broader than long, shallow but with sub-vertical walls	Proboscoidal fossa longer than broad, so shallow as virtually to lack walls	Proboscoidal fossa usually longer than broad, with vertical walls	Proboscoidal fossa longer than broad, with vertical walls
Basal rami of male antennae without bristles	Basal rami of male antennae without bristles or with apical bristles shorter than setae	Basal rami of male antennae with apical bristles absent or short, not or hardly exceeding setae	Basal rami of male antennae with apical bristles long, much exceeding setae, several subapical ventral bristles also present on each ramus
Ventral bristles of male antennae absent except apically	Ventral bristles of male antennae two per segment, sometimes absent except apically	Ventral bristles on male antennal shaft usually less than four per segment, sometimes absent	Ventral bristles on antennal shaft numerous (four on many segments) and strong
Male uncus short, thick, apex simple	Male uncus short, thick, apex with two widely separated lobes	Male uncus thick, apex simple or bilobed	Male uncus flattened, deeply bifid
Harpe very broad, basally overlapping side of ninth segment; inner spine long, arising near apex of harpe, base of spine directed anteriorly, apical part curved posteriorly	Harpe very broad, basally overlapping side of ninth segment; inner spine long, arising near apex of harpe, base of spine directed anteriorly, apical part curved posteriorly or sometimes harpes shaped more as in <i>Automeris, sensu stricto</i>	Harpe not unusually broad, inner spine, when present, not extraordinarily long, base often transverse or directed apically	Harpes of male not unusually broad, inner spine very long, its base directed anteriorly, each spine curving inward, apex directed posteriorly
Scutellum without long lanceolate scales	Scutellum without long lanceolate scales	Scutellum sometimes with very long, hair-like scales interspersed in vestiture, these only rarely expanded to form lanceolate scales	Scutellum with very long lanceolate scales interspersed in the vestiture
Anterior apical angles of hind wings rounded	Anterior apical angles of hind wings rounded	Anterior apical angles of hind wings usually rounded	Anterior apical angles of hind wings strong and slightly produced

by the series of genitalic drawings. However, the characters that vary are not well correlated with one another; moreover many of them merge through the series of species. Therefore, although a division of the genus into several groups or subgenera is desirable because of its large size (Bouvier's groups, except for those here segregated as genera, are largely artificial), it does not seem to be practicable at present. It is possible, however, to recognize three peculiar subgenera whose characters are shown in table 13. These are merely small groups of highly specialized species derived from the great bulk of *Automeris*. Nowhere else in this paper are subgenera of this sort recognized, as it is not considered that small subgenera based on a few specialized members of a genus ordinarily serve a useful purpose. In this instance, however, the segregates are so highly modified that recognition of some sort seems necessary. In many respects *Automeroides* is intermediate between *Automeris* proper and *Agliopsis*, while *Automerella* was derived from an unrelated section of *Automeris*.

SUBGENUS AUTOMERIS HÜBNER

Figures 66, 251-266

Automeris HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 154. Type: *Phalaena janus* Cramer, designated by Grote, 1874, Proc. Amer. Phil. Soc., vol. 14, p. 259.

Proiautomeris PACKARD, 1903, Jour. New York Ent. Soc., vol. 11, p. 245. Type: *Dirphia maeonia* Druce (monobasic).

This subgenus probably contains nearly 100 good species. While the bulk of them are tropical American, one ranges to Canada, and several range to Argentina. It has not seemed worth while to include a list of the species. All the species customarily included in *Automeris* are included in *Automeris* proper except those transferred to *Adetomeris*, *Automerina*, *Hyperchiria*, *Gamelia*, and the subgenera *Automerella*, *Automeroides*, and *Agliopsis*.

SUBGENUS AUTOMERELLA MICHENER

Figures 273-275

Automerella MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 145. Type: *Automeris flexuosa* Felder, by original designation.

The characters of this subgenus are indicated in table 13. The long antennal bristles and long spines of the harpes distinguish it from its closest relative, *Automeris* proper.

Included species are *Automeris* (*Automerella*) *flexuosa* Felder, *rubicunda* Schaus, and a possibly new species related to *rubicunda*. These species occur from Brazil to Argentina.

In several characters but not in genitalic structure *A.* (*Automeris*) *convergens* Walker and *cruentata* Walker constitute a link between *Automeris* proper and *Automerella*.

SUBGENUS AUTOMEROIDES MICHENER

Figures 267-269

Automeroides MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 145. Type: *Automeris orneates* Druce, by original designation.

The characters of this genus are indicated in table 13. Particularly distinctive features are the shallow proboscis fossa and reduced frontal protuberance, which separate this subgenus from its closest relative, *Automeris* proper. The wings are particularly broad for an *Automeris*.

This subgenus includes *Automeris* (*Automeroides*) *orneates* Druce and *tristis* Boisduval. The latter is closest to *Automeris* proper, having the last two palpal segments distinct and genitalia not greatly different from those of *A. banus* Boisduval. In appearance (the widely separated eyes and the reduced frontal protuberance), however, it is an *Automeroides*. The species of *Automeroides* occur from Central America to southern Brazil.

SUBGENUS AGLIOPSIS BOUVIER

Figures 270-272

Agliopsis BOUVIER, 1929, Compt. Rendus Acad. Sci., Paris, vol. 189, p. 606. Type: *Agliopsis intermedius* Bouvier = *Automeris obscura* Schaus = *Micrattacus violascens* Maassen and Weymer (monobasic).

The characters of this subgenus are indicated in table 13. The only species is *Automeris* (*Agliopsis*) *violascens* (Maassen and Weymer), which is probably an aberrant derivative of *Automeroides*. Because of its dull coloration and lack of eye spots, it has the appearance of a large *Hylesia*, but it is not

closely related to that genus. It occurs in southern Brazil.

Quite incorrectly, and not recognizing its close connection through *Automeroides* to *Automeris* proper, Bouvier (1936a) placed *A. violascens* in a separate genus near the Palearctic *Aglia*.

GENUS *EUBERGIODES* MICHENER

Figures 279-281

Eubergioides MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 145. Type: *Dirphia berthia* Schaus, by original designation.

The type and only species of this genus has markings superficially somewhat suggestive of the subgenus *Eubergia* of *Hylesia*. The male genitalia, however, are not like those of *Hylesia* but are similar to those of *Automeris*, to which *Eubergioides* must be closely related. The antennae of the female are more thickened than in *Automeris* and the eye spot of the hind wing is a mere black ring enclosing an area having the color of the ground of the wing.

Frontal protuberance distinct, apex rounded. Shortest distance between eyes slightly less than one-half of length of an eye, upper ends of eyes extending but little above lower margins of antennal sockets, lower ends of eyes extending slightly below lower end of face if frontal protuberance is ignored.

Antennae slightly longer than thorax, flagellum of male without scales, that of female with a few scales on dorsal surface nearly to apex; flagellum of male quadripectinate to apex, rami slender, slightly curved, apical rami of outer side about two-thirds as long as basal rami, those of inner side about three-fourths as long as basal rami, basal rami each with a terminal bristle and two or three ventral, subapical bristles, all these bristles inconspicuous and shorter than setae; antennal shaft scarcely compressed, not carinate beneath, each segment with a pair of inconspicuous bristles; antennal cones very small and inconspicuous, limited to apical sixth of antenna. Antennae of female strongly bidentate, each tooth ending in several bristles; shaft dorsoventrally flattened, broadest medially, each segment with an inconspicuous pair of ventral bristles, antennal cones similar to those of male.

Tentorial pits oval, lateral to frontal protuberance; clypeus separated from frons by an inconspicuous line or groove; clypeus about six times as broad as long; pilifers represented by distinct convexities. Mandibular rudiments very small but distinctly protuberant. Proboscis longer than broad, rather deep, with vertical walls; labial palpi three-segmented, arising behind middle of fossa, extending forward to a point well in front of the face.

Thorax covered with suberect hairs; patagia moderately broad; parapatagia lamelliform; tegulae not reaching back to anterior median angle of scutellum; anepisternum small, anepisternal suture directed upward posteriorly towards a point above middle of deeply impressed portion of pleural suture; deeply impressed portion of the pleural suture at an angle of about 170 degrees to straight lower portion of this suture, no conspicuous curved region intervening between these two main portions.

Fore tibiae slightly longer than tarsi; epiphysis of male elongate and flattened, reaching nearly to apex of tibia and furnished with abundant long hairs; epiphysis of female much smaller and slender, reaching but little beyond middle of tibia, provided with only a very few long hairs or hair-like scales; tibial spines absent; tibial spurs exceeding vestiture of tibiae, about as long as, or slightly longer than, diameter of tibiae, apical two-thirds concave on one side, margins finely serrated; posterior tibiae with a single subapical spur in addition to apical pair; tarsi without spines except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment rather small, sole scaled; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex; hind wings with anal angles rounded, not produced; vestiture consisting of broad scales, overlain on much of the hind wings by hairs; wing venation similar to that of *Automeris*.

Abdomen rather robust, its vestiture consisting of short, recumbent hairs which overlie scales, no abdominal color bands; eighth sternum of male simple, its apex not bilobed; uncus longer than ninth tergum, down-

curved and simple at apex; gnathos much produced medially and strongly bilobed, laterally neither produced to form an arm-like lobe nor connected to a lobe of harpe; anellus present but fused laterally to bases of harpes and posterolaterally to ninth sternum; harpes rather elongated, rounded apically, their lower basal portions fused to ninth segment, inner surface of each bearing a small spine.

Eighth tergum of female with a broad sclerotic band; eighth sternum with a sclerotic band which is broad and slightly produced posteriorly at sides but narrowed medially to form a postvulvar band, no sclerotization behind vulva; ductus bursae entirely membranous; bursa very small, elongated, and subcylindrical, narrowed posteriorly; ductus seminalis arising from right-hand side of base of bursa.

So far as known this genus contains only *Eubergioides berthae* (Schaus). This species occurs in southern Brazil.

GENUS *GAMELIA* HÜBNER

Figures 67, 276-278

Gamelia HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 155. Type: *Phalaena abasia* Stoll, by designation of Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 781.

This is a rather small genus of *Automeris*-like moths, differing from others by the unusually large labial palpi and the long terminal bristles of the basal rami of the male antennae.

Laterofrontal sutures visible; frontal protuberance distinct though not very long, its apex broadly rounded. Shortest distance between eyes between one-third and one-fourth of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending far below lower end of face.

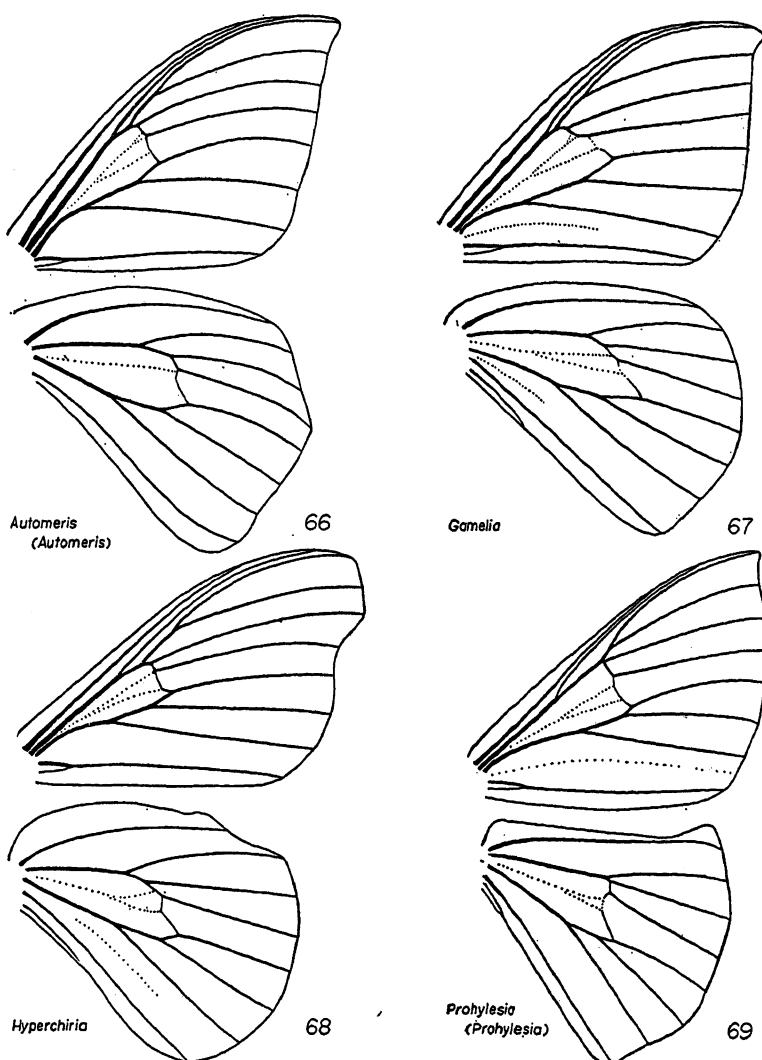
Antennae slightly longer than thorax to about one and one-third times as long as thorax, antennal shaft of male without scales, that of female with elongate scales on dorsal side to apex; antenna of male quadripectinate to apex or nearly so, rami slender and but little curved, apical rami of outer side one-half as long as basal rami or reduced to mere stubs, apical rami of inner side one-half to

two-thirds as long as basal rami, basal rami each bearing a long curved terminal bristle, much longer than setae, and sometimes also a subterminal ventral bristle; antennal shaft but little compressed, carinate or not ventrally, each segment with two to four ventral bristles, antennal cones moderate sized to small, limited to apical third or less of antenna. Antennae of female bidentate, each tooth bearing a long bristle and often one or more shorter bristles; bristles of shaft and cones similar to those of male.

Tentorial pits oval, lateral to and slightly below frontal protuberance; clypeus separated from frons by only a weak line, clypeus six or more times as broad as long; pilifers not or scarcely recognizable; mandibular rudiments rather small and not protuberant. Proboscis distinct, longer than broad, deep, walls subvertical; maxillary stipites small, extending back nearly to anterior margins of palpal sockets and free from walls of fossa; labial palpi arising slightly behind middle of fossa, very large, three-segmented, extending forward and upward to a point far in front of face, third segment very small, often fused with second so that line of division between the two is visible only on one side. Postoccipital bridge broad and rather weakly sclerotic.

Thorax covered with dense, suberect hairs or hair-like scales; patagia rather narrow but much broader than the lamelliform parapatagia; tegulae not reaching as far back as anterior median angle of scutellum; anepisternum usually rather small, anepisternal suture usually directed upward posteriorly towards a point slightly below middle of deeply impressed portion of pleural suture, rarely directed downward towards lower end of this portion of suture; deeply impressed portion of pleural suture directed in approximately the same direction as straight lower portion of this suture, a slight curved region intervening between these two portions.

Fore tibiae somewhat longer than tarsi; epiphysis of male large, reaching to apical fourth of tibia, bearing numerous long, hair-like scales, that of female slender, reaching to apical third of tibia, without long hairs or scales; tibial spines absent; tibial spurs not hidden in vestiture, slightly longer than diameter of tibia, apical three-fourths of each



FIGS. 66-69. Wings of Hemileucinae. 66. *Automeris (Automeris) janus* (Cramer). 67. *Gamelia abas* (Cramer). 68. *Hyperchiria nausica* (Cramer). 69. *Prohylesia (Prohylesia) friburgensis* (Schaus).

spur concave on one side, the margins finely serrated; posterior tibiae with a single sub-apical spur in addition to apical pair; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes of this segment bare, adjacent bare areas of following segment rather large, sole scaled; claws finely serrate; arolium and pulvillae well developed.

Forewings with outer margins convex except close to apex where they are concave because of the slightly produced apex; hind

wings with anal angles conspicuous and slightly produced; vestiture consisting of scales, overlain on bases of hind wings by hairs, hind wings with an eye, the iris of which is red or orange, slightly pinkish in *pygmaea*.

Abdomen covered with recumbent or sub-recumbent hair-like scales which obscure a covering of broad scales. Eighth sternum of male bilobed, uncus and gnathos of male weakly sclerotic or submembranous, often so short and inconspicuous that they might be

considered absent; uncus not or not much curved downward, apex usually rounded or bilobed; anellus absent as a free structure, possibly represented by a pair of long, strongly sclerotized spines which arise from ninth sternum or rarely from median ventral portions of harpes; harpes more or less completely fused to ninth segment, bilobed, with a strong, often denticulate, inner spine.

Eighth tergum of female with sclerotic band; eighth sternum with a band which is interrupted by the nearly round vulva, or is feebly continuous behind vulva; ductus bursae largely membranous; ductus seminalis arising from right-hand side of base of bursa.

This genus includes a large part of Bouvier's group of *Automeris irmina*. Species available for study are *Gamelia abas* (Cramer), *abasia* (Stoll), *anableps* (Felder), *banghaasi* (Draudt), *catharina* (Draudt), *irmina* (Stoll), *musta* (Schaus), *pygmaea* (Schaus), *pyrrhomelas* (Walker), and *remissa* (Weymer). Species of this genus occur from Mexico to Brazil.

GENUS AUTOMERINA MICHENER

This small genus is probably most closely related to *Hyperchiria*, sharing with it the greatly reduced uncus and gnathos and the red or orange iris of the eye spots. It differs, however, by the small harpes which are rather weakly bilobed. When present, the inner spine is of the type that occurs in *Automeris*. The anellus lacks the pair of long spines that occurs in *Hyperchiria*.

Laterofrontal sutures visible though often very close to eye margins; frontal protuberance distinct, broadly rounded, apex produced forward as a thin lamella. Shortest distance between eyes slightly more than one-half of length of an eye to slightly more than one-fourth, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae about one-half of length of thorax to nearly as long as thorax, antennal shaft without scales; antennal flagellum of male quadripectinate basally, rami rather short, robust, straight, apical rami or outer side short and mere stubs though sometimes about a third as long as basal rami, apical rami of inner side two-thirds as long as basal

rami to nearly as long as basal rami, apical rami reduced to mere stubs slightly beyond middle of antennae so that if they are pectinate at all beyond that point they are bipectinate; distal one-fifth to two-fifths of flagellum simple; rami without bristles or basal rami with inconspicuous terminal bristles about as long as setae; antennal shaft not much compressed (distinctly compressed, especially apically, in *caudatula*), not carinate beneath or feebly ridged beneath in *caudatula*; without bristles or with two or three inconspicuous ventral bristles on each segment, each segment of distal half of antenna with a single dorsal subapical bristle in *caudatula*; antennal cones rather small, limited to the apical third of antenna. Antenna of female feebly bidentate to conspicuously bipectinate, with distal rami indicated by distinct stubs on inner side, teeth or basal rami terminating in one or more distinct bristles, under surface of shaft not carinate, with a pair of inconspicuous bristles on each segment, antennal cones similar to those of male.

Tentorial pits oval, lateral to and slightly below frontal protuberance; clypeus separated from the latter by a weak line; clypeus about six times as broad as long; pilifers indicated by weak or distinct convexities. Proboscis longer than broad, deep, walls subvertical; maxillary stipites extending back to anterior margins of palpal sockets; labial palpi three-segmented, third segment small, sometimes fused to second on one side so that the line of division between the two is invisible from that side; labial palpi sometimes small, extending forward only to apex of frontal protuberance and other times much larger and extending forward to a point well in front of face.

Thorax covered with dense, recumbent, hair-like scales which obscure a scattering of much shorter broad scales; patagia rather narrow but broader than parapatagia; tegulae not reaching to anterior median angle of scutellum; anepisternum rather large, anepisternal suture directed downward posteriorly towards lower end of deeply impressed portion of pleural suture or a point scarcely above lower end; deeply impressed portion of pleural suture directed in same direction as straight lower portion, a short curved re-

TABLE 14
SUBGENERA OF *Automerina*

<i>Automerina</i> , <i>Sensu Stricto</i>	<i>Automerula</i>
Shortest distance between eyes one-third to one-fourth length of eye; laterofrontal sutures very close to eye margins	Shortest distance between eyes slightly more than one-half length of an eye; laterofrontal sutures widely separated from eye margins
Lower ends of eyes far below lower end of face	Lower ends of eyes scarcely below lower end of face
Antennae about three-fourths as long as thorax, with apical one-fifth or slightly more simple	Antennae about one-half length of thorax, with apical two-fifths simple
Longest apical rami of inner side about two-thirds as long as basal rami, of outer side about one-fourth as long as basal rami	Longest apical rami of inner side nearly as long as basal rami, of outer side over one-third as long as basal rami
Labial palpi extending well in front of face, third segment free	Labial palpi scarcely reaching in front of frontal protuberance, second and third segments fused except on one side
Male genitalia without a free dorsal plate	Male genitalia with a small free dorsal plate which probably represents the uncus
Male harpes with or without internal spines	Male harpes each with an internal spine
Forewing apices but little produced; female with angle near apex of vein M_1 , hind wings of male without well-developed anterior apical angles, anterior and outer margins forming a single curve or nearly so	Forewing apices strongly produced; no angle near apex of vein M_1 , hind wings of male with anterior apical angle
Margins of vulva of female produced; ductus bursae very large and long, heavily sclerotic laterally; ductus seminalis arising from left-hand side of dorsal surface of base of bursa	Margins of vulva of female not produced; ductus bursae very short, membranous; ductus seminalis arising from a pouch on right-hand side of dorsal surface of base of bursa

gion intervening between these two main portions.

Fore tibiae subequal to tarsi; epiphysis of both sexes of moderate size, extending to apical third of tibia, without or with few long scales or hairs; tibial spines absent; tibial spurs not completely hidden in vestiture, longer than diameter of tibiae, apical two-thirds or three-fourths of each spur concave on one side, margins finely serrated; posterior tibiae with a single subapical spur; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment rather large, but not extending to apex of segment, sole thinly scaled; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins at least slightly concave subapically, straight or even slightly convex posteriorly; hind wings with apex of vein Cu_1 produced as a short tail in *caudatula*, anal angles conspicuous and slightly produced; vestiture consisting of

scales, overlain on basal portion of hind wing by elongated scales and hairs, hind wing with an eye spot, the iris of which is red, this eye spot usually oval in males; wing venation similar to that of *Automeris*.

Abdomen covered with recumbent hairs or hair-like scales which hide a thin covering of short broad scales. Uncus of male small and membranous except for a very small sclerotic area; gnathos absent or nearly so; anellus absent or represented by a weakly sclerotic area fused to aedeagus; harpes fused to ninth segment, with or without internal spines.

Eighth tergum of female with a transverse sclerotic band; eighth sternum with a sclerotic band which may be interrupted by the apparently nearly round vulva.

Automerina is divisible into two very different subgenera. There is some doubt concerning the relationship of these groups. Their similarities may result from convergence associated with reduction of the antennae and male genitalia. The characteristics of these subgenera are indicated in table 14.

SUBGENUS AUTOMERINA MICHENER

Figures 282-285

Automerina MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 146. Type: *Hyperchiria caudatula* Felder, by original designation.

The characters of this subgenus are shown in table 14. The general appearance is more *Hyperchiria*-like than that of the following subgenus. The longer antennae, longer labial palpi, and large eyes readily distinguish this subgenus from *Automerula*.

So far as known, this subgenus contains only *Automerina* (*Automerina*) *caudatula* (Felder) and *cypria* (Cramer). These species occur in the Guianas, Brazil, and eastern Peru.

SUBGENUS AUTOMERULA MICHENER

Figures 286-290

Automerula MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 146. Type: *Jo auletes* Herrich-Schäffer, by original designation.

The characters of this subgenus are shown in table 14. The extraordinarily short antennae, the short labial palpi, and smaller eyes distinguish the subgenus from *Automerina*.

This subgenus appears to contain only *Automerina* (*Automerula*) *auletes* (Herrich-Schäffer). This species ranges from Panama to Bolivia.

GENUS HYPERCHIRIA HÜBNER

Figures 68, 291-293

Hyperchiria HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 155. Type: *Phalaena nausica* Cramer, designated by Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, p. 782.

Jo Herrich-Schäffer, 1858, Sammlung ausser-europäischer Schmetterlinge, vol. 1, p. 10. Type: *Phalaena nausica* Cramer (present designation).¹

¹ *Jo* Herrich-Schäffer is undoubtedly an emendation of *Io* (Boisduval manuscript), a name previously used in a different sense by Blanchard (see *Adetomeris*). Herrich-Schäffer indicated that *Jo* was a synonym of *Hyperchiria*, and I have established this synonymy by the above type designation. No species of *Adetomeris* (*Io* Blanchard) was included by Herrich-Schäffer; hence it would be impossible for *Io* and *Jo* to be synonyms. It should be noted that Herrich-Schäffer, on the plates of the work cited above (1854, *Heterocera* plates, figs. 96, 97) uses *Io*, not *Jo*. Therefore, *Jo* does not date from these plates. This is fortunate, for *Jo* would otherwise have become the valid name for the group here called *Automerina*.

Like *Gamelia*, this is an *Automeris*-like genus having the iris of the eye spots orange or red. The species have a characteristic appearance because of the more or less parallel lines across the wings, which characterize most species, and the angle that is almost always present at the apex of vein M_1 of the forewing. The male genitalia are very characteristic, for each harpe is deeply trilobed, the lobes being long and slender, and at least the median one, which is probably homologous to the inner spine of other genera, being pointed.

Frontal protuberance distinct, broadly rounded, apical margin produced forward as a lamella. Shortest distance between eyes less than one-half of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae two-thirds to three-fourths as long as thorax, antennal shaft without scales or that of female with a few scales on dorsal side nearly to apex; antenna of male pectinate to apex, quadripectinate in basal two-thirds or thereabouts, apical rami reduced in remaining third to mere stubs or completely absent; rami rather robust and but little curved, apical rami of outer side mere stubs, rarely as much as one-third of the length of basal rami, apical rami of inner side about three-fifths of the length of basal rami; basal rami with inconspicuous terminal and sometimes subterminal ventral bristles which are shorter than setae; antennal shaft somewhat compressed, especially apically, often feebly carinate beneath, each segment with a pair of inconspicuous median bristles; antennal cones moderate sized to rather small, present in apical third of antenna; antennal flagellum of female bidentate, each tooth with one or more terminal bristles, under surface of shaft not carinate, each segment with a pair of ventral bristles, antennal cones moderate sized to small, limited to apical two-fifths to one-fifth of antenna.

Tentorial pits oval, lateral to and slightly below frontal protuberance; clypeus five or six times as broad as long, separated from frons by a very inconspicuous line; pilifers mere convexities. Mandibular rudiments small and not strongly protuberant. Proboscial fossa distinct, walls vertical, fossa longer than broad; maxillary stipites small,

extending backward as far as anterior margins of palpal sockets; labial palpi arising slightly behind middle of fossa, three-segmented, reaching forward to a point well in front of face, third segment minute. Post-occipital bridge broad, only weakly sclerotic.

Thorax covered with recumbent, hair-like scales which obscure a thin coating of short, broad scales; patagia distinctly broader than lamelliform parapatagia; tegulae not reaching to anterior median angle of scutellum; anepisternum rather large, anepisternal suture directed slightly downward posteriorly towards a point near lower end of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in same direction as straight lower portion of this suture, a curved region intervening between these two main portions.

Fore tibiae subequal to tarsi; epiphysis of male large and robust, reaching to apical fourth of tibia, bearing but few elongated scales; epiphysis of female smaller and slender, reaching to apical third of tibia, without long hairs or scales; tibial spines absent; tibial spurs not completely hidden in vestiture, somewhat longer than diameter of tibiae, their apical three-fourths concave on one side, margins finely serrated; posterior tibiae each with a single subapical spur in addition to apical pair or with a subapical pair of spurs, one of them frequently reduced to a mere nodule; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment very large, often extending as broad bands to apex of segment, sole sometimes fully scaled, sometimes very thinly scaled or virtually bare; claws finely serrated; arolium and pulvilli well developed.

Forewings with outer margins usually angulate at apex of vein M_1 , behind this, outer margin concave, sometimes crenulate; hind wings with anterior apical angles distinct, anal angle rounded, not produced; eye spot of hind wing with iris red or orange; vestiture consisting of broad scales, overlain by elongated scales and at bases of hind wings by hair.

Abdomen covered with recumbent, hair-like scales, overlying broad scales and forming abdominal color bands in most species.

Eighth sternum of male deeply bilobed or with a row of apical spines. Uncus of male short and truncated in most species, rarely recognizable as a distinct structure; gnathos absent or nearly so; anellus fused laterally to bases of harpes, apically produced to a pair of long processes; harpes broadly fused to ninth segment, very deeply trilobed, the lobes elongated, at least median one acutely pointed and spine-like, one or more lobes usually denticulate.

Eighth tergum of female with a broad, sclerotic band, more or less interrupted mid-dorsally; eighth sternum very large and almost entirely sclerotic, containing near its anterior end the longitudinally slit-shaped vulva and near its posterior end three lobes; ductus bursae short, scarcely recognizable, membranous; bursa small and membranous; ductus seminalis arising from ventral side of base of bursa.

This genus includes a part of Bouvier's (1936a) group of *Automeris* "*cypria-nausica*." Species available for study are *Hyperchiria acuta* (Conte), *aniris* Jordan, *incisa* Walker, *nausica* (Cramer), *orodina* (Schaus), and *plicata* Herrich-Schäffer. Species of this genus occur from Mexico to Paraguay.

GENUS HYLESIA HÜBNER

This is a genus of small moths, most of which are inconspicuously marked although many have small eye spots on the hind wings. In such cases, the lines distad of the eye spot are not strongly curved except in *H. gamelioides* Michener which is marked like a *Gamelia*. Members of the subgenus *Eubergia* have a striking pattern of silvery white markings.

The genitalic structure of members of this genus is very characteristic. The large uncus is directed downward through its entire length. The harpes are directed upward posteriorly, so that the inner spine is largely above the level of the uncus. Medially the gnathos is very low, immediately above the aedeagus, but laterally it extends far upward to connect to a small inner upper lobe on each harpe.

If, as seems probable, *Hylesia* arose from *Gamelia*-like ancestors, *H. gamelioides* Michener is the most primitive (most *Gamelia*-like) *Hylesia*.

Hylesia is structurally similar to *Auto-*

meris, from which it differs in the genital characters mentioned above. *Hylesia* usually differs also in its small size and dull coloration. The eye spot of the hind wing, when present, contains red or orange except in *H. nanus* Walker. The postmedian bands of the hind wing are usually straight or but little curved. (In *Automeris*, *Adetomeris*, and *Hyperchiria* these bands are strongly curved, forming arcs, at least portions of which are concentric with the eye spot. In some *Gamelia* and *Automerina* they are less strongly curved, and in *Automeris* they are least curved in *A. stuarti* Rothschild.)

Frontal protuberance distinct and protuberant to absent; shortest distance between eyes less than one-half of length of an eye, sometimes less than one-third of length of an eye; upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae slightly shorter to slightly longer than thorax, antennal shaft without scales or that of female with a few scales from base nearly to apex, antennae of male quadripectinate to apex or last half dozen or more segments simple, rami not much curved, apical rami of outer side much shorter than those of inner side, usually one-third to two-thirds the length of basal rami, apical rami of inner side two-thirds of length of basal rami to subequal to them, rami without bristles or basal rami with inconspicuous apical bristles, shorter than or sometimes equal to setae, inconspicuous subapical ventral bristles sometimes present on basal rami; antennal shaft not or but little compressed, not carinate beneath, without bristles or with two or three small bristles on under surface of each segment; antennal cones small, confined to apical third or fourth of antenna. Antenna of female bidentate, each tooth bearing one or a few terminal bristles; under surface of antenna not carinate, sometimes with a pair of bristles on each segment; antennal cones similar to those of male.

Tentorial pits oval, lateral to and slightly below frontal protuberance, if latter is present; clypeus separated from frons by a distinct line or weak suture; clypeus about five times as broad as long, with an anterior surface if there is no frontal protuberance;

pilifers not or weakly indicated; mandibular rudiments not protuberant. Proboscical fossa distinct, longer than broad or as long as broad, with subvertical walls; maxillary stipites rather small, extending back to anterior ends of palpal sockets; stipites in contact with walls of fossa or somewhat separated from them; galeae short, represented by mere lobes, or as long as the proboscical fossa and curled; labial palpi arising but little behind middle of fossa, extending forward to a point well in front of frons, three-segmented, second and third segments often partially fused. Postoccipital bridge broad and rather weakly sclerotic.

Thorax covered with long, suberect, hair-like scales which obscure a scattering of short broad scales; patagia rather narrow but broader than the lamelliform parapatagia; tegulae not reaching anterior median angle of scutellum; anepisternum rather large, anepisternal suture usually directed downward posteriorly, especially near its posterior end, towards a point near or below middle (often near lower end) of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in approximately same direction as straight lower portion, only an inconspicuous curved region intervening between the two portions.

Fore tibiae subequal to tarsi; epiphysis of male large, reaching to apical third of tibia or beyond and bearing elongated scales or hairs, epiphysis of female absent or small and slender, without long hairs; tibial spines absent; tibial spurs not hidden in vestiture, somewhat longer than diameter of tibiae, their apical two-thirds or three-fourths broadly concave on one side, margins finely serrated; posterior tibiae with or without a subapical spur in addition to apical pair; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment large but sole scaled; claws faintly serrated; arolium and pulvilli well developed.

Forewings with outer margins convex to concave; hind wings with anal angles distinct but not produced; vestiture consisting of scales, overlain on wing bases and especially on hind wings by elongated scales and hairs.

TABLE 15
SUBGENERA OF *Hylesia*

<i>Hylesia</i> , <i>Sensu Stricto</i>	<i>Eubergia</i>
Antenna of female narrowly bidentate, widest near base	Antenna of female strongly bidentate, broadest in the middle
Epiphysis of female present	Epiphysis of female absent
Posterior tibia with or without a subapical spur	Posterior tibia without subapical spur
Mesoscutum without middorsal ridge	Mesoscutum with longitudinal middorsal ridge
Forewings without white lines	Forewings with a pattern of white lines along veins and a white postmedian line
M ₁ of forewing arising from anterior apical angle of cell	M ₁ of forewing stalked with radial stem

Abdomen covered with suberect or recumbent, hair-like scales or hairs which are particularly long at the apex, especially in female; abdominal vestiture usually not forming color bands. Eighth sternum of male bilobed; uncus of male large, strongly directed downward in contrast to upper portions of harpes which are directed upward; uncus simple or bifid at apex; gnathos slightly produced posteriorly immediately above the aedeagus, extending far upwards at sides to connect with inner upper lobes of harpes as well as with ninth tergum; anellus absent as a free structure; lower portions of harpes completely fused with ninth segment and with one another; harpes short and extremely broad, bearing an internal spine which projects posteriorly above uncus.

