JERRY A. POWELL

A Systematic Monograph of New World Ethmiid Moths (Lepidoptera: Gelechioidea)

SMITHSONIAN CONTRIBUTIONS TO ZOOLOGY NUMBER 120

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ABSTRACT

Powell, Jerry A. A Systematic Monograph of New World Ethmiid Moths (Lepidoptera: Gelechioidea). *Smithsonian Contributions to Zoology,* number 120, 302 pages, 294 figures, 22 plates, 68 maps, 1973.—The family Ethmiidae is represented in the Americas by 133 species, or about half the world fauna. A classification is proposed, based on correlation of a traditional biosystematic approach with a numerical phenetic analysis of adult characters. The 133 species are assigned to 3 previously existing genera; 49 species are described as new, 11 from Nearctic North America, 4 from the West Indies, 25 from Neotropical Mexico and Central America, and 9 from South America. Keys to the species are provided, based on external features of the moths. Literature synonymy, descriptions of morphological aspects, type data, geographical ranges, and flight periods are given for each species. All knowledge of geographical distribution patterns, behavior and biology, and morphology of the larva, pupa, and adult of the world ethmiid fauna is analyzed in development of speculation concerning the systematic position and phylogenetic relationships of these moths (see summary at end of text).

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Jerry A. Powell

A Systematic Monograph of New World Ethmiid Moths (Lepidoptera: Gelechioidea)

Introduction

The Ethmiidae are a family of small to moderate-sized moths that is of worldwide distribution, consisting of some 250 described species. The group occurs in all faunal realms, reaching its greatest diversity in the northern Neotropical region. In general ethmiids occupy areas of seasonal drought and are dependent upon plants of the large family Boraginaceae and to a lesser extent the Hydrophyllaceae, a much smaller family that is restricted primarily to North America.

As presently defined the New World fauna of Ethmiidae is composed of 133 species in 3 genera, of which 49 species are described as new. The state of knowledge is thought to be relatively complete for the Nearctic, with only about 9 species having been collected for the first time during the past 15 years and with something known of the biologies of about half the species. By contrast, the picture in Neotropical Mexico and Central America is less well defined with many new forms having been discovered during the past decade and with little information available on biologies. The South American fauna is incompletely known; any sizable collection from any place other than the extreme northern perimeter can be expected to include additional undescribed species.

No previous classification has been proposed for the Neotropical ethmiids that comprise the center of diversity, both in numbers of species and in morphological development for the New World fauna.

This study had its origin in early 1959, when in attempting to identify some small collections from California and Mexico, I found that little had been recorded about geographical distributions of the previously described species and almost nothing was known of their biologies. A preliminary report giving some of this information and describing three new species was published (Powell, 1959). However, no sooner was that manuscript prepared than I collected another new species near my home in central California, one of the best sampled areas for insects in the western United States. This, together with collections made the following year, led me to propose a California insect survey bulletin project on ethmiids in 1961, and I began to investigate the distribution and biologies of several species in detail. The following year I studied at eastern North American museums to assess western material and to survey the Neotropical fauna in order to gain some appreciation of an overall classification of the group. Unexpectedly, I found that nearly all of the previously described species were recognizable at the National Museum of Natural History, through Busck types, Walsingham material from the *Biologia Centrali-Americana* project, and through illustrations of Meyrick types which were then in preparation for publication (Clarke, 1965) and were made available to me by Dr. Clarke. There were only about 45 species described from the Neotropical region, mostly known only from few specimens, and a classification of all New World species thus seemed practical at that time.

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Through Walker paratypes and photographs sent from the British Museum, the few remaining species were nearly all incorporated, and a review was essentially completed by the end of 1963.

At about that time, however, there began a series of expeditions to Mexico, Central America, and northern South America that emphasized collection of smaller moths; these were primarily by the Duckworths, Flint, Spangler, and others of the Smithsonian Institution, and by Chemsak, myself, and others from the University of California, Berkeley. During 1963–1967 inclusive, no fewer than 20 separate moth-collecting expeditions were made from these two institutions alone. At the same time, collecting generally had increased in Neotropical regions, and many significant additions to the ethmiid data have been made by nonspecialists, such as those in connection with the development of the Organization for Tropical Studies in Costa Rica.

As a result, the first really major accumulation of Neotropical Microlepidoptera occurred after the early years of this century when material was gathered for the *Biologia Centrali-Americana* study. I estimate that nearly 50 percent of all collection records of Neotropical ethmiids (some 475 records), exclusive of the Caribbean Islands, are the result of fieldwork during the past decade, or since the present study began. No less than 60 percent have been produced by collections during the past 15 years. In terms of specimens, the proportions would be much higher, since collection techniques in recent years have resulted in larger series than in earlier times. The Antilles, by contrast, were more heavily worked in prior years, and only about 30 percent of available records have accumulated during the last 10 years. Nonetheless, the West Indies, like the mainland of Central America, have remained poorly sampled for Microlepidoptera.

Thus the material basis for the present project has more than doubled since work began, and the study has been prolonged, as well as having been rendered more complete by the added data. In many instances my earlier descriptions had to be revised or added to, while in others only geographical and seasonal data were added as specimens in better series became available.

My studies on the biology and life histories were concentrated on 14 species in California. The details and techniques involved are reported elsewhere (Powell, 1971), and the information is summarized in the present report. In general only the flight period, given as months of capture, and the food plant, where known, are reported in the systematic treatments of individual species. Further biological information is summarized in the introductory biological section. Biological data from the literature for the American species has been thoroughly treated, while that concerning Old World species has not been systematically reviewed.

Acknowledgments

Considering the duration of this study, I am unable to acknowledge individually all persons who have given assistance. However, I extend my heartfelt thanks to all contributors of specimens or information, both those persons mentioned here and elsewhere in the text, as well as the many others who have contributed indirectly in one capacity or another. I especially thank the following.

My colleagues, J. F. Gates Clarke, W. D. Duckworth (Smithsonian Institution), R. W. Hodges (U. S. Department of Agriculture), and Klaus Sattler (British Museum) helped immeasurably during development of interpretations of systematics and biogeography of ethmiids and through discussions and review of portions of the manuscript. It is a rare opportunity to have five specialists actively working in one superfamily of Microlepidoptera, all of whom are cooperating in synthesizing concepts of the fauna on a worldwide basis.

Annette Braun (Cincinnati, Ohio) and D. H. Habeck (University of Florida, Gainesville) supplied unpublished data on biologies of several eastern Nearctic species, which proved particularly significant in synthesizing biosystematic concepts.

Numerical analyses were made possible through cooperation by W. W. Moss (Academy of Natural Sciences, Philadelphia), who reviewed pertinent sections of the manuscript, J. W. Carmichael (University of Alberta), and J. T. Doyen (University of California, Berkeley), and by the U. C. Computer Center, which provided computer time through National Science Foundation support.

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western Mexico, during which J. A. Chemsak and I made important collections of ethmiids as a by-product to other fieldwork, was funded by the N. S. F. grant "Carpenter Bees of the World" (P. D. Hurd, Jr., principal investigator). N. S. F. grants GB–4014 (1965–1967) and GB–6813x (1967–1970) "Comparative Biology in Relation to Systematics of Microlepidoptera" funded all of my biological studies during those years (Powell, 1971), as well as travel to eastern museums in 1967 and much of the assistance with technical aspects of this study. A grant to me from the Associates in Tropical Biogeography, University of California, Berkeley, enabled travel and fieldwork by J. S. Buckett and M. R. Gardner in Veracruz during 1966, resulting in many valuable collections. Finally, a fellowship from the Office of Academic Programs, Smithsonian Institution, in support of a visiting research associateship during 1970–1971, has resulted in a more thorough development of theoretical concepts through association with personnel of the Division of Lepidoptera of the National Museum of Natural History.

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Pollen analyses were performed by R. W. Thorp, University of California, Davis.

Most of the art work was done by Celeste Green, Department of Entomology artist, University of California, Berkeley. Mrs. Green produced most of the drawings of male genitalia from preparations on microscope slides and inked most of the other drawings of adult structures, which I drafted from preparations in cellusolve, while I did those of the early stages.

The maps were prepared almost entirely by Bruce Manion, who assisted me on the National Science Foundation Project during 1966–1967 and 1970. The maps are the Goode Base Map Series, produced by the University of Chicago, which owns the copyright.

Photographic work was done by various persons over the past 10 years. Photographs of eggs and detailed parts of the moths were executed by A. A. Blaker, Scientific Photographic Laboratory, Uni-

versity of California, while either Bruce Manion or I produced those of the whole moths, using a Nikon 35–mm camera with Micro-Nikor lens and a single overhead electronic flash. Stereoscan Scanning Electron Micrographs were executed through the cooperation of T. E. Everhart, Electronics Research Laboratory, University of California, Berkeley, through support from National Science Foundation grant GB–6428 and grant No. 15536 from the National Institutes of Health.

Finally, my wife Frances provided help and encouragement in many ways and tolerated not only the seemingly endless prolonging of the project but the proofreading of drafts of large parts of the manuscript as well.

Taxonomy

Nomenclatural Review

The history of concepts and nomenclatural treatment of ethmiid moths has been a curious one. Since the time of conception of the genus *Ethmia* in the early 1800s, the genus has remained a consistent entity, with few species having been described elsewhere and later transferred to *Ethmia*, and with virtually no species ever having been described under *Ethmia* or any of its synonyms and later reassigned to other genera. Yet as discussed below, no one character, by which the genus can be characterized, can be cited as unique to *Ethmia* and present in all its species. At the family level, by contrast, there has been neither validity nor consistency in the treatment of included genera and characters that defined them as members of the alleged family.

The genus *Ethmia* was proposed by Hübner in 1819 to accommodate *pyrausta* Hübner (not Pallas, 1771) (=*aurifluella* Hübner, 1825), a European species which differs in many superficial respects from the bulk of the Palearctic fauna. This species comprises a monobasic species group in Sattler's (1967) treatment. Most of the species described during the remainder of the nineteenth century were assigned to either *Psecadia* Hübner, 1825, or to *Anesychia* Hübner, 1825, names which were proposed for the closely related European species, *decemguttella* Hübner, 1810 [invalid] (=*dodecea* Haworth, 1828) and *pusiella* Linnaeus. These species evidently were more familiar to European workers, and as a result the later generic names carried the concept of the genus during the following several decades. Thus between 1830 and 1890 some 20 Palearctic species were described as members of *Psecadia* and *Anesychia*, along with 5 assigned to *Hyponomeuta* (=*Yponomeuta*).

The first New World members of *Ethmia* were from the West Indies and South America and were described in 1863 and 1864 by Walker and Zeller, and were assigned to *Psecadia* and *Hyponomeuta*. At the same time Walker proposed the new genus *Tammarha* for his *nivosella*, a superficially bizarre species. This genus was defended and returned to the Yponomeutidae by Walsingham (1897) and Azinidae (Walsingham, 1906) on the basis of wing venation and the costal hair pencil of the hindwing in the male, a widespread character which apparently had been overlooked in all Palearctic species up until then, as it has been generally by previous American writers.

Babaiaxa Busck, 1902, with *delliella* Fernald as its type species, is the only other synonym of *Ethmia* based on American species. The synonymy with *Ethmia* was suggested by Busck (1906b) and with *Tammarha* (Busck, 1908b) and of both *Tammarha* and *Babaiaxa* with *Ethmia* by Busck (1909a).

During the 1870–1890 period, Chambers, Zeller, and Walsingham described some 23 species, including the early Nearctic ones, in *Psecadia*, *Anesychia*, and *Hyponomeuta*.

Reviews of the genus were presented by Walsingham (1897), for the West Indies, who first recognized the validity of the name *Ethmia* and treated *Psecadia* as a synonym; by Dyar (1902) for the Nearctic species; and by Walsingham (1912) for Central American species. All subsequently described species have been assigned to *Ethmia* or more recently proposed genera, and I have no new generic combinations in this study.

The greatest flurry of New World species descriptions occurred during the first two decades of the present century, with more than 40 names appearing, mostly in the works of Busck and Walsingham, including 12 species in the United States during 1900–1910, and some 25 species in Central America during 1910–1920.

Barnes and Busck (1920) illustrated the Nearctic species (including one previously undescribed), but

with that review available no further additions to the Nearctic *Ethmia* were made until Clarke (1950) described two species from California. During the interim only a scattering of Central and South American *Ethmia* were described, all by Meyrick.

The following additional generic entities have been defined as ethmiids in the New World.

The genus *Pyramidobela* Braun, 1923, was proposed to accommodate the Nearctic species, *quinquecristata* Braun, 1921, originally assigned to *Enicostoma* of the Oecophoridae. The change was made principally at the suggestion of Busck, on the basis of male genital characters. The genus as now defined consists of seven closely similar species, and I have retained its association with *Ethmia* despite the probability that its relationships will be shown elsewhere in the Oecophoridae when more is known of the Neotropical fauna.

Probolacma melanoclista Meyrick, 1921, was based on the female only and considered along with *Lotisma* Busck, 1909, to be related to *Ethmia* by Meyrick (1927), who assigned the group to Yponomeutidae. McDunnough (1939) followed this concept for *Probolacma* and *Lotisma* but not for *Ethmia*. Finally Clarke (1965) treated *Probolacma* as a synonym of *Ellabella* Busck, 1925, and placed the genus in Ethmiidae. I have examined both sexes of the two type species, *Lotisma trigonana* (Walsingham) and *Ellabella editha* Busck and see no close relationship to Gelechioidea in structure of the mouthparts and genitalia. However, the male genitalia do not at all resemble *Yponomeuta* or typical plutellids. Moreover, I have reared *L. trigona* in California, where the larvae feed in flowers and fruit of *Arctostaphylos* and *Arbutus* (Ericaceae), and neither larval nor pupal structure and habits resemble *Ethmia*. Although they may be allied to some Gelechioidea, I have found no evidence that either *Lotisma* or *Ellabella* is related to *Ethmia* and exclude treatment of them.

Eumeyrickia Busck, 1902 (type: *trimaculella* Fitch, 1856 (=*Eido albapalpella* Chambers, 1872, ?), was transferred from Oecophoridae to Ethmiidae by Clarke (1941), who also indicated that *Oecophora coloradella* Walsingham, 1888, is an ethmiid, primarily on the basis of wing venation and male genitalia. Later Clarke (1963) transferred *coloradella* back to *Schiffermülleria* in the Oecophoridae. I have elsewhere (in Lawrence and Powell, 1969) discussed morphological and biological bases by which these two species (both are fungus feeders) should be considered typical oecophorids (i.e., members of Oecophorinae when a higher classification of that family is realized), rather than relatives of *Ethmia*.

Pseudethmia Clarke, 1950, was described for *protuberans* Clarke, a species of the California desert. I have retained this monobasic genus on the basis of external characters (principally the protuberant front), which are equally well developed in both sexes, rather than as secondary characteristics of the male, as is the case with most morphological peculiarities in *Ethmia*.

A family concept for ethmiids was suggested by Busck in 1908 and formally proposed a year later (Busck, 1909a; Meyrick, 1909). The idea was followed by Walsingham (1912) and most subsequent North American authors, although Remington (1954) used a subfamily level for the same taxon without characterizing the remainder of the Oecophoridae into subfamilies. Meyrick, in the *Lepidopterorum Catalogus* and elsewhere (1914, 1927, etc.), assigned *Ethmia* to the Yponomeutidae, failing to explain his logic, and thus omitted the genus from the Oecophoridae in the *Genera Insectorum* (1922). The most recent taxonomic treatments have returned ethmiids to a family status within the Gelechioidea (Sattler, 1967; Common, 1970).

Walsingham (1906) mentioned Azinidae as a family including *Tammarha* and *Azinis* Walker, 1863. Although the latter is now considered a synonym of *Ethmia*, Walsingham used the family as a concept differentiated from *Ethmia*, and for this reason I do not consider the Ethmiidae of Busck, 1909, to be synonymous with Azinidae of Walsingham.

I have retained a family level for ethmiid moths merely for convenience. There seems little point in treating the group as a subfamily of Oecophoridae, the most logical position according to present knowledge, when no higher classification exists for the bulk of the world oecophorid fauna.

The present work includes the following new names and nomenclatural changes:

49 new species (1 in *Pyramidobela*, 48 in *Ethmia*)

4 new subspecies (in *Ethmia*)

1 new synonym (*abdominella* Busck, 1912, of *coronata* Walsingham, 1912)
1 new status as species (*albicostella* Beutenmüller from synonymy)
6 new statuses as subspecies (*fuscipedella, clarissa, ornata, coranella* from species; *caerulea, josephinella* from synonymy)

No new genera, subgenera, or generic combinations are proposed.

Materials and Descriptive Methods

Specimens.—I studied field biologies and laboratory behavior of 14 species of *Ethmia* (Powell, 1971) and one *Pyramidobela,* examined eggs of 12 of these species, larvae of all 15, and pupae of 9. Museum specimens representing larvae of 9 and pupae or pupal shells of 12 additional species were compared. Among these, only *E. confusella* from the Florida Keys and *E. delliella, E. bittenella,* and *E. semiombra* from southern Texas are Neotropical species. A detailed diagnosis of known larvae and pupae has not been prepared, but data from them is incorporated into the assessment of relationships of ethmiids.

About 9,000 specimens of adults were examined, representing the 133 species in this study. This included the material available in all major collections of North America, and a few in Europe and South America (see acknowledgments). Sixty percent of the specimens are Nearctic species, nearly all from the western United States. The five species that occur in the eastern United States and Canada are comparatively rare in collections, there being fewer than 50 specimens of each. In fact, more than 20 percent of all New World ethmiids in collections are one widespread species, *Ethmia discostrigella.*

By contrast, Neotropical species (60 percent of the fauna) are represented by about 3,400 specimens, of which more than 1,300 are the four most commonly collected species, *E. delliella, E. elutella, E. confusella,* and *E. playa.* Thus the 75 species most critical to evaluation of morphological diversity are known from around 2,000 specimens. Many species are very poorly collected; among 133 species, 6 are known only from females, 17 only from males, and a number known from both sexes were available by only a few specimens—too few for all needed measurements and dissections. About 25 species and subspecies are known only from the type localities.

Dissections and measurements.—Slide mount preparation and measurement techniques were essentially those described elsewhere (Powell, 1964), modified as discussed below in evaluation of taxonomic characters. Measurements were made via a micrometer disc, for head parts at 54×, for wings at 9× magnification. Generally measurements were made from five individuals of each sex where material permitted. Quantitative data are expressed as ranges in the descriptions, but each range was represented by the mean in tabulating data for numerical comparisons. The number of genital preparations varied with the relative similarity of species and the material available; the number is given for each sex in the description of each species. Head and wing preparations were executed only for representative species from the various groups. Drawings were prepared from individual slides, as noted in the descriptions, and are not composite. Size was not considered a factor in appraisal of genital characters. Larger specimens are drawn to smaller scale and figures of different enlargement appear on the same page in some instances.

Descriptions.—All descriptions are composite, based on the series available at the time of writing. Similarly, text diagnoses of genital features are composite, in contrast to the drawings, based on the number of preparations reported. Most of the descriptions were written early in the study, and in many cases additional material which became available has been used for geographical data but not in rewriting descriptions.

Application of the term "plesiotype" follows the broad definition given by Mayr, Linsley, and Usinger (1953:239), and its usage here is merely for convenience in discussing specimens from which the present illustrations were prepared. Those photographed are designated by labels (e.g., "photo JAP 65"), those from which genitalia drawings were made bear the preparation labels (e.g., "genitalia 2760 JAP '70") corresponding to the numbers given in the descriptions.

Data.—Locality, date, collector, and collection data were recorded for all specimens examined but, with the exception of new taxa, are not given in the text. (Data are available in files of the California Insect Survey, University of California, Berkeley.)

For previously described species the flight period is summarized by months of capture of specimens examined; localities are depicted on the species maps (Maps 13–70). No attempt has been made to summarize in detail the distributions and life cycles of Neotropical species. The majority of these are known from too few records to permit intelligent summary of them.

Evaluation of Taxonomic Characters

Selection of characters.—Owing to the premature state of knowledge of the majority of Neotropical species of Ethmiidae, phenetic assessment of similiarities was limited to attributes of dry, preserved, adult specimens. I selected 42 characters (Table 1) that may be grouped as follows: external features of both sexes (13), secondary characters of the male (6), male genitalia (11), secondary characters of the female (4), and female genitalia (8). Among these 13 were multistate characters. For some programs the multistate characters were converted to two-state by standard methods (Sokal and Sneath, 1963:76), rendering a total of 64 attributes.

These characters were selected primarily as those which I knew to consistently show interspecific and relatively little infraspecific variation. Thus these structures individually and by sets (e.g., male genitalia) are weighted by omission of others. I eliminated characters that were either too difficult to study to be practical (e.g., head and thoracic sclerites, maxillary palpi) or that were difficult to quantify satisfactorily (e.g., curvature of labial palpus, head vestitute, hind tibial brush, vestiture of the valva, shapes of the sterigma), or those for which infraspecific variation could not be effectively assessed without study of specimens in series (e.g., certain wing venation features, dentation of gnathos). Also omitted was any character believed to be correlated with one already used (e.g., tibial spur size with tarsal claw, head and thorax color with forewing color, certain wing venation features with breadth of wing). Finally, characters which appeared to vary completely randomly among species were omitted (e.g., absolute size, number of antennal segments, certain wing venation features, emargination of uncus when hoodlike, length of basal processes, number of loops in ductus bursae).

The following evaluation includes characters used in the numerical study (Table 1), as well as other characteristics such as color, structural shapes, and certain measurement ratios, which were primarily employed in differentiating species and which are useful in making species identifications. Character states indicated by an asterisk (*) were not differentiated in analyses in which multistate characters were converted to two-state.

Size.—The length of the forewing, measured on a straight line from base to apex (including fringe),

Table 1.—*Characters employed in phenetic assessments of similarity, with the number of states given at right* (*m*, male only; *f*, female only)

1.	Eye size	2
2.	Antennal scape modification	2
3.	Labial palpus II segment length	5
4.	Labial palpus III segment length	2
5.	Labial palpus vestiture	2
6.	Front protuberance	2
7.	Crown protuberance	2
8.	Tegulae modification (*m*)	2
9.	Tarsal claw enlargement	2
10.	Forewing breadth	4
11.	Forewing color pattern	6
12.	Abdomen color pattern	2
13.	Abdomen color	4
14.	Abdomen scale modification	2
15.	Uncus form (*m*)	5
16.	Gnathos development (*m*)	4
17.	Basal processes development (*m*)	6
18.	Valva form (*m*)	2
19.	"Clasper" development (*m*)	2
20.	Cucullus development (*m*)	2
21.	Distal "seta-bunch" of valva (*m*)	2
22.	Costal "plume" of valva, development (*m*)	3
23.	Sacculus ornamentation (*m*)	2
24.	Fultura ornamentation (*m*)	2
25.	Vesica-manica armature (*m*)	2
26.	Antennal enlargement (*m*)	4
27.	Thoracic brushes (*m*)	2
28.	Prothoracic leg vestiture	2
29.	Costal brush of hindwing (*m*)	2
30.	Costal fold modification of hindwing (*m*)	3
31.	Papillae anales setation (*f*)	2
32.	Papillae anales sclerotization (*f*)	2
33.	Posterior apophyses length (*f*)	2
34.	Anterior apophyses breadth (*f*)	2
35.	Sterigma development (*f*)	3
36.	Antrum development (*f*)	4
37.	Ductus bursae form (*f*)	2
38.	Signum form (*f*)	6
39.	Labial palpus sexual dimorphism	2
40.	Hindwing color sexual dimorphism	2
41.	Abdominal sternite VI form (*f*)	2
42.	Abdominal sternite VII form (*f*)	2

was used as a general size indicator for each species. This is expressed as a range, and no significance was given absolute size in the classification. Most species exhibit some sexual dimorphism in size, but whether male or female is larger varies among species. Most species are rather constant in size, while a few vary considerably, up to 35–40 percent (e.g., *Ethmia phoenicura*).

COLOR—Ethmiids are generally constant in color patterns, and most species can be recognized by forewing pattern. There are no polymorphic species, and few are sufficiently variable that the extremes would not be recognized as conspecific by nonspecialists. On the other hand, seasonal variation is marked in a few species, for example in *E. arctostaphylella* where differences in wing shape and size are correlated with color. Geographical variation in color and wing pattern is well defined in some species. Such variation may or may not be correlated with size differences in certain structures, such as labial palpi. Postmortem changes in color are slight (e.g, gradual paling of black), but considerable change in color pattern and general appearance may occur through loss of scaling while the moths are alive, especially in the dark diurnal species that have white "overscaling."

HEAD.—Shape: The basic head structure and shape is the same in all but a few species. Exceptions include the diurnal species, which have a bulging front that is correlated with the small eyes. These species and a few others have produced gular ridges toward the upper part of the front, but this development varies between species gradually to the state of being absent, and it was not employed in the classification. The male of *Ethmia mulleri* has the crown produced into a pronounced dome (Plate 2*a*) so that the front appears abnormally reduced. The female of *E. mulleri* is unknown. In *Pseudethmia protuberans* the front is strongly produced into a flat-conical structure with specialized scaling (Plate 2*f*). This development is equal in both sexes and it has been the primary criterion for retaining the generic level separation of this species.

Eye: Owing to its ease of accessibility, the eye has been the standard in most of the measurement ratios used in species differentiation. "Eye diameter" is equivalent to the greatest eye diameter, measured vertically from just behind the antenna, since the eye is flattened or a little concave on its dorsal rim and is slightly produced behind the antenna. The eye size varies between species and between sexes, however, so that ratios computed directly from eye size were not used in assessment of phenetic similarities. For this purpose, an "eye index" was computed, a numerical relationship of the eye diameter to the height of the front. The frontal height was measured on a straight line from the shortest horizontal line between the antennal sockets to the ventral margin of the clypeus (Figure 3). This index is about 1.0 in most species, varying between 0.9 and 1.2 in moths known or presumed to be nocturnal, but ranges from 0.7 to 0.8 in the diurnal species. This index is also somewhat variable and is difficult to measure accurately, so that only two states were defined, to quantify the diurnal behavior (0.8 or less vs. 0.9 or greater). Ratios comparing eye diameter: head appendage were modified by a factor of the eye index for purposes of standardizing ratios used in assessing relationships. Constancy in eye index was evaluated, using *E. arctostaphylella* as an example. This species exhibits a comparatively high degree of sexual dimorphism in antennal size, and both seasonal and geographical variation in wing shape and color. Moreover, it appeared by empirical comparison with other species that this is a species with sexual dimorphism in eye size. Ten specimens each of male and female from northern and southern populations and from spring and summer flight periods were measured. In this example the average absolute eye size was 0.66 mm for males (range 0.62–0.70) and 0.63 mm for females (range 0.59–0.66); and the average eye index was 0.93 for males (range 0.87–0.98) and 0.90 for females (range 0.84–0.92). Nonparametric tests (Wilcoxon, 1949) indicated that these differences were significant, while there were no significant differences between seasonal and geographical pair samples. Therefore the eye index was computed separately for the two sexes for all species, using three examples of each except where fewer specimens were available. Indices were rounded to the nearest 0.1 for purposes of standardizing eye:head appendage ratios.

Ocelli: Lacking in all species.

Labial palpus: The labial palpus is three-segmented (Figures 12, 17, etc.), usually strongly upcurved, and clothed with appressed (smooth) scaling in most species. The basal (first) segment is short and least variable among species and was not employed as a taxonomic character. The lengths

of the second and third segments, measured on a straight line from base to apex, were separately compared to the eye diameter. The segment lengths are variable between individuals of a species (usually by a factor of 0.1, rarely to 0.3). Five states for segment II were defined: vestigial (less than 0.2 eye index), short (0.5–0.9), moderately elongate (1.0–1.3), elongate (1.4–1.7), and greatly elongate (1.8–2.0). Segment III varies independently and was assigned two states: normal (0.5–0.8 the length of segment II) and elongate (0.9–1.1). Color pattern of the scaling is useful in species identification. In a few species the labial palpus is only slightly curved, a variable which was not assessed. In one group the vestiture includes erect, stiff hairs (bristled), while in certain species all of the scaling is erect (roughened). The two types were not differentiated from one another in the quantitative treatment but were separated from smooth scaling.

Maxillary palpus: This structure varies from minute, two-segmented (Figure 13) in diurnal species to well developed, four-segmented (Figures 18, 26, etc.). A full head preparation should be executed for any specimen from which the maxillary palpus is to be examined, and material was not available to enable this for some of the unique Neotropical species. Thus the maxillary palpus was omitted from the characters used in phenetic assessment. Example species provided the diagnosis of the structure for species groups.

Pilifers: Present and well developed in all species, these structures were not used in classification.

Proboscis: The tongue is scaled basally, unscaled in its coiled portion. It distorts on drying and no measurements were attempted. Sattler (1967) has shown remarkable differences among some Palearctic *Ethmia* in fine structure of the proboscis apex, through scanning electron microscopy. I examined examples of various species groups only by conventional, transmitted light (× 54), and found no usable differences.

Antenna: The antennal shaft (flagellum) is broadened (dilated), serrate, and setate differently in males than in females of most species (Figures 6, 7, etc.), and the width of the basal few segments was used as an indicator of the degree of dilation with four states: not dilated (0.16–0.19 eye index)*, slightly dilated (0.20–0.22)*, moderately dilated (0.23–0.26), and strongly dilated (0.27 and greater). In some species the scape is modified, enlarged, and sometimes provided with specialized scaling. In these species the females also have an enlarged scape, although not as greatly as in the male. The length of the scape ranges from 0.5 to 0.75 eye index for most species but up to 0.9–1.5 in species defined as having a modified scape. (Figures 10, 11; Plate 3*a-c*). The number of segments in the flagellum varies considerably, but this evidently is correlated with the absolute size of the moth. Small *Ethmia,* which are unrelated according to other structures, and *Pyramidobela* have 45–50 segments, while larger moths of various species groups have 70 or more segments. Therefore the count was not used in determining relationships.

Vestiture: The scaling is appressed on the front and crown, becoming raised tufts at the occipital margins except in a few species (e.g., *E. scythropa, E. nivosella*) which have elongate, erect scaling over the whole crown. The head scaling is unicolorous or has a dark spot at the middle of the occipital margin. Vestiture was not employed in numerical comparisons.

THORAX.—Vestiture: The pronotum and tegulae are smooth scaled in all species except *E. scythropa* and *E. nivosella,* which have normal scaling exteriorly, but in the male the tegulae and pronotum enclose tufts of matted, wavy hair that can be teased out into enormous, fluffy masses. The color pattern of the notum is of value in species identification but was not used in species relationships comparisons. The metanotum is nearly entirely unscaled except for lateral brushes. The venter is smooth scaled and unicolorous. A few species (*E. notatella* and allies) have in the male, elongate, posteriorly directed scale brushes that originate from the pleural area of the metathorax, just above the coxae, and extend along the sides of the abdomen (Plate 4*e*). These are completely lacking in all other species.

Legs: The foreleg is usually smooth scaled and more brightly colored than the others. The epiphysis is well developed and not differentiated among the species for which leg preparations were made, representing the major species groups. The fore tibiae are provided with elongate, shaggy vestiture in one species, *Ethmia mulleri.* The hind tibia is clothed with elongate hair scales in most species, and this varies in development, but no

attempt was made to assess the variation. The tibial and tarsal spines and tarsal claws are thin in *Pyramidobela* and *Ethmia,* strong in *Pseudethmia.* The legs are abnormally elongate in *Ethmia charybdis.* The foreleg, which is disproportionately longer than the others, is nearly 50 percent longer relative to the eye index than in other species.

Forewing: The shape of the forewing varies between species, and this was expressed by a length: width ratio. Length was measured on a straight line from basal attachment to apex, including the fringe; width along a perpendicular line at the end of the cell, excluding fringe. The ratio is variable within species, but usually by not more than a factor of 0.1. Four states were defined: broad (length 2.6–3.0 times width; Figure 45), moderately broad (3.1–3.4; Figure 44)*, moderately narrow (3.5–3.8; Figure 42)*, and narrow (3.9–4.2; Figure 43). The wing venation (Figures 42–45) is relatively constant throughout the group, and does not differ from certain oecophorid genera. A number of characters differ among species, but wing preparations should be examined in order to measure some of the differences; insufficient material was available, especially for several of the unique Neotropical species, to enable assessment of variation. Moreover, some features vary at random throughout all species groups. Characters found to differ among species include the following:

1. Length of discal cell, 0.66 to 0.75 of forewing length (to 0.80 in *Ethmia dentata* Diakonoff and Sattler, a Palearctic species); there is a tendency for long cell in the Cypraeella group, but the ratio varies widely in most groups.

2. Relative spacing of R_1, R_2, and R_3 at their origins; the ratio of the two intervein distances, R_1–R_2: R_2–R_3 ranges from 2.0 to 6.0 among most species (but up to 12.9 in *E. charybdis,* Figure 43), with no consistent correlation to forewing breadth, cell length, or to species clusters based on other characteristics.

3. R_5 to apex or costa before apex; always to apex in species with elongate cell, but otherwise the variation is random among species.

4. Ratio of branched portion to unbranched portion in An_{1+2}, 0.25 to 0.45, in part correlated with wing breadth (i.e., wing elongation evidently has affected venation distally, not basally).

The forewing is smooth scaled except in *Pyramidobela.* Pattern and color are fairly constant within species and have been used for species differentiation. For purposes of relationships comparison, color per se was deemphasized, but six basic patterns were defined: (1) dark gray ground with black markings; (2)* dark gray costal and white dorsal areas; (3)* dark brown costal and pale dorsal areas; (4) white ground with linearly arranged black markings; (5) white ground with essentially transverse metallic blue markings; (6) white ground with dorsal blotch and terminal band of metallic color. There are various additional patterns displayed by isolated species that were considered not comparable.

Hindwing: Differences in shape appear to be correlated with either forewing shape or costal modifications of the male, so were not defined as character states. Wing venation is variable, subject to the reservations discussed for the forewing. Characters found to differ among species but not employed in phenetic assessments are as follows:

1. Presence of crossvein between Sc and R (Figure 44); this appears to be limited to the Kirbyi, Cypraeella, and Exornata groups, although the vein is lacking or only partially developed in some species; it is totally lacking in all other species examined.

2. Relationship of M_2 to M_1 and M_3 at origin; M_2 rarely arises slightly nearer M_3 (Figure 43) but usually equidistant (Figures 42, 45) or nearer, often approximate, to M_1 (Figure 44) or even M_1 and M_2 connate. There seems to be a tendency for equidistant placement in Nearctic groups and approximation toward M_1 in Neotropical groups, but there are random exceptions.

3. M_3 and Cu_1 relationship at origin—given in the past as a consistent character for the genus, the veins are usually connate in Nearctic species groups (Figure 42) but often clearly stalked in Neotropical species (Figure 44); they are separate or connate in *E. charybdis* (Figure 43).

4. Curvature of An_1—usually strong in Nearctic species groups, moderate to slight in Neotropical species.

Males frequently exhibit modifications of the costal area. When present in the simplest form, this consists of an elongate scale brush arising near the base of the dorsal surface (Plate 4*c*); more complex forms have the costal brush enclosed in a costal

fold (Plate 4*a*) (which sometimes bears an external fringe, Plate 4*b*) or in a "pinch-fold" between veins Sc and R. In examples with the pinch-fold the brush may be weak or well developed or of double origin, with a portion exposed and a portion enclosed. In addition, appressed, specialized scaling may be present under the brush, whether or not a fold is developed. Costal fold modifications result in a straight costal margin and slightly more narrow wing. The brush and fold are normally hidden beneath the forewing on spread, museum specimens. I assigned two characters: (1) brush (present vs. absent); and (2) fold, with three states, absent (NC = no comparison, if brush absent), costal fold, and pinch-fold.

ABDOMEN.—Structural modifications: Basically all species have the same abdominal structures, but several minor modifications of unknown function have developed in scattered species. Members of the *Ethmia notatella* complex that bear metathoracic pleural scale brushes in the male have the second abdominal segment modified, either with a bulging flap which folds over, forming a pouchlike receptable for reception of the thoracic brush, or with specialized scaling at this spot (Plate 4*e*.) *Ethmia lichyi* (Longimaculella group) has a comparable patch of specialized scaling which forms a pouchlike structure at this spot, but this species does not have the metathoracic brushes.

Some species possess a deep, rounded emargination on the posterior margin of either the sixth (Bipunctella group) or seventh (Hagenella group) sternite, which is not correlated with specialized scaling or otherwise visible on the whole moth. The development is pronounced in females and is weakly exhibited by males. In a few species (e.g., *E. notomurinella*) females have sclerotized ridges on the seventh sternite that bear specialized scale tufts and are fused to the sterigma. In other species there are weakly developed modifications which appear to be homologous, but character states were not defined for them.

Vestiture: The abdomen is smooth scaled except on the genital segments. In many species the dorsum bears short, differentiated scaling, usually on the basal two or three segments, which renders a velvetlike appearance. This scaling may be concolorous with the rest of the abdomen or it may be a different color (usually ochreous) and usually it is well defined in the male, weak in the female. The abdominal scaling is either concolorous with the thoracic, entirely a different color (yellow or pink), or it may be concolorous except for the genital scaling which is differentiated (ochreous or red).

Male genitalia: Members of the genus *Ethmia* display a remarkable array of structural variation in genital structure. Within species there is little variation in male genital characters, even in geographically widespread species. These structures, taken as a unit, received the most weight in development of the present classification.

Six structures of the male genitalia vary independently between species and were employed as separate characters in the relationships comparison: uncus, gnathos, basal processes (labides), valvae (with four characters), fultura (anellus), and aedeagus.

The *uncus* shows the most profound range of development. Five states were defined: (1) hoodlike; (2) divided; (3) sclerotized, narrow; (4) membranous; (5) lacking. Among species with the hoodlike uncus, the hood may be entire or shallowly or deeply emarginate medially and variously shaped, differences which show good interspecific constancy but were not used in the phenetic analysis.

The *gnathos* is divided into anterior and posterior parts, both of which may be variously dentate or ornate (e.g., Figures 66–69). The anterior part or both may be completely lacking. Four states were defined: (1) anterior and posterior parts well developed; (2) anterior lacking, posterior dentate, short, not or only slightly exceeding base of uncus; (3) anterior lacking, posterior elongate, extending nearly the length of uncus (e.g., Figures 115–119); (4) both lacking. The number and development of teeth on the posterior gnathos is variable within species, and only major differences in gnathos form were used in species differentiation.

The *basal proceses* (labides of Sattler, 1967) are digitate projections that appear to originate from the lateral margins of the diaphragma near but anterior to the base of the costal margin of the valva. In *Pyramidobela* they are lacking; in *Ethmia* and *Pseudethmia* they are constant in form and are useful both in species differentiation and in relationships comparison. Six states were defined: (1) rudimentary (Figures 54–55); (2) membranous, narrow (e.g., Figures 83–87); (3) membranous,

broad (broader than long, Figures 51–53); (4)* partially sclerotized, with angulate edges (Figures 109–112); (5)* geniculate (Figures 75–76); (6)* sclerotized, broad (Figure 171).

The *valva* is always well developed but exhibits an assortment of accessories, absence or presence and details of which are of value both in relationships comparison and in species differentiation. These features were treated as six separate characters: (1) distal margin of valva simple vs. distinctly emarginate (e.g., Figures 83–97); (2) clasper absent vs. present (Figures 71–72); (3) cucullus distinct vs. not differentiated (i.e., Bipunctella group, Figure 76); (4) distal "seta-bunch" absent vs. present; this is a patch or row of large, flat, heavily sclerotized setae, the number and development of which represent useful species differences in some groups; (5) costal "plume" (Figure 126), with three states; this is a membranous extension originating from the costa in the distal area which may be (a) absent or present with, (b)* thick setae along its full length (e.g., Figures 125–128), or (c) toward the apex only (Figures 156–160); (6) sacculus simple vs. ornate (i.e., armed with sclerotized ridges, spurs, or various projections).

Sclerotization of the *fultura* superior and inferior is combined in ethmiids to form a sheath around the aedeagus. This is homologous with the anellus and probably the transtilla combined. In phenetic comparison it was treated as a two-state character, simple vs. ornate. The ornamentation or armature is highly variable within species in some instances, perhaps geographically, yet it forms the most obvious structural differences in some members of the Cypraeella group.

The *vesica* of the aedeagus is often wholly membranous, but in many cases is variously armed with cornuti (sclerotized structures, spiral rows of spurs, etc.). These were treated as representing a single character, cornuti absent vs. present, even though it is probable that the structures are of more than one origin, with attachment to the fultura in some instances (*manica*).

Female genitalia: Structures associated with oviposition and mating in female ethmiids offer a spectrum of good species characters, but these are more difficult to define in terms of species relationships than are the male features. In females seven structures were employed in the taxonomic assessment, but these do not take into account some of the more obvious differences between species, such as the form of the sterigma, which are difficult to quantify.

The *papillae anales* are oriented so that the setate surfaces face lateral and the ovipositor is conical or "bladelike," evidently adapted for inserting the eggs into hairy or roughened plant surfaces. The lateral surfaces are usually densely setate but rarely bare (e.g., *Ethmia minuta*) and are lightly to heavily sclerotized. The heavier sclerotization seems to be correlated with a general darkening of the integument and vestiture, as in the diurnal species.

The *posterior apophyses* represent by their length the degree to which the female can extend the VIII–IX intersegmental membrane and therefore exsert the ovipositor. An arbitrary division between "normal" and elongate (2× or more the length of the combined sterigma and antrum) was made for purposes of relationships comparison. The structure was not employed in species differentiation.

The *anterior apophyses* are more variable in development, being either broadly attached (sometimes very short) or thin and narrowly attached, without intergrade. When thin, they may be short to elongate, but this variation is in part correlated with the length of the posterior apophyses and was not used in the taxonomic assessment.

The *sterigma* offers the most obvious species differences, the only differentiation among females of some closely related species, but division of its variation into meaningful categories with regard to relationships is difficult. Therefore only three states were defined: sterigma simple vs. ornate (with folds or projections which protrude beyond the plane of the ostium, e.g. Figures 229, 234), and in ornate species, lateral lobes present vs. absent (NC for species with sterigma simple). Although nearly every species can be recognized by its sterigma form, intraspecific variation occurs, evidently geographically in some instances (e.g., see discussion of the *Ethmia penthica* complex), and single-specimen samples are not as reliable as in males.

The *antrum* is not always present as a defined enlargement but when present ranges in development to that of the Hagenella group, a large, sclerotized, oval chamber with flaplike inner struc-

tures and many inwardly directed spurs (Figures 202–205). Four states were defined: (1) not enlarged; (2) membranous enlargement; (3) enlargement with sclerotized structures; (4) sclerotized chamber with inner spurs. The structures are little variable and serve with the sterigma as the best characters by which females can be identified to species.

The *ductus bursae* (exclusive of the antrum and corpus bursae) is a membranous tube that is nearly always spiral in *Ethmia*. The number of coils ranges from 1–12, differing among species. No attempt was made to categorize the number of coils, but a division was defined between thick ductus with tightly appressed coils (Figures 185–189) and thin ductus with "loose" coils (with space between adjacent coils equal to the ductus diameter, Figure 177). The form and number of coils does not vary between virgin and mated individuals of one species (based on a few Nearctic species). Some species possess varying types of sclerotization in the basal portion of the ductus bursae which are of value in species differentiation, but the different types were considered to be of separate origins and were not employed in numerical assessment.

The *signum* is a sclerotized depression or invagination that occurs on the dorsal half of the corpus bursae, usually near the juncture of the ductus. The signum is variable within species, especially in development of the "lateral flanges," number of teeth, etc., but the basic form differs between species. Thus the signum is of more value in relationships comparison than in differentiation of closely related species. It presumably has been lost independently in several unrelated groups (e.g., *Ethmia minuta, E. brevistriga, E. humilis*), and signum lacking was considered NC, along with a few isolated, unusual types (e.g., *E. albitogata, E. apicipunctella, E. chemsaki*). The following six states were defined: (1) "dentate bar," a shallow crease with many short, more or less equal-sized teeth (Figure 187); (2) "dentate keel," a deep crease with prominent median fold or row of spurs forming an inwardly directed, toothed ridge (Figure 237); (3) "dentate long crease," a narrow, elongate, shallow crease, close set with similarly sized teeth (Figure 225); (4) "notched keel," a deep crease with median fold having a single, median, rounded emargination (Figures 261, 263); (5) "broad cone," a single, deep, cone-shaped keel from a broad, more or less round sclerotized invagination (Figures 279, 282); (6)* isolated teeth only (Figure 281).

Taxonomic Procedures

The present classification is the result of an attempt to correlate a conventional biosystematic approach with an assessment of phenetic relationships using numerical methods. Basically the study is a traditional one, since decisions about species limits were made deductively, partly on the basis of my previous experience with taxonomic characters and their variation in Microlepidoptera, especially Tortricoidea, and partly on biological aspects of coexisting species of *Ethmia* in the southwestern Nearctic. Moreover, characters employed in the morphological phenetic assessment were not a random representation of all parts of the insect's body but were selected as objectively as possible, representing those which I knew to differ among species and to be relatively easy to measure.

Most of my observations on the living animals were made in California, which is one of the best areas for New World ethmiids in terms of species diversity. Up to seven species reside within a few miles of one another, and studies on them have formed the basis of my knowledge of biological integrity and the correlation of behavioral and morphological features in the group. Aspects of diel periodicity and seasonal displacement in adult activity, hostplant specificity in selection by females and acceptance by young larvae, and behavior and morphology of the larvae were found to be operating in patterns of isolating mechanisms among comparatively closely related species (Powell, 1971). Extrapolating from knowledge of morphological variation in these species, decisions on species limits in other parts of the fauna were based on adult morphology, primarily male genital characters. Populations represented by different forms with essentially identical male genitalia (subject to variation discussed above in evaluation of characters) were considered to be conspecific. In cases where such populations differed conspicuously in easily visible features, especially wing color markings, the subspecies concept was employed.

Conventional methods.—All species were described and defined to a comparable level so far as

available material permitted. Previously described species were taken into account even if no specimens were examined during this study. Previously undescribed species in material examined were described no matter how poorly represented, so long as a male was extant. Female specimens which appeared to be additional undescribed species usually were omitted from the treatment. A preliminary arrangement of species groups was drawn up, based primarily on a sequence in male genitalic types, from the most complete, considered to be ancestral, to most reduced, considered to be derived.

However, because of the large number of species and the extent of morphological radiation, I was unable to rationally comprehend the similarity or disparity shown by other attributes, such as secondary features of males and female genitalic characters, among these groups. Relationships of some of the more distinct types, (both isolated unique species and closely knit species groups) to the larger groups were not evident. Therefore a series of morphological phenetic comparisons was executed and the results compared to my original groupings.

QUANTITATIVE METHODS (computational techniques).—Numerical taxonomic techniques were carried out using NTPAK (Numerical Taxonomic Package), a system of programs developed by W. W. Moss and L. N. Bell at the University of California, Berkeley, for use with the CDC–6400 computer. NTPAK included programs for character standardization by range and variance, computation and ranking of similarities, cluster analysis, phenograms, and Prim network generation (Prim, 1957), as well as an adaptation of J. W. Carmichael's program for taxometric analysis (TAXMAP; Carmichael and Sneath, 1969). Prim networks and taxometric maps are abbreviated subsequently in this paper as Primnets and taxmaps, respectively. The following steps were executed in data assembly and analyses.

1. Measurements and qualitative characters as given in the descriptions were tabulated for all species. Character states were then defined for quantitative and qualitative features. Data which were unavailable (e.g., female not studied) were recorded as No Comparison (NC), as were states logically defined as such in the evaluation of taxonomic characters (e.g., signum lacking). Their values were ignored during computations. After data were tabulated and transferred to IBM cards, the following were executed for each character set:

2. Similarity values (Simple matching S_{sm}, Sokal and Sneath, 1963, for two-state versions; and S_s, Colless, 1967, for versions including multistate characters) were computed between all species pairs (species = Operational Taxonomic Units, OTU's), generating a simple matching similarity matrix.

3. A hierarchical partitioning of the similiarity matrix was computed (Unweighted Pair-Group Method, Sokal and Sneath, 1963), and the results were summarized in a phenogram.

4. Similarity and cophenetic values were plotted on a scattergram and a cophenetic correlation value was generated as an indicator of degree of distortion in conversion from the similarity matrix to the two-dimensional phenogram.

5. The six highest similarity values were found and ranked for each OTU.

6. A minimally connected network (Primnet) was found. The results were diagrammed, illustrating each OTU connected by a straight line to its nearest neighbor.

7. Taxometric maps were generated and diagrammed.

Phenograms are two-dimensional dendrograms representing phenetic similarities among OTU's. Although phenograms superficially resemble traditional "phylogenetic tree diagrams," they do not imply evolutionary descent, only the level of phenetic relationship. The sequential order of OTU's in a phenogram is more or less arbitrary, dictated by the two-dimensional, linear arrangement; and the order may be altered by the rotation of any stem and its subtending vertical connectors. The phenogram permits the viewer to perform visual cluster analyses, the ordering together of sets of OTU's which are close to one another and distant from others.

Primnets are two-dimensional, minimally connected networks in which each point (OTU) is joined to its nearest neighbor by a line, the length of which represents the magnitude of similarity. It is presumed that the network reflects the underlying structure of the data, but neither hierarchy nor clusters are implied. As with phenograms, cluster limits may be superimposed (e.g., Figure 2). One advantage in such a scheme is that in summarizing results of a phenetic analysis,

there is no assumption that an OTU must be placed in a nested series of clusters. Therefore the distortion in representation of similarities between nearby OTU's is reduced. No attempt is made to show relationships between clusters at all except through nearest neighbor members of adjacent clusters. Thus there is no error in similarity between any pair of connected OTU's, but no other kind of relationship can be interpreted from the diagram except secondarily.

The taxometric map is a nonhierarchical method of cluster analysis which uses the frequency distribution of similarities to derive a discontinuity constant which is then applied to measures of simple and average linkage to delimit clusters. The results are used to produce a diagram of relationships, the taxmap. An index of cluster membership is provided, together with a peripherality order of the clusters. Beginning with the most central cluster, one diagrams by triangulation, using the highest and second highest similarity values (i.e., lowest distance of cluster A radius + cluster B radius + distance between nearest neighbors in A and B). One could add third and lower similarity values to the diagram by employing bent or zigzag lines, but for purposes of clarity, I felt that first and second order vectors were adequate. Each cluster is indicated by a circle, the diameter of which represents the similarity between its least related members. Lines connecting clusters represent center-to-center distances of similarity. Although two-dimensional, taxmaps can be envisioned by the viewer as being three-dimensional.

QUANTITATIVE METHODS (OTU and character sets).—Among 133 species of Ethmiidae, 123 were selected as OTU's for assessment (Table 2). Three species of *Ethmia, E. orestella, E. cypraspis,* and *E. cellicoma,* known only from females, were omitted. *Pyramidobela* (7 species) was also considered separately. Owing to lack of close relationship to *Ethmia* and *Pseudethmia,* members of *Pyramidobela* are not comparable for most characters used to differentiate species of *Ethmia.*

Of the 123 species that were included, 34 are known only from males or are species for which I did not study female genitalia. Thus for character numbers 31–42 in Table 1 (numbers 47–64 in two-state sets), there were a large number of NC values. Therefore duplicate runs of each analysis were executed, excluding female characters. I obtained a female of *E. piperella* after running the earlier analyses and was able to incorporate its data for the taxmap analyses. *Ethmia chalcodora* is known only from the female, and much of its high similarity with other species is due to the high NC count corresponding to male characters. Therefore this species was omitted from the 16–character (male only) appraisals.

Each analysis except taxmap was repeated for four sets: 42-character (Table 1), 30-character (Table 1, numbers 1–30, exclusively female characters omitted), 16-character (Table 1, numbers 15–30, male characters alone), and 64-character (all converted to two-state). Nonzero differences between states of multistate characters were set equal to 1.0 during computation of SG similarities. At the onset of data processing this alternative was not available, and the two-state data set was designed to eliminate possible effects of exaggerated differences spanning qualitative characters such as wing pattern and signum form. In the results, however, there still were appreciable differences between 42 character (which used S_r similarity coefficient) and 64-character (S_{sm} similarity coefficient) sets in phenograms and Primnets of clustering. In general those with the two-state characters tended to show greater agreement with one another and with my provisional groups than did the 42 character sets. As a result, I employed only the two-state sets in the taxmap programs.

A 120–OTU version of the computer program TAXMAP provided by J. W. Carmichael was initially adapted to the University of California IBM 360/40 computer. However, the version of this program available at the time proved to be too inefficient on this equipment to be practical. A 120–OTU study (*Ethmia nadia, E. baja,* and *E. mimihagenella* were omitted) ran 35 minutes before the run was terminated by a technician, with the results incomplete. It was difficult to adapt this version of TAXMAP to the CDC 6400 because it required excessive core space, but a smaller (75–OTU) version was adapted and two data sets comprising 75 OTU's with 64- and 46-characters were run successfully on this machine. The 45 additional species which I eliminated (Table 2) were selected as representing central members of clusters generated by previous programs, according

TABLE 2.—*List of 123 species (OTUs) used in assessments of morphological phenetic similarities, with four-letter designations employed in Figures 1 and 2* (The species indicated by an asterisk (*) were used in the 75-OTU versions of taxometric map analysis.)

1. CHAR* : Ethmia charybdis
2. UMBR : E. umbrimarginella
3. LASS : E. lassenella
4. COQU* : E. coquillettella
5. MINU* : E. minuta
6. TRIC* : E. tricula
7. ALBT : E. albitogata
8. PLAG* : E. plagiobothrae
9. BREV : E. brevistriga
10. SCYL* : E. scylla
11. MONA : E. monachella
12. ALBS* : E. albistrigella
13. NADI : E. nadia
14. SEMI* : E. semilugens
15. EPIL* : E. epileuca
16. ARCT* : E. arctostaphylella
17. MANS* E. mansita
18. DISC : E. discostrigella
19. SEMT : E. semitenebrella
20. PAPI* : E. papiella
21. VOLC* : E. volcanella
22. APIC* : E. apicipunctella
23. MACE* : E. macelhosiella
24. MACN : E. macneilli
25. GERA : E. geranella
26. TIMB* : E. timberlakei
27. PIPE* : E. piperella
28. BIPU* : bipunctella
29. MONT*: E. m. monticola
30. FUSC : E. m. fuscipedella
31. CALG : E. caliginosella
32. DELL : E. delliella
33. DAVS : E. davisella
34. LINS* : E. linsdalei
35. CLRK : E. clarkei
36. SUBS* : E. subsimilis
37. KIRB : E. kirbyi
38. BITT* : E. bittenella
39. PROX* : E. proximella
40. MULL* : E. mulleri
41. FEST* : E. festiva
42. CYPR : E. cypraeella
43. ABRX* : E. abraxasella
44. SCYT* : E. scythropa
45. NIVO* : E. nivosella
46. TERP* : E. terpnota
47. IRID : E. iridella
48. PERP : E. perpulchra
49. ELUT* : E. elutella
50. JANZ : E. janzeni
51. SUBM : E. submissa
52. FRIT* : E. fritillella
53. EPLG : E. epilygella
54. UNGU* : E. ungulatella
55. CHLD : E. chalcodora
56. NOTO* : E. notomurinella
57. CHLG* : E. chalcogramma
58. PHYP* : E. phylacops
59. EXOR* : E. exornata
60. PHYC : E. phylacis
61. MNES* : E. mnesicosma
62. GELD : E. gelidella
63. PHOE : E. phoenicura
64. ZEBR* : E. zebrata
65. CHEM* : E. chemsaki
66. NOTA* : E. notatella
67. HIRA : E. hiramella
68. PAUC* : E. paucella
69. WELL* : E. wellingi
70. BALI* : E. baliostola
71. CUBE : E. cubensis
72. FLAV : E. flavicaudata
73. LICH* : E. lichyi
74. CALM : E. calumniella
75. PLAU : E. plaumanni
76. HIER : E. hieroglyphica
77. OMEG : E. omega
78. TRAN : E. transversella
79. CONF : E. confusella
80. STRI* : E. striatella
81. CONT* : E. confusellastra
82. DUCK* : E. duckworthi
83. FARR* : E. farrella
84. SAND* : E. sandra
85. HUML : E. humilis
86. JULI* : E. julia
87. CORO* : E. coronata
88. NIGR* : E. nigritaenia
89. SUBN* : E. subnigritaenia
90. CATP : E. catapeltica
91. HOWD* : E. howdeni
92. LONG* : E. longimaculella
93. CONG* : E. conglobata
94. CYAN* : E. cyanea
95. GIGN* : E. gigantea
96. SEMO* : E. semiombra
97. ALBC* : E. albicostella
98. MIRU : E. mirusella
99. TRIF* : E. trifurcella
100. MARM : E. marmorea
101. HODG : E. hodgesella
102. PLAY* : E. playa
103. BAJA : E. baja
104. PENT* : E. penthica
105. SIML* : E. similatella
106. CORD : E. cordia
107. SCUT : E. scutula
108. PALA* : E. pala
109. CLAV* : E. clava
110. HEPT* : E. heptastica
111. SPHN* : E. sphenisca
112. OTER* : E. oterosella
113. PRAT* : E. prattiella
114. HAMM* : E. hammella
115. LIND* : E. linda
116. JOVI : E. joviella
117. PUNC* : E. punctessa
118. ANGS* : E. angustalatella
119. HAGN* : E. hagenella
120. MIMI : E. mimihagenella
121. BURN : E. burnsella
122. ZELL : E. zelleriella
123. PROT* : Pseudethmia protuberans

to ranked similarities. In essence this eliminated every OTU which had a sister OTU at or higher than the 0.950 similarity level. A few additional species with lower similarity values than this were withdrawn from clusters, which although not closely knit, had retained their integrity in previous programs (*E. cubensis, E. umbrimarginella, E. cypraeella, E. phylacis, E. hiramella,* and *E. mirusella*).

Finally, through Dr. Moss, the cooperation of Professor Carmichael was enlisted, and he ran 120–OTU versions using 64- and 45-character sets on the IBM 360/67 computer at the University of Alberta. Without knowing the meaning of the data, Professor Carmichael eliminated 19 characters (numbers 46–64) on the basis of high NC count, retaining all male characters except hindwing costal fold, and thus using nearly the same attributes as my 75–OTU × 46-character version.