Eighth tergum of female with transverse sclerotic band; eighth sternum of female with either the prevulvar or the postvulvar sclerotic band or both somewhat lobed along posterior margins; ductus bursae membranous, bursa elongated and membranous; ductus seminalis arising from right-hand side of base of bursa.

The genus *Hylesia* is divisible into two subgenera as indicated in table 15.

SUBGENUS *HYLESIA* HÜBNER

Figures 70, 294-299

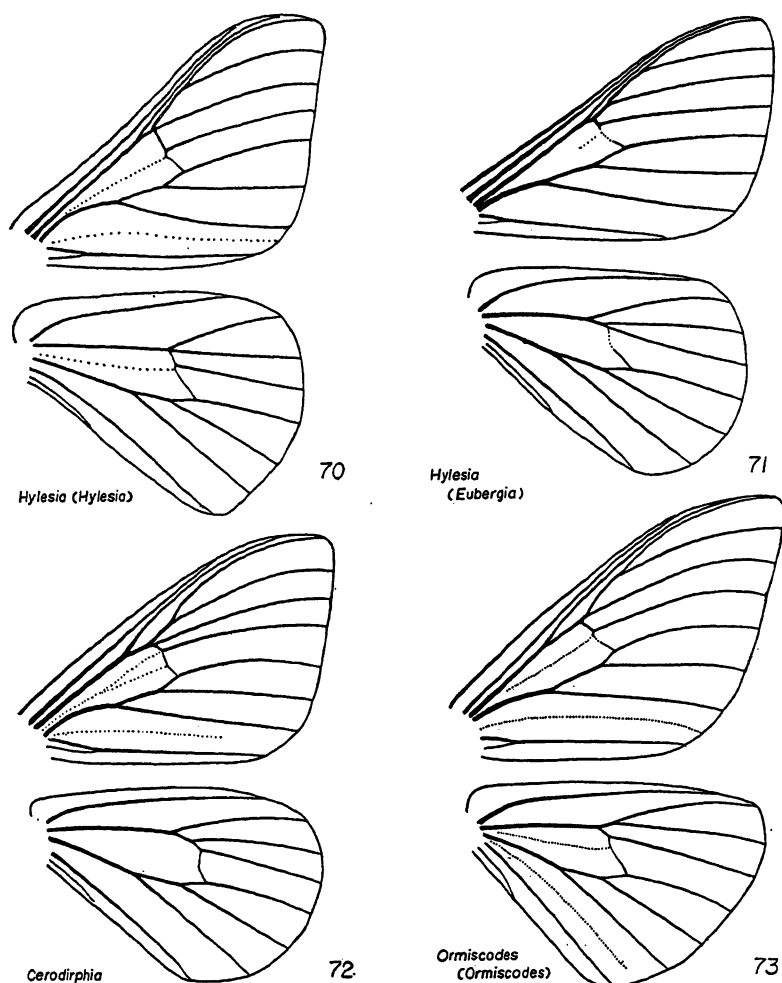
Hylesia HÜBNER, [1820], Verzeichniss bekannter Schmettlinge, p. 186. Type: *Phalaena canitia* Stoll, 1780, by designation of Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 792.

Micrattacus WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 6, p. 1335. Type: *Micrattacus nanus* Walker, 1855 (monobasic).

Hylosia HERRICH-SCHÄFFER, 1855, Sammlung aussereuropäischer Schmetterlinge, vol. 1, Heterocera, figs. 491-493 (emendation of *Hylesia*).

This subgenus contains the species usually placed in *Hylesia*. They range from Mexico to Argentina.

The species of *Hylesia* proper are mostly small and of rather uniform appearance, but vary interspecifically in certain characters which are often regarded as of at least generic importance. For example, most of the species have the frontal protuberance as usual in the Hemileucinae, but there is a group of species in which the frontal protuberance is entirely absent and the clypeus is not hidden but extends as far forward as the frons. Such species are *Hylesia coarya* Schaus, *dyarex* Schaus, *gracilex* Dyar, *hamata* Schaus, *indurata* Dyar, *mymex* Dyar, *petena* Schaus, *rosacea* Schaus, *subfasciata* Dognin, *lapabex* Dyar, and *tiphys* Dognin. There are intergradations (see, for example, *H. cottica* Schaus and *pallidex* Dognin) between such species and those with the more common facial construction. Species having the frontal protuberance exhibit considerable variation in its size and shape. Types of the following species, having a protuberance, have been examined: *andrei* Dognin, *annulata* Schaus, *ascodex* Dyar, *athlia* Dyar, *biolleya* Schaus, *bolivex* Dognin, *bouvereti* Dognin, *cedomonibus* Dyar, *chirex* Schaus, *coadjutor* Dyar, *coex* Dyar, *coinopus* Dyar, *colimatifex* Dyar, *colombex* Dognin, *colombiana* Dognin, *composita* Dognin, *coreria* Schaus, *cressida* Dyar, *croex* Schaus, *dalifex* Dognin, *dalina* Schaus, *darlingi* Dyar, *euphemia* Dyar, *frigida* Schaus, *gameloides* Michener, *huayna* Schaus, *humilis* Dognin, *ileana* Schaus, *in-*



FIGS. 70-73. Wings of Hemileucinae. 70. *Hylesia (Hylesia) canitia* (Stoll). 71. *Hylesia (Eubergia) boetifica* (Druce). 72. *Cerodirphia rosacordis* (Walker). 73. *Ormiscodes (Ormiscodes) cinnamonea* (Feisthamel).

durata Dyar, *invidiosa* Dyar, *iola* Dyar, *leilex* Dyar, *lilacina* Dognin, *liturex* Dyar, *livex* Dyar, *lolamex* Dyar, *margarita* Dognin, *medifex* Dognin, *minasia* Schaus, *morpheus* Dyar, *mortifex* Dyar, *multiplex* Schaus, *munonia* Schaus, *murex* Dyar, *murmur* Dyar, *mystica* Dyar, *novex* Dognin, *obtusa* Dognin, *olivencia* Schaus, *omeva* Dyar, *oratrix* Dyar, *orbana* Schaus, *orbifex* Dyar, *oroyex* Dognin, *pachobex* Dognin, *palcazua* Schaus, *paulex* Dognin, *pauper* Dyar, *pluto* Dognin, *pollex* Dyar, *praeda* Dognin, *remex* Dyar, *rex* Dyar, *roseata* Dognin, *rubrifrons* Schaus, *rufipes* Schaus, *schausi* Dyar, *sollex* Dyar, *sorana* Schaus, *subaurea* Schaus, *ter-*

ranea Schaus, *terrosex* Dognin, *tinturex* Schaus, *umbratula* Dyar, *valvex* Dyar, *vespex* Dognin, and *vindex* Dyar.

Varying quite independently of the frontal protuberance is the subapical spur of the posterior tibia. Such a spur is present in many species, absent in others. The galeae also vary, often being minute and uncurled, but in other species being as long as the head and curled. In most of the species the genitalia are rather uniform, but in *H. ileana* Schaus and a species identified as *inficilia* Walker the uncus is bifurcate instead of simple, and the posterior margin of each harpe bears a large acute projection.

SUBGENUS *EUBERGIA* BOUVIER

Figures 71, 300-302

Eubergia BOUVIER, 1929, Ann. Sci. Nat., Zool., ser. 10, vol. 12, p. 258. Type: *Dirphia caisa* Berg, 1883, designated by Draudt, 1930, in Seitz, Macrolepidoptera of the world, vol. 6, p. 785.

This subgenus contains the three species customarily placed in *Eubergia*. (*E. bertha* is a *Eubergioides*.) *Eubergia* occurs from Peru and southern Brazil to Argentina.

GENUS *PROHYLESIA* DRAUDT

This is a genus of rather small, dull-colored hemileucines in which the base of each harpe of the male bears a blade-like process. The male antennae are bipectinate.

Frontal protuberance strong, transverse, broadly rounded. Shortest distance between eyes less than one-third of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending well below lower end of face.

Antennae about one and one-third times as long as thorax, flagellum of male not scaled, that of female with scales on dorsal surface nearly to apex; flagellum of male bipectinate to apex, rami slender, strongly curved downward, each ending in one very long conspicuous bristle and often with one or more shorter bristles on the under side near the apex, setae of rami rather sparse, directed downward; shaft of antenna somewhat compressed and weakly carinate beneath, each segment with a group of two to five strong apical bristles on under surface, antennal cones small, slender, confined to apical third of antenna, each arising from a large ventral convexity which would be regarded as a large cone were it not for the small cone arising from it, these convexities progressively reduced towards bases of antennae. Antennae of female narrowly bipectinate to bidentate, each ramus or tooth ending in a long bristle; shaft not compressed, not or feebly carinate beneath, the bristles smaller and more scattered than in male, antennal cones similar to those of male but projections from which they arise much smaller.

Tentorial pits elongated, below and lateral to frontal protuberance; clypeus about four times as broad as median length, separated

by a distinct line from frons; pilifers strongly produced; mandibular rudiments small. Proboscis much longer than broad, rather deep, with walls vertical; maxillary stipites free from walls of fossa, extending back to anterior margins of palpal sockets; labial palpi arising slightly behind middle of fossa, extending downward and forward to a point well in front of face, three-segmented, third segment very small. Post-occipital bridge narrow and weakly sclerotic.

Thorax covered with long, suberect, hair-like scales or hairs; patagia rather narrow; parapatagia lamelliform; tegulae reaching almost as far back as anterior median angle of scutellum; anepisternum small, anepisternal suture directed upward posteriorly towards a point well below middle of deeply impressed portion of pleural suture, this portion of pleural suture directed in same direction as straight lower portion, no curved region intervening between the two main portions.

Fore tibiae subequal to tarsi; epiphysis rather small, not reaching beyond apical third of tibia, usually with some long hairs or long scales; tibial spines absent; tibial spurs not completely hidden in vestiture, posterior tibiae without subapical spurs or with one small one, tibial spurs longer than diameter of tibia, concave and finely serrated in apical two-thirds; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female; spine-bearing lobes on this segment bare, adjacent bare areas of following segment broad and extending as feebly scaled bands to apex of segment, sole lightly scaled; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex; hind wings with anal angles distinct and slightly produced in some, anterior apical angles slightly produced in some species; vestiture consisting of broad scales, thinly overlain by elongated scales or hairs.

Abdomen small, covered with broad scales which are overlain and hidden by recumbent or suberect, hair-like scales or hairs; uncus of male not downcurved at apex, bifid, narrowly produced or broadly truncate; gnathos large; anellus absent, harpes free from ninth segment except at their lower basal angles where they are fused to it and sometimes to

TABLE 16
SUBGENERA OF *Prohylesia*

<i>Prohylesia</i> , <i>Sensu Stricto</i>	<i>Hylesiopsis</i>
Male uncus bifid or medially produced	Male uncus broadly truncated
Bases of harpes separated from one another, their blade-like basal processes not connected	Bases of harpes fused ventrally, their blade-like basal processes arising from a short common stem
Male markedly smaller than female	Male and female subequal in size
Anterior apical angle of hind wing slightly produced forward	Anterior apical angle of hind wing not produced

one another; lower basal angles of harpes each produced to a long, slender, blade-like process; harpes each with a strong inner spine which extends beyond apex of harpe proper.

Eighth tergum of female with a sclerotic band which is narrowed medially; eighth sternum with a prevulvar sclerotization which may be produced posteriorly as a broad lobe and a postvulvar sclerotization which is feeble and quite extensive; ductus bursae largely membranous and two or three times as long as broad, bursa membranous and elongated; ductus seminalis arising from left dorsal area of base of bursa.

This genus is divisible into two subgenera as indicated in table 16.

SUBGENUS PROHYLESIA DRAUDT

Figures 69, 303-305

Prohylesia Draudt, 1929, in Seitz, *Macrolepidoptera of the world*, vol. 6, p. 749. Type: *Micrattacus friburgensis* Schaus by original designation.

This subgenus contains three species from southern Brazil.

SUBGENUS HYLESIOPSIS BOUVIER

Figures 306-308

Hylesiopsis BOUVIER, 1929, *Ann. Sci. Nat., Zool.*, ser. 10, vol. 12, p. 322. Type: *Hylesiopsis festiva* Bouvier (monobasic).

This subgenus, which contains only the type species from Colombia, was placed in a different subfamily from *Prohylesia* by Bouvier (1935), but this was clearly an error, since the relationship is very close.

GENUS ORMISCODES BLANCHARD

This genus is here interpreted in a sense very different from the usual one, to include

not only the species often placed under *Ormiscodes*, *Thauma*, and *Catocephala* but also *Meroleuca* and certain species frequently placed in *Dirphia* [Bouvier's *semirosea-hoegei* group, *ruschweyhi* group, and the species *litura* (Walker) and *carminata* Schaus and *Dirphiopsis albofasciata* Johnson and Michener]. *Ormiscodes* thus becomes one of the major genera of the subfamily. The species have many structural features in common, and even the pattern shows some similarities. The most distinctive structural feature is in the male genitalia, whose harpes are rather large and broad, usually articulated to the ninth segment, and trilobed, there being an upper and a lower outer lobe and an upper inner lobe, the latter connected to the gnathos. The genus as here delimited can be divided into seven subgenera (two of them monotypic) which are abundantly distinct from one another. They might well be called genera, but their relationship is more clearly indicated by the present arrangement. They cannot be grouped, except artificially, to form two or three genera of moderate size.

Among the related subgenera are *Paradirphia* and *Dirphiella*, which have in common an inner spine on the harpe in the male genitalia, remnants (though of a different sort in the two subgenera) of an anellus, carinate antennae, with larger and more numerous antennal cones than the other subgenera, and a reduced number of dorsal setae on the male antennal shaft. *Xanthodirphia* agrees with *Paradirphia* in most of these features. However, *Dihirpa* has a small inner spine on the harpe, and one species of *Rhodirphia* has an even more reduced inner spine or tubercle. *Rhodirphia* has very few

dorsal setae on the shaft of the male antenna. White spots along the premedian and postmedian lines, these lines usually being bent inward towards the costal margin of the forewing, are especially characteristic of *Paradirphia*, but can be seen also in *Dirphiella*, *Rhodirphia*, and some species of *Ormiscodes* proper. Throughout the group, reduction in the size of the epiphysis characterizes the females; indeed the epiphysis is known to be present only in females of *Hidripa*, although it may also be present in certain other subgenera in which the females are unknown. The epiphyses are absent in the males of *Dirphiella* and *Meroleuca*, subgenera which are also characterized by the reduced size of the eyes, reduced frontal protuberance, and absence of the subapical spurs on the hind tibiae. However, in view of the genitalic and antennal differences, it seems probable that *Dirphiella* and *Meroleuca* are not closely related and the several morphological similarities result from parallel loss or reduction in certain structures, various stages of which, for *Meroleuca*, can be seen in *Meroleucoides*.

Frontal protuberance highly variable, long and acutely pointed to low and transverse.¹ Shortest distance between eyes varies from more than the length of an eye to one-third of the length of an eye, upper ends of eyes usually extending above antennal sockets, lower ends of eyes usually extending below lower end of face.

Antennae slightly longer than thorax to one and one-half times as long as thorax, flagellum not scaled or with a few scales on dorsal surface near base in female,¹ antenna of male quadripectinate or rarely bipectinate to apex, rami slightly to strongly downcurved, apical rami varying from nearly as long as basal rami to completely absent, frequently represented by short stubs, basal rami with one or sometimes two or three terminal bristles and usually a subterminal ventral bristle, these bristles often shorter than setae and inconspicuous but sometimes conspicuous and much longer than setae; antennal shaft not or only moderately compressed, sometimes carinate ventrally; antennal cones small to moderate sized, sometimes restricted to apex of antenna, sometimes recognizable even

to basal segments; each segment with two or more ventral bristles which are usually subapical in position. Antennae of female bidentate, sometimes narrowly bipectinate, commonly broadest medially, the teeth each bearing one to several terminal bristles; shaft dorsoventrally flattened, each segment with two or more ventral bristles and sometimes with a single dorsal bristle; under surface of antenna without a carina or with carina limited to the apical half, antennal cones small, limited to apical two-fifths or less of antenna.

Tentorial pits round to oval, lateral to and slightly below frontal protuberance; clypeus five or six times as broad as long; pilifers recognizable as convexities; clypeus separated from frons only by a weak line or by a feeble groove. Mandibular rudiments rather large but not protuberant. Proboscical fossa longer than broad, not very deep, walls subvertical or much sloping; maxillary stipites in contact with wall of fossa, extending backward to middle or to posterior edge of palpal sockets; labial palpi three-segmented, arising slightly behind middle of fossa, reaching a point well in front of frons. Postoccipital bridge broad.

Thorax covered with suberect hairs, intermixed on tegulae with extraordinarily long hairs or hair-like scales (sometimes broadened to form lanceolate scales); patagia rather broad; parapatagia lamelliform; anepisternum small, anepisternal suture directed upward or slightly downward posteriorly towards a point scarcely below to slightly above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in almost same direction as straight lower portion of this suture, no conspicuous curved region intervening between these two portions.

Fore tibia subequal to tarsus, sometimes slightly shorter; epiphysis large, with long hairs in males of some species but reduced or absent in females, sometimes absent in males as well; tibial spines absent; tibial spurs usually exceeding vestiture, apical half to three-fourths concave on one side, with margins finely serrated, posterior tibiae with or without subapical pair of spurs; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female,¹ spine-

¹ Characters so marked break down in the short-winged females of the subgenus *Meroleuca*.

bearing lobes on this segment bare, adjacent bare areas of following segment rather large and sometimes extending to apex of segment,¹ sole of segment thinly scaled, scaling sometimes reduced to a median band; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex; hind wings with anal angles not produced; vestiture consisting of scales lightly covered on the hind wings, at least basally, and sometimes on the forewings as well with elongated scales or hairs; vein M_2 of forewing arising from near middle of apex of discal cell to near anterior apical angle of cell, M_1 sometimes arising from latter point, sometimes stalked with radial stem; radial stem sometimes arising from anterior apical angle of cell, sometimes from before apex of cell, R_1 arising before apex of cell, R_2 present or absent; hind wing with 3V absent or small, R_s arising before apex of discal cell.

Abdomen covered with recumbent or suberect hairs which sometimes form color bands; ninth tergum of male usually longer than uncus, the latter rather small and down-curved apically, the apex simple or bilobed; gnathos not much produced, connected laterally to upper basal angle of harpe; anellus absent, or, if present as a free structure, a mere transverse band; harpes large, freely articulated except in *Paradirphia* where they are fused at ventral extremities to ninth sternum and anellus and in *Xanthodirphia* where they are more broadly fused to ninth segment as well as fused to anellus; harpes three-lobed, there being a large lower lobe, somewhat smaller upper outer lobe and a third lobe connected to the last and also to the gnathos, lower lobe sometimes with a small to moderate-sized inner spine or blunt process.

Eighth tergum of female with broad sclerotic band, sometimes weakened or interrupted middorsally; eighth sternum with prevulvar and postvulvar sclerotic bands, the latter sometimes somewhat produced medially, a sclerotic lateral projection from pleural region of segment sometimes present; ductus bursae rather slender and principally membranous; bursa elongated; ductus semi-

nalis arising from right-hand side of base of bursa.

KEY TO THE NINE SUBGENERA OF *Ormiscodes*

1. Antennae quadripectinate in male. 2
 Antennae bipectinate in male (harpes each with large inner spine, inner upper lobe long and robust) *Dirphiella*
2. Antennal shaft not carinate; harpe of male free, usually without inner spine; anellus absent 3
 Antennal shaft of male carinate nearly to base; harpe of male fused to anellus and ninth segment 7
3. Male with basal rami of outer side in distal half of antenna each with one to several strong ventral teeth of spines; antennal shaft of male with one dorsal seta in middle of each segment; ground color of wings red *Rhodirphia*
 Antennal rami without such teeth; antennal shaft of male usually with several dorsal setae per segment; ground color of wings gray, brown, or black 4
4. Hind tibiae with one or two subapical spurs 5
 Hind tibiae without subapical spurs 8
5. Apical rami of male antennae with one to several dorsal bristles; labial palpi extremely long, longer than width of head. *Meroleucoides*
 Apical rami without bristles; labial palpi shorter than width of head. 6
6. Harpe of male with small inner spine arising from lower lobe. *Dihirpa*
 Harpe of male without inner spine *Ormiscodes*
7. Harpes each with a large, though often blunt, inner spine; posterior tibiae each with a subapical spur, sometimes minute; abdominal terga with pubescence forming color bands *Paradirphia*
 Harpes without inner spine; posterior tibiae without subapical spurs; abdominal terga with pubescence not forming color bands *Xanthodirphia*
8. Antennae large, apical rami at least half as long as basal rami, apical rami each with one to several dorsal bristles; labial palpi extremely long, often longer than total width of head (some *Meroleucoides* with much-reduced subapical hind tibial spurs may run here) *Meroleuca*
 Antennae small, apical rami of outer side, at least, less than half as long as basal rami; apical rami without bristles; labial palpi of usual length, shorter than width of head *Hidripa*

¹ Characters so marked break down in the short-winged females of the subgenus *Meroleuca*.

SUBGENUS *PARADIRPHIA* MICHENER

Figures 75, 76, 309-311

Paradirphia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 146. Type: *Phricodia coprea* Draudt, by original designation.

Male antennae of moderate size, quadripectinate; apical rami of outer side less (often much less) than one-half as long as basal rami, those of inner side more than one-half as long as basal rami; terminal bristles of basal rami subequal to setae or slightly longer, apical rami without bristles; male antennal shaft carinate nearly to base, antennal cones of moderate size and recognizable basad of middle of antenna, sometimes nearly to base, segments of antennal shaft of male each with a single dorsal subapical seta. Antennae of female narrowly bipectinate, broadest medially. Shortest distance between eyes more than one-third of length of eye; eyes extending above lower margins of antennal sockets and below lower end of face; frontal protuberance prominent; epiphysis of male rather large, with long hairs, that of female absent; hind tibiae with a single subapical spur (minute in *fumosa*). Abdominal hairs forming color bands. Eighth sternum of male with apical sclerotic processes or spines; harpe of male with a spine (often blunt) arising from inner side of lower lobe, lobe connected to gnathos blunt; lower basal extremities of harpe fused to anellus (?) which bears a pair of processes and to ninth sternum.

This subgenus includes all available species of Bouvier's (1935) group of *Dirphia semirosea-hoegei*. Species studied are *Ormiscodes* (*Paradirphia*) *antonia* (Dognin), *citrina* (Druce), *coprea* (Draudt), *fumosa* (C. and R. Felder), *gemeli* (Bouvier), *geneforti* (Bouvier), *hoegei* (Druce), *lasiocampina* C. and R. Felder, and *semirosea* (Walker). *Paradirphia* is best represented in Mexico and Central America but ranges southward as far as Peru.

SUBGENUS *XANTHODIRPHIA* MICHENER

Figures 316-318

Xanthodirphia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 146. Type: *Ormiscodes amarilla* Schaus, by original designation.

Male antennae rather large, quadripectinate; apical rami of outer side slightly more

than half as long as basal rami, apical rami of inner side nearly three-quarters as long as basal rami, terminal bristles of basal rami absent or shorter than setae, apical rami without bristles, male antennal shaft carinate beneath nearly to the base, antennal cones of moderate size and recognizable to base of flagellum, antennal shaft without dorsal setae. Shortest distance between eyes about two-fifths of length of an eye, upper ends of eyes extending nearly to lower margins of antennal sockets, lower ends extending slightly below lower end of face if frontal protuberance is ignored; frontal protuberance long and extremely slender and acute; epiphysis of male rather large, with long hairs, reaching to apical third of tibia; hind tibia without subapical spurs; abdominal vestiture not forming color bands. Eighth sternum of male with a pair of weak apical processes or teeth; harpes of male without an inner spine but with a low ridge or tubercle representing the spine, lower lobe of outer side broad and separated from upper lobe only by a shallow notch, upper lobe of outer side produced and acutely pointed, inner lobe which is connected to gnathos not elongated and slender, bases of harpes broadly fused to ninth segment and to anellus, which is bilobed.

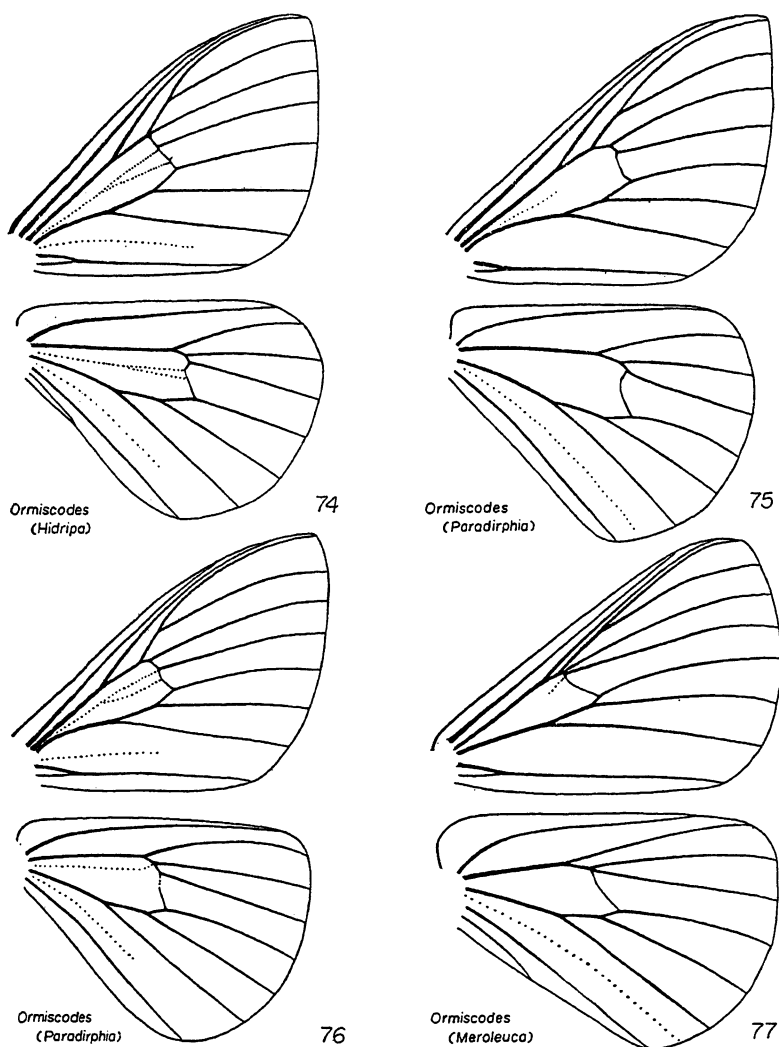
This subgenus is related to *Paradirphia* as shown by the fusion of the harpes with the anellus and the ninth sternum. It differs from *Paradirphia* by the absence of an inner spine on the harpes, by the absence of the subapical spurs on the hind tibiae, the absence of color bands on the abdomen, as well as by the difference in color pattern. The only species, *Ormiscodes* (*Xanthodirphia*) *amarilla* Schaus from Costa Rica, is a beautiful yellow species with pinkish lavender markings.

SUBGENUS *DIRPHIELLA* MICHENER

Figures 328-332

Dirphiella MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 146. Type: *Dirphiopsis albofasciata* Johnson and Michener, by original designation.

Male antennae of moderate size, bipectinate; rami strongly curved downward; terminal bristles of rami nearly twice as long as setae; male antennal shaft carinate nearly to base, antennal cones of moderate size and



FIGS. 74-77. Wings of Hemileucinae. 74. *Ormiscodes (Hidripa) ruscheweyhi* (Berg). 75. *Ormiscodes (Paradirphia) semirosea* (Walker). 77. *Ormiscodes (Meroleuca) famula* (Maassen).

recognizable nearly to base, segments of antennal shaft of male without setae or with a single dorsal subapical seta. Shortest distance between eyes subequal to length of eye; eyes reaching as high as lower margins of antennal sockets, not reaching lower end of face; frontal protuberance low and transverse; epiphysis of male absent; hind tibiae without subapical spurs. Abdominal hairs forming color bands. Eighth sternum of male unarmed; harpe of male with a spine arising from inner side of lower lobe; lobe connected to gnathos rather long; lower basal angles

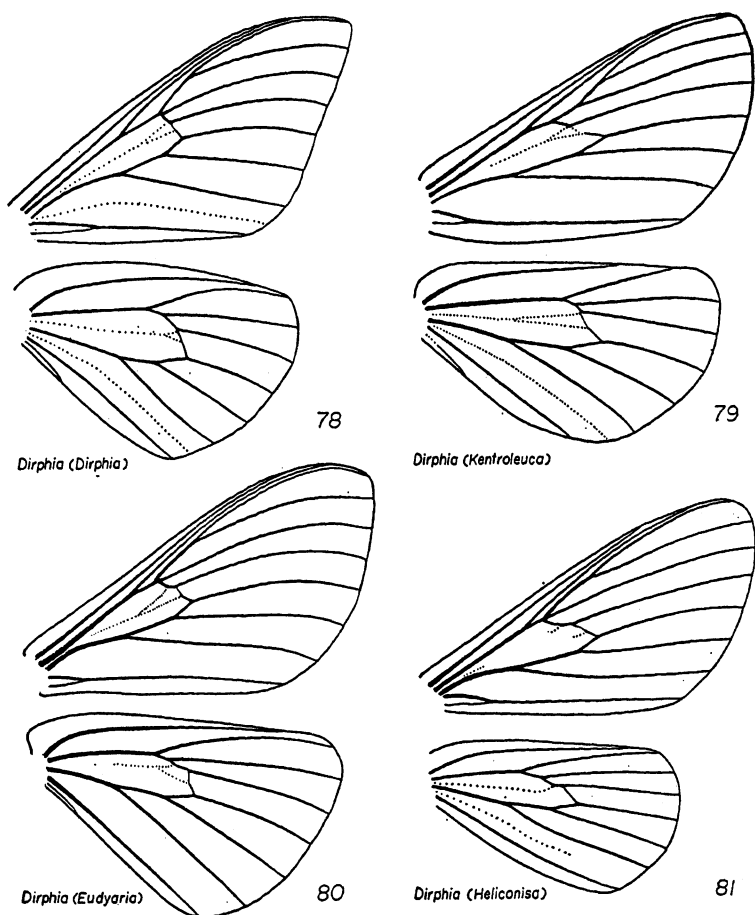
of harpes not fused; anellus free, a small transverse band.

So far as known this subgenus contains only a single species, *Ormiscodes (Dirphiella) albofasciata* (Johnson and Michener), known from a single specimen from southern Mexico. A new figure of this species is given in plate 5.

SUBGENUS **DIHIRPA** DRAUDT

Figures 324-327

Dihirpa DRAUDT, 1930, in Seitz, *Macrolepidoptera of the world*, vol. 6, p. 779. Type: *Dirphia litura* Walker (monobasic).



FIGS. 78-81. Wings of Hemileucinae. 78. *Dirphia (Dirphia) araucariae* Jones. 79. *Dirphia (Kentroleuca) dukinfieldi* (Schaus). 80. *Dirphia (Eudyma) venata* Butler. 81. *Dirphia (Heliconisa) pagenstecheri* (Geyer).

Male antennae of moderate size, quadripectinate; apical rami of outer side about one-fourth as long as basal, of inner side about one-half as long as basal; terminal bristles of basal rami inconspicuous, subequal to setae, apical rami without bristles. Male antennal shaft not carinate beneath; antennal cones small, recognizable only in distal half dozen segments, segments of antennal shaft of male each with several dorsal setae. Antennae of female bidentate, slightly broader medially than elsewhere, Shortest distance between eyes slightly more than one-half of length of an eye; eyes reaching above lower margins of antenna, below lower end of face, if prominent frontal protuberance is ignored; epiphysis of male reaching

to apical fourth of tibia, without long hairs, of female absent; hind tibiae with a single subapical spur. Abdominal hairs forming color bands; eighth sternum of male unarmed; harpe of male with small spine arising from inner side of lower lobe; lobe connected to gnathos elongate; lower basal angle of harpe not fused; anellus absent.

So far as known to me this subgenus includes only *Ormiscodes (Dihirpa) litura* (Walker) from Colombia and neighboring countries.

SUBGENUS **HIDRIPA** DRAUDT

Figures 74, 319

Hidripa DRAUDT, 1930, in Seitz, *Macrolepidop-*

tera of the world, vol. 6, p. 778. Type: *Dirphia ruscheweyhi* Berg, by original designation.

Male antennae small, quadripectinate; apical rami of outer side short, often mere stubs, those of inner side one-half to two-thirds as long as basal; terminal bristles of basal rami inconspicuous, subequal to setae, apical rami without bristles, male antennal shaft not carinate beneath; antennal cones small, recognizable only in distal half dozen segments, segments of antennal shaft of male each with several dorsal setae. Antennae of female bidentate, broadest near base. Shortest distance between eyes less than one-half of length of an eye; eyes reaching above lower margins of antennal sockets and below lower end of face; frontal protuberance moderate; epiphysis of male reaching well beyond middle of tibia, of female not reaching middle; epiphysis without or with few long hairs or scales; hind tibiae without subapical spurs.

Abdominal hairs not forming color bands; eighth sternum of male unarmed; harpe of male without inner spine; lobe connected to gnathos of moderate length; lower basal angles of harpes not fused; anellus absent.

This subgenus includes at least most of Bouvier's (1935) group of *Dirphia ruscheweyhi*. Species studied by me are *Ormiscodes (Hidripa) gschwandneri* (Draudt), *perdix* (Maassen and Weyding), *ruscheweyhi* (Berg), *taglia* (Schaus), and *weymeri* (Draudt), all from southern Brazil, Bolivia, Paraguay, and northern Argentina.

SUBGENUS RHODIRPHIA MICHENER

Figures 312-315

Rhodirphia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 147. Type: *Dirphia carminata* Schaus, by original designation.

Male antennae of moderate size, quadripectinate; apical rami of outer side one-half as long as basal, of inner side two-thirds as long as basal rami; terminal bristles of basal rami inconspicuous, subequal to setae, apical rami without bristles; basal rami of outer side of distal half of antenna each with one to several strong ventral spines; male antennal shaft not carinate beneath, antennal cones small, distinct only on distal eight or 10 segments but feebly indicated to middle of antenna, segments of antennal shaft of

male without or with a single dorsal median seta. Shortest distance between eyes less than one-half of length of an eye; eyes reaching above lower margins of antennal sockets and below lower end of face; frontal protuberance moderate; epiphysis of male reaching nearly to apex of tibia, without long hairs; hind tibiae without subapical spurs. Abdominal hairs forming color bands; harpe of male sometimes with very small inner spine; upper outer lobe acute; lobe attached to gnathos large, broad, submembranous; lower basal angles of harpes not fused; anellus absent.