Results, Discussion, and Taxa

Quantitative summaries.—It is inevitable that any attempt to summarize the multidimensional relationships of a similarity matrix will result in some degree of distortion and loss of information. However, in a study of a large number of OTU's, the matrix is too complex to be assessed directly by the reader (there were some 2,700 to 7,500 similarity values in the present half-matrices). Thus various schemes have been developed for representing clustering of values in matrices by two-dimensional diagrams (see reviews by Moss, 1967; Carmichael and Sneath, 1969; Michener, 1970; Rholf, 1970). Many such diagrams are easily comprehensible to the viewer, but the degree and kind of error which they represent varies. Therefore I selected three summary techniques which involve differing clustering methods: phenograms, Primnets, and taxmaps.

Phenograms obtained in this study showed rather low cophenetic correlation coefficients, indicating rather high information loss in transfer from the similarity matrices, a loss which interestingly, increased with reduction of character numbers: 64-character = 0.862; 42-character = 0.833; 30-character = 0.816; 16-character = 0.761.

It has been generally stated that phenograms represent relationships better among OTU's of terminal branches than they do for groupings connected by their main branches, since cluster analysis begins with the most similar and works toward the least similar (e.g., Moss, 1967). For this study, however, the reverse seemed to be true in most cases. Species within and between related groups were generally scrambled (compared to relationships shown by Primnets and taxmaps), while the major sections of the genus and more distant cluster groupings usually were represented in a manner more comparable to other analyses. Thus results obtained from phenograms generally were less satisfactory for displaying clusters equivalent to my species groups but comprised the most helpful method in illustrating major divisions.

For my purposes Primnets provided the best-fit representation of a linear arrangement of the groups. They were not as useful in interpreting relationships among some of the intermediate species, such as *Ethmia piperella* and *E. baliostola,* and some of the peripheral species such as *E. apicipunctella, E. prattiella, E. hammella,* and *E. conglobata.* The greatest disadvantage in a Primnet seems to be the lack of indication about relationships between fairly closely related clusters, for example the Kirbyi and Exornata groups in Figure 2. As with phenograms the two-dimensional format results in arbitrary placements, and the viewer must bear in mind that nearby clusters which are not connected by lines could be rotated on their stems, and no relationship among them is indicated by direct, spacial distances in this diagram.

In results obtained from my data, particularly using partial sets of attributes, there was a physical restriction of correct portrayal in the diagram due to clumping of species with high similarity values around central hubs. Thus bent or zigzag lines had to be employed in some instances to depict similarities, and this tended to detract from the visual comprehension.

Taxometric mapping produced illustrations which were more representative of overall relationships, since in my diagrams many groups occupied "hub" positions, with similarities to several other clusters indicated. One of the principal disadvantages of taxmaps is the fact that species relationships between and within clusters are not shown (the antithesis of Primnets). However, nearest neighbor distances for individual species to level 9 are provided separately by the program, and these were used in analyzing relationships of one- and two-species groups.

Another disadvantage of taxometric maps is the complexity of the diagram; inclusion of multidirectional similarities results in greater difficulty in visual interpretation. In order to assess likeness and to draw conclusions about groupings, I found it useful to compare copies of taxmaps, Primnets, and phenograms that were coded with a color scheme representative of the groupings.

In contrast to the two preceding techniques, there was fairly good agreement between taxmaps produced from full attribute sets (64 character) and partial sets (45, 46 character) and also between full species sets (120 OTU) and partial sets (75 OTU). Larger species groups tended to split or to combine in the same manner, distinct groups and unique species isolated uniformly and tended to show relationships to the same clusters, and the hub species were generally similar in all taxmaps

(i.e., *Ethmia piperella,* Kirbyi group, *E. baliostola,* and *E. semiombra*).

Two of the techniques employed intuitive cluster analysis imposed on the summaries. In addition, I attempted to select "best-fit" clusters compared to my original groups. Thus there was agreement in a general way in clustering formed by the various studies. However, there were some striking exceptions, particularly where "ex-group" species were involved (species which possess several unique characters, causing them to generate low similarity values to all other members of the study, including their nearest neighbors, these similarities being approximately equal; cf., Moss and Webster, 1969). Examples in the present work were *Ethmia minuta* and *E. scythropa-nivosella* complex. As might be expected on theoretical grounds, analyses based on more characters tended to produce results more comparable to one another, but, interestingly, also results which were more similar to my provisional groupings, than did those employing fewer characters. I did not expect this because my rationally proposed groups were based principally upon male genitalia, and I supposed that female characters were not wholly coincident and that their inclusion in similarity assessment would tend to dissolve groups. On analysis, however, it appears that when female characters were removed (30-, 16-, and 45-, 46-character sets), secondary features of the males tended to "swamp-out" patterns displayed by male genitalia. This was particularly true in the 16-character version, where results were too scrambled to be comparable at all in some subsets. Evidently there is better concordance among male genitalia, female genitalia, and certain external features such as labial palpus size than there is between male genitalia and secondary male characters. The enlargement of the antenna, hindwing costal area modifications, etc., appear to have been developed or lost many times within closely related species groups or pairs.

COLLATION OF CONVENTIONAL AND NUMERICAL ASSESSMENTS.—After all phenetic analyses were completed, I tabulated correspondences among the 12 two-dimensional representations of relationships (4 phenograms, 4 Primnets, 4 taxmaps) for each of my originally proposed species groups. Tabulations included nearest neighbor groups and assignment to one of four states: (1) distinct cluster; (2) single cluster mixed with another group; (3) split clusters retaining the group integrity; and (4) split clusters mixed with other groups. Species that appeared separately as isolates repeatedly were considered to represent distinct species groups. Each species group was then ranked according to its degree of clustering in both full character and non-female character versions. Groups which consistently mixed were combined and ranked as single units.

Finally, the originally proposed groups were altered according to the rankings, resulting from comparison of the phenetic clustering procedures. In addition, certain aspects of the species, such as biological characteristics, that had not been employed in the computation of morphological phenetic similarity were taken into account where data permitted. The conclusions are described below for the respective groups.

SECTIONS OF *Ethmia*.—A major division of *Ethmia* into two sections (exemplified by presence vs. absence of well-developed uncus and gnathos) was indicated by the hierarchical partitioning of the phenograms (Figure 1). This separation could be imposed on Primnets (e.g., Figure 2), but it was not clearly defined on taxmaps. The division was not envisioned in conventional taxonomic procedure, partly owing to diverse variation in uncus form and partly because *Ethmia baliostola* and *E. cubensis* possess an intermediate kind of uncus, while lacking the gnathos. Also there is strongly suggestive, albeit fragmentary, evidence from larvae and pupae to support this division. Section II, the nonuncus section, is a New World taxon of almost exclusively Neotropical distribution. As a result, biological data are available on only three species, *E. confusella* (Confusella group), *E. longimaculella* (Longimaculella group), and *E. semiombra* (Trifurcella group). These species share larval and pupal features of morphology and habits that are very different from all of the 30 or so Holarctic species of Section I for which larval and pupal characteristics have been recorded. These aspects are developed in more detail in succeeding discussions of relationships and biology of ethmiids.

ALBITOGATA GROUP.—This complex of southwestern Nearctic species mixed with the Semilugens group (especially *Ethmia mansita* and *E. epileuca*) in all clustering analyses except two Primnets. The

moths exhibit heterogeneous morphological traits, particularly in labial palpus size, secondary male features, and female genitalia, causing them to appear unrelated compared to the indication by male genitalia. However, I believe the correlation of small size, dark integument and vestiture, diurnal behavior, early spring flight, and larval reliance on seed rather than leaves (biologies of 6 of 10 species are partially known) indicates a monophyletic origin with subsequent rapid divergence during speciation under conditions of rigorous environmental situations. These attributes were represented in morphological phenetic comparisons only by small eye. Further dissimilarity in aspects, such as loss of signum in *E. plagiobothrae,* and use of Scrophulariaceae and loss of pupal "anal legs" in *E. scylla,* support this theory. A consistent relationship to the Charybdis and Macelhosiella groups was indicated, primarily due to male genitalia.

CHARYBDIS GROUP.—Several unique features of this species were not included in the assessment of phenetic similarity: rudimentary tongue, elongation and slenderness of legs (and disparity of the foreleg in this regard), and approximation of R_2 and R_3 relative to R_1 in the forewing. Moreover, the brachypterous female was not recognized until after the numerical analysis was completed. Even so, *Ethmia charybdis* precipitated as a distinct cluster in two-thirds of the summaries. It combined with the Semilugens and Albitogata groups in most phenograms and showed consistent relationship to these groups. In male genitalia the species appears closely related to the diurnal (Albitogata) group, while in behavior and life cycle it parallels members of the Macelhosiella group, with which it is in part sympatric.

SEMILUGENS GROUP.—This assemblage mixed with representatives of either the Albitogata or Macelhosiella group in nearly every analysis. The most peripheral member of the Semilugens group is *Ethmia epileuca,* which tended to separate and combine with *E. macelhosiella.* I attribute the similarity of the three groups to emphasis of male genitalia and justify their separation primarily on biological bases, as described below. The *albistrigella-nadia* complex remains an anomaly. I originally thought these two species might be related to the Albitogata group, on the basis of the small eye size, but phenetic appraisal showed almost no indication of this, usually ranking the complex nearest *E. semilugens* and *E. discostrigella.* It is interesting that field and laboratory studies did not conclusively show these species to be strictly diurnal as would be expected, and indicated that larvae prefer leaves rather than seed (Powell, 1971). The data suggest that small eyes and dark color in these species may be effects of more recent adaptation to diurnal behavior during invasion of high elevation habitats (these remarks also apply to *E. orestella* which was not included in the phenetic evaluation). The whole group is loosely tied, often with *E. apicipunctella* as well as *E. epileuca* clustering separately.

MACELHOSIELLA GROUP.—Pupal estivation, autumnal flight, hardiness to desiccation by adults, and egg (or adult?) diapause or prolonged quiescence are correlated biological features which corroborate minor attributes of the male genitalia (shape of valva, shape of uncus, etc.) and external features of the moths, indicating the integrity of this group. None of these characteristics was considered in the numerical summaries. As a result, the group almost invariably mixed with members of the Semilugens group (especially *E. macelhosiella* with *E. epileuca*) and the Albitogata group. It is noteworthy that although parallel aspects of the life cycle were not employed, relationship to *E. charybdis* was shown in more than half the appraisals. This was due to basic features of male genitalia and external traits such as wing pattern and elongate wings, which probably represent convergence.

PAPIELLA GROUP.—This pair of species is unique in its possession of a pink abdomen and several morphological peculiarities of genitalia of both sexes, yet the two species show strong divergence, especially in secondary features of the male. The complex was set off as a distinct cluster in two-thirds of the analyses and expressed relationship to the Semilugens group in three-fourths of them. Moderate affinity with the Macelhosiella and Hagenella groups was also indicated.

PIPERELLA GROUP.—As noted, female genital attributes of *E. piperella* were not employed in the early assessments but were incorporated for the taxmap programs. I assumed that this species' apparent relationship to a number of groups in early comparisons was in part due to the NC values for

missing female characters, but in the taxmaps *E. piperella* assumed an even greater role as a "hub" species. This is the only Antillean species with appreciable similarity to Nearctic groups. It displayed relationship to members of the Semilugens group, especially *E. mansita,* in two-thirds of the analyses. Although there was apparent dilution of affinities, absence of the Sc-R crossvein in the hindwing indicates that *E. piperella* may be an island derivative of a Nearctic group, despite the fact that it was clustered with the Cypraeella group in the 75 OTU × 46 character taxmap.

BIPUNCTELLA GROUP.—Nearctic representatives of this Holarctic group assembled in nearly every test as a distinct cluster relative to the rest of the New World fauna. The only consistent relationship indicated was to the Semilugens group, with secondary affinity to all other Nearctic groups.

HAGENELLA GROUP.—These four similar species are so distinctive in both male and female genitalia that I was uncertain of their relationships to other OTU's in my preliminary arrangement of the groups. Thus it was not surprising that the group was a distinct cluster in all numerical summaries. Phenetic relationships were not concentrated, but affinity to the Papiella group was shown in half the analyses, with indication of a slightly lesser resemblance to the Piperella, Kirbyi, and Semilugens groups.

KIRBYI GROUP.—The striking similarity in male genitalia among six species intuitively indicated them as a clear-cut species group. However, the distinctive valva shape and manica armature were not considered in quantitative evaluation, and phenetic similarities based on the characters used failed to differentiate these species from parts of the Cypraeella group in two phenograms and one taxmap. A consistent relationship between the two groups was always indicated. Moreover, the Sc-R crossvein of the hindwing is present in all species of the Kirbyi group, a feature which might have further clouded the picture of resemblance to the Cypraeella group (in which this character is not consistent) had it been included in the numerical assessment. Secondary strong likeness to the Mulleri and Notatella groups, and but little agreement with the Exornata group, which resulted, would also have been altered by consideration of this venation character. *Ethmia bittenella,* which possesses unique male genital features, appeared as a marginal member of the Kirbyi group in each summary.

CYPRAEELLA GROUP.—Although this heterogeneous assemblage did not mix with other groups (except with the Kirbyi group, as noted above), it generally failed to congregate in a single cluster. The *cypraeella-festiva-abraxasella* complex collected separately in more than half the analyses, a position which is enhanced by absence of the Sc-R crossvein in the hindwing in these three species. The degree to which the male secondary peculiarities of *Ethmia scythropa* and *E. nivosella* should be weighted also determines whether these species are a distinct group, a position which they occupied in one-third of the phenetic analyses. Retention of the Cypraeella group as presently defined reflects a conservative treatment (as expressed in Figure 2) which is correlated with that of the rest of the Neotropical fauna (e.g., Longimaculella and Trifurcella groups). In part this is the result of our lack of knowledge of the biological roles of these species.

EXORNATA GROUP.—Nearly uniform appearance as a distinct cluster and consistent relationship to the Cypraeella group in numerical assessment confirmed my preliminary appraisal of the complex. A weaker similarity to the Kirbyi group was exhibited. Presence of the Sc-R crossvein in the hindwing further corroborates the group's position.

NOTATELLA GROUP.—Although diverse, particularly in development of male secondary characters, this group retained its identity throughout the phenetic evaluation (it was split only in the 16 character versions). A nearly uniform relationship to the Kirbyi group was displayed, along with secondary resemblance to the Cypraeella group (in most summaries except taxmap) and the Baliostola group (in taxmaps).

BALIOSTOLA GROUP.—Although similar in external appearance to members of the Longimaculella-Confusella groups, this pair of species was placed by numerical methods as a distinct cluster in nearly every evaluation. In phenograms using multistate characters the group combined with *Ethmia conglobata,* with highest ranked similarity to that species, *cyanea* and *lichyi* in other analyses. In Primnet and taxmap summaries *E. baliostola* and *E. cubensis* tended to occupy a bridge position be-

tween Section I, the groups with well-developed uncus-gnathos, and Section II, the groups which lack the uncus-gnathos, a position that is suggested by the uncus of *E. baliostola* and *E. cubensis* itself.

Clustering was not consistent for the following eight groups, with each mixed with members of others, varying between different programs. Apparently morphological divergence in male genital features has been more rapid than in other characteristics, and groupings suggested by male genitalia did not compare well with clusters based on numerical evaluations of all attributes. The result has been that the Longimaculella and Trifurcella groups are more inclusive than I would have intuitively proposed, while the other groups are justified on features which were not employed in the phenetic assessment.

CONFUSELLA GROUP.—Retention of this complex of eight species as a separate group relies on my weighting details of male genitalia (vestiture, shape, and armature of the valva) which were not evaluated in numerical analyses. There was a consistent tendency to split off *Ethmia confusellastra* and *E. duckworthi* as a unit and *E. confusella* as another, or all three of these as one, variously associated with members of the Longimaculella group. Thus the separation of this group must be reappraised when more data become available, for example, likeness or disparity of larval and pupal characters to those of *E. confusella.*

LONGIMACULELLA GROUP.—Male genital characters indicate two sets of species, exemplified by *E. flavicaudata* and *E. longimaculella,* but no tendency for comparable clustering developed from the quantitative study. By contrast, *E. coronata* and *E. subnigritaenia* paired as a distinct subgroup in most of the analyses, a situation that would not have been expected from male genital characters and may have been an artifact of high NC count, since females of both were not included.

CONGLOBATA GROUP.—This species was a distinct cluster in all quantitative assessments except multistate character phenograms, where it paired with the Baliostola group. In most programs similarity was shown to either the Longimaculella group (taxmaps) or Trifurcella group (most Primnets). Individual ranked similarities displayed comparable diversity, with *Ethmia scutula* (Trifurcella group) and *E. lichyi* (Longimaculella group) each the nearest neighbor twice in the full attribute sets.

CYANEA GROUP.—In giving weight to several morphological features which were not used in the phenetic analysis, the bizarre external structure of *Ethmia cyanea* is emphasized. I consider this species an evolutionary spin-off of the Trifurcella group that has diverged to a level comparable with other groups, although it failed to cluster separately in numerical programs. It was a peripheral isolate to Confusella or Longimaculella group elements in Primnets but combined with these or Trifurcella group members in other summaries. In ranked similarities of the four programs employing all attributes, the closest relative was *E. julia* (Confusella group) twice, but all other nearest neighbors to level five were members of the Trifurcella group. The characters justifying *E. cyanea's* separation are: strongly arched costa and extraordinarily elongate stalked portion of vein An_1 in the forewing (at 0.45 the highest proportion of any species examined); the metallic blue color (which was treated as NC in forewing pattern), the only species with unicolorous body and wings; and the intermediate scape size in the female, which indicates it is modified in the male. Moreover the intermediate eye size and the moths' color suggest the adults may be diurnal.

GIGANTEA GROUP.—This species failed to separate distinctly or to demonstrate consistent relationship to one group. It united with elements of the Trifurcella and Longimaculella groups in about equal numbers. In full attribute programs, ranked similarities showed members of the latter group nearest in multistate sets, but nearest neighbors to level two were in the Trifurcella group in two-state sets. This combination plus the extraordinary superficial appearance through large size and robustness indicate a position as an intermediate group.

TRIFURCELLA GROUP.—Although this group is composed of superficially similar species which also share the same general features of male genitalia, other characters were sufficiently diverse to split the assemblage into two or three clusters in most numerical assessments. The fragments mixed variously with parts of the Longimaculella group, with *Ethmia gigantea,* and with *E. hammella.* Most often separated was *E. semiombra,* with the *E. bajaplaya* complex isolated in most Primnet and taxmap summaries, and *E. mirusella* in most

phenograms. By contrast *E. oterosella,* the only Antillean species, is only marginally related according to wing pattern and male genitalia, but it clustered with some part of this group in all analyses.

PRATTIELLA GROUP.—The obvious uniqueness of this species was emphasized by its consistent appearance in phenetic summaries as a distinct cluster, showing no close relationship to other groups. Similarity to the Confusella group was usually indicated, and to the Punctessa group, its nearest geographical relative, in nearly half the analyses. The species' isolation was further displayed by its nearest neighbors, which were various Confusella group members, *E. cyanea,* and *E. hammella,* in the ranked similarities to level three in full attribute set analyses.

JOVIELLA GROUP.—These species exhibited uniqueness by clustering as a distinct pair in all programs except the 16 character phenogram. Consistent relationship was indicated only for the Trifurcella group (*E. playa-baja* complex).

HAMMELLA GROUP.—This unusual species failed to segregate as a distinct cluster in most assessments, combining with portions of the Confusella-Longimaculella groups. It did isolate in three of the six versions employing all attributes, with ranked similarities indicating *Ethmia julia* the nearest and other nearest neighbors varying among Longimaculella group and Punctessa group members.

PUNCTESSA GROUP.—Although this species pair rationally seems to represent a monophyletic, biogeographical segregate, on the basis of male genitalia and general facies, the two differ in several respects. As a result they did not consistently cluster as a distinct group, and in two instances the pair was split. A generally diluted similarity to most of Section II was shown, with only the Trifurcella group represented in more than half the analyses.

PSEUDETHMIA PROTUBERANS.—This species was included in the phenetic assessments, although no attempt was made to exploit all the features by which it differs from *Ethmia.* Aspects of vestiture, robustness of body and appendages, thick spurs, etc., were considered to be correlated with appraised characters. Nonetheless the species always isolated as a distinct cluster, usually producing the lowest similarity values. The relationships most frequently indicated in two-dimensional summaries were with the Punctessa and Trifurcella groups, and ranked similarities in full attribute versions were highest among members of these two groups.

CONCLUSIONS.—Numerical taxonomic procedures, enabling incorporation of the diverse characteristics of secondary male features, female genitalia, etc., were effective in three general ways in formation of decisions on taxa:

1. The larger Neotropical species groups (for which I had little other than morphological phenetic evidence) were rendered more encompassing concepts than would have been the case on the basis of male genitalia. The Cypraeella group, Longimaculella group, and Trifurcella group each encompasses greater variation in male genital characteristics than in Nearctic *Ethmia,* where I used biological traits to help define groups. Two or more clusters within each of these Neotropical groups, each originally envisioned as a species group on the basis of male genitalia, were deemphasized after numerical assessment.

2. Relationships of several unique species or clusters were indicated, where there had been no convincing rational placements in the preliminary scheme (i.e., *Ethmia piperella,* Hagenella group, Exornata group, Baliostola group, *E. conglobata,* Joviella group). For example, although the Hagenella group is clearly a distinct, close-knit cluster, I had no logical assignment for it. In my original classification the Hagenella group was placed at the end of the linear arrangement, a concept which also contributed to the masking of recognition of the major sections of the genus until phenetic studies were carried out.

3. A division of New World *Ethmia* into two sections was suggested, a concept which is corroborated by fragmentary biological and morphological evidence from larvae and pupae.

SYSTEMATIC POSITION OF THE ETHMIIDAE

During the nineteenth century ethmiids were associated with the Yponomeutidae (=Hyponomeutidae) because of superficial resemblance, especially in wing shape and color. According to Friese (1960), this concept is attributable to Stainton (1854) who treated British *Ethmia* (as *Anesychia*) in the Yponomeutidae despite the close resem-

blance to certain oecophorid genera (then considered Gelechiidae) in labial palpus and wing venation. As pointed out by Busck (1914a), Stainton had carefully prepared illustrations of wing venation in his *Insecta Britannica,* but neither there nor in later works did he use venation characters in determining generic relationships.

Von Heinemann (1870) seems to have been the first to associate ethmiids with the Gelechioidea, treating *Ethmia* (as *Psecadia*) in the Gelechiidae, along with the oecophorids—in effect proposing the higher classification followed by Meyrick (1883, 1895) and others prior to the concept of Ethmiidae as a family.

The ethmiids were assigned family status in the Gelechioidea in 1909, and most workers have followed this concept. However, as late as 1932, Meyrick listed *Ethmia* in the Yponomeutidae. Evidence described in the following paragraphs indicates affinity with various gelechioid groups and none suggests relationship with *Yponomeuta* or related genera. This conclusion corroborates that of Friese (1960), the most recent student of the Yponomeutidae.

An overall assessment of the world fauna of moths comprising the Gelechioidea will be necessary before the precise relationships and taxonomic status of the ethmiids are known. As has become increasingly evident in recent years (e.g., Hodges, 1964, 1966; Duckworth, 1970), the means of defining families of the Gelechioidea has gradually disappeared as our view of extra-Holarctic faunas has begun to focus. In particular, Clarke's (1955b, 1963, 1965) illustrations of Meyrick's types in the British Museum have shown that for the centers of diversity of the major taxa we have neither usable generic concepts nor definitions of higher categories.

The two major groups in the world fauna are the Gelechiidae and the Oecophoridae, each with something on the order of 4,000 described species. The gelechiids may be the better known, since they are better represented in North Temperate zones, although a large fauna is to be expected anywhere arid or seasonally dry regions are exploited. Even in the Nearctic the picture is incomplete, both at the species level and in higher categories. Oecophorids comprise a more poorly known assemblage because the great centers of diversity, Australia and South America, are relatively unworked. There are 2,500 species described from Australia alone (Common, 1970), virtually none of which has been fully illustrated. Clarke's (1963) work has given us some preview of the South American fauna, but the whole group is without any higher taxonomic framework on a world basis.

The Stenomidae, a primarily New World group, with more than 1,500 described species in the Neotropical Region (Duckworth, 1965), appears to be somewhat better defined with stronger morphological divergence from oecophorids and gelechiids than is shown by the ethmiids. Stenomids are characterized particularly by long-ciliated antennae in the male; forewing with veins R_4 and R_5 separate, with R_5 running to the termen; hindwing with Rs and M_1 stalked; valvae of male divided into lobes, bearing bifurcate or palmate setae. All of these features distinguish the group from Ethmiidae but not from every oecophorid, so that it appears the Oecophoridae is a more ancestral group.

Ethmiids are best characterized by the following combination of characters: labial palpus usually uniformly slender, strongly upcurved, tapering; veins R_4 and R_5 in forewing stalked with R_5, running to the apex or costa; veins Rs and M_1 in hindwing separate; M_2 originating about equidistant between M_1 and M_3 or nearer to M_1; male genitalia (except in *Pyramidobela*) with well-defined "basal processes" (*labides* of Sattler, 1967; everted lobes of the diaphragma that originate anteriorly of the base of the costa); gnathos when present single (joined), median, dentate; valva divided; phallobase usually strongly recurved; larva with elongate prolegs and secondary setae, particularly in SV group; pupa with lateral condylic movement of abdominal segments V–VII (*Pyramidobela*) or V–VI (*Ethmia*). However, each of these characters is shared with at least a few oecophorids, so that no one feature is exclusively diagnostic for Ethmiidae, unless one excludes *Pyramidobela.*

The genus *Pyramidobela*[1] differs from *Ethmia,*

[1] After completion of the present manuscript, it was discovered that *Pyramidobela* is closely related to *Ectaga* Walsingham, 1912, and to *Atopotorna* Meyrick, 1932, which are currently assigned to the Oecophoridae. Members of this Neotropical group are essentially indistinguishable in external characteristics of the adult and pupa from *Pyramidobela.* The genitalia, however, differ appreciably and may

Pseudethmia, and Old World ethmiids of other genera by having the second segment of the labial palpus much larger than the third (Figure 40), by having upraised scale tufts on the forewing, by possession of an extra lobe on the valva, by absence of the "basal processes" (Figures 46–50), and by female genitalia that feature a short, straight, ductus bursae which is sclerotized, contiguous with the upper portion of the ductus bursae (Figures 173–176). The genus is retained within the family concept primarily on the basis of vein M_2 of the hindwing slightly nearer to M_1 than to M_3, the divided valva, strongly recurved phallobase, and presence of secondary setae on the anal proleg of the larva.

The following characteristics of ethmiids are indicative of gelechioid, and in particular oecophorid relationships.

LARVA.—Characters which known ethmiids share are as follows: head with primary setae only, their arrangement not differing from Gelechiidae and Oecophoridae; adfrontal sutures usually ending before cervical triangle; prothorax with L group trisetose; meso- and metathoracic segments L group unisetose; SD dorsad of spiracles on abdominal segments 1–7, cephalodorsad on 8; L_1 and L_2 adjacent on 8; SV group on abdominal segments often with secondary setae; abdominal crotchets a mesoseries, mesopenellipse, or circle; anal comb lacking. This combination, particularly the approximate L_1 and L_2 on abdominal segments, indicates lack of relationship to Yponomeutidae, but it is not sufficient to distinguish ethmiids as a taxon from other Gelechioidea.

As can be seen in Table 3, many features vary considerably among ethmiid larvae, even within species groups. In several ways there are two basically different kinds of larvae in *Ethmia,* corresponding to the sections defined by study of adults: (a) Section I (uncus-possessing groups) members have secondary setae that are not on well-defined pinacula, usually on SV group of abdominal segment 9, and sometimes 1, 2, 7, and 8, but not on the abdominal prolegs, and have the crotchets in a mesoseries or mesopenellipse; while (b) members of Section II (non-uncus groups; larvae represented by 3 species in 3 groups) have numerous secondary setae on abdominal prolegs (on a distinct pinaculum) and anal prolegs, but few on SV of segments 1, 2, 7, 8, and none on 9, and have the crotchets arranged in a circle.

Thus most features with which ethmiid larvae were characterized by past writers were based on examination of too few species. For example, Peterson (1948) relied heavily on arrangement of abdominal proleg crotchets in a "mesoseries which may resemble a penellipse" in his diagnosis of the family. However, this generalization seems to have been at least in part based on some kind of error by Fracker (1915) who described but did not illustrate the larvae of *Ethmia longimaculella* and *E. zelleriella. Ethmia longimaculella* represents Section II and according to one larva examined by me is like that of *E. confusella* and *E. semiombra* (Trifurcella group) in having the crotchets in a distinct circle and numerous secondary setae on a distinct pinaculum on the abdominal prolegs (Figures 286, 287). Fracker stated that *E. longimaculella* had the crotchets arranged in a mesoseries and that there were 8 or 10 secondary setae in the SV (=Pi) group of the abdominal segments.

Similarly, Fracker found the short frons and adfrontal sutures to be characteristic for *Ethmia* he examined, and this feature was cited by Peterson (1948) as diagnostic for ethmiids, even though the more elongate front with adfrontals reaching the cervical triangle had been shown in *E. macelhosiella* by Busck and Heinrich (1922). A very short frons apparently is characteristic of many stenomids (e.g., Busck and Dampf, 1929; Keifer, 1936b, 1937; Silva and Heinrich, 1946) which also have a large, heavily sclerotized head capsule. This development is similar to that of Section II of *Ethmia,* although the short frons appears in scattered groups (Table 3).

Other authors (e.g., Benander, 1937, 1965) have emphasized the secondary setae, particularly those

provide some insight into the relationship of *Pyramidobela* to other ethmiids. In the male of *Ectaga* the general form is similar, but the basal processes are retained and the valva is simple, without the accessory lobe. These features suggest that *Ectaga* has a closer relationship to *Ethmia* than has *Pyramidobela.* The female also shows similarity to *Pyramidobela.* It has a short, straight ductus (but it is not strongly sclerotized as in *Pyramidobela,* and a simplified, patchlike, scobinate signum is retained. An assessment of the status and affinities of species of *Ectaga* and related forms should be of value in interpreting ethmiid-oecophorid relationships.

TABLE 3.—*Larval Characters in New World Ethmiidae*

Species group	*(Species examined)*	*Adfrontals reach cervical triangle*	*Sclerotized depression posterodorsal to spiracle*	*Secondary setae*				*Crotchets*
				SV on Abd. 1,2,7,8	*SV Abd. prolegs*	*SV Abd. 9*	*Anal proleg*	
Albitogata	(5)	0.6 to nearly	no	0–2	0	0–8	0	penellipse
Charybdis	(1)	yes	no	0	0	0–1	3	penellipse
Semilugens	(6)	no	no	0–2	0	1–14	0–3	penellipse or mesoseries
Macelhosiella	(2)	yes	no	0	0	8	0	penellipse
Bipunctella	(2)	no	no	0	0	6–18	0	penellipse or mesoseries
Zelleriella	(1)	no	no	0	0	?	?	penellipse or mesoseries
Kirbyi	(1)	nearly	yes (no sclerot.)	0	0	5–6	0	mesoseries
Confusella	(1)	no	yes	8–12, 5	20–25	0	20–22	circle
Longimaculella	(1)	no	no	6–10	18–20	?	?	circle
Trifurcella	(1)	0.5	yes	10, 2–4	18–22	0	20–22	circle
Pyramidobela	(1)	nearly	no	0	0	0	15	circle

of the SV group on abdominal 9, as a diagnostic character after study of Holarctic species. This is neither a constant feature of *Ethmia,* nor is it limited to ethmiids. Accessory setae of the SV group occur occasionally in Oecophoridae (e.g., *Apachea;* Clarke, 1941) and on abdominal segment 9 in some Stenomidae (e.g., *Antaeotricha manzanitae* Keifer, 1937).

The presence of secondary setae in general is a characteristic of most ethmiids, but the placement and number of the accessory setae is highly variable. In addition to the range shown in Table 3, Old World species of the Assamensis and Nigroapicella groups (of Sattler, 1967) possess secondary setae in all setal groups, including the thoracic segments (Issiki, et al., 1969; specimens USNM). Secondary setae, especially on the anal proleg, occur in isolated genera throughout the Gelechioidea. According to Keifer (1936a), these are confined to the lower series of primary setae and are only on the lateral and anterior sides of the proleg in most western Nearctic gelechioids, whereas there were many accessory setae in both upper and lower series on *Ethmia* and *Pyramidobela* examined by him. Occurrence of anal proleg secondary setae in species I examined appeared to be as variable as any of the other secondary setae placements (Table 3).

The extreme development of secondary setae among Gelechioidea appears to be in *Aetia* (=*Chaetocampa*)[2], as indicated by *A. bipunctella* Chambers (=*crotonella* Bottimer) and an undescribed species in Florida, which possess numerous secondary setae all over the body (Bottimer, 1926; specimens USNM).

PUPA.—As distinguished by Mosher (1916), pupae of Gelechioidea differ from Yponomeutoidea by having the prothorax the same length on the meson as at the sides (distinctly shorter in Yponomeutoids), by having the labial palpi concealed (both maxillary and labial palpi exposed in Yponomeutoidea), and by having the distal portion of the antennae adjacent, often separated again at the apex (usually entirely separate or scarcely adjacent well before apex in Yponomeutoidea). Although certain of these features may be more variable than she appreciated on the basis of the number of genera examined, and although some groups share certain characteristics of both superfamilies (e.g., Scythrididae), the diagnosis seems to be generally valid. Ethmiidae, which were excluded from Mosher's survey, possess features of

[2] Clarke (1962, 1964) has proposed that this and related genera consitute a separate family, Blastodacnidae, in part on the basis of larval and pupal characteristics. It is another group in the Gelechioidea for which relationships have not been defined.

the Gelechioidea and show no resemblance to any genera of Yponomeutidae in these general characters.

Pupae of all Gelechioidea remain anchored in place at emergence of the moth, usually within a cocoon.

The ethmiids align with the Oecophoridae and Stenomidae according to pupal structure. All have relatively short appendages that are correlated with a reduction in the number of movable abdominal segments. The appendages extend caudad only to the fifth or sixth abdominal segment and the abdomen has strongly movable fourth to sixth or seventh segments, via deep incisions dorsally and ventrally. This basic structure is common to all genera of the three families that I have examined, including many Nearctic and a scattering of Neotropical oecophorids and stenomids.

In certain oecophorid genera (e.g., *Schiffermülleria, Esperia, Carcina*) the incisions are equal all around the abdomen, while in others the movement is restricted to dorsoventral by means of constrictions called lateral condyles by Keifer (1936a). This mechanism is partially developed in *Psilocorsis* and well developed in other spined-gnathos groups of Oecophoridae *(Agonopterix, Depressaria, Apachea),* as well as in Stenomidae *(Antaeotricha, Stenoma, Gonioterma, Setiostoma)* and Ethmiidae.

It is interesting that the basic structure is retained even in the bizarre pupa of *Gonionota* (Bourquin, 1945; specimens USNM, CIS). Members of this Neotropical genus possess curious pupal shapes and ornamentation, the product of cryptic resemblance through exposed pupation on foliage, which is accomplished by a flat, stublike cremaster arrangement formed of constricted VIII–IX segments.

Corroborating evidence in larvae, there are two distinct types of pupae in *Ethmia,* corresponding to the major sections defined by adult morphology (Table 4). In addition to their mode of anchoring by condylic grasp (see Biology Section; Plate 20*g-h*), pupae of the Confusella-Longimaculella-Trifurcella groups (Section II) are more cylindrical, with much heavier integument, and have the appendages more elongate, extending caudad to segment 6 (Figures 291, 292). This apparently restricts movement in general, particularly that of the 6–7 intersegmental incision. The structure appears to be correlated with a frail cocoon; although diapause is not recorded with certainty in pupae of these groups, the pupa shell appears to be the protective mechanism, whereas the cocoon serves this purpose in the other section of the genus (Powell, 1971). Section I groups possess a dorsoventrally flattened pupa with relatively thin integument (not resistent to dessication), and in all species except *E. scylla* (Figure 290) anchor by means of the peculiar caudal extensions that I have termed "anal legs" (Figures 288, 289). This structure, which is well developed on all previously described species, had been thought of as perhaps the single most distinctive characteristic of the genus. The seventh and eighth segments are constricted ventrally, and the ninth forms an expansion. From the anterior portion of the ninth segment two broad, boot-shaped structures extend anteriorly, reaching the sixth segment. Distally, the

TABLE 4.—*Pupal characters in New World Ethmiidae*

Species group	*(Species examined)*	*Spiracular grid/pit*	*Condylic segments*	*Anal "prolegs"*	*Condylic grasp to anchor*	*Setaceous*
Albitogata	(3)	no	VI–VII	yes (no *scylla*)	no	no
Charybdis	(1)	no	VI–VII	yes	no	no
Semilugens	(6)	no	VI–VII	yes	no	no
Macelhosiella	(2)	no	VI–VII	yes	no	no
Bipunctella	(2)	no	VI–VII	yes	no	no
Zelleriella	(1)	shallow	VI–VII	yes	no	no
Kirbyi	(2)	deep	VI–VII	yes	no	no
Confusella	(1)	very deep	VI–VII	no	yes	no
Longimaculella	(1)	shallow	VI–VII	no	yes	no
Trifurcella	(1)	deep	VI–VII	no	yes	no
Pyramidobela	(2)	no	V, VI, VII	no	no	yes

anal legs bear a series of strong, hooked setae that act as a cremaster in anchoring the pupa at emergence of the moth. The size and divergence of the anal legs and the number of setae vary somewhat within species, but some general species differences are exhibited (Powell, 1971).

The pupa of *Pyramidobela* lacks any development of these caudal structures. (The pupa of *Pseudethmia* is unknown.) Moreover, as pointed out by Keifer (1936a) *Pyramidobela* has three flexible sutures (making segments 5, 6, 7 movable), a trait similar to *Depressaria, Agonopterix,* and related Oeophoridae, whereas the flexible sutures are restricted to two in *Ethmia.* Thus, although one might expect the pupal structure to be a conservative character, the two specialized types in *Ethmia,* one worldwide, the other apparently of New World derivation, restrict use of the pupa as a source of information on family relationships.

Although the anal legs are unique as compared to Lepidoptera in general, apparently homologous structures occur in scattered genera of Gelechioidea in other families. For example, Fletcher (1933) illustrated them in species then referred to three families: *Microcolona technographa* Meyrick (a momphid of the blastodacnid type), *Aeolanthes sagulata* Meyrick (Xyloryctidae), and *Cladobrostis melitricha* Meyrick (which was called a blastobasid but said to be a curious form of uncertain affinities, and figures of it suggest that it also may be a blastodacnid). Two of these pupate in twig galleries, but *Aeolanthes* pupates in the larval shelter formed between two leaves. None diapause as pupae. The same structural development is shown in *Aetia (=Chaetocampa) bipunctella (=crotonella)* and an undescribed species from Florida (Bottimer, 1926; specimens USNM), which have been considered Blastodacnidae.

By comparison, most Oecophoridae possess a generalized pupal anchoring structure, consisting of setae on the relatively unspecialized ninth segment. This may be either unmodified with about eight caudal setae *(Carcina, Psilocorsis,* some *Agonopterix),* with a rodlike caudal extension bearing the hooked setae at its apex *(Esperia, Schiffermülleria,* some Neotropical species currently without proper generic assignments), or may be a ventrally modified segment with caudal and lateral rows of setae (some *Agonopterix, Depressaria, Apachea*) (Keifer, 1936a; specimens USNM, CIS). In the recently described South American genus *Maesara* (Clarke, 1968), the pupal features and anal legs are quite similar to *Ethmia* (specimens USNM).

The Stenomidae exhibit the greatest range of cremaster modification of any group mentioned here, but no species examined has anal legs as in *Ethmia* (Busck and Dampf, 1929; Keifer, 1936b, 1937; Silva and Heinrich, 1946; specimens USNM). Some stenomids have a generalized type with a produced, attenuated caudal structure bearing apical setae, while others possess both this and hooked setae along the anterior margin of the ninth segment (e.g., *Antaeotricha,* undescribed species from Venezuela) or only the anterior setae, such as *A. manzanitae* Keifer, *A. frontalis* (Z.), while *A. virens* Meyrick displays strong, anteriorly produced, attenuated structures comparable to the anal legs of *Ethmia. Setiostoma* has a further derivation, with hooked structures on the anterior margin of the seventh segment (Keifer, 1936b; Duckworth, 1971).

Thus a variety of cremaster mechanisms has been developed from the less movable pupal type that is common to the depressariine oecophorid-ethmiid-stenomid line, and the peculiar anal legs appear to have been independently developed in Ethmiidae, Blastodacnidae, Oecophoridae, and Xylorictidae.

ADULT.—The tapering, strongly upcurved labial palpus is common to all ethmiids except a few reduced forms such as *Ethmia charybdis, E. scylla,* and *E. mulleri.* Though not stable throughout, this feature is characteristic of most Gelechioidea, distinguishing them from Yponomeutoidea. The maxillary palpus is well developed, 4-segmented and scaled, folded over the base of the haustellum, in most Ethmiidae as in most Gelechioidea; but it is minute, 1- or 2-segmented, presumably a derivative reduction, in the certain *Ethmia* of both Palearctic (Sattler, 1967) and Nearctic. The base of the haustellum is scaled in ethmiids, as in most Gelechioidea but not Yponomeutoidea. The antenna is short ciliated in all New World ethmiids; in the Australian species, *Ethmia sphaerosticha* (Meyrick), the male antenna bears a large, expansible tuft of long silky hairs (Common, 1970). Probably this is an isolated kind of male secondary

character not homologous with the long ciliation of stenomids. The pecten of the scape, two types of which are characteristic of many oecophorids, is lacking in ethmiids.

The wing venation in general does not differ much from many genera of oecophorids. The forewing has R_4 and R_5 stalked, with the basal stem absent in the cell (present in *Yponomeuta*) and R_5 terminating at the apex or on the costa (on the termen in Yponomeutoidea). The origin of hindwing vein M_2 was used by Busck and others to distinguish ethmiids, nearer to M_1 than to M_3, in contrast to nearer M_3 in stenomids and oecophorids. This character is consistent in a general sense. In Ethmiidae it varies from distinctly nearer to M_1 in *Pyramidobela* and some *Ethmia* (Figure 44), to essentially equidistant in *Pseudethmia* and most *Ethmia* (Figures 43, 45), to slightly nearer M_1 in occasional *Ethmia;* whereas in Oecophoridae, M_2 is usually near $M_3 + Cu_1$ (e.g., see figures given by Clarke, 1941, 1963) or even stalked with M_3 (e.g., in *Arctoscelis*), but often the veins are equidistant, and occasionally M_2 is closer to M_1 (e.g., slightly in *Anchonoma* and *Eomichla,* distinctly so in the Australian *Eupselia* and in the South American *Maesara* Clarke, 1968). Veins M_3 and Cu_1 may be stalked, connate, or separate in Oecophoridae, and in Ethmiidae stalked or connate (Figures 42, 44), varying to slightly separate in *Ethmia charybdis* (Figure 43), despite the fact that this character was used to distinguish *Ethmia* (connate) in some keys. The occurrence of a crossvein in the hindwing between Sc and Rs in the Delliella, Cypraeella, and Exornata groups (Figure 44) is a curious anomaly, and this is rare in Oecophoridae (e.g., tht African *Epiphractis;* see Clarke, 1963) and in Gelechioidea in general, but is usual in Yponomeutoidea (Forbes, 1923). This led Walsingham (1897, 1906) to separate West Indian moths here referred to *Ethmia* into two families.

Characters of the male genitalia have long been relied upon by microlepidopterists as primary criteria for differentiating species and defining higher categories. Since these structures often provide the most easily distinguished differences at the species level, we can assume they are the most rapidly evolving morphological features, and for this reason, in general, they provide better bases for distinguishing between families and superfamilies than in indicating relationships among them. Ethmiids (and Gelechioidea in general) provide an excellent example: species and species groups are easily separable on genital morphology (relative to the situation in many Microlepidoptera genera, Tortricoidea for example), and some indications of relationships between groups are displayed; but defining the family on the basis of genitalia is difficult, and indications of relationships on this basis are almost nonexistent. In Ethmiidae the uncus is of two wholly different kinds or completely lacking; the gnathos is characteristic, single and strongly dentate, differing from all other Gelechioidea, but it is absent from one-third of the New World species; the valva characteristically is divided, but the types of division may not be homologous (basal part of costa or cucullus in *Ethmia,* accessory lobe in *Pyramidobela*), and the wide variety of ornamentations similarly are without apparent relationships to one another or to other gelechioid forms. The basal processes provide perhaps the single most unifying character in *Ethmia* and *Pseudethmia* but are lacking in *Pyramidobela.*[3] A comparable structure appears in occasional Oecophoridae (e.g., *Pseudodoxia* and *Psaltica* in Ceylon and India, Clarke, 1963), but usually this appears to originate from a more sclerotized region of the basal part of the valva itself rather than from the membranous diaphragma posterior to the costa. The strongly recurved phallobase is present in all ethmiids except the Notatella group, but this feature is developed in occasional oecophorids, for example, the Oriental genus *Eutorna* and *Philomusaea* in Argentina (Clarke, 1963), and the Old World *Tanyzancla* (Diakonoff, 1967), as well as elsewhere in the Gelechioidea.

The female genitalia are more conservative in morphological diversity, and although species differences such as in sterigma form usually exist, group relationships corresponding to those indicated by male genitalia are inconsistent. The form of the papillae anales, with the setate surfaces rotated to face laterally, is common to many groups of Gelechioidea, while the generally short posterior apophyses, restricting extension of the ovipositor, is a derivative type suggesting relationship with depressariine Oecophoridae and Stenomidae. Cer-

[3] However, they are present in *Atopotorna* and some *Ectaga* (see footnote 1).

tain of the more elaborate sterigma developments, such as the lateral lobes in the Cypraeella group, appear occasionally in oecophorids (e.g., the African *Epiphractis;* see Clarke, 1963), while other specialized types like that of Zelleriella group are unique to *Ethmia.* The strong tendency for spiral loops in the ductus bursae in *Ethmia* is lacking in *Pyramidobela,* but sporadic in Oecophoridae (e.g., *Epiphractis, Tanyzancla*), and rare in stenomids. The ethmiid signum is too variable to be categorized, but the forms shown in nonuncus groups believed to be of New World derivation ("broad cone," "notched keel") do not occur elsewhere in related families, while the "dentate bar" characteristic of Holarctic *Ethmia* groups evidently is a more ancestral type, appearing in many genera of oecophorids and stenomids. The female genitalia of *Pyramidobela* are unlike anything here discussed, either in *Ethmia* or in oecophorids I have seen.

Conclusion.—In characters of larva, pupa, and adult, ethmiids show relationships to Gelechioidea and not to Yponomeutoidea, with which they have been allied by some past workers.

Larvae exhibit different types of development of secondary setae to a greater degree than in other Gelechioidea except Blastodacnidae. Arrangement of secondary setae and crotchets corresponds to the two sections of *Ethmia* based on adult and pupal characters.

The pupa is a specialized type common to *Depressaria* and related genera of Oecophoridae and to Stenomidae, wherein the movable segments of the abdomen are reduced to 5, 6, and 7. A further reduction occurs in *Ethmia,* to 6 and 7, and functionally if not morphologically in the primarily Neotropical nonuncus section, to segment 6 alone, which is used to grasp the exuvium or cocoon in anchoring. In the remainder of the genus, anchoring is accomplished by anteriorly directed "anal legs," while the cremaster is of a simple type in *Pyramidobela.*

Adult characteristics in Ethmiidae are most similar to Oecophoridae, with similarity in each feature shown sporadically in typical oecophorid genera of both Old and New Worlds.

The monobasic oecophorid genus *Maesara* Clarke, 1968, described from Colombia (and its allies when discovered), may provide a key to ethmiid relationships when more is known of tropical faunas. Although superficially and in most aspects of genital morphology, this species is unlike any ethmiids, the wing venation of *Maesara gallegoi* is similar to *Pyramidobela,* and the pupa resembles *Ethmia* in possession of anal legs but has the condylic flexion of the 5–7 segments of other Oecophoridae. Moreover, the spiral ductus bursae and rudimentary basal processes are unusual characters in oecophorids that suggest relationship to ethmiids. Clarke found no close relative in the Neotropical fauna and believed *Maesara* to be related to the Australian genus *Sphyrelata.* Since *Maesara gallegoi* is known only from agricultural situations, as an associate of apple trees, an introduced plant in Colombia, it is possible that the moth is also introduced in South America from the Old World.

It is possible that the Ethmiidae as presently defined is not a monophyletic unit and certainly probable that it does not comprise a taxon of comparable level to the Oecophoridae and some other families of the Gelechioidea. Most likely the group will best be considered a subfamily or tribe within the Oecophoridae when some assessment of the higher taxa in that family is available, and at that time treatment of *Pyramidobela* as a separate taxon of equivalent level may be realized, perhaps related to different oecophorids.

Biology

Whereas our knowledge of the New World ethmiids based on adults gradually decreases as one considers the fauna successively southward, biological information on the group drops abruptly in the Neotropical region. In fact, south of the United States virtually nothing is known of the habits of these moths. With the exception of two species that have been reared in southern Texas, one in southern Florida, and two in Cuba, for which little other than the foodplant is known, life histories of Neotropical *Ethmia* have not been studied.

Thus several species groups are wholly lacking from the discussion which follows, i.e., the Cypraeella group, the Exornata group, the Notatella group, and several of the unique smaller groups. This fact should be borne in mind in considering generalizations about the family, since several of these groups are New World derivatives which are remote from other species groups in adult morphology and may well exhibit biological

features that are equally distinctive. Moreover, data on *Pseudethmia* and *Pyramidobela* are limited to a little information on the latter, further emphasizing the incompleteness of the picture.

Biological data are available for a relatively good representation of the taxonomic spectrum for Nearctic species. Although only about 20 species have been reared (in addition to the Neotropical species in Florida and Texas mentioned above), members of all the species groups in North America are included. Therefore, the following discussion, while omitting unique Neotropical species groups, nonetheless encompasses most of the taxonomic diversity in New World *Ethmia,* since the major adult groupings are represented in the Nearctic.

Most of the following summary is based on my study of 14 species in California (Powell, 1971), although some species groups are represented only by work done in the eastern United States and in Europe. Additional information has been incorporated from Old World studies where these seem pertinent, but no attempt has been made to review literature on ethmiid biology on a worldwide basis. Food-plant information has recently been summarized and assessed for the Palearctic fauna by Sattler (1967). However, species groups in the Palearctic are comparable with only a small portion of our fauna.

Host-Plant Relationships

Worldwide.—Most *Ethmia* are host specific on some genus of Boraginaceae or Hydrophyllaceae. Inasmuch as the latter family is restricted to the New World, the Boraginaceae is the principal plant family with which ethmiids are associated when the group is considered on a worldwide basis. In the Palearctic, *Anchusa, Echium, Lithospermum,* and *Symphytum* are the most widely used among some 15 borage genera recorded for various *Ethmia,* while Nearctic species have been reared from *Amsinckia, Lithospermum, Cryptantha, Plagiobothrys,* and *Cynoglossum.* Two Neotropical species, four species in the Indo-Oriental region (Fletcher, 1921, 1933; Sattler, 1967), two species in South Africa (Taylor, 1951), and one in Australia (Common, 1970) have been reared from *Ehretia.* Even in the Pacific Islands a borage, *Cordia,* is used (Swezey, 1944; LeGrand, 1965).

There are a number of exceptions to the use of Boraginaceae, representing taxonomically diverse plant families. In his summary of food plants used by Palearctic species, Sattler (1967) has analyzed the source literature and as a result has indicated that most of the plant families which have been recorded are not hosts of *Ethmia.* Most of these are excluded on the grounds that either the larvae or plants were misidentified or because some erroneous assumption had been made, or that they appeared through mechanical error in publication. The most numerous examples of confirmed hosts other than Boraginaceae are from the closely related family Hydrophyllaceae, which serves nearly half of the Nearctic species for which biological information is available. In Europe, the genotype, *E. aurifluella* (Hübner), and three other species feed on *Thalictrum* (Ranunculaceae), while in other parts of the world this family is not known to be used. The Rosaceae genus *Cercocarpus* is the host of two closely related Nearctic species, and *Collinsia* in the Scrophulariaceae harbors one. The only two rearing records from the Caribbean region are for Meliaceae (*Trichilia*) and Phytolaccaceae (*Stegnospermum*), both in Cuba.

Finally, *Meliosma* (Sabiaceae) is reported as a host of *E. assamensis* (Butler), a species which also feeds on *Ehretia* (Moriuti, 1963, cited by Sattler, 1967) and similarly, *Lychnis* (Caryophyllaceae) is considered by Sattler as a validly recorded food plant of *E. pusiella* (L.). This species is known to feed on at least seven genera of Boraginaceae, while most of the records for Caryophyllaceae, including several for two genera other than *Lychnis,* are discredited by Sattler.

The host of *Pseudethmia* is unknown, while two species of *Pyramidobela* have been recorded using *Penstemon* (Scrophulariaceae) (Braun, 1921a) and *Buddleia* (Loganiaceae), the latter in California where the plant is introduced (Keifer, 1936a).

Among exceptional host records for American species are several that are probably not valid because the pupation site formed the basis of the association. Owing to the habit *Ethmia* larvae display in wandering and often burrowing into soft wood or similar substrates for pupation, cocoon sites should be considered suspect in deriving food-plant records. Thus, *E. arctostaphylella* received its name from a supposed association with

Arctostaphylos (Ericaceae), but this species has been shown to be specific on various members of *Eriodictyon* (Hydrophyllaceae) (Powell, 1971). This species has also been reared from a dry *Yucca* (Agavaceae) inflorescence stalk. Similarly, *E. monticola fuscipedella,* which has been taken feeding on *Lithospermum,* is represented by reared specimens in collections labeled as having emerged from burrows in young pine. Two Texas species, at least one of which has *Ehretia* as a host, were reared from pupae in aegeriid-infested stems of *Wissadula* (Malvaceae) (Heinrich, 1921).

NEW WORLD.—There is no clear-cut pattern of host relationships correlating plant taxa and species groups which might indicate coevolutionary radiation among *Ethmia.* If we consider the Hydrophyllaceae to be a New World derivative, it appears that no one line or group of *Ethmia* has proliferated after adaptation to these plants. Species which have adopted hydrophylls are scattered across the full spectrum of Nearctic species groups, primarily through use of various species of *Phacelia.*

In general, deviations from an alleged primitive association with Boraginaceae seems to have occurred by species independent of one another, adapting to several unrelated Nearctic plants, especially endemic forms in arid parts of the western states. In the Hydrophyllaceae, *Eriodictyon,* a genus restricted to California and adjacent states, is the host for *E. arctostaphylella* and all species of the plant genus are used. Moths of closely related species use not only *Phacelia,* but also western endemics in Rosaceae and Boraginaceae. Thus, members of the *discostrigella* complex are restricted to *Cercocarpus* although they are among the more widespread species of New World *Ethmia.* Of the several endemic species in California, two use *Amsinckia,* one depends upon *Plagiobothrys,* and one feeds on *Cryptantha.* The latter example, *E. minuta,* exhibits considerable morphological adaptation in specialized oviposition, associated with this densely bristled, xeric annual. The most radical departure in this group is by *scylla,* which feeds on *Collinsia* (Scrophulariaceae).

HOST SPECIFICITY.—In Palearctic *Ethmia* a pattern seems to be emerging wherein a more or less indiscriminate acceptance of Boraginaceae is revealed with increase of rearing records. Thus, of 18 species for which Sattler (1967) summarizes records, 15 feed on Boraginaceae and three solely on plants of other families; and 7 of 15 have been recorded from more than one genus (up to seven genera) of Boraginaceae. Moreover, of those known only on one genus, seven of eight have been documented by only one report, suggesting that in effect no information on specificity is available. By contrast, three of four species associated with Ranunculaceae (*E. pyrausta* (Pallas), *E. chrysopygella* (Kolenati), and *E. flavianella* (Treitschke)) have each been recorded on the one genus *Thalictrum* from two to seven times. The only species that have been reported feeding on both Boraginaceae and some member of another family are associated with the nonborage by only a single record, and these need to be confirmed.