This subgenus can be recognized superficially by the deep red color. The pattern of white markings is suggestive of that of *Paradirphia*. The subgenus includes *Ormiscodes (Rhodirphia) carminata* (Schaus) and *neipelti* (Draudt). They occur in Mexico and Colombia.

SUBGENUS ORMISCODES BLANCHARD

Figures 73, 320-323

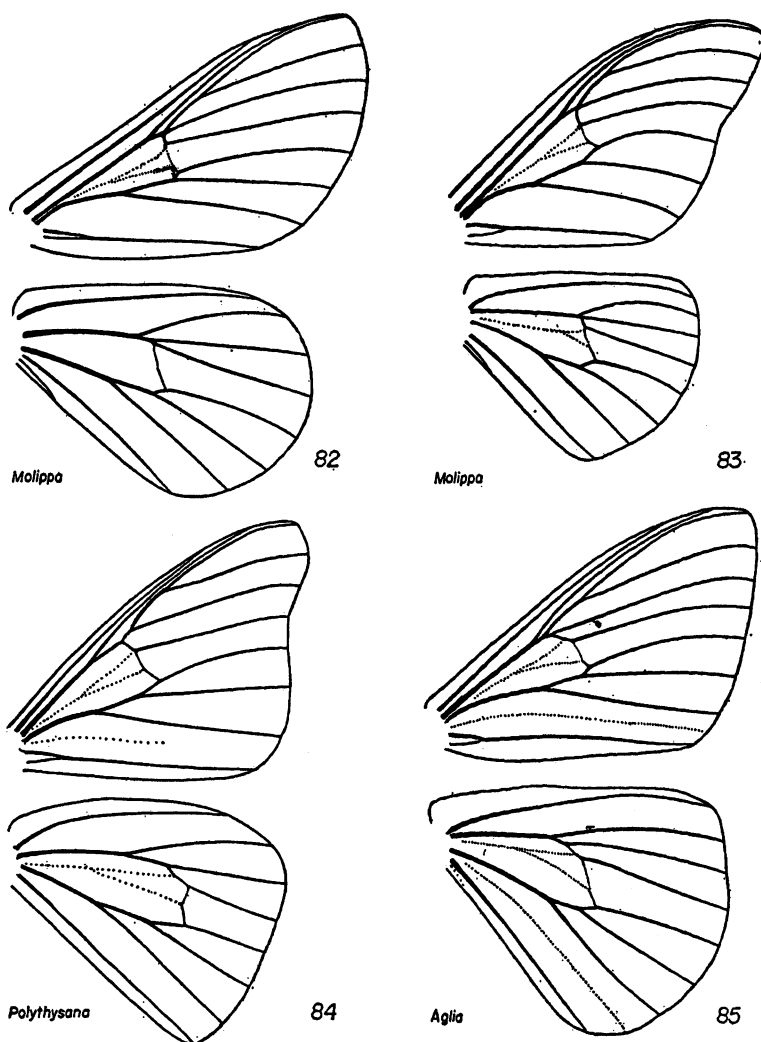
Ormiscodes BLANCHARD, 1852, in Gay, Historia de Chile, Zoologia, vol. 7, p. 61. Type: *Bombyx cinnamomea* Feisthamel (monobasic).

Catocephala BLANCHARD, 1852, in Gay, Historia de Chile, Zoologia, vol. 7, p. 62. Type: *Catocephala rufosignata* Blanchard, designated by Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 790.

Hormiscodes PHILIPPI, 1863, Stettiner Ent. Zeitg., vol. 24, p. 210 (emendation of *Ormiscodes*).

Thauma EDWARDS, 1874, Proc. California Acad. Sci., ser. 1, vol. 5, p. 265. Type: *Thauma ribis* Edwards [= *Bombyx socialis* Feisthamel (monobasic)].

Male antennae large to moderate sized, quadripectinate; apical rami little more than half as long as basal, to nearly as long as basal rami; terminal bristles of basal rami inconspicuous, shorter than setae; apical rami without bristles; male antennal shaft not carinate beneath; antennal cones small, distinct only on distal eight to 12 segments, segments of antennal shaft of male each with several dorsal setae. Antennae of female bidentate, usually broadest medially. Shortest distance between eyes less than one-half of length of an eye; eyes reaching above lower margins of antennal sockets and below lower end of face if long and pointed frontal protuberance is ignored. Tegulae usually with some long, lanceolate scales much exceeding



FIGS. 82-85. Wings of Hemileucinae (82-84) and Agliinae (85). 82. *Molippa strigosa* (Maassen and Weymer). 83. *Molippa sabina* Walker. 84. *Polythysana rubescens* (Blanchard). 85. *Aglia tau* (Linnaeus).

rest of vestiture; epiphysis of male reaching to apical third of tibia or beyond, with few long hairs; epiphysis of female absent; hind tibiae with one or two subapical spurs. Abdominal hairs forming bands on sterna only, or not at all; harpes of male without inner spine, lobes rather elongated, lower basal angles of harpes not fused; anellus absent.

The species placed in this subgenus are those customarily included in *Ormiscodes* or *Catocephala*, for example, by Draudt (1930), Schussler (1934), and Bouvier (1935). There

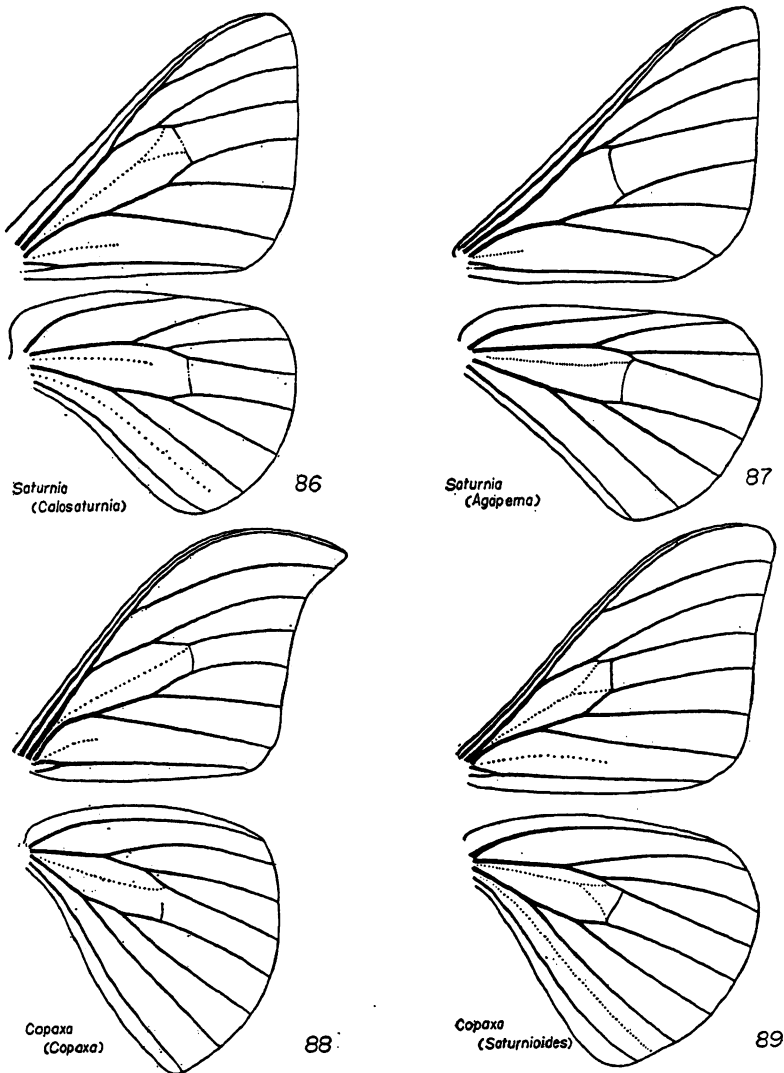
are about 15 species, all inhabitants of the cool southern temperate parts of South America, principally of Chile.

SUBGENUS *MEROLEUCOIDES* MICHENER

Figures 333-335

Meroleucoides MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 147. Type: *Dirphia flavodiscata* Dognin, by original designation.

Male antennae large, quadripectinate; distal rami of outer side about two-thirds as long as basal rami, distal rami of inner side



FIGS. 86-89. Wings of Saturniinae. 86. *Saturnia (Calosaturnia) menodocino* Behrens. 87. *Saturnia (Agapema) galbina* Clemens. 88. *Copaxa (Copaxa) decrescens* Walker. 89. *Copaxa (Saturnioides) copaxoides* (Dyar).

slightly more than half as long as basal rami, distal rami with one to three large, coarse, widely separated dorsal bristles, basal rami each with one or more apical bristles which exceed the setae in length and with two or three subapical ventral bristles; antennal shaft not carinate beneath, each segment with two to four unusually large ventral bristles; antennal cones very small, present only at the extreme apex of the antenna; segments of the antennal shaft each with a

single seta or two or three dorsal setae. Shortest distance between eyes about one-third of length of an eye, eyes reaching to or slightly above lower margins of antennal sockets and reaching to lower end of face, if frontal protuberance is ignored, frontal protuberance conspicuous and rounded. Epiphysis of male present and reaching to apical third of tibia or beyond, epiphysis without long hairs; hind tibiae with a very weak subapical spur or this spur sometimes virtual-

ly absent. Abdominal vestiture forming distinct color bands; eighth sternum of male bilobed but unarmed; harpe of male without inner spine, lobe connected to gnathos delicate, slender, and rather inconspicuous, lower basal angles of harpes not fused; anellus absent.

This subgenus is most closely related to *Meroleuca* which it resembles rather closely in the male genitalia. It differs from that subgenus in the presence of an epiphysis in the male, of a subapical spur on the hind tibia, of abdominal color bands, and in the presence of terminal bristles on the basal rami of the male antennae which exceed the setae of the rami. *Meroleucoides* differs further from *Meroleuca* in that the base of vein M_2 of the forewing is some distance from the anterior apical angle of the discal cell, instead of very close to this angle as in *Meroleuca*.

This subgenus includes *Ormiscodes* (*Meroleucoides*) *albomaculata* (Dognin), *erythropus* (Maassen), and *flavodiscata* (Dognin). I have no doubt that it also includes *laverna* (Druce), although I have not examined specimens of this species (unless *albomaculata* is a synonym). These forms occur from Colombia to Bolivia.

SUBGENUS *MEROLEUCA* PACKARD

Figures 77, 336-338

Mesoleuca PACKARD (not Hübner), 1903, Jour. New York Ent. Soc., vol. 11, p. 247. Type: *Hemileuca venosa* Walker, by original designation.

Meroleuca PACKARD, 1904, Jour. New York Ent. Soc., vol. 12, p. 250 (proposed to replace *Mesoleuca* Packard).

Male antennae large, quadripectinate; apical rami one-half to three-fourths as long as basal rami, each with one to several dorsal bristles; terminal bristles of basal rami subequal to setae; male antennal shaft not carinate beneath; antennal cones small, distinct only on apical eight to 12 segments, segments of antennal shaft of male each with several dorsal setae. Antennae of female bidentate. Shortest distance between eyes one-half of length of an eye to subequal to length of an eye; eyes not or scarcely reaching lower margins of antennal sockets or lower end of face; frontal protuberance often low and transverse, but large in *famula*. Epiphysis

of male absent; hind tibiae without subapical spurs; base of vein M_2 of forewing very near anterior apical angle of discal cell. Abdominal hairs not forming color bands; eighth sternum unarmed; harpe of male without inner spine, lobe connected to gnathos delicate, slender, and inconspicuous; lower basal angles of harpe not fused; anellus absent.

The species of this subgenus have usually been regarded as constituting a distinct genus. Probably most of the species (six in number) included by Bouvier (1935) in *Meroleuca* are properly placed, although *laverna* is a *Meroleucoides*. However, I have studied only *Ormiscodes* (*Meroleuca*) *famula* (Maassen) and *venosa* (Walker). All the species occur in South America.

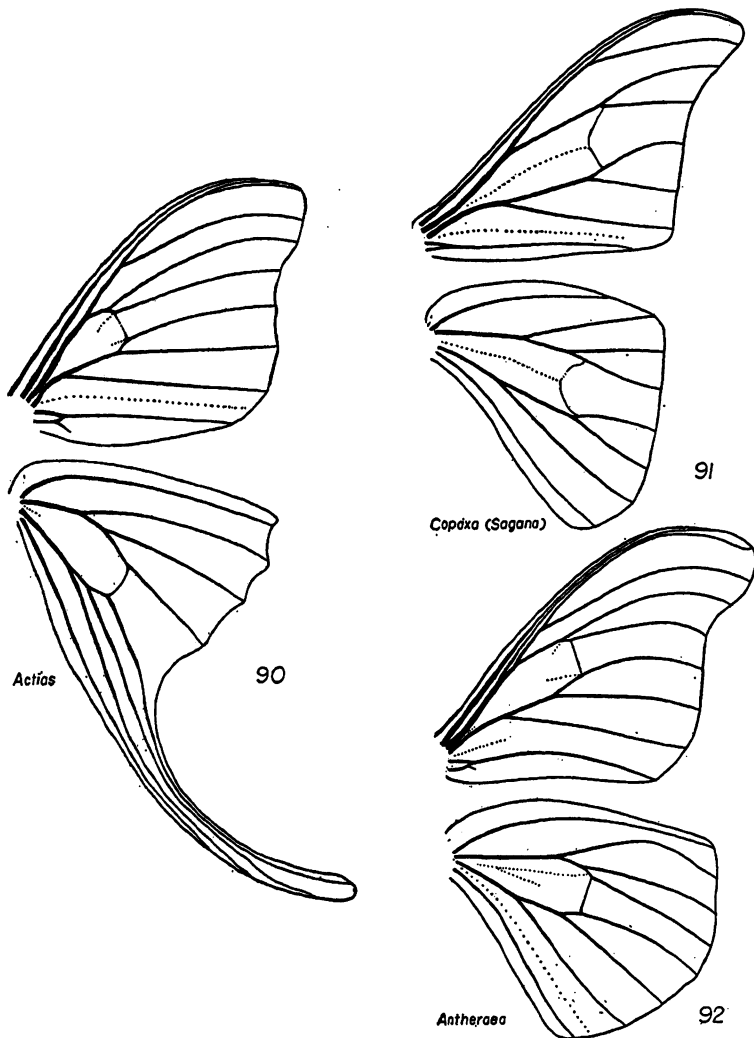
Normal females are known for some species which have been assigned to *Meroleuca*. However, the known females of *O. venosa*, or at least of its form *nigra* (Dognin), are short winged, the wings being represented by small, hairy pads. The antennae are short and robust, broadest beyond the middle where the segments are about three times as broad as long. The flagellum is weakly bidentate, the blunt teeth bearing two or more bristles each. The antennal cones are minute, and several bristles arise from the under surface of each segment, especially near the apex of the antenna. The flagellum bears scattered scales on all surfaces, particularly near the base. The penultimate fore tarsal segment lacks the spines found in most female saturniids, and the bare areas of this and the following segment are absent. The eyes are even smaller and more widely separated than in the male, the shortest distance between them being one and one-half times the length of an eye. The frontal protuberance is absent, the clypeus projecting farther forward than the frons. The thoracic sclerites are surprisingly similar to those of the male.

GENUS *CERODIRPHIA* MICHENER

Figures 72, 339-345

Cerodirphia MICHENER, 1949, Jour. Kansas Ent. Soc., vol. 22, p. 147. Type: *Phricodia rubripes* Draudt, by original designation.

This genus is probably a derivative of *Ormiscodes*, from which it differs not only by the somewhat different male genitalia



FIGS. 90-92. Wings of Saturniinae. 90. *Actias luna* (Linnaeus). 91. *Copaxa (Sagana) sapatoza* (Walker). 92. *Antheraea polyphemus* (Cramer).

but by the very long and coarse antennal bristles, there being one especially long dorsal bristle on each segment in the male. Members of the genus can be recognized also by the narrow bands of white vestiture at the bases of the abdominal terga (except for *C. flavoscripta*). The dorsal bristles of the apical rami of the male antennae, as well as the appearance of some species, indicate a relationship between *Cerodirphia* and the subgenus *Mero-leucoides* of *Ormiscodes*.

Laterofrontal sutures close to eye margins; frontal protuberance rather low and broadly

rounded. Shortest distance between eyes between one-half and one-third of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antenna slightly longer than thorax, flagellum not scaled, flagellum of male quadripectinate to apex, basal rami long, slightly curved downward, apical rami of outer side one-third to slightly over one-half of length of basal rami, those of inner side one-half to about three-quarters of length of basal rami,

basal rami each with a very long and strong terminal bristle and several shorter terminal bristles, often also with several long subterminal bristles both dorsally and ventrally, apical rami of inner side in almost all species and of outer side in a few species with one or more long dorsal bristles arising from near apex or from middle of ramus; antennal shaft strongly compressed, strongly carinate ventrally to base, with moderate-sized antennal cones which are distinct at least to middle of antenna and sometimes to its base, under surface of each segment with a subapical pair of distinct bristles, dorsal surface of each segment with a single subapical bristle which is extremely long and strong. Antennae of female bidentate, each tooth bearing one long terminal bristle and a few shorter bristles, under surface of shaft weakly carinate to base or nearly so, each segment with a pair of subapical ventral bristles, dorsal surface of each segment in almost all species with a single subapical bristle, antennal cones sometimes recognizable only in the apical third, sometimes to the base of the antenna.

Tentorial pits elongated, lateral to and slightly below frontal protuberance; clypeus not separated from frons and in same plane as under surface of frontal protuberance; pilifers present as distinct tubercles. Proboscis fossa considerably longer than wide, rather deep, the walls subvertical; maxillary stipites free from walls of fossa, extending backward as far as anterior margins of palpal sockets; labial palpi arising somewhat behind middle of fossa, three-segmented, extending forward well in front of frontal protuberance. Postoccipital bridge rather narrow and weakly sclerotic.

Thorax covered with long hair which hides scattered scales, very long suberect hairs present on tegulae; patagia rather broad; parapatagia lamelliform; tegulae not reaching back as far as anterior median angle of scutellum; anepisternum rather large, anepisternal suture horizontal or directed slightly upward posteriorly, bent somewhat downward at extreme posterior end, reaching deeply impressed portion of pleural suture below its middle; deeply impressed portion of pleural suture continued in about same direction as straight lower portion of this

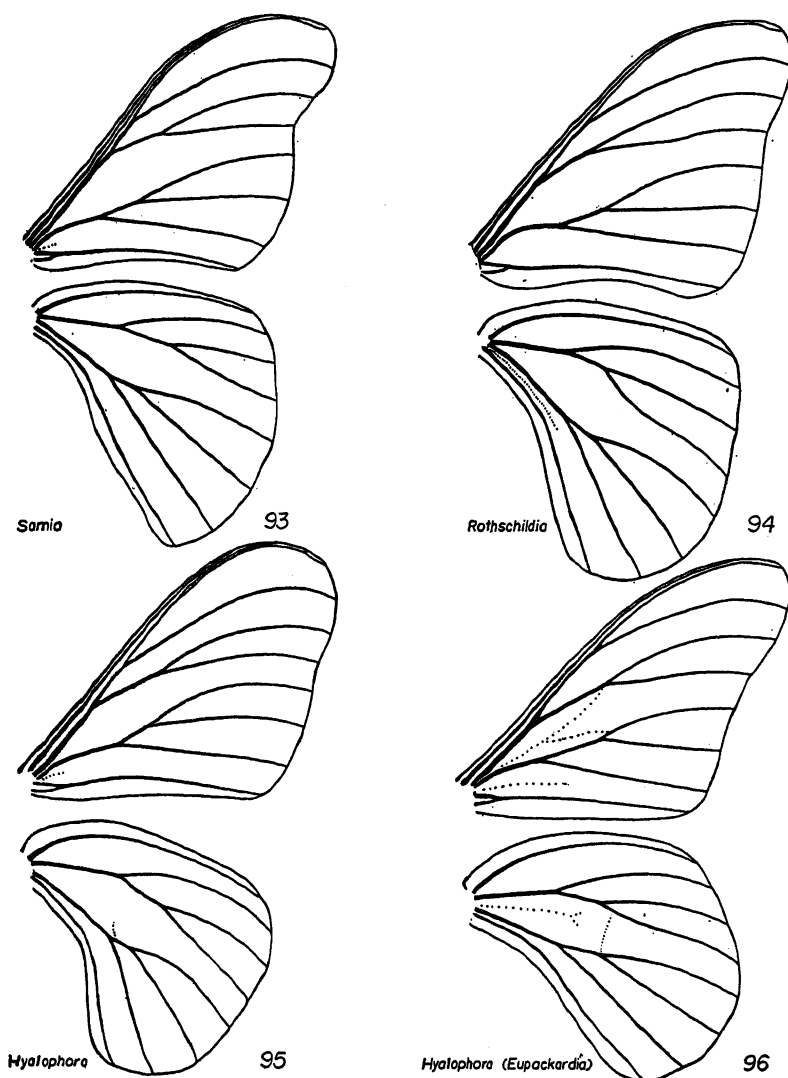
suture, no conspicuous curved region intervening between these two main portions.

Fore tibia subequal to the tarsus; epiphysis of male large, reaching to apical fourth of tibia, with long hairs, that of female very small, without long hairs, scarcely reaching middle of tibia; tibial spines absent; tibial spurs exceeding vestiture of tibiae, longer than diameter of tibia, apical two-thirds to three-fourths concave on one side, margins finely serrated; posterior tibiae without subapical spurs; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes of this segment bare, adjacent bare areas of following segment large, contiguous with the sole of the segment which is nearly bare, having only scattered small scales; claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex; hind wings with anal angles not produced; vestiture consisting of scales, overlain at bases and especially on hind wing with elongated scales and hairs; forewing with vein M_2 arising well in front of middle of apex of discal cell, M_1 and radial stem from near anterior apical angle of cell, R_1 from before apex of cell, R_2 absent, hind wing with 3V slightly less than half of length of 2V, R_4 arising before apex of discal cell.

Abdomen covered with appressed, hair-like scales which hide or nearly hide a covering of broad scales, abdominal terga (except in *C. flavoscripta*) with narrow basal bands of white vestiture which contrast with the otherwise black or brown dorsal surfaces. Eighth sternum of male with a pair of apical processes or a single forked median process or the posterior margin finely serrated, produced, and heavily sclerotic; uncus of male simple or slightly bilobed at apex, down-curved, sometimes slightly produced medially; anellus absent; harpes usually not fused together ventrally, but sometimes fused around the lower side of the aedeagal opening; harpes rather small, at least partially fused to the ninth segment, the lobe which is connected to gnathos often widely separated from other portions of harpes, gnathos in some extending downward and inward to form a roof for aedeagal opening.

Eighth tergum of female with a sclerotic band which is often narrowed or interrupted



FIGS. 93-96. Wings of Saturniinae. 93. *Samia cynthia* (Drury). 94. *Rothschildia jorulla* Westwood. 95. *Hyalophora* (*Hyalophora*) *cecropia* (Linnaeus). 96. *Hyalophora* (*Eupackardia*) *callela* (Westwood).

middorsally; eighth sternum with a prevulvar sclerotic band as well as a postvulvar one, the latter produced posteriorly to form a broad lobe or sometimes bilobed medially, sometimes not heavily sclerotic; ductus bursae largely sclerotic; bursa cylindrical, a large ventral posterior area somewhat stiffened and wrinkled; ductus seminalis arising from right-hand side of base of bursa.

This genus includes Bouvier's (1935) group of *Dirphia rosacordis*, as well as the first part of his group of *D. tarquinia*. Species

that I have studied which belong in this genus are: *arpi* (Draudt), *brunnea* (Draudt), *consaepta* (Draudt), *cutteri* (Schaus), *flavoscripta* (Dognin), *flavosignata* (Johnson and Michener), *mota* (Druce), *opis* (Schaus), *pachona* (Draudt), *radema* (Druce), *rosacordis* (Walker), *rubripes* (Draudt), *simplex* (Dognin), *speciosa* (Cramer), *upanoma* (Draudt), *vagans* (Walker), and *zikani* (Schaus). Species of *Cerodirphia* range from southern Central America to southern Brazil.

GENUS *MOLIPPA* WALKER

Figures 82, 83, 346-361

Molippa WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 6, p. 1345. Type: *Molippa sabina* Walker (monobasic).

Rhodormiscodes PACKARD, 1903, Jour. New York Ent. Soc., vol. 11, p. 244. Type: *Ormiscodes rosea* Druce (monobasic).

Prodirphia BOUVIER, 1928, Compt. Rendus Acad. Sci., Paris, vol. 186, p. 819. Type: *Hemileuca strigosa* Maassen and Weymer, designated by d'Almeida, 1943, Bol. Mus. Nac., Brazil, Zool., no. 7, p. 9.

The members of this genus resemble *Dirphia* and *Ormiscodes* in general appearance, but differ from both very markedly in the male genitalia, especially the presence of a long acute process arising from the lower margin of each harpe. The characteristics of these structures are so unusual that Bouvier placed the groups here included under *Molippa* in a separate tribe.

I have not recognized the groups *Rhodormiscodes* and *Prodirphia* as subgenera. *M. strigosa*, the type and only species of *Prodirphia*, has a very distinctive appearance, but its coarsely serrate uncus is like that of *M. simillima*, which has the appearance of typical *Molippa*. Most of the species having the appearance of typical *Molippa* have broad, elongated, lance-shaped scales on the dorsum of the thorax. Of those with such scales, some (e.g., *M. simillima*) have the uncus serrate as in *M. strigosa*, while others (e.g., *M. sabina*) have a dorsal horn on the uncus. The latter feature also characterizes certain species (e.g., *M. boliviana* Bouvier) in which the longest scales or hairs of the thorax are filiform, not lanceolate, as in *M. rosea*, the type of *Rhodormiscodes*, in which the uncus has a broad, spiny, dorsal surface. In *M. lulesa* and *tusina* the uncus has a broad dorsal surface as in *rosea*, but lacks the spines, and in the former, at least, each harpe is provided with an inner spine, absent in other species of *Molippa*. In these species there are no long lanceolate thoracic scales. Thus there seems to be a series of combinations of the characters which precludes their use except for the separation of species.

Molippa strigosa is distinctive, not only by its peculiar pattern but by the absence

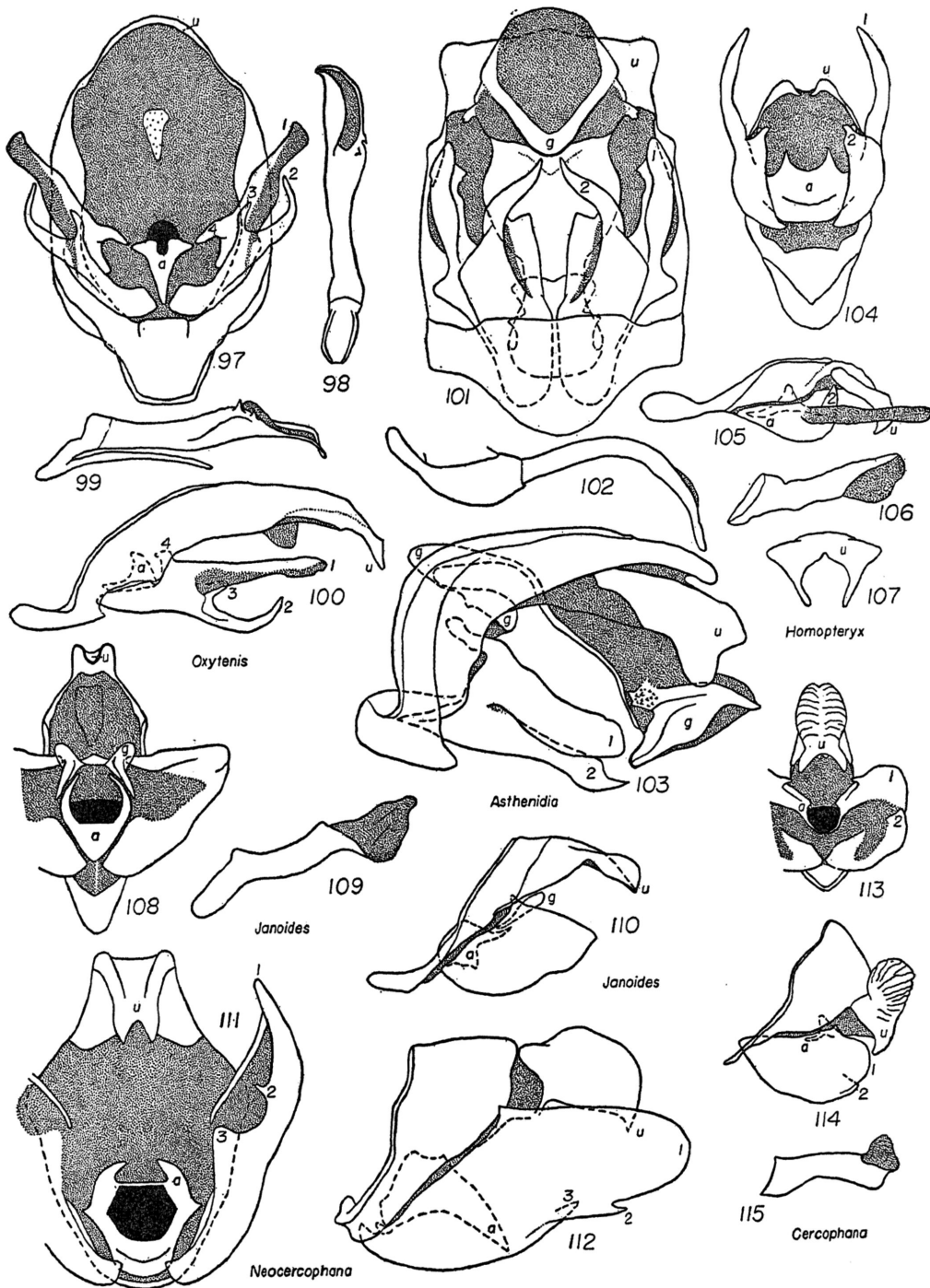
of the epiphysis in the female and the virtual absence, on the abdomen, of the very long, hair-like scales such as occur on both thorax and abdomen of other species. It hardly seems necessary, however, to recognize a subgenus for this one specialized species, especially in view of its genitalic similarity to *M. simillima*.

In general appearance *M. lulesa* and *tusina* are very similar to certain *Automeris* such as *A. cruenta* and *convergens*. This may well indicate a relationship between these species of *Automeris* and the most primitive species of *Molippa*.

Frontal protuberance rather low and broadly rounded. Shortest distance between eyes about one-third of length of an eye, upper ends of eyes extending slightly above lower margins of antennal sockets, lower ends of eyes extending below lower end of face.

Antennae as long as the thorax or slightly longer, flagellum of male not scaled, that of female sometimes with a few scales on dorsal surface in basal two-thirds or three-quarters, flagellum of male quadripectinate to apex, the apical rami two-fifths to four-fifths as long as basal rami, often reduced or absent near apex of antenna where the antenna is therefore bipectinate; basal rami with one to a few inconspicuous terminal bristles, these bristles only rarely exceeding the setae; antennal shaft not much compressed, not carinate ventrally, each segment with two to four inconspicuous ventral bristles; antennal cones small to moderate sized, limited to distal fourth or fifth of antenna. Antennae of female bidentate, each tooth ending in a few long bristles, antennal shaft with one to four ventral bristles on each segment, without a carina; antennal cones limited to the apical eight or 10 segments.

Tentorial pits oval, lateral to and slightly below frontal protuberance; clypeus about three times as broad as long, with distinctly produced pilifers; clypeus separated from frons by a weak line. Proboscoidal fossa longer than broad, rather deep, walls vertical; maxillary stipites free from or nearly in contact with walls of fossa, extending backward to or behind anterior margins of palpal sockets; labial palpi arising near posterior end of proboscoidal fossa, extending forward to a point in front of face, three-segmented, third



segment small. Postoccipital bridge rather broad but not strongly sclerotic.

Thorax covered with long, suberect hairs, among which on dorsum are very much longer hair-like scales which are sometimes broadened subapically to form very long lanceolate scales; patagia and parapatagia both narrow, the latter lamelliform; tegulae not reaching so far back as anterior median angle of scutellum; anepisternum rather small, anepisternal suture horizontal or directed slightly upward posteriorly except at its extreme posterior end where it is commonly bent sharply downward; except for this extremity the suture is directed towards middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture at an angle of about 170 degrees to straight lower portion, an inconspicuous curved region intervening between these two main portions.

Fore tibiae subequal to tarsi; epiphysis of male reaching to apical third of tibia or beyond and with long hairs, epiphysis of female small and bare or absent; tibial spines absent; tibial spurs exceeding vestiture, longer than diameter of tibia, their apical half or slightly more concave on one side, with margins finely serrated; posterior tibiae with a single subapical spur in addition to apical pair; tarsal spines absent except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes of this segment bare, adjacent bare areas of following segment rather large but not extending to apex of segment, sole densely scaled; claws finely serrate; arolium and pulvilli present.

Forewings with outer margins convex or nearly straight; hind wings rounded, without produced anal angles; vestiture consisting of scales overlain by hair-like scales or hairs; forewing with vein M_2 arising slightly to considerably in front of middle of apex of

discal cell, M_1 very briefly if at all stalked with radial stem, R_1 arising before apex of cell, R_2 absent; hind wing with 3V absent, R_s arising near apex of cell or before apex.

Abdomen with rather long, recumbent or suberect hairs, usually forming distinct colored bands, these hairs obscuring a light covering of broad scales; abdominal terga with some very long, hair-like scales much exceeding the hairs and in some species broadened subapically and lanceolate; uncus of male down-curved, not bifid apically, usually with a dorsal horn or with several dorsal spines; gnathos narrow and not much produced, extending far down towards the aedeagus; anellus absent as a free structure, probably represented by a long, sickle-shaped arm arising from the lower basal angle of each harpe; harpes broadly fused to ninth segment.

Eighth tergum of female with a broad sclerotic band; eighth sternum with a broad and heavily sclerotized, apparently prevulvar portion which is broken by a longitudinal midventral slit which contains the vulva, postvulvar sclerotization rather extensive but weak, not produced; ductus bursae about as broad as long, laterally compressed near vulva; bursa long and cylindrical; ductus seminalis arising from right-hand side of base of bursa.

This genus includes a number of species which were placed in *Dirphia* by Draudt (1930). The species available for study are listed below: *amazonica* (Bouvier), *basina* Maassen and Weyding, *basinoides* Bouvier, *binasa* (Schaus), *boliviana* (Bouvier), *late-media* (Druce), *lulesa* (Schaus), *ninfa* (Schaus), *placida* (Schaus), *rosea* (Druce), *sabina* Walker, *simillima* Jones, *strigosa* (Maassen and Weyding), and *tusina* (Schaus). The species of this genus range from Mexico to northern Argentina.

GENITALIC STRUCTURES

FIGS. 97-100. *Oxytenis modestia* (Cramer). 97. Ventral view. 98. Dorsal view of aedeagus. 99. Lateral view of aedeagus. 100. Lateral view.

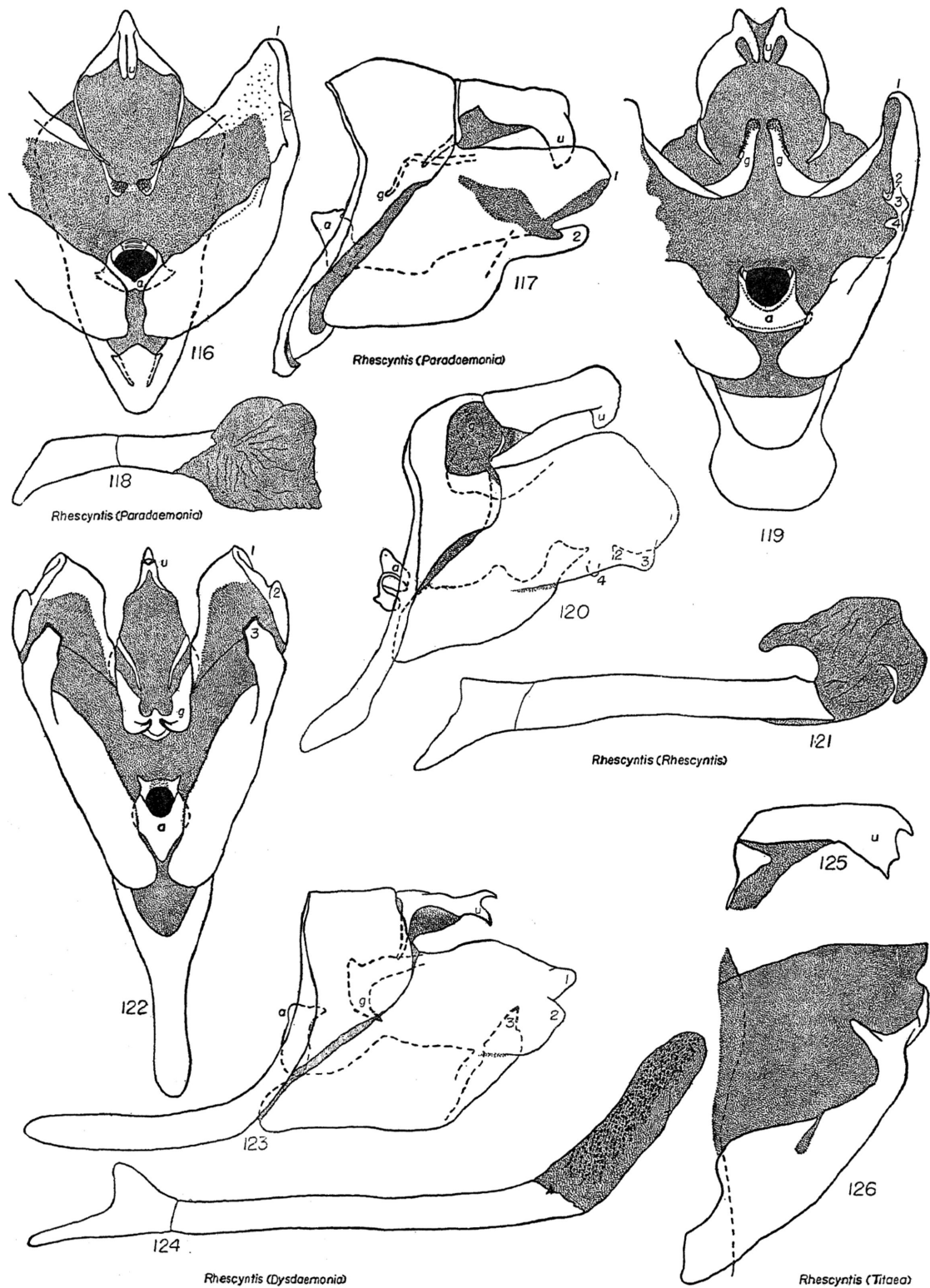
FIGS. 101-103. *Asithenidia* sp.? 101. Ventral view. 102. Aedeagus. 103. Lateral view.

FIGS. 104-107. *Homoeopteryx malecena* (Druce). 104. Ventral view. 105. Lateral view. 106. Aedeagus. 107. Posterior view of uncus.

FIGS. 108-110. *Janoides ecuadorensis* (Dognin). 108. Ventral view. 109. Aedeagus. 110. Lateral view.

FIGS. 111-112. *Neocercophana philippii* Izquierdo. 111. Ventral view. 112. Lateral view.

FIGS. 113-115. *Cercophana frauenfeldti* Felder. 113. Ventral view. 114. Lateral view. 115. Aedeagus.



GENUS *DIRPHIA* HÜBNER

This large genus is distinguishable from superficially similar genera by the distinctive form of the genitalia, the harpes being thoroughly fused to the ninth segment, the principal produced lobe of each harpe being the one which is connected to the gnathos, in other words the homologue of the upper inner lobe of *Ormiscodes*. The majority of the species have very long hairs interspersed in the abdominal vestiture.

Dirphia is here used in a very different sense from the usual one. It includes only a part of the species usually placed in the genus, but in addition it includes the species usually listed in *Heliconisa*, *Kentroleuca*, *Eudyma*, and *Ithomisa*, as well as the groups placed by Bouvier in *Dirphiopsis* and *Pseudodirphia*. There is great similarity in genitalia as well as in other structural features among these forms, and they seem closer to one another than do the subgenera of *Ormiscodes*.

There are, however, structural differences among the seven subgenera here recognized. However, a number of the differences indicated are closely correlated, thus the distance between the eyes and the positions of the upper and lower ends of the eyes are all merely expressions of the size of the eyes, and the reduction in the labial palpi is correlated with the reduction of the proboscis fossa. Thus the number of actual characters separating the subgenera is less than the descriptions would suggest. Moreover, the subgenera merge together in such a way as to make it undesirable to treat the groups as genera. For example there is every intervening stage between bipectinate and quadripectinate male antennae. The four small subgenera all have the fore tibiae spined, but the spine has apparently arisen independently in *Kentroleuca* and in the other groups. *Kentroleuca* seems to have arisen from *Dirphiopsis*, for in *D. (K.) lineosa* and *D. (K.)*

albilinea Schaus the strongly oblique pre-median line of the forewing which characterized a large section of *Dirphiopsis* is recognizable; the small pale lateral spots on the abdomen characteristic of this same section of *Dirphiopsis* are present in *Kentroleuca*, especially in *D. (K.) dukinfieldi* Schaus; and the male antennae are bipectinate as in *Dirphiopsis*. The other group of subgenera with anterior tibial spines is not related to *Dirphiopsis* or *Kentroleuca* but seems to have arisen from *Dirphia* proper, *Eudyma* being most *Dirphia*-like, the others progressively modified by reduction in the size of the eyes, in the length and segmentation of the palpi, in the depth of the proboscis fossa, and in the wing scaling of the males. The relation between *Dirphia* proper and *Dirphiopsis* is emphasized by the Y-shaped white mark of the forewing, occurring in the *tarquinia* group of *Dirphia* and in several *Dirphiopsis*.

Frontal protuberance strong and directed forward or occasionally low and directed largely downward. Shortest distance between eyes usually one-third to one-fifth of length of an eye, more rarely greater, up to more than length of an eye, upper ends of eyes usually extending well above lower margins of antennal sockets but sometimes not reaching these margins, lower ends of eyes usually extending below lower end of face but sometimes not reaching the latter.

Antennae as long as thorax or longer, flagellum of male not scaled, that of female usually also without scales but sometimes with a row or series of scales along dorsal surface extending in some species to apex, antennae bipectinate or quadripectinate, showing various degrees of reduction of distal rami and therefore all stages between these two conditions; rami slender, curved downward, particularly so in species with bipectinate or nearly bipectinate antennae, basal rami usually each with one to several terminal

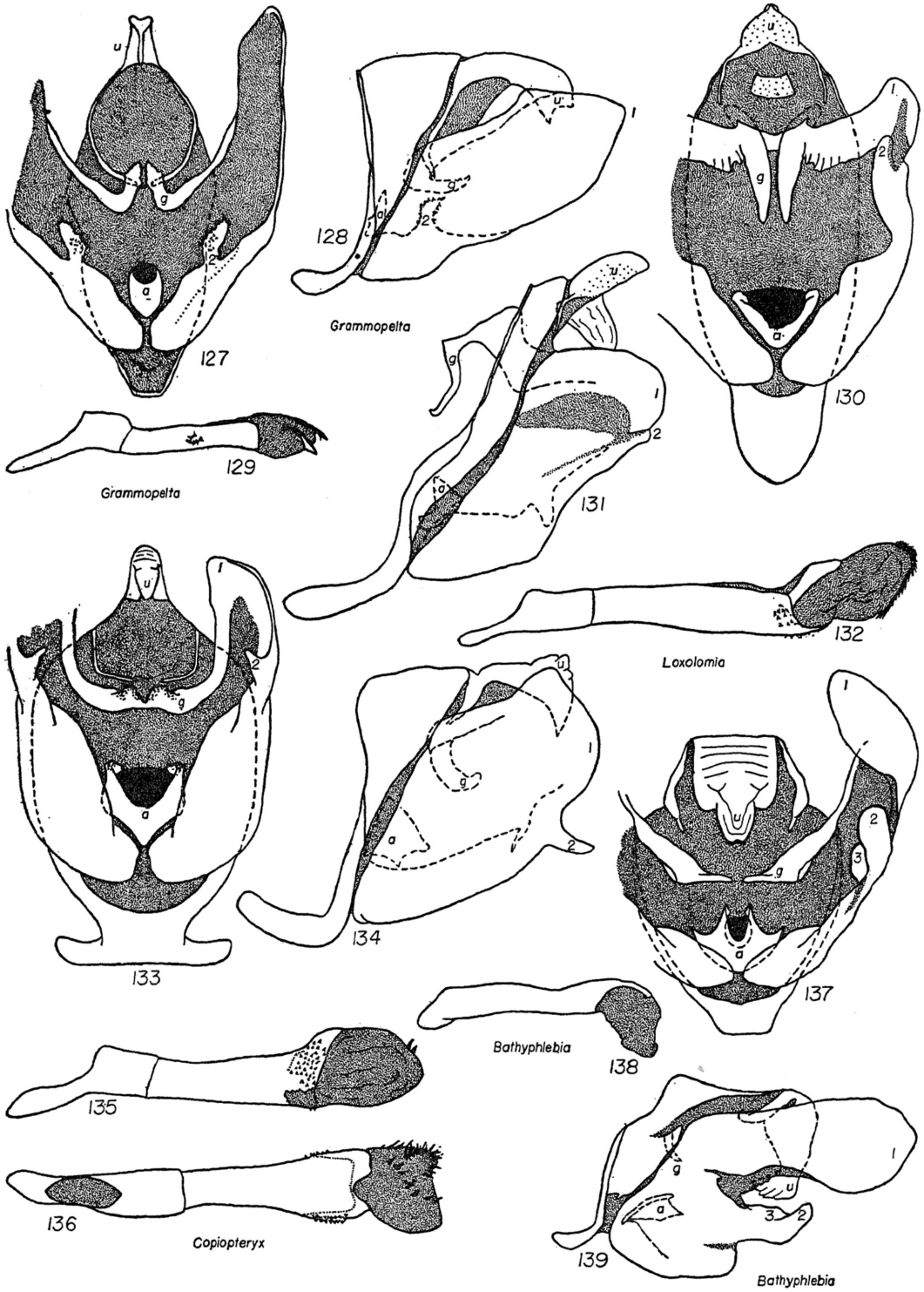
GENITALIC STRUCTURES

FIGS. 116-118. *Rhescyntis (Paradaemonia) pluto* (Westwood). 116. Ventral view. 117. Lateral view. 118. Aedeagus.

FIGS. 119-121. *Rhescyntis (Rhescyntis) hippodamia* (Cramer). 119. Ventral view. 120. Lateral view. 121. Aedeagus.

FIGS. 122-124. *Rhescyntis (Dysdaemonia) boreas* (Cramer). 122. Ventral view. 123. Lateral view. 124. Aedeagus.

FIGS. 125-126. *Rhescyntis (Titaea) orsinome* (Hübner). 125. Uncus. 126. Inner view of clasper.



bristles which are sometimes inconspicuous and no longer than setae; antennal shaft somewhat compressed, usually distinctly carinate ventrally, antennal cones large, present in distal half of antenna and often indicated to base, shaft usually with two inconspicuous bristles on under surface of each segment. Antennae of female bidentate, often weakly so, rarely the teeth elongate so that antennae are narrowly bipectinate, teeth with one or a few terminal or subterminal bristles, shaft of flagellum slightly flattened dorsoventrally, usually carinate, at least in the apical half, segments with inconspicuous bristles ventrally similar to those of male, antennal cones smaller than those of male, present in apical half to quarter of antenna.

Tentorial pits round to oval, lateral to and (except in species with greatly reduced frontal protuberance) slightly below frontal protuberance; clypeus six or more times as broad as long and usually separated from the frons by an inconspicuous groove; pilifers rather distinct. Mandibular rudiments small to moderate in size. Proboscis fossa usually longer than broad, occasionally twice as long as broad, with the walls vertical, more rarely only as long as broad, with the walls sloping or even almost completely absent; maxillary stipites more or less free from wall of fossa, extending backward to about middle of palpal sockets, galeae reduced to small lobes or projections, often with elongated scales or hairs, except in subgenus *Periphoba* in which the galeae are several times as long as broad, somewhat curled; labial palpi arising near posterior end of fossa, usually three-segmented and extending forward to a point in front of frons, occasionally two-segmented or even one-segmented, in the latter case not reaching clypeus. Postoccipital bridge broad.

Thorax covered with long, suberect hairs, often with some extraordinarily long ones arising from tegulae; patagia broad; parapatagia lamelliform; tegulae not reaching anterior median angle of scutellum or nearly

reaching this angle; anepisternum small, anepisternal suture horizontal or directed slightly upward posteriorly towards a point slightly above to slightly below middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture continued in about same direction as straight lower portion, no conspicuous curved region intervening between these two main portions.

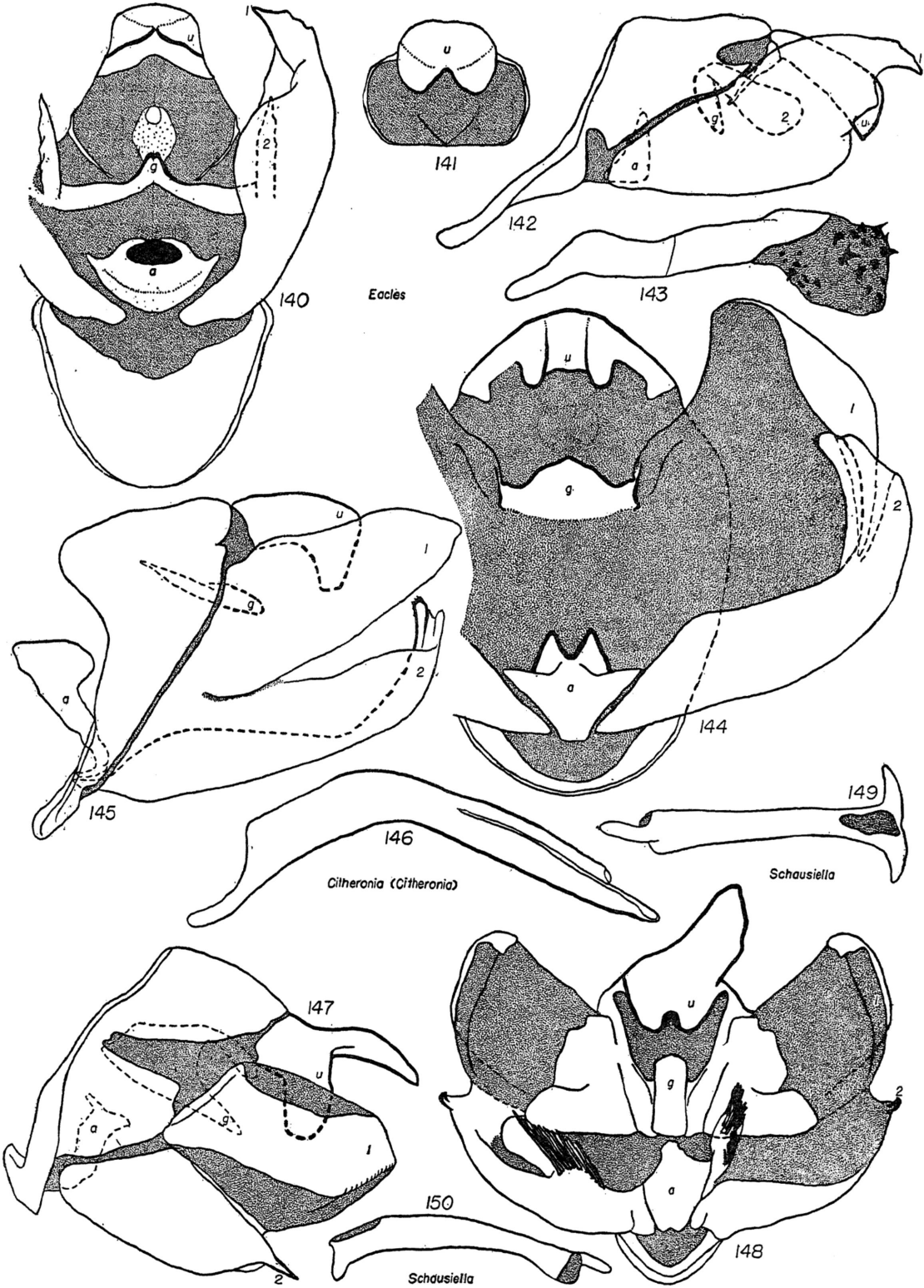
Fore tibiae about as long as tarsi or slightly shorter; epiphysis of male moderate sized to large, usually without long hairs, that of female small or absent; tibial spines usually absent, but fore tibia and sometimes also middle tibia sometimes with an outer apical spine; tibial spurs exceeding vestiture of tibiae, longer ones longer than diameter of tibiae, apical one-third to two-thirds concave on one side, the margins finely serrated; posterior tibiae with a single subapical spur in addition to the apical pair; tarsal spines absent except for penultimate fore tarsal segment of female, spine-bearing lobes on this segment bare, adjacent bare areas of following segment not extending to apex of segment, sole scaled (in two small subgenera these spines and bare areas of the fore tarsi of the female are absent); claws finely serrate; arolium and pulvilli well developed.

Forewings with outer margins convex to slightly concave; hind wings with anal angles rounded to moderately angulate; vestiture of wings consisting of scales, overlain in most areas by elongate scales or short hairs, in a few species scales sparse or even completely absent in large areas of the wing; vein M_2 of forewing arising near or in front of middle of apex of discal cell, M_1 arising from anterior apical angle of cell or stalked with radial stem, R_1 arising before apex of discal cell, hind wing with 3V absent or small, R_2 arising from cell before apex.

Abdomen usually robust, covered with long hairs, which are usually suberect and usually form transverse color bands; uncus of male small, slightly down-curved apically, the apex

GENITALIC STRUCTURES

- FIGS. 127-129. *Grammopelia lineata* (Schaus). 127. Ventral view. 128. Lateral view. 129. Aedeagus.
 FIGS. 130-132. *Loxolomia serpentina* Maassen. 130. Ventral view. 131. Lateral view. 132. Aedeagus.
 FIGS. 133-136. *Copiopteryx semiramis* (Cramer). 133. Ventral view. 134. Lateral view. 135. Lateral view of aedeagus. 136. Dorsal view of aedeagus.
 FIGS. 137-139. *Bathyphebia aglia* Felder. 137. Ventral view. 138. Aedeagus. 139. Lateral view.



simple or broadly truncate; gnathos heavily sclerotic, not much produced medially, connected at sides to upper basal portions of harpes; anellus absent; harpes very short and broadly fused to ninth segment.

Eighth tergum of female with a sclerotic band; eighth sternum with a sclerotic band which is sometimes interrupted medially, this band usually divided so that there is a prevulvar and a postvulvar portion, neither of which is produced posteriorly, or postvulvar one produced or lobed medially, either prevulvar or postvulvar, or occasionally both, may be absent medially; ductus bursae sometimes partly sclerotic; bursa usually slender posteriorly but elongate-cylindrical to nearly spherical anteriorly; ductus seminalis arising from right-hand side of base of bursa.

KEY TO THE SEVEN SUBGENERA OF *Dirphia*

1. Fore tibiae subequal to tarsi, unarmed. 2
Fore tibiae at least slightly shorter than tarsi, each with outer apical spine 4
2. Antennae of male bipectinate, eighth sternum of male without lateral spines . . . *Dirphiopsis*
Antennae of male quadripectinate, or, if bipectinate, eighth sternum of male with a large spine on each side 3
3. Antennae of male with apical rami greatly reduced, mere stubs on outer side, or rarely bipectinate; eighth sternum of male with large spine on each side *Periphoba*
Antennae of male with apical rami not greatly shorter than basal rami; eighth sternum of male unarmed *Dirphia*
4. Labial palpi one-segmented, not reaching clypeus; shortest distance between eyes slightly more than length of eye . . . *Heliconisa*
Labial palpi two- or three-segmented, reaching in front of face; shortest distance between eyes less than length of eye 5
5. Labial palpi three-segmented; shortest distance between eyes about three-fifths of length of an eye or less. 6
Labial palpi two-segmented; shortest distance between eyes about four-fifths the length of an eye. *Ithomisa*

6. Middle tibiae unarmed; antennal rami of male with terminal bristles longer than setae *Kentroleuca*
Middle tibiae armed with outer apical spine; antennal rami without bristles or with inconspicuous ones not longer than setae *Eudyarida*

SUBGENUS *DIRPHIA* HÜBNER

Figures 78, 362-364

Dirphia HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 153. Type: *Phalaena tarquinia* Cramer, designated by Grote, 1874, Proc. Amer. Phil. Soc., vol. 14, p. 259.

Phricodia HÜBNER, [1820], Verzeichniss bekannter Schmettlinge, p. 187. Type: *Phalaena avia* Cramer, designated by Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 788.

Plateia HÜBNER, [1820], Verzeichniss bekannter Schmettlinge, p. 187. Type: *Phalaena somniculosa* Cramer, designated by Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 791.

Hyperdirphia PACKARD, 1903, Jour. New York Ent. Soc., vol. 11, p. 245. Type: *Phalaena tarquinia* Cramer, by original designation.

Phidira DRAUDT, 1930, in Seitz, Macrolepidoptera of the world, vol. 6, p. 782. Type: *Dirphia araucariae* Jones (monobasic).

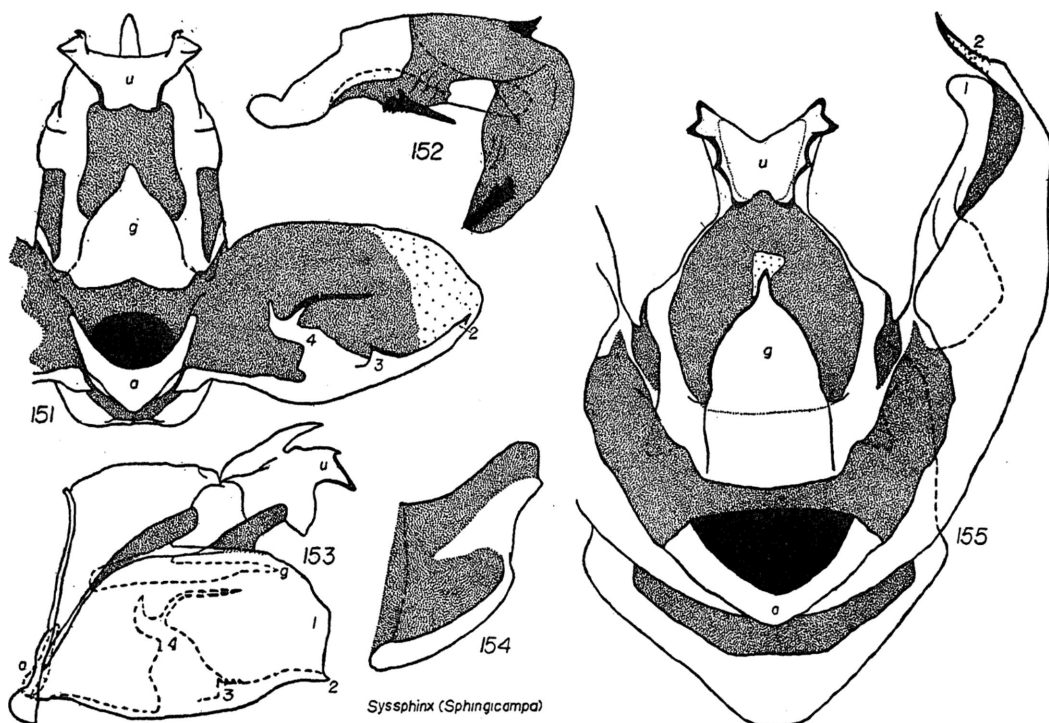
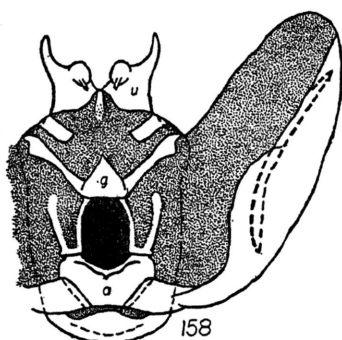
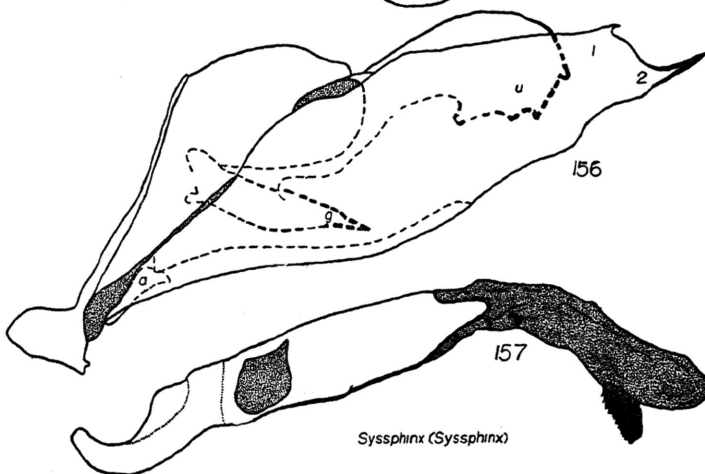
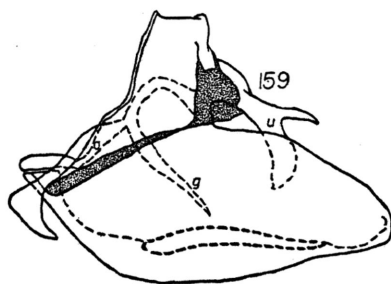
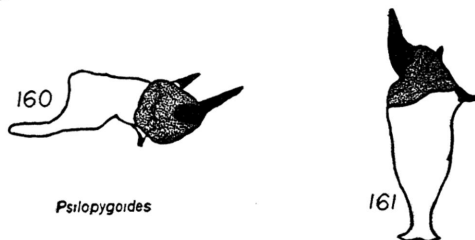
Antennae of male quadripectinate, apical rami much reduced only in certain species with narrowly pectinate antennae; basal rami provided with terminal bristles longer than setae of rami or not, or bristles absent. Antennae of female bidentate. Shortest distance between eyes one-third to one-fifth of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes reaching below lower end of face; frontal protuberance of moderate size. Proboscis fossa rather deep, with vertical walls; labial palpi three-segmented, reaching to a point in front of face, second segment much the longest; galeae rudimentary, not curled. Fore and middle tibiae subequal to tarsi, without spines; penultimate segment of

GENITALIC STRUCTURES

FIGS. 140-143. *Eacles imperialis* (Drury). 140. Ventral view. 141. Posterior view of uncus. 142. Lateral view. 143. Aedeagus.

FIGS. 144-146. *Citheronia (Citheronia) regalis* (Fabricius). 144. Ventral view. 145. Lateral view. 146. Aedeagus.

FIGS. 147-150. *Schausiella polybia* (Stoll). 147. Lateral view. 148. Ventral view. 149. Dorsal view of aedeagus. 150. Lateral view of aedeagus.

*Syssphinx (Bouvieria)**Psilopygoides**Syssphinx (Syssphinx)**Psilopygoides*

fore tarsus of female with the usual apical pair of spines and adjacent bare areas. Eighth sternum of male unarmed.

This subgenus includes Bouvier's (1935) groups of *Dirphia somniculosa* and *avia* and part of his group of *targuinia*. The species listed below have been available for study and fall in this subgenus: *Dirphia* (*Dirphia*) *acidelia* (Hübner), *aculea* Vuillot, *araucariae* Jones, *avia* (Stoll), *avicula* Draudt, *baroma* (Schaus), *callosa* Draudt, *centralis* Johnson and Michener, *curitiba* Draudt, *dentimacula* Schaus, *fassli* (Dognin), *fraterna* (C. and R. Felder), *horca* Dognin, *horcana* Schaus, *hortsensia* (Schaus), *javarina* Butler, *jorgenseni* (Schaus), *melanosoma* Niepelt, *muscosa* Schaus, *panamensis* (Schaus), *radiata* Dognin, *rothschildi* (Dognin), *rufescens* Johnson and Michener, *somniculosa* (Cramer), *subhorca* Dognin, *tarpeia* (Hübner), *targuinia* (Cramer), *theobromana* Draudt, and *thliptophana* (C. and R. Felder). The species of this subgenus occur from Mexico to Argentina.

SUBGENUS PERIPHOBIA HÜBNER

Figures 365-367

Periphobia HÜBNER, [1820], Verzeichniss bekannter Schmettlinge, p. 187. Type: *Periphobia amalia* (Cramer) = *Altacus amalia* Stoll (present designation).

This subgenus can be recognized by the characters listed below. It is closest to *Dirphia* proper, but in the reduction of the apical rami of the antennae it approaches *Dirphiopsis*. It is not, however, merely an intermediate between *Dirphia* and *Dirphiopsis*, for *Periphobia* has a number of peculiar characters of its own, such as the curled galeae and the spines of the eighth sternum of the male.

Antennae of male large, bipectinate or quadripectinate with apical rami greatly reduced, mere stubs on outer side; basal rami provided with terminal bristles longer than setae of rami. Antennae of female bidentate. Shortest distance between eyes about one-

third of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes reaching below lower end of face, frontal protuberance of moderate size. Proboscoidal fossa rather deep, with vertical walls; labial palpi three-segmented, reaching to a point in front of face, second segment much the longest; galeae short but curled. Fore and middle tibiae subequal to tarsi, without spines; penultimate segment of fore tarsus of female with the usual apical pair of spines and adjacent bare areas. Eighth sternum of male with large sub-lateral spine.

This subgenus includes Bouvier's group of *Dirphia hircia* except for *D. rubicunda* Bouvier which I have not seen but which probably falls in *Dirphia* proper. The following species have been studied and found to fall in this subgenus: *Dirphia* (*Periphobia*) *afflata* (Strand), *arctus* Bouvier, *hircia* (Cramer) (*amilia*, the type species, is probably a form of *hircia*), *nigra* (Dognin), *parallela* Schaus (antennae of male bipectinate), and *rosacea* (Draudt). The species of this subgenus range from Central America to Brazil.

SUBGENUS DIRPHIOPSIS BOUVIER

Figures 368-370

Dirphiopsis BOUVIER, 1928, Compt. Rendus Acad. Sci., Paris, vol. 186, p. 820. Type: *Dirphia multicolor* Walker, designated by d'Almeida, 1943, Bol. Mus. Nac., Brazil, Zool., no. 7, p. 3.

Pseudodirphia BOUVIER, 1928, Compt. Rendus Acad. Sci., Paris, vol. 186, p. 820. Type: *Phalaena eumedide* Cramer, designated by d'Almeida, 1943, Bol. Mus. Nac., Brazil, Zool., no. 7, p. 9.