For the North American fauna a similar pattern of host ranges may obtain, but there are fewer field larval records and these are scattered among a wider array of species. However, this information is in part corroborated by experimental data from my studies with California *Ethmia,* which indicate that host specificity is manifested to varying degrees both in females' selection of oviposition sites and in acceptance of food by larvae (Powell, 1971). Thus, *plagiobothrae* females selected *Phacelia californica* when the true host *Plagiobothrys* (confirmed by many field collections of larvae) was also present. However, first instar larvae were unable to feed on the *Phacelia* at all. Similarly, *brevistriga* females failed to oviposit on *Cryptantha* when it was offered alone, but accepted it in combination with the known field host, *Phacelia distans.* The newly hatched larvae selected *Phacelia* when both these plants were available. Females of *albitogata,* a species which in the field feeds only on *Amsinckia* so far as known, refused to oviposit at all when only *Phacelia californica* was provided, but showed a weak oviposition response (35 eggs among 4 females) when offered *Plagiobothrys.* First instar larvae mostly rejected the latter plant, but a few fed on it, dying in an apparently starved condition, in the second and third instars. Newly hatched larvae of *coquillettella,* a species believed to feed on *Phacelia* (based on one collection), accepted both *Phacelia tanacetifolia* and *Nemophila,* a host which appeared to be nutritionally adequate, but probably is not used in the field owing to its rapid maturation rate. However, larvae of *coquillettella*

in the second and third instars which had previously fed on *Phacelia* rejected *Nemophila*. The best evidence of specificity was provided by *scylla;* females refused to oviposit when offered *Amsinckia,* displayed a weak reponse (35 eggs by 4 females) to *Plagiobothrys,* and responded well to the confirmed field host *Collinsia* (124 eggs by 4 females). First instar larvae completely rejected *Amsinckia* and *Phacelia,* both when offered as a choice with *Collinsia* and in absence of *Collinsia.*

There are 23 North American species of *Ethmia* for which we have reliable data on larval food plant (Table 5) (including three essentially Neotropical species in southern Texas and Florida),

TABLE 5.—*Food plants of New World Ethmiidae*

Species	*Field host*	*Laboratory accepted*	*Source*
Ethmia: Section I			
E. coquillettella Busck	*Phacelia distans*	*Phacelia tanacetifolia*	Powell, 1971
		Nemophila maculata	Powell, 1971
E. minuta Powell		*Cryptantha intermedia*	Powell, 1971
E. plagiobothrae Powell	*Plagiobothrys nothofulvus*		Powell, 1971
	P. tenellus		Powell, 1971
E. albitogata Walsingham	*Amsinckia lunaris*		Powell, 1971
	A. spectabilis		Powell, 1971
E. brevistriga Clarke	*Phacelia distans*		Powell, 1971
E. b. aridicola Powell	*P. distans* var. *australis*	*Phacelia distans*	Powell, 1971
E. scylla Powell	*Collinsia heterophylla*		Powell, 1971
E. charybdis Powell	*Amsinckia tessellata*		Powell, 1971
	A. intermedia		Powell, 1971
E. albistrigella (Walsingham)	*Phacelia ramosissima*		Powell, 1971
E. nadia Clarke	*P. ramosissima* var. *suffrutescens*	*Phacelia tanacetifolia*	Powell, 1971
E. arctostaphylella (Walsingham)	*Eriodictyon californicum*		Powell, 1971
E. discostrigella (Chambers)	*Cercocarpus ledifolius*	*Cercocarpus montanus*	Powell, 1971
E. semitenebrella Dyar	*C. parvifolius*		Dyar, 1902
		Cercocarpus ledifolius	Powell, 1971
E. semilugens (Zeller)	*Phacelia crenulata*		Powell, 1971
	P. calthifolia		Powell, 1971
E. timberlakei Powell	*P. ramosissima* var. *suffrutescens*		Powell, 1971
E. macelhosiella Busck	*P. covillei*		Busck and Heinrich, 1922
E. fuscipedella (Walsingham)	*Lithospermum gmelini*		Braun, in litt. (Ohio)
	L. canescens		Specimen (F. P. Ide, Ontario)
E. zelleriella (Chambers)	*Phacelia dubia*		Dyar, 1904
	P. bipinnatifida		Braun, in litt. (Ohio)
E. delliella (Fernald)	*Ehretia elliptica*		Busck, 1908b; specimens (Texas)
E. subsimilis (Walsingham)	*Trichilia hirta*		Busck, 1934, Bruner et al., 1945
Ethmia: Section II			
E. confusella (Walker)	*Bourreria ovata*		Specimens (D. H. Habeck, Florida)
E. l. longimaculella (Chambers)	*Lithospermum officinale*		Specimen (Fletcher, Ontario)
	L. latifolium		Braun, 1921
	Onosmodium hispidissimum		Braun, in litt. (Ohio)
E. semiombra Dyar	*Ehretia elliptica* (?)		Specimen labels (Texas)
E. albicostella (Beutenmüller)	*Lithospermum* sp.		Braun, in litt. (Wyoming)
E. trifurcella (Chambers)	*Cynoglossum virginianum*		Braun, in litt. (Ohio and Kentucky)
E. oterosella Busck	*Stegnospermum halimifolia*		Busck, 1934
Pyramidobela quinquecristata (Braun)	*Penstemon confertus*		Braun, 1921 a
	P. deustus		present data
P. angelarum Keifer	*Buddleia ?davidii*		Keifer, 1936 a

but more than one-third of them (8) have been studied at only one locality and therefore can be eliminated from consideration in development of generalizations on host specificity. The remaining 15 have been reared mostly at two sites (three California species from numerous populations), so that at best the apparent host specificity pattern is tentative.

Only one Nearctic species has been reared from more than one host genus. Larvae of *E. trifurcella* have been taken twice each on *Lithospermum* and *Onosmodium* (Boraginaceae).

Among those feeding on Hydrophyllaceae, good evidence is available, indicating specificity to *Eriodictyon* by *E. arctostaphylella,* with several species of the genus used. The same appears to be true of the *Phacelia* feeders, judging from evidence provided by pairs of closely related species, i.e., *albistrigella-nadia* (three populations sampled), and *macelhosiella-timberlakei* (one population in each of two species).

In Boraginaceae feeders, western species which have adapted to *Cryptantha, Plagiobothrys,* and *Amsinckia* appear to exhibit specificity within each genus, based in part on association of the adults of these diurnal species. Similarly, several specimen label records, although varying in completeness of the identification, suggest that *E. semiombra* is constant on *Ehretia,* at least in southern Texas. Records are too few for any of the rest of the Nearctic species, but those which have been reared from *Lithospermum* and *Cynoglossum* may well feed on other genera of Boraginaceae in the manner of the Palearctic *Ethmia.*

Seasonal Life History

The majority of New World species have been collected too few times or only in such scattered geographical areas that no conclusion about flight periods can be made. Using the best known species as representatives of their respective species groups, it appears that the Neotropical groups are all multivoltine. Many may breed more or less continously. Included in species exhibiting this indiscriminate pattern are members of the Kirbyi group (*E. davisella* may be an exception), Cypraeella group, Exornata group, Notatella group, Confusella group, Joviella group, and *E. hammella.*

At least two groups appear to be composed of species which are multivoltine and others that are univoltine or bivoltine. Thus *E. elutella* and *E. janzeni* have been taken only in the winter months (dry season) at localities which have been sampled at other times of the year, while the closely related *E. submissa* flies throughout the year in the Caribbean. The widespread Longimaculella and Trifurcella groups include Temperate Zone members with univoltine or bivoltine patterns and Neotropical species that are multivoltine. A series of thorn-forest species may be single brooded, flying in summer months, prior to, during, and just after the rainy season and foliation of the deciduous thorn forest.

In Nearctic species a more clear-cut pattern can be seen, not only because the climate dictates narrower seasonal activity limits, but because more documentation is available for most species. Both univoltine and bivoltine life cycles are represented, and at least two species, *E. arctostaphylella* and *E. discostrigella,* probably have one generation in parts of their range and are facultatively multivoltine elsewhere.

Among strictly univoltine species, whole groups have usually developed as such together. Thus all members of the Albitogata group are single brooded, flying early in the season. They have evolved diurnal flight habits presumably in response to low nighttime temperatures at that time of year. By contrast, members of the Macelhosiella group and *E. charybdis* have a single annual generation, but fly in late fall, having developed two-stage diapause in order to feed as larvae in early spring when the annual hosts are available.

Whether uni- or multivoltine, diapause in Nearctic species usually occurs in the pupal stage. Pupation normally occurs within 10–12 days after the cocoon is constructed, and if it is the overwintering generation, diapause evidently obtains soon thereafter. An exception occurs in the Macelhosiella group and *E. charybdis* where aestivation takes place as a pupa, and the moths emerge in late fall. In *E. timberlakei* and *E. charybdis* oviposition takes place in November, and the eggs enter diapause. With *E. macelhosiella,* however, Busck and Heinrich (1922) were unable to obtain oviposition, although mating was observed. They surmised that the adults hibernate. California members of this group live in desert

areas, and may have their emergence, oviposition, and diapause tied to winter rains, which result in germination of the food plant. In the eastern United States, *E. macelhosiella* would appear to be governed by different factors, and hibernation may occur in the adult through some type of arrest in reproductive development.

Adult

Diel periodicity.—On the basis of light attraction records, it appears that the majority of ethmiids are nocturnal moths. This generalization probably encompasses all of the Neotropical species, although activity periods of many have not definitely been recorded as yet, even by collections at light. In the Temperate Zone a number of species are diurnal in both the Old and New World. The Albitogata species group, centered in the southwestern United States, is comprised entirely of diurnal species that fly in early spring. Evidently the correlation of specialized seasonal and diel rhythms has set the stage for adaptation to a niche which could not be available later in the season when nighttime temperatures are suitable for activity by the majority of Microlepidoptera. The annual Boraginaceae and Hydrophyllaceae in this area are available for a relatively short time prior to the long, dry season which coincides with the warmer months.

None of these species has ever been taken at light and when caged, their activities, including mating and oviposition, are confined to a few hours between noon and sunset, the time of height of activity varying somewhat between species. As discussed in the taxonomic section, these moths have relatively smaller eyes, with the "eye index" (a comparison of eye size to height of the front) ranging 0.7 to 0.8, whereas it is 1.0 to 1.2 in most of the rest of the New World species, which are known or believed to be nocturnal.

There are a number of species which are somewhat intermediate in behavior, in eye size, or both. Members of the *albistrigella* complex are evidently primarily diurnal, with a small eye, and both field and laboratory observations indicated an afternoon flight in *E. albistrigella*. This species flies early in the season at the higher elevation sites observed, while there is still snow on the ground in some situations, and presumably nighttime temperatures would drop too soon after sundown to enable a nocturnal activity period. The same is almost certainly true of *E. a. icariella* and *E. orestella*, both of which occur only above 11,000 feet, so far as known. On the other hand, the closely related species *E. nadia* lives at low-elevation stations for the most part, flies relatively later in the season, and has been taken at light at least once. Inconclusive field and laboratory observations indicate the activity period may be late afternoon and crepuscular (Powell, 1971). Isolated species in other groups may have also adapted to high elevation life similarly, for example, certain members of the Bipunctella group, especially *E. caliginosella*, which has been recorded only above 11,000 feet and has an intermediate eye size (index 0.9).

Ethmia arctostaphylella also has an intermediate eye size, and this species is known to begin its activity period early, at or before sundown in many instances. One mating pair was taken at about 4:00 p.m. on a cool day early in the season. Under cage conditions (uniform temperature) activity began prior to sunset and was highest during the next two hours. Some individuals remained active as late as 11:00 p.m., and there have been a number of light attraction records for this species in the field. Presumably the early activity period has enabled *E. arctostaphylella* to exploit a long season in relation to its evergreen host. In central California it is active from February, when it flies along with several of the true diurnal species, until October, a longer season than is utilized by any other Nearctic species.

Species in the Macelhosiella group which fly in late fall, again at a time when one would expect a low nocturnal temperature deterrent, have been collected both during the day and at light at night. Here too the eye size, especially in *E. macelhosiella*, suggests the possibility of crepuscular activity.

In Neotropical species there have also been conflicting observations. For example *E. phoenicura*, in southern Baja California, has been observed active at flowers in bright sunshine, yet is commonly taken at lights, as are other members of the Notatella group. These species and others in various Neotropical species groups have an eye index tending toward intermediate, but whether this is correlated with behavioral phenomena is unknown.

The diurnal aspect of *Ethmia* behavior seems to

have been only poorly documented in the Palearctic, but at least *E. pyrausta* (Pallas) (Nolcken, 1871, cited by Sattler, 1967) and *E. chrysopygella* (Kolenati) (Thomann, 1923; Staudinger, 1879) are said to be day fliers or active in afternoon or evening. On the basis of my studies in California, it seems a distinct possibility that all members of the Pyrausta and Nigripedella species groups (of Sattler, 1967) are diurnal, particularly in view of their generally early seasonal flight periods. Moreover, from their external appearance, *E. rothschildi* (Rebel) and *E. pseudoscythrella* (Rebel) parallel members of the Albitogata group in California. It seems likely that these two Palearctic species, which have remained exceedingly poorly known, will be rediscovered when they are sought during the daytime in early spring. The diurnal species of the Pacific coast are similarly small and dull colored and seem nearly always to occur in localized colonies, which, with their early seasonal flight period, render them amnesty from collectors. More than 80 percent of the records for the California diurnal *Ethmia* have accumulated during the past decade since we began to recognize the habits of these inconspicuous day fliers and to search for them.

MATING.—Courtship behavior has not been observed for any species. A study of this aspect of their behavior should prove most interesting, since males of nearly all species exhibit secondary specialization. In addition to the genital scaling, a remarkable array of structural and setation modifications is displayed. Most universal among secondary features are the enlarged antennae—the diameter of the basal segments usually range from 10 to 20 percent greater than in the female, but in some species up to 40 percent larger (Figures 6–9). The costal area of the hindwing is simple, not differing from the female in males of many species, but others exhibit a range of specializations, from a hair tuft or pencile to hair pencile enclosed in a costal fold or a pinch fold between veins Sc and R, sometimes with additional specialized scaling. In males of the Notatella group, further specialization of the antenna, through enlargement and scale tufting of the scape, is accompanied in some species by elongate, lateral scale tufts of the metathorax, which are either exposed or provided with a receptacle formed by a pouch fold on the abdomen. The function of none of these structures is known.

Mating has been witnessed primarily in the diurnal species (Powell, 1971). A typical tail-to-tail position is assumed and the moths walk about some, but probably only when disturbed by external factors. The duration of copulation has not been defined for any species, but it seems to vary widely, both between and within species, from about 4 hours to at least 16 hours when it extends into the inactive period of the diel rhythm. In *E. charybdis* coition lasted 22–26 hours (based on one observation). Multiple mating is common in the field, judging from the occurrence of spermatophores in the females' bursae. In both Nearctic and Neotropical species two spermatophores are often found, and sometimes the remains of a third and even fourth are visible. It is difficult to differentiate any more than three, as the remains of empty spermatophores deteriorate at the distal end of the corpus bursae.

OVIPOSITION—The papillae anales are rotated so that the two setae-bearing surfaces face laterally, rather than ventrally, forming a somewhat blade-shaped ovipositor. The posterior apophyses and associated intersegmental membrane are greatly variable in length from one species group to another, so that the depth to which females are capable of probing during oviposition differs among species. It appears the structural modifications are correlated with a general adaptation to placement of the eggs into or between objects, such as among plant hairs, between unopened buds, etc.

During oviposition females characteristically crawl over foliage, move spirally up a stem, or on other suitable substrates, with the ovipositor extended and turned ventrally. Movements occur slowly, accompanied by a continuous vibrating of the antennae. The substrate is tapped periodically, and several times at one site prior to deposition of an egg.

The eggs (Plates 21–22) are deposited singly. The eggs are cemented to the substrate by an invisible adhesive, affixed on an area nearly as large as the length and width of the egg.

Data are incomplete as to the range in number of eggs and duration of production of which individual females are capable. With most species that I studied, females were not individually caged, but 200 eggs deposited by several females of *E. arctostaphylella* was the highest total I obtained.

Single field-collected females of *E. plagiobothrae* and *E. coquillettella* deposited 62 and 70 eggs in confinement, while a reared and lab-mated *E. charybdis* produced 75 eggs. Females of various species usually oviposited under cage conditions only during the first two or three days, suggesting that in the field, with adequate feeding, multiple matings, etc., a much higher egg production probably obtains through succeessive egg maturation. Busck and Heinrich (1922) found 20–40 eggs in the abdomen of *E. macelhosiella,* and this total is probably representative for mature eggs carried at any one time by female *Ethmia* in general, according to dissections I have made.

With most species there seems to be a strong stimulus to the specific food plant which is necessary to elicit oviposition. Thus in a few cases where the food plant was not known, and I provided the wrong plants, virtually no eggs were deposited. For example, I tried unsuccessfully several times with *E. scylla* females, offering a splendid menu of *Amsinckia, Phacelia,* and other suspect Borage-Hydrophyll plants. When at last the unlikely *Collinsia* was included the females were quite responsive, depositing their eggs entirely in leaf axils of *Collinsia* and in the mesh of the nylon-stocking ceiling of the cage, ignoring *Amsinckia* and *Phacelia* which were simultaneously offered. *Ethmia* in general are more restricted in selection of oviposition sites than are many other Microlepidoptera, limiting these sometimes to particular parts of the given food plant, such as between sepal and carpel (*E. minuta*), around buds and main stem (*E. brevistriga*), leaf axils (*E. scylla*), underside of leaves (*E. albistrigella*), underside or upper side midrib of leaves (*E. arctostaphylella*), fibrous surfaces (*E. discostrigella*). Sometimes some of the eggs were placed on nearby surfaces which were apparently similar to the tactile sense, such as creases in masking tape, cotton fibers, or the nylon screen, but only in the presence of the food plant. One species, *E. sandra,* in El Salvador probably deposits the eggs in mature flowers, because all the females (which were collected at light) had considerable pollen on the abdomen. *Ethmia minuta* exhibits the most specialized oviposition arrangement among species I have studied. This species feeds on *Cryptantha intermedia,* a short-lived, densely hispid annual of arid, coastal southern California. The female has evolved a peculiarly elongated, heavily sclerotized ovipositor which lacks the usual setae of typical papillae anales (Figures 182–183; Plate 3*e*). The eggs, which are smooth, rather than with the normal reticulation of the chorion, are inserted into unopened buds next to the carpels. The larvae hatch directly into the buds, where they feed. Exposed, newly hatched larvae placed on the exterior of densely setose buds or leaves invariably were unable to penetrate the buds and died without feeding.

In one example, *E. timberlakei,* females deposited large numbers of eggs in containers which were provided with no fresh food plant of any kind, but still with dried leaves from the original larval collection made six months previously. As discussed below, this species is believed to diapause in the egg, and it may be that in the field, females oviposit on or near dried plants from the previous spring.

LONGEVITY.—If provided with water, caged *Ethmia* generally lived up to 8 to 14 days. However, mating and oviposition, by both field-collected and reared individuals, usually took place only during the first few days of capitivity. One female of *E. nadia* which was reared in January, when no males were available, lived 16 days. The Macelhosiella group and *E. charybdis* again provide an exception to the usual pattern. Reared *E. timberlakei* and *E. charybdis* survived two to three weeks in dry containers and deposited fertile eggs without having been offered any nourishment. These species are adapted to survival in desert areas at the end of the dry season. Individuals of other groups invariably died in two or three days if not given water.

Busck and Heinrich (1922) indicated that *E. macelhosiella* adults lived up to several weeks in captivity and suggested that the moths overwinter.

The fact that I did not provide any protein diet in most cage studies may have been a factor in failure to obtain more continued oviposition (i.e., successive egg maturation). Some experimental groups were given contemporary flowers from the collection site, but these may have been nutritionally unsuitable or otherwise unacceptable. Ethmiids do visit flowers in the field and presumably nectar is a sources of protein. Thus various diurnal species have been observed at flowers: *E. coquillettella,* 1♂, 2♀♀ at *Coreopsis californica* (Compositae)

at midday; *E. minuta*, ♂♂ at *Cryptantha intermedia* (the larval food plant); *E. brevistriga aridicola*, both sexes in large numbers on *Cryptantha circumcissa*; and *E. nadia* at *Cryptantha intermedia*. Generally no observations have been made on nocturnal species. However, one female of *E. epileuca* taken at light was found to have Compositae pollen about the head and thorax, indicating flower visitation.

Egg

Description.—The eggs are deposited singly. They are whitish, somewhat oval or nearly rectangular in outline, cylindrical in cross section, ranging in size from 0.25 × 0.5 to 0.3 × 0.6 mm in small, diurnal species, to 0.6 × 1.2 mm in *E. semitenebrella*, the largest *Ethmia* for which eggs were measured. Neotropical behemoths such as *E. gigantea* or *E. wellingi* presumably deposit larger eggs. The shape of individual eggs varies within a given colony, affected to some extent by the nature of the substrate. Often they taper somewhat toward one end. They are soft when deposited and take on irregularities in shape when deposited on irregular surfaces.

The chorion of most species is regularly reticulate with raised ridges. At high magnification (Plate 21*b-d*), the network is seen to consist of simple ridges without any finer structure or respiratory stigmata as are known in Macrolepidoptera. The pattern of reticulation has been assessed neither for variation within species nor for possible interspecific differences. In one species, *E. minuta* (among about a dozen for which eggs have been described), the egg has a smooth chorion (Plate 21*e-f*). (No visible raised structure at × 54 magnification.) Presumably this has developed in conjunction with the highly specialized oviposition arrangement (described above) which this species employs to cope with the densely hispid inflorescence of the host plant.

Although eggs of most *Ethmia* do not operate as a long-term resting stage, they seem to be highly resistant to environmental extremes such as temperature, dessication, or drowning. Thus eggs can be kept in dry containers at laboratory temperature and humidity, which would be fatal to adults, and development occurs normally. When stored at low temperatures (± 4°C) (up to 9 days) development was delayed but not impaired. In one case a breeding jar containing eggs and first instar larvae of *E. semitenebrella* was allowed to become overheated in an automobile during transit from the field (in approximately 40°C air temperature)—the eggs survived but all larvae died. In another experiment eggs of *E. arctostaphylella* were submerged in water in a vial from the first to fifth day after oviposition. After the vial was emptied and allowed to dry, the eggs hatched, development having been slowed about two to three days over that of sibs.

Development.—The time required for incubation is dependent upon temperature. With most species, hatching occurred 10–11 days following oviposition when eggs were stored at laboratory temperatures (daily cyclic 12–20°C). The fastest development I observed occurred in *E. brevistriga aridicola* when eggs were stored in a warm field laboratory near Palm Desert, California, in April, and hatching occurred in 8–9 days. As noted above, storage at ± 4°C effectively postpones development, and I have routinely used this method to retain eggs for photographing, delays in obtaining food plant, etc. Delay over normal development time is usually about equal to the cold storage time.

During development, eggs of *Ethmia* turn yellowish, then pink to orange, usually by the second or third day. Later changes during embryonic development are not visible, owing to the thick chorion. In the last day or two prior to hatching, the pink color disappears and the darkened head capsule of the larva can be obscurely discerned.

Diapause evidently occurs in the eggs of *E. charybdis* and *E. timberlakei* and probably in related species. As discussed above, the seasonal life history of the Macelhosiella group involves a late fall flight as a strategem to cope with the brief occurrence of annual hosts in arid areas. Although Busck and Heinrich (1922) failed to obtain oviposition in *E. macelhosiella*, the females of *E. timberlakei* that I caged laid eggs in comparably large numbers for laboratory conditions. These eggs turned to a dull tomato-red within a few days. The color is different from the pink of normally developing *Ethmia eggs* and matches closely the color of Tortricinae eggs in diapause (Powell, 1964). The *E. timberlakei* eggs were stored at

laboratory temperatures, and hatching occurred at sporadic intervals during the following few months.

Larva

Behavior.—At hatching the larvae chew a ragged hole in the micropylar end of the egg, sometimes well off center. The hole is about one-half the diameter of the egg, and no further feeding on the eggshell takes place. Larvae of *Ethmia* live solitarily, and because of the oviposition behavior no wandering by newly hatched larvae is necessary in most species. Feeding on the plant usually begins near the egg site and occurs in skeletonizing fashion while the caterpillars are young.

Characteristic modes of specialization in feeding site and type of shelter are developed by most species which I studied. Specialized oviposition sites are correlated with occurrence of larval feeding at these sites: on immature flower buds, especially the carpels (*Ethmia coquillettella, E. minuta, E. brevistriga*), on undersides of leaves (*E. albistrigella, E. nadia, E. semilugens*), and in crotches of leaflet axils (*E. discostrigella, E. semitenebrella*). In the case of *E. scylla,* the eggs are placed in leaf axils, and the young larvae migrate upward to young buds, a sequence that is probably necessitated by the rapid growth of the host, *Collinsia,* and its loose inflorescence (a raceme) in contrast to the tight scorpioid spike of Borage-Hydrophyll hosts of other *Ethmia* which feed in developing flowers.

Those species that feed on developing ovules and flower parts are western endemics which are associated with hosts such as *Phacelia, Amsinckia,* and *Cryptantha* that are herbaceous only during a short growing season. The amount of foliage developed by these plants is highly variable, depending upon irregular rainfall. The larvae do not eat leaves at all but characteristically construct well-defined shelters of silk which advance along the inflorescence as it grows. The larvae, even in late instars, live completely concealed within the spike, between the paired rows of flowers, feeding at the inner sides of the developing ovules, often causing little or no externally evident effects on the flowers. Probably all species which are dependent on annuals are adapted to feed on flowers and immature seed, and there was evidence, at least for *Ethmia coquillettella,* that larvae could not mature on a diet of leaves (Powell, 1971).

By contrast, species which feed on the leaves of Boraginaceae and Hydrophyllaceae are mostly members of more boreal groups, and they feed exposed, usually on a slight web, ignoring flowers. This habit has been reported in the literature for a number of unrelated species both in the Palearctic and Nearctic (e.g., *E. albistrigella, E. nadia, E. bipunctella, E. macelhosiella, E. timberlakei, E. longimaculella, E. zelleriella).* Three western species (*E. arctostaphyllella, E. discostrigella, E. semitenebrella*), having adapted to shrub hosts with quite different foliage form, entire, often tough leaves, employ variable webs to tie up terminal growth or bring together the sides of leaves during their multivoltine feeding cycles.

Ethmia plagiobothrae, one of the diurnal species which has specialized to the demands of a short lived annual host, feeds at first on the basal leaf rosettes of *Plagiobothrys,* then moves up to the inflorescence during the late instars. In this case the tightly compacted flowers form a small inflorescence and the black and orange larvae feed completely exposed on the popcorn-like white flower heads.

There is preliminary evidence to indicate that behavioral protective mechanisms have been developed in association with the differing shelter types. Thus later instars of shelter dwellers (*E. albitogata, E. brevistriga, E. discostrigella, E. semitenebrella*), when disturbed, react by wriggling violently backward to attain some protected spot on the substrate. Some species seem to nearly "jump," moving a distance of several centimeters in an instant when prodded. On the other hand some species which feed exposed on leaves (e.g., *E. plagiobothrae, E. charybdis, E. albistrigella, E. macelhosiella, E. nadia, E. semilugens*) curl and drop from the host at the slightest disturbance, and feign death, lying motionless on the substrate, even when this is an unhospitable site such as a rocky wash in the desert sun as in the case of *E. semilugens.*

Thomann (1908) reported an ant association for two Palearctic species, *Ethmia dodecea* (Haworth) and *E. pusiella* (L.), given as *Psecadia decemguttella* Hbn. and *P. pusiella* (Rom.), and this evidently is the source of the mention by Klots (1958) that

larvae of these two species are attended by ants because of the nectar which leaks from the torn flowers. However, Sattler (1967) indicated there may have been no direct relationship between the ants and larvae.

DEVELOPMENT.—The number of instars has not been determined for many *Ethmia* with certainty. On the basis of unsexed head capsule measurements, I recorded five instars in *E. brevistriga* and *E. scylla,* and this number appeared probable for other diurnal species (*E. plagiobothrae, E. albitogata*). With members of the Semilugens group a sixth instar, at least in occasional individuals, appeared possible. D. H. Habeck (in litt.) has preliminary evidence indicating that a stenomid in Florida undergoes one more instar in the female than in the male, as is known in certain Macrolepidoptera. If the data for the stenomid are substantiated by future studies, they suggest the possibility of the same phenomenon in ethmiids.

The time required for growth varies, depending upon environmental conditions, especially temperature. Moreover, the time may inherently differ between species. Estimates based on my observations are limited to closely related western species and mostly result from larvae reared under laboratory conditions (Powell, 1971). In the field, estimates ranged from 40 days (*Ethmia plagiobothrae*), 45 days (*E. scylla*), and 50 days (*E. brevistriga*) for early spring species to 32 days (*E. albistrigella*) in midsummer at high elevations. In the laboratory, growth time was less variable and more accurately recorded, ranging from 30 to 39 days from egg hatch to cocoon spinning in several broods (*E. brevistriga, E. albistrigella, E. semitenebrella*). It was over 40 days in the larger species *E. arctostaphylella* and *E. discostrigella* and ranged to over 60 days in the latter species when a continuous supply of food plant could not be provided.

COCOON CONSTRUCTION.—At maturity, *Ethmia* larvae usually disperse from the feeding sites to seek out sheltered places for pupation. In only one species, *E. arctostaphylella,* have I found an indication of normal pupation on the host. Although this species has been reared from such foreign substrates as a dry inflorescence stalk of *Yucca whipplei,* I found several cocoons in late summer in tightly folded leaves of the host plant, in shelters similar to those of the larvae. A number of reports in the literature have indicated that larvae bore into substrates such as soft bark. For example, larvae of *E. macelhosiella* were observed to "bore into sound bark, chewing their way with the mandibles and leaving the chips behind" (Busck and Heinrich, 1922). As a result, microlepidopterists have often provided woody substrates in rearing these moths, and successful pupation has been obtained in bark of cork elm (Busck and Heinrich, 1922; Braun, in litt.) and inflorescence stalk pith of *Yucca whipplei* (Powell, 1971). In my experience larvae usually used abandoned beetle burrows or other cavities in the yucca blocks, perhaps modifying them somewhat by gnawing, rather than boring directly into sound pith.

The most striking example of this appropriation of holes was provided by F. D. Parker and D. S. Horning of the University of California, Davis, who reared five species of *Ethmia* (*E. lassenella, E. albistrigella, E. discostrigella, E. semitenebrella, E. monticola*), including two or more individuals of three of them, from among some 5,000 trap nests placed in scattered western Nearctic localities during a single season. The traps consisted simply of 18-inch sections of *Sambucus* stems that had been stuck upright into the ground with a $\frac{1}{16}$–$\frac{1}{4}$-inch hole in the exposed end (Parker and Bohart, 1966). Not only is this the largest number of American *Ethmia* species reared in a single season's effort, two of them, *E. lassenella* and *E. monticola,* have never been reared elsewhere and their food plants are unknown. As discussed above, scattered host records for several other species are suspect or have been shown to be misleading as they probably represent pupation sites remote from the true hosts (e.g., *Arctostaphylos* and *Yucca whipplei* for *E. arctostaphylella;* pine for *E. m. fuscipedella*; *Wissadula* for *E. delliella* and *E. bittenella*).

Among Nearctic species groups of *Ethmia,* whether in early season generations of multivoltine species or in univoltine species which diapause as pupae, the cocoon is a dense, tough structure. In open spots, such as the corner of a rearing container, the outer surface is a dense, white, papyrus-like oval cover. Within, cocoons of most species have a loose mesh of strands of silk which apparently aid in anchoring the pupa. The small, diurnal moths appear generally to develop less inner mesh. Under normal circumstances in the

field, the cocoon is tightly affixed to the substrate, preventing access to adverse environmental agents, since it is the pupa that acts as the long resting stage. In the laboratory, pupae invariably succumb to dessication if the cocoon is broken. As discussed below, the pupa differs structurally in the few members of Neotropical species groups where pupae are known. In these groups protection from dessication and other factors may be provided by the heavier pupal integument.

Pupa

Development.—Pupation occurs within 10 to 14 days following cocoon construction in all species for which data are available. Among multivoltine species, the pupation period for a nondiapause generation has been recorded only in *Ethmia arctostaphylella,* where it required 11–13 days under laboratory conditions, including cocoon formation.

All temperate species undergo diapause in the pupa so far as known. In univoltine, spring flying species (e.g., the Albitogata group) pupal diapause usually encompasses about 10 months, whereas in *Ethmia charybdis* and the Macelhosiella group the pupa aestivates, with emergence in late fall, after 6–8 months diapause. Overwintering is accomplished by eggs in this system. In multivoltine temperate species, presumably about 4–6 months are spent in pupal hibernation, although no specific data are available. In some species (e.g., *E. discostrigella*) the life cycle is multivoltine in parts of the range, but may be bivoltine or even univoltine at stations characterized by shorter growing season. Thus, when I reared *E. discostrigella* originating from eggs deposited in June at 10,000 feet in eastern California, pupation lasted 8–9 months, and probably emergence occurred prematurely relative to that in the field. By contrast, near the coast in California this species flies during 7–8 months each season.

Facultative diapause in the pupa may take place in *E. semilugens* and other species associated with xeric habitats. This is suggested by the flight records for several species, and when we reared *E. semilugens* from mature larvae collected in May, a few moths emerged after about 6 weeks pupation, while others did not. In this case the remaining individuals failed to develop, even though the pupae were exposed to outdoor shed conditions, and pupae were still living after 16 months.

Facultative delay of two or more seasons may be a widespread mechanism by which ethmiids cope with environmental conditions, particularly in areas of long seasonal drought. In Europe de Joannis (1926) recorded second year hibernation in the pupa of *Ethmia decemguttella* (Hübner). Larvae collected in September produced adults in June the next season and again in June the following year. During my studies pupae of several species (e.g., *E. plagiobothrae, E. scylla, E. semilugens*) remained in viable-appearing condition after 16–24 months, but second year emergence did not occur in these instances.

There was convincing evidence that at least some species (e.g., *E. plagiobothrae, E. charybdis, E. timberlakei, E. discostrigella*) are not affected by photoperiod during pupal diapause, with emergence of adults at or near normal seasonal timing from pupae stored in darkness. For *E. plagiobothrae* my experiments indicated that temperature and moisture factors stimulate diapause break. However, with *E. timberlakei* and *E. discostrigella* none of the factors were changed. Pupae housed in dry, dark containers at laboratory temperatures of constant daily fluctuation matured, suggesting that diapause break is triggered by stimuli received during larval life. None of my larval rearings were carried out in darkness.

Anchoring mechanisms.—As is the case with all Gelechioidea, pupal shells of ethmiids remain anchored within the cocoon at emergence of the adult. The cremaster as is developed in most Lepidoptera is nonfunctional in all described ethmiid pupae. In its stead anchoring is accomplished for most *Ethmia* by the peculiar "anal legs" (Figures 288–289), ventral extensions of the ninth abdominal segment that project forward and bear numerous stout, hooked setae that become enmeshed in the silk. This structure is known in a variety of Palearctic species and, as is discussed elsewhere in reference to relationships of ethmiids, in certain other gelechioid pupae, notably blastodacnids. The structure appears to have been lost in two separate places in New World ethmiids (in addition to *Pyramidobela*). *Ethmia scylla* has a simple pupa without anal legs, spiracular modification, or

setation (Figure 290). The cocoon possesses two silken caps, one at the surface of the substrate into which the larva tunneled for pupation, and one recessed a few mm, at the anterior end of the pupal chamber. This inner cap appears to be smaller than the diameter of the pupa and the reduced aperture may serve to hold the pupal shell in place.

In Neotropical groups of Section II of *Ethmia,* the few representatives for which pupae are known (*E. confusella, E. longimaculella, E. semiombra*) possess quite different structural modifications. The anal legs are lacking and the overall shape is more robust, with heavier, more rugose integument. Anchoring is accomplished by a bizarre behavioral feat unlike anything recorded elsewhere among Microlepidoptera known to me. I have not seen living material of these species, but preserved specimens exhibit characteristic grasping of the exuvium head capsule or cocoon between the sixth and seventh abdominal segments. Pupae of *E. semiombra*[4] consistently grasped the split larval head capsule in a symmetrical fashion, holding each epicranial lobe near the ventral margin, clamped between the abdominal segments in the same pleural area in several individuals (Plate 20*g-h*). The grip is so secure that either the head capsule or the pupal abdomen must be broken into pieces in order to separate them. Emerged pupal shells of *E. confusella* from Florida show the same grasping inconsistently, suggesting that the abdominal segments are moved and the exuvium is sometimes disengaged during emergence. One pinned pupa of *E. longimaculella* from Ontario has a portion of cocoon material grasped in exactly the same manner.

It appears that cocoons in these species are fragile or fluffy in consistency, without a tough, outer, paper-like layer as is characteristic of all Section I *Ethmia* which I reared (Powell, 1971). It may be that the heavier pupal integument displayed by species with the grasping pupae protects the resting stage from factors such as dessication, a function carried by the cocoon in Nearctic species groups. It is not known if any Neotropical species of Section II undergo diapause as pupae, but *E. longimaculella* is believed to overwinter in the pupa (Braun, 1921b).

The heavy-walled, robust pupa of the above three species also represents the extreme development of the peculiar spiracular pits that are discussed elsewhere. These structures, however, are not unique to the grasping pupae, being present in *E. delliella* and *E. zelleriella,* which have well developed anal legs. The spiracular structures, which are of unknown function, are completely lacking in all representatives of Holarctic and western Nearctic species groups that I have examined (14 species). (See Table 4 and Figures 293, 294.)

Natural Enemies

Records of parasites of ethmiids are scarce, in part because there have been generally few species reared, and in part because none of the species are of appreciable economic concern to man. Thus Thompson (1945) lists only five records, two Tachinidae, two Ichneumonidae, and one braconid, from five species of *Ethmia,* in Europe, India, and Hawaii.

Although most of my rearing in California was carried out with material originating as eggs from caged females and therefore unavailable to parasitism, two genera of Braconidae, *Apanteles* and *Microgaster,* were encountered in field collections of late instar larvae (Powell, 1971). One of the *Microgaster* species was obtained at three widely scattered localities from the same host, *Ethmia arctostaphylella.*

The Hawaiian species *Ethmia nigroapicella* (Saalmüller) (=*colonella* Walsingham) has attracted some attention as a repeated defoliator of ornamental *Cordia* in gardens (Swezey, 1944, 1947). In this connection, a braconid, *Apanteles marginiventris* (Cresson), introduced from the United States in 1942 as a biological control agent, has been reared from the ethmiid (Beardsley, 1961).

Late instar larvae in field collections of three California species, *Ethmia albitogata, E. plagiobothrae,* and *E. charybdis,* repeatedly fell victim to disease epidemic under laboratory conditions, whereas this never occurred with other species housed in comparable conditions (Powell, 1971). The disease was caused by a bacterium, *Pseudomonas* sp. It was assumed that the epidemics were brought on by rearing conditions, since the inci-

[4] Deposited in the U.S. National Museum and associated with reared adults. Presumably they were placed in alcohol when alive, in 1938 and 1941.

dence was lower when larvae were isolated in separate containers; but the frequency of occurrence in these three species indicates their body flora differs from that of most *Ethmia*. Although similarly affected larvae were not observed in the field, it may be significant that larvae of these species are more easily found in high numerical density than the adults, whereas the reverse is true with other *Ethmia* I have studied.

Geographical Distribution

Worldwide Fauna

Consisting essentially of the one large genus *Ethmia*, the family is distributed throughout Temperate and Tropical regions of the world, being about equally well represented in both Old and New World. The majority of described species occur in the Northern Hemisphere, with about two-thirds of the Old World total represented in the Palearctic fauna of 76 species, and more than four-fifths of the New World species occurring in North America and Central America. Most likely this discrepancy will diminish as our knowledge of southern faunas increases, particularly those of Africa and South America, judging from the number of recent discoveries in such areas as Madagascar and southern Brazil.

The center of greatest diversity appears to be the northern Neotropical region, with some 60 species in southern Mexico and Central America, representing an array of species groups which is more diverse than contained in all the Old World fauna, in terms of morphological radiation. The African, Indo-Malayan, and Australian regions are, by contrast, about equally represented in described species and are rather uniform in morphological diversity. There are a few species known from Oceanic islands, and they appear to have Indo-Malayan and Philippine origins. The one species described from Hawaii probably is of recent introduction, as it has been placed in synonymy with *E. nigroapicella* (Saalmüller), a widespread southeast Asian and Oceanic species which was originally described from Madagascar (Sattler, 1967).

New World Fauna

Centers of distribution.—A total of 133 species is described, 7 being in *Pyramidobela*, 125 in *Ethmia*, and 1 in *Pseudethmia*, and these occur in four general centers of distribution: Nearctic (48 species), northern Neotropical mainland (60 species), Caribbean islands (21 species), and a lesser center (probably poorly known) in temperate South America (17 species). No species are recorded north of about 55° N lat. or south of 39° S lat. Other areas which the group has evidently failed to invade to any extent include the Mississippi Valley and midwestern Nearctic Prairie; the tropical wet lowlands, of British Honduras and southward in eastern coastal Central America, the Guyanas and Amazon Basin; the Andes; and the Chilean desert.

Within each of the broad areas of concentration, radiation in subregions is responsible for most of the species total. The eastern Nearctic has a depauperate fauna with only 5 species east of the Mississippi Valley, while 47 of 48 Nearctic species occur in the southwest (including Colorado, Texas, and Nueva Leon). California alone has 21 species, or 45 percent of the native Nearctic fauna (in addition to *Pyramidobela angelarum*, presumed to be introduced). Among these, seven species occur within a few miles of one another in the Hamilton Range of central coastal California. In the West Indies, 20 of 21 species occur in the Greater Antilles, with 15 on Cuba, 11 on Jamaica, 7 on Hispaniola, and 6 on Puerto Rico. The area of greatest species diversity is in the northern Neotropical region, with 48 species in the lowlands of Mexico, 22 of which occur in the Veracruz-Yucatan region. Of these, 13 have been recorded at Chichen Itza, Yucatan, by E. C. Welling. The Sinaloan thornforest area is the third richest in species diversity, with 18; of these, 14 have been collected in the vicinity of Mazatlan.

Widespread species.—Although most species are either poorly known or are known to occupy relatively restricted ranges, a few are widespread. Thus *Ethmia discostrigella* occurs throughout the foothills and intermediate elevations of the Great Basin ranges and Rocky Mountains from northeastern Oregon to northern Baja California, Chihuahua, and Nueva Leon, from about 25° to 45° N lat. *Ethmia albicostella*, a more boreal species, ranges from 24° to 55° N lat. in a narrow belt along the Rocky Mountain and Sierra Madre Occidental cordillera. *Ethmia hodgesella*, an austral species, is a

resident of a disjunct area extending from southern California to Sinaloa and from southern Texas to eastern Oaxaca, a range encompassing 99–117° W long. and 18–34° N lat. *Ethmia confusella* is primarily Antillean, occurring on Trinidad, the lesser Antilles, Bahama Islands, Florida Keys, Greater Antilles, to the Yucatan Peninsula. Probably the most widespread American ethmiid is *E. exornata,* which ranges from Sinaloa to southern Brazil, but not into the Antilles. Although its distribution is not well defined in South America, the total range extends from 52° to 106° W long. and 23° N lat. to 27° S lat.!

ENDEMISM.—Relatively narrow ranges are the rule for most species. Of course the incomplete state of knowledge, especially for the Neotropical fauna, emphasizes apparent restrictions of distributions. However, comparing major geographical areas (Table 6), one finds a high degree of endemism, suggesting that even though most species may occur rather widely within a biogeographical region, few cross from one to another as in the examples of *E. hodgesella, E. exornata,* and *E. confusella.*

Moreover, within these zones there are indications of narrow endemics in areas which have been relatively well sampled. For example, 10 of 21 species native in California are endemic there, and each is known from a restricted part of the state; 3 others have been collected only at boreal stations in Colorado. Among 21 Antillean species, 9 have been recorded from only one of the larger islands and another is endemic to the lesser Antilles so far as known.

Employing the same geographical subdivisions defined in Table 6, restriction of species' ranges can be further illustrated by comparing pairs of regions in terms of species common to both, species differential, and percent relationship (Table 7). This analysis compares species differential (total species not common to both), which is in part a function of the sizes of the faunas, and percent relationship (number of species common to both divided by the total in the smaller of the two), which disregards size differential. Naturally, areas far removed exhibit no relationship, but even in adjacent zones the percent relationship is low (e.g., 2 percent between Nearctic and Neotropical Mexico, 61 percent between Mexico and the rest of Central America, and 30 percent between northern and central South America). Of special significance are the West Indian species, which show a 24 percent relationship to eastern Mexico, but 0 to the Nearctic and only 9 percent (1 species in Trinidad) to northern South America, suggesting that the Antillean fauna had its origin through the Yucatan peninsular avenue.

DISTRIBUTION PATTERNS.—Owing to the paucity of records, especially for Neotropical species, I have attempted no analysis of distribution patterns displayed by individual species. However, by assessing composite patterns exhibited by the largest species groups of *Ethmia* (Maps 1–12)[5] certain generalizations can be proposed.

In keeping with the high species differential between major geographic elements of the New World (Table 7), several groups are either wholly Nearctic or northern Neotropical; in contrast, others combine two or more seemingly distinct areas in terms of species endemism. Thus, six basic patterns of geographical distribution are shown by the 12 species groups (111 species) as follows:

1. Holarctic Boreal Range (Map 1). The Bipunctella group of the Palearctic (Sattler, 1967) is extended into North America not only by the recently introduced *Ethmia bipunctella,* but by three native species which are morphologically similar to Old World representatives. These species occur widely through more northern and high elevation parts of the United States and southern Canada. One species *(E. caliginosella)* has adapted to Arctic-Alpine conditions at 11,000–12,000 feet in Colorado; another, *E. monticola fuscipedella* (which is virtually indistinguishable from an Asian species, *E. cirrhocnemia* Lederer), lives in Steppe or Transition Zone areas of the plains from Manitoba to New Mexico.

2. Eastern Nearctic Range (Map 2). The Hagenella group is a New World derivative without

[5] Each dot and concentric circle on these maps represents the occurrence of one species in a given political entity, regardless of the number of available records for each of the species. Dots are centrally placed among available records within each political entity. Political entities employed are: provinces of Canada and Argentina; states of United States, Mexico, and Brazil; islands of the Caribbean; and countries of Central America and South America except Argentina and Brazil. Almost no attempt was made to define biogeographical zones with the shading which represents the overall range of the group.

TABLE 6.—*Endemism in New World Ethmiid species*

Species	*Nearctic*[1]	*Antilles*[2]	*Neotropical Mexico*[3]	*Central America*	*Northwest South America*[4]	*Central-south South America*[4]
Total	46[6]	21	48	23	11	17
Endemic	45	16	29	5	2	14
Percent Endemic	98	76	60	22	18	82

[1] Includes Sierra Madre Occidental and the Central Mexican plateau to Hidalgo.
[2] Includes the Florida Keys.
[3] Includes Sonoran lowland and east coast lowland to southern Texas.
[4] Includes Trinidad.
[5] Includes the Amazon Basin.
[6] Excludes introduced species

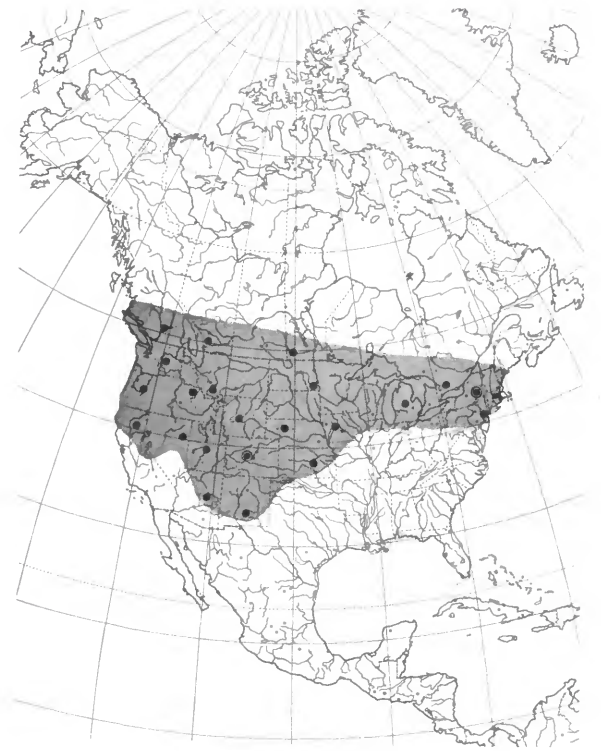
TABLE 7.—*Relationships of Ethmiid species among geographical areas of the New World* (*a*, species common to both; *b*, species differential; *c*, percent relationship)

Species		*Nearctic*	*Antilles*	*Neotropical Mexico*	*Central America*	*Northwest South America*	*Central-south South America*
Nearctic	*a.*	–	0	1	0	0	0
	b.	–	67	92	69	57	63
	c.	–	0	2	0	0	0
Antilles	*a.*		–	5	1	1	0
	b.		–	59	42	30	38
	c.		–	24	5	9	0
Neotropical Mexico	*a.*			–	14	5	2
	b.			–	44	49	61
	c.			–	61	45	12
Central America	*a.*				–	7	3
	b.				–	20	34
	c.				–	64	18
Northwest South America	*a.*					–	3
	b.					–	19
	c.					–	30
Central-south South America	*a.*						–
	b.						–
	c.						–

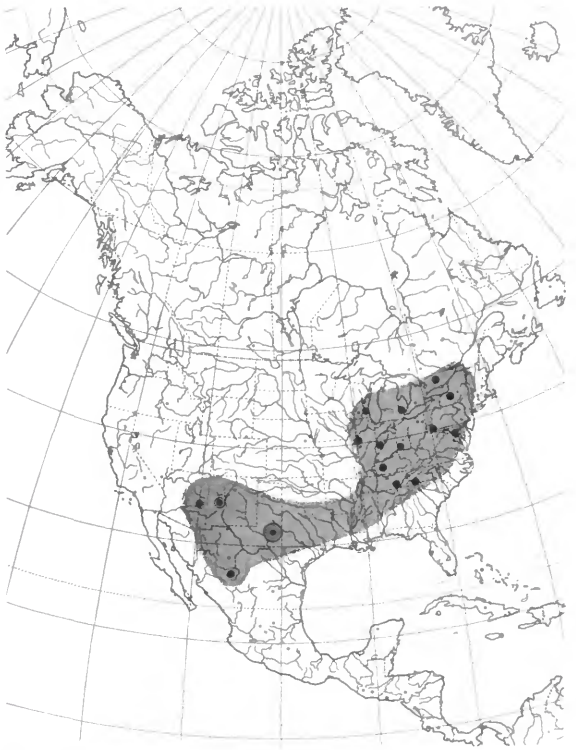
close morphological relationship to any other species group. Its distribution is confined to moderate elevations of the eastern United States and northern Mexico and is disjunct according to available records, with *Ethmia zelleriella* occurring on both sides of the Mississippi Valley.

3. Western Nearctic Austral Range (Maps 3, 4). The Semilugens group (Map 3) occurs throughout the Great Basin ranges and Pacific states, mainly at intermediate elevations. Two species (*E. albistrigella, E. orestella*) have adapted to moderate to high boreal situations. This group apparently could be related to any one of several different Palearctic species groups of Sattler (1967). The Albitogata group (Map 4) occupies a similar range, but in generally more austral situations, having adapted to annual hosts in areas of prolonged dry season.

The Macelhosiella group (Map 5) also represents a specialized line, having employed fall flight



MAP 1.—Concentration of species and distribution of the Holarctic Bipunctella group of *Ethmia* in North America (see footnote 5).



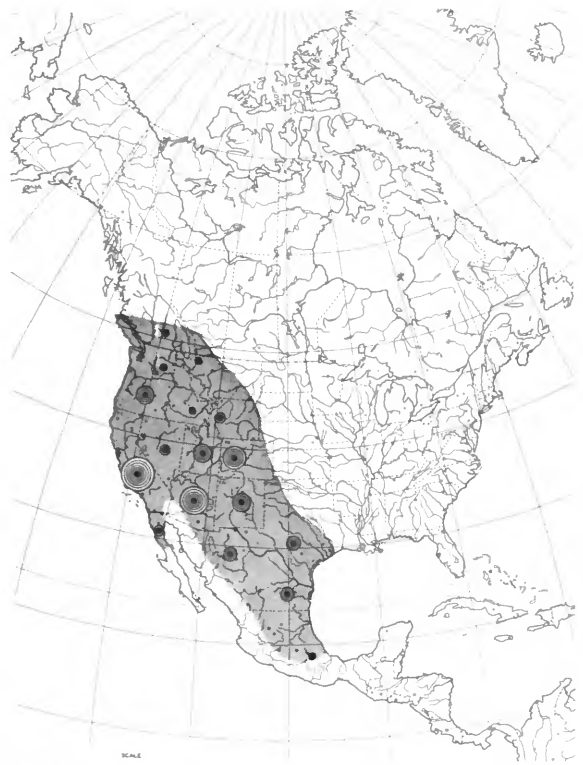
MAP 2.—Concentration of species and distribution of the Hagenella group of *Ethmia* (see footnote 5).

and egg diapause to enable speciation in arid regions of the southwest. However, its distribution is disjunct, with *E. macelhosiella* occurring in the eastern United States, where its flight in October and November in mesic, deciduous forest situations is an anomaly. Thus, the group may have originally had affinity with either of the foregoing Nearctic range types, its two present elements representing post-glacial refugia.

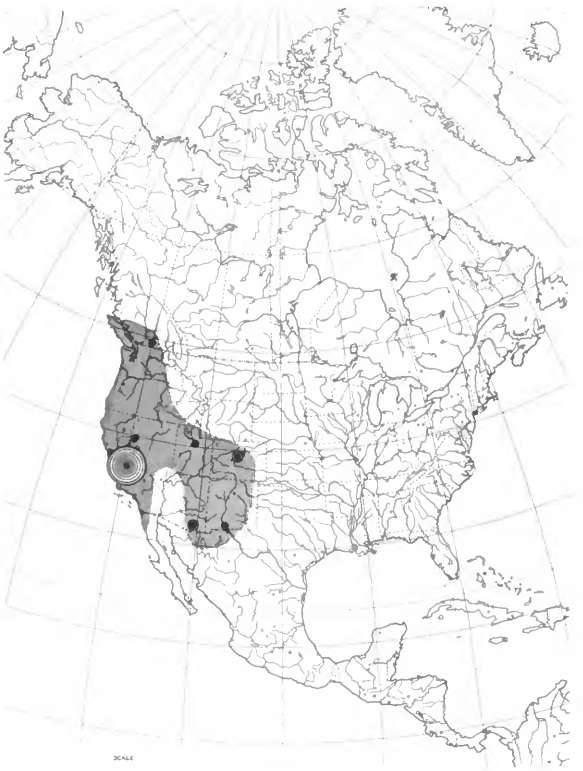
The low deserts of California, Arizona, and northwestern Mexico have not been invaded by any species of *Ethmia*, so far as known, but the monotypic *Pseudethmia protuberans* has evolved to exploit this habitat. As a result, its distribution is essentially allopatric with all of the other Nearctic ethmiid ranges.

4. Nearctic-Austral and Neotropical Scrub-Forest Range (Map 6). The Trifurcella group, with 17 species, has its center of distribution in the Sinaloan coastal region, with isolated species extensions into the southeastern United States, the Great Basin ranges, and the boreal cordillera of the Sierra Madre Occidental and Rocky Mountains. One additional species, *Ethmia oterosella*, which is treated in the systematic section as a marginal member of this group, is endemic to Cuba.

5. Central American-Caribbean Range (Maps 7–9). Corroborating the indication by percent relationships of species (Table 7), seven species groups give strong evidence in support of the supposition that the Caribbean ethmiid fauna is an extension of the Central American. Although 16 of 21 Antillean species are endemic to the islands, all but 2 are members of one of the species groups treated in this and the following range types. The Kirbyi group has five mainland and two Antillean



MAP 3.—Concentration of species and distribution of the Semilugens group of *Ethmia* (see footnote 5).



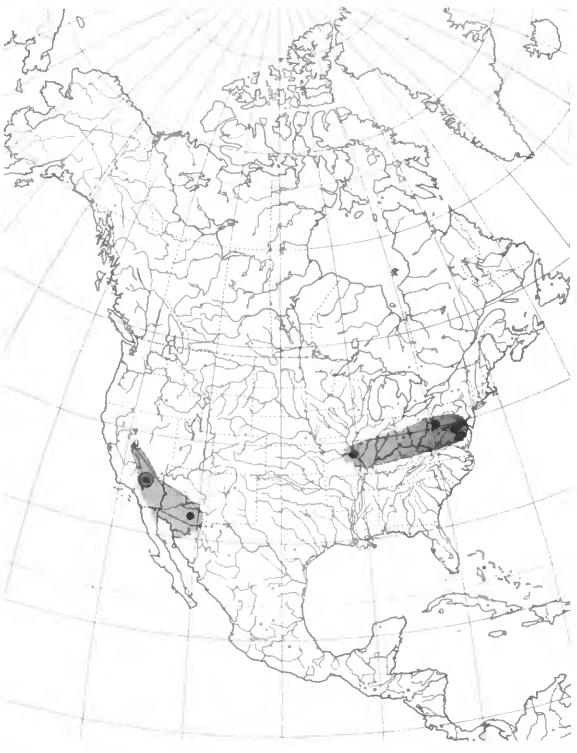
MAP 4.—Concentration of species and distribution of the Albitogata group of *Ethmia* (see footnote 5).

species with none common to both. The Notatella group is more widespread, reaching Baja California, Costa Rica, and the Florida Keys and Bahama Islands. This range is encompassed by four mainland and three island species, including *E. hiramella* in Cuba and *E. paucella* on Hispaniola, each endemic to a single island.

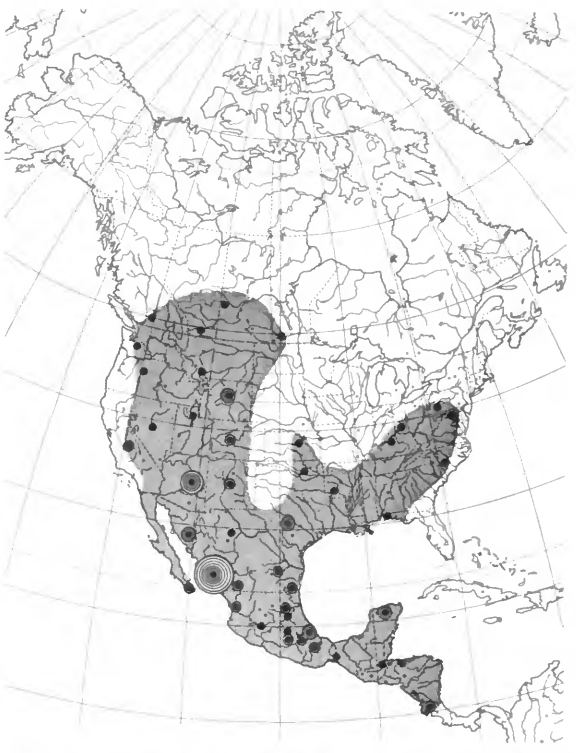
The Confusella group is the most widespread of the three, occupying all of Central America's length and both the Greater and Lesser Antilles. The complex could be more easily conceived as Antillean in origin, with subsequent reinvasion of the mainland, than any other species group, since it consists of three mainland species, three island endemics, and two species which occur both on the Yucatan Peninsula and Cuba.

6. Neotropical Extensive Range (Maps 10–12). The final three species groups, although not closely related to one another, occur throughout similar ranges encompassing Central America from the Sinaloan coast southward, into northwestern South America, the Greater Antilles, and portions of Central-southern South America along the eastern Andes and in southern Brazil. A modification occurs in the Longimaculella group (Map 12), where a single North American species (*Ethmia longimaculella*), itself disjunct, provides a disjunct nature to the group's range. Although absent from the Antilles, this is the most widespread species group among New World Ethmiidae, ranging from 50° N lat. to 27° S lat.