Antennae of male bipectinate, rami provided with terminal bristles longer than setae of rami. Antennae of female bidentate. Shortest distance between eyes one-third to one-fifth of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes reaching below lower end of face, frontal protuberance of

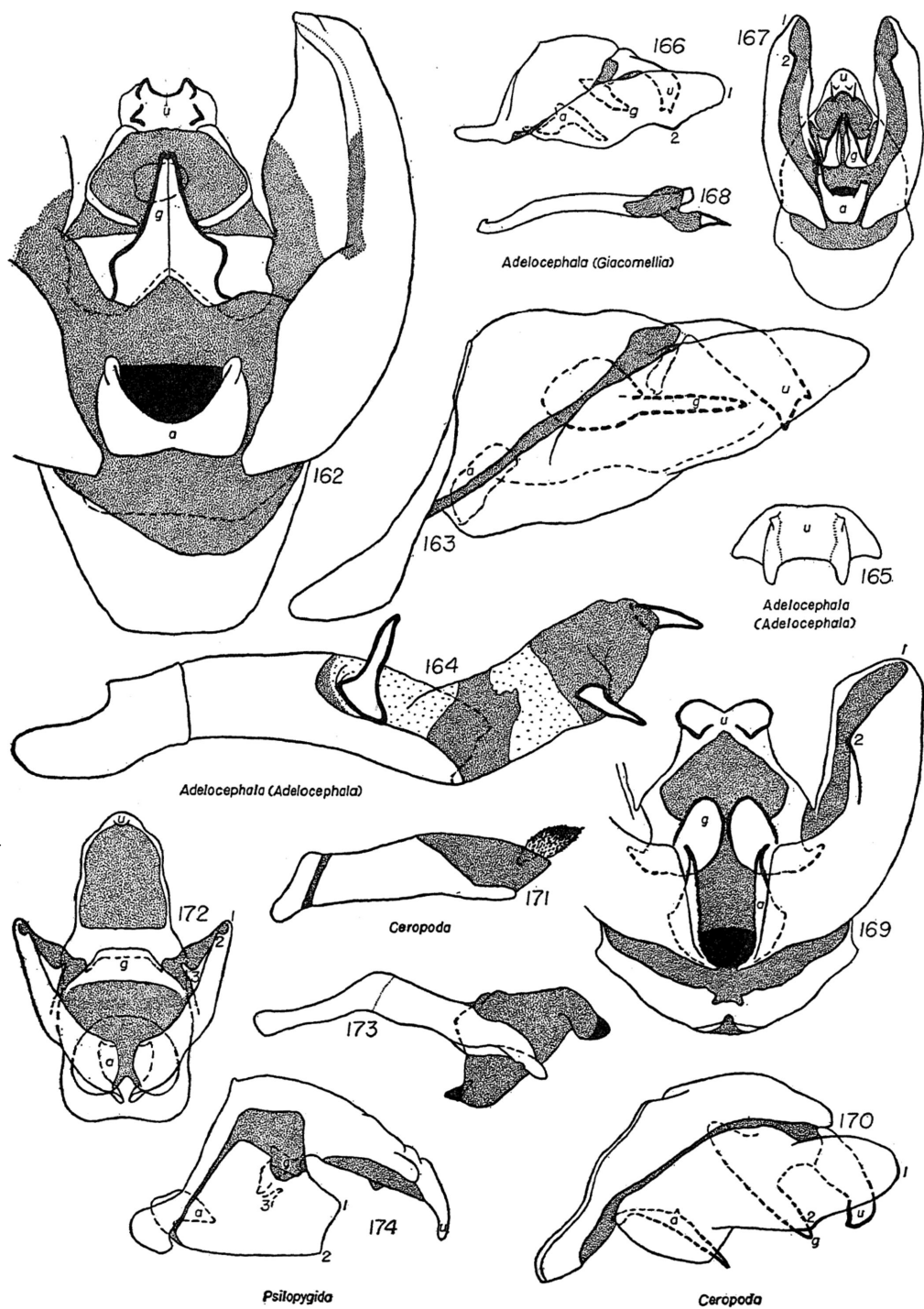
GENITALIC STRUCTURES

FIGS. 151-153. *Syssphinx* (*Bouvierina*) *hagei* (Druce). 151. Ventral view. 152. Aedeagus. 153. Lateral view.

FIG. 154. *Syssphinx* (*Sphingicampa*) *bicolor* (Harris). Inner view of clasper.

FIGS. 155-157. *Syssphinx* (*Syssphinx*) *molina* (Cramer). 155. Ventral view. 156. Lateral view. 157. Aedeagus.

FIGS. 158-161. *Psilopygoides oda* (Schaus). 158. Ventral view. 159. Lateral view. 160. Lateral view of aedeagus. 161. Ventral view of aedeagus.



moderate size. Proboscoid fossa rather deep, with vertical walls; labial palpi three-segmented, reaching to a point in front of face, second segment much the longest; galeae rudimentary, not curled. Fore and middle tibiae subequal to tarsi, without spines; penultimate segment of fore tarsus of female with the usual apical pair of spines and adjacent bare areas. Eighth sternum of male unarmed.

In *Dirphiopsis* the lower lobe of the clasper usually projects more or less outward instead of directly to the rear as is usual in the other subgenera. In some *Dirphiopsis* (certain but not all of the species of the group which Bouvier called *Pseudodirphia*) the antennae lack or nearly lack ventral carinae which are present in all other groups. The very short ninth segment of the male shown in the figure of *Dirphiopsis multicolor* is not characteristic of all *Dirphiopsis*.

This subgenus includes the species listed by Bouvier (1934) under his genera *Dirphiopsis* and *Pseudodirphia*, except for those removed to *Kentroleuca*. The following species have been studied and found to fall in this subgenus: *agis* (Cramer), *alba* Druce, *andicola* (Bouvier), *angulata* (Bouvier), *aphrodite* Schaus, *aurora* (Vuillot), *epiolina* (Felder), *eumedide* (Stoll), *flora* Schaus, *gregatus* (Bouvier), *imperialis* Draudt, *infusata* (Bouvier), *medinensis* Draudt, *menander* Druce, *mexicana* (Bouvier), *multicolor* Walker, *niceros* (Dognin), *obliqua* (Bouvier), *oridoclea* Schaus, *pallida* Walker, *peruvianus* (Bouvier), *pictulata* Schaus, *pulchra* Bouvier, *pulchricornis* Walker, *regia* Draudt, *schreiteri* (Schaus), *triplicata* Johnson, *trisinata* (Felder), *undulinea* Johnson, and *varia* Walker. The species of this subgenus occur from Mexico to Argentina.

SUBGENUS *KENTROLEUCA* DRAUDT

Figures 79, 374-376

Kentroleuca DRAUDT, 1930, in Seitz, *Macrolepidoptera of the world*, vol. 6, p. 783. Type: *Heliconia lineosa* Walker (monobasic).

Antennae of male bipectinate, rami provided with terminal bristles longer than setae of rami. Antennae of female bidentate. Shortest distance between eyes one-third of length of an eye or slightly more, upper ends of eyes scarcely reaching lower margins of antennal sockets, lower ends of eyes reaching below lower end of face, frontal protuberance rather small. Proboscoid fossa shallow, with subvertical walls; labial palpi three-segmented, reaching to a point in front of face, second segment much the longest; galeae rudimentary, not curled. Fore tibia shorter than tarsus, with an outer apical spine, middle tibia unarmed; fore tarsi without spines or bare areas. Eighth sternum of male unarmed.

This subgenus includes *Dirphia* (*Kentroleuca*) *albilinea* (Schaus), *dukinfieldi* (Schaus), and *lineosa* (Walker). These species occur in Brazil and Paraguay.

SUBGENUS *EUDYARIA* GROTE

Figure 80

Eudytaria GROTE, 1896, Mittheil. Roemer-Mus., Hildesheim, no. 6, p. 4. Type: *Dirphia venata* Butler, by original designation.

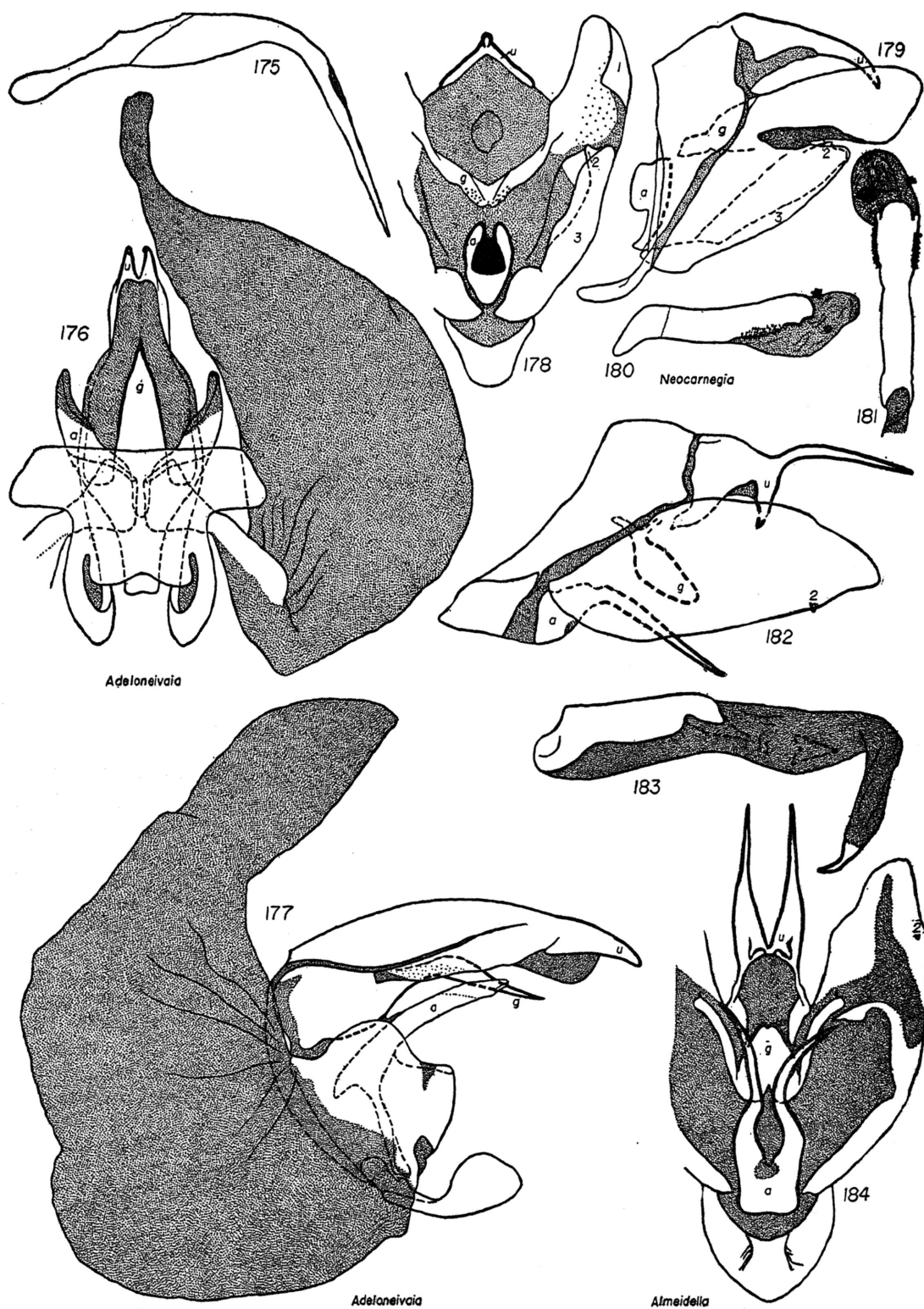
Antennae of male quadripectinate, with apical rami very short, or bipectinate; terminal bristles of basal rami absent or inconspicuous, not longer than setae of rami. Antennae of female narrowly bipectinate. Shortest distance between eyes one-third to three-fifths of the length of eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes reaching lower end of face or not, frontal protuberance of moderate size to very low. Proboscoid fossa shallow, with sloping walls; labial palpi three-segmented, reaching to a point in front of face, second segment much the longest, third segment sometimes immovably fused to second; galeae rudimentary, not curled. Fore and middle tibiae slightly shorter than tarsi, each with a spine on outer apical angle; penultimate segment of fore tarsus of female with the usual apical pair of spines and ad-

GENITALIC STRUCTURES

FIGS. 162-165. *Adelocephala* (*Adelocephala*) *cadmus* Herrich-Schäffer. 162. Ventral view. 163. Lateral view. 164. Aedeagus. 165. Posterior view of uncus.

FIGS. 166-168. *Adelocephala* (*Giacomellia*) *bilineata* (Burmeister). 166. Lateral view. 167. Ventral view. 168. Aedeagus.

FIGS. 172-174. *Psilopygida crispula* (Dognin). 172. Ventral view. 173. Aedeagus. 174. Lateral view.



jacent bare areas. Eighth sternum of male unarmed.

This is a small subgenus, of which I have studied *Dirphia* (*Eudyarina*) *carilapha* (Schaus) which has bipectinate antennae and a much-reduced frontal protuberance, and *D. (E.) venata* Butler, which has short apical rami on the antennae of the male and a conspicuous frontal protuberance. The species of this subgenus occur in Argentina, Paraguay, and Uruguay.

SUBGENUS ITHOMISA OBERTHÜR

Ithomisa OBERTHÜR, 1881, *Études d'entomologie*, vol. 6, p. 114. Type: *Ithomisa kinkelini* Oberthür (monobasic).

Antennae of male quadripectinate, with apical rami very short; terminal bristles of basal rami absent or inconspicuous, not longer than setae of rami. Antennae of female bidentate. Shortest distance between eyes four-fifths of length of eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes scarcely reaching lower end of face, frontal protuberance very low and directed downward. Proboscis shallow, with sloping walls; labial palpi two-segmented, reaching to a point in front of face, second segment somewhat longer than first; galeae rudimentary, not curled. Fore tibia slightly shorter than tarsus, with spine on outer apical angle; middle tibiae with this angle acute but not produced into a spine; penultimate segment of fore tarsus of female with the usual apical pair of spines and adjacent bare areas. Eighth sternum of male unarmed.

This subgenus contains but few species. Those studied by me are *Dirphia* (*Ithomisa*) *catherina* (Schaus) and *kinkelini* (Oberthür), which occur from southern Brazil to Argentina.

SUBGENUS HELICONISA WALKER

Figures 81, 371-373

Heliconisa WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British

Museum, pt. 6, p. 1333. Type: *Heliconisa impar* Walker (= *Nyctemera pagenstecheri* Geyer), by original designation.

Antennae of male essentially bipectinate but apical rami present as stubs on inner side; terminal bristles of basal rami absent or inconspicuous, not longer than setae of rami. Antennae of female bidentate. Shortest distance between eyes slightly more than length of an eye, upper ends of eyes not reaching so high as lower margins of antennal sockets, lower ends of eyes not reaching lower end of face, frontal protuberance very low and directed downward. Proboscis virtually absent, without walls; labial palpi one-segmented, not reaching to clypeus; galeae rudimentary, not curled. Fore tibia shorter than tarsus, with spine on outer apical angle; middle tibia with this angle acute but not produced into a spine; fore tarsi without these spines or bare areas. Eighth sternum of male unarmed.

So far as known this subgenus contains only the type species, *Dirphia* (*Heliconisa*) *pagenstecheri* (Geyer), from southern Brazil, Uruguay, and Argentina. It is a diurnal form.

GENUS CATHARISA JORDAN

Catharisa JORDAN, 1911, *Novitates Zool.*, vol. 18, p. 133. Type: *Catharisa cerina* Jordan (monobasic).

As no specimens have been available for study, the proper position of this genus has not been determined. It is clearly a hemileucine. The antennae of the female are bipectinate. The fore tibiae are shorter than the tarsi, and each bears an apical spine. The posterior tibiae lack subapical spurs. This genus, of which but one species is known, occurs in Paraguay.

TRIBE POLYTHYSANINI

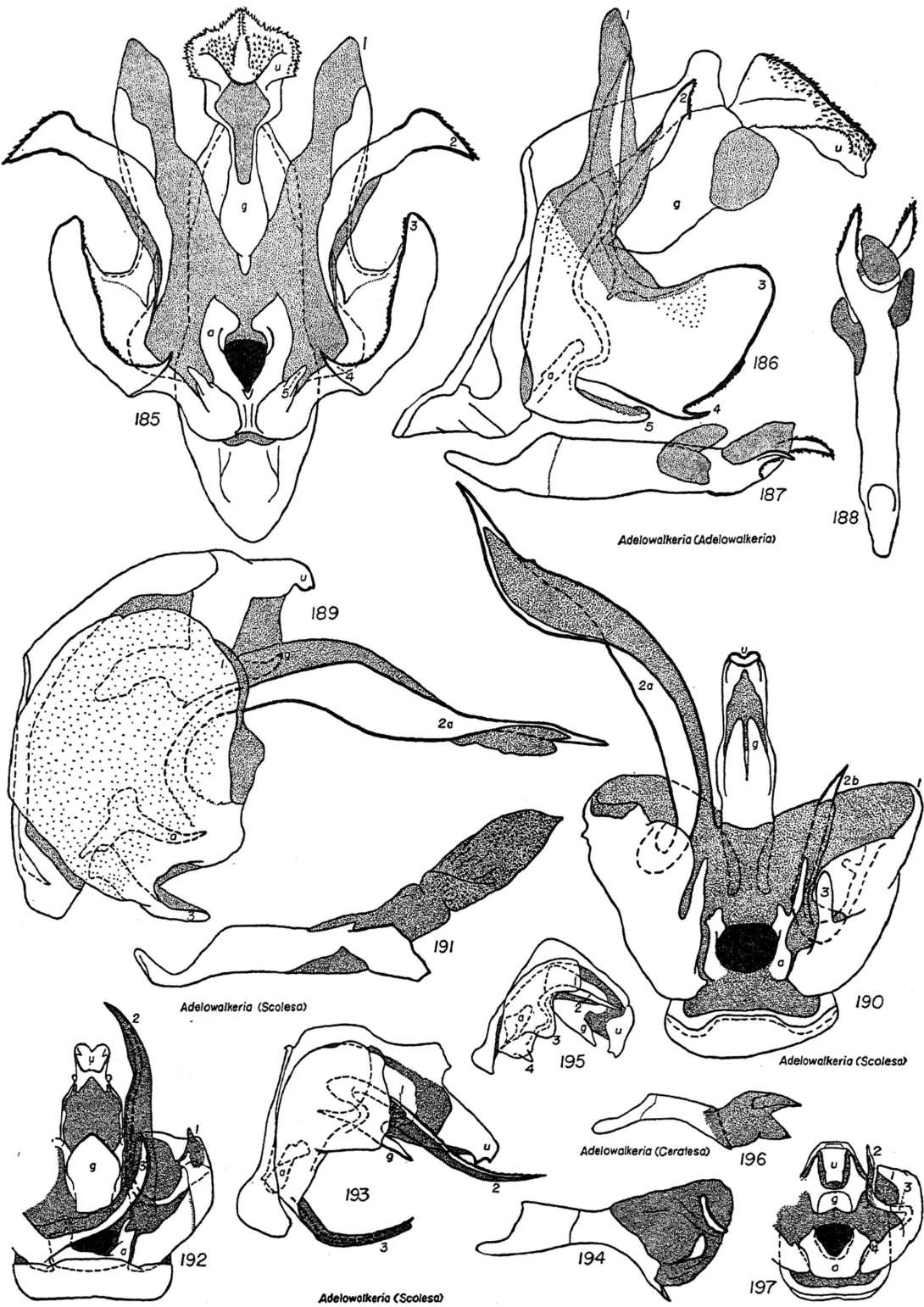
This tribe, containing the single genus *Polythysana*, is so different from the remainder of the Hemileucinae that it should perhaps be recognized as a distinct subfamily. Although its wing venation is like that of the

GENITALIC STRUCTURES

FIGS. 175-177. *Adeloneivaia subangulata* (Herrich-Schäffer). 175. Aedeagus. 176. Ventral view. 177. Lateral view.

FIGS. 178-181. *Neocarnegie basirei* (Schaus). 178. Ventral view. 179. Lateral view. 180. Lateral view of aedeagus. 181. Dorsal view of aedeagus.

FIGS. 182-184. *Almeidella approximans* (Schaus). 182. Lateral view. 183. Aedeagus. 184. Ventral view.



Hemileucinae, it exhibits several characters that suggest a relationship with the Saturniinae. Among these is the absence of the frontal protuberance, the presence of eye spots on both forewings and hind wings, and the peculiar, inconspicuous, blunt, dorsoventrally flattened projections which represent the antennal cones. The latter are much like those of certain species of *Saturnia*, and there exists the possibility that the antennal "cones" of *Polythysana* are derived by reduction from multiple cones like those of the Saturniinae rather than from simple cones like those of the Hemileucinae.

GENUS *POLYTHYSANA* WALKER

Figures 84, 377-380

Polythysana WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 6, p. 1314. Type: *Attacus rubescens* Blanchard (monobasic).

This remarkable genus is placed in the Hemileucinae with hesitation. It is obviously primitive and seems about as closely related to the Palearctic *Aglaia* (Agliinae) and to some of the Saturniinae as to the Hemileucinae. Distinctive features are the peculiar reduced antennal cones and the presence of large eye spots on both forewings and hind wings.

Laterofrontal sutures rather widely separated from eyes; frontal protuberance entirely absent. Shortest distance between eyes about one and one-third times the length of an eye, upper ends of eyes not quite reaching so high as lower margins of antennal sockets, lower ends of eyes not reaching so far downward as lower end of face.

Antennae about one and one-half times as long as thorax, flagellum of male not scaled, that of female with some elongate scales dorsally in basal third; flagellum of male broadly quadripectinate to apex or nearly so, rami long and slender, nearly straight or

apical rami alone curved downward, apical rami nearly as long as basal rami, rami without bristles; antennal shaft not much compressed, not carinate ventrally, sometimes with a pair of weak ventral bristles near base of each segment of distal two-thirds of antenna; antennal cones reduced to small projections which are dorsoventrally flattened, slightly eroded and irregular and unpointed, present only on distal half of antenna. Antennae of female narrowly bipectinate, with the distal rami present as short stubs so that antennae might be considered quadripectinate; rami short, straight, flattened, each bearing one or more inconspicuous terminal bristles; antennal shaft similar to that of male, each segment with an inconspicuous pair of basal or subbasal ventral bristles; antennal cones similar to those of male, or sometimes subapical ones more elongated, with a simple pointed apex.

Tentorial pits oval, far from eyes, and at the ends of frontoclypeal suture; clypeus about three and a half times as broad as long, separated from frons by a distinct suture and extending farther forward than frons, having a distinct anterior face; pilifers indicated as broad convexities. Mandibular rudiments rather large and slightly protuberant, widely separated from the eye margins. Proboscis fossa extremely shallow, without walls; maxillary stipites large and extending backward behind the palpal sockets to anterior margin of postoccipital bridge; labial palpi arising well behind middle of fossa, one-segmented, extending forward almost to mandibular rudiments. Postoccipital bridge broad and heavily sclerotic.

Thorax covered with long hair, among which on dorsum are even longer hair-like scales; patagia and parapatagia both narrow and lamelliform; tegulae not reaching anterior median angle of scutellum; anepisternum

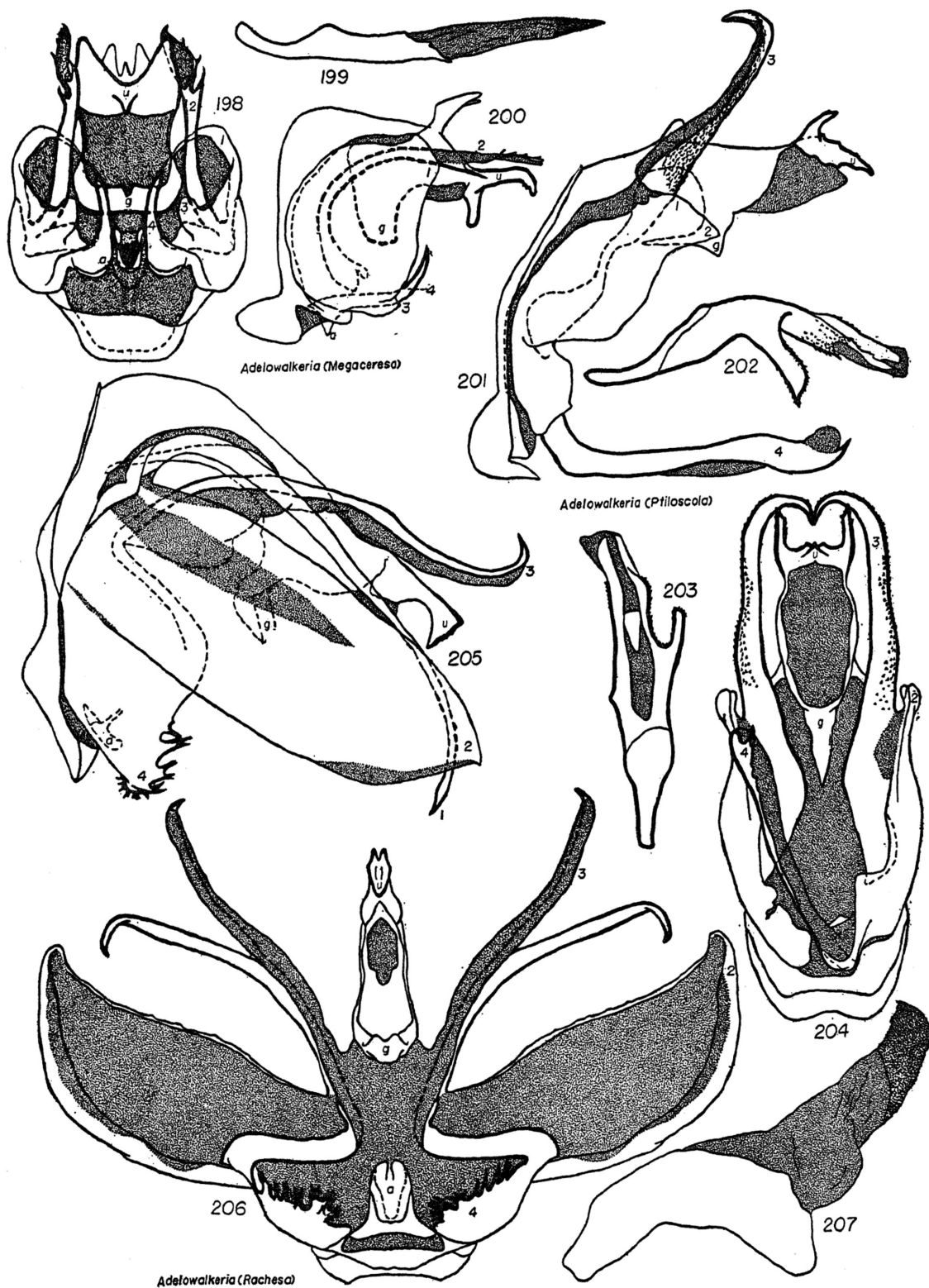
GENITALIC STRUCTURES

FIGS. 185-188. *Adelowalkeria* (*Adelowalkeria*) *flavosignata* (Walker). 185. Ventral view. 186. Lateral view. 187. Lateral view of aedeagus. 188. Dorsal view of aedeagus.

FIGS. 189-191. *Adelowalkeria* (*Scolesa*) *analís* (Rothschild). 189. Lateral view. 190. Ventral view. 191. Aedeagus.

FIGS. 192-194. *Adelowalkeria* (*Scolesa*) *hypoxantha* (Rothschild). 192. Ventral view. 193. Lateral view. 194. Aedeagus.

FIGS. 195-197. *Adelowalkeria* (*Ceratesa*) *hemirhoda* (Schaus). 195. Lateral view. 196. Aedeagus. 197. Ventral view.



small, anepisternal suture directed slightly upward posteriorly towards a point below middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in same direction as straight lower portion of this suture, a curved region intervening between these two main portions.

Fore tibiae subequal to tarsi or slightly shorter; epiphysis of male long and slender, reaching to apical third of tibia, with long hairs; epiphysis of female absent; tibial spines absent; tibial spurs exceeding vestiture of tibiae, but little longer than tibial diameter, their apical thirds concave on one side, margins finely serrated; posterior tibiae without subapical spurs; tarsal segments one to three in male and one to four in female with two or three pairs of apical spines; penultimate fore tarsal segment of female with the usual pair of enlarged spines arising from apical lobes, these lobes largely bare, adjacent bare areas of following segment continuous with the entirely bare sole of the segment; claws simple; arolium and pulvilli well developed.

Forewings with outer margins straight or concave in female, concave in male; hind wings broad, with anal angle distinct but not produced; vestiture consisting of broad scales, overlain at wing bases, especially on hind wing, with elongated scales or hairs; both fore and hind wings with large eye spots.

Abdomen covered with scales, overlain on dorsum by recumbent hair-like scales, among which are interspersed very much longer hair-like scales; uncus of male distinctly longer than ninth tergum, from which it is separated by a distinct suture, apex of uncus not much down-curved; gnathos complete, somewhat produced medially; anellus present and free from harpes; harpes freely articulated to ninth segment, rather large, with a somewhat produced and ornate dorsal lobe separated from the broad median portion by a deep emargination, harpes with a long, spine-like process arising from ventral lower margin.

Ninth tergum of female with a distinct

sclerotic band; ninth sternum with a sclerotic prevulvar band and a somewhat produced postvulvar area which is not connected laterally to form a band.

This genus contains about four Chilean species.

SUBFAMILY LUDIINAE

Frons flat laterally, adjacent to eyes; laterofrontal sutures visible; frontal protuberance absent; antennae, when quadripectinate, with distal rami arising adjacent to basal rami of following segment except in *Goodia*; antennal cones simple or multiple; pilifers without bristles. Anepisternum at least moderately large, anepisternal suture directed at least slightly downward posteriorly. Vein M_1 of forewing arising from anterior apical angle of discal cell, usually separating from radials before apex of cell; vein M_2 of forewing arising near middle of apex of cell. Tibial spurs short, commonly not longer than tibial diameter, posterior tibiae without subapical spurs; tarsi with or without ventral, spine-like setae in addition to those of penultimate fore tarsal segment of female.

Larva with tubercles short and bearing a mixture of sharply pointed spines and long hairs. Pupa in a cocoon.

This is a small African subfamily, obviously related to the Saturniinae yet exhibiting many of the features of the more primitive American subfamilies.

SUBFAMILY SALASSINAE

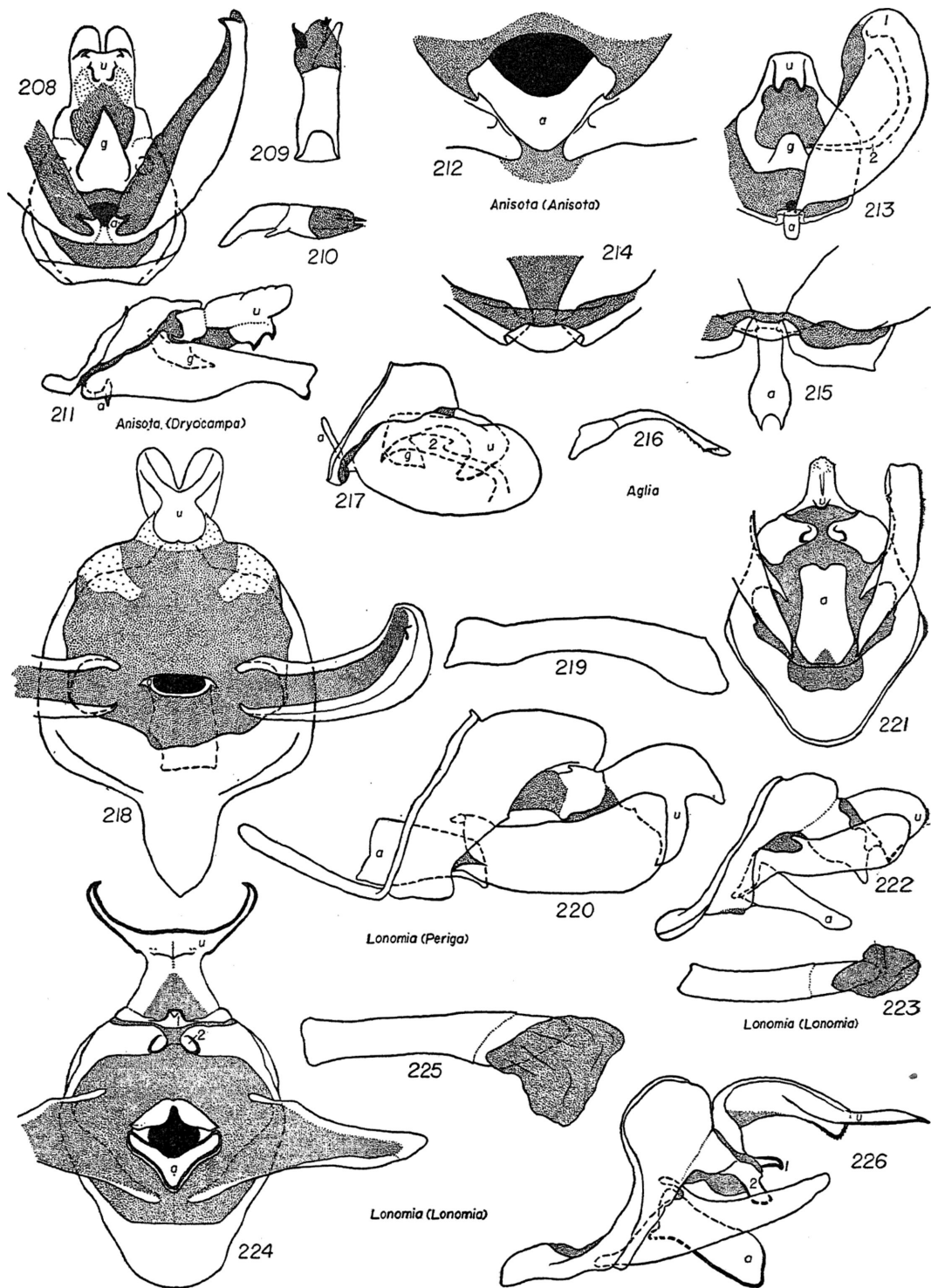
Frons flat laterally, next to eyes; laterofrontal sutures visible; frontal protuberance present; antennae with distal rami arising adjacent to basal rami of following segment; antennal cones absent; pilifers without bristles; anepisternum rather large but anepisternal suture horizontal, directed downward only at extreme posterior end. Veins M_1 and M_2 of forewing arising together from anterior apical angle of discal cell, being separately stalked from radials. Tibial spurs short, often

GENITALIC STRUCTURES

FIGS. 198-200. *Adelowalkeria (Megaceresa) pulchra* (Bouvier). 198. Ventral view. 199. Aedeagus. 200. Lateral view.

FIGS. 201-204. *Adelowalkeria (Ptiloscota) lilacina* (Schaus). 201. Lateral view. 202. Lateral view of aedeagus. 203. Dorsal view of aedeagus. 204. Ventral view.

FIGS. 205-207. *Adelowalkeria (Rachesa) colombia* (Schaus). 205. Lateral view. 206. Ventral view. 207. Aedeagus.



no longer than tibial diameter, posterior tibiae with a subapical spur; tarsi without ventral spine-like setae or with very few in addition to pair on penultimate fore tarsal segment of female.

Pupa in a cocoon.

This subfamily, which is represented by a single genus, *Salassa*, occurs in southern Asia. It seems to be just as much a relict type as *Aglia*. Obviously, as shown by the wing venation, it is related to the Saturniinae, yet it exhibits primitive characters, such as the frontal protuberance, the adjacent basal and apical rami of the male antennae, and the subapical hind tibial spur, which are not found in the Saturniinae.