The distribution of *Pyramidobela* is not illustrated, but this genus occupies a territory unlike any of the six foregoing patterns exhibited by *Ethmia*, being disjunct in North and South America and restricted to the Temperate regions excepting two species in southern Mexico. The few records for the four native North American and two South



MAP 5.—Concentration of species and distribution of the Macelhosiella group of *Ethmia* (see footnote 5).

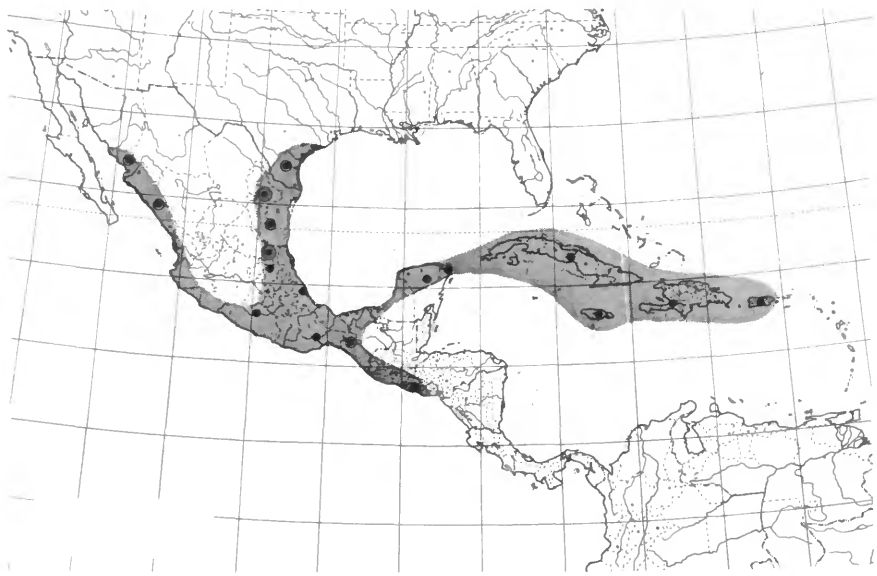


MAP 6.—Concentration of species and distribution of the Trifurcella group of *Ethmia* (see footnote 5).

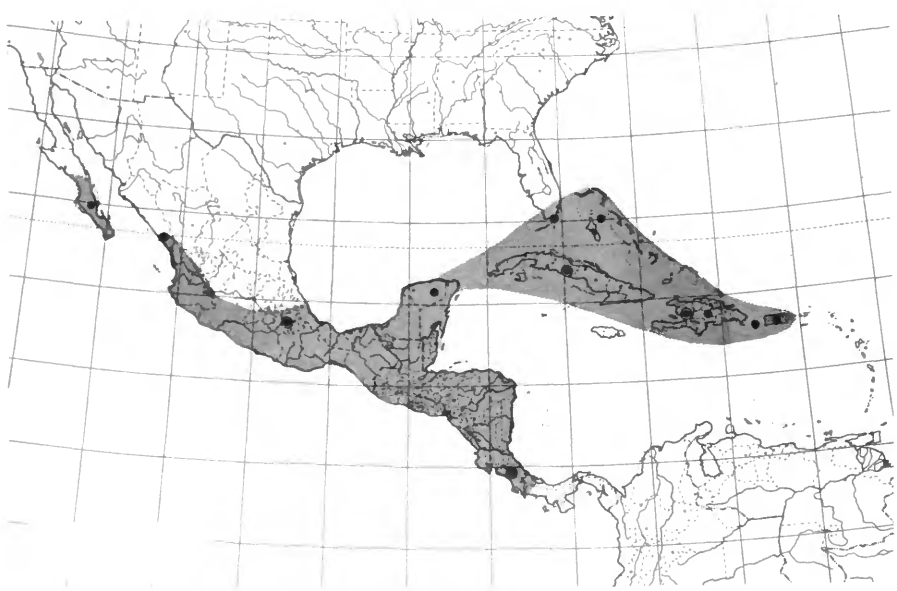
American species preclude interpretation of their geographical distributions, and it may be that the group eventually will prove to be much more extensive in the Neotropical region. One species (*P. angelarum*) is believed to be introduced in coastal California, but its native source is unknown.

BIOGEOGRAPHICAL CORRELATIONS.—The widespread range of *Ethmia* evidently is correlated with the distribution of Boraginaceae. This is a large and diverse plant family of nearly 100 genera and 1,800 species which is equally characteristic of Temperate and Tropical regions (Abrams, 1951; Good, 1964). As outlined in more detail in the host-plant discussion, 15 of 18 Palearctic species for which food plant information is available use Boraginaceae, and most of the few scattered records for *Ethmia* in all three sectors of the tropics are for other genera of borages. By contrast, in the Nearctic the Hydrophyllaceae becomes a dominant element. Here 17 of 20 known *Ethmia* are specific to either Boraginaceae (8 species) or Hydrophyllaceae (9 species). The latter is a moderately large family of about 25 genera and 250–300 species, which is essentially western North American but includes a few species in the eastern United States and South America (Constance, 1951). One small genus (*Hydrolea*) occurs in all three sectors of the tropics (Good, 1964) but has not been recorded as an ethmiid food plant.

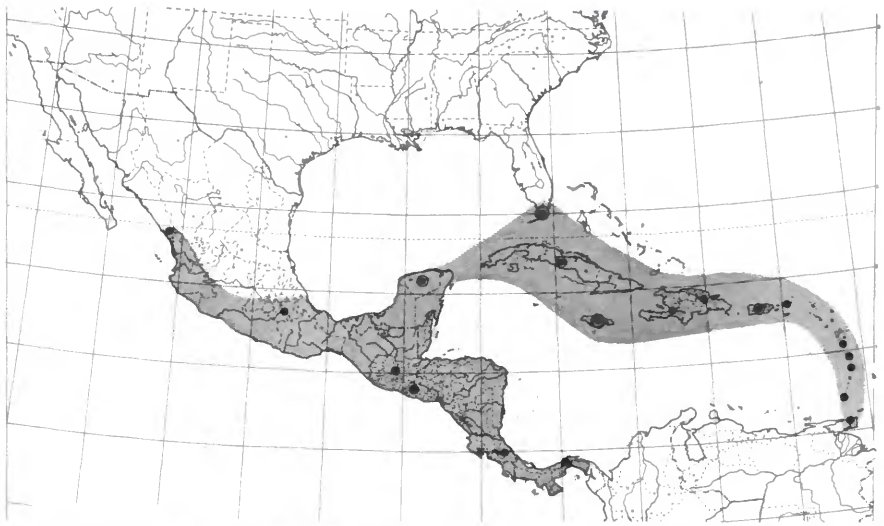
Nearctic species groups display distribution patterns not in relation to those of particular plant taxa, but instead members of each group have adapted to diverse host genera which in general occupy similar ecological situations. Radiation of species, particularly in the southwestern United States, has been accomplished by widespread use of hydrophylls, especially *Phacelia*, by sporadic representatives of various species groups. *Phacelia* is



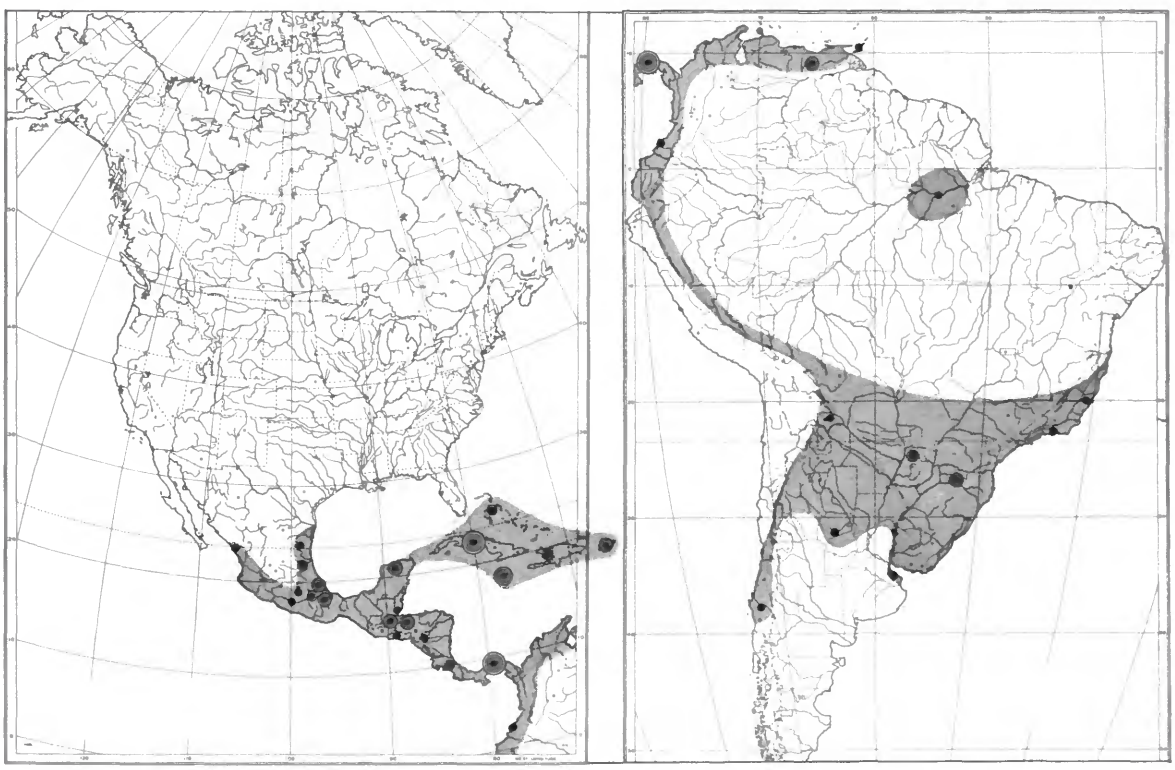
MAP 7.—Concentration of species and distribution of the Kirbyi group of *Ethmia* (see footnote 5).



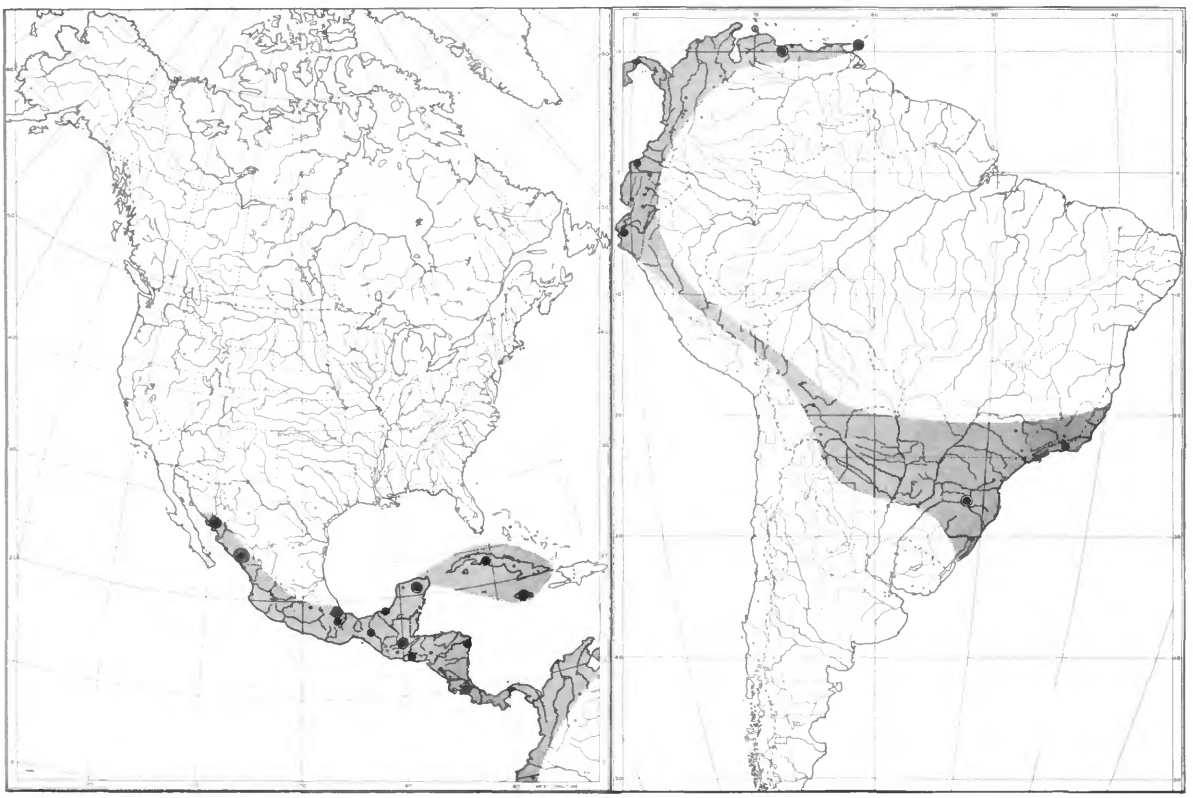
MAP 8.—Concentration of species and distribution of the Notatella group of *Ethmia* (see footnote 5).



MAP 9.—Concentration of species and distribution of the Confusella group of *Ethmia* (see footnote 5).



MAP 10.—Concentration of species and distribution of the Cypraeella group of *Ethmia* (see footnote 5).



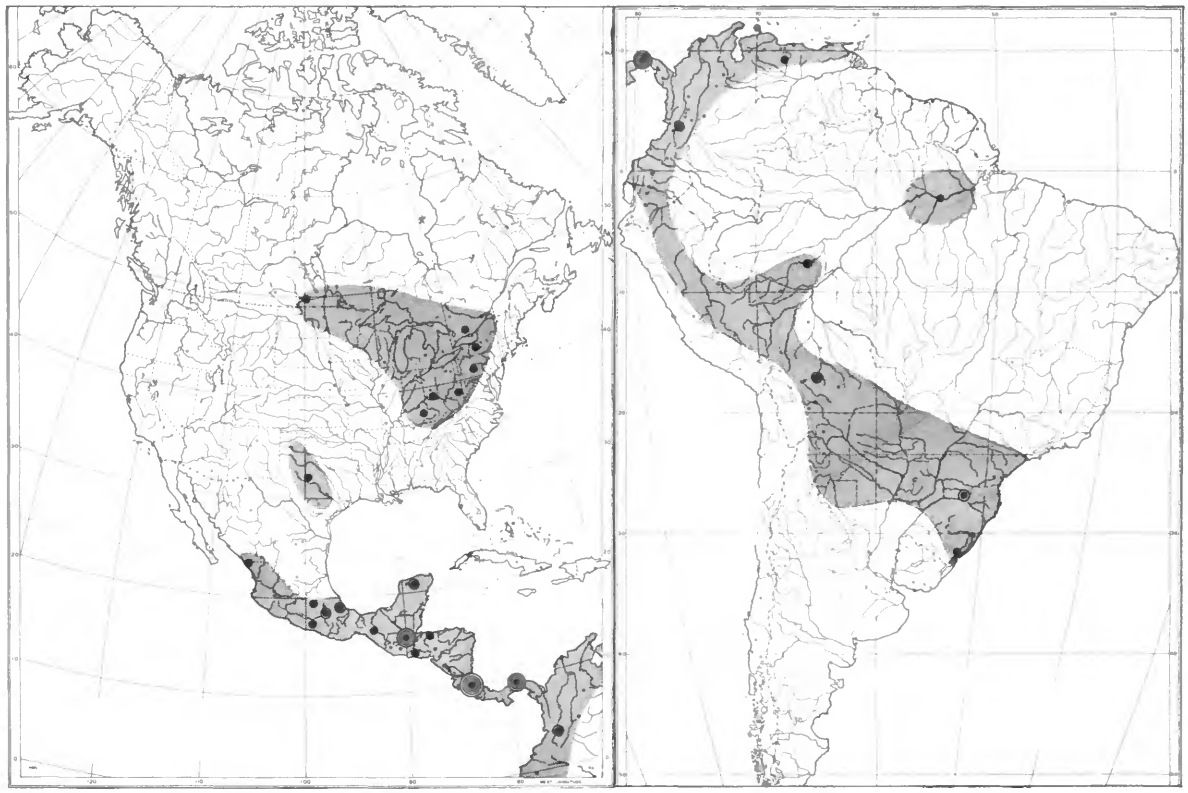
MAP 11.—Concentration of species and distribution of the Exornata group of *Ethmia* (see footnote 5).

a polymorphic genus of annuals and perennials comprising some 150–200 species that occupy a wide range of ecological niches, principally in the western United States and Mexico (Constance, 1951). Thus the Semilugens group (Map 3) lives in generally arid areas at moderate elevations, through use of *Eriodictyon,* a woody hydrophyll (one species), *Cercocarpus,* a woody Rosaceae (two species), perennial *Phacelia* (two species), and annual *Phacelia* (one species). Two members have invaded Hudsonian to Arctic-Alpine Zone habitats in the Rocky Mountains and Sierra Nevada, adapting to diurnal habits to do so. One and probably both members use *Phacelia.*

The Albitogata group (Map 4) is distributed in generally still more arid regions, mostly Transition and Upper Sonoran Zone localities characterized by a long dry season. Speciation has been effected through adaptation to annuals: Boraginaceae (*Amsinckia, Plagiobothrys, Cryptantha*), Hydrophyllaceae (*Phacelia),* and Scrophulariaceae (*Collinsia*). The smaller Nearctic species groups enact similar roles, enabling distributions primarily in high desert areas: Charybdis group (one species using *Amsinckia),* Macelhosiella group (two of four species using *Phacelia*), and Hagenella group (one of four species using *Phacelia*).

The Bipunctella group is restricted in the Nearctic portion of its Holarctic distribution to boreal regions, principally Canadian to Arctic-Alpine Zones, and it may be that it has not adapted to Hydrophyllaceae, with the known species dependent on genera of boreal and mesic habitat Boraginaceae such as *Lithospermum* and *Cynoglossum.*

In tropical regions data are fragmentary, but host associations thus far available indicate that woody Boraginaceae comprise the main host reservoir. Nine *Ethmia* species, representatives of all three sectors of the tropics and tropical Australia have been reared from *Ehretia.* This is a genus



MAP 12.—Concentration of species and distribution of the Longimaculella group of *Ethmia* (see footnote 5).

with most of its species in the Old World, while *Cordia,* which is the host of one widespread Indo-Oriental and Oceanic species, is a genus with most of its species in the New World tropics (Good, 1964). *Bourreria,* another widespread genus of woody borage, is used by *E. confusella* in the Florida Keys and presumably throughout the Caribbean, so that members of these three genera and their shrub and herbaceous relatives such as *Tournefortia* and *Heliotropium,* may act as host plants for much of the northern Neotropical fauna. Moreover, all North American representatives of Neotropical species groups with known hosts (*E. delliella, E. longimaculella, E. albicostella, E. semiombra, E. trifurcella*) feed on Boraginaceae rather than Hydrophyllaceae.

The only other Neotropical host records are two in Cuba for unrelated plants, *Trichilia* (Meliaceae), used by *Ethmia subsimilis,* and *Stegnospermum* (Phytolaceae), used by *E. oterosella.* The former moth is morphologically close to *E. delliella,* which feeds on *Ehretia,* while *E. oterosella* is an island endemic marginally related to the Trifurcella group, North American members of which use *Ehretia, Lithospermum,* and *Cynglossum.* This suggests two possibilities, either that island speciation has resulted in adaptive radiation to unrelated plant types, or that Neotropical species in general have radiated away from specificity to Boraginaceae, perhaps in response to the more heterogeneous nature of plant communities in the tropics. Of course it is probable that at least occasional species in various groups are associated with plants that are unrelated to borages used by their close relatives, as is the case in the Nearctic.

Even though host data are sketchy, biogeographical distribution of Neotropical *Ethmia* is indicated as a fairly strict association with semievergreen and deciduous forest types characterized by seasonal drought. There are few if any species indigenous

to tropical wet lowlands and rain forest zones. Eyre (1968) has classified the seasonal communities of the tropics into four principal types aligned with increasingly more pronounced dry season: semievergreen seasonal forest, deciduous seasonal forest, microphyllous forest (thorn forest), and semidesert scrub. Of these, the thorn forest appears to be the primary home of northern Neotropical *Ethmia*. According to my observations in Sinaloa and Baja California and descriptions of other areas I have received, the four centers of highest species density are typical thorn-forest zones in Mexico: vicinity of Mazatlan, Sinaloa (14 species), Atlixco-Tehuacan area in Puebla (10 species), Merida-Chichen Itza area in Yucatan (13 species), and the area of Galeana, Nueva Leon–Victoria, Tamaulipas (9 species). Certainly the thorn forests of Mexico comprise the center of distribution of the Kirbyi group and the Trifurcella group, the latter being the second largest group in the New World. Moreover, a number of unique spin-off species including *Ethmia mulleri,* and *E. mansita,* and the Papiella and Punctessa groups (two species each) are restricted to thorn-forest areas. Probably the other Caribbean groups (Notatella and Confusella) are also essentially residents of microphyllous seasonal forest communities,, which is true of most of their mainland representatives.

The more southern species groups apparently occupy more diverse habitats, ranging into the tropical semievergreen and deciduous forests of Eyre (1968), at least through Central America and northern South America. The centers of distribution of the Cypraeella and Longimaculella groups appear to be in these zones.

In the subtropical and south temperate parts of South America there are no host records for any of the 17 species of Ethmiidae, most of which are endemic to the region. However, it is noteworthy that there are no South American species groups in *Ethmia*. All are members of Neotropical extensive groups (Maps 10–12), northern representatives of which live for the most part in semievergreen and deciduous forest communities. For the South American species two additional vegetation types appear to be involved, portions of the tropical montane forest in Bolivia and evergreen mixed forest in southern Brazil and Chile. Although there are extensive thorn-forest regions in northeastern Brazil and northern Argentina-Paraguay, there are very few ethmiid records for them, probably due to lack of collecting. Conversely, sampling error has resulted in the best south temperate concentration (seven species), in inland Santa Catarina, Brazil, where Fritz Plaumann has collected for many years. This area, classified as evergreen mixed forest by Eyre, is characterized as a climax mixture of evergreen coniferous (especially *Auricaria*) and broadleafed dominants of intermediate elevations. The species in Brazil are principally endemics related to Central American species, but three species, *Ethmia exornata, E. lichyi,* and *E. mnesicosma,* appear to exist in populations which are disjunct from northwestern South American portions of their ranges. Possibly there are intervening populations along the eastern flank of the Andes at intermediate elevations. Eyre (1968) defines this zone as consisting of submontane (approximately 4,000–6,000 feet elevation) and montane (6,000–12,000 feet), ranging to cloud forests, with *Podocarpus* and *Agathis* as conifer types, but with no one family or type of tree singled out as characteristic. Probably ethmiids are limited to the lower, transition portions of the zone (only one species, *E. sphenisca,* is known from the montane forests of Mexico) or to drier, rain-shadow valleys within the zone. The type locality of *E. exornata,* Chanchamajo, Peru, presumably represents such a record. Two species, *E. catapeltica* from Central America and Venezuela, and *E. chalcogramma* from Santa Catarina, are recorded, apparently in this zone, in Bolivia, in addition to one endemic (*E. hieroglyphica*).

The two species recorded for evergreen mixed forest areas of Chile are *Ethmia elutella* from Panama and Venezuela, and *Pyramidobela compulsa,* an endemic. There are none known in the Chilean cactus shrub and true desert regions to the north. This may be an artifact of collecting, because all genera of Boraginaceae (*Amsinckia, Plagiobothrys,* and *Cryptantha*) used by diurnal *Ethmia* in California also occur in arid parts of western South America (Abrams, 1951) as does *Phacelia* (Constance, 1951).

In all the vast expanse of the Guyanas and Brazilian Amazon Basin, only two species of *Ethmia* are recorded (*E. calumniella* and *E. cypraspis*), both endemic members of widespread species

groups. It is doubtful that many ethmiids exist in this region, judging from the tremendous discrepancy in size of the known faunas of Ethmiidae and Stenomidae there. Nearly 600 species of stenomids are described from the Guyana area alone (Duckworth, 1965, 1969), but not one ethmiid. Since the moths of both groups are comparable in size and appearance (if anything, ethmiids are more colorful) and apparent attractiveness to light, they should be taken by general collectors in any given area without sampling bias. Thus it can be assumed that if *Ethmia* species existed in any numbers in the wet lowlands of northern South America, at least a few should have gotten into the hands of Edward Meyrick during the decades of his descriptive productivity.

No doubt many additional species of *Ethmia* will be discovered in the South American fauna as our knowledge increases, but I expect they will be mainly limited to thorn forest, tropical semievergreen, deciduous, and evergreen mixed forest regions of southern Brazil, Paraguay, northern Argentina, and eastern portions of the Andes.

The Guyana discrepancy between the Ethmiidae and Stenomidae is a focal point of the curious phenomenon that these closely related groups tend to be geographically mutually exclusive, with their centers of abundance in general allopatric throughout the New World. The centers of stenomid species diversity, in the southeastern United States, the wet forests of Central America, and particularly the tropical wet lowlands of northern South America, are depauperate in ethmiids, while arid parts of western North America, the thorn forests of Mexico, and the Antilles, all rich in *Ethmia*, are relatively poorly represented in stenomids. The displacement in general numbers is corroborated by Duckworth's statement (1969) that the number of species of stenomids attracted to light increases as one moves from dry scrub to wet forest conditions in Central America and northern South America, and by my characterization of the principal habitat for *Ethmia* as seasonal forests, especially microphyllous thorn forests, in regions of seasonal drought.

Phylogeny

Any discussion of possible evolutionary relationships in ethmiids must be speculative owing to lack of data. There is no relevant fossil evidence, and definition of ancestral characters is theoretical. By comparison with other Gelechioidea, the following features appear to be derived in Ethmiidae:

Adult: Small eyes and diurnal behavior; reduction of mouthparts; hindwing costal modifications in the male, first the hair pencil, then folding of the membrane; brightly colored abdominal scaling, and secondarily restriction of the colored scaling to the genital segments; development of hoodlike uncus form and strongly dentate gnathos, followed by reduction and loss of uncus and gnathos; divided valva (possibly homologous with so-called segmentation in some other Gelechioidea); development of distal "seta-bunch" and costal "plume" of the valva; short, broad anterior apophyses; spiral ductus bursae; deep crease, "keel-like" signum.

Larva: Secondary setae; crotchets arranged in a mesal penellipse.

Pupa: Loss of caudal cremaster; development of "anal legs"; reduction in number of movable abdominal segments; spiracular pits; condylic grasp of exuvium in anchoring.

The New World ethmiid fauna is composed of three major elements which may not be monophyletic. It is possible that the *Pyramidobela* and *Ethmia* stocks evolved from separate lines of oecophorid-like ancestors. Moreover, within the *Ethmia* branch, American components of one of the two sections show affinities separately to temperate and tropical Old World ethmiids. Hypothetical phylogenetic relationships of the three elements may be characterized as follows.

1. *Pyramidobela.* Many features, but particularly the female genitalia, secondary setae of the larva, and the setaceous pupa with three moveable abdominal segments, indicate this genus has closer relationship to certain oecophorids than to *Ethmia*. Its nearest relatives appear to be *Ectaga* and *Atopotorna*, which are presently assigned to the Oecophoridae, and examination of those groups should shed light on relationships of *Ethmia*.

2. *Ethmia*, Section I. There are two principal series of American species groups, a primarily Nearctic one, which shows strong similarity to the Palearctic fauna, and a Neotropical one, which exhibits affinity to some Old World tropical ethmiids. The Neotropical groups are distinguished by metallic colored scaling, development of hindwing costal

fold in the male, the Sc-R crossvein of the hindwing, and the emarginate distal margin of the valva. In male genital structure and the Sc-R crossvein, members of the Cypraeella group are more similar to Indo-Australian species groups than to any American species. Thus it may be that the Nearctic and Neotropical groups originated separately and migrated to or from the Old World via different routes, rather than as direct descendants from a common ancestor in the New World.

The section includes several species groups which evidently are New World derivatives, and in some ways these lines exhibit greater morphological radiation than has been shown in any other ethmiids. Diurnal behavior (and associated structural changes) and use of annual plants by means of larval preference for seed, in the Albitogata group; and winter activity and reduction of mouthparts in the Macelhosiella and Charybdis groups, with female brachyptery in the latter, must be recent adaptations to Nearctic habitats of prolonged seasonal drought. Similarly, the Hagenella and Notatella groups, showing marked morphological radiation, are seen as comparatively recent specialized tangents.

3. *Ethmia,* Section II, and *Pseudethmia.* Relative to other *Ethmia,* several characters appear to be derivative in this group: loss of uncus and gnathos; development of the distal seta-bunch of the valva; pinch-fold modification of the hindwing in the male; the strong pinaculum of secondary setae on the larval proleg; and in the pupa, reduction of movable segments of the abdomen and condylic grasping as a means of anchoring. None of these features is known in Old World ethmiids. As as result, I envision this series of species to be of New World origin, more recent than the rest of the American ethmiids.

The larger eyes, more elongate labial palpi, elongate apophyses, crotchet arrangement in a circle, and the frail cocoon must be interpreted as secondary developments (in part reversals) in order to render this theory tenable.

The spiracular pits (Figures 293–294) of the pupal abdomen, although of unknown function, offer a clue as to the origin of *Ethmia* Section II. Presence of these structures in a reduced form in the Kirbyi group and their absence from Nearctic groups (and evidently all other Microlepidoptera) suggests that Section II groups are derived from the tropical element of Section I and not directly from the Holarctic ethmiid fauna or from spin-off groups such as the Notatella group, as one might interpret from phenetic evidence based on adults (e.g., see Figure 2).

On the basis of similiarity in male genitalia, it is presumed that *Pseudethmia* is a tertiary development from the Section II ancestral line. Presumably *Pseudethmia* has undergone rapid morphological divergence in external features in response to the rigorous desert environment.

Systematic Treatment

Family ETHMIIDAE

Azinidae Walsingham, 1906:177.
Ethmiidae Busck, 1909a:91.
Ethmiadae Meyrick, 1909:422.
Ethmiinae Remington, 1954:257.

Small to moderately large moths, forewing length 4–18 mm. *Head*: Eyes naked. Ocelli lacking. Pilifers well developed. Proboscis elongate and functional in all but a few species; scaled at base. Maxillary palpus small, 1–4-segmented, usually scaled and folded over base of proboscis. Labial palpus 3-segmented, usually strongly upcurved. Antenna about 0.6 as long as forewing, flagellum with 45–75 segments; ventral half unscaled, covered with short setation; scape (basal segment) sometimes modified in size, shape, and scaling, without pecten. *Forewing*: Moderately broad to narrow, length 2.8–4.8 times width; costa usually evenly curved from base to apex, without fold. Veins, 13 to margin: Sc free, R, M, and Cu stems lost in cell; R with 5 branches, R_{4+5} stalked, R_5 to apex or costa; M and Cu branches about equidistantly spaced, Cu_1 from lower corner of cell or slightly before, Cu_2 from before end of cell; Cu_3 present toward margin only; AN_{1+2} forked basally 0.25–0.45 their length. *Hindwing*: Usually about as broad as forewing. Frenulum a single spur formed of several setae in male, tripartite in female. Veins, 10 to margin: Sc free; R stems combined (Rs), to apex; M branches all separate, M_2 equidistant between M_1 and M_3 or nearer M_1; M_3 and Cu_1 connate or short-stalked, from lower corner of cell; Cu_2 from before end of cell; An_1 moderately to strongly sinuate, separate from An_2. *Male genitalia:* Uncus well developed

or rudimentary; gnathos absent or joined into single median, dentate ridge; tegumen simple, vinculum not extended anteriorly; diaphragma usually with everted lobes ("basal processes") anterior and mesad of base of valvae; valva divided. Aedeagus with strongly recurved phallobase. *Female genitalia:* Papillae anales rotated, with state surfaces laterad, usually sclerotized basally. Ductus bursae often coiled; signum usually a single, invaginated crease, on dorsal half or corpus bursae.

Key to New World Genera of Ethmiidae Based on External Characters

1. Forewing with upraised scale tufts; labial palpus second segment broad (Figure 40) with spreading scales outwardly, third segment much narrower, smooth scaled. ..... ***Pyramidobela*** Braun
   Forewing smooth scaled; labial palpus with second and third segments similar in diameter and vestiture 2
2. Front with a strong, round protuberance, covered by short, differentiated scaling ..... ***Pseudethmia*** Clarke
   Front evenly convex from antennal bases to labrum, scaling not differentiated ..... ***Ethmia*** Hübner

Pyramidobela Braun

Pyramidobela Braun, 1923:118.

TYPE.—*Enicostoma quinquecristata* Braun, 1921; monobasic (North America).

DESCRIPTION.—Moderately small moths, forewing length 7–10 mm. *Head:* Front normal. Maxillary palpus well developed, 4-segmented, lengths subequal, II slightly longer. Labial palpus elongate; segment II much broader than III, with expanding scaling forming a broadly truncate distal margin, segment III thin, tapering to a point; smooth scaled about 0.5–0.9 as long as II. Antenna of male not or only slightly broader than in female. *Forewing*: Narrow, length 3.9–4.8 times width; apex acute, termen strongly angled back, tornal angle not evident. Cu_1 from before, Cu_2 well before corner of cell, both strongly curved near base. Wing surface with strongly upraised scale tufts. *Hindwing*: Costal area not modified in male. Lanceolate, termen very strongly angled back, tornal angle not evident. Vein M_2 slightly nearer to M_1 or equi-

Key to the Species of *Pyramidobela* Based on External Characters

1. Basal and tornal areas of FW whitish, contrasting with dark ground color, dorsal area with a darker triangular patch ..... ***epibryas*** Meyrick
   Basal and tornal areas not contrasting, whole ground either pale or dark 2
2. FW ground color pale, irregularly suffused with brownish, costa blackish from ¼ to ⅔; Chile. ..... ***compulsa*** Meyrick
   FW if pale, costa not blackish; North America 3
3. Larger moth (FW 9.4–9.7 mm); FW pale tan with upraised scale tufts blackish ..... ***tetraphyta*** Meyrick
   Smaller moths (FW 7.2–9.4 mm); FW if pale, scale tufts brownish to ochreous 4
4. FW gray with darker shade diagonally across basal ¼; segment III of labial palpus 0.75–0.90 as long as II; male antenna slightly dilated (0.20 eye diameter) ..... ***angelarum*** Keifer
   FW pale or dark, without dark transverse shade; segment III of labial palpus shorter, 0.55–0.70 as long as II; male antenna not or scarcely dilated (0.15–0.18 eye diameter) 5
5. FW rather broad (3.9–4.3), dark brown with blackish upraised tufts; Nearctic Great Basin. ..... ***quinquecristata*** (Braun)
   FW narrow (4.3–4.6), pale with brown to ochreous upraised tufts; west Texas and Mexico 6
6. Smaller moth (FW 7.2 mm); upraised scale tufts ochreous; male antenna not dilated (0.15 eye diameter). ..... ***ochrolepra*** Powell
   Larger moth (FW 7.5–9.3 mm); scale tufts rusty- to ochreous-brown; male antenna slightly dilated (0.18 eye diameter) ..... ***agyrtodes*** (Meyrick)

distant between M_1 and M_3; M_3 and Cu_1 connate. *Male genitalia*: Uncus and gnathos membranous or rudimentary; valva divided with strongly sclerotized, separated costa tapering to a point (no defined cucullus) and accessory lobe anterior to costa; sacculus well developed. *Female genitalia*: Apophyses elongate; sterigma simple or ornate; antrum not defined; ductus bursae sclerotized, straight; corpus bursae sclerotized on proximal half, separate signa spurlike or not defined.

REMARKS.—As presently defined this is a genus of seven species which occur primarily in temperate zones of North America and South America. Further study will be necessary to define relationships of the South American species (specimens of which were not available during this investigation) to *Atopotorna* Meyrick and *Ectaga* Walsingham, which are currently assigned to the Oecophoridae (see footnote 1).

Pyramidobela quinquecristata (Braun)

FIGURES 47, 174; PLATES 1*a*, 20*b*

Enicostoma quinquecristata Braun, 1921a:11.
Pyramidobela quinquecristata.–Braun, 1923:118.–Keifer, 1936a: 12, pl. 7, fig. 1.—McDunnough, 1939:83.

A species with dark brown forewing in the mountains around the Nearctic Great Basin.

MALE.—Length of forewing 8.2–9.2 mm. *Head*: Labial palpus greatly elongate, not strongly curved, well exceeding crown; second segment slightly curved, length 2.1–2.6 times eye diameter, third slightly curved, 0.58–0.68 as long as second; second segment with broad scale brush (as wide or wider than eye diameter), mixed brown and white with a more or less defined ochreous blotch on ventral half of exterior side; third segment thin, smooth scaled, banded ochreous and dark brown. Antenna not dilated, width of shaft near base about 0.16 eye diameter; scaling dark brown with segmental ochreous bands ventrally. Tongue, maxillary palpus, front, and crown with roughened scaling, brown, frosted with white scale tips. *Thorax:* Dorsal scaling uniform brown to intermixed with blackish brown; lateral brushes of metanotum sparse, elongate, extending over the scarcely scaled scutellum. Underside and legs intermixed brown and white; hind tibial fringe dense, elongate, pale gray-brown. *Forewing*: Narrow, length 3.9–4.2 times width; costa curved on basal half. Fringe broad, beginning well before apex, giving the wing an oval appearance. Ground color dark brown, longitudinally streaked with blackish and ochreous, varying in density and ill-defined except on veins in terminal area; five strongly upraised scale tufts of blackish brown becoming white on their distal edges: two large tufts, just below Cu at basal one-third and at end of cell, three smaller ones above them in costal half of cell, one just above each of the larger tufts, the third between them, slightly lower and nearer to basal one; a dark shade in ground color surrounding tufts. Fringe brown, paler in tornal area. Underside pale brown; fringe darker in apical area. *Hindwing*: Apex narrow, rounded; tornal angle not evident. Ground color pale gray-brown, slightly darker toward apex. Underside similar. *Abdomen*: Scaling pale, shining gray-brown. Genitalia as in Figure 47 (drawn from plesiotype, Tom's Place, California, JAP prep. no. 2601; two preparations examined); extensions of costa and cucullus slightly broader than in other *Pyramidobela,* sacculus with upcurved tip at apex, vesica with a cornutus of two elongate, sclerotized arms.

FEMALE.—Length of forewing 8.8–9.0 mm. External features essentially as in male, palpus size in the small sample available within the range shown by male; forewing apparently slightly narrower, length 4.0–4.3 times width. Genitalia as in Figure 174 (drawn from plesiotype, Tom's Place, California, JAP prep. no. 2333; one preparation examined); sterigma simple, ductus with a relatively short sclerotized sleeve (shorter than anterior apophyses), sclerotized portion of bursa copulatrix with two upcurved and two short, straight internal spurs.

TYPE DATA.—Trail to Dawson Pass, Two Medicine Lake, Glacier National Park, Montana, 5,500 feet, reared from *Penstemon confertus,* emerged August 6–17, 1921 (A. F. Braun); holotype male in Braun collection.

GEOGRAPHICAL DISTRIBUTION.—Mountains around the margins of the Great Basin. In addition to the type locality, *P. quinquecristata* has been taken only at three sites: Seton Lake, British Columbia; in eastern California, near Ravendale, Lassen County; and near Tom's Place, Mono County, California.

FLIGHT PERIOD.—June (British Columbia), August to early September (California, at 8,000 feet elevation).

FOOD PLANT. — *Penstemon* (Scrophulariaceae); Braun (1921a) reared the species from larvae collected in July on *P. confertus,* and we reared it from larvae collected in May on *P. deustus* in Lassen County (P. A. Opler collector).

Pyramidobela angelarum Keifer

FIGURES 40, 41, 46, 172, 173; PLATE 20*d*

Pyramidobela angelarum Keifer, 1936a:13, pl. 5, 7.—McDunnough, 1939:83.—Essig and Hoskins, 1944:31.—Pritchard and Powell, 1959:82.—Tilden, 1959:194.

A moth, known only from urban situations in California, that has gray-brown forewings with a black smudge preceding the upraised tufts.

MALE.—Length of forewing 7.8–9.4 mm. *Head*: Labial palpus variable in length, moderately strongly upturned, exceeding crown; second segment length 1.9–2.3 times eye diameter, slightly curved; third segment 0.75–0.90 as long as second (about 1.7 times eye diameter, not varying with second segment), nearly straight; brush of second segment uniformly broad, mixed pale brown and white, with a few blackish scales at times tending to form a transverse band; third segment smooth scaled, slender, mixed pale brownish and dark, tip dark. Antenna slightly dilated, width of shaft near base about 0.20 eye diameter; scaling dorsally pale brown, ventrally ochreous basally becoming light and dark banded distally. Scaling of tongue, maxillary palpus, front, and crown roughened, pale brown frosted with white scale tips. *Thorax*: Dorsal scaling more or less uniform brown to gray-brown; lateral brushes of metanotum elongate, whitish, covering the scaled scutellum. Underside shining pale gray; legs speckled dark brown; hind leg paler, tibial fringe elongate, dense. *Forewing*: Narrow, length 4.6–4.8 times width; costa gently curved, nearly straight on distal half. Ground color gray-brown, lightly speckled with brown; a variable blackish suffusion diagonally outward across wing at basal one-fourth; five upraised scale tufts of blackish brown: largest on Cu fold (at times with some ochreous scales on its outer side) in the dark suffusion at one-fourth; second tuft just above and before first; third and fourth subequal to second, at middle of cell and outer lower corner of cell; fifth smaller, just above and before fourth, latter three becoming white on their outer margins, at times preceded and emphasized by white scaling; at times some pale streaks angling into fringe around apex. Fringe gray-brown. Underside brown, a pale area in cell near base. *Hindwing*: Costal margin shallowly excavate before apex, tornal angle scarcely evident. Ground color pale gray; fringe gray-brown. Underside similar, speckled blackish in apical area. *Abdomen*: Dorsal scaling pale gray-brown, ventral suffused with dark brown except along midline. Genitalia as in Figure 46 (drawn from plesiotype, Berkeley, JAP prep. no. 2611; five preparations examined); extensions of costa and cucullus slender, of costa attenuated gradually, not strongly turned down (apicad), apex of sacculus strongly upcurved; vesica without defined cornutus.

FEMALE.—Length of forewing 8.4–9.5 mm. External features essentially as described for male; eye apparently slightly smaller but palpus ratio range within that of male; antenna not dilated, width of shaft about 0.15 eye diameter. Genitalia as in Figures 172, 173 (drawn from plesiotypes, Pleasant Hill, Redwood City, JAP prep. nos. 2600, 2791; two preparations examined); sterigma with upturned rims around ostium and at anterior margin, ductus with short sclerotized sleeve (about two-thirds the length of anterior apophyses), sclerotized portion of bursa copulatrix without inner spurs.

TYPE DATA.—Los Angeles, California, reared from larva collected on *Buddleia* (*davidii*?) in April, emerged May 27, 1935; holotype male in California Academy of Sciences.

GEOGRAPHICAL DISTRIBUTION.—Known only from urban situations near the coast in Califronia.

FLIGHT PERIOD.—The species breeds more or less continually, with flight records from late February to early December.

FOOD PLANT.—*Buddleia* (Loganiaceae); Keifer (1936a) described the early stages in detail. The larvae roll and skeletonize the leaves and bore into terminal buds.

REMARKS.—*Pyramidobela angelarum* most likely is introduced into California, since the only known food plant among several rearing records is ornamental *Buddleia,* a primarily tropical genus of both

Old and New Worlds. The moth was established rather widely in cismontane southern California by the time it was recognized in 1935. The earliest record I have seen is March, 1934, at Los Angeles; presumably the species was a resident some years prior to that. Probably it was secondarily introduced into the central coastal part of the State, having been collected at San Jose as early as 1940 and at Santa Cruz in 1947. *P. angelarum* was commonly collected at lights in the San Francisco Bay area during the 1950s but evidently has not been taken in the immediate bay area since 1960, possibly an artifact of sampling since it has been collected east of the Berkeley Hills on several occasions in subsequent years. I have seen no record of its occurrence north of the San Francisco Bay.

Pyramidobela agyrtodes (Meyrick)

FIGURES 48, 176; PLATE 20*c*

Idioptila agyrtodes Meyrick, 1927:344.
Pyramidobela agyrtodes.—Keifer, 1936a:83.—Clarke, 1955a:40; 1965:434, pl. 215.

A small, pale gray moth of western Texas and northern Mexico.

MALE.—Length of forewing 7.5–9.3 mm. *Head*: Labial palpus elongate, moderately upcurved, well exceeding crown; second segment length 2.0–2.3 times eye diameter, slightly curved; third segment 0.55–0.65 as long as second, nearly straight; scale brush of second segment very broad (about 1.5 eye diameter), mixed pale brown and white; third segment smooth scaled, about half obscured by scaling of second, whitish, apex dark. Antenna slightly dilated, width of shaft basally about 0.18 eye diameter; scaling whitish. Scaling of tongue, maxillary palpus, and front white to mixed white and pale brown, crown roughened, mixed white and brownish. *Thorax*: Dorsal and ventral scaling mixed white and pale brown; metathoracic brushes dense, moderately long, extending over the scaled scutellum. Legs mottled with brownish; hind tibial fringe elongate, white. *Forewing*: Narrow, length 4.4–4.6 times width; costa gently curved, appearing slightly concave at middle (owing to fringe). Ground color pale gray, lightly speckled with pale brownish; costal half with scattered ochreous. Five upraised scale tufts, pale ochreous-brown to dark rusty brown, at times emphasized by white scaling on their outer side: first just below Cu fold at basal one-fourth and second at outer, lower corner of cell, large; three smaller tufts in cell, one just above and before each large one, third in middle, equidistant between planes of large and small pairs. Fringe brownish white. Underside pale gray-brown; fringe pale. *Hindwing:* Costal margin slightly excavate before apex, tornal angle not evident. Ground color whitish basally becoming gray-brown toward apex; fringe whitish. Underside whitish, mottled with gray on costal half. *Abdomen*: Dorsal scaling whitish ochreous, ventral white to mixed white and brown. Genitalia as in Figure 48 (drawn from plesiotype, Alpine, Texas, JAP prep. no. 2330; four preparations examined); costa extension slender, evenly tapered, strongly turned down; extension of cucullus slender; sacculus with slightly preapical upturned tip, rather sparsely setate; vesica without defined cornutus.

FEMALE.—Length of forewing 7.4–9.1 mm. Essentially as described for male; labial palpus apparently slightly larger (eye possibly slightly smaller), length of second segment 2.4–2.5 times eye diameter, third 0.65–0.70 as long as second. Scale coloring variable, as in male. Genitalia as in Figure 176 (drawn from plesiotype, Alpine, Texas, JAP prep. no. 2333; three preparations examined); sterigma simple, scarcely sclerotized; sclerotized sleeve of ductus elongate (about 1.1 as long as anterior apophyses), bursa copulatrix with a single, tiny inner spur near juncture of ductus seminalis.

TYPE DATA.—Texas, Alpine, 5,000–8,000 feet, April, May; lectotype male in British Museum, designated by Clarke (1965).

GEOGRAPHICAL DISTRIBUTION.—Extreme western Texas to southern Chihuahua (near Hidalgo del Parral), and Nueva Leon (near Galeana).

FLIGHT PERIOD.—April-May (Texas), July (S Chihuahua), September (N Chihuahua).

FOOD PLANT.—Unknown.

Pyramidobela ochrolepra Powell, new species

FIGURE 50; PLATE 20*f*

A small, pale brown moth from southern Mexico, with three ochreous, upraised scale tufts on the forewing.

MALE.—Length of forewing 7.2 mm. *Head*: Labial palpus elongate, moderately strongly upcurved, ex-

ceeding crown; second segment length 2.1 times eye diameter, slightly curved, third segment about 0.6 as long as second, slightly curved; second segment with broad, distally spreading scale tuft, mixed pale brownish and white, third segment about half obscured by scaling of second, slender, smooth scaled, whitish, dark at apex. Antenna not dilated, width of shaft basally about 0.15 eye diameter; scaling brown dorsally, pale ventrally, becoming ochreous distally. Scaling of tongue, maxillary palpus, front, and crown whitish intermixed with pale brownish. *Thorax*: Dorsal scaling brownish, the scale tips not so broadly white as on head; lateral brushes of metanotum elongate, covering the unscaled scutellum. Underside whitish; legs mottled with brownish; hind tibial fringe moderately short. *Forewing*: Narrow, length about 4.3 times width; costa gently curved, appearing concave at middle (owing to fringe). Ground color brownish white, costal and dorsal areas faintly suffused with darker brown, leaving an ill-defined, whitish clouding longitudinally through middle of wing. Three ochreous, upraised tufts: first largest (about as wide as eye), on Cu fold at basal one-third; second small, of a few scales in middle of cell; third at end of cell, intermediate in size (a fourth tuft of other *Pyramidobela,* just above and before the large one on Cu fold, inconspicuously represented by a few weakly upraised, white scales). Fringe pale brownish. Underside brown; fringe paler. *Hindwing*: Costal margin slightly excavate toward apex, tornal angle not evident. Ground color pale gray; fringe whitish gray. Underside similar, irregularly mottled with brown. *Abdomen*: Scaling shining pale gray with intermixed dark brown on dorsum and venter. Genitalia as in Figure 50 (drawn from holotype, JAP prep. no. 2609; one preparation examined); very similar to *P. tetraphyta,* cucullus extension slightly narrower, sacculus setae larger and more sparsely distributed.

FEMALE.—Unknown.

TYPE.—Holotype male: Mexico, El Sumidero, 15 miles northwest of Tuxtla Gutierrez, Chiapas, August 1, 1957, at light (J. A. Chemsak and B. J. Rannals); unique; in California Academy of Sciences.

REMARKS.—Superficially this moth looks most similar to *P. agyrtodes* among the described species, but the genitalia relate it to *P. tetraphyta.*

Pyramidobela tetraphyta Meyrick

FIGURES 49, 175; PLATE 20*e*

Pyramidobela tetraphyta Meyrick, 1931a:174.—Keifer, 1936a: 12.—Clarke, 1955a:306.

A relatively large, pale, tan moth in central Mexico that has the basal upraised tuft of the forewing blackish.

MALE.—Length of forewing 9.4–9.7 mm. *Head*: Labial palpus presumably as in other *Pyramidobela,* with broadly scaled second segment and smooth-scaled, slender third (lacking from all specimens examined). Antenna very slightly dilated, width of shaft near base about 0.17 eye diameter; scaling whitish tan. Scaling of tongue, maxillary palpus, and front whitish tan, becoming brownish in the roughened crown. *Thorax*: Dorsal scaling pale tan, slightly brownish anteriorly; lateral brushes of metanotum elongate, covering the unscaled scutellum. Underside shining whitish; legs mottled with brown; hind tibial fringe dense, white *Forewing*: Narrow, length 4.4–4.6 times width; costa gently curved, straight toward middle. Ground color pale tan, more or less evenly dusted with brownish, at times tending to form longitudinal streaks on costa and in apical area. Four strongly upraised scale tufts: basal one largest, on Cu fold before one-third, blackish becoming pale tan at its outer side to pale brown becoming whitish outwardly; second tuft much smaller, just above and before first, in cell, blackish to brownish; third subequal to second, at middle of cell, brownish to whitish; fourth at outer, lower corner of cell, intermediate in size, narrowly brownish becoming pale tan to white outwardly. Fringe dark around apex, becoming pale toward tornus. Underside brown; fringe paler. *Hindwing*: Costal margin slightly excavate beyond middle, tornal angle not evident. Ground color pale gray; fringe whitish tan. Underside whitish, rather heavily mottled with brown on costal half. *Abdomen*: Scaling pale tan. Genitalia as in Figure 49 (drawn from lectotype, Real del Monte, AB slide, April 30, 1931, one slide examined); costal extension abruptly attenuated, sacculus broad with apex upcurved, densely set with fine setae; vesica without defined cornutus.

FEMALE.—Length of forewing 10.3 mm. Essentially as described for male in external features (labial palpi missing); antenna not dilated, width of shaft

basally about 0.15 eye diameter (eye possibly slightly smaller than that of male). The one female examined shows no differences in scale color pattern from the range exhibited by male. Genitalia as in Figure 175 (drawn from cotype, Real del Monte, AB slide, April 30, 1931; one slide examined; flattened obliquely and therefore difficult to compare with other species); sterigma without upcurved rims, ductus with moderately long sclerotized sleeve (about equal to length of anterior apophyses), bursa copulatrix apparently without longitudinal folds, with a small knoblike inner projection near juncture of ductus seminalis.

TYPE DATA.—Mexico, Real del Monte, (Van Ostrand); lectotype male, by present designation, is one of two specimens labeled cotype by Busck, among a series of specimens at the U.S. National Museum, which also bears the information that this locality is in Hidalgo.

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality.

FLIGHT PERIOD.—April, September to November.

FOOD PLANT.—Unknown.

REMARKS.—The poor condition of the type series suggests the specimens may be uniformly faded.

Pyramidobela epibryas Meyrick

Pyramidobela epibryas Meyrick, 1931a:88.—Clark, 1955a:128.

A brazilian species with brown forewings having whitish basal suffusion and a dark dorsal triangle; specimens not examined during this study, the following is based on the original description.

MALE.—Unknown.

FEMALE.—Length of forewing about 7.5 mm. *Head*: Light brownish, face white. Labial palpus second segment thickened with slightly rough scales, these forming a small projecting tuft at apex posteriorly, whitish fuscous with three black marks anteriorly, tuft mixed black, terminal segment blackish with white median band. *Thorax*: Fuscous mixed light brown. *Forewing*: Elongate, costa gently arched, apex obtuse, termen obliquely rounded. Ground color dark brown; basal fourth suffused with whitish, some scattered black scales, two or three small blackish spots near base; a triangular blotch of dark fuscous suffusion on dorsum before middle, terminated by a black tuft representing first discal stigma; a black tuft before middle of disc, and some small tufts about this; two black tufts partly white-edged, placed transversely on end of cell; an irregular white patch with scattered blackish scales occupying lower half of wing from end of cell to tornus, leaving a rather broad terminal fascia. Fringe dark fuscous, becoming light grayish on tornal area. *Hindwing*: Gray, light anteriorly; fringe light gray. *Abdomen*: Genitalia not examined.

TYPE DATA.—Brazil, São Paulo, Alto de Serra, October (Dr. H. Zerny); unique type female in Vienna Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality.

FLIGHT PERIOD.—October, a single record.

FOOD PLANT.—Unknown.

Pyramidobela compulsa Meyrick

Pyramidobela compulsa Meyrick, 1931b:399.—Clarke, 1955a:97.

A pale grayish Chilean species which was not examined during the present study. The following is based on the original description.

MALE.—Length of forewing about 9.5 mm. *Head*: Whitish-ochreous, face whitish. Labial palpus second segment ochreous-whitish speckled light brownish, with roughly expanded whitish hairs at apex beneath, terminal segment short, very slender, whitish, a blackish median band. *Thorax*: Pale grayish-ocherous, two blackish marginal dots posteriorly. *Forewing*: Elongate, rather narrow, costa slightly arched (apex injured), termen very obliquely rounded. Ground color whitish ochreous irregularly suffused brownish, darker brown toward median area of costa, a streak of dark fuscous suffusion along costa from one-fourth to two-thirds; stigmata represented by small blackish-gray raised dots, discal remote, plical near and somewhat before first discal, an additional dot before and above first discal. Fringe whitish ochreous tinged brownish. *Hindwing*: Thinly scaled, gray-whitish; fringe ochreous-whitish; veins 5–7 near together, 5 arched upward toward base. *Abdomen*: Genitalia not examined.

FEMALE.—Unknown.

TYPE DATA.—South Chile, Llanquihue Province, Casa Pangue, December; unique male type stated to be in the British Museum but not located by Clarke (1955).

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality.

FLIGHT PERIOD.—December (a single record).

FOOD PLANT.—Unknown.

Ethmia Hübner

Ethmia Hübner, 1819:163.
Psecadia Hübner, 1825:412.[6]
Anesychia Hübner, 1825:413.
Disthymnia Hübner, 1825:413.
Melanoleuca Stephens, 1829:202.
Aedia Duponchel, 1836:305.
Chalybe Duponchel, 1836:343.
Azinis Walker, 1863:541.
Tamarrha Walker, 1864a:816.
Ceratophysetis Meyrick, 1887:1044.
Theoxenia Walsingham, 1887:506.
Babaiaxa Busck, 1902:95.
Wiltshireia Amsel, 1949:317.

TYPE.—*Ethmia pyrausta* Hübner, 1819:163 (not Pallas), [=*aurifluella* Hübner, 1825]; monobasic (Europe) (Figure 74).

DESCRIPTION.—Small to moderately large moths, forewing length 4–18 mm. *Head*: Front normal. Maxillary palpus 1–4-segmented, minute to moderately elongate, scaled and folded over base of proboscis. Labial palpus short to elongate, thin, evenly tapering; segment I short, II elongate, III 0.5 to 1.1 as long as II. Antenna of male often broader than in female. *Forewing*: Moderately broad to narrow, length 2.8–4.2 times width; termen usually not strongly angled back, tornal angle evident. Vein Cu_2 from slightly before lower corner of cell. Smooth scaled. *Hindwing*: Costal area of male often modified: elongate scale brush ("hair-pencil") from base, free or enclosed in costal fold or pinch-fold between Sc and R, rarely with a second hair pencil free of fold. Termen moderately to strongly angled back, tornal angle not always evident. Vein M_2 distinctly nearer to M_1 to slightly nearer M_3; M_3 and Cu_1 short-stalked or connate. *Male genitalia*: Uncus well developed to absent; gnathos well developed to absent; basal processes present; valva divided below costa or before cucullus, without accessory lobe. *Female genitalia*: Apophyses short to elongate, sterigma simple or ornate; antrum absent to well developed; ductus bursae usually membranous, coiled; corpus bursae membranous, signum a crease on dorsal half of bursa.

REMARKS.—A worldwide genus of about 240 described species. There are 125 species described from the New World.

[6] Generic name synonymy from the Old World literature is repeated from Sattler (1967).

Key to the New World Species and Certain Subspecies of *Ethmia*, Based on External Characters

1. Crown strongly produced, bulging the diameter of eye above eye; foretibia densely clothed with long hair (female unknown) ..... ***mulleri*** Busck
   Crown not produced, evenly rounded slightly above eye; tibiae smooth scaled 2
2. Eye small, diameter 0.7–0.8 the height of front (Figure 3) 3
   Eye moderate to large, diameter 0.9–1.2 height of front 15
3. FW pattern divided by a straight, longitudinal line on Cu, dorsal half pale gray, costal half blackish except costa narrowly pale gray ..... ***monachella*** Busck
   FW pattern black with median white longitudinal line or not divided by straight, longitudinal line 4
4. Abdomen with bright yellow scaling, at least ventrally on distal segments 5
   Abdomen white, gray, brown, or black 6
5. Abdomen dorsum entirely yellow except basal segment ..... ***nadia*** Clarke
   Abdomen dorsum black, on at least basal 3–5 segments ..... ***albistrigella*** (Walsingham)
6. Labial palpus shaggy scaled with many interspersed stiff bristles (Plate 1*b*); antenna of male strongly dilated (0.4–0.5 eye diameter) 7
   Labial palpus smooth scaled or roughened, without bristles; male antenna less strongly dilated (0.30–0.35 eye diameter) 9
7. FW with orange or reddish spots at base and end of cell 8
   FW with yellowish or white spots at base and end of cell ..... ***coquillettella*** Busck

8. FW blackish with costa narrowly whitish, a median longitudinal orange streak from base to end of cell ..... ***umbrimarginella*** Busck
   FW including costa blackish, no longitudinal orange streak ..... ***lassenella*** Busck
9. HW of male with costal hair pencil; labial palpus short (II + III segments, 1.4–1.8 eye diameter) 10
   HW of male with costal area simple; labial palpus moderately elongate (II + III 2.2–3.0 eye diameter) 11
10. Moth pale brownish gray; labial palpus very short (II + III 1.4 eye diameter) ..... ***scylla*** Powell
    Moth dark brownish black; labial palpus longer (II + III 1.8 eye diameter) ..... ***brevistriga*** Clarke
11. Larger moth (FW 9.0–10.0 mm) with entirely dark wings; FW with a poorly contrasted but well-defined median longitudinal, paler line ..... ***orestella*** Powell
    Smaller moths (FW 4.3–7.0 mm); median line of FW if present, white 12
12. Small moths (FW 43.–5.0 mm); FW dark with a median, longitudinal white line 13
    Larger moths (W 5.5–7.0 mm); FW with dorsal half mostly white 14
13. HW of male white, of female dark brown ..... ***minuta*** Powell
    HW of male dark brown (female unknown) ..... ***tricula*** Powell
14. Labial palpus moderately elongate (II + III 3.0 eye diameter); FW with pale whitish marking and overscaling more or less uniformly over dorsal half ***albitogata*** Walsingham
    Labial palpus shorter (II + III 2.4–2.6 eye diameter); FW with more contrasting white markings, especially linear spots on Cu fold ..... ***plagiobothrae*** Powell
15. Labial palpus minute, hidden in scaling of head; female brachypterous ... ***charybdis*** Powell
    Labial palpus large, extending at least eye diameter from head scaling; female fully winged 16
16. Moth entirely dark metallic blue ..... ***cyanea*** Walsingham
    Moth not unicolorous; hindwing usually hyaline, FW not entirely metallic blue 17
17. Male with large tufts of fluffy hair under tegulae; FW with large dorsal blotch of metallic bluish margined with olivaceous gray clouding 18
    Male tegulae simple; FW dorsal blotch if present bronzy, purplish, or coppery 19
18. Antennal scape elongate (1.6 eye diameter in male); FW costal area gray, contiguous with bluish blotch on dorsum ..... ***scythropa*** Walsingham
    Antennal scape much shorter (0.7 eye diameter in male); FW with white marking separating dark costal shade and dorsal blotch ..... ***nivosella*** (Walker)
19. Antennal scape enlarged (male 0.9–1.5, female 0.75–1.3 eye diameter); FW white with metallic blue markings; tip of abdomen bright ochreous or red 20
    Antennal scape unmodified (0.5–0.75 eye diameter); FW if white with metallic blue markings, abdomen tip not red or bright ochreous 26
20. Large moth (FW 12.7–16.4 mm) with broad blue FW markings, much broader than eye diameter ..... ***wellingi*** Powell
    Smaller moth (FW 7.0–13.5 mm) markings narrow bands or spots, about eye diameter or less in width 21
21. Male with elongate metathoracic brushes extending alongside basal segments of abdomen; tip of abdomen ochreous; Antilles 22
    Male without metathoracic brushes; tip of abdomen red; Mexico and mainland Central America 24
22. Antennal scape weakly modified (male 0.9, female 0.75 eye diameter); male labial palpus modified, clublike (Plate 2*c*), HW pale yellow ..... ***paucella*** (Walker)
    Antennal scape strongly modified (male 1.4–1.5, female 0.9–1.0 eye diameter); male labial palpus normal, HW white at least basally 23
23. HW of male with specialized ochreous scales on distal half; female with a median peglike protuberance on VIII sternite ..... ***hiramella*** Busck
    HW of male white, without specialized scaling; female without peglike abdominal protuberance ..... ***notatella*** (Walker)
24. HW of male without costal brush; FW markings narrow, less than 0.5 eye diameter in width ..... ***chemsaki*** Powell, 1959
    HW of male with hair pencil, enclosed in pinch-fold between Sc-R; FW markings broader than 0.5 eye diameter 25

25. Labial palpus elongate (II + III 2.5 times eye diameter); FW with complete transverse stripes ..... *zebrata* Powell, 1959
Labial palpus shorter (II + III 1.8–2.1 times eye diameter); transverse markings of distal half of FW broken into spots ..... *phoenicura* Meyrick
26. Dorsum of abdomen pink 27
Dorsum of abdomen yellow, gray, brown, or black 28
27. HW mostly shaded pink; male antenna dilated (0.45 eye diameter); male HW without costal hair pencil ..... *volcanella* Powell
HW mostly gray, anal fringe tinged with pink; male antenna not dilated (0.20 eye diameter); male HW with costal hair pencil ..... *papiella* Powell
28. HW with crossvein between Sc-R beyond end of cell; FW usually with metallic colored scaling in a large middorsal blotch and/or a terminal band (bronzy, purplish, golden, etc.) 29
HW without crossvein between Sc-R; FW usually without metallic colored scaling 56
29. FW white, with dark costal band and scattered dark, longitudinal spots 30
FW if white, with metallic transverse bands or dorsal blotch 31
30. FW with broken black spot pattern, a cluster of spots near tornus; male HW with costal hair pencil, no fold. ..... *bittenella* (Busck)
FW with broad, uniform gray costal brown band, remainder of spotting more or less evenly spaced; male HW with costal hair pencil enclosed in Sc-R pinch-fold ..... *proximella* Busck
31. FW with bluish transverse bands, termen golden 32
FW with large middorsal blotch of metallic color, termen often concolorous 37
32. FW white with narrow, blue-black, more or less evenly spaced transverse bands; Mexico and Central America 33
FW grayish or blue-gray with various darker markings; Antilles 36
33. Male HW with costal hair pencil 34
Male HW without costal hair pencil 35
34. FW transverse bands moderately broad (0.5 eye diameter), mostly complete ..... *delliella* (Fernald)
FW transverse markings thin, broken into spots ..... *clarkei* Powell
35. FW transverse markings broad (0.5 eye diameter), complete ..... *linsdalei* Powell
FW transverse markings thin, broken ..... *davisella* Powell
36. FW pale gray with numerous blue-gray irregular spots ..... *subsimilis* Walsingham
FW whitish with broad costal and dorsal gray-brown markings ..... *kirbyi* (Mocschler)
37. FW broad (2.7–3.0) with bronzy dorsal blotch, blue spots near base and golden termen; male HW without costal hair pencil 38
FW slightly narrower (3.0–3.5), often without basal blue spots and/or golden termen; male HW with costal hair pencil in fold 41
38. FW basal bluish connected to dorsal blotch by a broad dark shade through cell to termen; Antilles ..... *gelidella* (Walker)
FW basad of dorsal blotch white with isolated blue spots; mostly mainland Central and South America 39
39. FW with 0 or 1 blue spot on dorsal half near base. ..... *phylacis* Walsingham
FW with 2 or more blue spots on dorsal half near base 40
40. FW with 2 isolated bluish spots on dorsal half near base. ..... *exornata* (Zeller)
FW with several nearly contiguous blue spots on dorsal half near base ..... *mnesicosma* Meyrick
41. FW bronzy with white spots, no defined dorsal blotch 42
FW pale with metallic spots, including large dorsal blotch 44
42. FW with well-defined, evenly spaced, round, white spots 43
FW with irregular white blotches, especially on dorsal half ..... *epilygella* Powell
43. Large moth (FW 13 mm); (male unknown) ..... *cupreoniwella* (Walsingham)
Smaller moth (FW 11 mm); male antenna not dilated (0.18 eye diameter); (female unknown) ..... *fritillella* Powell
44. Smaller moths (FW 6.3–8.7 mm); genital scaling whitish, concolorous with abdominal venter 45
Larger moths (FW 8.4–13.8 mm); genital scaling ochreous, contrasting with whitish abdominal venter 48

45. FW pale with distinctly margined purplish dorsal blotch 46
FW ground color clouded with dark gray, broadly from costa at middle, contiguous with and obscuring margins of steel-blue dorsal blotch ..... *notomurinella* Powell

46. FW ground color relatively uniform whitish; Antilles. ..... *submissa* Busck
FW ground color clouded with numerous grayish blotches; mainland Central and South America 47

47. Male HW hair pencil ochreous; female HW mostly white; Mexico and northern Central America ..... *janzeni* Powell
Male HW hair pencil gray; female HW mostly grayish; Panama and South America ..... *elutella* Busck

48. Scaling of abdominal II–III terga undifferentiated; male antenna slightly dilated (0.20–0.21 eye diameter) 49
Abdominal terga II–III with differentiated, ochreous scaling; antenna usually more dilated (0.22–0.25 eye diameter) 51

49. Large moths (FW 11.8–13.8 mm); FW without differentiated color band on terminal area 50
Smaller moth (FW 8.2–11.7 mm); FW dorsal blotch coppery, termen golden ochreous ..... *perpulchra* Walsingham

50. FW with broad gray costal band contiguous with purplish coppery dorsal blotch ..... *terpnota* Walsingham
FW with purplish coppery dorsal blotch isolated in white ground color, costa not broadly gray ..... *iridella* Powell

51. FW dorsal blotch well defined, purplish- or reddish-copper 52
FW dorsal blotch if defined, brownish or gray, at times reflecting metallic blue 55

52. FW apical area golden ochreous ..... *phylacops* Powell
FW without golden ochreous markings 53

53. HW mostly brown; male HW hair pencil enclosed in costal fold; male antenna dilated (0.25 eye diameter); Mexico and Central America ..... *ungulatella* Busck
HW white, tinged with brownish or gray toward apex; (male unknown); southern South America 54

54. FW with about 8 evenly scattered gray-brown spots on basal one-third, dorsal blotch bronzy ..... *cypraspis* Meyrick
FW with blackish or gray spots arranged in a longitudinal band from base of costa to termen, dorsal blotch deep coppery ..... *cellicoma* Meyrick

55. FW dorsal area markings brown, reflecting bluish, without coppery streaks ..... *chalcodora* Meyrick
FW pattern obscured by extensive gray-brown suffusion, in part reflecting greenish, basal, and cubital fold with longitudinal coppery streaks ..... *chalcogramma* Powell

56. FW unusually broadened (2.6–2.9), costa strongly arched in distal half, pale yellowish with squarish blue markings ..... *hammella* Busck
FW not broadened distally, costa evenly curved, usually narrower (2.9 or greater), color pattern otherwise 57

57. Small moths (FW 7–10 mm) with FW broad (2.7–3.0), with a large or small ochreous spot toward middle 58
FW mostly narrower, no ochreous spots 60

58. FW with black lines and large, squarish yellow spot on dorsum; mainland Central and South America 59
FW with metallic bluish spots and a small yellow spot on Cu fold; Antilles ..... *abraxasella* (Walker)

59. FW white with black, transverse bands broad, complete (0.5 eye diameter), dorsal spot bright ochreous yellow ..... *festiva* Busck
FW transverse bands thin, distal ones incomplete, dorsal spot pale ochreous ..... *cypraeella* (Zeller)

60. Thorax and abdomen concolorous pale ochreous; labial palpus moderately short (II + III segments 1.5–1.7 eye diameter) 61
Abdomen, if yellow, contrasting with gray thorax; labial palpus usually much longer 65

61. FW gray with more or less evenly scattered black spots ..... *zelleriella* (Chambers)
FW mostly dark on costal half, pale on dorsal half 62

62. FW ground color, HW, body, all pale ochreous ..... ***burnsella*** Powell
FW ground color and HW white, contrasting with yellowish body 63

63. Smaller moth (FW 9–11 mm); FW with costal half uniformly pale brown, paler than adjoining spots in dorsal area. ..... ***hagenella hagenella*** (Zeller)
Larger moths (FW 10.5–12 mm); FW with costal half not uniform, often whitish toward costa, as dark as adjoining spots of dorsal area toward middle 64

64. FW dorsal half with more or less equal-sized, evenly spaced spots ***mimihagenella*** Powell
FW dorsal half with irregular dark blotching toward tornal area ..... ***hagenella josephinella*** Dyar

65. FW narrow (3.7–4.2); grayish 66
FW broad to moderately narrow (3.0–3.7) 73

66. FW pattern divided by a straight line from base to apex; costal half gray, dorsal half whitish; male with HW hair pencil under costal fold. . (part)***albicostella*** (Beutenmüller)
FW pattern not divided by a straight line if gray costal, whitish dorsal; male HW hair pencil either lacking or not enclosed under costal fold 67

67. FW pattern costal gray, dorsal whitish; labial palpus relatively short (II + III segments 1.8 eye diameter). ..... ***epileuca*** Powell, 1959
FW pattern not distinctly costal gray, dorsal whitish; labial palpus segments longer (II + III 2.0–2.4 times eye diameter) 68

68. FW moderately narrow (3.7) with median longitudinal black band; male HW without costal hair pencil ..... ***macelhosiella*** Busck
FW without median black band or narrow (4.0); male HW with costal hair pencil 69

69. Small moths (FW 8.5–9.1 mm); southern Mexico ..... ***mansita*** Busck
Larger moths (FW 9.0–11.0 mm); northern Mexico and U.S. 70

70. FW narrow (4.0–4.2), usually with median longitudinal black line or lines along veins 71
FW slightly broader (3.7–3.8), without black markings. ..... ***angustalatella*** Powell

71. Median black line of FW narrow, distinct, strongly contrasted with whitish ground ..... ***macneilli*** Powell
Median line of FW narrow or broadened, not so dark, poorly contrasted with gray ground 72

72. Median line of FW broadened, indistinctly margined on costal side ..... ***geranella*** Barnes and Busck
Median line of FW narrow, distinctly margined on costal side ..... ***timberlakei*** Powell

73. FW pattern distinctly divided by sinuate or straight line along Cu fold, costal half dark (more or less unicolorous, not strongly mottled or streaked), dorsal half pale 74
FW pattern not distinctly divided, dark costal, pale dorsal (may be divided longitudinally by a dark median band) 97

74. FW costal half gray or black 75
FW costal half brown 83

75. Abdomen yellow, at least ventrally 76
Abdomen gray except genital scaling ochreous ..... ***sphenisca*** Powell

76. Large moth (FW 12.7–15.5 mm); male with HW hair pencil enclosed in Sc-R pinch-fold; southern Mexico. ..... ***coronata*** Walsingham
Mostly smaller moths (FW 8.7–14.0 mm); male with HW costal hair pencil lacking or exposed; northern Mexico and U. S. 77

77. FW ground color and HW dark gray ..... ***monticola emmeli*** Powell
FW ground color and HW pale gray to whitish 78

78. FW with two narrow, inwardly oblique black lines extended into dorsal white on basal half; male HW with brownish or yellow costal hair pencil ..... ***semitenebrella*** Dyar
FW with one or no oblique black lines extended into dorsal white; HW without costal hair pencil 79

79. FW costal half black 80
FW costal half gray 82

80. Abdomen yellow; labial palpus rather short (II + III segments 2.1 times eye diameter); northeastern U.S. ..... ***bipunctella*** (Fabricius)
Abdomen dorsum partly blackish; labial palpus more elongate (2.5–2.9 times eye diameter); western U.S. 81

81. FW dorsal half white, distinctly margined, strongly contrasting with black costal half; male antenna only slightly dilated (0.20 eye diameter) ..... ***semilugens*** (Zeller)
FW dorsal area gray, paler than costal half but not distinctly margined; male antenna strongly dilated (0.26–0.28 eye diameter) ..... (part) ***arctostaphylella*** (Walsingham)

82. FW costal half pale gray with longitudinal black streaks..... ***discostrigella*** (Chambers)
FW costal half pale to dark gray, paler toward costa, no black streaks .....
..... (part) ***arctostaphylella*** (Walsingham)

83. Large (FW 14.5–17.5 mm), heavy bodied moth ..... ***gigantea*** Busck
Smaller moths (FW 5.4–13 mm), not unusually bulky 84

84. Pronotum with 7 dark spots ..... ***heptastica*** Walsingham
Pronotum with 0–5 dark spots 85

85. Moderately large moth (FW 9.2–11.7 mm) with no dark spots on pronotum .....
..... (part) ***semiombra*** Dyar
Small moth (FW 5–8 mm) or pronotum with 5 dark spots 86

86. Genital scaling bright or dark ochreous, distinctly contrasted with remainder of abdomen 87
Genital scaling not distinctly ochreous 94

87. FW pattern divided by a straight, longitudinal line; FW narrower (3.5–3.7) .....
..... (part) ***albicostella*** (Beutenmüller)
FW pattern divided by a sinuate line; FW broader (3.0–3.5) 88

88. Small moth (FW 6.0–7.8 mm); abdominal terga with differentiated, ochreous scaling; pronotum with the 3 posterior spots connected ..... ***hodgesella*** Powell
Mostly larger moths, abdominal terga II + III scaling not differentiated; pronotum with 5 separate spots 89

89. HW whitish ..... ***cordia*** Powell
HW dark brown 90

90. FW costal area blackish brown, extended more than halfway beyond Cu toward dorsal margin ..... ***clava*** Powell
FW costal area brown, not extended more than halfway beyond Cu to dorsal margin 91

91. FW broad (2.9–3.1), dorsal area shaded with grayish; labial palpus shorter (II + III segments 1.3–1.5 times eye diameter) ..... ***scutula*** Powell
FW narrower (3.2–3.5) with dorsal area white; labial palpus more elongate (1.5–1.8 times eye diameter) 92

92. FW usually with ill-defined whitish costal blotch at end of cell, sometimes enclosing a black dot; abdomen tan or pale ochreous; western U.S. and northern Mexico .....
..... ***marmorea*** (Walsingham)
FW costal area unicolorous dark brown; abdomen brown with bright ochreous genital scaling; west coast of Mexico to Costa Rica 93

93. FW pattern with strongly sinuate dividing line, lobes of brown extending more than halfway beyond Cu toward dorsal margin; labial palpus more elongate (II + III segments 2.5–2.8 times eye diameter) ..... ***penthica*** Walsingham
FW pattern usually divided by a less strongly sinuate line, lobes of brown not extending half the distance beyond Cu toward dorsal margin; labial palpus shorter (II + III 2.1–2.5 eye diameter) ..... ***similatella*** Busck

94. Small moths (FW 5.4–8.0 mm) with no dark spots on pronotum; II–III abdominal terga with differentiated, ochreous scaling 95
Mostly larger moths; pronotum with 5–6 dark spots; scaling of II–III abdominal terga not differentiated 96

95. FW costal area brown, dorsal area pale grayish; mainland Mexico ..... ***playa*** Powell
FW colors strongly contrasting, costal half dark brown, darker near Cu; dorsal area whitish; Baja California. ..... ***baja*** Powell

96. Small moth (FW 6.5–7.5 mm); west coast Mexico ..... ***pala*** Powell
Larger moths (FW 7.5–9.8 mm); north central Mexico and U.S. .....
..... (part) ***trifurcella*** (Chambers) and ***mirusella*** (Chambers)

97. FW ground color and HW dark gray; posterior margin of VI sternite with strong concavity 98
FW if dark gray, not concolorous with the paler HW; VI sternite posterior margin straight, without concavity 100

98. Abdomen blackish, at least on basal 3 segments; labial palpus scaling strongly roughened; male antenna dilated (0.26 eye diameter) ..... ***caliginosella*** Busck
Abdomen nearly entirely bright ochreous; labial palpus smooth scaled; male antenna only slightly dilated (0.20–0.22 eye diameter) 99

99. FW narrower (3.4–3.5), markings longitudinal black lines. ..... ***monticola monticola*** (Walsingham)
FW broader (3.2–3.4), markings isolated, small black spots. ..... ***monticola fuscipedella*** (Walsingham)

100. FW basically gray or brownish with a median, longitudinal blackish band 101
FW if gray, longitudinal marks scattered, not concentrated into a median dark band ..107

101. Abdomen yellow; male HW without costal hair pencil. ..... (part) ***arctostaphylella*** (Walsingham)
Abdomen gray or whitish, at least ventrally; male HW with costal hair pencil enclosed in fold 102

102. Small moth (FW 6.7–8.0 mm); labial palpus short (II + III segments 2.0 times eye diameter); male antenna not dilated (0.16 eye diameter); Antilles..... ***oterosella*** Busck
Mostly larger moths with longer labial palpus (II + III 2.4–2.8 times eye diameter); male antenna at least slightly dilated (0.18–0.22 times eye diameter); mainland 103

103. Abdomen yellowish dorsally, whitish ventrally; FW narrower (3.5) with median band obscure ..... ***subnigritaenia*** Powell
Abdomen brownish or gray dorsally, at least terga IV–VII; FW broader (3.1–3.4) with median band strongly contrasting 104

104. Smaller moths (FW 7.6–11.8 mm) with FW white and brown to blackish brown 105
Larger moths (FW 10.4–14.0 mm) with FW gray and black 106

105. Labial palpus shorter (II + III segments 2.4 times eye diameter); female without differentiated scaling on aydominal terga II–III ..... ***trifurcella*** (Chambers) and (part) ***mirusella*** (Chambers)
Labial palpus longer (II + III 2.5–2.7 times eye diameter) ..... (part) ***semiombra*** Dyar

106. Genital scaling ochreous ..... ***nigritaenia*** Powell
Genital scaling grayish, concolorous with rest of abdomen ..... ***omega*** Powell

107. FW white with 2 broad, longitudinal, slightly serpentine, black bars from base and midcosta. ..... ***hieroglyphica*** Powell
FW markings if well defined, small dots or thin streaks 108

108. FW pattern generally grayish or whitish, with many contiguous, longitudinal paler and darker streaks 109
FW white or tan with isolated, darker, distinct or obscure spots 124

109. Abdomen entirely yellow 110
Abdominal scaling gray or whitish, at most genital scaling ochreous 111

110. Labial palpus elongate, with III segment nearly as long as II (each about 1.4 times eye diameter); male HW with hair pencil enclosed in costal fold ***striatella*** Busck
Labial palpus shorter, II segment appreciably longer than III (1.4, 1.0 times eye diameter); HW costal area simple (part) ***discostrigella*** (Chambers)

111. Second abdominal segment laterally with differentiated ochreous scaling, in male forming a pouchlike flap ..... ***lichyi*** Powell
Scaling of second abdominal segment not differentiated, concolorous with rest of pleural areas 112

112. Large, broad winged moths (FW 2.8–3.8); male HW with divided hair pencil, anterior portion exposed, posterior part enclosed in Sc-R pinch-fold 113
Small to large moths, mostly with narrow wings (FW 3.1–3.6); male costal hair pencil absent or entirely within costal fold 114

113. Large moth (FW 10.7–14.0 mm) with broad wings (FW 2.8–2.9); mainland Central America ..... ***baliostola*** Walsingham
Smaller moths (FW 9.0–11.0 mm) with narrower wings (FW 3.1–3.2); Antilles ..... ***cubensis*** Busck

114. Large moth (FW 14.0–15.5 mm); male antenna not dilated (width 0.18 eye diameter) ..... ***transversella*** Busck
Smaller moths (FW 6.5–12.0 mm); male antenna usually slightly to moderately dilated (0.20–0.25) eye diameter) 115

115. Labial palpus III segment length subequal (0.95–1.05) to length of II 116
Labial palpus III segment length appreciably shorter (0.8–0.9) than length of II 121

116. Male HW without hair pencil 117
Male HW with hair pencil enclosed in costal fold 118

117. Small moth (FW 7.0–7.7 mm); II-III abdominal terga with differentiated, ochreous scaling ..... ***confusellastra*** Powell
Larger moth (FW 11.9–13.4 mm); abdominal scaling of basal terga undifferentiated ..... ***duckworthi*** Powell

118. Small moth (FW 6.5–7.0 mm) with narrow wings (FW 3.5–3.6); abdomen unicolorous gray ..... ***farrella*** Powell
Larger moths (FW 8.0–13.0 mm) with broader wings (FW 3.0–3.5); genital scaling ochreous 119

119. FW broad (3.0); male antenna scarcely dilated (width near base 0.19 eye diameter) ..... ***conglobata*** Meyrick
FW narrower (3.1–3.5); male antenna slightly to well dilated (0.20–0.25 eye diameter) 120

120. FW with dorsal area pale, having 2 fairly distinct gray spots near base; male antenna dilated (width 0.25 eye diameter); Antilles and Yucatan ..... ***confusella*** (Walker)
FW with variable pattern, usually without 2 spots in dorsal pale area; male antenna slightly dilated (0.20–0.22 eye diameter); mainland Central and South America ..... (part) ***catapeltica*** Meyrick

121. Antenna of male dilated (0.25 eye diameter); FW ground color white ..... ***plaumanni*** Powell
Antenna of male only slightly dilated (0.20–0.22 eye diameter); FW ground color usually gray 122

122. FW with markings mostly concentrated in costal half; HW of male without external blackish fringe on costal fold; Amazon basin ..... ***calumniella*** Powell
FW usually more or less concolorous in costal and dorsal halves; HW of male with blackish fringe externally on costal fold; northwestern South America and Central America 123

123. FW ground color usually pale grayish; HW of male with external black fringe on costal fold sparse; Central and South America ..... (part) ***catapeltica*** Meyrick
FW ground color dark gray; HW of male with external costal fringe dense, dark; Mexico ..... ***flavicaudata*** Walsingham

124. Large moth (FW 10.2–12.7 mm); abdomen entirely dark ochreous; antenna of male not dilated (width 0.16 eye diameter) ..... ***sandra*** Powell
Mostly smaller moths; abdomen with at most genital scaling ochreous; antenna of male slightly to well dilated (0.19–0.25 eye diameter) 125

125. Labial palpus short (II + III segments 1.4–1.8 times eye diameter); HW of male without hair pencil 126
Labial palpus elongate (II + III about 2.0 or greater times eye diameter); HW of male with hair pencil, usually enclosed in costal fold 128

126. FW broad (3.1); II and III segments of labial palpus equal in length ***prattiella*** Busck
FW narrower (3.4–3.7); II segment of labial palpus longer (1.2–1.9 ×) than III 127

127. FW narrow (3.5–3.7) with short, linear, black markings; labial palpus III segment 0.8 as long as II ..... ***apicipunctella*** (Chambers)
FW broader (3.4–3.5) with a single black dot at end of cell; labial palpus II segment nearly 2 times the length of III ..... ***punctessa*** Powell

128. Small moth (FW 5.4–6.8 mm); labial palpus shorter (II + III segments about 2 times eye diameter); HW of male without fold, hair pencil exposed ..... ***piperella*** Powell
Small to larger moths with elongate labial palpus (II + III segments 2.1–2.6 times eye diameter); HW of male with costal or pinch-fold enclosing hair pencil 129

129. Small moth (FW 5.4–6.7 mm); FW tan with obscure darker spots; antenna of male only slightly dilated (0.19 eye diameter) ..... ***humilis*** Powell
Small to larger moths with FW white or pale gray, markings black, distinct; antenna of male more strongly dilated (0.21–0.26 eye diameter) 130

130. Larger moths (FW 8.6–11.4 mm); labial palpus with II segment more elongate (1.1–1.4) than III 131
Small moths (FW 5.6–7.3 mm); labial palpus with III segment more elongate (1.1) than II 132

131. FW markings broad lines; antenna of male dilated (0.25 eye diameter); Mexico and Central America ..... ***howdeni*** Powell
FW markings thin lines; antenna of male slightly dilated (0.21–0.23 eye diameter); U.S. and Canada ..... ***longimaculella*** (Chambers)
132. Abdominal terga II-III with differentiated ochreous scaling; HW of male with hair pencil enclosed in Sc-R pinch-fold; Lesser Antilles and mainland Neotropical 133
Abdominal terga scaling undifferentiated; HW of male with hair pencil enclosed in costal fold; Greater Antilles and Florida Keys ..... ***julia*** Powell
133. Small moth (FW 5.8–6.7 mm) with slightly narrower FW (3.1–3.4); antenna of male slightly dilated (0.21–0.23 eye diameter); Lesser Antilles ..... ***joviella*** Walsingham
Larger moth (FW 7.0–7.3 mm) with broad FW (3.0); antenna of male strongly dilated (0.26 eye diameter); Central and South America ..... ***linda*** Busck

Section I

ADULT.—Eye small to moderately large (index 0.7–1.0, rarely 1.1). Male with uncus well developed, hoodlike or strongly sclerotized, narrow; gnathos with either posterior or anterior portion, or both, present, joined (single); valva without modified scalelike setae that are bifid apically and differentiated, enlarged, distal setae ("distal setabunch"). Female with posterior apophyses usually short, anterior apophyses short, broad or narrow.

MATURE LARVA.—Head capsule somewhat flattened, not strongly sclerotized (mottled); adfrontal sutures usually reaching or nearly reaching cervical triangle. Secondary setae in SV group: 0–2 on abdominal segments 1, 2, 7, 8; 0–18 on abdominal segment 9; none on abdominal prolegs; 0–3 on anal proleg. Crotchets arranged in a mesal penellipse or mesoseries.

PUPA.—Dorsoventrally flattened; integument smooth, moderately sclerotized. Appendages extending to posterior margin of abdominal segment 5. Segments 6–7 movable by lateral condyles. Anchoring by means of hooked setae on anteriorly directed extensions of the segment 9 ("anal legs").

COCOON.—Dense, opaque, tightly closed; resistant to desiccation.

The Albitogata Group

Eye index 0.7–0.8. Maxillary palpus rudimentary, one or two tiny, subequal segments. Labial palpus short to moderately elongate, II segment index 0.5–1.6, vestiture rough or bristled. Antenna of male dilated, shaft index 0.22–0.40. Forewing moderately broad to narrow; pattern longitudinal, sometimes costal-dorsal, usually with a white spur at end of cell. Hindwing of male with or without costal hair pencil, fold lacking. Genital scaling red, orange, or undifferentiated. Uncus hoodlike, gnathos dentate anteriorly and posteriorly, basal processes membranous, broad or rudimentary, valva, fultura-manica, and vesica without armature. Papillae anales heavily sclerotized, setate or bare; posterior apophyses not elongate; anterior apophyses broad, sterigma simple; antrum not developed; ductus bursae membranous, coils tight or loose, 3–8; signum a dentate bar or lacking.

Small, diurnal, predominantly gray moths which fly in early spring in the western United States, comprising a group of 10 closely related species. The group is similar and possibly closely related to the Rothschildi group of Asia (Sattler, 1967).

THE UMBRIMARGINELLA COMPLEX

The three species which comprise this complex are diurnal moths that differ from all other New World *Ethmia* by having a broad black margin on the whitish hindwing and by their gray forewings bearing basal and discal spots of red, orange, or yellowish. Within the group, the members are too poorly known to allow satisfactory interpretation of variation and species limits.

Two names *E. umbrimarginella* and *E. coquillettella* were proposed by Busck (1907) to accommodate single males from Las Cruces, New Mexico, and Los Angeles, California. The following year he described *E. lassenella* on the basis of a male and female from Redington, Arizona. The three differ in details of wing pattern and genitalia but form a closely knit group of allopatric entities. Drawings of the moths given by Barnes and Busck (1920) depicting obvious differences between individuals of the three are misleading. They are very similar in appearance and genital form. The genitalia preparations from which the Barnes and

Busck (1920) microphotographs were made are so badly flattened that comparison with recent material is difficult. The genitalia show minor differences in gnathos sculpture, breadth of basal processes, etc., but males have not been available in series, so that the scope of individual variation is unknown. Each of five slides examined representing *lassenella* and *coquillettella* differs in some detail. Differences in female genitalia between the two latter are apparent, but again variation has not been assessed.

During the past half century there appear to have been only about a dozen specimens of the group deposited in collections, these representing eight localities, three additional geographical areas, and all three species. Among recent material are specimens from British Columbia that do not differ from southern California *coquillettella* except by their larger size. In contrast, a short series from Pinyon Flat in the San Jacinto Mountains of southern California exhibits similarities to both *coquillettella* and *lassenella*. The red basal and discal spots shown by *lassenella* are yellowish in the Pinyon Flat series, as in *coquillettella*, but the hindwing is almost entirely dark, as in *lassenella*. The series is tentatively referred to *coquillettella*, on the basis of female genital features.

One additional male specimen has been examined (Echo Lake, El Dorado County, California, VII–5–53, W. W. Middlekauff) which is not readily referable to any species because of its poor condition; nearly all the scales are lacking from the forewings. The locality is remote ecologically from any known record for the group; the flight period, which is commensurate with the elevation of Echo Lake (8,000 feet), also represents a marked divergence from other members of the group. In genital features the Echo Lake male differs from all other populations sampled by having a series of thick, finger-like spurs on anterior margin of gnathos, and a somewhat broader basal processes.

The answer as to whether two or more of these entities represent geographical segregates of a single, variable species will have to await the accumulation of additional material.

Ethmia umbrimarginella Busck

PLATE 5*a*

Ethmia umbrimarginella Busck, 1907:94.—Barnes and Busck, 1920. pl. 26, 36.—McDunnough, 1939:82.

A moderately small moth having the dark gray forewing marked by a longitudinal reddish orange line from base nearly to the end of the cell.

MALE.—Length of forewing about 9.5 mm. *Head:* Labial palpus moderately upcurved, rather short, second segment about equal to eye diameter, third segment about two-thirds the length of second, scaling extending well beyond; with elongate, spreading, stiff black hairs, dense at base becoming sparse distally in addition to black scaling. Scaling of antennae and head black. *Thorax:* Collar ochreous; scaling of pronotum and venter including legs deep bluish black. *Forewing:* Length about 3.2 times width; apex blunt, termen not strongly angled back, fringe moderately broad. Ground color dark slate gray; immediate costal edge dirty white to distal one-fourth; a narrow line of bright red-orange from concolorous spot at base, extending outward above cubital fold nearly to end of cell; a short, vertical red-orange bar at end of cell; five velvet black spots as follows: an elongate one on cubital fold in basal one-fourth, a rounded one on fold before middle of wing, a slightly smaller round one at middle of wing in cell, a pair adjoining and emphasizing vertical orange bar at end of cell, preceding and following it. Fringe of ground color. Underside dark gray, costa whitish, broadly clouded with whitish scales in central area. *Hindwing:* About as broad as forewing; costal hair tuft presumably present, not examined; fringe moderately broad, slightly less than one-half membrane width. Ground color white; a broad dark gray margin around apical, terminal, and dorsal areas, ill defined inwardly, produced into central area as a broad lobe along dorsum. Fringe dark gray. Underside similar. *Abdomen:* "Blackish brown" as originally described, subsequently removed. Genitalia figured by Barnes and Busck (1920, pl. 36) similar to *lassenella* and *coquillettella*, apparently differing by a more elongate costal rim of the valva and possibly shorter basal processes.

FEMALE.—Length of forewing 9.7 mm. Essentially as described for male. White of forewing costa extended nearly to apex; basal orange spot smaller. Costal brush of hindwing lacking; gray border of hindwing more diffuse. Abdomen tip scaling orange. Genitalia not examined.

TYPE DATA.—Las Cruces (Mesilla Park), New Mexico, February (T. D. A. Cockerell); holotype male deposited in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Southern Arizona and New Mexico; besides the type, evidently known only from a single female taken at Nogales, Arizona, in quarantine from the Nogales area in February 1959.

FLIGHT PERIOD.—February.

FOOD PLANT.—Unknown; the type specimen was recorded as taken on "Cãnagre" [*Rumex hymenosepalus* Torrey (Polygonaceae)], an illogical host.

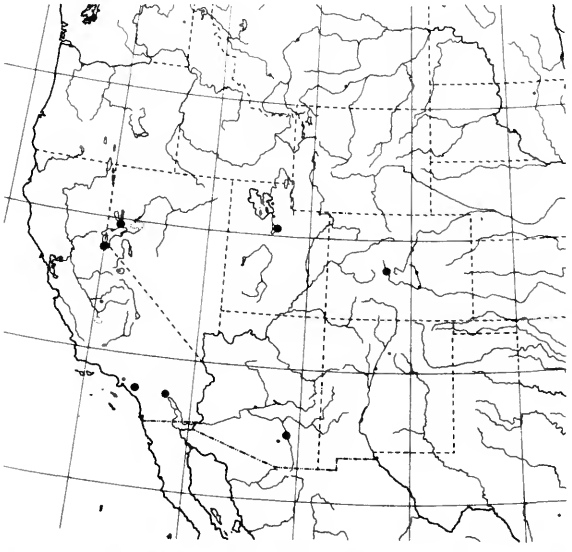
Ethmia lassenella Busck

PLATE 5*b*; MAP 13

Ethmia lassenella Busck, 1908a:92.—Barnes and Busck, 1920, pls. 26, 35.—McDunnough, 1939:82.

A moderately small moth with shining steel gray forewings marked at the base and end of cell with bright red-orange spots.

MALE.—Length of forewing 8.2–8.3 mm. *Head:* Labial palpus moderately strongly upcurved, rather short, second segment 1.0 eye diameter, third segment about 0.5 as long; scaling black, with scattered whitish basally and ventrally, second segment with elongate spreading hairs forming a sparse brush on underside. Antenna dilated; basal segments of shaft about 0.5 eye diameter. Scaling of head black or steel gray, a few whitish scales at occipital margin; a bare area behind eye. *Thorax:* Scaling including legs dark steel gray; femora and tibiae densely clothed with long black and whitish hairs. *Forewing:* Length about 3.3 times width; costa gently curved in distal half to rounded apex, termen an even curve to dorsum, fringe narrow, apical half thus oval in appearance. Ground color steel gray including fringe; two bright red-orange spots, one near base in cell, second one paler, at outer edge of cell, at times becoming whitish at its dorsal edge; five smaller black spots: two on cubital fold, at outer margin of basal orange spot and just before middle of wing, third in upper part of cell at about middle of wing, remaining two preceding and following orange spot at end of cell, adjoining and emphasizing it. Underside dark gray; orange spot at end of cell showing from upperside and reproduced by a few white scales. *Hindwing:* Slightly broader than forewing, attenuate, costa strongly sloping off toward apex, latter acute, tornus not distinguishable; dorsal brush, a thick tuft of elongate pale ochreous hairlike scales arising at base of costa. Ground color white, a broad (about ⅓ wing width), black, moderately well defined marginal band from anal angle to distal one-third of costa, broadest in apical area; costal area under brush mixed white and black. Underside similar; costal area black. *Abdomen:* Scaling entirely dark gray or black. Genitalia similar to *E. coquillettella* (Figure 51) (one Busck slide examined).



MAP 13.—Geographical distribution of *Ethmia lassenella* Busck.

FEMALE.—Length of forewing 7.8–8.0 mm. Essentially as described for male. Labial palpus more elongate, II plus III about 1.9 eye diameter, i.e., 3.2:3.7:2.2. Antenna moderately dilated, width of shaft near base nearly 0.8 that of male. Hindwing costal brush lacking; ground color almost entirely dark gray or blackish, paler basally. Genitalia, one preparation examined Nixon, Nevada; similar to *E. coquillettella,* differing by a broader sterigmal plate which lacks the subtending spurs, a short sclerotized area at base of ductus bursae, and signum with numerous, multiserial spurs projecting into bursa.

TYPE DATA.—Redington, Pima County, Arizona; lectotype female by present designation, in U.S.

National Museum, with the following data: "Redington, Ariz., Ethmia lassenella Bsk., Type ♀." A male with the same locality data formed the basis of the genitalia figure given by Barnes and Busck (1920) from a poorly prepared slide.

GEOGRAPHICAL DISTRIBUTION.—Arizona (Redington, Globe), Nevada (Nixon, Washoe County), and Utah (Provo).

FLIGHT PERIOD.—Mid-March to mid-April.

FOOD PLANT.—Unknown.

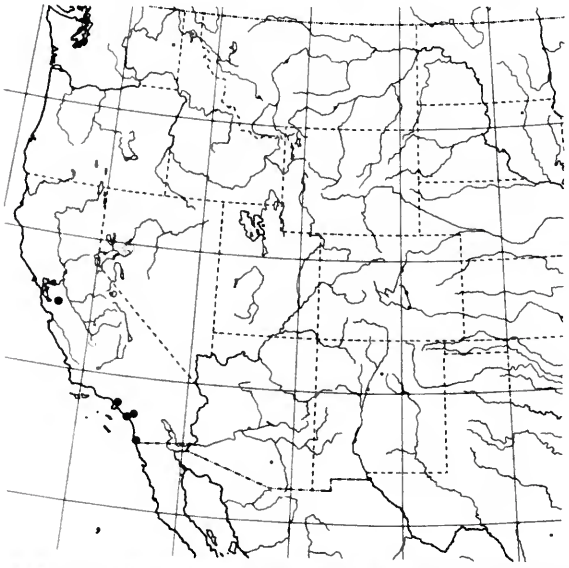
Ethmia coquillettella Busck

FIGURES 3, 12, 13, 42, 51, 177–179; PLATES 1*b*, 5*c–d*; MAP 14

Ethmia coquillettella Busck, 1907:95.—Barnes and Busck, 1920, pls. 26, 34.—McDunnough, 1939:82.—Powell, 1959:135; 1971:8 [biol.].

A moderately small moth having dark gray forewings, with a pale yellow dot at the end of the cell, and white hindwings with a broad black border.

MALE.—Length of forewing 6.5 to 7.7 mm (California), 8.4 mm (British Columbia). *Head:* Labial palpus rather short; second segment length about 1.3 times eye diameter, moderately curved, third segment more than one-half the length of second, straight; underside with a dense brush of spreading, hairlike scales, white at base, black beyond, white at apex of second segment, third segment smooth scaled, black. Antenna dilated, diameter of shaft at basal one-third 0.40 to 0.45 eye diameter; black, a few scales near base dorsally. Scaling of front and crown appressed, black; white at eye margin, base of scape and on occipital margin, spreading and hairlike at latter; a broad, bare rim behind eye, black. *Thorax:* Dorsal scaling smooth, black. Underside clothed with appressed, black scaling and elongate, white hair. Legs black, white at segment apices, metathoracic tibia with well-developed, dorsal fringe, white. *Forewing:* Length 3.5 to 3.8 times width; costa gently curved from base to apex, latter blunt, hidden in broad fringe which also obscures the strongly angled termen, giving a truncate appearance to wing. Ground color including fringe mouse gray or blackish gray (possibly pale with age in collections), sparsely to heavily dusted with whitish. Two pale yellow to yellowish orange marks, the first small, in cell near base, second larger (two-thirds eye diameter), at end of cell. Black marks as follows: an elongate spot just beyond basal yellow mark on lower fold; a larger, oval one on lower fold at basal one-third, fold between the two at times with concentration of white overscaling; an oval spot above lower fold at middle of wing, rarely containing an ochreous-orange dot; an elongate streak through end of cell, interrupted and emphasizing the yellow spot; rarely extended basad to connect with preceding spot in cell. Underside black with whitish scaling along costa, lower fold and dorsal margin, spot at end of cell reproduced, white. *Hindwing:* Slightly broader than forewing. Dorsal hair brush of costa well developed, elongate, cream-white; costa slightly sloping to apex, latter rather acute, termen broadly curved to dorsum. Ground color white, a broad (1/6 to 1/4 membrane width) black border from before apex to anal angle; costal area of hair brush ochreous or gray; hair of anal area black. Fringe entirely black or white distally. Underside similar, a broad gray costal streak. *Abdomen:* Dorsal scaling black, first three terga smooth, velvet-like, underside with a broad median white band, extended laterally at caudal fringes of segments; genital scaling shining white below. Genitalia as in Figure 51 (drawn from plesiotype, Chula Vista, San Diego County, JAP prep. no. 1142; three prepa-



MAP 14.—Geographical distribution of *Ethmia coquillettella* Busck.

rations examined); uncus round, hoodlike, posterior gnathos teeth dense, short, anterior gnathos toothed laterally only or more or less evenly across margin; basal processes broad; valvae narrowed distally.

FEMALE.—Length of forewing 7.3 to 8.0 mm (California), 8.7 mm (British Columbia). Essentially as described for male. Labial palpus slightly longer; antenna scarcely dilated, diameter about one-half that of male; generally less white scaling and hairs on head and body; forewing with little white overscaling (no fresh specimens available); hindwing border broader, the wing about one-half blackish, whitish toward base, black area not well defined as marginal band as in male; abdomen colored as in male. Genitalia as in Figures 177–179 (drawn from plesiotypes, Railroad Canyon, Riverside County, JAP prep. no. 2146, and Del Puerto Canyon, Stanislaus County, JAP prep. no. 2760; four preparations examined); papillae anales heavily sclerotized; anterior apophyses broad, sclerotization of VIII segment variable; sterigma a rather simple, shallow funnel, sclerotized ventrally, subtended by a row of 15 spurs; ductus bursae a loose spiral, entirely membranous; signum a flanged, spurred fold, bearing about five variable, flat teeth projecting into bursa.

TYPE DATA.—Los Angeles, California (D. W. Coquillett); holotype male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Incompletely known; southern and inner central coast range of California; interior British Columbia (Oliver; Keremeos).

FLIGHT PERIOD.—February to April (California); April to May (British Columbia).

FOOD PLANT.—*Phacelia;* possibly *P. distans* and *cicutaria.* Larvae were reared on *Phacelia* from eggs deposited by females taken on flowers of *Coreopsis californica* (Compositae) which was growing near *P. cicutaria* in Railroad Canyon, Riverside County, and on *P. distans* from eggs deposited by females taken flying near this plant at Del Puerto Canyon, Stanislaus County, California (Powell, 1971).

REMARKS.—Specimens from British Columbia are larger than those from southern California, but are not otherwise distinguishable.

Ethmia monachella Busck

PLATE 5*e*

Ethmia monachella Busck, 1910b:53.—Barnes and Busck, 1920, pls. 26, 36.—McDunnough, 1939:82.

A moderately small moth having the pale forewing marked by a broad, well-defined black band from base to apex just below the costa.

MALE.—Length of forewing about 11 mm. *Head:* Labial palpus rather short, moderately upcurved, shaped as in *E. coquillettella,* densely clothed with stiff, spreading, black hairs in addition to scaling, a few on third segment. Scaling of head and antennae black. *Thorax:* Scaling black. Legs black with white annulations; metathoracic legs, originally described as bearing "bright orange tibial tuft," now lacking. *Forewing:* Ground color pale slate gray; a broad, black, evenly and distinctly margined band from base to apex, tapered slightly at the ends, just below costa, leaving a thin costal margin of ground color to distal one-fifth; two small black spots in dorsal area, one at basal fourth just below Cu fold, the other on fold at about middle of wing. A slightly darker grayish shade along dorsal margin from base to tornus, narrowing distally. Apical and terminal margin with a row of black dots. *Hindwing:* Costal brush lacking. Ground color blackish; fringe ochreous. *Abdomen:* Dorsal scaling black, posterior margins of all but first two segments orange. Final two segments removed subsequent to original description; genital scaling described as bright orange. Genitalia figured by Barnes and Busck (1920), similar to *E. lassenella,* but with the uncus deeply cleft as in *E. albitogata.*

FEMALE.—Unknown.

TYPE DATA.—Boulder, Colorado (S. A. Rohwer); holotype male in U.S. National Museum bears the date March 7, 1908.

REMARKS.—This species was described from a unique specimen, has not been recollected, and remains the rarest and in some respects most elegant of the North American Ethmiidae. I predict that when rediscovered it will prove to be a day flier which has escaped notice owing to an early spring flight at any given locality.

Ethmia scylla Powell, new species

FIGURES 52, 290; PLATES 1*d*, 5*f*, 21*a-d*

Ethmia scylla Powell, 1971:12 [*non descr.*, biol.].

A small, grayish brown moth somewhat resembling a pale *E. brevistriga* Clarke.

MALE.—Length of forewing 5.8 to 7.2 mm. *Head:* Labial palpus very short, nearly porrect, second segment length about 0.7 eye diameter; pale brownish exteriorly, whitish at base and interiorly; third segment subequal in length to second; scaling pale brownish, tip white. Antenna shaft moderately dilated (scarcely larger than in female), width of shaft near base about 0.3 eye diameter; densely setate ventrally, scaling dark brown. Scaling of vertex short, erect, roughened in appearance, becoming smooth below crown and on front; dark brown, some whitish scales at lower margins of front and on occipital margin. *Thorax:* Dorsal and ventral scaling pale brownish gray with intermixed white scales; tegula paler; metathoracic leg paler, with well-developed dorsal tibial fringe. *Forewing:* Length about 3.6 times width; termen strongly angled back to dorsum; fringe not as broad, relative to wing length, as in *brevistriga* so that wing not so truncate appearing. Ground color pale grayish brown; clouded and marked by whitish scaling as follows: a rather distinct, broad band along median fold to middle of cell, with distinct, dark indentations on its dorsal side at about its middle and distal end; a distinct white spot at end of cell margined by darker scales; a diffuse blotch on tornus extending up to spot at end of cell; a diffuse whitish area at apex, ending abruptly at midtermen. In well-marked specimens a distinct, curving bar of ground color runs from middorsum through end of cell to termen above tornus, interrupted only by and emphasizing the distinct white spot at end of cell. In some specimens (apparently not always worn) the white scaling is partially to almost entirely lost, leaving the spot at the end of the cell as a solitary marking. Fringe whitish except where curving brown bar meets termen, termen entirely whitish on unmarked specimens, or entirely brownish white. Underside pale brown, the spot at end of cell indistinctly reproduced, whitish along dorsum, a white spot at midtermen in fringe. *Hindwing:* Slightly narrower than forewing; costa sloping gradually to the acute apex, costal brush reduced to a dozen or so ochreous hairs. Ground color gray-brown; fringe whitish with basal brown band. Underside whitish, irregularly blotched with brownish. *Abdomen:* Dorsal scaling black, appressed, velvet-like on first two segments; interspersed brownish and whitish, with roughened appearance beyond. Ventral and genital scaling mostly whitish. Genitalia as in Figure 52 (drawn from paratopotype, JAP prep. no. 1466; three preparations examined); uncus broad, hoodlike, only shallowly notched; gnathos with a few blunt teeth posteriorly, with numerous elongate, curved teeth anteriorly; basal processes short, broad.

FEMALE.—Length of forewing 6.0 to 7.2 mm. Essentially as described for male. Forewing tending to be more heavily overlaid with whitish, the brown areas more well defined. Costal brush of hindwing lacking. Genitalia similar to *E. coquillettella,* the papillae anales not strongly sclerotized; sterigma a shallow funnel subtended by a row of small, weak teeth; ductus with 3 loops; signum broad, not flanged, the fold bearing a row of flat, blunt teeth (3 preparations examined).

TYPES.—Holotype male and allotype female: California, Russelmann Park (north slope of Mount Diablo, 1,100 feet), Contra Costa County, April 2, 1960 (J. Powell) deposited in the California Academy of Sciences. Thirty-six paratypes, all California, as follows: Russelmann Park, 1♂, III–18–59 (J. Powell), 14♂, 4♀, IV–2–60 (J. M. Burns and J. Powell), 9♂, 1♀, IV–6–62 (J. Powell); 3 mi NW Rumsey, Yolo County, 3♂, III–8–64 (J. Powell). Del Puerto Canyon, 20 mi E Patterson, Stanislaus County, 1♂, II–23–63 (R. L. Langston), 6♂, III–5–63 (J. Powell). Deposited in collections of American Museum of Natural History, California Academy of Sciences, British Museum, California Insect Survey, R. L. Langston, and U.S. National Museum.

Subsequent to the above writing, *Ethmia scylla* adults were encountered in large numbers, and the biology studied, at the Del Puerto Canyon locality (Powell, 1971).

FLIGHT PERIOD.—Late February to early April.

FOOD PLANT.—*Collinsia heterophylla* (Scrophulariaceae); the larvae feed in the flowers. The pupa lacks the "anal legs" (Figure 290), presumably a secondary reduction.

Ethmia brevistriga Clarke

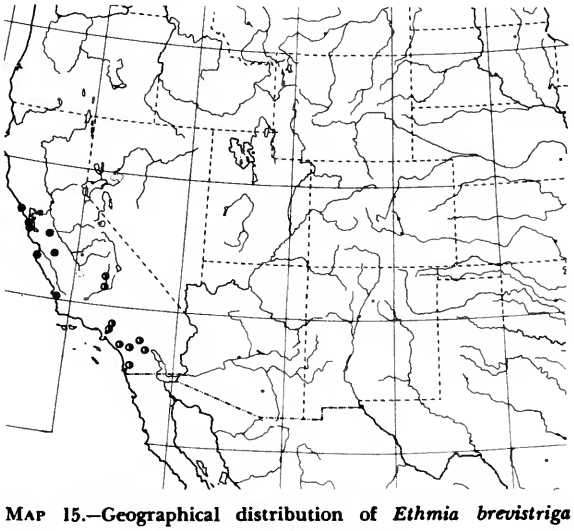
Ethmia brevistriga Clarke, 1950:163.–Powell, 1959:134; 1962: 67 [biol.]; 1971:17 [biol.].

A small, dark moth having the brownish gray forewing mottled with whitish. The typical subspecies, which has more extensive whitish markings, occurs along the immediate coastal strand in central California.

Ethmia brevistriga brevistriga Clarke, new status

FIGURES 53, 180, 181; PLATES 5*g*, 22*a-b*; MAP 15

MALE.—Length of forewing 5.6 to 6.4 mm. Head: Labial palpus short, little upcurved, second segment slightly shorter than eye diameter, only slightly curved, rough scaled whitish below, smooth scaled dark brown above; third segment subequal in length to second, relatively broad and blunt, dark brown with a few scattered white scales. Antenna dilated, shaft diameter near base about one-third eye diameter, setation reduced, dark brown with scattered pale scales. Scaling of front smooth, of crown rather rough, of occipital margin spreading, brownish black with scattered whitish scales, paler along lower margin of front and base of proboscis; a broad white scale tuft below palpus; an unscaled, shining black plate behind eye. *Thorax:* Dorsal scaling brownish black, tegula whitish distally. Underside shaggy in appearance with many spreading hairlike scales, shining pale brownish and whitish; legs darker ventrally, metathoracic leg whitish, tibia with a conspicuous fringe of white hairs along dorsal margin. *Forewing:* Length about 3.5 times width, truncate in appearance owing to broad terminal and tornal fringe. Ground color dark brown; a thin, distinct white line along Cu from base to just before middle of wing, an upturned white mark at end of cell; considerable whitish overscaling (largely lost in worn specimens) as follows: dorsal area below longitudinal white line, a blotch before tornus joined to white line by a curving stripe, costal area on distal half, meeting terminal area whitish above middle. Rather distinct ground color areas are thus defined on fresh specimens above longitudinal white line, continuing outward as a band to just above tornus, interrupted only by the white mark at end of cell, a large round spot on middorsum; all obscure in worn specimens. Fringe of mixed brownish and whitish. Underside brown, some ochreous scaling below cell and along dorsum. Fringe brown with a white spot at midtermen. *Hindwing:* Slightly narrower than forewing; costa excavated in distal half; apex blunt. A pale ochreous, dorsal scale brush arising at base of costa. Ground color dark brown, costal area paler. Fringe broad, equal to one-half the membrane width; pale ochreous with a basal brown band. Underside brown, veins and fringe pale ochreous. *Abdomen:* Dorsal scaling blackish brown, ventral and genital scaling ochreous-brown. Genitalia as in Figure 53 (drawn from plesiotype, San Francisco, JAP prep. no. 1500; five preparations examined); uncus deeply notched; gnathos dentate posteriorly, with roughened lobes anteriorly; basal processes short, broad.



MAP 15.—Geographical distribution of *Ethmia brevistriga* Clarke.
● *E. b. brevistriga* ○ *E. b. aridicola* Powell

FEMALE.—Length of forewing 5.4 to 6.0 mm. Essentially as described for male, but specimens available mostly worn and not showing as much whitish pattern. Antenna shaft about two-thirds as thick as in male. Hindwing without costal scale brush; underside generally paler. Genitalia similar to *E. coquillettella* (Figures 177–179); papillae anales heavily sclerotized basad, more broadly so ventrally; sterigma a simple band, subtended by a lightly sclerotized basal neck of the ductus bursae which bears four or five tiny spurs; ductus bursae entirely membranous with about eight loops in a

loose spiral; signum a narrow fold bearing numerous, variable, scattered flat spurs (Figures 108, 181, drawn from plesiotype San Francisco, JAP prep. no. 2724; two preparations examined).

TYPE DATA.—Bodega Bay, California, May 2, 1937 (E. C. Johnston); holotype male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Immediate coastal areas of central California, from Sonoma County to San Luis Obispo County (Pismo Beach).

FLIGHT PERIOD.—March to mid-May.

HOST PLANT.—*Phacelia distans* Benth. A detailed biology is given elsewhere (Powell, 1971).

Ethmia brevistriga aridicola Powell, new subspecies

Plate 5*h*; MAP 15

Ethmia brevistriga aridicola Powell, 1971:20 [*non descr.*, biol.].

An inland race in California (Map 15) resembling the nominotypic form but differing by partial reduction of the whitish, especially in the costal half of the forewing, giving the wing a bicolored appearance, recalling *E. epileuca*.