SUBFAMILY SATURNIINAE

Frons flat or convex laterally; laterofrontal sutures visible or not; frontal protuberance absent (sometimes there is a superficially similar clypeal projection); antennae, when quadripectinate, with bases of rami well separated; antennal cones almost always multiple (absent or reduced to blunt and sometimes simple projections in *Saturnia*); pilifers without bristles. Anepisternum small, anepisternal suture horizontal or directed upward posteriorly. Veins M_1 and M_2 of forewing arising together from at or near anterior apical angle of discal cell, being separately stalked from radials. Tibial spurs short, often no longer than tibial diameter, posterior tibiae without subapical spurs; tarsi usually with ventral spine-like setae, in addition to those of penultimate fore tarsal segment of female.

Larva with tubercles, sometimes elongated into short horns, sometimes with hairs or short spines, or tubercles sometimes nearly absent; thoracic tubercles sometimes slightly longer than most of the others but not forked

apically, even in young larvae; subventral abdominal spines usually present on segments one to three, rarely on segments four and five also (see Munroe, 1949). Pupa enclosed in cocoon except in certain African groups.

This large subfamily of worldwide distribution contains several tribes, some of which are purely African. Only two tribes occur in the New World.

In addition to the characters listed in the above diagnosis, the members of this subfamily occurring in the Western Hemisphere agree in the following features¹:

Antennal rami slender and long, at least in male, nearly straight or but slightly curved; antennal shaft not compressed and without ventral carina; tegulae not reaching back as far as anterior median angle of scutellum; fore tibiae subequal to tarsi and without apical spines. Forewings with torni distinct though sometimes rounded.

KEY TO THE AMERICAN GENERA OF SATURNIINAE

1. Discal cell of both forewings and hind wings closed; forewings and hind wings each with an eye spot formed by colored lines which sometimes surround clear areas (tribe Saturniini) 2
- Discal cells open; forewings and hind wings without eye spots although often with clear areas (tribe Attacini) 5
2. Frons convex at sides next to eye; laterofrontal sutures not visible; posterior wings tailed *Actias*
- Frons flat at sides next to eyes; laterofrontal sutures visible; posterior wings not tailed 3
3. Mandibular rudiments very large, extending forward in front of clypeus and frons to form a pair of distinct projections on either side of

¹ It should be noted that many groups occurring in the Eastern Hemisphere do not agree in these characteristics.

GENITALIC STRUCTURES

FIGS. 208–211. *Anisota (Dryocampa) rubicunda* (Fabricius). 208. Ventral view. 209. Dorsal view of aedeagus. 210. Lateral view of aedeagus. 211. Lateral view.

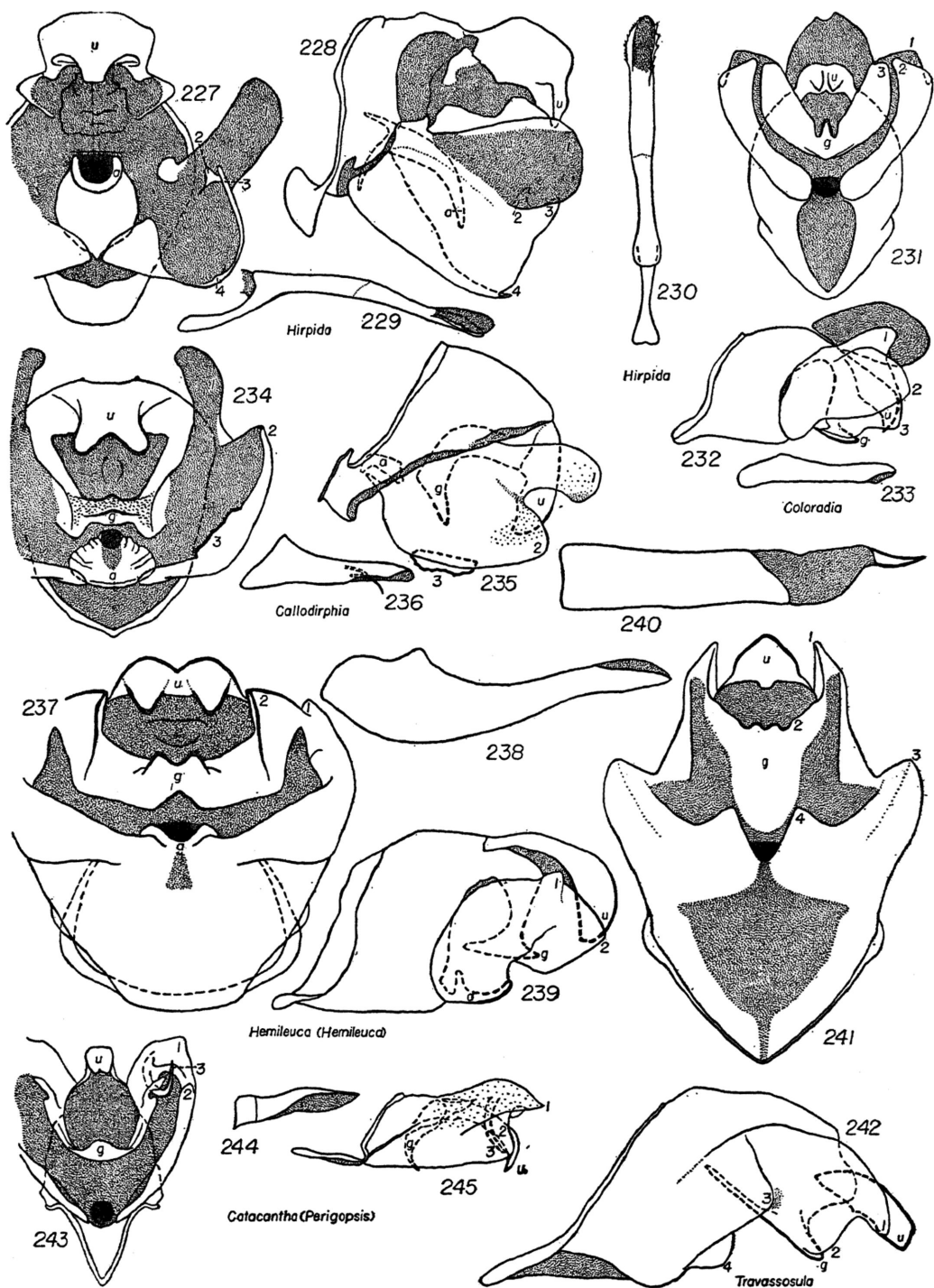
FIG. 212. *Anisota (Anisota) stigma* (Fabricius). Ventral view of anellus and adjacent structures.

FIGS. 213–217. *Aglia tau* (Linnaeus). 213. Ventral view. 214. Posteroventral view of region of anellus. 215. Anteroventral view of region of anellus. 216. Aedeagus. 217. Lateral view.

FIGS. 218–220. *Lonomia (Periga) circumstans* (Walker). 218. Ventral view. 219. Aedeagus. 220. Lateral view.

FIGS. 221–223. *Lonomia (Lonomia) electra* Druce. 221. Ventral view. 222. Lateral view. 223. Aedeagus.

FIGS. 224–226. *Lonomia (Lonomia) achelous* (Cramer). 224. Ventral view. 225. Aedeagus. 226. Lateral view.



- clypeus; labial palpi with at least indications of segmentation and reaching in front of face *Antheraea*
- Mandibular rudiments small, not forming such projections; labial palpi unsegmented, not reaching in front of face 4
4. Clypeus usually with a median projection; antennal cones clearly multiple; arolia and pulvilli well developed; epiphysis of male present *Copaxa*
- Clypeus not produced; antennal cones represented by small, eroded, or blunt-pointed projections (absent in some Eurasian species); pulvilli reduced in size or absent; epiphysis of male absent (in ours). *Saturnia*
5. Each wing with a large, well-defined, transparent, or rarely merely translucent fenestra at apex of discal cell; harpes of male genitalia much produced upward, above the uncus *Rothschildia*
- Wings without well-defined transparent areas although sometimes with poorly delimited crescentic translucent areas at apices of discal cells; male harpes not produced upward 6
6. Wings with crescentic translucent areas at apices of discal cells; antennae of female nearly as broadly pectinate as those of male; male genital harpe without a spiculate or dentate inflexed lobe along lower margin; vein R_1 of forewing arising before base of R_4 *Samia*
- Wings without translucent areas; antennae of female much more narrowly pectinate than those of male; male genital harpe with spiculate or dentate inflexed lobe on lower margin near base; vein R_1 , when present, arising beyond base of R_4 *Hyalophora*

GENUS SATURNIA SCHRANK

The American species usually placed in *Calosaturnia* and *Agapema* are closely related to a principally Palearctic group of saturniids, consisting of the so-called genera *Saturnia* Schrank, *Perisomena* Walker, *Eriogyna* Jordan, *Eudia* Jordan, *Neoris* Moore, and *Rina-*

ca Walker. The total number of species contained in all of these groups, American and Eurasian, is about 12. Structurally they are exceedingly similar, all having reduced antennal cones (sometimes eroded, sometimes simple, often absent); narrowly quadripectinate to bipectinate antennae in the female, with every intervening stage existing in the various species; reduced, often globular, and often fused labial palpi; reduced pulvilli (sometimes absent), and essentially similar genitalia, a noteworthy feature of which is the very large and bifurcate anellus. All the groups listed above are here regarded as subgenera of *Saturnia* (Schrank, 1802, Fauna Boica, vol. 2, p. 149). The Palearctic groups are characterized by Jordan (1911). The two American subgenera are differentiated in table 17. The Asiatic genera *Dictyoploca* Jordan and *Caligula* Moore are also very close to *Saturnia*, but differ by having clearly multiple antennal cones and less-reduced pulvilli. Probably they too should be included in *Saturnia*.

The following description is based principally upon the two American subgenera, although certain of the outstanding features of other subgenera are indicated:

Frons flat at sides; laterofrontal sutures visible; shortest distance between eyes a little more than one-half of length of an eye to one and one-half times length of an eye; upper ends of eyes extending slightly above lower margins of antennal sockets or not reaching these margins, lower ends of eyes extending scarcely below lower end of face or not reaching lower end of face.

Antennae one and one-third to one and two-thirds as long as thorax, flagellum not scaled or female with a few scales on dorsum of proximal third; flagellum of male broadly quadripectinate, virtually to apex; rami without bristles, basal rami subequal to apical

GENITALIC STRUCTURES

FIGS. 227-230. *Hirpida gaujoni* (Dognin). 227. Ventral view. 228. Lateral view. 229. Lateral view of aedeagus. 230. Dorsal view of aedeagus.

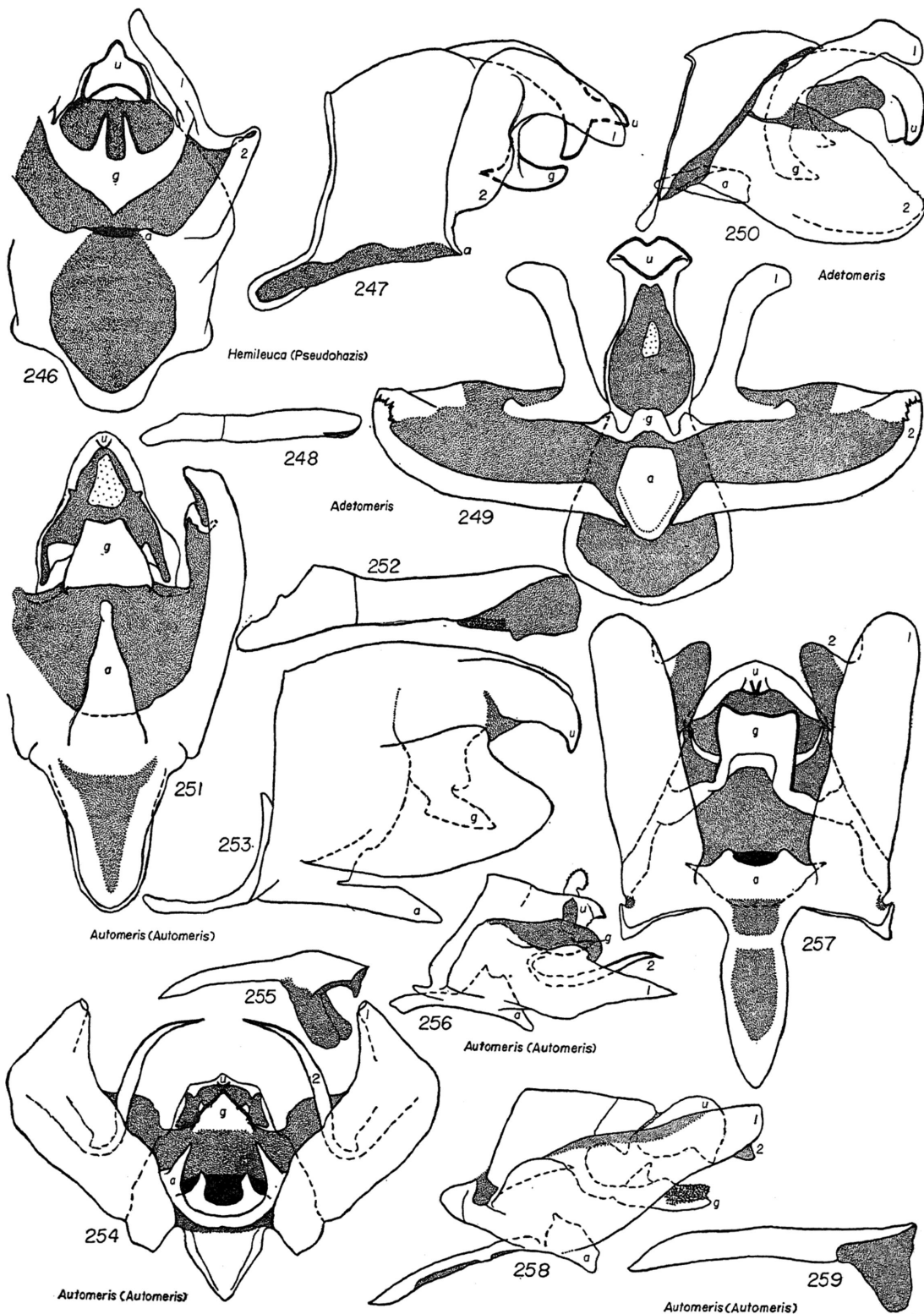
FIGS. 231-233. *Coloradia pandora* Blake. 231. Ventral view. 232. Lateral view. 233. Aedeagus.

FIGS. 234-236. *Calodirphia arpi* (Schaus). 234. Ventral view. 235. Lateral view. 236. Aedeagus.

FIGS. 237-239. *Hemileuca* (*Hemileuca*) *maia* (Drury). 237. Ventral view. 238. Aedeagus. 239. Lateral view.

FIGS. 240-242. *Travassosula subfumata* (Schaus). 240. Aedeagus. 241. Ventral view. 242. Lateral view.

FIGS. 243-245. *Catocantha* (*Perigopsis*) *oculata* (Schaus). 243. Ventral view. 244. Aedeagus. 245. Lateral view.



rami or slightly longer; shaft without bristles, antennal cones virtually absent, being represented by a small, dorsoventrally flattened, simple or slightly eroded and irregular, but unpointed apical projection on each segment of extreme apex of antenna (cones entirely absent in some Eurasian subgenera). Antennae of female bipectinate or quadripectinate to apex, much more narrowly pectinate than in male; rami slender, not curved; basal rami each bearing one to three terminal bristles, distal rami, when present, somewhat shorter than basal; rami of inner side, especially proximal ones, often shorter than those of outer side; shaft with segments frequently with a few inconspicuous ventral bristles; antennal cones (in *Agapema*) slightly more distinct than in male and more eroded so that some of them are more or less distinctly multiple or (in *Calosaturnia*) smaller than those of male but more eroded.

Tentorial pits large and oval, lateral to clypeus which is not produced, not separated from frons by any visible line or separated by a scarcely discernible line, in the latter case clypeus over four times as broad as long; pilfers indicated by convexities which sometimes bear long hairs. Mandibular rudiments not produced, sometimes scarcely recognizable. Proboscoidal fossa about as long as broad, very shallow, walls sloping or virtually absent; maxillary stipites extending back at least as far as posterior margin of palpal sockets, galeae represented, if at all, by inconspicuous lobes; labial palpi arising near posterior end of proboscoidal fossa, minute and globular, unsegmented, sometimes fused together basally (they may be fused or not fused in the one species, *S. (Agapema) galbina*; apparently they are not fused in *Calosaturnia*). Postoccipital bridge broad.

Thorax covered with long dense hair which may hide or partially hide some broad scales; patagia and parapatagia thick lamelliform;

anepisternal suture directed towards a point near or above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in nearly same direction as straight lower portion, an inconspicuous curved region intervening between these two portions.

Epiphysis absent in both sexes (in American species); tibial spurs almost completely hidden in vestiture of tibiae, about as long as diameter of tibiae, apical two-fifths or less of each spur concave on one side, margins with rudimentary serrations; tarsal spines numerous on under surfaces of segments one to four, even fifth segment sometimes with two or three ventral spines; penultimate fore tarsal segment of female with a pair of spines arising one on each apical lobe, these spines larger than the other spines in this segment, apical lobes of this segment largely bare, under surface of apical segment of fore tarsus bare; claws simple; arolium of moderate size to minute, pulvilli small or absent.

Forewings with outer margins straight or slightly convex or concave; hind wings with anal angles rounded, not produced; vestiture consisting of broad scales, overlain with long hairs which are sparse except at wing bases; forewings and hind wings each with a minute transparent spot, surrounded by rings which form an eye spot at apex of discal cell.

Abdomen covered with long, suberect hairs. Uncus robust, down-curved, and bifid at apex, subequal in length to ninth tergum; gnathos absent; anellus very large, produced posteriorly on each side of aedeagus, free from harpes; harpes freely articulated to ninth segment, simple except for a short subapical tooth on ventral margin, this tooth being apex of that portion of harpe beneath cleft, and in some Eurasian subgenera being drawn out into a short spine extending upward mesad of that portion of harpe above cleft.

Eighth tergum of female broadly sclerotic;

GENITALIC STRUCTURES

FIGS. 246-247. *Hemileuca (Pseudohazis) eglanterina* (Boisduval). 246. Ventral view. 247. Lateral view.

FIGS. 248-250. *Adetomeris erythrope* (Blanchard). 248. Aedeagus. 249. Ventral view. 250. Lateral view.

FIGS. 251-253. *Automeris (Automeris) grammivora* Jones. 251. Ventral view. 252. Aedeagus. 253. Lateral view.

FIGS. 254-256. *Automeris (Automeris) banus* Boisduval. 254. Ventral view. 255. Aedeagus. 256. Lateral view.

FIGS. 257-259. *Automeris (Automeris) castrensis* Schaus. 257. Ventral view. 258. Lateral view. 259. Aedeagus.

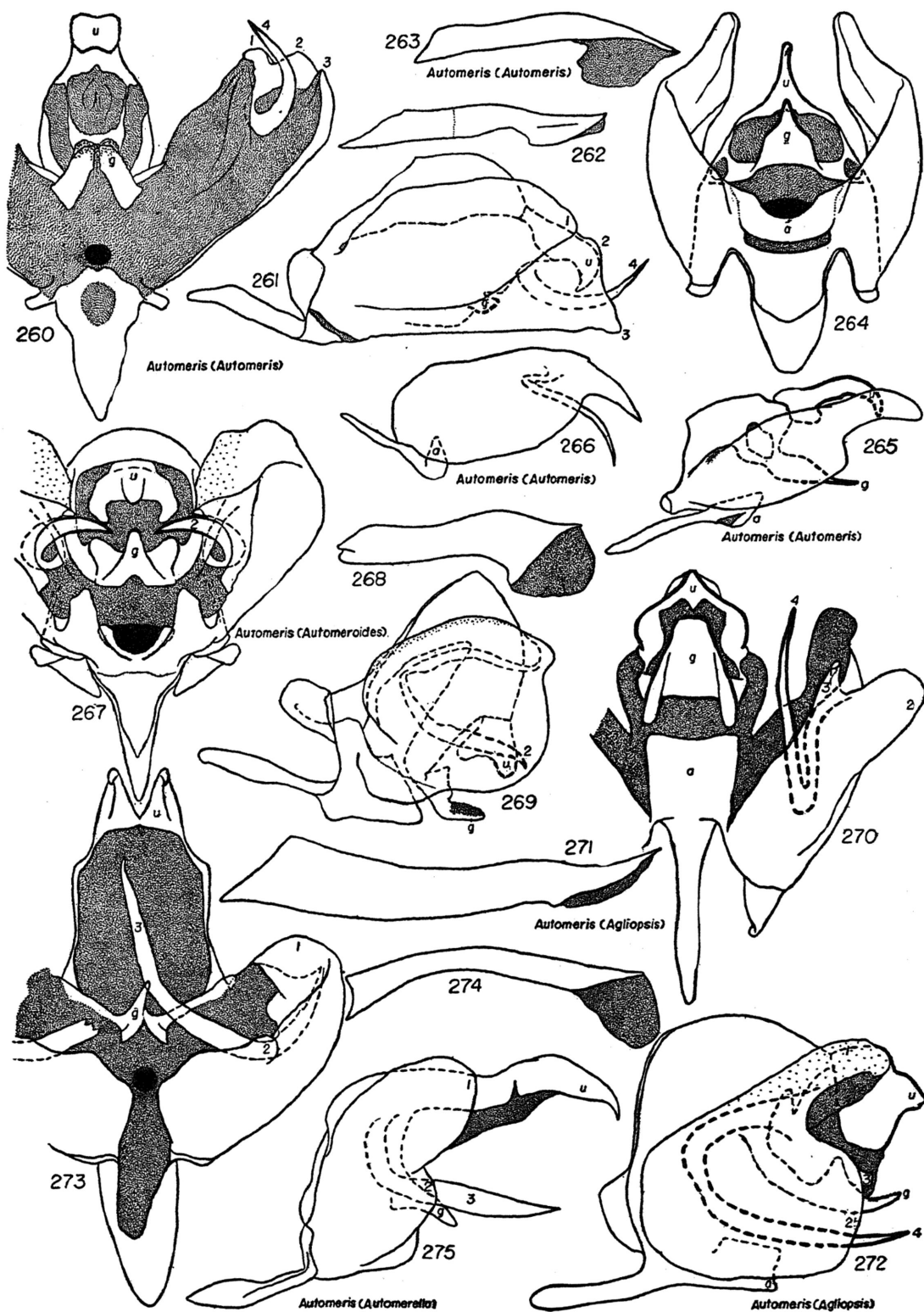


TABLE 17
SUBGENERA OF *Saturnia*

<i>Agapema</i>	<i>Calosaturnia</i>
Shortest distance between eyes slightly over half length of eye; upper ends of eyes extending above lower margins of antennal sockets; lower ends of eyes extending slightly below lower end of face	Shortest distance between eyes one and one-half times length of eye; ends of eyes not reaching lower margins of antennal sockets nor lower end of face
Antennal cones in male represented by slightly eroded projections	Antennal cones in male represented by simple, blunt projections
Antennae of female quadripectinate	Antennae of female bipectinate
Proboscoidal fossa with recognizable although low and sloping walls	Proboscoidal fossa virtually absent, without walls
Arolium minute, pulvilli absent	Arolium of moderate size, pulvilli small
Under surfaces of all tarsal segments very sparsely scaled in female	Under surfaces of tarsal segments scaled in female except for last fore tarsal segment and distal portions of other apical tarsal segments

eighth sternum more narrowly so, the sclerotization entirely postvulvar and sometimes extending into a pouch-like pocket, the dorsal wall of which is sclerotic; ductus bursae slender and membranous if this pouch like pocket is excluded.

The two American subgenera of *Saturnia* can be distinguished by the characters indicated in table 17.

SUBGENUS *AGAPEMA* NEUMOEGEN AND DYAR

Figures 87, 383-385

Agapema NEUMOEGEN AND DYAR, 1894, Jour. New York Ent. Soc., vol. 2, p. 121. Type: *Saturnia galbina* Clemens (monobasic).

This is the only American group of Saturniinae in which the pulvilli are absent and the arolia greatly reduced. It contains two species found in the arid regions of the southwestern United States and Mexico.

SUBGENUS *CALOSATURNIA* SMITH

Figures 86, 381, 382

Calosaturnia SMITH, 1886, Proc. U. S. Natl. Mus., vol. 9, p. 431. Type: *Saturnia mendocino* Behrens (monobasic).

A distinctive character of this subgenus, which separates it from other subgenera of *Saturnia*, is the reduction of the lines of the wings. The frons is strongly swollen between the antennal bases. An extraordinary character is the absence of the aedeagus.

This subgenus contains three species, all from California.

GENUS *COPAXA* WALKER

This genus is here understood to include not only the species customarily placed in *Copaxa*, but also those placed by other authors in *Saturniodes* and *Sagana*. These are the Neotropical representatives of the Sa-

GENITALIC STRUCTURES

FIGS. 260-262. *Automeris (Automeris) janus* (Cramer). 260. Ventral view. 261. Lateral view. 262. Aedeagus.

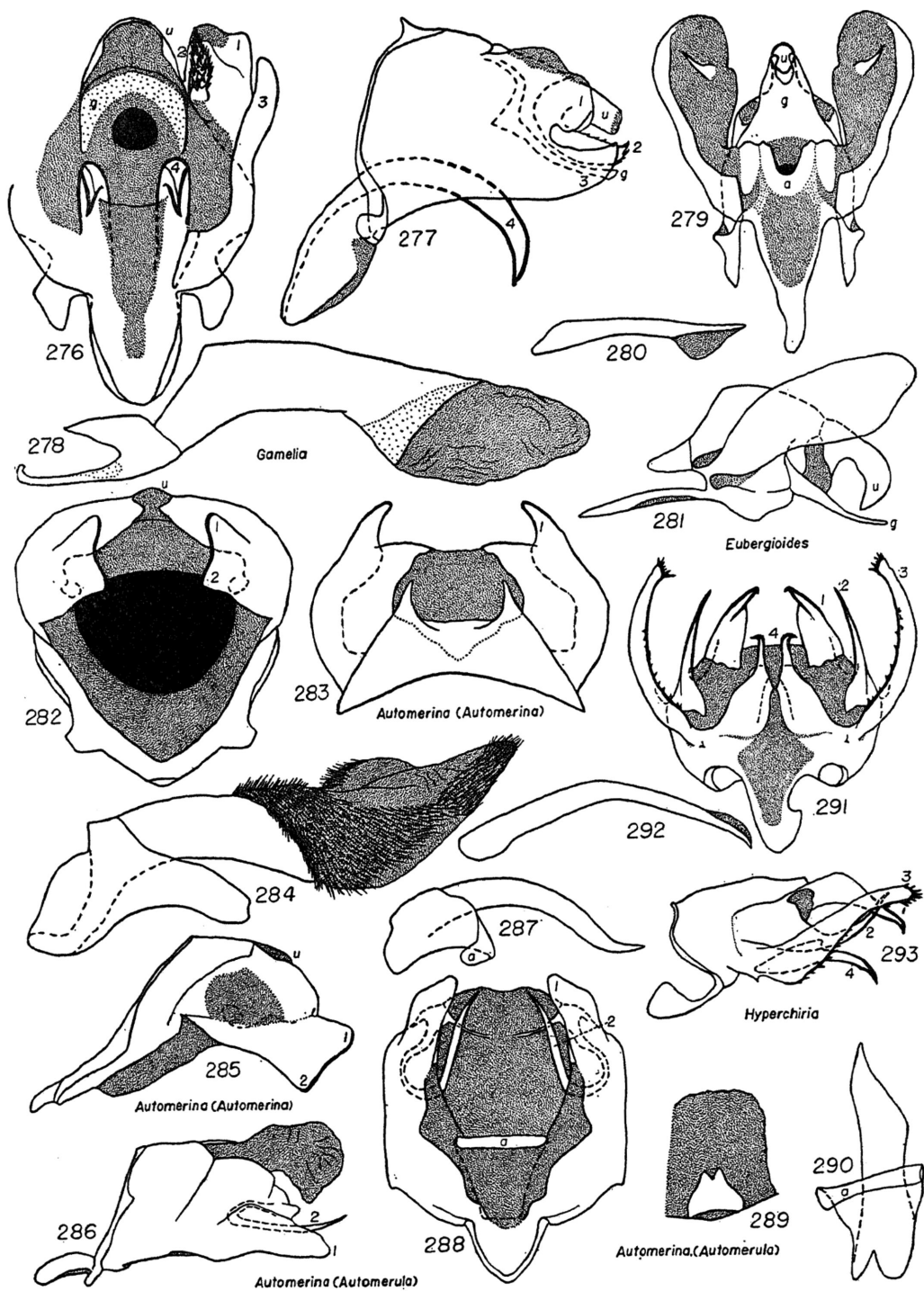
FIGS. 263-265. *Automeris (Automeris) egeus* (Cramer). 263. Aedeagus. 264. Ventral view. 265. Lateral view.

FIG. 266. *Automeris (Automeris) zozine* Druce. Inner view of clasper.

FIGS. 267-269. *Automeris (Automeroides) orneates* Druce. 267. Ventral view. 268. Aedeagus. 269. Lateral view.

FIGS. 270-272. *Automeris (Agliopsis) violascens* (Maassen and Weymer). 270. Ventral view. 271. Aedeagus. 272. Lateral view.

FIGS. 273-275. *Automeris (Automerella) rubicunda* Schaus. 273. Ventral view. 274. Aedeagus. 275. Lateral view.



turnia group, and are closely related to *Saturnia*. *Copaxa* differs from *Saturnia* by the clearly multiple antennal cones, the origin of the labial palpi in front of the middle of the proboscoidal fossa, the reduction in the tarsal spines, and the somewhat differently constructed male anellus. *Copaxa* is even more similar to the Asiatic genera *Dictyoploca* Jordan and *Caligula* Moore which in many ways constitute a connecting link between *Saturnia* and *Copaxa*. Their genitalia are more like those of *Saturnia*, with which their geographical distribution suggests a relationship. However, their clearly multiple antennal cones and reduced number of tarsal spines are suggestive of *Copaxa*. The small genera *Loepa* Moore and *Euphranor* Herrich-Schäffer¹ of tropical Asia and the East Indies are also very closely related to *Copaxa*, from which they differ in the absence of a gnathos, and in the differently formed, more *Saturnia*-like anellus.

Frons flat at sides, next to eyes; latero-frontal sutures visible; shortest distance between eyes about one-third to nearly two-thirds of length of an eye, upper ends of eyes extending above lower margins of antennal sockets in most species, lower ends of eyes usually extending below lower end of face.

Antennae slightly longer than thorax to about one and two-thirds times as long as thorax, flagellum without scales, antennae of male broadly quadripectinate to apices, apical rami often very much reduced on last half dozen segments so that distal part of flagellum is virtually bipectinate; rami long

and slender, straight or slightly curved, without bristles, or basal rami with inconspicuous terminal or subterminal bristles; antennal shaft without bristles, or with two to four inconspicuous bristles on under surface of each segment; antennal cones small, multiple, limited to apical third of antenna or less. Antennae of female bipectinate, apical rami sometimes represented by small tubercles or (in *C. simson* Maassen and Weymer) by short stubs, so that the antennae might be called quadripectinate, rami straight, slender, each bearing one or occasionally more terminal bristles, often also a dorsal bristle and sometimes a ventral bristle.

Tentorial pits large, round or oval, line between clypeus and frons inconspicuous or absent; clypeus usually with a median apical projection which is small but none the less similar to frontal protuberance of many hemileucines; pilifers absent. Mandibular rudiments low and inconspicuous. Proboscoidal fossa usually longer than broad, the walls sloping, sometimes virtually absent because of the shallowness of fossa; maxillary stipites small, extending back to posterior margins of palpal sockets; galeae small lobes; labial sclerite very feebly sclerotic; labial palpi arising in front of middle of fossa, one-segmented, the segment longer than broad and extending forward sometimes almost to clypeus. Post-occipital bridge consisting of a very large, broad, sclerotic plate.

Thorax covered with long, hair-like scales; patagia rather thick but parapatagia lamelliform; anepisternal suture directed towards a point at or slightly above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in same direction as straight lower portion of this suture, a short curved region intervening between these two portions.

Epiphysis of male sometimes short, reaching only to the basal third of tibia and with-

¹ *Euphranor* Herrich-Schäffer ([1854], Sammlung aussereuropäischer Schmetterlinge, vol. 1, Heterocera, fig. 80) has priority over *Circula* Walker (1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 5, p. 1186), if the dating of the Herrich-Schäffer plates given by Horn and Schenckling (1928, Index litteraturae entomologicae, vol. 2, p. 546) is correct.

GENITALIC STRUCTURES

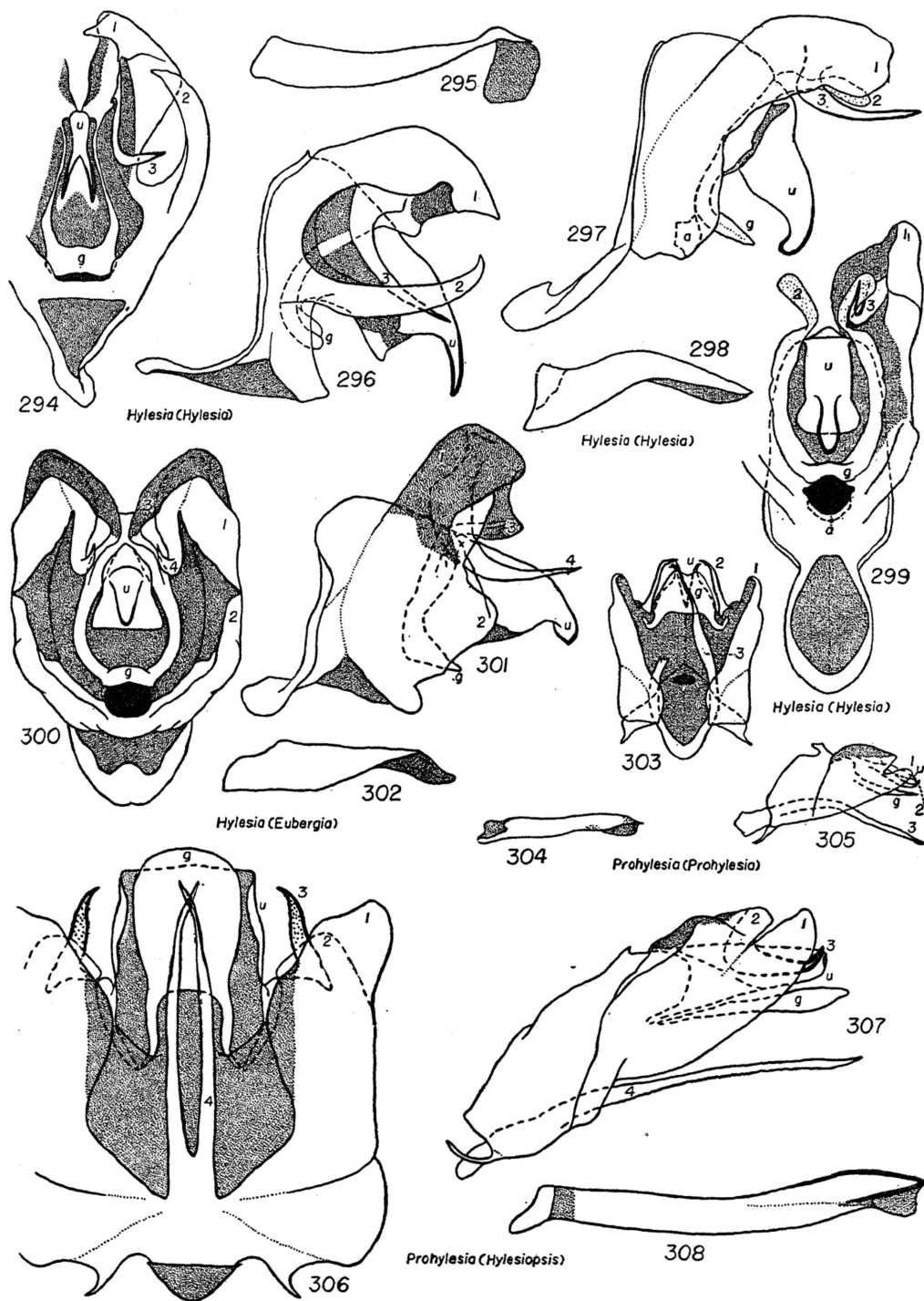
FIGS. 276-278. *Gamelia abasia* (Stoll). 276. Ventral view. 277. Lateral view. 278. Aedeagus.