MALE.—Length of forewing 4.7 to 5.9 mm. Differing from *E. b. brevistriga* as follows. *Head:* Labial palpus more porrect, smaller, length of second segment about four-fifths eye diameter. Third segment slightly shorter than second; white with scattered dark scales. Scaling of head and thorax generally more whitish. *Forewing:* Slightly narrower, length about 3.7 to 3.8 times width. Ground color darker owing to reduction of the whitish overscaling, especially on costal half; white line on fold extended outward and upward, recurving to meet upturned spot at end of cell, sharply defining the dark costal half (which is nearly black adjoining the white line) from whitish dorsal area; costa without whitish scaling before distal third. Underside paler. *Hindwing:* Underside whitish; costal area ochreous brown.

FEMALE.—Length of forewing 4.9 to 6.0 mm. Essentially as described for male, tending to have the whitish overscaling even more reduced so that some individuals have the costal half of forewing entirely dark, the dorsal whitish reduced to rather distinct markings. Genitalia not distinguishable from *E. b. brevistriga* except by being apparently lighter sclerotized (two preparations examined).

TYPES.—Holotype male: California, 2 mi NE of Lakeside, San Diego County, March 13, 1963 (J. Powell). Allotype female: Pinyon Flat, 16 road mi SW of Palm Desert, Riverside County, April 7, 1963 (J. Powell). Both deposited in the California Academy of Sciences. Ninety-six paratypes: 2 mi NE Lakeside, 11♂, 2♀, III–13–63 (J. A. Chemsak and J. Powell); Pinyon Flat, 42♂, 41♀, IV–(7 to 13)–63 (D. E. Bright, R. L. Langston, J. Powell, G. Tamaki, C. A. Toschi). Deposited in California Academy of Sciences, British Museum, California Insect Survey and U.S. National Museum.

FOOD PLANT.—*Phacelia distans* var. *australis* Brand. A partial biology is given elsewhere (Powell, 1971).

REMARKS.—The following additional specimens from California have been examined but not designated as paratypes. Tuolumne County: South Fork Stanislaus River, 4.5 airline mi NE Columbia, 1♂, III–28–64 (C. D. MacNeill). Tulare County: 2 mi E. Johnsondale, 1♂, IV–27–64, sweeping *Prunus subcordata* (C. A. Toschi). Kern County: 3 mi W Woffard Hts., 1♂, IV–29–64 (J. Powell). Los Angeles County: Largo Vista, 4 mi E Valyermo, 1♂, IV–17–65 (R. L. Langston); near Pasadena, 1♂, IV–2–09 (F. Grinnell, Jr.). Riverside County: Railroad Canyon, 4 mi E Elsinore, 1♂, IV–14–65 (J. Powell); 5 mi S Sage, 1♀, IV–16–65 (J. Powell).

The species may show further subspecific differentiation, proceeding northward along the Sierra Nevada. The Tuolumne County specimen has further reduction of white scaling, leaving only a central longitudinal line on the forewing.

Ethmia albitogata Walsingham

FIGURES 4, 54, 184; PLATES 1*c*, 5*i*

Ethmia albitogata Walsingham, 1907:199.—Barnes and Busck, 1920, pls. 26, 34.—Keifer, 1936a:15, 29.—McDunnough, 1939:82.—Powell, 1959:134; 1971:22 [biol.].

A small moth having dark gray forewings mottled with whitish and with white hindwings.

MALE.—Length of forewing 6.0 to 7.1 mm. *Head:* Labial palpus elongate, second segment about 2.0 times eye diameter, moderately curved upward; third segment more than one-half the length of second, straight; scaling slightly roughened at base, smooth distally, white and black mixed, mostly white basally and dorsally. Antenna dilated, width

of shaft basally about 0.3 eye diameter; scaled basally, black with some white scales dorsally. Scaling of head smooth, black, whitish at base of proboscis and at occipital angle laterally, a broad, bare area behind and below eye, shining black. *Thorax:* Dorsal scaling black, some white scales intermixed in collar and on tegula distally. Underside scaling mostly white; pro- and mesothoracic legs with broad blackish areas exteriorly on tibiae and tarsi. *Forewing:* Narrow, length 3.7 to 4.0 times width; costa appearing flattened or slightly excavate on distal half; termen strongly angled back, broadly curved to dorsum, tornus not defined; fringe moderately broad, giving a subtruncate appearance to termen. Ground color dark gray; in fresh specimens heavily overscaled with white as follows: dorsal area below a sinuate longitudinal line along Cu, the white extending into cell as two broad triangular projections, one at basal one-fourth, containing a black spot, the other terminated by a pure white mark at end of cell, emphasized by black blotches in adjoining costal area that forms a broad, dark obtuse angle in the middle of the wing; immediate dorsum sparsely whitish; costal area sparsely whitish on basal half, more densely so toward apex; terminal area with irregular white blotches or entirely whitish from end of cell outward. Much of the white scaling is lost on older individuals. Fringe white, usually with dark blotches at tornal area, midtermen, and apex. Underside gray, costa and dorsal areas whitish, fringe as above. *Hindwing:* Slightly broader than forewing; costal brush lacking; narrow apicad, termen strongly angled back to anal angle; fringe broad, greater than half the width of membrane. Ground color including fringe white, apical area and base of adjoining fringe, blackish. Underside white with scattered gray scales in costal area and at apex. *Abdomen:* Dorsal scaling shining gray, darker basally; some white scales distally; ventrally mostly whitish; genital scaling white. Genitalia as in Figure 54 (drawn from plesiotype, Tocaloma, Marin County, California, JAP prep. no. 1459; five preparations examined); uncus deeply notched; anterior gnathos strongly dentate, posterior gnathos with minute teeth; basal processes very reduced; valva not much narrowed distally.

FEMALE.—Length of forewing 6.0 to 6.9 mm. Essentially as described for male; antenna shaft diameter about 0.8 that of male; generally more white scaling on head, thorax, and forewing; the white markings more distinct in fresh specimens. Genitalia: (Figure 184, drawn from plesiotype, Arroyo Mocho, Alameda County, JAP prep. no. 2766; four preparations examined); papillae anales heavily sclerotized on dorsal half; sterigmal plate simple; ductus bursae very weakly sclerotized at base; recurved posteriorly after three large coils; signum a large, flanged, deep fold without spines; ductus seminalis with a sclerotized ring near bulla seminalis.

TYPE DATA.—"California (Zeller Coll.)"; holotype male in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Central California.

FLIGHT PERIOD.—February and March.

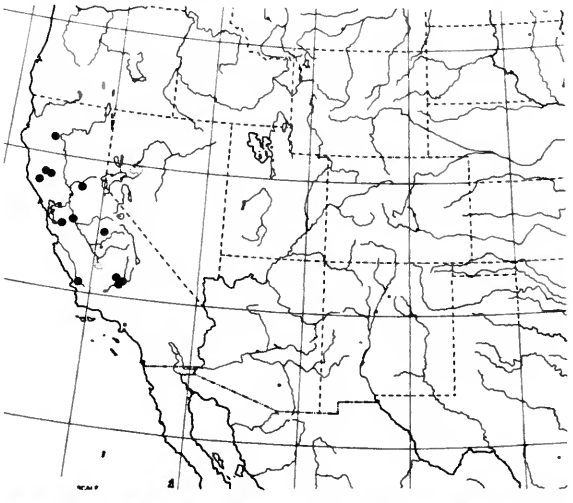
FOOD PLANT.—*Amsinckia lunaris* MacBride (Boraginaceae) and presumably other *Amsinckia*. Biology is reported elsewhere (Powell, 1971).

Ethmia plagiobothrae Powell, new species

Ethmia plagiobothrae Powell, 1971:25 [*non descr.*, biol.].

FIGURES 55, 185; PLATES 5*j*, 22*c*; MAP 16

A small Californian moth similar to *E. albitogata* in appearance, with bristled palpi, less extensive whitish overscaling on the forewing and more strongly contrasting white spots along the fold.



MAP 16.—Geographical distribution of *Ethmia plagiobothrae* Powell, including localities represented only by larval collections (see Powell, 1971).

MALE.—Length of forewing 6.0 to 7.0 mm. *Head:* Labial palpus elongate; length of second segment 1.4 to 1.6 times eye diameter; third about 0.65 to 0.75 as long as second; second segment densely clothed with suberect, bristly scaling (as in *coquillettella*), mixed white and black; third segment smooth scaled, black ventrally, white dorsally. Antenna dilated, width of shaft basally about 0.33 eye diameter; unscaled. Head venter and tongue with erect, whitish scaling; front and crown smooth, black, a few white, hairlike scales below eye; occipital tufts whitish laterally. *Thorax:* Tegula brownish black, white apically; notum shining black, reflecting bluish, a thin, transverse band of white preceding scutellum. Underside blackish, shaggy, with elongate, white hairlike scales, including femora; legs otherwise smooth, blackish, banded with white. *Forewing:* Length 3.5 to 3.6 times width. Blackish gray, the pattern similar to *albitogata,* the whitish overscaling reduced, especially on costal half, and the white along Cu fold intensified, more strongly contrasting. The basal white spur reduced, projecting a shorter distance into cell, Cu area darker, black; apical area nearly devoid of whitish. Fringe mostly dark gray, margins with white above tornus and below apex. Underside dark gray, with broad whitish overscaling costal and dorsal of cell. *Hindwing:* Slightly broader than forewing; costal area simple, margin nearly straight; apex acute; dorsum concave before anal angle. White, apical area rather broadly blackish, except fringe white. Underside white, apex narrowly blackish. *Abdomen:* Dorsum of I–VII with velvet-like coat of short, shining black scales; lateral, ventral, and genital scaling more elongate, mixed whitish and gray. Genitalia as in Figure 55 (drawn from holotype, JAP prep. no. 1642; two preparations examined); uncus cleft to base, tegumen with ventrad "shoulders," gnathos anteriorly broadly notched, without dentation, posteriorly with only fine teeth; basal processes very reduced; valva apex somewhat falcate.

FEMALE.—Length of forewing 5.6 to 6.7 mm. Essentially as described for male; labial palpus slightly shorter; antenna not dilated, width of shaft about 0.5 that of male; usually somewhat more white scaling on forewing as an intensifying of markings of male, not developed broadly over wing as in *albitogata.* Forewing broader, length 3.2 to 3.4 times width. Abdomen with the short, velvet-like black restricted to dorsum of segments I–III. Genitalia similar to *albitogata,* ductus with only 2 loops, not so strongly recurved posteriorly; (Figure 185, drawn from plesiotype, Del Puerto Canyon; four preparations examined).

TYPES.—Holotype male: California, Cool, El Dorado County, March 21, 1962 (J. Powell). Allotype female: Elk Mountain, 12 mi N of Upper Lake, Lake County, California, March 18, 1965 (J. Powell). Both to be deposited in California Academy of Sciences. Ten paratypes, all California, as follows: Cool, El Dorado County, 1 ♀, IV–24–61, reared from *Plagiobothrys nothofulvus,* emerged I–'62 (JAP 61D4); Elk Mountain, 2,600–3,000 ft, 11–12 mi N Upper Lake, Lake County, 4 ♀, IV–2–62 (J. Powell), 1 ♂, 3 ♀, III–18–65 (R. Langston and J. Powell); 1 mi N Posey, Tulare County, 1 ♀, V–14–63, reared from *Plagiobothrys nothofulvus* (JAP 63E2); deposited in collections of California Insect Survey and U. S. National Museum.

REMARKS.—Numerous larvae from these and localities in other areas of California (Map 16) have been examined but not designated as paratypes. Biological data is given elsewhere (Powell, 1971).

The close superficial similarity of *E. plagiobothrae* and *albitogata* concealed their separation in earlier collections. Differences in food plant and larval coloration led to discovery of the present impostor. The bristled palpi and shaggy venter of the head and thorax, together with the distinctive uncus and gnathos, serve to distinguish adults of *E. plagiobothrae.*

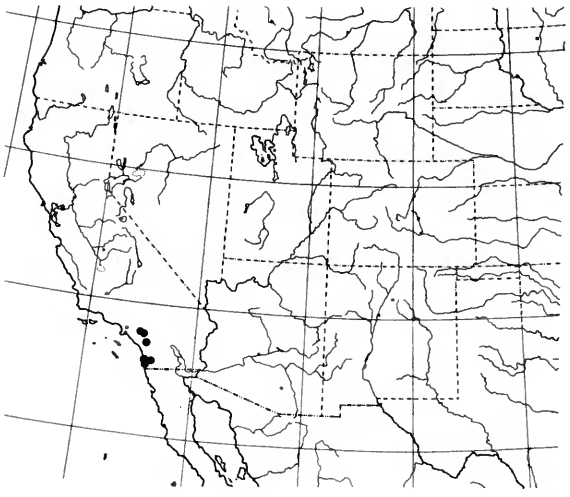
Ethmia minuta Powell, new species

Ethmia minuta Powell, 1971:30 [*non descr.,* biol.].

FIGURES 56, 182, 183; PLATES 3*e,* 5*k-l,* 21*e-f*; MAP 17

A tiny moth with dark forewings marked by a white line from base to termen; the hindwings are white in the male, dark in the female.

MALE.—Length of forewing 4.4 to 5.0 mm. *Head:* Labial palpus elongate, moderately upcurved, second segment about 1.66 times eye diameter, slightly curved, somewhat shaggy ventrally, white at base and dorsally, blackish ventrally in distal half, third segment 0.6 the length of second, straight, smooth scaled, white above, black below. Antenna dilated, width of shaft near base 0.3 eye diameter; smooth



MAP 17.—Geographical distribution of *Ethmia minuta* Powell.

scaled, black; densely setate ventrally. Scaling appressed, black, white at base of front and proboscis; occipital margin scaling erect, loose, spreading, white laterally. Area under and back of eye unscaled, shining black. *Thorax:* Pronotal scaling black, tegula white, black at base. Underside dark gray, legs white ventrally, blackish dorsally, metathoracic leg white. *Forewing:* Length about 3.4 times width; costa very slightly bowed in basal half, nearly straight; terminal and tornal fringe broad, giving a truncate appearance to wing. Ground color black, reflecting shining bronzy, indistinctly mottled by scattered whitish scales in distal one-third. A narrow, well-defined, white stripe from base through lower portion of cell, angled slightly upward at end of cell, becoming broader and less distinct before termen, distinct again through fringe below apex. A well-defined, oblong spot of ground color interrupts the longitudinal stripe at end of cell from dorsal side. Underside brownish black, costal and dorsal margins indistinctly whitish, white band through terminal fringe distinctly reproduced. *Hindwing:* Slightly narrower than forewing; costa without dorsal hair tuft; dorsal fringe broad, equal to about one-half the width of membrane. Ground color white, a narrow blackish area around apex; fringe entirely white. Underside white, scaling of vein Sc gray. *Abdomen:* Dorsal scaling black, ventral, lateral and genital scaling white. Genitalia as in Figure 56 (drawn from paratype, Lakeside, JAP prep. no. 1469; three preparations examined); uncus hoodlike, deeply notched; gnathos dentate posteriorly, with smooth lateral lobes anteriorly; valvae narrowed distally.

FEMALE.—Length of forewing 4.4 to 4.7 mm. Essentially as described for male; antenna slightly dilated, width of shaft near base about 0.8 that of male; coloration generally paler, ground color brownish gray. Hindwing above entirely brownish gray including fringe, below whitish at base, along costa, termen, and in anal area; fringe at apex white. Genitalia as in Figures 182, 183 (drawn from plesiotypes, Moreno, Cardiff, JAP prep. nos. 2143, 2560; three preparations examined); papillae anales heavily sclerotized, greatly elongated; anterior apophyses broad and broadly joined to sterigmal plate; latter not sclerotized caudad of ostium; ductus bursae with a short, basal sclerotized ring; signum lacking.

TYPES.—Holotype male: California, 3 mi NE of Moreno, Riverside County, April 5, 1963 (J. Powell). Allotype female: 2 mi NE of Lakeside, San Diego County, March 30, 1961 (J. Powell), deposited in the California Academy of Sciences, San Francisco. Seventy paratypes, all California, as follows: Riverside, 1♀, III–25–53 (P. H. Timberlake); 3 mi NE Moreno, 30♂, IV–5–63 (J. Powell, W. A. Steffan, C. A. Toschi), 30♂, 3♀, IV–12–63 (J. Powell); 2 mi NE Lakeside, 2♂, 1♀, III–29–61 (J. Powell); San Diego, 2♂, 1♀, III–11–16 (W. S. Wright), deposited in collections of American Museum of Natural History, British Museum, California Academy of Sciences, California Insect Survey, Los Angeles County Museum, San Diego Museum of Natural History, U.S. National Museum, University of California, Riverside.

Additional specimens: One female from Torrey Pines, San Diego County (III–29–64, P. A. Rude) and a series collected April 15–16, 1965, near Sage, Riverside County, some 30 mi S of the type locality (D. Veirs, Powell, Toschi).

FOOD PLANT.—*Cryptantha intermedia* (Gray). A partial biology is reported elsewhere (Powell, 1971).

Ethmia tricula Powell, new species

FIGURE 57; PLATE 6*a*

This is the smallest member of the genus in the New World. The wings are dull gray-brown with

an indistinct longitudinal white line through the cell of the forewing.

MALE.—Length of forewing 4.3 mm. *Head:* Labial palpus moderately upcurved, elongate, second segment more than 1.5 times eye diameter, third segment about one-half the length of second; scaling only slightly roughened, dark brown with scattering of white scales near base and dorsally on third segment. Antenna dilated, width of shaft near base 0.3 eye diameter; scaling dark brown. Head scaling brownish black, occipital tufts and proboscis whitish laterally; bare area behind eye. *Thorax:* Dorsal scaling brownish black. Scaling of underside including legs mixed dark brown and whitish; metathoracic tibia with a dorsal white fringe. *Forewing:* Narrow, length about 4.0 times width; apex acute; termen strongly angled back, fringe only moderately broad, the wing not truncate appearing. Ground color uniform, dull gray-brown including fringe; an ill-defined whitish longitudinal streak through lower part of cell, from about basal one-fourth of wing to end of cell, broadest at middle, interrupted slightly on dorsal side near basal end by a patch of scales darker than ground color. Underside brown, a row of whitish scales on Sc near base. *Hindwing:* About as broad as forewing; dorsal brush of costa lacking. Ground color uniform dull gray-brown including fringe; basal area somewhat translucent owing to fewer scales. Underside slightly paler; costal fringe whitish. *Abdomen:* Scaling uniform brownish black. Genitalia as in Figure 57 (drawn from holotype, JAP prep. no. 1645; one preparation examined); similar to *E. minuta,* differing by the lack of a deep cleft in the uncus, by smaller gnathos teeth, extremely reduced basal processes, and narrower valvae.

FEMALE.—Unknown.

TYPE.—Holotype male: California, 3 mi NE of Moreno, Riverside County, April 12, 1963 (J. Powell); unique, deposited in California Academy of Sciences.

The Charybdis Group

Eye index 1.0. Maxillary palpus rudimentary. Labial palpus extremely small, II segment index 0.15, vestiture smooth. Antenna of male not dilated. Forewing narrow; pattern longitudinal, obscured costal-dorsal. Hindwing of male with costa simple. Legs unusually elongate. Abdomen scaling undifferentiated. Uncus hoodlike; gnathos dentate anteriorly and posteriorly; basal processes membranous, broad; valva, fultura-manica, and vesica without armature. Female unknown.[7]

A single species in California.

Ethmia charybdis Powell, new species

FIGURES 43, 58, 285; PLATES 1*e*, 6*b*

Ethmia charybdis Powell, 1971:31 [*non descr.*, biol.].

A unique, gray, California species with very reduced mouthparts and extraordinarily elongate legs and wings.

MALE.—Length of forewing 10.6 mm. *Head:* Labial palpus very small, scarcely protruding beyond the clypeus; total length including first segment about 0.6 eye diameter, second and third segments subequal in length, each less than 0.15 eye diameter; scaling whitish. Antenna not dilated, width of shaft near base about 0.15 eye diameter; densely setate all around; sparsely scaled, gray. Tongue vestigial, unscaled. Scaling of front whitish ventrally, becoming dark gray-brown at crown. *Thorax:* Dorsal scaling mixed dark gray and whitish; metathoracic brushes sparse, not reaching the unscaled scutellum. Underside scaling shining pale gray. Legs extraordinarily long and thin; prothoracic leg with tibia + tarsi length: eye diameter ratio, about 6.2:1 (range about 2.9 to 4.6:1 in other *Ethmia;* mesothoracic and metathoracic legs not as disproportionately elongate, the differential between the three more than in other *Ethmia). Forewing:* Extremely narrow, length 4.2 times width; costa straight for most of its length, termen slightly convex, broadly curved to dorsum, tornal angle scarcely evident. Ground color gray, heavily overlaid with whitish, especially on dorsal half, the dividing line separating gray costal half not well defined; a slightly elongate white spot at end of cell; some blackish scaling tending to form longitudinal lines between the veins in distal half and a subterminal line in tornal area. Fringe pale grayish with a dark streak just below apex. Underside

[7] Subsequent to completion of the taxonomic assessment, the female of *Ethmia charybdis* was discovered. It is brachypterous but otherwise resembles the male in possession of reduced mouthparts and thin, elongate legs.

gray, the white mark at end of cell reproduced; fringe whitish. *Hindwing:* Slightly narrower than and proportionately as elongate as forewing; costal area simple, costal margin nearly straight, apex round, termen flattened, nearly straight to dorsum (shape similar to *Holcocera* or *Borkhausenia*). Ground color pale gray; fringe whitish. Underside similar. *Abdomen:* Dorsal scaling mixed grayish and whitish; ventral whitish. Genitalia as in Figure 58 (drawn from holotype, JAP prep. no. 2555; one preparation examined); similar to *E. albitogata,* gnathos dentate along entire length, basal processes small, membranous, setate; valva produced into a short, recurved spur apically.

FEMALE.—Unknown.[8]

TYPE.—Holotype male: California, Big Panoche Creek at San Benito-Fresno County line, April 20, 1967, reared from *Amsinckia tessellata,* emerged after September, 1967 (J. Powell and P. A. Rude, JAP 67D87); unique, in California Academy of Sciences.

REMARKS.—Although characteristics of the male genitalia ally this species with the Albitogata group and other members of the genus in western North America, the greatly modified morphological features of mouthparts, wings, and legs indicate a strong divergence by *E. charybdis* from its congeners. No doubt these characters would have given the moth a monotypic generic assignment had it been described prior to a study in which the male genitalia represent the emphasis on classification. The eyes are large, suggesting that the adults may be nocturnal, but whether they fly in late fall or early spring is unknown. Diurnal surveys in February and March have failed to reveal the moths' presence. Colonies of this species may be expected along the western edge of the San Joaquin Valley and northern part of the Mojave Desert, according to the distribution of the food plant and of other insect species that occur at the type locality.

The Semilugens Group

Eye index 0.7–1.0. Maxillary palpus moderately large or large, 4 segments of subequal or 2:2:1:2 lengths. Labial palpus moderately elongate, II segment index 1.1–1.5, vestiture smooth. Antenna of male not dilated to dilated, index 0.18 to 0.28. Forewing moderately broad to narrow; pattern costal-dorsal. Hindwing of male with or without costal hair pencil, fold lacking. Abdomen yellow or gray; anal scaling undifferentiated. Uncus hoodlike; gnathos dentate anteriorly and posteriorly; basal processes membranous, rudimentary or broad; valva, fultura-manica, and vesica without armature. Papillae anales weakly or heavily sclerotized, setate; posterior apophyses not elongate; anterior apophyses broad; sterigma simple; antrum undifferentiated or enlarged with sclerotized band; ductus bursae membranous, 3–11 tight coils; signum a dentate bar or nondentate fold.

A somewhat diverse assemblage of 10 species in the western United States. Phenetic similarity values indicate that *Ethmia apicipunctella* and *E. epileuca* are marginal members; the latter is the only member with short palpi, narrow forewings, and nondilated antenna in the male. Phenetic results indicate a relationship for *E. epileuca* with the Albitogata group, but it has large eyes. Three species, *E. albistrigella, E. nadia,* and *E. orestella* have small eyes but in other respects show similarity to the *E. semilugens* group, and may be secondarily diurnal due to their occurrence at high elevations. *Ethmia arctostaphylella* has an intermediate eye size and appears to be primarily crepuscular (Powell, 1971).

This group is similar to and perhaps a component of the Palearctic Dodecella group of Sattler (1967).

Ethmia albistrigella (Walsingham)

Psecadia albistrigella Walsingham, 1880:89.

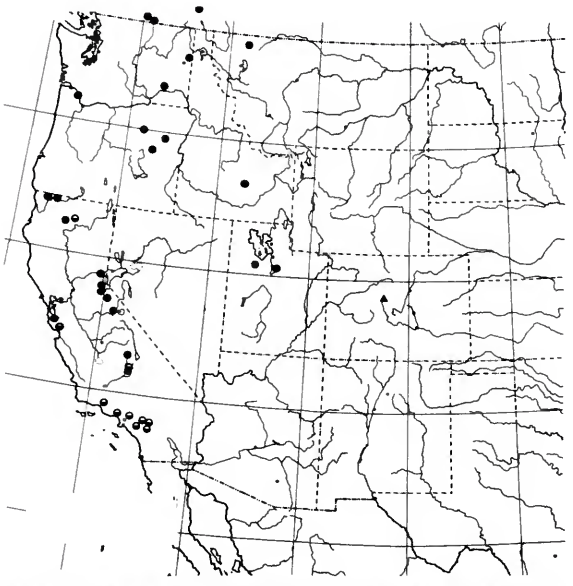
Ethmia albistrigella.—Dyar, 1902:203.—Busck, 1909b:184 [synonymy].—Barnes and Busck, 1920, pl. 26, 34.—Braun, 1921a:12.—McDunnough, 1939:82.—Clarke, 1950:161.—Powell, 1959:135; 1971:35 [biol.].

Breckenridgia (error) *chrysurella* Dietz, 1905:42.

Brackenridgia chrysocomella—Busck (not Dietz, 1905), 1906a, 8:348.

A moderately small moth having black wings and yellow abdomen, the forewings marked by a distinct white longitudinal streak. The typical race is widespread in the mountains of western North America.

[8] See footnote 7. The adults are active in December and are nocturnal. Mating by the one pair observed was unusually long, relative to other *Ethmia,* and the eggs entered diapause (Powell, 1971).



MAP 18.—Geographical distribution of members of the *Ethmia* Albistrigella complex.
◒ *E. nadia* Clarke ● *E. a. albistrigella* (Walsingham)
▲ *E. orestella* Powell

Ethmia albistrigella albistrigella (Walsingham), new status

FIGURES 59, 186, 187; PLATE 6*c-d*; MAP 18

MALE.—Length of forewing 7.4 to 9.1 mm. *Head:* Labial palpus usually elongate, strongly upcurved, smooth scaled, exceeding crown, length of second segment 1.5 (rarely) to 1.7 times eye diameter; length of third about 1.0 times eye diameter; black, white scaling as follows: scattered at base, apex of second segment and basally on third segment above; at times white mostly lacking. Eye size variable by about 10 percent between populations, smaller eye accompanying larger palpus. Antenna dilated, diameter of shaft near base about 0.35 eye diameter; black. Scaling of front and crown smooth; black, scattered whitish scales on base of proboscis, crown and lateral occipital tufts white. *Thorax:* Dorsal scaling black, only sparse scattered white scales; tip of tegula white. Underside including prothoracic and mesothoracic legs shining dark gray with scattered white scales; metathoracic leg blackish, dusted with ochreous, tibia bright ochreous with a weakly developed dorsal fringe. *Forewing:* Length about 3.4 times width; costa nearly straight in distal half, apex acute, termen only moderately angled back, tornus distinct. Ground color dark blackish brown, darkest in cell, paler toward margins; a distinct white longitudinal streak along Cu fold from base to near end of cell, curving upward and sending an ill-defined spur toward tornus near end; distinctly margined on costal side, somewhat indistinct and often broadened on dorsal side, at times to include a distinct, oblong, black spot, slightly darker than ground color, at basal one-fourth; usually reduced so that the black spot only slightly indents the streak from dorsal side; a similar dark spot at termination of streak on upper angle of cell. A row of seven or eight dark spots around termen from before apex to tornus. Underside uniform dark gray-brown. *Hindwing:* About as broad as forewing; costal area simple; costa only slightly sloping to apex, latter round, termen broadly curved to dorsum, latter slightly excavate before anal angle. Ground color dark brown; fringe narrow, about one-fourth the width of wing membrane, gray-brown. Underside dark gray-brown. *Abdomen:* Dorsal scaling of first and second terga black, usually extending in decreasing width to sixth tergite, rarely ending on third; lateral, ventral, and genital scaling bright ochreous. Genitalia as in Figure 59 (drawn from plesiotype, Chipmunk Flat, Tuolumne County, California, JAP prep. no. 1480; five preparations examined); uncus deeply cleft, gnathos heavily spined posteriorly, with numerous, irregular teeth-like projections anteriorly.

FEMALE.—Length of forewing 7.2 to 9.4 mm. Essentially as described for male, differing as follows: Labial palpus ranging to more elongate, second segment about 1.55 to 1.85 times eye diameter; antenna not dilated, shaft about 0.25 eye diameter; generally more whitish scaling on head and thorax, a white band across crown, collar white, pronotum whitish laterally, coxae and femora whitish exteriorly; dorsum of abdomen more broadly black, posterior extent of black variable as in male. Genitalia as in Figures 186, 187 (drawn from plesiotype, Tuolumne County, California, JAP prep. no. 1997; three preparations examined); papillae anales heavily sclerotized dorsally; sterigma simple, unsclerotized posterior to ostium, latter with a sclerotized half ring subtended by light sclerotization in ductus; signum a dentate, concave bar with scarcely any lateral development.

TYPE DATA.—Siskiyou Mountains, on the border of California and Oregon, June 8, 1872, at an elevation of about 6,000 feet, types in British Museum (*albistrigella*); "Colorado," data on the type male at Museum of Comparative Zoology, Harvard, reads "S. W. Col. 6–28–99" (*chrysurella*).

GEOGRAPHICAL DISTRIBUTION.—Southern British Columbia southward in the Rocky Mountains to southwestern Colorado and into the Wasatch Range in northern Utah; on the Pacific coast through western Washington and Oregon into the mountains of California.

FLIGHT PERIOD.—Univoltine; late April to early August; in early spring conditions for the locality.

FOOD PLANT.—*Phacelia ramosissima* (Hydrophyllaceae), in Tuolumne and Nevada counties, California; the biology reported elsewhere (Powell, 1971). In Montana, Braun (1921a) listed *Lappula* [*Hackelia*] *floribunda* (Boraginaceae) as a possible host. Two adults were reared from *Sambucus* stick "trap nests" (Parker and Bohart, 1966) by Parker in January 1966. The 18-inch sticks were placed in the ground at Craters-of-the-Moon National Monument, Idaho, in December 1964, by D. S. Horning, who suggests (in litt.) that *Phacelia heterophylla* or *P. leucophylla* may be a host there.

REMARKS.—The type of *chrysurella* Dietz is in worn condition but it does not appear to differ appreciably from western *albistrigella*. The wings are partly descaled and may have had a reduced white band, as in *E. a. icariella,* described below. However, the yellow abdomen is of typical *albistrigella* form in *chrysurella,* which is the only Colorado specimen I have seen.

A single female from eastern Washington (Palouse Falls, Whitman County, V–3–31, J.F.G. Clarke) has the dorsum of the abdomen yellow except for the basal two segments. Additional material from the area will be necessary to ascertain the relationship of this population with *E. nadia* Clarke.

Ethmia albistrigella icariella Powell, new subspecies

PLATE 6*e*

An Arctic-Alpine zone race of *albistrigella* which is almost wholly black dorsally, including the abdomen.

MALE.—Length of forewing 7.1 to 7.4 mm. Similar to nominate subspecies, but the white scaling reduced, almost lacking, differing as follows: *Head* and *Thorax:* Entirely dark brownish black. Labial palpus tending to slightly shorter, second segment 1.4 to 1.5 times eye diameter. Hindleg pale ochreous beyond trochanter, paler than in *albistrigella. Forewing:* Slightly narrower, length 3.2 to 3.4 times width, ground color brownish black, the longitudinal band showing as a trace (about two scales wide) or evidenced only by a blackish shade, darker than ground color, along Cu fold; white spur at end of cell indicated by a small white spot. Marginal dark dots, darker than grayish brown fringe, evident. *Abdomen:* Black, ochreous scaling reduced to narrow lateral margins of segments VII, and VIII, segment IX dorsally and ventrally, and the valvae; dorsal genital scaling also black. Genitalia indistinguishable from typical *albistrigella.*

FEMALE.—Length of forewing 7.4 to 8.5 mm. As described for *E. a. albistrigella* and male of *icariella.* Some examples without any white scaling on forewing and the genital scaling pale ochreous. Genitalia not differing from *E. a. albistrigella* and *nadia.*

TYPES.—Holotype male and allotype female: California, Inyo County, near Mono Pass, 12,500 feet, September 2, 1965 (J. Powell), to be deposited in California Academy of Sciences. Five paratypes, all California, as follows: 1♂, 1♀, same data as holotype; 1♀, same data except VIII–30–65 (C. D. MacNeill); 1♀, near Mono Pass, 12,000 feet, VIII–4–63 (M. J. Tauber and C. A. Toschi); 1♂, Mt. Dana, Yosemite National Park, VII–19–38 (E. C. Johnston); deposited in California Insect Survey and Canadian National collections.

REMARKS.—According to similarity in genitalia, this seems to be a high elevation, small form of *albistrigella* with the white and yellow scaling largely replaced by black. Whether the colonies sampled represent genetically differing, isolated populations or the extreme of a continuum in increased melanism is unknown. The species has not been collected between 9,000 and 12,000 feet elevation in the Sierra Nevada..

The Mono Pass site is well above climatic timberline, and the moths were taken on talus slopes or rocky moraines. *Phacelia frigida* Greene was the only likely host plant discovered in the sparse,

prostrate floral community in the vicinity. The Mt. Dana specimen was probably taken in a similar situation, between 12,000 and 13,000 feet elevation.

Ethmia nadia Clarke

FIGURES 6, 7, 14, 60; PLATE 6*f-g*; MAP 18

Ethmia nadia Clarke, 1950:161.—Powell, 1959:135; 1971:38 [biol.].
Ethmia albistrigella.—Powell, 1959 (not Walsingham, 1880): 135 [in part].

A moderately small moth resembling *E. albistrigella* but with the abdomen entirely yellow except the first tergite.

MALE.—Length of forewing 7.7 (reared) to 9.4 mm. Essentially as described for *E. albistrigella,* differing as follows: *Head:* Labial palpus variable, second segment usually about 1.4 to 1.5 times eye diameter (rarely to 1.65); at times with considerable whitish scaling. Scaling of head generally more whitish. *Thorax:* Dorsal scaling black, heavily dusted with white as follows: collar; tegula except base; lateral bands mesad of tegulae, blending indistinctly toward middle; a distinct transverse band before scutellum; an indistinct midscutellar line; distinct black spots thus defined at bases of tegulae and laterally preceding and following the prescutellar transverse band. Underside largely whitish including prothoracic and mesothoracic legs exteriorly; metathoracic leg ochreous yellow including coxa and femur. *Forewing:* Ground color dark gray, paler distally, dark spots adjoining longitudinal streak and at outer margin more contrasting. Longitudinal white streak usually broadened to include dark spot at basal one-fourth; at times considerable white scaling over whole dorsal area and in fringe. *Abdomen*: Scaling entirely pale to dark ochreous yellow, except first tergum black. Genitalia as in Figure 60 (drawn from plesiotype, 5 mi E McCloud, Siskiyou Co., JAP prep. no. 1479; five preparations examined); anterior, flared margin of gnathos without teeth, otherwise similar to *albistrigella.*

FEMALE.—Length of forewing 8.0 to 9.7 mm. Essentially as described for male, differing as follows: Labial palpus more elongate, second segment about 1.55 to 1.75 times eye diameter; antenna less dilated, diameter of shaft near base about 0.25 eye diameter; white scaling of head and thorax and forewing usually more extensive. Genitalia not distinguishable from *albistrigella* except by a slightly larger signum with short lateral flanges (three preparations examined).

TYPE DATA.—McCloud, Siskiyou County, California, June 5, 1935 (E. C. Johnston); holotype male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—California; in addition to the vicinity of McCloud, specimens tentatively referred to *nadia* have been taken at localities representing semiarid parts of cismontane California from Kern to Riverside counties and in the Coast Ranges from Santa Clara County to the Santa Monica Mountains in Los Angeles County.

FLIGHT PERIOD.—March to May (Southern California), June and July (Siskiyou County).

FOOD PLANT.—*Phacelia ramosissima* var. *suffrutescens* Parry (at Riverside). Biology is reported elsewhere (Powell, 1971).

Ethmia orestella Powell, new species

PLATE 6*h*; MAP 18

A moderately small *Ethmia* resembling *albistrigella,* but with the ground color including the abdomen gray-brown and the longitudinal streak obscure.

MALE.—Unknown.

FEMALE.—Length of forewing 9.2 to 9.9 mm. *Head*: Labial palpus moderately elongate, second segment about 1.65 to 1.75 times eye diameter, basally strongly upcurved; smooth scaled, brown, apex of second segment whitish or pale brownish white. Antenna not dilated, diameter of shaft near base about 0.15 eye diameter; scaled near base, brown. Scaling of crown and front appressed unicolorous chocolate brown or with some whitish scales down middle of front and base of proboscis and at margins of crown and occipital area. *Thorax*: Dorsal scaling brown, collar and tegula white or pale brownish white. Underside scaling brownish gray; legs brown, hind tibia and tarsi pale brownish white, tibial fringe reduced. *Forewing*: Length about 3.4 to 3.5 times width; shape and narrow fringe as in *E. albistrigella.* Ground color uniform dull gray-brown; longitudinal pale streak along Cu fold from base to end of cell, broadened at end, whitish or pale brownish, well defined but not strongly contrasting with ground color, terminated at upper angle of cell by a dark brown spot; a row

of similar spots at margin from before apex to tornus. Underside dull brown. *Hindwing*: About as broad as forewing; costa gently sloped to apex, latter narrow, round, termen broadly curved with dorsum, tornus not defined. Ground color smoky brown, slightly paler than forewing; an indistinct dark brown marginal line at base of fringe. Underside similar. *Abdomen*: Scaling dark brown, a few ochreous scales on caudal margins of last three segments. Genitalia not examined, probably not differing from *E. albistrigella*.

TYPES.—Holotype female: Colorado, Hall Valley, 11,500 feet, Park County, July 2, 1941 (A. B. Klots). One paratype, without abdomen: "Col.," (G. D. Hulst collection). Both deposited in American Museum of Natural History, New York.

REMARKS.—I have examined the type male of *chrysurella* Dietz, which was described from Colorado, and believe it to be conspecific with *albistrigella*. The present species differs principally by the well-developed yet not contrasting longitudinal band of the forewing and by the dark abdomen.

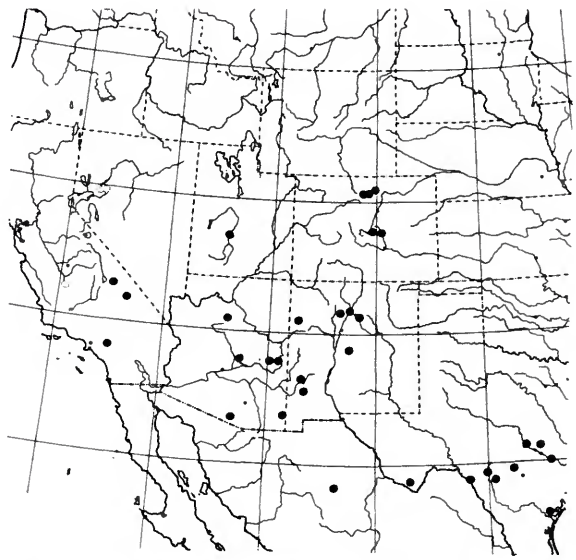
Ethmia semilugens (Zeller)

FIGURES 61, 288, 289; PLATE 6*i*; MAP 19

Psecadia semilugens Zeller, 1872:561.
Ethmia semilugens.—Dyar, 1902:206 [synonymy].—Barnes and Busck, 1920, pls. 27, 34.—McDunnough, 1939:83.—Powell, 1959:146; 1971:40 [biol.].
Anesychia multipunctella Chambers, 1874:233.
Psecadia semiopaca Grote, 1881:275.
Psecadia plumbeella Beutenmüller, 1889:9.

A moderately large *Ethmia* superficially resembling members of the *marmorea* complex, with the forewing dark brown on costal half, white on dorsal, the latter with a single dark dot near base.

MALE.—Length of forewing 8.7 to 12.0 mm. *Head*: Labial palpus upcurved, moderately elongate; second segment about 1.1 to 1.25 times longer than eye diameter, third segment about 0.67 the length of second; smooth scaled, dark brown, mostly whitish basally, third segment white. Antenna slightly dilated, shaft basally about 0.2 eye diameter; scaled dorsally, dark brown. Scaling of vertex and crown smooth, white, becoming roughened behind antennae, front and a spot at midoccipital margin dark brown. *Thorax*: Dorsal scaling white, with black spots at midcollar,



MAP 19.—Geographical distribution of *Ethmia semilugens* (Zeller).

tegulae bases, two at middorsum mesad of tegulae, and on scutellum. Underside scaling white, prothoracic leg dark brownish exteriorly, meso- and meta-pale brownish to pale ochreous, tarsi dark with pale bands; hind tibial fringe well developed, whitish ochreous. *Forewing*: Length about 3.4 to 3.5 times width; costa nearly straight, apex blunt, termen strongly angled back, dorsum straight. Ground color brownish black with a broad white dorsal margin; white produced as a rounded lobe upward to lower margin of cell and containing a round black spot at about basal one-fourth, an irregular extension of white to end of cell and one to midtermen, a white blotch on apex; a series of about 10 black dots along margin from before apex to beyond tornus. Fringe white, broken by a streak of dark brown just below apex. Underside brownish, indistinctly whitish dorsally, marginal spots reproduced. *Hindwing*: About as broad as forewing; costal area simple; costa excavated in distal half, apex blunt, termen broadly curved to dorsum. Ground color whitish, slightly to strongly brownish toward apex, at times mostly brownish except basally. Underside similar, paler. *Abdomen*: Dorsal scaling dark brown, each terga with paler caudal margin; underside and genital scaling bright ochreous. Genitalia as in Figure 61 (drawn from plesiotype, Surprise Canyon, Inyo

County, California, JAP prep. no. 1483; four preparations examined); uncus notched, gnathos broad, with fine teeth anteriorly and posteriorly; basal processes small and narrow; valva narrowed apically.

FEMALE.—Length of forewing 10.0 to 11.1 mm. Essentially as described for male. Antenna basally about 0.8 the diameter of that of male. Hindwing usually darker, brownish; fringe white. Genitalia similar to *E. albistrigella,* sterigma forming a narrower, more complete sclerotized ring around ostium (two preparations examined).

TYPE DATA.—Texas, April (Belfrage); type male in Zeller collection, presumably at British Museum (*semilugens*); "from Mr. Belfrage, of Waco, Texas," April and May. Lectotype, by present designation: male, bearing the labels, "Chambers [machine], Tex" [inked by hand], "Anesychia multipunctella Cham.," "Type #1425" [Type no. by Banks], in Museum of Comparative Zoology, Harvard (*multipunctella*); "Colorado," location of type unknown (*semiopaca*); "Texas," type stated to be ♂, but is a female without abdomen, at U.S. National Museum (*plumbeella*).

Geiser (1948) states that between 1870 and 1879 Belfrage lived near Norse, Bosque County, Texas, some 40 miles from Waco.

GEOGRAPHICAL DISTRIBUTION. — Arid parts of Colorado through central Texas, New Mexico, northern Chihuahua, Arizona, and southern California. Braun (1925) reported *semilugens* in northern Utah, but a specimen sent to me representing that data and identified as *E. semilugens* by Braun is *E. marmorea* (Walsingham), a more widespread species.

FLIGHT PERIOD—Probably facultatively double brooded; late February and March (southwestern Texas) to September (Chihuahua). Most records are for April or July.

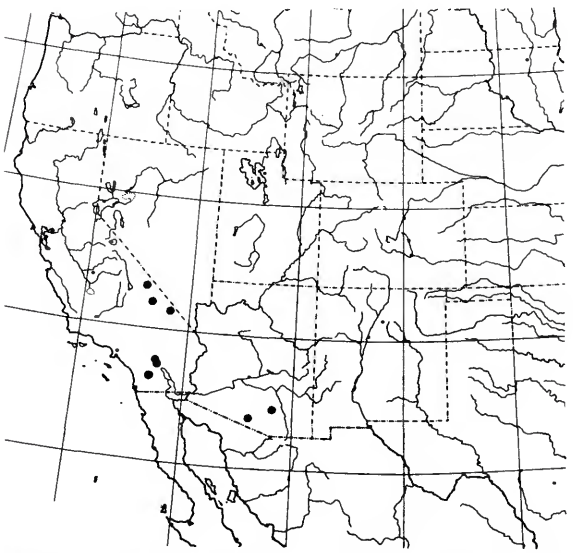
FOOD PLANT.—*Phacelia calthifolia* and *P. crenulata* in California. The larvae live on the leaves without a shelter (Powell, 1971).

Ethmia epileuca Powell

FIGURE 62; PLATE 6*j*; MAP 20

Ethmia epileuca Powell, 1959:140.

A medium sized *Ethmia* with gray forewings, having the dorsal and terminal areas shaded with whitish.



MAP 20.—Geographical distribution of *Ethmia epileuca* Powell.

MALE.—Length of forewing 9.4 to 10.4 mm. *Head*: Labial palpus moderately elongate, strongly upcurved; second segment slightly longer than eye diameter, third segment about 0.6 the length of second; smooth scaled, brown, white ventrally and interiorly. Antenna not dilated, diameter of shaft basally about 0.18 eye diameter. Scaling light brownish, heavily mixed with whitish at vertex and on front; occipital tufts white. *Thorax*: Dorsal scaling white with scattered brownish, a median longitudinal brown streak. Underside scaling pale brownish and dirty whitish, including legs; prothoracic and mesothoracic legs darker; hind tibial fringe white. *Forewing*: Narrow, length about 3.7–4.0 times width; costa slightly convex beyond middle, apex acute, termen strongly angled back, broadly curved to dorsum. Ground color divided by a straight longitudinal line along Cu fold, to end of cell, brown or gray-brown above, white below; costal half darkest at dividing line, paler toward margins, blending to whitish gray in terminal area, sending two dark spurs into white at about basal one-fourth and a square one just before middle of wing, the basal one at times an isolated spot; white dorsal half with intermixed light brownish scales toward dorsum and tornus; a distinct, white, upcurved spur at end of cell; a series of ill-defined dark spots along termen. Fringe mostly brownish with a white basal band. Under-

side dirty whitish becoming pale brownish toward apex. *Hindwing*: Slightly broader than forewing; costal area simple; costa excavate on distal one-third, apex sublanceolate; termen strongly angled back to anal angle, tornus not developed; fringe narrow, less than one-half the membrane width. Ground color white including fringe and underside. *Abdomen:* Dorsal scaling pale brownish, caudal margins of segments, underside, and genital scaling dirty whitish. Genitalia as in Figure 62 (drawn from paratopotype, JAP prep. no. 262; three preparations examined); uncus slightly notched; gnathos with elongate teeth on posterior margin, anteriorly broad with margin entire below, irregularly dentate above; basal processes broad and elongate; valva not narrowed distally.

FEMALE.—Length of forewing 8.3 to 9.0 mm. Essentially as described for male except smaller. Genitalia similar to *E. albistrigella* and *semilugens*; ductus with a narrow, sclerotized sleeve at base, followed by an elongate, unsclerotized, yet stiff, uncoiled antrum bearing a row of about 10 small teeth; ductus distally with about 6 membranous coils; signum weakly developed, teeth irregular, lateral flanges lacking (two preparation examined).

TYPE DATA.—California, Surprise Canyon, Panamint Mountains, Inyo County, April 22, 1957 (J. Powell); holotype female in California Academy of Sciences.

GEOGRAPHICAL DISTRIBUTION. — Desert area of southern California and Arizona (Tucson).

FLIGHT PERIOD.—February to April.

FOOD PLANT.—Unknown.

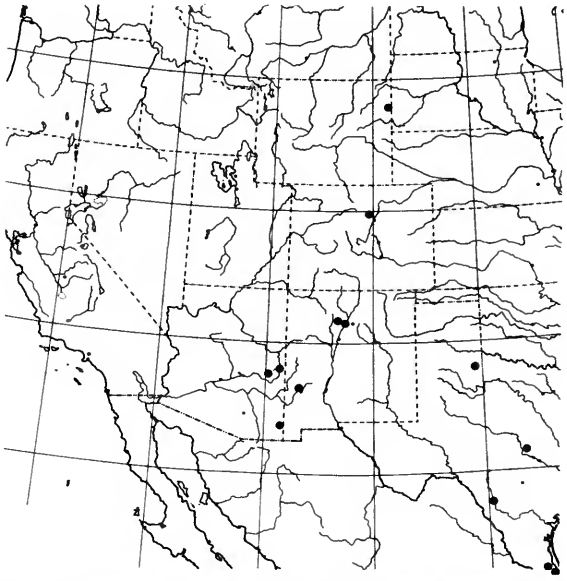
REMARKS.—Specimens from the Coachella Valley area of California tend to exhibit a more gray, washed out appearance, with the markings less distinct. Those from Arizona (Tucson) are more distinctly marked than typical.

Ethmia apicipunctella (Chambers)

FIGURES 63, 189; PLATE 7*a*; MAP 21

Hyponomeuta apicipunctella Chambers, 1875:8.
Psecadia apicipunctella.—Dyar, 1900:38.
Ethmia apicipunctella.—Dyar, 1902:207.—Barnes and Busck, 1920, pls. 26, 36 [synonymy].—McDunnough, 1939:83.
Ethmia zavalla Busck, 1915:84.

A small, white moth having the forewings dotted with black.



MAP 21.—Geographical distribution of *Ethmia apicipunctella* (Chambers).

MALE.—Length of forewing 7.2 to 9.4 mm. *Head*: Labial palpus rather short, not strongly upcurved; second segment length 1.0 times eye diameter, only slightly curved; third segment about 0.7 to 0.8 as long as second, straight; scaling smooth, white, second segment brown exteriorly on distal half or mostly brownish exteriorly. Antenna slightly dilated, width of shaft basally about 0.2 eye diameter; scaled dorsally, white, scape brownish anteriorly. Scaling of front appressed, white, a brown spot adjoining eye, of crown rather roughened, of occipital margin spreading, white, at times with a brown median spot. *Thorax*: Pronotal scaling white; seven blackish spots: two at bases of tegulae and one between them, two just beyond tegulae apices, two laterally on scutellum. Underside white; prothoracic and mesothoracic legs and hind tarsi brown exteriorly; hind tibial fringe well developed, white. *Forewing*: Rather broad, length about 3.5 to 3.7 times width; costa gently, evenly curved from base to apex, latter blunt, narrow, termen strongly angled back, tornus scarcely discernible. Fringe moderately broad. Ground color white or pale gray with black spots that are variable in size as follows: costa at extreme base; a spot in cell near base, followed by two somewhat elongated longitudinal marks in cell at basal one-third and middle of wing; two smaller spots above and below

and just basad of the first of the two longitudinal marks, another roundish spot on lower fold below second longitudinal mark; a series of about five small spots at end of cell and in terminal area, often coalesced to form a sinuate, longitudinal bar; a small blotch on dorsum at basal one-third; a series of marginal dots from outer one-third of costa around termen to outer one-third of dorsum. Fringe white with a brown dot at apex; at times brownish in tornal area. Underside pale brownish, fringe white, the apical spot reproduced or fringe with a brown band along its whole length. *Hindwing*: About as broad as forewing; costal brush lacking; costa only slightly excavate on distal half; apex blunt, termen broadly curved to dorsum. Ground color whitish, slightly tinged with brownish toward apical area, to pale brownish, darker apically. Fringe white. Underside similar, slightly darker. *Abdomen*: Scaling dorsally and ventrally white, tinged with pale brownish; genital scaling white. Genitalia as in Figure 63 (drawn from plesiotype, Jemez Springs, New Mexico, JAP prep. no. 1171; four preparations examined); uncus moderately deeply notched; gnathos dentate, anterior and posterior regions not differentiated; basal processes short; valvae tapered distally.

FEMALE.—Length of forewing 8.7 to 9.3 mm. Essentially as described for male; antenna slightly narrower, width of shaft about 0.8 that of male; wing markings tend to be larger; hindwing color variation about the same. Genitalia as in Figure 189 (drawn from plesiotypes, Boulder, Colorado, JAP prep. nos. 2138, 2347; three preparations examined); anterior apophyses short, broad; sterigma broadly joined to IX tergite, sclerotized completely around ostium; signum a deep, narrow fold without dentation.

TYPE DATA.—"Basque" [Bosque] County, Texas (Belfrage). lectotype male by present designation: "Tex, Chambers," "Type 1404" (lacking wings and legs from one side), in Museum of Comparative Zoology, Harvard (*apicipunctella*); Zavalla County, Texas, April (F. C. Pratt), holotype female in U.S. National Museum (*zavalla*).

GEOGRAPHICAL DISTRIBUTION. — Southern Texas (Brownsville) and Nueva Leon to eastern Arizona (Paradise, Cochise County), undoubtedly adjoining parts of Mexico; northward into Colorado and southern Wyoming.

FLIGHT PERIOD.—March to July, possibly double brooded; most records are for April and May.

FOOD PLANT.—Unknown.

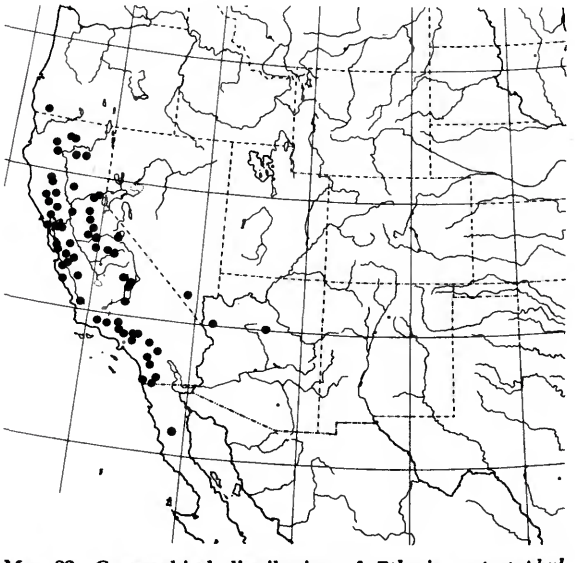
REMARKS.—Specimens from New Mexico and Arizona tend to have the black markings of the wings elongated longitudinally and somewhat coalesced, rather than distinct dots as in the Texas material. All of those studied from more northern areas (Boulder, Colorado; near Newcastle, Wyoming) have the forewing pale gray, but this is not a strictly geographically related feature. The southernmost specimen examined (3 mi E Galeana, Nueva Leon, Mexico) is also of the gray type.

Ethmia arctostaphylella (Walsingham)

FIGURES 8, 9, 17, 18, 64, 190; PLATES 7*b-d*, 21*g-h*, 22*d*; MAP 22

Psecadia arctostaphylella Walsingham, 1880:88.
Ethmia arctostaphylella.—Dyar, 1902:203.—Busck, 1912:85.—Barnes and Busck, 1920:241, pls. 26, 34 [synonymy].—Keifer, 1936a:16.—McDunnough, 1939:82.—Powell, 1959:143; 1971: 42 [biol.].—Patterson and Powell, 1960:232.
Psecadia obscurella Beutenmüller, 1888:29.
Ethmia obscurella.—Dyar, 1902:203.
Ethmia mediella Busck, 1913a:99.

A moderately large *Ethmia* having gray forewings that are whitish on the dorsal half, and a yellow abdomen. The shade of gray on the forewing varies from blackish to whitish.



MAP 22.—Geographical distribution of *Ethmia arctostaphylella* (Walsingham).

MALE.—Length of forewing 8.4–11.7 mm. *Head*: Labial palpus elongate, strongly upcurved, exceeding antenna base; second segment strongly curved, length about 1.4–1.6 eye diameter; third segment straight, about 0.65–0.80 as long as second; smooth scaled, entirely whitish to mostly blackish exteriorly, whitish interiorly, usually mostly whitish, second segment blackish exteriorly. Antenna dilated, width of basal one-third of shaft 0.26–0.28 eye diameter; scaled dorsally pale to dark gray. Scaling of proboscis, front and crown appressed, white or mixed white and black, of occipital white laterally, black in middle. *Thorax*: Collar dark basally, white distally; pronotal scaling white with two pairs of small, distinct, black spots below tegulae apices and on scutellum, to heavily mixed with black scales, the four spots large. Underside mostly white to grayish; prothoracic and mesothoracic legs gray to black exteriorly with white tibial and tarsal bands; metathoracic leg pale ochreous, dorsal fringe of tibia well developed. *Forewing*: Width variable, length from 3.2 times width (pale form) to 3.8 times width (dark form); costa gently curved, flattened near middle; apex blunt, termen not strongly angled back, tornus developed. Ground color divided by longitudinal line along Cu fold, curving upward at end of cell and angling back toward tornus, becoming obsolete before latter; dark gray on costal half, whitish gray on dorsal; black spots as follows: a mark obliquely angled inward from costal gray toward dorsum before middle of cell, a short bar in dorsal white adjoining gray at dividing line in outer half of cell, about ten distinct dots along termen from before apex to beyond tornus. Terminal area usually and costal area often clouded with whitish, at times the whole ground pale, rarely whitish so that dividing line scarcely discernible (*mediella*); at times costal half blackish, dorsal half heavily infused with dark gray, the dividing line poorly shown (*obscurella*). Underside pale to dark gray, costa and dorsal margin pale ochreous. *Hindwing*: Slightly broader than forewing; costal area simple; costa sloping from before middle to apex, latter blunt, rather narrow, termen strongly angled back, broadly curved to dorsum. Ground color pale to dark gray; anal area including hairs and fringe pale ochreous; fringe ochreous to apex except in darkest form. Underside mostly pale ochreous, clouded with pale to dark gray through median area above anal area. *Abdomen*: Dorsal scaling dark gray; dark toward base, or entirely bright ochreous; underside and genital scaling ochreous. Genitalia as in Figure 64 (drawn from plesiotype, Alpine Lake, Marin County, California, JAP prep. no. 1363; six preparations examined); uncus notched; gnathos densely spined posteriorly, weakly dentate anteriorly; basal process short, membranous; valva round distally.

FEMALE.—Length of forewing 10.1 to 14.0 mm. Essentially as described for male. Antenna not dilated, width of shaft near base 0.18–0.20 eye diameter. General color tending to be lighter than male, wing markings often more distinct, the dividing line emphasized by black. Abdomen ochreous, only rarely black near base, not black over whole dorsum in dark forms. Genitalia as in Figure 190 (drawn from plesiotype, El Dorado County, California, JAP prep. no. 2701; three preparations examined); sterigma not sclerotized posterior to ostium, sides angled steeply anteriorly; antrum with a short, broad, sclerotized sleeve and transverse fold; signum a strongly sclerotized, dentate fold; corpus bursae with distal accessory pouch.

TYPE DATA.—"Mendocino and Lake counties and near San Francisco, California, 1871" (Walsingham), data from the type male in British Museum reads "Coal Creek Canon, Mendocino Co., California, VI–14–1871," (*arctostaphylella*); Havilah, California, June, 1869 (Hy. Edwards), type male in U.S. National Museum (*obscurella*); San Diego, California, June, July (W. S. Wright), type female in U.S. National Museum (*mediella*).

GEOGRAPHICAL DISTRIBUTION.—Southern Oregon (Josephine County) and northern California (Trinity and Shasta counties), southward to the Sierra San Pedro Martir, Baja California; eastward in southern Nevada (Charleston Mountains) and Arizona (Pinal Mountains; Oak Creek Canyon) according to available records. Possibly following the distribution of its hosts northward in Oregon and into Utah.

FLIGHT PERIOD.—February to October, multivoltine.

FOOD PLANT.—Species of *Eriodictyon* (Hydrophyllaceae); the association has been observed for *E. californicum, tomentosum,* and *trichocalyx* and is presumed for *angustifolium* in Baja California,

Nevada, and Arizona. A detailed biology is reported elsewhere (Powell, 1971).

REMARKS.—As discussed previously (Powell, 1959), the wing color variation is in part seasonally correlated. It is also in part geographically related in that the paler forms tend to represent arid areas as well as the dry time of year. The dark form, *obscurella,* which has narrower forewings, is the typical phenotype taken in early spring in the central Coast Ranges of California, but I have not seen it from southern California. In summer, paler forms replace the dark spring generation at central coastal localities, but these do not reach the white extreme (*mediella*) exhibited by some summer generation individuals in southern California.

The association of *Ethmia arctostaphylella* with *Eriodictyon* rather than *Arctostaphylos* suspected earlier (Powell, 1959) is confirmed. Numerous collections of adults and larvae have been made from the above-mentioned species of *Eriodictyon,* while no further evidence of use of *Arctostaphylos* has accumulated. At maturity larvae pupate on the host leaves or wander, and the latter behavior probably resulted in Walsingham's find of a cocoon on *Arctostaphylos.*

Ethmia mansita Busck

FIGURE 65; PLATE 7*e*

Ethmia mansita Busck, 1914c:55.

A small gray moth resembling *E. discostrigella,* from central Mexico.

MALE.—Length of forewing 8.5 to 9.1 mm. *Head*: Labial palpus elongate, upcurved; second segment curved, about 1.4 times eye diameter, third segment straight, about 0.7 as long as second; smooth scaled, whitish, second segment brownish exteriorly. Antenna slightly dilated, width of shaft about 0.23 eye diameter; scaled dorsally near base, white, scape brown above. Scaling of front and crown whitish, of occipital margin, white with intermixed brown toward middorsum. *Thorax*: Dorsal scaling white with a brown, longitudinal, median streak; a brown spot at base of tegula. Underside scaling shining whitish including legs; tarsi brownish. *Forewing*: Narrow, length about 3.7–3.9 times width; costa straight except near base and apex, latter acute; termen strongly angled back, broadly curved to dorsum; fringe broad, reducing narrow appearance of wing. Ground color pale gray, overlaid with whitish. Black markings as follows: a short longitudinal streak from base in cell; two short longitudinal streaks in cell, one at basal one-fourth, one at middle of wing; a dot below and between these, below Cu fold; an irregular mark angled toward apex at end of cell; a thin line from middle of terminal area to apex; a series of about ten dots along margin from well before apex to tornal area. Fringe white, grayish in tornal area. Underside pale brownish; some differentiated brown scaling (possibly sex scaling) through cell; fringe whitish at apex. *Hindwing*: About as brown as forewing; dorsal hair pencil of costa exposed, rather short, pale brownish; costa only slightly sloping to apex, latter blunt, termen broadly curved to dorsum. Ground color pale brownish, whitish basally; fringe elongate, nearly one-half as long as membrane width; white. Underside similar, darker brownish. *Abdomen:* Dorsal and ventral scaling shining whitish gray. Genitalia as in Figure 65 (drawn from cotype, JAP prep. no. 1507; two preparations examined); uncus hoodlike, notched; gnathos broad, dentate posteriorly; basal processes short, broad; valva with a notch in costa and triangulate folds on inner face.

FEMALE.—Not studied in detail. Similar in size and general appearance to male (based on one specimen). Genitalia not examined.

TYPE DATA.—Tehuacan, Puebla, Mexico, September (R. Müller), holotype female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality.

FLIGHT PERIOD.—September (records from 1913 and 1937).

FOOD PLANT.—Unknown.

THE DISCOSTRIGELLA COMPLEX

Members of this group are the common gray *Ethmias* of arid regions of the southwestern United States. They are by far the most common species in collections; at times the moths teem by the hundreds to lights in eastern California and Arizona. Local and seasonal variations are superimposed upon the wide geographical range of two similar appearing species which fly together.

The first species to be described was *E. discostrigella* (Chambers, 1877) from Edgerton,

Colorado (near Colorado Springs). The forewings were described as being purplish, gray with a pale longitudinal streak containing three black lines (Plate 7*f*). Walsingham (1880) named a second entity, *E. subcaerulea,* from central coastal California which has pale bluish gray forewings with many fine black streaks in the costal half (Plate 7*g*). Later, however, after studying material from Arizona, Utah, and Colorado, Walsingham (1888) concluded that his supposed species was synonymous with *discostrigella.* A third name, *semitenebrella,* was proposed by Dyar (1902) for a more distinctly marked form with forewing having a gray costal half and white dorsal area, the latter marked by two conspicuous black, diagonal streaks. (Plate 7*h*). The moth, which was represented by specimens from Colorado, Arizona, and California, was described as a species but stated to be probably only a variety of *discostrigella* by Dyar. Dyar's name was treated as synonymous with *discostrigella* by Meyrick (1914). Barnes and Busck (1920), however, figured the male genitalia and showed slight differences between *semitenebrella* and *discostrigella,* which they treated as species.

A subsequent discussion (Powell, 1959) added little clarity to the picture except to cite considerable additional western material, none of which showed genital characters intermediate between the two. The two diagonal black marks of the dorsal area were given as an indicator for *semitenebrella* (as opposed to one or none in *discostrigella*).

The hindwing of *E. semitenebrella* bears a conspiculous hair pencil on the costa, which has been previously overlooked, and this correlates with both male and female genitalia and wing color differences, confirming the two as separate species. Accumulation of hundreds of specimens together with diurnal observations on the host associations and larval rearings during the past ten years have enabled further clarification of phenotypic variation extant in the complex.

The two species are widespread in arid and semiarid parts of southwestern United States and northwestern Mexico, following the distribution of their hosts, species of *Cercocarpus* (Rosaceae). Although the two are often found flying together, *E. semitenebrella* is considerably less common in collections and is less phenotypically variable and less widespread (Maps 23, 24). *E. discostrigella* is multivoltine in some, if not all, areas and is seasonally variable. *E. semitenebrella* evidently is adapted to a narrower range of ecological situations and does not show much wing color variation from one area to another; it may be double brooded, but there are no data from individual localities showing two flights.

The typical forms representing both of the names applicable to *discostrigella–subcaerulea* in California and *discostrigella* from Colorado–are distinct from *semitenebrella* in wing pattern. However, over much of the southern half of its range, *discostrigella* exhibits a slightly to decidedly white dorsal area, which causes a superficial resemblance to *semitenebrella.*

For purposes of discussion, I am applying a subspecific designation to the two available names for *discostrigella,* although in parts of the range of the species neither name is appropriate in a subspecific sense. The Great Basin areas of eastern Oregon and California (east of the Sierra Nevada) through Nevada, Utah, and Colorado are occupied by populations of *discostrigella* in which the individuals are large (wing expanse mostly 25–30 mm) and which have dark metal-gray forewings with whitish only through the median longitudinal area and the black marks more or less similarly restricted. These may be referred to as *E.d. discostrigella.* In cismontane California and doubtless Baja California Norte and possibly western Oregon, most of the moths are smaller (20–26 mm expanse) and have the forewing much paler–whitish gray which is bluish gray in appearance. The costal half, which usually is not darker gray, bears numerous longitudinal, fine black streaks. Walsingham's name *subcaerulea* is applicable to these, but in southern California many specimens exhibit development of a pale dorsal and dark costal area.

Populations in Arizona and New Mexico may be interpreted as representing a broad zone of blend in wing color phenotype between *d. discostrigella, d. subcaerulea,* and a race similar in general appearance to *semitenebrella.* In northwestern Arizona several large samples indicate that variation here is similar to *subcaerulea.* In June (Hualapai Mountains) the size is about the same as that shown in cismontane California, while in late August and September (Kaibab Plateau; Oak

Creek Canyon) the moths are consistently small (expanse 19–21 mm). Farther to the south and east, the forewing pattern varies away from typical *subcaerulea* but only in part toward typical *discostrigella* (to the north, even in southern Nevada and Utah, typical *discostrigella* is almost exclusively present). Samples from the Chiricahua Mountains in southeastern Arizona show a form approaching Colorado *discostrigella* in April, but a much paler phenotype, more distinctly marked with black lines, in September. The latter are indistinguishable from extremes in southern California, which, however, do not seem to be seasonally predominent. Similar seasonal variation may occur in other regions of Arizona, New Mexico, and adjacent parts of Texas and Mexico, but samples at individual localities are inadequate at present.

Ethmia discostrigella (Chambers)

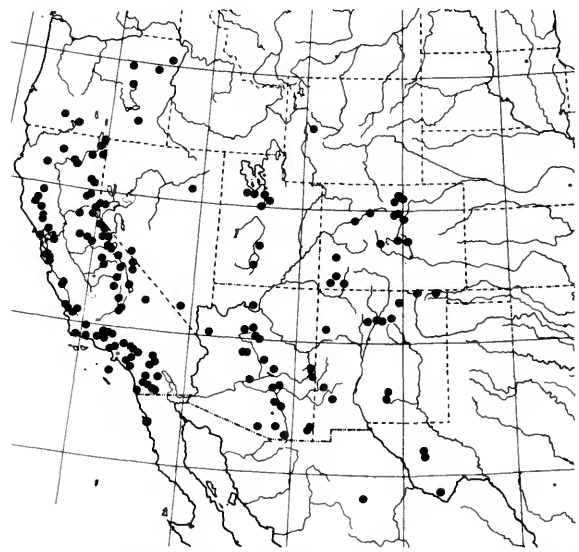
Anesychia discostrigella Chambers, 1877:122.
Ethmia discostrigella.—Walsingham, 1888:149 [in part] [synonymy].—Dyar, 1902:204 [in part].—Barnes and Busck, 1920:242, pls. 26, 27, 34 [in part] [synonymy].—Braun, 1925: 198.— McDunnough. 1939:82 [in part].—Powell, 1959:136 [in part]; 1971:46 [biol.].
Psecadia discostrigella.—Riley, 1891:99 [in part].

A large moth having dark gray forewings with median longitudinal whitish and black lines, and a yellow abdomen. The typical subspecies, which is larger, with more uniformly gray forewings, is widespread in the Great Basin and Rocky Mountains.

Ethmia discostrigella discostrigella (Chambers), new status

FIGURES 16, 66, 188; PLATE 7*f*; MAP 23

MALE.—Length of forewing 10.4–14.0 mm. *Head*: Labial palpus strongly upcurved, elongate, exceeding crown; second segment strongly curved, length 1.4–1.5 times eye diameter; third segment very slightly curved, about 0.7–0.75 as long as second; smooth scaled, mostly brownish gray, whitish at base, at apex of second segment and basal half of third, to mostly whitish, brownish gray exteriorly on second segment above base and subapically on third. Antenna slightly dilated, width of shaft in basal third about 0.25 eye diameter; scaled above, basally whitish, scape white below and anteriorly, dark posteriorly. Scaling of proboscis, front, and vertex smooth, mostly brownish gray, becoming mostly white at vertex and crown, spreading at occipital margin, white laterally, dark at middorsum. *Thorax*: Collar brownish basally; pronotal scaling white with three pairs of lateral, black spots at tegulae bases, just beyond tegulae apices, and on scutellum. Underside scaling shining whitish; pro- and mesothoracic legs dark gray exteriorly, hindleg pale ochreous; tibial fringe small. *Forewing*: Length about 3.4–3.5 times width; costa gently curved from base to apex, flattened slightly beyond middle, apex acute, termen strongly angled back, tornus discernible. Ground color dark gray, overlaid with scattered whitish scales, usually more numerous in dorsal and terminal areas and concentrated through upper part of dorsal area to form an ill-defined longitudinal white streak from base to a conspicuous spur at end of cell; at times whitish more or less concentrated over whole dorsal area. Black markings, at times reduced or partially obsolete, as follows: a narrow line on Cu fold from base to about inner one-fourth; a second shorter line just beyond, sending a diagonal spur toward anal angle; a third line on Cu fold in outer half of cell; an elongate streak through middle of cell in outer half; small blotches preceding, following, and above white spur at end of cell; a series of about nine conspicuous dots around margin from before



MAP 23.—Geographical distribution of *Ethmia discostrigella* (Chambers).

apex to tornus, at times continued as a thin line along dorsal margin. Fringe pale grayish; costal fringe pale ochreous. Underside uniform gray. *Hindwing*: About as broad as forewing; costal brush lacking; costa slightly excavate toward apex, latter blunt, termen broadly curved to dorsum, tornus not discernible. Ground color pale gray, becoming whitish ochreous toward anal area. Fringe narrow, whitish ochreous with gray basal band. Underside the same. *Abdomen*: Scaling entirely pale to bright ochreous. Genitalia as in Figure 66 (drawn from plesiotype, Union Co., New Mexico, JAP prep. no. 1370; 15 preparations examined); uncus hoodlike, with a shallow notch bordered by weak lateral peaks; gnathos dentate posteriorly and anteriorly; basal processes small, membranous; valva broadened distally, round apically.

FEMALE.—Length of forewing 11.0–14.7 mm. Essentially as described for male; eye slightly smaller, diameter about 0.9 that of male; antenna not dilated, width of shaft about 0.7 that of male. Wing color variation as in male. Ochreous of abdomen usually brighter and somewhat more extensive on legs and hindwing. Genitalia as in Figure 188 (drawn from plesiotype, San Luis Obispo County, California, JAP prep. no. 2714; eight preparations examined); sterigma sclerotized only anterior to ostium, sides angled steeply away anteriorly; base of ductus with a short sclerotized sleeve, followed by about 1 mm uncoiled membranous section which bears one or two weakly sclerotized bands with variable, tiny spurs; signum a dentate fold 0.36–0.44 mm in length.

TYPE DATA.—Edgerton, Colorado, among oaks; altitude, 6,500 feet. Lectotype male, present designation: "Anesychia discostrigella Cham. Col., Chambers, Colorado, Type 1421," in Museum of Comparative Zoology, Harvard.

GEOGRAPHICAL DISTRIBUTION.—Great Basin portions of eastern Oregon and California (east of the Sierra Nevada), southwestern Idaho, Nevada, and Utah; southward through Colorado, eastern New Mexico and western Texas, into Chihuahua and Nueva Leon, Mexico.

FLIGHT PERIOD.—April to September; multivoltine, at least in southern portions of the range. Most flight records in northern areas are for June and July.

FOOD PLANT. — *Cercocarpus ledifolius* Nutt. (Rosaceae) and undoubtedly other species of *Cercocarpus*. Biological studies are given elsewhere (Powell, 1971).

Ethmia discostrigella subcaerulea (Walsingham), new status

PLATE 7*g*; MAP 23

Psecadia subcaerulea Walsingham, 1880:89.—Beutenmuller, 1888:29.
Ethmia subcaerulea.—Dyar, 1902:204 [in part].—Busck, 1907:94.
Ethmia discostrigella.—Walsingham, 1888:149 [in part] [synonymy].—Meyrick, 1914:30 [in part] [synonymy].—Barnes and Busck, 1920:242, pls. 26, 27, 34 [in part].—Keifer, 1936a:16.—McDunnough, 1939:82 [in part].—Powell, 1959: 136 [in part]; 1971:47 [biol.].

A Pacific Coast race which usually has the forewing densely covered with white overscaling, giving a uniform bluish-white appearance.

MALE.—Length of forewing 10.0–13.0 mm. Structural characters as described for nominate subspecies. Scaling generally more whitish on head, body, and legs. Forewing ground color dark gray, but usually overlaid with white over whole surface, somewhat less densely on costal area, leaving a series of darker longitudinal streaks; at times less so over whole wing resulting in a generally dark, white-streaked appearance; rarely the dorsal area uniform whitish, costal area mostly dark. Black markings as on nominate subspecies, tending to be larger on the gray-streaked forms, correspondingly more strongly contrasting with dorsal area. Abdomen pale ochreous. Genitalia not distinguishable from nominate subspecies (four preparations examined).

FEMALE.—Length of forewing 10.4-13.1 mm. As described for male and nominate subspecies. Abdomen pale ochreous, usually paler than in *d. discostrigella*. Genitalia as in *d. discostrigella*.

TYPE DATA.—"Sonoma and Mendocino Counties, California, May 23 and June 13, 1871" (Walsingham), types in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Cismontane California, west slope of the Sierra Nevada and Coast Ranges to southern California, and undoubtedly Baja California Norte.

FLIGHT PERIOD.—March to September; multivoltine.

FOOD PLANT.—*Cercocarpus betuloides* Nutt. (= *montanus*) and *C. minutiflorus* Abrams. Biological observations are given elsewhere (Powell, 1971).

REMARKS.—As discussed above, individuals from Arizona and western New Mexico do not correspond well to either of the above subspecies. Most are similar to *subcaerulea* but tend to have a well-defined contrast between the dark costal and whitish dorsal areas. The diagonal and median longitudinal black marks usually show more conspicuously on the pale dorsal area than in the California race or *d. discostrigella*.

Ethmia semitenebrella Dyar

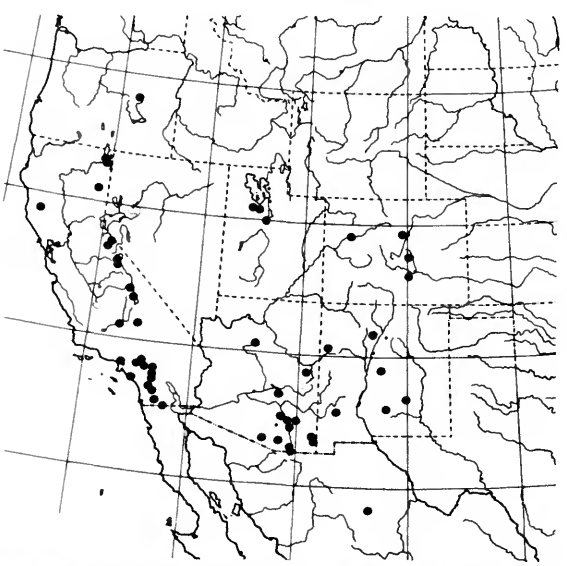
FIGURES 67, 191; PLATES 4*c*, 7*h*; MAP 24

Ethmia semitenebrella Dyar, 1902:204.—Barnes and Busck, 1920, pls. 26, 34.—Braun, 1925:197.—McDunnough, 1939:82.—Powell, 1959:139; 1971:51 [biol.].

Ethmia discostrigella [in part].—Meyrick, 1914:30.—Powell, 1959:136.

A moderately large *Ethmia* with forewings having dark costal and whitish dorsal areas. The latter marked on basal half by two inwardly directed, diagonal black streaks. Hindwing of male with costal hair pencil.

MALE.—Length of forewing 10.1–13.4 mm. *Head*: Labial palpus moderately elongate, not strongly curved; second segment slightly curved, length about 1.2–1.35 times eye diameter; third segment straight or nearly so, about 0.65–0.70 as long as second; scaling appressed, mostly dark brownish gray with whitish blotches anteriorly on basal half of second segment and at joint between second and third, to mostly white with subapical dark spots on each segment. Antenna slightly dilated, width of shaft basally about 0.22 eye diameter, scaled dorsally white, becoming brown beyond basal segments. Scaling of front smooth, dark brown, whitish at base, of crown white with median dark spot at occipital margin. *Thorax*: Dorsal scaling white, paired black spots at tegulae bases, just beyond tegulae apices and on scutellum. Underside shining white; prothoracic and mesothoracic legs dark brown exteriorly; metathoracic leg whitish ochreous. *Forewing*: Length about 3.5–3.6 times width; costa gently curved from base to apex, slightly flattened beyond middle; apex blunt, termen moderately strongly angled back, tornal angle well developed. Ground color dark gray on costal half, whitish gray on dorsal half; costal half usually with considerable whitish overscaling between the veins resulting in longitudinal streaks, more well defined beyond middle; dorsal white extending well into cell in basal half of wing, indented by a broad triangular spur of dark ground color in outer half of cell, upcurved as a white spur at end of cell. Black markings as follows: a short, longitudinal streak on Cu fold at base; two broad, distinct, diagonal, slightly sigmoid streaks from Cu fold toward anal area, the first at basal one-fourth, isolated in white dorsal area, the second, just before middle of wing, from apex of triangular dark ground projection; some black scaling preceding and following white spur at end of cell; a thin longitudinal streak through middle of outer half of cell, blending in terminal area with streak of dark ground color to termen just below apex; a series of about ten dots around margin from before apex to beyond tornus, the last usually elongated as a dorsal line. Fringe whitish, interspersed with pale brownish, a brown spot at longitudinal streak just below apex. Underside uniform pale brownish; fringe as above. *Hindwing*: About as broad as forewing; costal hair pencil exposed, well developed, from base extending more than one-third the length of wing, brownish gray or brownish



MAP 24.—Geographical distribution of *Ethmia semitenebrella* Dyar.

white; costa slightly excavate toward apex, latter narrow, termen strongly angled back to dorsum, tornus not developed. Ground color whitish becoming pale brownish on apical half; a patch of dark ochreous sex scaling under and slightly exceeding costal hair pencil. Fringe whitish, becoming pale ochreous in anal area. Underside similar, slightly paler, specialized costal scaling absent. *Abdomen:* Scaling entirely pale whitish ochreous. Genitalia as in Figure 67 (drawn from plesiotype, Chiricahua Mountains, Arizona, JAP prep. no. 318; eight preparations examined); similar to *E. discostrigella,* differing by well-developed lateral peaks on uncus; lateral flanges of gnathos posteriorly, and by a less broadened cucullar area with apex slightly pointed.

FEMALE.—Length of forewing 10.4 to 14.3 mm. Essentially as described for male; eye slightly smaller; antenna not dilated, width of shaft basally about 0.80–0.85 that of male; forewing markings generally more contrasting and distinct; costal area of hindwing simple, ochreous scale patch lacking; hindwing anal area with a pale ochreous tinge, more evident than in male. Genitalia similar to the preceding species, differing by the sides of sterigma not angled anteriorly from ostium (Figure 191, drawn from plesiotype, Monitor Pass, California, JAP prep. no. 2716; eight preparations examined) and an elongate uncoiled basal portion of the ductus bursae, and from *discostrigella* by a slightly larger signum, 0.41–0.55 mm in length.

TYPE DATA.—Fort Grant, Arizona, "20–7" (H. G. Hubbard); lectotype female, by present designation, in U.S. National Museum. "Ft. Grant, Ar. 20.7, H. G. Hubbard, Collector, Type No. 6621, USNM, ♀ Genitalia on slide Nov. 16, 1936, JFGC 793."

GEOGRAPHICAL DISTRIBUTION.—Colorado, Utah, New Mexico, and Nueva Leon Mexico, to Arizona, southern and eastern California; similar to but apparently not so widespread to the north and west as *E. discostrigella.*

FLIGHT PERIOD.—April to August; double brooded.

FOOD PLANT.—*Cercocarpus ledifolius* Nutt. (Rosaceae) and undoubtedly other species of *Cercocarpus.* Biological observations are given elsewhere (Powell, 1971). The report of *C. parvifolius* as a food plant at Williams, Arizona (Dyar, 1902), may refer to either *C. betuloides* Nutt. or *C. breviflorus* Gray according to present concepts.

The Papiella Group

Eye index 0.95–1.05. Maxillary palpus moderately large, four subequal segments. Labial palpus moderately short, II segment index 1.1–1.2, smooth or weakly roughened. Antenna of male not dilated or strongly dilated (index 0.45). Forewing moderately broad or moderately narrow. Hindwing of male with or without costal hair pencil, fold lacking. Abdomen pink, scaling undifferentiated. Uncus hoodlike; gnathos dentate anteriorly and posteriorly; basal processes moderately sclerotized, angulate or bifid; valva with broad setae on costa; fultura-manica simple; vesica armed. Papillae anales sclerotized, setate; posterior apophyses not elongate; anterior apophyses broad or narrow; sterigma ornate; antrum undefined or defined; ductus bursae membranous or sclerotized basally, 8–9 coils; signum a broad cone.

Two nocturnal species in Mexico and Central America which show strongest phenetic similarity to the Semilugens group but are unique in several respects, particularly the pink abdomen.

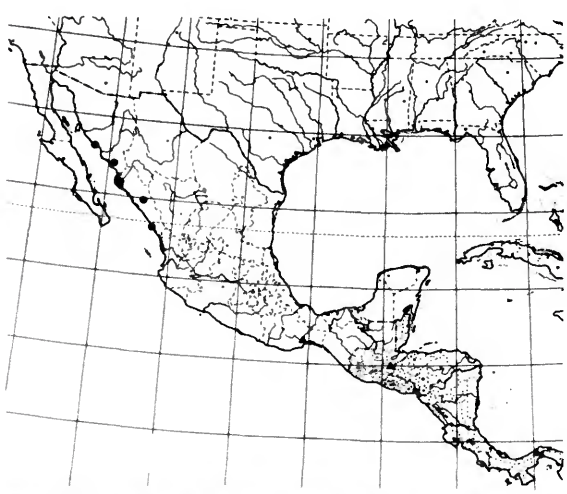
Ethmia papiella Powell, new species

FIGURES 68, 193, 194; PLATE 7*j*; MAP 25

A moth of *discostrigella* appearance, with the abdomen pink, occurring in the Sinaloan thorn forest on the west coast of Mexico.

MALE.—Length of forewing 6.7–7.8 mm. *Head:* Labial palpus elongate, strongly curved, exceeding base of antenna; length of second segment 1.1–1.25 times eye diameter (eye extraordinarily large, 1.4 mm diameter); third segment 0.7–0.8 eye diameter; scaling slightly roughened ventrally, whitish gray, second segment with a dark subapical blotch. Antenna slightly dilated, width near base 0.19 eye diameter; dorsal scaling whitish. Scaling of tongue whitish, of front appressed, pale gray, intermixed with brownish black between eyes, of crown whitish with some brownish black intermixed. *Thorax:* Tegula whitish, with a black spot at base, becoming broadly pink distally. Dorsal scaling of collar and pronotum whitish gray, four indistinct black spots, one preceding, a pair at sides of and one at apex of scutellum. Underside whitish gray, foreleg blackish exteriorly, hind tibia pale pink. *Forewing:* Length 3.4–3.5 times width; costa rather strongly arched; terminal fringe broad,

giving a subtruncate appearance. Ground color gray, overlaid with whitish in varying intensity (possibly lessened with age of the individual), when heavily so, wing mostly whitish except costal area on basal one-third, when less, only the outer costal area and a streak along fold whitish; a series of longitudinal black streaks, at times largely obscured by whitish: one at base in subcostal area and one just above cell before middle; a narrow streak at base on Cu fold and two broader ones on fold at one-third and middle of wing; an elongate one from midcell to termen below apex, interrupted at end of cell by white spur; a blurred blotch on dorsal margin before middle; a row of short streaks around termen from outer one-third of costa to beyond tornus. Fringe mostly gray, darker below apex, which is white. Underside pale brownish gray, a white streak through fringe at apex. *Hindwing:* Broader than forewing; upperside with a thick, whitish hair pencil to middle of costal area. Costal margin beyond not concave, angled obliquely to the narrow apex; dorsal margin concave before anal angle. Ground color whitish basally becoming pale grayish distally; costal area under hair pencil gray. Underside uniform pale whitish gray. *Abdomen:* Scaling of basal tergite pale gray, of remainder bright pink, extending laterad beyond midpleural area; venter and scaling of valvae pale gray. Genitalia as in Figure 68 (drawn from paratopotype, JAP prep. no. 1723, and plesiotype, Navajoa, JAP prep. no. 1603; four preparations examined); similar to *E. semitenebrella*, uncus and valvae narrowed distally, gnathos heavily spined anteriorly, basal processes greatly elongate, vesica with a series of strong spurs and a membranous connection to a sclerotized ring at the fultura (shown in Figure 68 in situ where they remain when aedeagus is removed).



MAP 25.—Geographical distribution of members of the Papiella group of *Ethmia*.
● *E. papiella* Powell ▲ *E. volcanella* Powell

FEMALE.—Length of forewing 7.3–8.7 mm. Essentially as described for male; eye slightly smaller (about 0.9 of male), labial palpus as large as in male; antenna not dilated, width of shaft near base about two-thirds that of male. Forewing averaging narrower, length 3.5–3.8 times width. Hindwing costal area simple. Genitalia as in Figures 193, 194 (drawn from paratype, Mazatlan, JAP prep. no. 2719; five preparations examined); sterigma a heavily sclerotized, thick ring, incomplete on posterior side of ostium; ductus entirely membranous; signum a deep fold, terminating in a single keellike projection into bursa.

TYPES.—Holotype male and allotype female: Mexico, Los Mochis, Sinaloa, August 7, 1964 (J. A. Chemsak and J. Powell) (taken at lights of a motel in the north part of town); to be deposited in California Academy of Sciences. Thirty-two Paratypes, all Mexico, as follows: *Sinaloa:* Rio del Fuerte, 13 mi N Los Mochis, 1♂, 6♀, VIII–7–64, at black and white fluorescent lights (J. A. Chemsak and J. Powell); same data as holotype, 20♂, 2♀; 6 mi S Culiacan, 1♀, VIII–6–64, at black and white lights (J. A. Chemsak and J. Powell); 5 mi N Mazatlan, 1♀, VII–27–64, at black and white lights (J. A. Chemsak and J. Powell). *Sonora:* 1 mi E San Carlos (Bay) Yacht Club, 1♀, VIII–13–64 (M. R. and S. H. Lundgren). Deposited in California Academy of Sciences, California Insect Survey and U.S. National Museum.

Also examined but not designated as paratypes was an additional series of 6 males and 3 females preserved in alcohol, with the following data: Sonora: 13 km SW Navajoa, VIII–22–54 (R. E. Ryckman, C. Christianson, and D. Spencer).

REMARKS.—The pink abdomen and tegulae will at once distinguish this species from any New World *Ethmia* except *E. volcanella*, which has pink hindwings.

Ethmia volcanella Powell, new species

FIGURES 69, 192; PLATE 8*a-b*; MAP 25

A Central American species with black-marked gray forewings and a bright pink abdomen and anal area of the hindwings.

MALE.—Length of forewing 8.7 mm. *Head:* Labial palpus elongate, reaching to base of antenna; length of second segment about 1.2 times diameter of the unusually large eye, not strongly curved; third segment 0.6 as long as second; whitish, with broad blackish blotches on second segment medially and third segment basally. Antenna greatly dilated, width of basal 6–8 segments of shaft, 0.45 eye diameter, tapering to moderate diameter (0.22 eye diameter) by 12th segment; thickly scaled dorsally, pale gray-brown. Scaling of front whitish, becoming pale gray-brown at crown. *Thorax:* Dorsal scaling pale gray-brown, two pairs of black spots, anteriorly near collar and posteriorly at sides of scutellum, possibly a median spot preceding scutellum. Underside whitish gray; foreleg dark brownish gray exteriorly with whitish tibial and tarsal bands, epiphysis very large, widely flared from tibia; meso-leg whitish marked with dark brown on tibia and tarsus; meta-leg pale pink, becoming whitish distally. *Forewing:* Length about 3.6 times width; costa gently curved, termen strongly angled back, tornal angle distinct. Ground color gray, with a distinct white spur at end of cell, and marked with black, as follows: a short streak at base of costa into subcostal area; an elongate streak along Cu fold from base to beyond middle of cell, interrupted by irregular white spotting; a streak from middle of cell in costal half into terminal area, not reaching submarginal dots, notched from below but not fully interrupted by the white spur at end of cell; about seven submarginal dots from before apex to tornus. Some scattered white scaling on dorsal half. Fringe gray. Underside pale brown, the black streaks of upperside indistinctly evident. *Hindwing:* Slightly broader than forewing; costal area simple, costal margin slightly excavate before the narrow apex. Ground color pale pink, brightest in anal area, becoming paler distally, apical area dark brownish. Fringe whitish. Underside the same. *Abdomen:* Dorsal scaling, including genital tufts, bright pink; ventral scaling pale pink. Genitalia as in Figure 69 (drawn from holotype, JAP prep. no. 2179; one preparation examined); uncus broadened near base, basal processes forked, valva with a series of very large, heavily sclerotized setae on costal margin distally, vesica with five elongate, toothed, sclerotized cornuti, an apical hooklike structure on aedeagus.

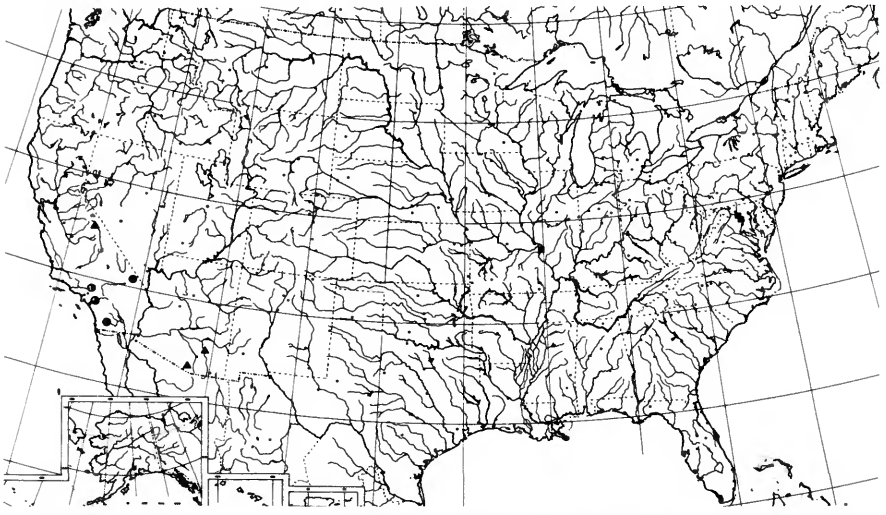
FEMALE.—Length of forewing 9.7–11.2 mm. As described for male; labial palpus more elongate, length of second segment 1.3 times eye diameter, third segment 0.67 the length of second; antenna not dilated, width of shaft near base about 0.17 eye diameter. Coloration and markings as in male, color brighter, the forewing markings more distinct and contrasting, whitish scaling of dorsal area tending to form a dot in basal one-third and two zig-zag lines enclosing a darker gray area just beyond middle; abdomen and hindwing brighter pink than in male. Genitalia as in Figure 192 (drawn from paratype, JAP prep. no. 2180), sterigma produced laterally, basal two loops of ductus partially sclerotized, seven loops beyond membranous; signum similar to *papiella* but the keel dentate.

TYPES.—Holotype male: Mexico, Tehuantepec, Oaxaca, July 15–16, 1964 (P. J. Spangler). Allotype female and two paratype females: Guatemala, Rio Teculutan, Zacapa, August 18, 1965 (Flint and Ortiz). All deposited in U.S. National Museum.

The Macelhosiella Group

Eye index 0.9–1.1. Maxillary palpus small, three or four globose segments. Labial palpus moderately short, II segment index 1.0–1.4, smooth scaled. Antenna of male moderately dilated, index 0.20–0.25. Forewing narrow; pattern costal-dorsal. Hindwing of male with or without costal hair pencil, fold lacking. Uncus hoodlike; gnathos dentate anteriorly and posteriorly; basal processes membranous, broad or rudimentary; valva with "clasper" on inner side; fultura-manica and vesica without armature. Papillae anales weakly sclerotized, setate; posterior apophyses not elongate; anterior apophyses broad; sterigma simple; antrum undefined; ductus bursae membranous or sclerotized basally, five to seven tight coils; signum a dentate bar.

A closely related quartet of United States species which has developed pupal estivation, late fall flight, and egg hibernation. *Ethmia macelhosiella* has an intermediate eye size and apparently is diur-



MAP 26.—Geographical distribution of members of the Macelhosiella group of *Ethmia*.
■ *E. macelhosiella* Busck ◑ *E. timberlakei* Powell
● *E. geranella* Barnes and Busck ▲ *E. macneilli* Powell

nal, possibly a secondary development in response to low nocturnal autumnal temperatures in the eastern United States.

Ethmia macelhosiella Busck

FIGURES 70, 195; PLATE 8c; MAP 26

Ethmia macelhosiella Busck, 1907:93.—Barnes and Busck, 1920, pls. 27, 34. —Busck and Heinrich. 1922:1 [biology].—Forbes, 1923:245 [taxonomy].—McDunnough, 1939:82.—Clench, 1957:44.

A moderately large moth with elongate, narrow gray forewings having a broad, ill-defined, longitudinal black streak from base to apex.

MALE.—Length of forewing 12.3 to 12.7 mm. *Head:* Labial palpus elongate, moderately upcurved; second segment slightly curved, length 1.4 times eye diameter; third segment straight, about one-half the length of second; smooth scaled, second segment blackish, white at base and apex, third segment mixed whitish and pale brownish. Antenna dilated, scape flattened, ovoid, length 0.75, width about 0.4 eye diameter, dorsal scaling brown, ventral white; shaft basally about 0.25 eye diameter, unscaled, densely setate. Scaling of head white except front and spot at back of crown brown. *Thorax:* Dorsal scaling mostly whitish, base of tegula and scutellum with lateral spots dark brown. Underside scaling whitish; legs brown, metathoracic leg paler, dorsal fringe of tibia weakly developed. *Forewing:* Length about 3.7 times width; costa nearly straight from basal one-fourth nearly to apex, curved abruptly to apex; termen strongly angled back to dorsum, tornus scarcely discernible; fringe narrow. Ground color whitish, sparsely to densely irrorate with pale brownish; a broad, dark line from base to apex, through lower half of cell, narrowed beyond cell, well defined on dorsal side, sending a small, squarish dark spur into pale dorsal area just before middle, an upturned white spur at end of cell; costal side of median line less well defined in basal half; veins at times with blackish scaling toward costa in outer half. Fringe white. Underside light brown, paler toward dorsum and termen. *Hindwing:* Slightly broader than forewing; costal area simple; costa only slightly sloped toward apex, latter blunt, round; termen broadly curved to anal angle. Ground color pale brownish or dirty whitish; fringe whitish with brown basal band. Underside similar. *Abdomen:* Scaling above and below pale brownish, posterior bands of segments and genital scaling whitish. Genitalia as in Figure 70 (drawn from plesiotype, Plummer's Island, Maryland, JAP prep. no. 1524; five preparations examined); uncus rather narrow, hoodlike, shallowly notched; gnathos with fine

teeth posteriorly, bare anteriorly; basal processes elongate, broad; valvae attenuate, acute apically.

FEMALE.—Length of forewing about 10.7 mm. Similar to male but generally smaller and with more development of dark markings. *Head:* Eye relatively smaller, diameter about 0.8 that of male; labial palpus correspondingly shorter. Antenna not dilated, diameter of shaft basally about 0.67 that of male. *Forewing:* Dark scaling variable, more extensive than on male, the longitudinal median line broadened toward costal side, covering most of cell, blending gradually toward pale costa. A line of ochreous yellow scales along the distinct dorsal side of dark area. *Hindwing:* Darker brown than on male. Genitalia as in Figure 195 (drawn from plesiotype, Plummer's Island, Maryland, JAP prep. no. 2258; one preparation examined); anterior apophyses broad, strongly developed; sterigmal plate broad, extended laterally halfway around abdomen, ostium simple; ductus bursae with two sclerotized loops well below ostium, remainder of spiral unsclerotized.

TYPE DATA.—St. Louis, Missouri (H. A. McElhose); further data on type, which lacks most of the abdomen, is: November 17, 1904, in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Eastern United States. Known from only three widely scattered areas: St. Louis, Missouri, Plummer's Island and Cabin John, Maryland, and Finleyville, Pennsylvania.

FLIGHT PERIOD.—October and November.

FOOD PLANT.—*Phacelia* sp. (Hydrophyllaceae). Busck and Heinrich (1922) reported on the biology of *E. macelhosiella* at Plummer's Island. Larval specimens from their study in the U.S. National Museum bear the data *Phacelia covillei*. The larvae were found on *Phacelia* in May, and larvae selected cracks in or bored into bark of logs or trees to pupate for estivation.

REMARKS.—The type specimen is a little paler and has the median stripe slightly more well defined than the variable series from Plummer's Island; its genitalia have been lost, apparently to dermestid damage.

Ethmia geranella Barnes and Busck

FIGURE 71; PLATE 8*e-f*; MAP 26

Ethmia geranella Barnes and Busck, 1920:242, pls. 27, 34.—McDunnough, 1939:82.

A medium-sized *Ethmia* having whitish gray forewings usually marked by a conspicuous but somewhat ill-defined dark brownish streak from base to apex.

MALE.—Length of forewing about 10.4 mm. *Head:* Labial palpus nearly porrect, rather short; second segment slightly curved, length about equal to eye diameter, third segment nearly as long as second (0.95 eye diameter); smooth scaled, mostly whitish, some brown scales intermixed exteriorly. Antenna slightly dilated, diameter of basal portion of shaft about 0.2 eye diameter; scaled, gray, densely setate. Scaling of front and crown appressed, brownish with intermixed whitish scales; tufts at occipital margin spreading, white. *Thorax:* Dorsal scaling mixed brown and white; tegula white distally. Underside shining whitish; legs brownish exteriorly; metathoracic leg dirty whitish, tibial fringe well developed, elongate, white. *Forewing:* Narrow, length about 4.0 times width; costa nearly straight from basal one-third to apical one-fourth, abruptly curved to apex, latter blunt, termen strongly angled back; fringe moderately broad. Ground color whitish, more or less uniformly irrorate with scattered brown scales; usually with a longitudinal dark brown streak from base to apex through lower half of cell, well defined on dorsal side, which sends two distinct, short spurs into pale dorsal area before middle of wing; streak bends upward at second spur, interrupted on dorsal half by an outwardly angled, distinct, oval white spot at end of cell; poorly defined on costal side. Fringe of ground color, distinctly interrupted by longitudinal streak at apex. Underside pale brownish. *Hindwing:* Slightly broader than forewing; costa with well-developed dorsal hair tuft, arising at base, white; costa strongly excavate toward apex, latter blunt, termen strongly angled back to anal angle, slightly concave before anal angle. Ground color uniform pale brownish; fringe broad, about one-half membrane width, white. Underside whitish. *Abdomen:* Scaling shining pale brownish, more or less unicolorous including genital vestiture. Genitalia as in Figure 71 (drawn from cotype, JAP prep, no. 1505; two preparations examined); teeth of posterior portion of gnathos elongate, anterior portion minutely dentate; basal processes short; valvae attenuate.

FEMALE.—Unknown.

TYPE DATA.—La Puerta Valley, southern California. The lectotype male in U.S. National Museum bears no additional data.

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality, which is on the western edge of the Colorado Desert in San Diego County, and from one male taken in the Ivanpah Mountains of the eastern Mojave Desert.

FLIGHT PERIOD.—October.

FOOD PLANT.—Unknown; probably *Phacelia.*

REMARKS.—The brown color of the markings may be in part the result of the age of the specimens and could be blackish on fresh individuals. The single male from the Ivanpah Mountains lacks the longitudinal, dark streak. It shows a trace of the streak and some development of blackish streaking along the veins.

Ethmia timberlakei Powell, new species

FIGURES 5, 15, 196, 197; PLATE 8*g*; MAP 26

Ethmia timberlakei Powell, 1971:53 [*non descr.*, biol.].

A gray moth resembling *E. geranella,* differing by more elongate palpi and having the longitudinal streak more well defined and black on a dark gray ground, as well as by minor genitalic differences.

MALE.—Length of forewing (reared) 9.0 to 10.6 mm. *Head:* Labial palpus subporrect; second segment slightly curved, length variable, about 1.2 to 1.35 times eye diameter, smooth scaled, mostly blackish exteriorly, white ventrally at base and interiorly at least on third segment. Antenna slightly dilated, diameter of shaft basally about 0.2 eye diameter; scaled, gray. Scaling of front and crown appressed, mixed dark gray and whitish, white at sides. *Thorax:* Dorsal scaling dark gray with intermixed white. Underside shining pale gray; legs dark gray exteriorly, metathoracic leg paler, tibial fringe well developed, elongate, white. *Forewing:* Narrow, length about 4.0 times width, having a broader appearance owing to broad tornal fringe; costa straight on middle one-third, strongly curved to apex, termen strongly angled back to dorsum, tornus not developed. Ground color dark gray, sparsely to densely irrorate with scattered white scales; a well-defined or indistinct narrow black line from base to apex through lower part of cell, not broadened on costal side; sending a short spur into dorsal area just before middle of wing, beyond this the line slightly offset toward costa; interrupted and broken by an oval white spot at end of cell, which is more conspicuous than on *E. geranella,* due to the dark ground color of *E. timberlakei;* streak ill-defined at apex and in fringe, latter concolorous with ground. Underside pale gray. *Hindwing:* Slightly broader than forewing; costa with well-developed dorsal hair pencil, arising at base, cream-white; costa excavate on distal one-third, apex blunt, narrow, termen strongly angled back, dorsum slightly concave before anal angle. Ground color uniform pale gray; fringe broad, about one-half membrane width, white. Underside whitish. *Abdomen:* Scaling shining whitish gray, more or less unicolorous including genital. Genitalia similar to *E. geranella* (Figure 71) but with the teeth of anterior portion of gnathos small; basal process broad, elongate, length equal to width of valva (three preparations examined).

FEMALE.—Length of forewing (reared), 8.7 to 10.0 mm. Essentially as described for male; eye and labial palpus smaller; antenna not dilated, diameter of shaft basally about 0.67 that of male; median dark streak of forewing often obscure; hindwing without costal hair pencil. Genitalia with anterior apophyses broad, as in *macelhosiella,* but sterigmal plate not as well developed and ductus bursae entirely unsclerotized (Figures 196, 197, drawn from paratopotype; JAP prep. no. 2328; three preparations examined); signum a depressed, oval patch, minutely, densely dentate, without lateral flanges.

TYPES.—Holotype male: California, Citrus Experiment Station, Riverside, Riverside County, March 21, 1961 (larva) (P. H. Timberlake), reared from *Phacelia ramosissima,* emerged November 8, 1961 (JAP 61C12). Allotype female: Same data except larva collected March 24, 1961, moth emerged November 14, 1961 (R. L. Langston and J. Powell, JAP 61C12, C13). Both deposited in California Academy of Sciences, San Francisco. Sixteen paratypes, all California, as follows: Riverside County: 1♂, 1♀, same data as holotype: 4♂, 1♀, same data as allotype; 1♂, 4♀, same data except larvae collected V–13–62, emgd. XI–62 (J. Powell, JAP 62E7); Riverside, 1♂, 2♀, XI–16–35 (C. M. Dammers); San Bernardino County: Desert Springs, 1♀, X–17–60 (P. D. Hurd and J. Powell). De-

posited in California Insect Survey, U.S. National Museum, and University of California, Riverside.

FOOD PLANT.—*Phacelia ramosissima* var. *suffrutescens* Parry. Biology is reported elsewhere (Powell, 1971).

Ethmia macneilli Powell, new species

FIGURE 72; PLATE 8*d*; MAP 26

A moderately large moth of the Macelhosiella group having a whitish forewing, marked by a distinct narrow black line from base to apex.

MALE.—Length of forewing 10.7 to 11.1 mm. *Head:* Labial palpus strongly upcurved, elongate; second segment evenly curved, length about 1.3 times eye diameter, third segment curved, 0.67 the length of second; smooth scaled, whitish with a broad, brown blotch exteriorly on second segment. Antenna, scape elongate, 0.85 eye index, flagellum slightly dilated, diameter of shaft basally 0.2 eye diameter, scaled dorsally, pale gray. Scaling of front and vertex smooth, brown with scattered white scales, of crown roughened, whitish, tufts of occipital margin spreading, white. *Thorax:* Dorsal scaling whitish, dark brown at base of tegula and indistinctly along median longitudinal line, scutellum with distinct, dark, lateral lines. Underside shining pale gray; legs dark gray exteriorly, metathoracic paler, tibial fringe small. *Forewing:* Narrow, length about 4.0 to 4.2 times width; costal curve flattened at middle, sloping to lanceolate apex, termen strongly angled back, fringe narrow. Ground color white with scattered dark scales tending to form lines between the veins in distal half; a well-defined, narrow, black line from base to apex through lower half of cell, sending off a short spur toward tornal area just before middle of wing, offset toward costa beyond; broken by an outwardly angled white spot at end of cell. Fringe white around apex, broken by the black median line, brownish toward tornal area. Underside pale brownish. *Hindwing:* About as broad as forewing; costa with dorsal hair pencil from base rather small, cream-white; costa sloped off to narrow apex, termen broadly curved toward anal angle. Ground color white, becoming pale brownish toward margins; fringe white. Underside white. *Abdomen:* Dorsal scaling whitish with an ochreous tinge at base becoming pale tan or brownish distally and on underside. Genitalia as in Figure 72 (drawn from paratype, JAP prep. no. 807; one preparation examined); teeth of anterior portion of gnathos small; basal process large; process of inner side of valva finger-like.

TYPES.—Holotype male: California, Rock Creek, one mile west of Tom's Place, Mono County, September 6, 1960 (C. D. MacNeill); deposited in California Academy of Sciences. One paratype: ♂, same data; in California Insect Survey. One male subsequently examined, same data except collected IX–4–64.

REMARKS.—One female (presumed to represent this species, but not designated as allotype) from "Redington, Arizona," in U.S. National Museum, may be characterized as follows: Length of forewing 9.6 mm. Essentially as described for male; eye smaller, diameter about 0.8 that of male, labial palpus only slightly smaller, length of second segment about 1.6 times eye diameter; longitudinal streak of forewing slightly paler and less well defined, but not diffusely spreading costad. Genitalia not examined.

One additional male from Arizona (Baboquivari Mountains, Dec. 15, 1923, O. C. Poling) is referred here tentatively since the genitalia do not differ appreciably from typical *macneilli*. The moth is small (forewing length 9.0 mm), but the labial palpus is elongate (second segment 1.3 times eye diameter) but not strongly curved. The forewing pattern is also somewhat intermediate between *geranella* and *macneilli*, with a moderately well-defined central streak on a pale gray ground.

The Piperella Group

Eye index 1.05. Labial palpus moderately short, II segment index 1.05–1.10; smooth scaled. Antenna of male dilated, index 0.27. Forewing moderately narrow; pattern scattered spots. Hindwing of male with costal hair pencil, no fold. Uncus hoodlike; gnathos dentate posteriorly; basal processes membranous, narrow; valva, fultura-manica, and vesica without armature. Papillae anales weakly sclerotized, setate; posterior apophyses not elongate; anterior apophyses narrow, short; sterigma simple; antrum differentiated, with sclerotized band; ductus bursae membranous, 3 loose coils; signum a broad cone.

A single species in Cuba and Jamaica.

Ethmia piperella Powell, new species

FIGURES 73, 198, 199; PLATE 7*i*

A small Jamaican moth having a dull tan forewing peppered with black specks which are surrounded with whitsh.

MALE.—Length of forewing 5.4–6.4 mm. *Head:* Labial palpus moderately elongate, rather strongly curved, barely exceeding base of antenna; second segment 1.0–1.05 times eye diameter; third segment slightly curved, slightly shorter than second (about 0.95 eye diameter); scaling whitish, lightly tinged with pale tan exteriorly. Antenna dilated, width of shaft near base about 0.25 eye diameter; dorsal scaling whitish, becoming pale tan distally. Scaling of tongue, front, and crown whitish, tinged with pale tan. *Thorax:* Dorsal scaling concolorous with head, extreme base of tegula and four spots on notum brownish black, a pair mesad of apices of tegulae and a pair, sometimes indistinct, at sides of scutellum. Underside whitish, foretibia and tarsi and midtarsi mostly brown. *Forewing:* Length about 3.4–3.6 times width; costa evenly curved from base to apex, latter acute, termen strongly angled back, tornus not discernible. Ground color grayish tan, dorsal area somewhat paler, not well defined; markings more or less uniform-sized brownish black dots about one-half eye diameter, each bordered and emphasized by a narrow whitish area: a pair at base, on costa and below Cu; a group of four near base, one below and one above cell, preceded and followed by two in cell; a pair just before middle of wing, one on Cu fold, the other in cell just beyond, a single one at end of cell. Terminal area irregularly blotched with light and dark areas, not as dark or distinct as the blackish dots. A row of dark dots along termen, usually partially obliterated. Fringe gray-brown, paler at tornus. Underside pale brown; a well-dened whitish area in cell beyond retinaculum. *Hindwing:* About as broad as forewing; costa without a fold, bearing from base a brush of ochreous-tan hair scales extending to beyond middle of cell; costa excavate before apex, latter acute, termen broadly curved to dorsum. Ground color uniform pale gray; fringe concolorous. Underside pale brownish gray, paler basally. *Abdomen:* Dorsal scaling shining pale gray, underside and genital scaling whitish. Genitalia as in Figure 73 (drawn from paratype, JAP prep. no. 1215; two preparations examined); uncus deeply notched, gnathos developed anteriorly, irregularly dentate, basal processes short, moderately heavily sclerotized; valva very broad, bearing interior projections along saccular margin.

FEMALE.—Length of forewing 6.2–6.8 mm. Essentially as described for male. Labial palpus about as long as in male. Antenna less dilated, width of shaft basally about 0.9 that of male. Ground color of forewing often darker, the pale areas more contrasted. Hindwing without costal brush. Genitalia as in Figures 198, 199 (drawn from plesiotype, Cuba, JAP prep. no. 2828; one preparation examined); VIII segment broadly sclerotized, fused with sterigma; antrum with elongate, sclerotized band, signum similar to that of *papiella.*

TYPES.—Holotype male and allotype female: Jamaica, Runaway Bay, March 23 and April 24, 1905 (Walsingham); deposited in the British Museum. Eighteen paratypes: 5♂, 11♀, same data as holotype except collected I–22 to IV–6–1905; 1♀, near Farmouth, Trelawny Parish, Jamaica, VII–28–1962 (Farr, O. & R. Flint); 1♀, central Baragua, Cuba, V–1–1931 (H. K. Plank). Deposited in British Museum, California Insect Survey, and U.S. National Museum. The Walsingham specimens bear numbers ranging from 76915 to 76932.

REMARKS.—One additional female, from Cuba (Prov. Habana, Marianao, 15m, III–10 to IV–30–66, F. Gregor) has been examined but not designated as a paratype. The specimen, which is deposited in the Moravian Museum, Brno, is somewhat worn but appears to differ from the Jamaican moths only in having a slightly darker ground color on the forewing, with the dark spots less distinct.

The male genitalia relate *E. piperella* to the Nearctic groups, but the valvae are unique among New World Ethmiidae and recall the Old World type of the genus, *Ethmia aurifluella* (Hübner) (Figure 74). The female genitalia show relationships to *E. apicipunctella* and *E. papiella.*

The allotype bears what I take to be a manuscript name of Walsingham, but its spelling is not decipherable.

The Bipunctella Group

Eye index 0.9–1.0. Maxillary palpus moderately large, 4 segments, the basal largest. Labial palpus

moderately elongate, II segment index 1.2–1.6, smooth scaled or roughened. Antenna of male moderately dilated, index 0.20–0.23. Forewing moderately broad, pattern costal-dorsal or uniform gray. Hindwing of male with costal area unmodified. Abdomen yellow, scaling not differentiated. Uncus hoodlike; gnathos dentate anteriorly and posteriorly; basal processes sclerotized and geniculate; valva with cucullus separated; fultura-manica and vesica simple. Papillae anales weakly sclerotized, setate; posterior apophyses not elongated; anterior apophyses narrow, short; sterigma simple; antrum enlarged, with sclerotized structures; ductus bursae membranous, 3–4 tight coils; signum a dentate bar.

A Holarctic group of about eight closely related species, three (or four) of which occur in the boreal Nearctic (*Ethmia bipunctella* is introduced). *Ethmia cirrhocnemia* (Lederer) of arid regions in central Asia and *E. monticola fuscipedella* of midwestern United States are virtually indistinguishable. The moths are nocturnal with the exception of *caliginosella,* which has an intermediate eye size and may be secondarily diurnal because of its occurrence at high elevations.

Ethmia bipunctella (Fabricius)

FIGURE 75; PLATE 8*h*

Alucita bipunctella Fabricius, 1775:668.[9]
Psecadia bipunctella.—Hübner, 1825:412.—Stainton, 1873:268 [biology].—Spuler, 1910, pl. 10 [larva].—Benander, 1965:21 [larva].
Ethmia bipunctella.—Meyrick, 1914:29.—Ford, 1950:28 [biology].—Wakely, 1952:144 [biology].—Sattler, 1967:89 [taxonomy, synonymy].
Phalaena Tinea echiella Denis and Schiffermüller, 1775:140.
Tinea hochenwartiella Rossi, 1790:208.
Psecadia bipunctelia [error] Uffeln, 1938:21.
Ethmia bipunctella griseicostella Wiltshire, 1947:126.