FIGS. 279-281. *Eubergioides berthae* (Schaus). 279. Ventral view. 280. Aedeagus. 281. Lateral view.

FIGS. 282-285. *Automerina (Automerina) cypria* (Cramer). 282. Ventral view. 283. Dorsal view of uncus. 284. Aedeagus. 285. Lateral view.

FIGS. 286-290. *Automerina (Automerula) auletes* (Herrich-Schäffer). 286. Lateral view. 287. Lateral view of aedeagus. 288. Ventral view. 289. Dorsal view of uncus. 290. Ventral view of aedeagus.

FIGS. 291-293. *Hyperchiria nausica* (Cramer). 291. Ventral view. 292. Aedeagus. 293. Lateral view.



out or with but few long hairs, at other times much larger and reaching to apical third of tibia, and with more or less numerous long hairs or hair-like scales; epiphysis of female absent or very small, reaching only to basal third of tibia; tibial spurs not or but little exceeding vestiture, their apical third or less concave on one side, margins sometimes minutely serrated; tarsi usually without spines, except for apical pair on penultimate fore tarsal segment of female, rarely [*C. orios* (Dyar)] segments one to three on all legs have an apical pair of spines; apical lobes of penultimate fore tarsal segment of female bare, adjacent bare areas of following segment large and contiguous with the usually bare or nearly bare sole of the segment (sole scaled in *C. simson* Maassen and Weymer); claws simple; arolium and pulvilli well developed.

Forewings with outer margins concave in male, concave to convex in female; hind wings with anal angles distinct but not produced; vestiture consisting of scales, which are overlain but are not hidden by hairs or elongated scales; fore and hind wings each with transparent spot at apex of discal cell, this spot often surrounded with rings of color to form an eye spot; smaller transparent spots sometimes also present in adjacent cells.

Abdomen covered with suberect hairs which do not form color bands. Uncus of male subequal in length to ninth tergum, deeply bifid; gnathos not much produced, occasionally absent; anellus very large, free from harpes and from ninth sternum, often ornately spined; harpes large, freely articulated to ninth segment, apical margins inconspicuously cleft, upper lobe of each broad, usually rounded, lower lobe bearing an upturned, spine-like apex which lies mesad to upper lobe; inner surfaces of harpes at bases each with a spine-like projection, sometimes small or even absent, which is connected to upper basal angle of harpe.

Ninth tergum of female with a rather broad sclerotic band; ninth sternum unsclerotized or with a rather broad postvulvar sclerotic area which is slightly produced posteriorly; ductus bursae membranous; bursa slender posteriorly and enlarged and bulbous anteriorly; ductus seminalis arising from right-hand side of base of bursa.

This genus is divisible into three subgenera, as indicated in table 18.

SUBGENUS COPAXA WALKER

Figures 88, 386-389

Copaxa WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 5, p. 1235. Type: *Copaxa decrescens* Walker, designation of Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 755.

This subgenus is represented by about 18 species, ranging from Mexico to Argentina.

SUBGENUS SATURNIODES JORDAN

Figures 89, 390-393

Saturniodes JORDAN, 1911, Novitates Zool., vol. 18, p. 132. Type: *Saturnia medea* Maassen (designated by Draudt, 1929, in Seitz, Macrolepidoptera of the world, vol. 6, p. 722).¹

This subgenus is represented by about six species, occurring from northern Mexico to Peru.

SUBGENUS SAGANA WALKER

Figures 91, 394-397

Sagana WALKER, 1855, List of the specimens of lepidopterous insects in . . . the British Museum, pt. 5, p. 1234. Type: *Saturnia sapotoza* Walker (monobasic).

This subgenus is represented by a single species occurring from Mexico to Colombia.

¹ Since Jordan, when he named *Saturniodes*, listed several subspecies of *medea*, the name cannot be considered strictly monobasic as d'Almeida (1943a) has done.

GENITALIC STRUCTURES

- FIGS. 294-296. *Hylesia* (*Hylesia*) *ileana* Schaus. 294. Ventral view. 295. Aedeagus. 296. Lateral view.
 FIGS. 297-299. *Hylesia* (*Hylesia*) *canitia* (Stoll). 297. Lateral view. 298. Aedeagus. 299. Ventral view.
 FIGS. 300-302. *Hylesia* (*Eubergia*) *caisa* Berg. 300. Ventral view. 301. Lateral view. 302. Aedeagus.
 FIGS. 303-305. *Prohylesia* (*Prohylesia*) *zikani* Draudt. 303. Ventral view. 304. Aedeagus. 305. Lateral view.
 FIGS. 306-308. *Prohylesia* (*Hylesiopsis*) *festiva* (Bouvier). 306. Ventral view. 307. Lateral view. 308. Aedeagus.

TABLE 18
SUBGENERA OF *Copaxa*

<i>Copaxa, Sensu Stricto</i>	<i>Saturniodes</i>	<i>Sagana</i>
Antennae slightly longer than thorax to about 1.5 times as long as thorax	Antennae over 1.5 times as long as thorax	Antennae slightly longer than thorax
Upper ends of eyes extending above lower margins of antennal sockets	Upper ends of eyes extending to lower margins of antennal sockets	Upper ends of eyes extending above lower margins of antennal sockets
Lower ends of eyes extending below lower end of face	Lower ends of eyes extending below lower end of face	Lower ends of eyes extending to lower end of face
Proboscoidal fossa longer than broad, with rather high walls posteriorly	Proboscoidal fossa longer than broad, with rather high walls posteriorly	Proboscoidal fossa as broad as long, almost without walls
Epiphysis of male large, reaching to apical third of tibia; that of female absent, or similar to that of male	Epiphysis of male small, reaching to basal third or to middle of tibia	Epiphysis of male small, reaching to basal third of tibia; that of female present but minute and slender
Fenestra of wings round to lens shaped, sometimes multiple	Fenestra of wings lens shaped	Fenestra of wings crescentic
Postmedian line of forewings usually straight	Postmedian line of forewings undulate	Postmedian line of forewings undulate
Vein M ₁ of forewing arising before apex of discal cell. Vein R ₂ of forewing present	Vein M ₁ of forewing arising before apex of discal cell. Vein R ₂ of forewing absent	Vein M ₁ of forewing arising from anterior apical angle of discal cell. Vein R ₂ of forewing absent

SUBGENUS *ANTHERAEA* HÜBNER

Figures 92, 398-400

Antheraea HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 152. Type: *Phalaena mylitta* Drury, designated by Kirby, 1892, A systematic catalogue of Lepidoptera Heterocera, vol. 1, p. 759.

Telea HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 152. Type: *Phalaena polyphemus* Cramer (monobasic).

Metosamia DRUCE, 1892, Ann. Mag. Nat. Hist., ser. 6, vol. 9, p. 276. Type: *Metosamia godmani* Druce, by original designation.

This is a genus of large moths which can be readily recognized, aside from the distinctive appearance, by the large and protuberant mandibular rudiments and the peculiar male genital claspers which bear coarse, spine-like setae.

Frons flat at sides, next to eyes; latero-frontal sutures distinct; shortest distance between eyes slightly less than length of an eye, upper ends of eyes reaching about as far up as lower margins of antennal sockets; lower ends of eyes reaching far below the lower end of face.

Antennae about one and one-third or one and one-fourth times as long as thorax, flagellum in both sexes with a few dorsal scales on proximal half dozen segments; antennae of male very broadly quadripectinate almost to apex, the last few segments only narrowly bipectinate, rami very long and slender, nearly straight, or apical rami alone curved downward, apical rami nearly as long as basal rami, rami without bristles; antennal shaft not much compressed, not carinate ventrally, without bristles or with a pair of inconspicuous ventral bristles on each segment; antennal cones small, multiple, limited to apical dozen segments or less. Antennae of female narrowly quadripectinate, rami lacking the long setae found in male, basal rami slender, straight or nearly so, with several terminal and subterminal bristles on each, apical rami more robust, usually about one-fourth of the length of basal rami, apical rami arising much closer to basal rami of following segment than to the basal rami of same segment.

Tentorial pits slit shaped and very inconspicuous; clypeus about six times as broad

as long, sometimes scarcely separable from frons, without pilifers. Mandibular rudiments extremely large, adjacent to eye margins, extending forward in front of clypeus and frons to form a distinct pair of projections on either side of clypeus adjacent to the tentorial pits. Proboscis longer than broad, rather deep, the walls vertical; maxillary stipites small, not extending backward as far as palpal sockets, galeae much larger than stipites, robust, truncated at apices and having a fleshy appearance, not at all curled; labial sclerite rather large but feebly sclerotic; labial palpi arising near posterior end of proboscis, extending forward to a point well in front of face, three-segmented, but third segment more or less completely fused to second, and second sometimes fused to first, second segment much longer than either of the others and slender. Postoccipital bridge narrow.

Thorax covered with long, suberect hairs or hair-like scales, among bases of which are scattered broad scales; patagia and parapatagia both broad; anepisternal suture directed towards a point slightly above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture at an angle of about 170 degrees to straight lower portion of this suture, no conspicuous curved region intervening between these two main portions.

Epiphysis of male rather large, extending to apical third or fourth of tibia, with a few or with many long, hair-like scales; epiphysis of female much smaller, very slender, without or with very few elongated scales; tibial spurs nearly concealed in vestiture, slightly longer than diameter of tibiae, apical three-fifths of each spur concave on one side, the margins coarsely serrated; tarsal segments with several pairs of apical and subapical spines on under surfaces of segments one to four; penultimate fore tarsal segment of female with the usual pair of rather large spines arising from the apical lobes, apical lobes largely bare, adjacent bare areas of following segment large and continuous with the almost entirely bare sole of the segment; claws finely serrated; arolium and pulvilli well developed.

Forewings with outer margins concave, particularly so in males, in which apices of

wings are produced; hind wings with anal angles rounded, outer margins sometimes undulate; vestiture consisting of broad scales, overlain and largely hidden by hairs, each wing with a transparent spot at apex of discal cell.

Abdomen covered with long, suberect or recumbent hairs, overlying broad scales. Uncus of male down-curved, with apex simple; gnathos narrowly produced medially, far below uncus and fused around aedeagus to anellus, gnathos connected at sides to very large upper lobes of claspers; anellus but little produced, fused around the aedeagus and connected to ninth sternum as well as to lower lateral portions of harpes and to gnathos; lower portions of harpes fused to ninth segment, upper portions deeply bilobed, each lobe bearing a series of long bristles, inner lobe much exceeding the outer, connected to gnathos.

Eighth tergum of female with a narrow sclerotic band; eighth sternum with a post-vulvar sclerotization which is produced posteriorly as a broad projection; ductus bursae membranous; bursa membranous, somewhat enlarged anteriorly and slender posteriorly; ductus seminalis arising from right-hand dorsal side of base of bursa.

This genus contains several Asiatic species, as well as three North American ones, one of which occurs as far south as Colombia. There is nothing whatever to separate the American from the Asiatic species generically, although it is customary to do so.

GENUS ACTIAS LEACH

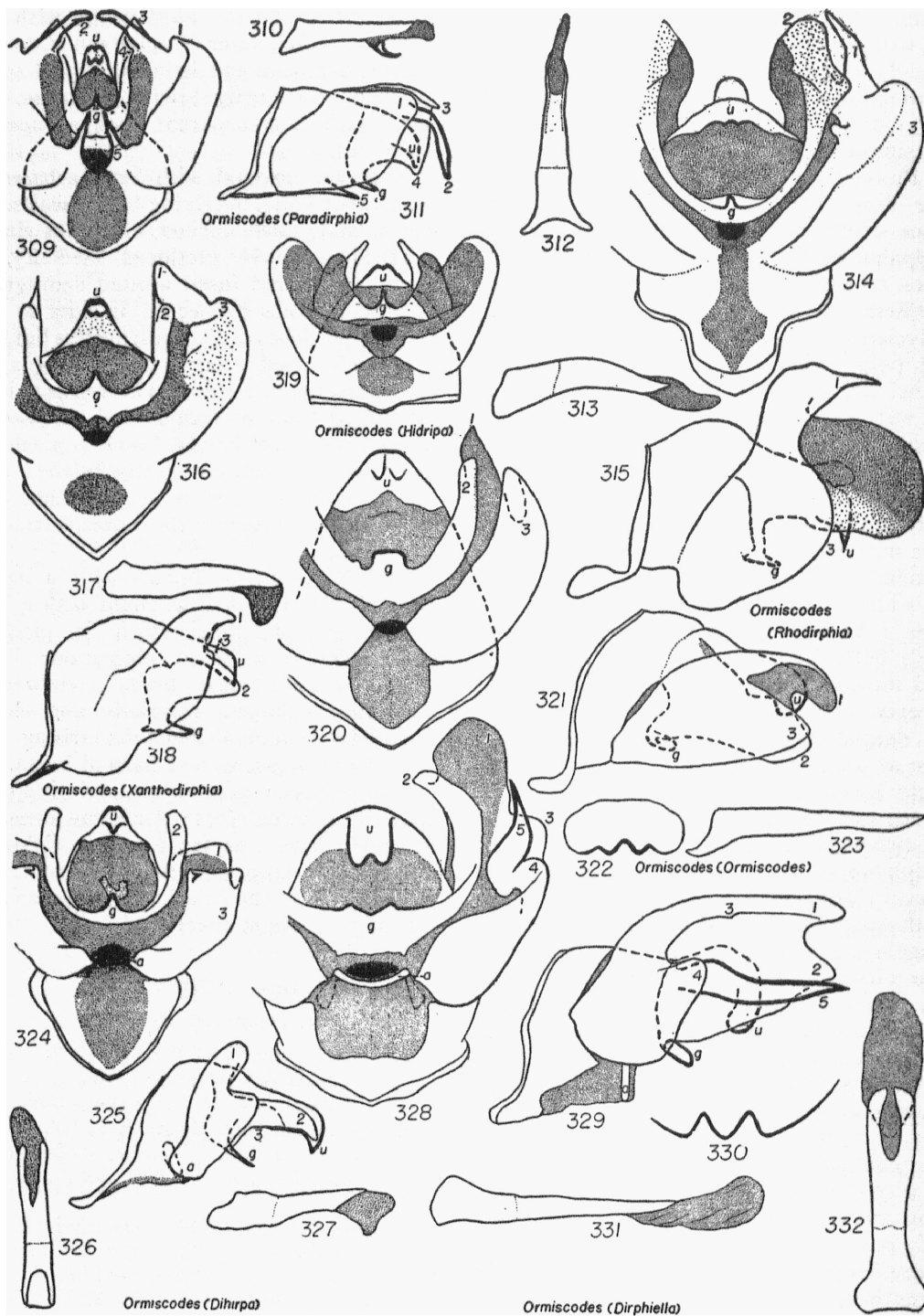
Figures 90, 405-409

Echidna HÜBNER (not Forster), [1807], Sammlung exotischer Schmetterlinge, vol. 1, pl. [173]. Type: *Phalaena luna* Linnaeus (monobasic).

Actias LEACH, 1815, Zool. Misc., vol. 2, p. 25. Type: *Phalaena luna* Linnaeus, designated by Grote, 1874, Proc. Amer. Phil. Soc., vol. 14, p. 257.

Tropaea HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 152. Type: *Echidna selene* Hübner, designated by Barnes and Lindsey, 1922, Ann. Ent. Soc. Amer., vol. 15, p. 97.

Plectropteron HUTTON, 1846, Ann. Mag. Nat. Hist., ser. 1, vol. 14, p. 60. Type: *Plectropteron dianeae* Hutton = *Echidna selene* Hübner (monobasic).



This is a genus of large, pale green, tailed moths.

The contention of d'Almeida (1943a) that *luna* is the type of both *Actias* and *Tropaea* because Hutton in 1846 removed *selene* from each of these genera to a new genus, leaving only *luna* in each, is incorrect, for Hutton did not in a strict sense remove *selene* but described what he thought was a new species (*dianae*) which only subsequently was placed in the synonymy of *selene*.

Frons convex at sides, next to eyes; latero-frontal sutures not visible. Shortest distance between eyes slightly less than one-half of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending slightly below lower end of face.

Antennae about as long as thorax, shaft of flagellum without scales, flagellum of male broadly quadripectinate nearly to apex, but last three or four segments narrowly bipectinate, apical rami nearly as long as basal rami, both basal and apical rami with a few terminal and subterminal inconspicuous bristles; antennal shaft with three to five inconspicuous ventral bristles on each segment, antennal cones multiple and much subdivided, limited to distal fifth of antenna. Antenna of female quadripectinate, much more narrowly so than that of male, apical rami, where longest, only a little more than half as long as basal rami; distal half dozen segments without apical rami, basal rami with several terminal and ventral subterminal bristles, apical rami without bristles, rami without the long setae characteristic of

male; antennal cones similar to those of male but cones less subdivided.

Tentorial pits small, nearly round, close to eye margin; clypeus without a median projection, separated from frons only by a weak line, clypeus seven or eight times as broad as long, its anterior margin concave, partly because of the strongly protuberant pilifers. Mandibular rudiments large and strongly protuberant, forming conspicuous projections below and lateral to pilifers. Proboscoidal fossa slightly longer than broad, deep, with walls vertical posteriorly, sloping anteriorly; maxillary stipites small, extending back slightly beyond anterior margins of palpal sockets, galeae produced and pointed, about as long as stipites and not at all curled; labial sclerite broad, rather distinctly sclerotic; labial palpi arising in front of middle of fossa, short but reaching in front of clypeus, one-segmented but with the line of separation between the first and second segments indicated by a weak constriction on one side. Postoccipital bridge broad.

Thorax covered with long, more or less recumbent hair; patagia and parapatagia of equal width, rather broad; anepisternal suture directed towards a point near middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture at an angle of about 170 degrees to straight lower portion of this suture, no conspicuous curved region intervening between these two main portions.

Epiphysis of both sexes reaching nearly to apical third of tibia and with long hairs, that of female more slender than that of

GENITALIC STRUCTURES

FIGS. 309-311. *Ormiscodes* (*Paradirphia*) *semirosea* (Walker). 309. Ventral view. 310. Aedeagus. 311. Lateral view.

FIGS. 312-315. *Ormiscodes* (*Rhodirphia*) *niepelti* (Draudt). 312. Ventral view of aedeagus. 313. Lateral view of aedeagus. 314. Ventral view. 315. Lateral view.

FIGS. 316-318. *Ormiscodes* (*Xanithodirphia*) *amarilla* (Schaus). 316. Ventral view. 317. Aedeagus. 318. Lateral view.

FIG. 319. *Ormiscodes* (*Hidripa*) *ruscheweyhi* (Berg). Ventral view.

FIGS. 320-323. *Ormiscodes* (*Ormiscodes*) *lupina* (Draudt). 320. Ventral view. 321. Lateral view. 322. Posterior view of uncus. 323. Aedeagus.

FIGS. 324-327. *Ormiscodes* (*Dihirpa*) *litura* (Walker). 324. Ventral view. 325. Lateral view. 326. Dorsal view of aedeagus. 327. Lateral view of aedeagus.

FIGS. 328-332. *Ormiscodes* (*Dirphiella*) *albofasciata* (Johnson and Michener). 328. Ventral view. 329. Lateral view. 330. More direct ventral view of gnathos. 331. Lateral view of aedeagus. 332. Dorsal view of aedeagus.

male; tibial spurs not or scarcely exceeding vestiture, scarcely longer than diameter of tibiae, apical two-thirds of each spur with margins serrated, surface between margins smooth and bare and with a strong median carina; tarsal spines numerous on under surfaces of segments one to four, segment five sometimes with a pair of small spines, penultimate fore tarsal segment of female with a pair of spines arising from apical lobes, these spines larger than any of the others on this segment, these lobes largely bare, adjacent bare areas of following segment large and contiguous with sole of segment which is also bare; claws simple or sometimes showing rudimentary serration; arolium and pulvilli well developed.

Forewings with outer margins slightly concave; hind wings with anal angles produced into long tails, veins M_3 , Cu_1 and Cu_2 , and 2A involved in tail; vestiture consisting of broad scales, overlain and largely hidden by hairs, forewings and hind wings both with small, lens-shaped, transparent spots surrounded by lines forming eye spots.

Abdomen covered with hairs which overlie and hide scales; uncus subequal in length to ninth tergum, its apex bifid, its dorsal portion somewhat elevated and sometimes serrated; gnathos not heavily sclerotic, not produced posteriorly, sometimes connected with upper basal angles of harpes; anellus free from harpes and ninth sternum, bearing a pair of posteriorly projecting horns; harpes large, freely articulated to ninth segment, each with a spine or horn below a notch on outer margin.

Eighth tergum of female with a broad sclerotic band; eighth sternum with a post-vulvar sclerotic band, broken or nearly so medially, but without a prevulvar sclerotization; ductus bursae short and sclerotic dorsally; bursa elongated and striate posteriorly, enlarged and bulbous anteriorly; ductus seminalis arising from right-hand side of base of bursa.

The genus *Actias* is represented by but few species and occurs in eastern Asia and eastern North America and in Mexico. There seems to be little justification for separating the Asiatic from the American species generically, although most authors have made such a distinction.

GENUS *SAMIA* HÜBNER

Figures 93, 401-404

Samia HÜBNER, [1819], Verzeichniss bekannter Schmettlinge, p. 156. Type: *Phalaena cynthia* Drury, designated by Grote, 1865, Proc. Ent. Soc. Philadelphia, vol. 5, p. 228.

Philosamia GROTE, 1874, Proc. Amer. Phil. Soc., vol. 14, p. 258. Type: *Phalaena cynthia* Drury, by original designation.

This is a genus of large moths which differs from the somewhat similar *Hyalophora* in lacking the denticulate lower portion of the clasper and in having vein R_1 of the forewing arising before the base of R_4 .

Frons strongly convex at sides, next to eyes; laterofrontal sutures visible. Shortest distance between eyes about three-fourths of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes extending to lower end of face or slightly below.

Antennae about one and one-fourth times as long as thorax, flagellum of male not scaled, that of female with a few elongate scales dorsally on basal segments, flagellum of both sexes broadly quadripectinate, that of female only slightly narrower than that of male; apical rami subequal to basal rami, rami of male without bristles, basal rami of female each with one or a few inconspicuous terminal bristles, rami of male with the usual long setae, those of both basal and apical rami directed downward and distally, rami of female also provided with setae which are somewhat shorter and sparser than those of male but otherwise similar; antennal shaft of male without bristles except on ventral surface of apical segments, that of female with one to three or four inconspicuous bristles ventrally on each segment; antennal cones multiple, on moderate-sized apical projections of the segments, limited to apical third or fourth of antenna.

Tentorial pits small and round or oval, very close to eye margins and low down on face near mandibular rudiments; clypeus not produced, separated from frons by only a weak line, arched upward medially so that its lower margin is above level of tentorial pits; pilifers not or scarcely recognizable. Mandibular rudiments small and not protuberant. Proboscis fossa broader than long, shallow, walls sloping; maxillary stipites

small, extending back to the anterior margins of palpal sockets, maxillary palpi represented by rather large tubercles; galeae longer than proboscoidal fossa, curled, but robust and bluntly tipped, their margins each provided with a row of long bristles, each of which is flattened and spatulate at its apex; labial sclerite broad, distinctly sclerotic; labial palpi widely separated, extending forward to a point well in front of face, three-segmented, first and second segments subequal in length, third much shorter but more than twice as long as broad. Post-occipital bridge broad and sclerotic.

Thorax covered with long hairs which are suberect; patagia rather broad; parapatagia lamelliform; anepisternal suture directed towards a point near middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed slightly more anteriorly than straight lower portion, a distinct curved region intervening between the two main portions.

Epiphysis in both sexes rather large, that of female slightly smaller than that of male, reaching to apical third of tibia, epiphysis of male with a few long hairs near apex, that of female without such hairs; tibial spurs hidden in vestiture and shorter than diameter of tibiae, apices of spurs bare and hooked, flattened on one side; tarsal segments one to four with one or two pairs of ventral apical spines, penultimate fore tarsal segment of female without spines except for the usual pair of enlarged ones arising from apical lobes, these lobes bare, adjacent bare areas of following segment large and contiguous with bare sole of segment; claws simple; arolium and pulvilli well developed.

Forewings with outer margins concave; hind wings with anal angles distinct and somewhat produced; vestiture consisting of scales, overlain and largely hidden by elongated scales or, especially on the hind wings, by hairs; forewings and hind wings both with large, crescentic translucent area in the discs.

Abdomen covered with dense, somewhat appressed hairs which completely hide scattered broad scales, hairs (in ours) not forming colored bands but forming a distinctive pattern of tufts. Uncus subequal to ninth tergum, bifid at apex; gnathos not much

produced posteriorly, a mere band connected to upper basal portions of harpes; anellus rather large and free from harpes and ninth sternum; harpes large, freely articulated to ninth segment, lacking the toothed or spiculate lower projection characteristic of *Hyalophora* but with a long projection in middle of outer margin.

Eighth tergum of female broadly sclerotic laterally but membranous middorsally; eighth sternum with a narrow prevulvar sclerotic band and a broad postvulvar plate; ductus bursae broad and partly sclerotic posteriorly, narrow and more membranous anteriorly; bursa small and cylindrical; ductus seminalis arising from dorsal surface of base of bursa to the right of midline.

This is an Oriental genus represented in the eastern United States by a single introduced species.

GENUS ROTHSCILDIA GROTE

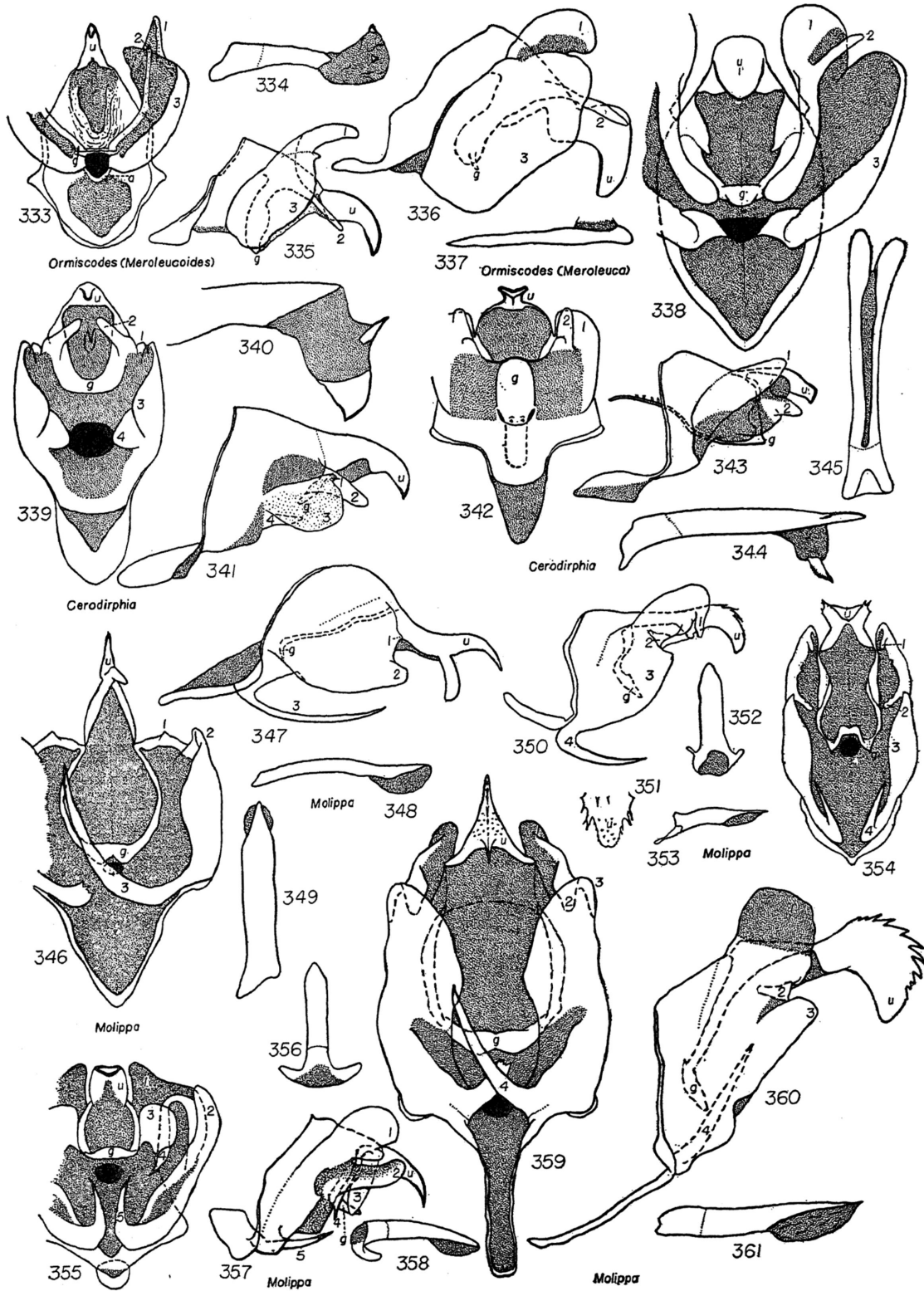
Figures 94, 414-416

Rothschildia GROTE, 1896, Verhandl. Gesellsch. Deutscher Naturf. Aerzte, vol. 68, p. 204. Type: *Attacus jacobaeae* Walker, by original designation.

This a genus of large moths having a transparent area in each wing. The male genitalia are distinctive in having the harpes extending upward, high above the uncus.

Frons convex at sides, near eyes; latero-frontal sutures usually visible, at least above. Shortest distance between eyes less than half to nearly two-thirds of length of an eye, upper ends of eyes extending above lower margins of antennal sockets, lower ends of eyes usually extending below lower end of face but sometimes not quite reaching lower end.

Antennae slightly longer than thorax to about one and one-third times as long as thorax, flagellum of male usually without scales, sometimes with some scales on dorsum of basal portion, that of female usually with dorsal scales basally, sometimes extending to middle of antenna and sometimes with scales on dorsal surfaces of first few pairs of rami; flagellum of male broadly quadripectinate except for last few segments which are narrowly bipectinate, apical rami subequal to basal or slightly shorter, rami without bristles or basal rami, or sometimes also distal rami, with one or a few



inconspicuous terminal bristles and sometimes also with inconspicuous subterminal bristles; setae of basal rami, if curved at all, curved apically, setae of apical rami curved basally; antennal shaft usually with a pair of inconspicuous bristles on under surface of each segment, antennal cones multiple, the cones themselves small but sometimes arising from rather large prominences on apical portions of segments, cones limited to last dozen segments of antenna or less. Antennae of female quadripectinate, noticeably more narrowly so than those of male, basal and apical rami with several terminal bristles and also with subterminal and occasionally even median dorsal bristles and with subterminal ventral bristles; setae of rami present and directed as in the male but much shorter.

Tentorial pits oval; clypeus not produced, not clearly separated from frons but apparently very short and seven or eight times as broad as long; pilifers not recognizable. Mandibular rudiments rather large, somewhat protuberant. Proboscoidal fossa very shallow, without or with only sloping walls; maxillary stipites small, scarcely reaching backward to anterior margins of palpal sockets, galeae reduced to mere lobes; labial sclerite rather weakly sclerotic; labial palpi arising slightly behind middle of fossa, commonly three-segmented and reaching forward to a point conspicuously in front of the face, the second segment longer than either of the others, but third segment considerably longer than broad; third segment sometimes short and fused to the second

either completely or incompletely, in such species [for example, *zacateca* (Westwood)] palpi scarcely reach the clypeus.

Thorax covered with long dense hair; patagia and parapatagia subequal, both rather thick; anepisternal suture directed towards a point well above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture continued in about same direction as straight lower portion, curved region between these two main portions short and inconspicuous.

Epiphysis in both sexes reaching to or nearly to apical third of tibia, usually without long hairs or scales; tibial spurs often hidden in vestiture of tibiae, about as long as diameter of tibiae, apical quarter flattened or concave on one side, margins bearing rudimentary serration; tarsi without spines except for apical pair on penultimate fore tarsal segment of female, spine-bearing lobes of this segment bare, adjacent bare areas of following segment large and continued to apex of segment but sole scaled or at least with a broad median band of scales; claws simple; arolium and pulvilli well developed.

Forewings with outer margins straight or concave, sometimes largely convex; hind wings with posterior portions in vicinity of anal angles large and somewhat produced posteriorly but rounded; vestiture consisting of broad scales, overlain but not hidden by elongated scales and hairs; fore and hind wings each with a large discal transparent area.

Abdomen covered with recumbent hairs or

GENITALIC STRUCTURES

FIGS. 333-335. *Ormiscodes* (*Meroleucoides*) *flavodiscata* (Dognin). 333. Ventral view. 334. Aedeagus. 335. Lateral view.

FIGS. 336-338. *Ormiscodes* (*Meroleuca*) *venosa* (Walker). 336. Lateral view. 337. Aedeagus. 338. Ventral view.

FIGS. 339-341. *Cerodirphia rosacordis* (Walker). 339. Ventral view. 340. Aedeagus (base wanting). 341. Lateral view.

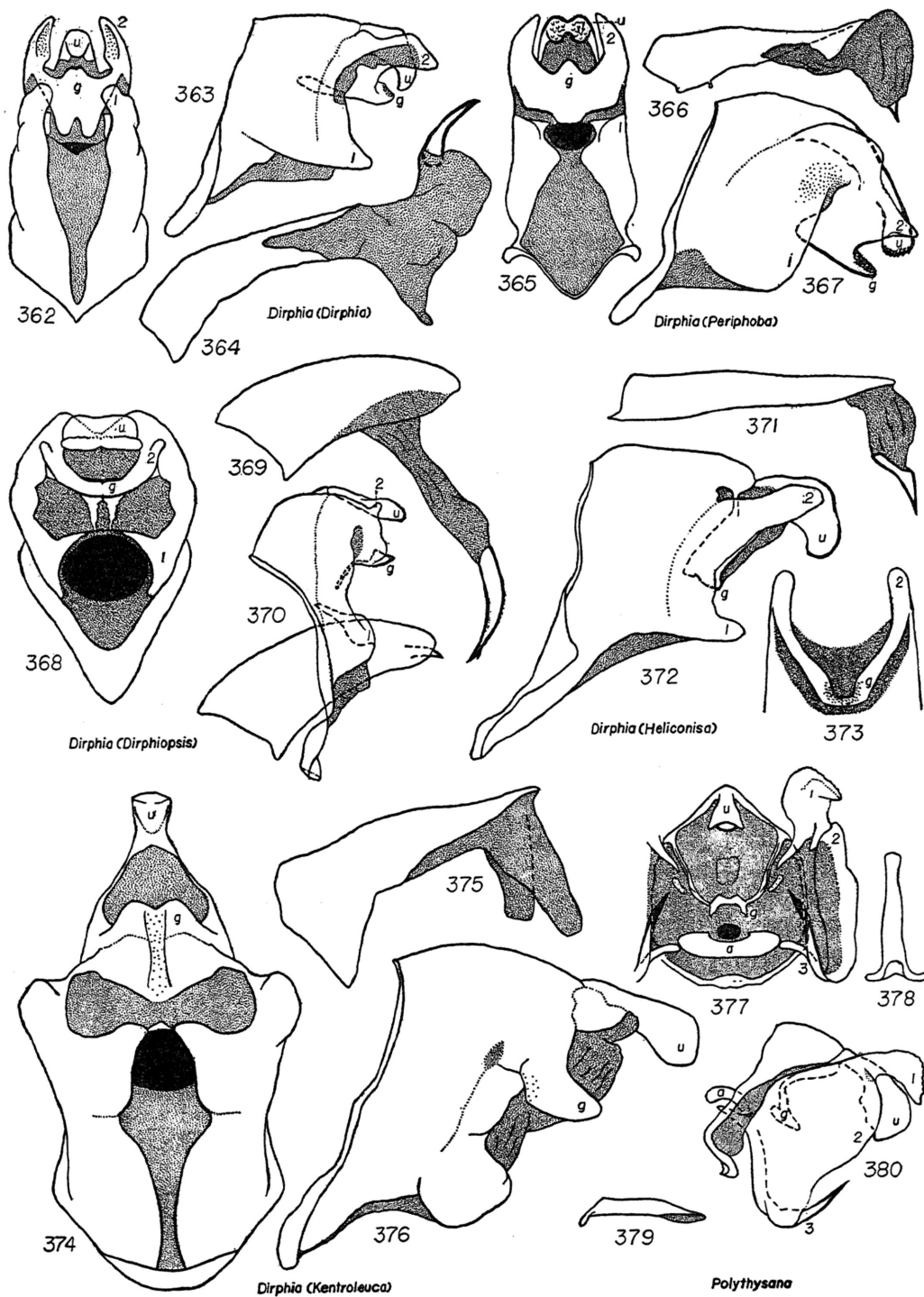
FIGS. 342-345. *Cerodirphia speciosa* (Cramer). 342. Ventral view. 343. Lateral view. 344. Lateral view of aedeagus. 345. Dorsal view of aedeagus.

FIGS. 346-349. *Molippa sabina* Walker. 346. Ventral view. 347. Lateral view. 348. Lateral view of aedeagus. 349. Ventral view of aedeagus.

FIGS. 350-354. *Molippa rosea* (Druce). 350. Lateral view. 351. Dorsal view of uncus. 352. Dorsal view of aedeagus. 353. Lateral view of aedeagus. 354. Ventral view.

FIGS. 355-358. *Molippa lulesa* (Schaus). 355. Ventral view. 356. Dorsal view of aedeagus. 357. Lateral view. 358. Lateral view of aedeagus.

FIGS. 359-361. *Molippa strigosa* (Maassen and Weymer). 359. Ventral view. 360. Lateral view. 361. Aedeagus.



elongated scales. Uncus of male subequal to ninth tergum, apex down-curved and bidentate; gnathos consisting of a finely spiculate, lightly sclerotized median plate above aedeagus, separated by membrane from the elongated connections to upper basal angles of harpes; anellus large and free from harpes and ninth sternum; harpes freely articulated to ninth segment, large, much produced upward, the upward projection sometimes hooked.

Eighth tergum of female broadly sclerotic on each side, membranous middorsally; eighth sternum with a prevulvar sclerotic band and a postvulvar sclerotic plate; ductus bursae sclerotic dorsally, bursa small, narrow posteriorly, enlarged and bulbous anteriorly; ductus seminalis arising from right-hand side of base of bursa.

This genus contains about 20 species which occur from Arizona and Texas south to Argentina.

GENUS *HYALOPHORA* DUNCAN

This is a genus of large moths, without transparent areas in the wings. In the male there is an inflexed denticulate area or lobe along the lower margin of each harpe which differentiates the genus from its relatives. There are other generic characters as indicated in the following description.

The generic name *Hyalophora* was correctly used by Bouvier (1936b) in place of *Platysamia*.¹ Its applicability to this group was recognized by Grote, who, however, regarded the name as inappropriate and therefore did not use it after 1865. It is here

used in a broader sense, to include the species often placed in *Callosamia* and *Eupackardia*. The differences between these groups, especially between *Hyalophora* proper and *Callosamia*, are so slight as to be scarcely generic in importance, especially when it is considered that only about seven species are involved.

Frons distinctly convex at sides, next to eyes; laterofrontal sutures almost completely invisible in front view because of this convexity; shortest distance between eyes slightly more than one-half to more than two-thirds of length of an eye, upper ends of eyes not or scarcely reaching lower end of face.

Antennae one and one-half times as long as thorax or more, flagellum without scales or that of female with a few scales on dorsal surfaces of segments of basal half, antenna of male very broadly quadripectinate nearly to apex, but last half dozen segments or less narrowly bipectinate; basal rami sometimes with inconspicuous terminal bristles shorter than setae, apical rami subequal in length to basal rami; antennal shaft without bristles or with extremely inconspicuous ones; antennal cones small, multiple, limited to apical third of antenna or less, usually much less. Antennae of female quadripectinate but much more narrowly so than those of male, basal and apical rami subequal, both bearing terminal and subterminal bristles, or apical rami somewhat shorter than basal and without bristles; setae of rami much shorter than those of male.

Tentorial pits elongate oval to nearly round; clypeus not produced, four to six times as broad as long, sometimes not separated from frons but at other times with a distinct depressed line between the two

¹ Since this manuscript was prepared, d'Almeida (1950) has agreed with this synonymy.

GENITALIC STRUCTURES

Figs. 362-364. *Dirphia* (*Dirphia*) *tarquinia* (Cramer). 362. Ventral view. 363. Lateral view. 364. Aedeagus.

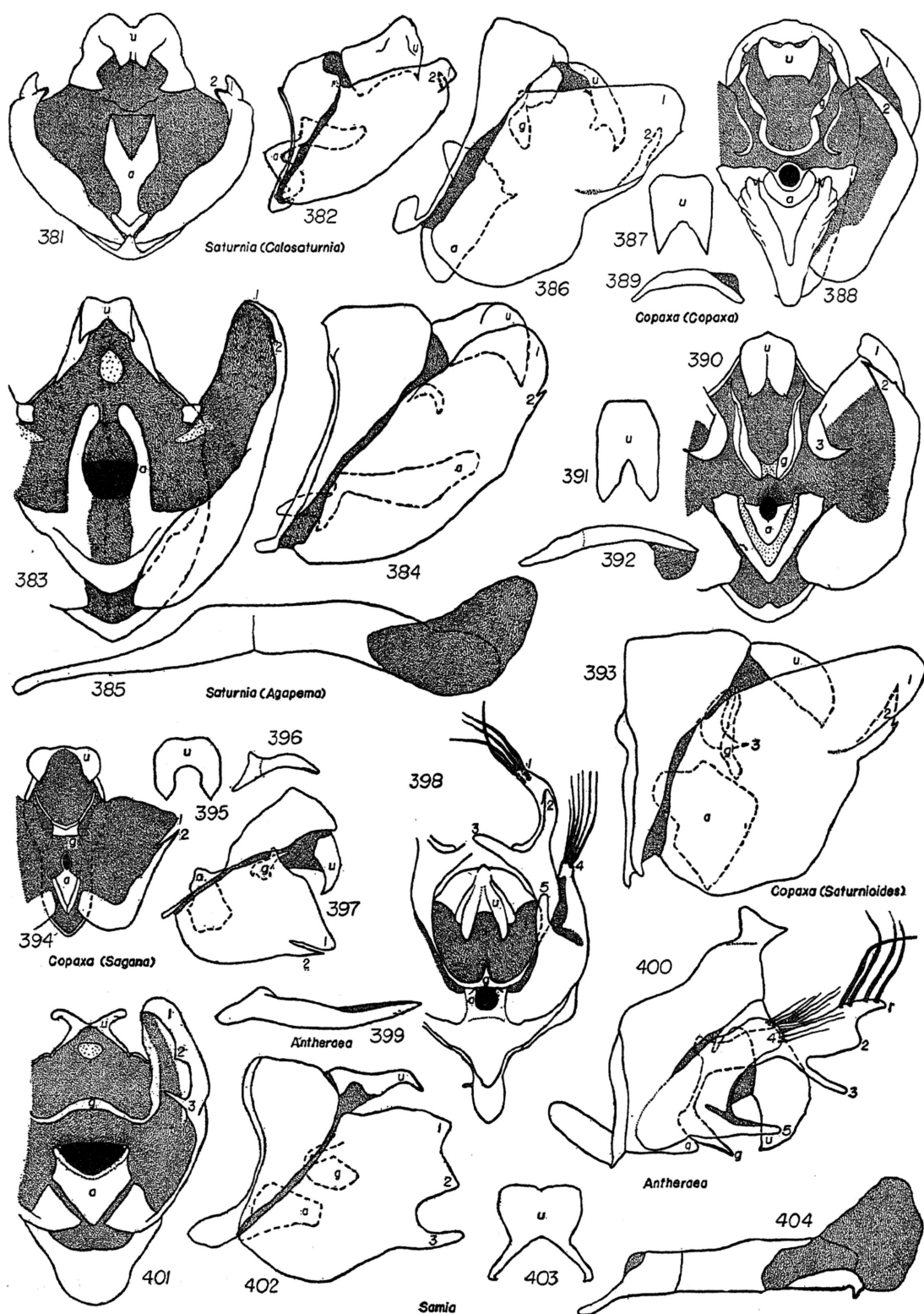
Figs. 365-367. *Dirphia* (*Periphoba*) *hircia* (Cramer). 365. Ventral view. 366. Aedeagus. 367. Lateral view.

Figs. 368-370. *Dirphia* (*Dirphiopsis*) *multicolor* Walker. 368. Ventral view. 369. Aedeagus. 370. Lateral view (aedeagus *in situ*).

Figs. 371-373. *Dirphia* (*Heliconisa*) *pagenstecheri* (Geyer). 371. Aedeagus. 372. Lateral view. 373. Ventral view of gnathos and associated structures.

Figs. 374-376. *Dirphia* (*Kentroleuca*) *lineosa* (Walker). 374. Ventral view. 375. Aedeagus. 376. Lateral view.

Figs. 377-380. *Polythysana rubescens* (Blanchard). 377. Ventral view. 378. Dorsal view of aedeagus. 379. Lateral view of aedeagus. 380. Lateral view.



sclerites; pilifers absent. Mandibular rudiments rather large and sometimes protuberant. Proboscis fossa broader than long, extremely shallow, sometimes virtually without walls and other times with low sloping walls; maxillary stipites very small and extending back to middle of palpal sockets, galeae reduced to mere lobes; labial sclerite small and very feebly sclerotic; labial palpi arising behind middle of fossa, short and not or scarcely reaching clypeus, not divided into segments or sometimes with indications of division into three segments but without actual articulations.

Thorax densely covered with long hairs; patagia rather thick; parapatagia lamelliform; anepisternal suture directed towards a point above middle of deeply impressed portion of pleural suture; deeply impressed portion of pleural suture directed in approximately same direction as straight lower portion of this suture, curved region intervening between these two main portions inconspicuous.

Epiphysis of both sexes rather slender and bearing long hairs, that of male often reaching to apical third of tibia, that of female usually not reaching beyond middle of tibia; tibial spurs scarcely exceeding the vestiture, apices dark and hardened on one side, sometimes concave; tarsal segments usually with a few spines near apices of segments one to four, penultimate fore tarsal segment of female with the usual pair of apical spines, spine-bearing lobes of this segment bare, adjacent bare areas of following segment large and contiguous with sole of segment which is either bare or has only a broad median band of scales; claws simple; arolium and pulvilli well developed.

Forewings with outer margins concave to straight; hind wings with anal angles rounded, not produced; vestiture consisting of scales, overlain by elongated scales and hairs, wings without transparent spots. Vein R_1 of forewing, when present, separating from R_{2+3} beyond R_4 .

Abdomen covered with erect or suberect hairs or hair-like scales which frequently hide some broad scales. Uncus of male bifid at apex; gnathos nearly absent, represented only by sclerotic bars connected to upper basal angles of harpes or these bars large and connected across to form a complete gnathos which is not much produced posteriorly in the middle; anellus free from ninth sternum and from harpes; harpes large, freely articulated to ninth segment, lower portion of each harpe with a rather large, finely denticulate or spiculate lobe; margin of harpe above this lobe usually drawn out into a long process which may be reduced to a mere angle.

Eighth tergum of female broadly sclerotic on either side of midline but middorsal portion membranous; eighth sternum with narrow prevulvar sclerotic band and a broader postvulvar sclerotic plate which is broadly produced posteriorly; ductus bursae largely sclerotic; bursa membranous, sometimes slender and cylindrical, usually enlarged and bulbous; ductus seminalis arising from right-hand side of base of bursa.

This genus can be divided into three subgenera as indicated in table 19.

SUBGENUS *HYALOPHORA* DUNCAN

Figures 95, 420

Hyalophora DUNCAN, 1841, in Jardine, Natural-

GENITALIC STRUCTURES

FIGS. 381-382. *Saturnia (Calosaturnia) mendocino* Behrens. 381. Ventral view. 382. Lateral view.

FIGS. 383-385. *Saturnia (Agapema) galbina* Clemens. 383. Ventral view. 384. Lateral view. 385. Aedeagus.

FIGS. 386-389. *Copaxa (Copaxa) lavendera* Westwood. 386. Lateral view. 387. Posterior view of uncus. 388. Ventral view. 389. Aedeagus.

FIGS. 390-393. *Copaxa (Saturniodes) medea* (Maassen). 390. Ventral view. 391. Posterior view of uncus. 392. Aedeagus. 393. Lateral view.

FIGS. 394-397. *Copaxa (Sagana) sapatoza* (Walker). 394. Ventral view. 395. Posterior view of uncus. 396. Aedeagus. 397. Lateral view.

FIGS. 398-400. *Aniheraea polyphemus* (Cramer). 398. Ventral view. 399. Aedeagus. 400. Lateral view.

FIGS. 401-404. *Samia cynthia* (Drury). 401. Ventral view. 402. Lateral view. 403. Posterior view of uncus. 404. Aedeagus.

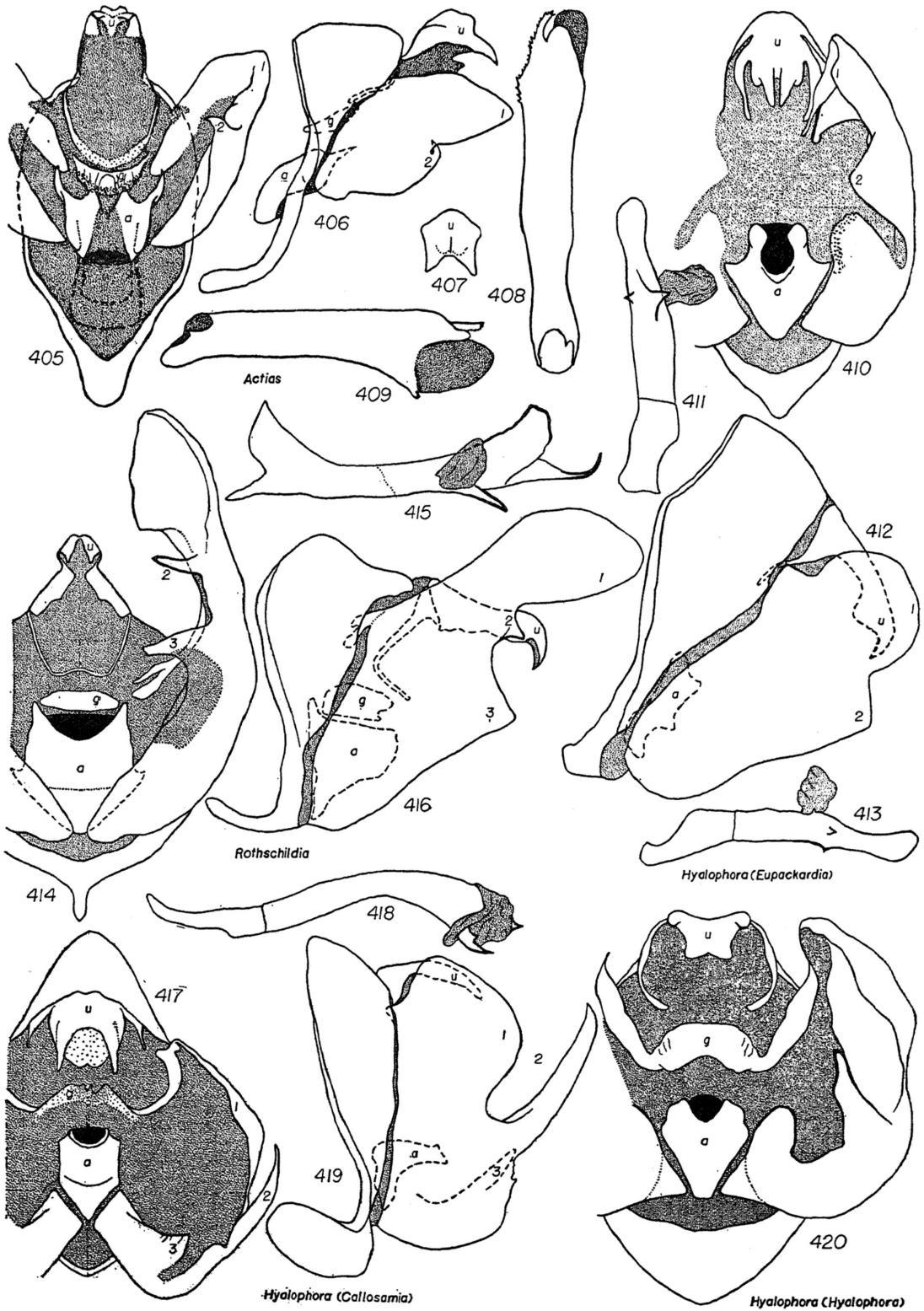


TABLE 19
SUBGENERA OF *Hyalophora*

<i>Hyalophora</i> , <i>Sensu Stricto</i>	<i>Callosamia</i>	<i>Eupackardia</i>
Labial palpi divided by a line or constriction indicating the division between first and second palpal segments	Labial palpi undivided	Labial palpi divided by two constrictions, so that the three segments are indicated
Tarsal segments one to four with apical and subapical spines	Tarsal segments one to four with apical and subapical spines	Tarsal spines absent except apical pair on penultimate fore tarsal segment of female
Forewing with veins R_1 and R_2 present	Forewing with veins R_1 and R_2 present	Forewing with veins R_1 and R_2 absent
Wings with comma-shaped or transverse discal marks	Wings with angulate discal marks, or without such marks	Wings with angulate discal marks
Abdomen banded	Abdominal terga unicolorous	Abdominal terga unicolorous
Outer margin of male harpes with a long pointed projection	Outer margin of male harpes with a long pointed projection	This projection of harpe reduced to an angle
Gnathos complete	Gnathos membranous medially	Gnathos absent except for lateral sclerotizations connected to claspers
Distal rami of female antennae subequal to basal rami	Distal rami of female antennae markedly shorter than basal rami	Distal rami of female antennae slightly shorter than basal rami

ist's library, vol. 32, pp. 124, 132.¹ Type: *Phalaena cecropia* Linnaeus, by designation of Grote, 1865, Proc. Ent. Soc. Philadelphia, vol. 5, p. 228.

Platysamia GROTE, 1865, Proc. Ent. Soc. Philadelphia, vol. 5, p. 229. Type: *Phalaena cecropia* Linnaeus, by original designation (p. 228).

This subgenus contains a few (perhaps four) North American species.

¹ Duncan first used the name *Hyalophora* on page 124 of this work for *atlas* and its congeners. On this page he mentions the distinctive features of large size and large vitreous spaces on the wings. In the same work, however (see p. 132), he includes the species *cecropia* and *promethea* in *Hyalophora*, and they must therefore be considered among the originally included species of the genus. It is unfortunate that Grote selected *cecropia* instead of *atlas* as the genotype. However, since *cecropia* is one of the originally included species, it seems that this designation is binding, even though this species does not agree with the original generic diagnosis of Duncan.

SUBGENUS CALLOSAMIA PACKARD

Figures 417-419

Callosamia PACKARD, 1864, Proc. Ent. Soc. Philadelphia, vol. 3, p. 379. Type: *Phalaena promethea* Drury, designated by Grote, 1896, Mitth. Roemer-Mus., Hildesheim, no. 6, p. 2.

This subgenus probably contains but two species, both occurring in eastern North America, and one of them supposedly ranging into Mexico.

SUBGENUS EUPACKARDIA COCKERELL

Figures 96, 410-413

Eupackardia COCKERELL, 1912, Ent. News, vol. 23, p. 228. Type: *Saturnia calleta* Westwood, by original designation.

This subgenus contains a single species which ranges from Arizona to Guatemala.

GENITALIC STRUCTURES

FIGS. 405-409. *Actias luna* (Linnaeus). 405. Ventral view. 406. Lateral view. 407. Posterior view of uncus. 408. Dorsal view of aedeagus. 409. Lateral view of aedeagus.

FIGS. 410-413. *Hyalophora (Eupackardia) calleta* (Westwood). 410. Ventral view. 411. Ventral view of aedeagus. 412. Lateral view. 413. Lateral view of aedeagus.

FIGS. 414-416. *Rothschildia jacobaeae* (Walker). 414. Ventral view. 415. Aedeagus. 416. Lateral view.

FIGS. 417-419. *Hyalophora (Callosamia) promethea* (Drury). 417. Ventral view. 418. Aedeagus. 419. Lateral view.

FIG. 420. *Hyalophora (Hyalophora) cecropia* (Linnaeus). Ventral view.

LITERATURE CITED

- ANDER, KJELL
1942. Die Insektenfauna des baltischen Bernsteins nebst damit verknüpften zoogeographischen Problemen. Lunds Univ. Årsskr., new ser., vol. 38, no. 4, pp. 1-83, 10 maps.
- BERLESE, ANTONIO
1909. Gli Insetti. Milan, Kramer, vol. 1, x+1104 pp., figs. 1-1292, pls. 1-10.
- BOUVIER, E. L.
1931. Étude des saturnioïdes normaux famille des syssphingidés. Mém. Acad. Sci. Inst. France, ser. 2, vol. 60, no. 2, pp. 1-290, figs. 1-92, pls. 1-5.
1932. Étude des saturnioïdes normaux famille des hémileucidés, Première partie. Ann. Sci. Nat., Paris, Zool., ser. 10, vol. 15, pp. 363-426, figs. 1-22, pl. 1.
1935. Étude des saturnioïdes normaux famille des hémileucidés, Deuxième partie. *Ibid.*, ser. 10, vol. 18, pp. 217-418, figs. 1-39, pls. 1-6.
1936a. Étude des saturnioïdes normaux famille des hémileucidés, Troisième et dernière partie. *Ibid.*, ser. 10, vol. 19, pp. 31-293, figs. 1-41, pls. 1-4.
1936b. Étude des saturnioïdes normaux, famille des saturniidés. Mém. Mus. Nat. Hist. Natl., Paris, new ser., vol. 3, pp. 1-350, figs. 1-82, pls. 1-12.
- BUSCK, AUGUST, AND CARL HEINRICH
1921. On the male genitalia of the Microlepidoptera and their systematic importance. Proc. Ent. Soc. Washington, vol. 23, pp. 145-152, pls. 12-13.
- D'ALMEIDA, R. FERREIRA
1943a. Alguns tipos de gêneros da ordem Lepidoptera, 3.a nota. Arq. Mus. Paranaense, vol. 3, pp. 123-130.
1943b. Alguns tipos de generos da ordem Lepidoptera, quinta nota. Bol. Mus. Nac., Brazil, new ser., zool., no. 7, pp. 1-10.
1943c. Sobre a nomenclatura de alguns grupos superiores da ordem Lepidoptera. Papéis Avulsos Dept. Zool., Secretaria Agric., São Paulo, vol. 3, pp. 237-254.
1950. Nota retificativa e adicional sobre alguns tipos de gêneros e sobre a nomenclatura de alguns grupos superiores publicados por nós em 1942, 1943 e 1944. Rev. Ent., vol. 21, pp. 223-224.
- DUPORTE, E. MELVILLE
1946. Observations on the morphology of the face of insects. Jour. Morph., vol. 79, pp. 371-417, pls. 1-7.
- EYER, JOHN R.
1924. The comparative morphology of the male genitalia of the primitive Lepidoptera. Ann. Ent. Soc. Amer., vol. 17, pp. 275-342, figs. 1-10, pls. 25-38.
- FERRIS, G. F.
1940a. The morphology of *Plega signata* (Hagen) (Neuroptera: Mantispidae). Microentomology, vol. 5, pp. 33-56, figs. 6-20.
1940b. The myth of the thoracic sternites of insects. *Ibid.*, vol. 5, pp. 87-90.
1942. Some observations on the head of insects. *Ibid.*, vol. 7, pp. 25-62, figs. 10-27.
- FORBES, WILLIAM T. M.
1920. The Lepidoptera of New York and neighboring states. Mem. Cornell Univ. Agr. Exp. Sta., no. 68, pp. 1-729, figs. 1-439.
1939. The muscles of the lepidopterous male genitalia. Ann. Ent. Soc. Amer., vol. 32, pp. 1-10, figs. 1-5.
- HUXLEY, JULIAN S.
1932. Problems of relative growth. London, Methuen.
- JORDAN, KARL
1902. Das mesosternit der Tagfalter. Verhandl. Internatl. Zool. Congr. Berlin, 1901, pp. 816-828, pls. 1-3.
1911. Family Saturniidae. In Seitz, A., The Macrolepidoptera of the world. Stuttgart, div. 1, vol. 2, pp. 209-226.
1922. A monograph of the saturnian subfamily Ludiinae. Novitates Zool., vol. 29, pp. 249-326, figs. 1-169, pls. 1-2.
1923. A note on the families of moths in which R_2 (=vein 5) of the forewing arises from near the centre or from above the centre of the cell. *Ibid.*, vol. 30, pp. 163-166.
1924. On the saturnoidean families Oxytenidae and Cercophanidae. *Ibid.*, vol. 31, pp. 135-193, pls. 6-21.
- KIRBY, W. F.
1892. A synonymic catalogue of Lepidoptera Heterocera. London, Gurney and Jackson, vol. 1, Sphingidae and Bombyces, xii+951 pp.
- LAMEERE, A.
1922. Sur la nervation alaire des insectes. Bull. Classe Sci., Acad. Roy. Belgique, ser. 5, vol. 8, pp. 138-149.
- MADDEN, A. H.
1944. The external morphology of the adult tobacco hornworm (Lepidoptera, Sphingidae). Ann. Ent. Soc. Amer., vol. 37, pp. 145-160, figs. 1-19.
- MATHER, K.
1943. Polygenic inheritance and natural selection.

- tion. Biol. Rev., Cambridge Phil. Soc., vol. 18, pp. 32-64.
- MAYR, ERNST, AND CHARLES VAURIE
1948. Evolution in the family Dicruridae (birds). *Evolution*, vol. 2, pp. 238-265.
- MELIS, ANTONIO
1940. Contributo alla conoscenza del Bombice del Pino. *Redia*, vol. 26, pp. 73-175, figs. 4-23.
- MICHENER, CHARLES D.
1944a. Comparative external morphology, phylogeny, and a classification of the bees (Hymenoptera). *Bull. Amer. Mus. Nat. Hist.*, vol. 82, pp. 157-326, figs. 1-246.
1944b. A comparative study of the appendages of the eighth and ninth abdominal segments of insects. *Ann. Ent. Soc. Amer.*, vol. 37, pp. 336-351, figs. 1-35.
1949a. Parallelisms in the evolution of saturniid moths. *Evolution*, vol. 3, pp. 129-141, figs. 1-8, tables 1-2.
1949b. New genera and subgenera of Saturniidae (Lepidoptera). *Jour. Kansas Ent. Soc.*, vol. 22, pp. 142-147.
1950. New genera and subgenera of Saturniidae (Lepidoptera): A correction. *Ibid.*, vol. 23, p. 26.
- MULLER, H. F.
1939. Reversibility in evolution considered from the standpoint of genetics. *Biol. Rev.*, Cambridge Phil. Soc., vol. 14, pp. 261-280.
- MUNROE, EUGENE G.
1949. An unnoticed character in the Saturnioidea (Lepidoptera). *Ent. News*, vol. 60, pp. 60-65.
- OTICICA, JOSÉ, FILHO
1940. Estudo sobre pernas de Adelocephalidae (Lepidoptera). *Papéis Avulsos Dept. Zool., Secretaria Agric.*, São Paulo, vol. 1, pp. 17-38, pls. 1-15.
1941. Sobre a nomenclatura dos lepidópteros da família Adelocephalidae. *Arq. Zool. Estado São Paulo*, vol. 2, pp. 325-339.
- PACKARD, ALPHEUS SPRING
1905. Monograph of the bombycine moths of North America, Part II. *Mem. Natl. Acad. Sci.*, vol. 9, pp. 1-151, pls. 1-61.
1914. Monograph of the bombycine moths of North America, Part III. *Ibid.*, vol. 12, pp. ix+1-276+503-516, pls. 1-113.
- RENSCH, BERNARD
1939. Typen der Artbildung. *Biol. Rev.*, Cambridge Phil. Soc., vol. 14, pp. 180-222.
- SCHÜSSLER, H.
1933, 1934. Saturniidae. In Strand, E., *Lepidopterorum catalogus*. Berlin, pts. 55, 56, 58, 65, pp. 1-769.
1936. Syssphingidae. In Strand, E., *op. cit.* Berlin, pt. 70, pp. 1-230.
- SCHULZ, HILDEGARD
1914. Das Pronotum und die Patagia der Lepidopteren. *Deutsche Ent. Zeitschr.*, pp. 17-42, pls. 1-11.
- SHEPARD, HAROLD H.
1930. The pleural and sternal sclerites of the lepidopterous thorax. *Ann. Ent. Soc. Amer.*, vol. 23, pp. 237-260, figs. 1-50.
- SIMPSON, GEORGE GAYLORD
1944. Tempo and mode in evolution. New York, Columbia University Press, xviii-235 pp., figs. 1-36.
- SNODGRASS, R. E.
1935. Principles of insect morphology. New York, McGraw-Hill Book Co., ix+667 pp., figs. 1-319.
1947. The insect cranium and the "epicranial suture." *Smithsonian Misc. Coll.*, vol. 107, no. 7, pp. 1-52, figs. 1-15.
- STURTEVANT, A. H., AND E. NOVITSKI
1941. The homologies of the chromosome elements in the genus *Drosophila*. *Genetics*, vol. 26, pp. 517-541.
- TILLYARD, R. J.
1919. The panorpoid complex. Part 3:—The wing-venation. *Proc. Linnean Soc. New South Wales*, vol. 44, pp. 533-718, figs. 16, 35-111, pls. 31-35.
- TRAVASSOS, LAURO, AND EDUARDO MAY
1943. Adelocephalinae da coleção Julius Arp. *Bol. Mus. Nac., Brazil, new ser., zool.*, no. 11, pp. 1-22.
- TURNER, A. JEFFERIS
1947. A review of the phylogeny and classification of the Lepidoptera. *Proc. Linnean Soc. New South Wales*, vol. 71, pp. 303-338, figs. 1-96.
- VIETTE, P.
1948. Morphologie des genitalia males des lépidoptères. *Rev. Française d'Ent.*, vol. 15, pp. 141-161.
- WEBER, HERMANN
1924. Das Thorakalskelett der Lepidopteren. *Zeitschr. Anat. Entwickl.-Gesch.*, vol. 73, pp. 277-331, figs. 1-9.
1928. Die Gliederung der Sternopleuralregion des Lepidopteren thorax. *Zeitschr. Wiss. Zool.*, vol. 131, pp. 181-254, figs. 1-21.
- WRIGHT, SEWALL
1929. Fisher's theory of dominance. *Amer. Nat.*, vol. 63, pp. 274-279.
- ZANDER, E.
1903. Beiträge zur Morphologie der männlichen Geschlechtsanhänge der Lepidopteren. *Zeitschr. Wiss. Zool.*, vol. 74, pp. 557-615, figs. 1-15, pl. 1.