This well known, widespread Palearctic species, which has the forewing black costally and white dorsally and a bright ochreous abdomen, recently has been introduced in northeastern North America. The following description is based on a series from Tunisia and Greece and single males from New Jersey and Ontario.

[9] Synonymy from the European literature follows Sattler (1967).

MALE.—Length of forewing 10.0 to 12.5 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; length of second segment 1.2 times eye diameter, of third 0.9 eye diameter; second segment scaling black except scattered whitish at base and extreme apex, third segment white. Antenna slightly dilated, width of shaft near base 0.20 diameter; dorsal scaling black, including scape. Scaling of tongue brownish white, front shining bluish black, crown white, including occipital tufts. *Thorax:* Dorsal scaling white, extreme base of tegula and lateral margin of collar brownish black; notum with two pairs of large, round, blue-black spots, first between tegulae, second at sides of scutellum. Underside whitish tinged with gray, prothoracic and mesothoracic legs dark gray, metathoracic leg ochreous. *Forewing:* Moderately narrow, length about 3.4 to 3.5 times width; costa curve slightly flattened at middle; apex acute; termen concave. Ground color divided by longitudinal line along Cu fold from base to termen below apex, costal half black becoming brownish toward costa, dorsal half white; black extended as two squarish spurs, the outer one broader, into dorsal white at basal one-third and middle of wing; white produced as a squarish spur upward at end of cell, preceding a third, triangular black extension above tornus; apex whitish; a row of 10 black dots around termen from before apex to beyond tornus, darker than terminal brownish black ground. Fringe white, broken by brownish black below apex. Underside dark gray, the pale dorsal area of upperside visible. *Hindwing:* Broader than forewing; costal area simple, margin excavate toward apex; dorsum concave beyond anal area. Ground color semitranslucent white, brownish toward apex, pale ochreous toward anal margin. Underside whitish, costal area dark gray. *Abdomen:* Scaling entirely bright ochreous. Genitalia as in Figure 75 (drawn from plesiotype, Hoboken, New Jersey, JAP prep. no. 1834; two preparations examined); similar to *E. monticola,* uncus narrow, hoodlike; basal processes narrower; valva broader.

FEMALE.—Length of forewing 11.2 to 13.3 mm. Essentially as described for male; labial palpus slightly more elongate, second segment length 1.2 to 1.4 times eye diameter, third segment about 1.0 eye diameter. Antenna not dilated, width of shaft basally about 0.16 eye diameter. Forewing slightly

broader, length 3.3 to 3.4 times width. Genitalia very similar to *E. m. fuscipedella* (two preparations, Tunisia examined); sterigma a broad band with ostium on its posterior margin preceded by an upraised flap; ductus irregularly sclerotized basally, with an irregular, curving plate terminating in a curved thorn and bearing a variable number of small spurs (e.g., Sattler, 1967, pl. 90).

TYPE DATA.[10]—Germany, Saxonia, location of type unknown (*bipunctella*); Austria, vicinity of Vienna, type lost (*echiella*); Italy, Prov. Florence and Piza, location of type unknown (*hochenwartiella*); Teheran, N. Iran, VII–17–39, holotype male in Tring Museum (*griseicostella*).

GEOGRAPHICAL DISTRIBUTION.—Widespread in the Palearctic Region; from Great Britain, where it may be introduced; central and southern Europe, Asia Minor, and North Africa (Meyrick, 1895; Sattler, 1967). In North America, introduced in the New Jersey and Quebec-Ottawa areas.

FLIGHT PERIOD.—Bivoltine, at least in part; June-July and September, in southern parts of its distribution in the old world, the generation pattern is not clear, with flight records from January to October (Sattler, 1967).

FOOD PLANT.—*Echium vulgare* and *Symphytum;* biology discussed by Ford (1950) and Wakely (1952); literature on food plants, summarized by Sattler (1967), includes records for *Cynoglossum, Anchusa,* and *Lithospermum* as well (all are Boraginaceae).

REMARKS.—It is probable that this species is of recent establishment in North America, although *Echium vulgare* has long been a weed of the eastern United States and Canada. The earliest record I have seen for the moth in North America is Picton Island, Clayton, Jefferson County, New York, July 24, 1964 (B. Heineman). It was also taken at Hoboken, New Jersey, in August 1964, so the introduction evidently occurred prior to the 1964 season. In conversation, Klaus Sattler reported presence of a colony of *E. bipunctella* at Ottawa during the 1965 season. The Canadian National Collection has specimens collected at Ottawa May 20 and 31, 1965, by G. G. Lewis, and a specimen dated August 2, 1965, was sent to me by H. F. Howden. According to Sheppard (1970) it was also collected in the Quebec area in 1965 and on another island in the St. Lawrence during 1969. Also in recent years, *Ethmia bipunctella* has been taken at New Haven, Connecticut, in 1967 by D. C. Ferguson, and inland, at Ithaca, New York, in 1970 (J. G. Franclemont, in litt.).

Since the moth is large and fairly conspicuous in appearance, there being no other eastern Nearctic species similar to it, and since adults are attracted to light, the adventive colonies probably have not been widespread many years. In 1962 I checked collections for *Ethmia* in most of the major eastern North American institutions, and no *bipunctella* were found. In addition, I received an extensive assortment of light trap samples from the New Jersey-southern New England area in 1962 and *E. bipunctella* was not represented.

Ethmia monticola (Washingham)

Psecadia monticola Walsingham, 1880:87.
Ethmia monticola.—Dyar, 1902:203.—Barnes and Busck, 1920, pls. 26, 35.—McDunnough, 1939:82.
Ethmia fuscipedella Powell, 1959 (not Walsingham, 1888):136 [in part].

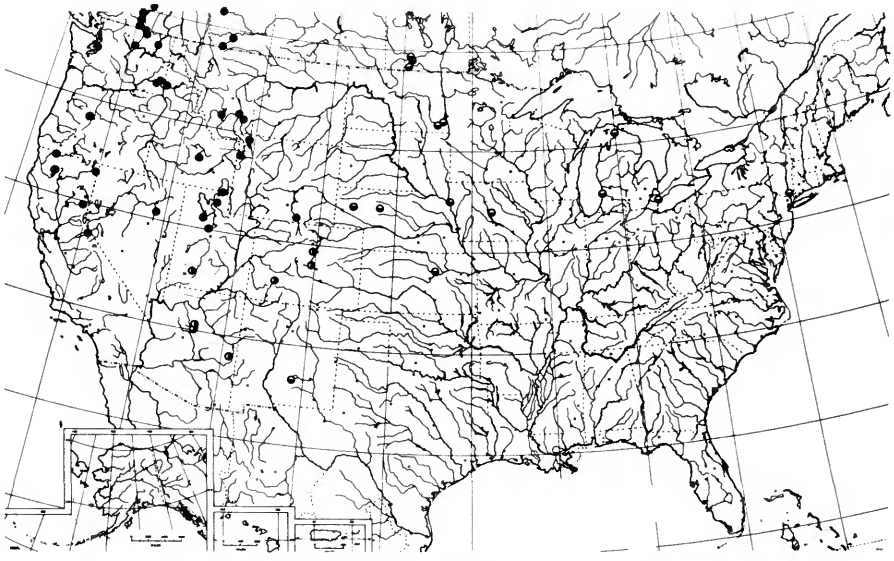
A moderately large, dark gray moth with black lines or markings on the forewing and a bright ochreous abdomen. The nominotypic race, which has longitudinal lines on the forewing, occurs in the northern Rocky Mountains and along the cordillera of the Pacific states.

Ethmia monticola monticola (Walsingham), new status

FIGURES 76, 77; PLATES 1*f*, 8*i-j*; MAP 27

MALE.—Length of forewing 11.1–14.6 mm. *Head:* Labial palpus elongate, strongly upcurved, exceeding antenna base; second segment strongly curved, length 1.5–1.6 times eye diameter; third segment straight, 0.70–0.75 as long as second; smooth scaled, black sprinkled with white scales exteriorly. Antenna slightly dilated, width of shaft basally about 0.20–0.22 eye diameter; scaled dorsally, pale gray. Scaling of front smooth, of crown and occipital margins loosely appressed, black with scattered pale slate gray scales. *Thorax:* Dorsal scaling pale slate gray; paired, large, round, black spots at bases of tegulae, between apices of tegulae, and on scutel-

[10] Type locality data and location of types according to Sattler (1967).



MAP 27.—Geographical distribution of *Ethmia monticola* (Walsingham).
● *E. m. monticola* ◑ *E. m. emmeli* Powell ◒ *E. m. fuscipedella* (Walsingham)

lum. Underside blackish gray including prothoracic and mesothoracic legs; metathoracic leg bright ochreous. *Forewing:* Moderately narrow, length 3.4–3.5 times width; costa very slightly curved from base to apex; apex rather blunt, termen not strongly angled back, tornal angle well defined. Ground color pale to dark slate gray. Markings black, conspicuous, variable, as follows: a longitudinal streak in costal area, from base to beyond middle, at times diffuse toward base; four roundish spots in cell, the first pair on Cu fold at basal one-fourth and before middle of wing, second pair above and distad of first, at about middle of cell and end of cell; a line from base along lower fold at times connects first pair of spots or ends before outer one, rarely absent, the spots isolated; a parallel line connects pair of spots in cell, rarely broken before inner one, an ill-defined, often indistinct, parallel, short streak in cell just below outer spot; a series of four to seven short streaks radiating out from cell in outer costal and terminal areas between the veins, ending before margin; a series of dots on margin from before apex to tornus; a thin line on dorsal margin. Underside entirely dark gray, paler toward dorsum. *Hindwing:* Slightly broader than forewing; costal area simple; costa very slightly excavate on distal half; apex blunt, termen strongly angled back, broadly curved to dorsum. Ground color pale to dark gray; fringe pale ochreous on anal half, pale gray on apical half of wing. Underside similar, paler. *Abdomen:* Dorsal scaling of first segment black, of second and third segments mostly or partially black, or entirely ochreous, remainder of dorsum, underside and genital scaling bright ochreous. Genitalia as in Figures 76, 77 (drawn from plesiotype, Cedarville, Modoc County, California, JAP prep. no. 1488; six preparations examined); uncus and basal processes broad, cucullus narrow, flared distally, valva attenuate distally, anterior gnathos ridge rather sparsely dentate.

FEMALE.—Length of forewing 10.8 to 13.1 mm. Essentially as described for male; eye smaller, diameter about 0.8 that of male; antenna slightly smaller, width of shaft basally about 0.8 to 0.9 that of male. General coloration and maculation as in male except abdomen black only on first tergite. Sixth and seventh abdominal sternites unusually heavily sclerotized, sixth with an anterior median lobe, not correlated with modified scaling or other modification visible externally. Genitalia as in *E. m. fuscipedella* (Figures 200, 201) (two *m. monticola* preparations examined); sterigma protruded ventrally but not well differentiated from the broadly sclerotized VIII sternite, antrum with a broad, curled plate ending in a strong thorn,

similar to that of *bipunctella* but lacking the small subtending spurs, signum a broad, shallow fold with one lateral expansion.

TYPE DATA.—Siskiyou Range, border of California and Oregon, June 10, 1872 (Walsingham); type in British museum.

GEOGRAPHICAL DISTRIBUTION.—Widespread in boreal western North America from Alberta (Calgary) westward through southern British Columbia and much of Washington, southward through western Montana and Wyoming into northern Utah, Idaho, and the mountains of California (to Alpine County).

FLIGHT PERIOD.—May to July.

FOOD PLANT.—Unknown. D. S. Horning reared several specimens from stick traps (see Parker and Bohart, 1966) at Craters-of-the-Moon National Monument, Idaho. He believes (in litt.) that if the food plant were Boraginaceae or Hydrophyllaceae, either *Phacelia heterophylla, P. leucophylla,* or *Lithospermum ruderale* were the most likely hosts at the site.

REMARKS.—Specimens from northern California (Plumas, Modoc, and Siskiyou Counties) have blackish gray forewing ground, while those from Rocky Mountain areas are consistently pale gray.

Ethmia monticola emmeli Powell, new subspecies

PLATE 9*a*; MAP 27

A race in the southern Rocky Mountains and adjoining ranges, differing from nominate *monticola* by having the costal half of the forewing black.

MALE.—Length of forewing 11.7 to 14.0 mm. Generally as described for *m. monticola,* differing as follows. *Head:* Labial palpus usually relatively shorter, length of second segment 1.3–1.5 times eye diameter, second segment 0.70–0.78 as long as second. Scaling of front and crown mostly pale slate gray. *Forewing:* Ground color and pattern basically as in *m. monticola* but whole costal half black to end of cell, at times with some pale gray scaling above middle of cell, forming ill-defined longitudinal streaks; dorsal pale gray extends above Cu fold in cell before basal spot of Cu fold, thence along line at lower fold, invaded by the two Cu fold spots, upcurved as a spur at end of cell; two black spots of *m. monticola* in cell evident, slightly darker than costal black ground; terminal area as in *m. monticola. Abdomen:* Entirely bright ochreous except first segment dorsally brownish gray. Genitalia indistinguishable from nominate subspecies (four preparations examined).

FEMALE.—Length of forewing 11.9 to 13.8 mm. As described for male and nominate subspecies. Wing pattern variation apparently the same as in male. Genitalia not distinguishable from *m. fuscipedella* (Figures 200, 201) (two preparations of *m. emmeli* examined).

TYPES.—Holotype male and allotype female: Arizona, Fort Valley, 7,350 feet, 7.5 miles northwest of Flagstaff, Coconino County, June 22, 1961 (R. W. Hodges); deposited at Cornell University. Forty-one paratypes, as follows: *Arizona:* same locality as holotype, 17 ♂, 12 ♀, VI–19 to VII–18–61; Hart Prairie, 8,500 feet, 10 mi NNW Flagstaff, Coconino County, 1 ♀, VII–12–61 (R. W. Hodges). *Utah:* Red Canyon Camp, 7,200 feet, 11 mi SE Panguitch, Garfield County, 1 ♂, VII–13–60 (F., P. and B. Rindge). *Colorado:* Chimney Gulch, Golden, Jefferson County, 1 ♀, VII–27–07 (Oslar); Big Springs Ranch, Florissant, Teller County, 3 ♂, 4 ♀, VII–21 to VIII–8–60 (T. C. Emmel); Lake City, 8,684 feet, Hinsdale County, 1 ♂, VII–3–57 (F. and P. Rindge); Rock Creek Canyon, El Paso County, 1 ♂, VI–26–61 (M. May). *New Mexico:* McGaffey, Zuni Mountains, McKinley County, 7,500 feet, 2 ♂, VII–22,23–62 (E. and I. Munroe); Cimmaron Canyon, Sangre de Cristo Mountains, Colfax County, 1 ♀, VII–7–62 (E and I. Munroe). Paratypes deposited in collections of American Museum of Natural History, British Museum, California Insect Survey, Canadian National Collection, Cornell University, R. W. Hodges, C. P. Kimball, Los Angeles County Museum, and U.S. National Museum.

REMARKS.—I take pleasure in naming the race for Thomas E. Emmel who has collected many Microlepidoptera in Colorado during the past few seasons, including the first specimens of *emmeli* which I had the opportunity to study.

Specimens from the type locality have a somewhat darker slate gray ground color than do those from Colorado. In addition to the above I have seen three individuals with a wing pattern roughly intermediate between *m. monticola* and *m. emmeli,* but these are labeled simply "Col." or "Colo." At present a broad zone exists from which I have seen no specimens of the monticola complex; ie., central

and southern Nevada, through central Utah, northern Colorado, and northward in eastern Wyoming and Montana and western Nebraska and the Dakotas to Saskatchewan. If blend zones between *emmeli* and *monticola* exist, for example in the southern Wasatch Range or in northern Colorado, they have not been sampled. *E. m. fuscipedella* may be entirely allopatric. To the south, a narrow area in central New Mexico separates *emmeli* from *fuscipedella* (Ruidoso, Lincoln County). The *emmeli* phenotype remains fairly typical in the Sangre de Cristo Mountains of northern New Mexico, while a long series of *fuscipedella* from Lincoln County shows no indication of increase of black on the forewing. Further field work in the area may reveal that the two are sympatric and distinct species.

Ethmia monticola fuscipedella (Walsingham), new status

FIGURES 19, 20, 200, 201; PLATE 9*b-c*; MAP 27

Psecadia fuscipedella Walsingham, 1888:150.
Ethmia fuscipedella.—Dyar, 1902:203 [taxonomy].—Barnes and Busck, 1920, pls. 26, 35.—Forbes, 1923:245 [taxonomy].—McDunnough, 1939:82.—Powell, 1959:136 [in part].

An eastern Nearctic race similar to typical *monticola* but with the black markings of the forewing reduced to a few isolated spots.

MALE.—Length of forewing 12.4 (reared) to 15.3 mm. Structural and color characteristics similar to *m. monticola,* differing as follows. *Forewing:* Slightly broader, length 3.2 to 3.5 times width; costa more strongly curved at middle. Ground color pale slate gray, not ranging to the dark extreme of *m. monticola.* Black markings as follows: the four roundish black spots of *monticola* present, distinct, two on Cu fold at basal one-fourth and just before middle of wing, two above and beyond them, in cell at middle of wing and at end of cell; a fifth spot present or absent, smaller, at outer, lower angle of cell; a series of about ten dots on margin, from before apex to tornus; a short line on outer one-third of dorsum, at times almost entirely lacking. *Hindwing:* Entirely gray including anal fringe. *Abdomen:* Entirely ochreous except first segment dorsally brownish gray. Genitalia very similar to *m. monticola,* differing by a wider anterior dentate ridge of the gnathos and by slightly broader apices on the cuculli (three preparations examined).

FEMALE.—Length of forewing 12.1 to 14.0 mm, apparently not consistently smaller than male as in *m. monticola.* As described for nominotypic subspecies and male. Genitalia as in Figures 200, 201 (drawn from plesiotype, Lincoln County, New Mexico, JAP prep. no. 2542; two preparations examined).

TYPE DATA.—"North Carolina"; type female in British Museum. In view of the known distribution this label is suspected to be in error.

GEOGRAPHICAL DISTRIBUTION.—Widespread in eastern North America, but incompletely known (i.e., known only from the type locality and West Point, New York); in the midwest from southern Ontario (Point Pelee) and southern Manitoba, south to Kansas (Riley County), and in south-central New Mexico (Ruidoso).

FLIGHT PERIOD.—May to July.

FOOD PLANT.—*Lithospermum canescens* (Michx.) (Boraginaceae) according to a reared series in the Canadian National Collection from Point Pelee, Ontario (F.P.Ide). The larvae live in a slight web on *L.gmelini* in Ohio (Braun, in litt.).

REMARKS.—The three preceding entities, here treated as subspecies, comprise a component of a holarctic species or species complex with an extremely unusual distribution pattern. As pointed out by Sattler (1967) *Ethmia cirrhocnemia* (Lederer) of central Asia is more similar in appearance to *E. m. fuscipedella* than the latter is to *E. m. monticola.* The former two are essentially indistinguishable in external features. *E. cirrhocnemia* evidently has a slightly different sclerotization pattern of the sterigma and antrum from members of the *monticola* complex according to Sattler's figures. *E. cirrhocnemia* occurs in arid regions from Iran through southern U.S.S.R. to Mongolia and northeastern China. The distribution of *fuscipedella* is unlike any other Nearctic Ethmiid and is difficult to explain, especially in view of the montane distribution of *monticola, emmeli,* and *caliginosella.* However, *fuscipedella* and *cirrhocnemia* may occupy similar habitats, dry steppe or comparable semiarid situations or perhaps edaphic factors are involved, the species living in areas with sandy or other well-drained soils to which the food plants they follow are adapted. The host plant of *E. cirrhocnemia* is unknown.

Ethmia caliginosella Busck

FIGURE 78; PLATE 9*d*

Ethmia caliginosella Busck, 1904:44.—Barnes and Busck, 1920, pls. 26, 35.—McDunnough, 1939:82.

A high montane, dark gray moth resembling members of the *monticola* complex, but with bushy labial palpus and dark hind legs.

MALE.—Length of forewing 11.7 to about 12.0 mm. *Head:* Labial palpus elongate, strongly upcurved, exceeding antennal base; second segment strongly curved, length about 1.5 times eye diameter, with a brush of elongate, spreading, hairlike scales ventrally; third segment slightly curved, about 0.7 as long as second, smooth scaled; blackish gray (color of scales of whole moth becoming dark brown or brownish gray with age in museums). Antenna dilated a short distance near base, width of shaft at base about 0.26 eye diameter. Scaling under eye spreading, hairlike, of front appressed, of crown slightly roughened; blackish gray. *Thorax:* Dorsal scaling black; tegula mostly dark slate gray. Underside dark gray, densely hairy; prothoracic and mesothoracic legs blackish exteriorly; metathoracic leg pale slate gray, tibial brush elongate, pale gray. *Forewing:* Length about 3.5 times width; costa evenly curved from base to apex, latter blunt; termen rather strongly angled back, tornal angle developed. Ground color dark slate gray, markings black, as follows: two rather broad, ill-defined longitudinal lines corresponding to those of *E. m. monticola* on lower fold in basal half of wing and in outer half of cell; a series of short streaks between the veins, radiating out from distal portion of cell; a series of dots on margin from well before apex to beyond tornus; a line on dorsal margin. Underside entirely dark gray. *Hindwing:* About as broad as forewing; costal area simple; costa strongly sloped from beyond middle to apex, latter narrow, blunt; termen strongly angled back, broadly curved to dorsum. Ground color pale gray; hairs of anal area darker, fringe in anal area paler. Underside slightly paler. *Abdomen:* Scaling dark grayish at base, gradually becoming ochreous, segments 5 to 7 with ochreous caudal bands, final segments and genitalia ochreous. Sclerotizations of 6th and 7th sternites heavier, with a slight anterior median extension not present in male but well developed in female *monticola*. Genitalia as in Figure 78 (drawn from plesiotype, Colorado, Bruce, JAP prep. no. 1464; three preparations examined); very similar to *E. monticola,* differing by slightly shorter, more abruptly attenuate sacculus and a more heavily dentate anterior ridge of the gnathos.

FEMALE.—Known only from the holotype which is in worn condition. Length of forewing 11.0 mm. Essentially as described for male in external appearance except hindwing as dark as forewing. Labial palpus slightly larger, second segment 1.6 times eye diameter. Genitalia not dissected.

TYPE DATA.—Silverton, Colorado, 12,000 feet altitude (C. P. Gillette); holotype female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—High montane Colorado. I have seen eight specimens with detailed data, all labeled 11,500–12,500 feet, "timberline," etc.

FLIGHT PERIOD.—Late June to late July.

FOOD PLANT.—Unknown. A specimen from "Cont. Divide" bears a handwritten label which I decipher as "on *Pseudocymopterus multifidus*" (=*montanus* (Gray) (Umbelliferae), an unlikely host.

The Hagenella Group

Eye index 0.9–1.0. Maxillary palpus moderately large, four subequal segments. Labial palpus moderately short, II segment index 0.95–1.2, smooth scaled. Antenna of male not dilated. Forewing moderately narrow, pattern costal-dorsal as longitudinal streaks. Hindwing of male with costal area unmodified. Abdomen yellow, I–II terga with or without specialized scaling. Uncus sclerotized, narrow; gnathos dentate posteriorly; basal processes sclerotized, broad or distally broadened; valva and fultura-manica simple; vesica armed. Papillae anales heavily sclerotized, setate; posterior apophyses not elongate; anterior apophyses broad; sterigma simple; antrum enlarged, heavily sclerotized with inner spurs; ductus bursae membranous, eight tight coils; signum a broad cone.

A closely knit group of four species in eastern United States and Mexico which is widely distinct from all other groups. Southwestern species are nocturnal but *Ethmia zelleriella* of the eastern United States has an intermediate eye size and may be primarily crepuscular.

Ethmia hagenella (Chambers)

Anesychia hagenella Chambers, 1878:80.
Ethmia hagenella.—Dyar, 1902:207.—Meyrick, 1914:30.—Barnes and Busck, 1920:242, pl. 27 [in part].—McDunnough 1939: 83 [in part].

This is a southwestern Nearctic species, with forewings marked on costal half with black spots or blotches.

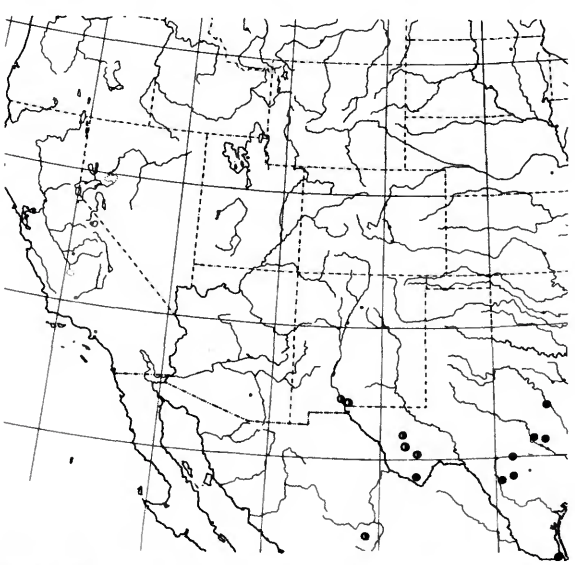
Ethmia hagenella hagenella (Chambers), new status

FIGURE 79; PLATE 9*f*; MAP 28

A central Texan subspecies with white forewings, having a brown costal area and black dots scattered over the dorsal half.

MALE.—Length of forewing 9.1–11.0 mm. *Head:* Labial palpus rather short, not strongly curved, not reaching base of antenna; second segment length about equal to (0.95–1.05) eye diameter; third segment 0.55–0.70 as long as second (0.53–0.72 eye diameter); smooth scaled, second segment dark brown exteriorly except apex white, third segment white. Antenna scarcely dilated, width of shaft basally about 0.18 eye diameter; dorsal scaling dark brown, scape mostly white. Scaling of tongue white, front brown basally, becoming white, crown white, occipital tufts with median black spot. *Thorax:* Dorsal scaling white, tegula and collar dark brown at extreme base, notum with two pairs of large black spots, first adjoining collar, second at sides of scutellum. Underside white; legs tinged with pale yellowish, prothoracic and mesothoracic legs and hind tarsi brown spotted. *Forewing:* Narrow, length 3.6–3.7 times width; costa very slightly curved from base to apex, latter acute, termen strongly angled back, tornal angle indistinct. Ground color white, costal area broadly pale brown, extending into cell from base nearly to apex, with an irregular spur into terminal area not reaching marginal dots; dorsal half marked by more or less evenly distributed blackish brown spots (slightly darker than costal area) arranged in four oblique rows of two or three dots each, the upper (basal) of each row larger and adjoining and partially obscured by the costal brown; a row of nine black dots along margin from before apex to beyond tornus. Fringe white. Underside with costal brown weakly reproduced, dorsal half white, the darker spots not reproduced. *Hindwing:* Broader than forewing; costal area simple; costal margin steeply tapered toward the acute apex, the wing strongly narrowed in distal half; tornal angle not evident. Ground color white, pale brownish toward distal margins, concentrated into darker spots between veins, fringe white. Underside white, costal area brownish, the marginal dots reproduced. *Abdomen:* Scaling whitish, tinged with pale brownish dorsally, pale yellowish laterally and ventrally. Genitalia as in Figure 79 (drawn from plesiotype, Bosque County, Texas, JAP prep. no. 1625; five preparations examined); uncus rather short, tapered to a point, gnathos not developed anteriorly, posteriorly narrow, variable, with about four teeth, basal processes elongate, equal to tegumen length, variably broadened distally, at times nearly as much as in *h. josephinella* (Figure 80); valva broad, not emarginate distally; vesica-manica with a large thorn-shaped cornutus, with or without a lateral spur.

FEMALE.—Length of forewing 9.1 mm. As described for male; labial palpus within range of male; antenna not dilated, diameter of shaft about 0.9 that of male. Abdominal sternite VII with a deep, rounded emargination posteriorly. Genitalia



MAP 28.—Geographical distribution of *thmia hagenella* (Chambers).
● *E. h. hagenella* ◐ *E. h. josef inella* Dyar

not examined; presumably as in *h. josephinella* (Figure 202).

TYPE DATA.—Bosque County, Texas; lectotype male, by present designation, "6/10, Tex, 27, Hagenella Chb., Type 1422," in Museum of Comparative Zoology, Harvard. A specimen labeled "Texas" and "su 100" or "sn 100" in the U.S. National Museum is labeled as the type and presumably is a pseudotype.

GEOGRAPHICAL DISTRIBUTION.—Central Texas, from Bosque County south to San Benito, westward to Big Bend, probably southward in Chihuahua.

FLIGHT PERIOD.—Multivoltine; records available for January, March, April, and October.

FOOD PLANT.—Unknown.

Ethmia hagenella josephinella Dyar, new status

FIGURES 80, 202; PLATE 9*g*; MAP 28

Ethmia josephinella Dyar 1902:205.—Meyrick, 1914:30.
Ethmia hagenella.—Barnes and Busck (not Chambers, 1878), 1920:242, pl. 27 [in part].—McDunnough, 1939:83 [in part].

A subspecies in western Texas and New Mexico which differs from *h. hagenella* by its larger size and a more extensive black blotching in the dorsal half of the forewing.

MALE.—Length of forewing 10.4–11.9 mm. *Head:* As described for *h. hagenella,* the labial palpus size less variable in the sample available. *Forewing:* Narrow, length 3.6–3.7 times width, and shape as in *h. hagenella.* Ground color white, costa broadly dark gray-brown nearly to apex; blackish marks on dorsal half of *h. hagenella* enlarged, in cell and on distal half of wing coalesced, particularly just before and above tornus, forming an oblique blotch from dorsal margin toward termen. *Hindwing* and *abdomen* as in *h. hagenella.* Genitalia very similar, gnathos narrow, teeth variable in size and number (usually 5 or 6), basal processes elongate, variably broadened (e.g., Figure 80, drawn from plesiotype, Davis Mountains, Texas, JAP prep. no. 626; four preparations examined); vesica with thorn-shaped cornutus with lateral spur.

FEMALE.—Length of forewing 10.9–11.5 mm. As described for male and *h. hagenella.* Genitalia similar to *E. mimihagenella,* differing by having fewer spurs inside antrum and a more conspicuous flaplike plate just posterior of ostium (Figure 202; drawn from plesiotype, Davis Mountains, Texas, JAP prep. no. 2308; one preparation examined); ductus membranous, tightly coiled, with about eight spirals; signum large, with a more pronounced keel into the corpus bursae, similar to *E. zelleriella* (Figure 205).

TYPE DATA.—New Mexico, Dripping Springs, Organ Mountains (Cockerell); the holotype male in U.S. National Museum bears the additional data "April 23" and "at light."

GEOGRAPHICAL DISTRIBUTION.—Extreme western Texas (Davis Mounatins and Alpine) and southern New Mexico.

FLIGHT PERIOD.—Probably multivoltine; late March to May, September.

FOOD PLANT.—Unknown.

REMARKS.—Barnes and Busck (1920), who synonymized *Ethmia josephinella* with *E. hagenella,* stated that the two wing patterns grade into each other, but I have seen no evidence of this in older material.

Two recently collected males from southern Chihuahua represent the only sample I have examined of the Hagenella group in Mexico. These specimens are dissimilar both from Texas populations and from one another. One of them, from Hidalgo del Parral (5,500 feet, VII–30–67, Gardner, Kovacic, and Lorenzen) is somewhat intermediate between *E. h. hagenella* and *josephinella* in wing pattern, being similar to the former in restriction of costal brown and in size (forewing length 10.0 mm), but resembles *josephinella* with enlarged spots in the tornal area. The genitalia show relatively narrow basal processes, as in most *E. h. hagenella,* but possess six teeth on the gnathos and a strongly serrate cornutus with large lateral spur, more characteristic of *josephinella.*

The second specimen may represent yet another race, as it has an appreciably different appearance. It was collected in the mountains 25 miles west of Hidalgo del Parral (6,800 feet, VII–15–64, Chemsak and Powell). The forewing costal brownish is a little restricted and distinctly paler, causing the dark spots of the dorsal half, especially those in the cell, to appear more contrasting. The spots are larger than those of *h. hagenella,* but remain roundish, not elongated and coalesced as in *josephinella* (Plate 9*i*). The specimen is large (forewing length 11.4 mm) and has a broader gnathos with 10 teeth,

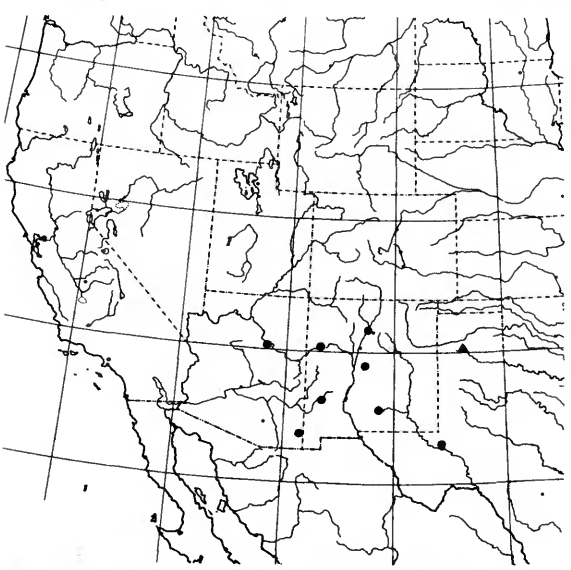
and the basal processes are broadened as much or more than in any *josephinella* examined, but the cornutus has no lateral spur.

Ethmia mimihagenella Powell, new species

FIGURES 21, 22, 203, 204; PLATE 9*h*; MAP 29

A widespread species in the southwestern states that resembles *E. h. hagenella,* but is larger and has different genital characters.

MALE.—Length of forewing 11.2–12.1 mm. *Head:* Essentially as described for *h. hagenella,* labial palpus second segment length slightly less or equal to eye diameter. Antenna shaft about 0.19 eye diameter; dorsal scaling with whitish banding basally. Scaling of tongue whitish or brownish, front mostly brown. *Thorax:* Scaling as in *h. hagenella,* underside more yellowish. *Forewing:* Narrow, length 3.65–3.80 times width. Ground color white, dark pattern similar to *h. hagenella,* the costal brown slightly more extensive, in cell and apical area reaching first marginal dot, less uniform, darkest in cell, becoming variably whitish at costa; marks of dorsal half not noticeably darker than costal area except basally, somewhat elongated (not greatly enlarged as in *h. josephinella*), the terminal one fused with costal area dark as an extended spur through terminal area to the 10 marginal dots, which are scarcely darker, extending well beyond tornus. Fringe white, a dark area below apex opposite, at times contiguous with terminal streak. *Hindwing* and underside: As described for *h. hagenella. Abdomen:* Scaling entirely pale yellow. Genitalia similar to *E. burnsella,* gnathos teeth variable but usually larger, 7–9; basal processes slightly narrower; thornlike cornutus of vesica smaller, lacking spurs (three preparations examined).



MAP 29.—Geographical distribution of members of the Hagenella group of *Ethmia.*
● *E. mimihagenella* Powell ▲ *E. burnsella* Powell

FEMALE.—Length of forewing 10.3 to 11.8 mm. As described for male and *h. hagenella.* Genitalia as in Figure 203, 204 (drawn from paratypotype, JAP prep. no. 2087; one preparation examined); papillae anales moderately heavily sclerotized; sterigma a broad anteriorly pronged plate, subtended by a deep, oval, sclerotized antrum that bears numerous inwardly directed spurs; ductus bursae with about 8 tight spirals; signum a broad triangular plate, produced inwardly into a median keel and with numerous short spurs on inner side; keel shorter than in *E. burnsella* (Figure 206).

TYPES.—Holotype male and allotype female: New Mexico, Gran Quivira National Monument, Socorro County, July 20, 1957, and July 17, 1958 (S. F. Wood); deposited in the Los Angeles County Museum. Thirty-five paratypes as follows: *Arizona,* Fort Valley, 7,350 feet, 7.5 mi NW Flagstaff, Coconino County, 1♂, VII–30–61 (R. W. Hodges); *New Mexico,* McGaffey, Zuni Mountains, McKinley County, 1♂, VII–21–62, black light (E. and I. Munroe); Frijoles Canyon, Bandelier National Monument, 9♂, VII–(15–18)–62, black light (E. and I. Munroe); Frijoles Canyon, 1♂, VI–19–42 (G. H. and J. L. Sperry), same data as holotype, 1♂, 1♀, VII–1–56, 4♂, VII–20 to VIII–4–57, 1♀, VIII–16–57, 4♂, 3♀, VI–28 to VIII–9–58; *Texas,* Monahans Sand Hills, State Park, Ward County, 1♂, 7♀, IV–16, 17–61 (Rozen and Schrammel); Big Bend National Park Basin, 1♂, III–29–65 (A. and M. E. Blanchard). Deposited in collections of American Museum of Natural History, André Blanchard, California Insect Survey, Canadian National Collection, R. W. Hodges, Los Angeles County Museum, and U.S. National Museum.

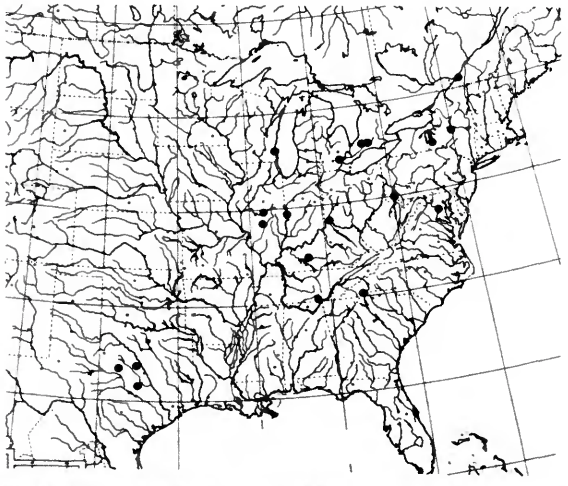
Ethmia burnsella Powell, new species

FIGURES 81, 206; PLATE 9*j*; MAP 29

A moderately large member of the Hagenella

group, in northern Texas, resembling *hagenella hagenella,* but with a pale ochreous ground color on thorax and forewings. The male genitalia are similar to *mimihagenella.*

MALE.—Length of forewing 11.0 mm. *Head:* Essentially as described for *hagenella;* labial palpus, length of second segment equal to or slightly greater than eye diameter; scaling pale ochreous, second segment mostly dark brown exteriorly. Antennal shaft basally about 0.19 eye diameter; scape pale ochreous, with dark brown dorsal, apical spot. Scaling of front and crown whitish ochreous. *Thorax:* As described for *E. hagenella,* ground color pale ochreous. *Forewing:* Essentially as described for *E. hagenella,* slightly broader than *E. minihagenella,* length 3.5–3.7 times width; ground color pale ochreous, costal area pale gray-brown, distinctly paler than the brownish black spots of dorsal half; outer, tornal area black spots slightly larger than the others. Underside pale ochreous, legs and costa dark ochreous. *Hindwing:* White basally, becoming pale ochreous distally and along anal margin. Underside similar. *Abdomen:* Scaling entirely ochreous, slightly darker than other members of the complex. Genitalia as in Figure 81 (drawn from paratype, JAP prep. no. 1633; two preparations examined); similar to *E. mimihagenella;* gnathos teeth blunt, 10–14; basal processes slightly broader than *E. mimihagenella;* vesica with ornate cornutus, bearing three curved spurs.



MAP 30.—Geographical distribution of *Ethmia zelleriella* (Chambers).

FEMALE.—Length of forewing 10.2 to 10.6 mm. Essentially as described for male and *E. h. hagenella;* forewing slightly broader, 3.4–3.5 times width. Genitalia very similar to *E. mimihagenella* (Figures 203, 204); fewer spurs in antrum; signum moderately broad with deep keel (Figure 206, drawn from JAP prep. no. 2091; two preparations of *burnsella* examined).

TYPES.—Holotype male and allotype female: Texas, Palo Duro Canyon, 2,800 feet, Randall County, May 9 1959 (J. M. and S. N. Burns) deposited in California Academy of Sciences. Two male and two female paratypes: Same data, deposited in California Insect Survey and U.S. National Museum.

Ethmia zelleriella (Chambers)

FIGURES 82, 205; PLATE 9e; MAP 30

Hyponomeuta zelleriella Chambers, 1878:80.
Psecadia zelleriella.—Walsingham, 1888:149.—Dyar, 1900:38.
Ethmia zelleriella.—Dyar, 1902:207; 1904a:3 [larva].—Barnes and Busck, 1920, pls. 27, 35.—Forbes, 1923:245.—McDunnough, 1939:83.—Clench, 1957:45.
Hyponomeuta texanella Chambers, 1880:180.
Psecadia texanella.—Walsingham, 1888:149 [synonymy].

A moderately large species of eastern United States with whitish forewings marked by elongate black spots and with a yellow abdomen.

MALE.—Length of forewing 10.7–11.8 mm. *Head:* Labial palpus moderately elongate, slightly exceeding base of antenna; second segment 1.25–1.40 times eye diameter, third segment about 0.8 as long as second (slightly longer than eye diameter); without distinct color bands, mostly dark gray basally and exteriorly, mostly to slightly whitish interiorly and on distal half exteriorly. Antennal shaft not dilated, width of shaft basally about 0.16 eye diameter; scape simple, white-scaled; basal few segments of shaft scaled dorsally, white. Scaling of tongue white, of front brown basally, becoming white before crown; occipital tufts white laterally, black at middle. *Thorax:* Dorsal scaling whitish, with four black spots, a pair at juncture of tegulae and collar, usually large, occasionally small, nearly hidden by collar; second pair at sides of scutellum. Underside whitish, legs pale ochreous. *Forewing:* Length 3.50–3.65 width; costal curve slightly stronger toward base; termen moderately strongly angled back. Ground color white, dusted with gray

along costa to midcell; a series of elongated black spots more or less evenly distributed over the wing; those in costal area at times somewhat obscured by infuscation; those in cell aggregated into two longitudinal bars in series, one in basal half, one in distal half of cell; six in dorsal area scarcely elongated. A row of conspicuous submarginal black spots from well before apex to beyond tornus. Fringe white, unbroken by markings. Underside pale brown, the upper side markings showing through. *Hindwing:* About as broad as forewing; costal area simple, margin concave before apex. Upper side white basally, becoming pale brownish in apical area. Fringe white. Underside white, costal area lightly tinged with brownish. *Abdomen:* Dorsal scaling of basal segment dark brown, of succeeding segments brownish gray with posterior ochreous scale fringe; lateral, ventral, and genital scaling bright ochreous. Genitalia as in Figure 82 (drawn from plesiotype, Plummer's Island, Maryland, JAP prep. no. 1508; two preparations examined); uncus heavily sclerotized, trifid; gnathos small, notched apically, not denate; basal processes narrow, heavily sclerotized.

FEMALE.—Length of forewing 10.4–12.0 mm. Similar to male; labial palpus slightly shorter in relation to eye diameter, length of second segment 1.15–1.35 times eye diameter, third segment 0.8–0.9 the length of second. Scaling darker, of thorax and forewing often entirely pale gray, costal area usually more heavily infuscated than male, almost completely obscuring markings in extreme cases; of hindwing pale brownish gray on distal half to almost wholly brownish gray, darkening toward apical area. Abdominal sternite VII with shallow posterior emargination. Genitalia similar to *E. mimihagenella,* the sterigmal plate shorter and signum larger, as in Figure 205 (drawn from plesiotype, Indiana, JAP prep. no. 2122; two preparations examined).

TYPE DATA.—Bosque County, Texas; lectotype by present designation: female (lacking wings on one side), bearing the data "Tex, 15/4, 28, zelleriella Chb., Type #1405," in Museum of Comparative Zoology, Harvard (*zelleriella*). "Texas," lectotype (lacking metathorax and abdomen) by present designation: labeled "*Hyponomenta texanella* Chamb. Texas" [in what appears to be Chambers' hand], "Type #1406" [probably by Hagen or Banks], "Ethmia (Psecadia) AB 1902" in Museum of Comparative Zoology, Harvard (*texanella*).

GEOGRAPHICAL DISTRIBUTION. — Eastern North America, from southern Ontario and Quebec through the Ohio Valley and southern Appalachian regions and in central Texas. Records are not available from the Mississippi Valley.

FLIGHT PERIOD.—April to June (Ohio and Maryland), May to July (Indiana). Two records from Monteagle, Tennessee, late April and early August, suggest two generations; an August record is also available from North Carolina. One specimen from Bosque County, Texas, in the British Museum is labeled "X–6–1876."

FOOD PLANT.—*Phacelia.* The larva of *E. zelleriella* was described by Dyar (1904a); specimens from Plummer's Island, Maryland, in the U.S. National Museum, and adult dissected from the pupa, blown larvae, and a pupal shell bear the Dyar number B81116 (emerged specimen data 18493). Information from the Dyar Notebook entry of this number states that the larvae were free feeding, without a web, on *Phacelia dubia.* Specimens of *zelleriella* from Cincinnati, Ohio, which bear the number B1106 were reared by Annette Braun. Dr. Braun (in litt.) noted that the larvae associated with this rearing number fed exposed on the upper surface of leaves of *Phacelia bipinnatifida.* At pupation they bored into pieces of corky bark of *Ulmus racemosa.* Larvae were collected August 15, 1923, and the moths emerged in April 1924.

REMARKS.—The peculiar nomenclatorial confusion, created when Chambers described a gelechiid as *Anesychia* (a synonym of *Ethmia*) *texanella* and the present ethmiid twice, as *zelleriella* and as *Hyponomenta texanella,* was clarified by Dyar (1902).

The Kirbyi Group

Eye index ± 1.0. Maxillary palpus small, four segments, the distal two reduced. Labial palpus moderately short, II segment index 1.0–1.2, smooth scaled. Antenna of male not or slightly dilated, index 0.19–0.22. Forewing moderately broad, pattern transverse metallic lines. Hindwing of male with costal hair pencil, with or without pinch-fold, or unmodified. Abdomen usually with I–II tergal scaling modified. Uncus hoodlike; gnathos dentate posteriorly; basal processes membranous, narrow;

valva with distal notch; fultura simple; manica-vesica with elongate sclerotized spur. Papillae anales with lateral lobes; antrum enlarged with sclerotized band; ductus bursae membranous with ± 6 loose coils; signum an elongate-narrow dentate keel.

An assemblage of seven nocturnal species in Mexico and the Caribbean. With the exception of *Ethmia bittenella,* the species are extremely similar in genital characters. *E. bittenella* is included, despite its modifications in uncus and other structures, on the basis of similarity in the phenetic assessments.

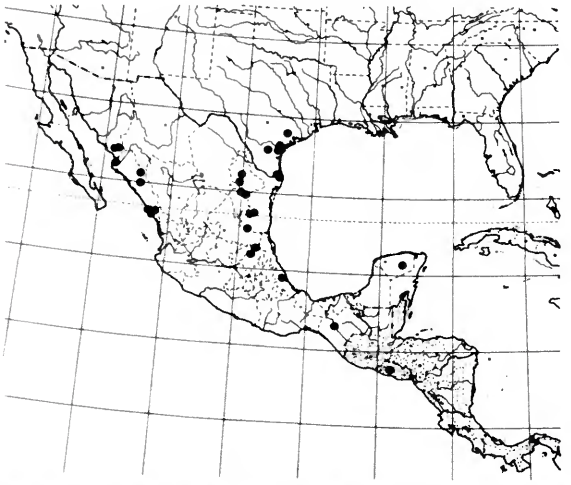
Ethmia delliella (Fernald)

FIGURES 23, 24, 83, 207, 208; PLATE 10*a*; MAP 31

Psecadia delliella Fernald, 1891:29.
Babaiaxa delliella.—Busck, 1902:95.
Tamarrha delliella.—Busck, 1906b:729 [taxonomy]; 1908b:205 [biology].—Barnes and Busck, 1920, pls. 26, 36.
Ethmia delliella.—Meyrick, 1914:27.—Heinrich, 1921:819 [biology].—McDunnough, 1939:83.—Powell, 1959:150 [in part].

A primarily Mexican species having white forewings with narrow, transverse, steel blue stripes and a bright ochreous terminal band.

MALE.—Length of forewing 9.0–10.9 mm. *Head:* Labial palpus not strongly upcurved, rather short, not reaching antennal base; second segment moderately curved, about 1.1 times as long as eye diameter; third segment slightly bent, about 0.67 times the length of second; smooth scaled, white, black exteriorly at apex of second segment. Antenna slightly dilated, width of shaft basally about 0.19 eye diameter; scaled dorsally, white at base, dark gray beyond. Scaling of tongue, front, crown, and occipital tufts white. *Thorax:* Pronotal scaling white; two transverse bands, black reflecting metallic steel blue, between tegulae and across scutellum. Underside shining white; coxae and trochanters tinged with bright ochreous, tibiae, tarsi, and prothoracic femur banded with blackish; hind tibial fringe dense, white. *Forewing:* Length about 3.2–3.3 times width; costa curve very slightly flattened toward apex, latter blunt, termen not strongly angled back, tornal angle well developed, fringe moderately broad. Ground color white, markings black, reflecting metallic steel blue, as follows: a small spot at base of costa; three transverse bands, narrow to rather broad (about 0.3 to 0.6 eye diameter), from costa, first near base ending before dorsum, second at one-fourth outwardly curved, ending before dorsum, third from costa before middle curved outward to middle of wing, sending a spur outward in cell with a detached spot above it, usually complete to dorsum, at times broken below spur; distal half of wing with two similar, incomplete bands, first bent outward toward end of cell, broken at lower outer angle of cell, second more or less straight from costa before apex to tornus, connected to the preceding band by a longitudinal mark at end of cell; a short band, sometimes broken, in lower terminal area; a series of about eight submarginal dots from apex to dorsum. A conspicuous, bright ochreous marginal band from apex to dorsum. Fringe gray, whitish basally. Underside pale brownish, whitish toward dorsum, markings of upperside showing through; ochreous terminal band partially reproduced. *Hindwing:* Broader than forewing; costal area with an exposed hair pencil rather thin, cream-white; costa slightly excavate toward apex, termen strongly angled back, tornal angle scarcely discernible. Ground color white, becoming slightly to strongly brown toward apex (more extensive brown accompanying broader forewing markings). Fringe white. Underside white, costal and apical area brownish. *Abdomen:* Dorsal scaling of second segment bright



MAP 31.—Geographical distribution of *Ethmia delliella* (Fernald).

ochreous, of remainder gray-brown with pale caudal and lateral fringes; ventrally dark brownish on middle, whitish laterally and posteriorly. Genital scaling bright ochreous, paler dorsally. Genitalia as in Figure 83 (drawn from plesiotype, Brownsville, Texas, JAP prep. no. 1471; eight preparations examined); uncus broad, width 0.90 to 1.05 times length; basal processes elongate, about 1.5 times uncus length; spines of anterior portion of gnathos, 11–18, variable.

FEMALE.—Length of forewing 9.5 to 12.0 mm. Essentially as described for male; antenna not dilated, width of shaft basally about 0.8 that of male; hindwing costal area simple. Color and markings, including thise of abdomen, not differing appreciably from male; females tending to have slightly broader forewing markings than males at any given locality. Genitalia as in Figures 207, 208 (drawn from plesiotype, Sinton County, Texas, JAP prep. no. 2005; two preparations examined); anterior apophyses thin, elongate; sterigma a simple plate, subtended by a deep, irregularly rugose, bilobed plate; ductus bursae sclerotized basally, membranous with about 6 loose coils distally; signum a thin fold with a row of short, blunt teeth.

TYPE DATA.—Texas; female type in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Gulf region of Texas (Victoria to Brownsville) and Mexico (Monterrey to San Luis Potosi, Veracruz, and Yucatan); west coastal plain of Mexico (Alamos, Sonora, to southern Sinaloa); Chiapas; and El Salvador.

FLIGHT PERIOD.—Apparently multivoltine; March to October in Texas, scattered records April to August elsewhere.

FOOD PLANT.—*Ehretia elliptica* de Candollé (Boraginaceae) at Victoria, Texas (Busck, 1908b). Collections of larvae in the U.S. National Museum from several Texas localities are labeled *Ehretia anacua*, a synonym of *elliptica*. Heinrich (1921) reported one moth reared at Brownsville from *Pseudabutilon* (=*Wissadula*) *lozani* (Rose) (Malvaceae), stems of which were heavily affected by an aegeriid and may have provided a pupation site but not food of the *E. delliella*. A specimen in the U.S. National Museum from Victoria, Texas, is labeled "on Anogra pallida" (=*Oenothera pallida* Lindl. Onagraceae)), an unlikely larval host.

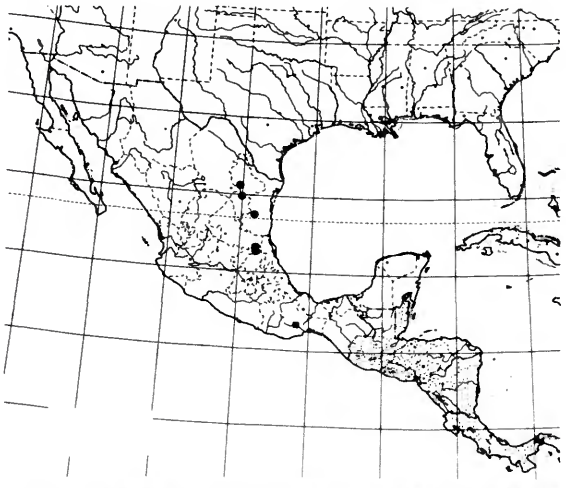
REMARKS.—Specimens from Texas and northeastern Mexico are rather consistent in having narrower bands on the forewing, and generally reduced dark coloring including the hindwing, than those from Sonora and Sinaloa. Individuals of the series from San Salvador are the darkest of all and most are somewhat larger than those from the northern parts of the range.

Ethmia davisella Powell, new species

FIGURE 84; PLATE 10*b*; MAP 32

A species in northeastern Mexico, similar to *E. delliella*, differing by reduced dark markings of the forewing (transverse bands broken) and by lacking the hindwing costal hair pencil.

MALE.—Length of forewing 8.0–9.0 mm. *Head:* As described for *E. delliella*; labial palpus slightly longer, owing to third segment length about 0.7–0.8 that of second. *Thorax:* As described for *delliella*; pronotal bands distinctly broken into paired spots between tegulae and on scutellum. *Forewing:* Shape and shining white ground color as in *delliella*; markings black, reflecting metallic blue, in same general pattern as *delliella* but reduced, as isolated spots: costa at base; first band near base as short bars on costa and in dorsal area; second band at one-fourth, as subcostal spot and



MAP 32.—Geographical distribution of members of the Kirbyi group of *Ethmia*.
● *E. davisella* Powell ▲ *E. clarkei* Powell
■ *E. linsdalei* Powell

short bars in cell and dorsal area; third band as costal spot before middle, short bar in cell and two in dorsal area, the last at dorsum sometimes lacking, outward spur in cell represented by isolated spot or short longitudinal bar; fourth band as thin bars in subcostal area, at lower, outer corner of cell and in dorsal area or reduced to the one at end of cell only; fifth bar thin, more or less complete from costa before apex to just above tornus; terminal dots and golden-ochreous marginal band about as conspicuous as in *delliella.* Fringe dark gray to nearly white. *Hindwing:* Shape as in *delliella;* costal brush absent. Ground color whitish basally, pale brownish over distal one-third to one-half. Fringe white. *Abdomen:* Scaling paler than on *delliella,* second segment dull ochreous dorsally, other segments brownish, broadly margined with pale tan to wholly whitish tan. Underside, segments brownish with pale caudal bands to almost entirely whitish; genital scaling pale ochreous. Genitalia as in Figure 84 (drawn from paratopotype, JAP prep. no. 1672; four preparations examined); similar to *delliella,* differing by a narrower uncus, its length about 1.10–1.30 times width and by shorter basal processes, 1.1 times uncus length; spines of anterior portion of gnathos, 12–14, variable but tending to be reduced toward middle.

FEMALE.—Length of forewing 8.2–9.7 mm. Essentially as described for male. Antenna not dilated; forewing markings tending to be slightly more extensive, the bands at times nearly complete, but all at least slightly separated into spots. Genitalia very similar to *E. delliella* (Figures 207, 208) (one preparation examined).

TYPE.—Holotype male and allotype female: Mexico, 6 miles south of Ciudad Victoria, Tamaulipas, 1,050 feet, August 6, 1963 (W. D. Duckworth and D. R. Davis); deposited in U.S. National Museum. Forty-nine paratypes all Mexico, as follows: same data as type, 12♂, 10♀; 4 mi SW Ciudad Victoria, Tamaulipas, 1,100 feet, 5♂, 4♀, VII–10–63; same data, 1,200 feet, 1♀, VIII–5–63 (Duckworth and Davis); 2 mi S Monterrey, Neuva Leon, 4,200 feet, 2♀, VIII–10–63 (Duckworth and Davis); 3 mi E Galeana, Neuva Leon, 5,000 feet, 5♀, VIII–(7–9)–63 (Duckworth and Davis); 25 mi N Tamazunchale, San Luis Potosi, 400 feet 5♂, 2♀, VII–(3, 4)–63 (Duckworth and Davis); 2 mi S Tamazunchale, San Luis Potosi, 400 feet, 1♂, 2♀, VII–15–63 (Duckworth and Davis); deposited in California Insect Survey and U.S. National Museum.

REMARKS.—Lack of a costal hair pencil on the upperside of the male hindwing readily separates this and the following species from *E. delliella.*

Ethmia linsdalei Powell, new species

FIGURE 85; PLATE 10c; MAP 32

Ethmia delliella.—Powell, 1959 (not Fernald, 1891):150 [in part]

A Mexican species of the *delliella* group, having broad, entire bands on the forewing, the median of which lacks the outward projecting spur, and having no hindwing costal hair pencil in the male.

MALE.—Length of forewing 9.2 mm. As described for *E. delliella,* differing as follows. *Head:* Labial palpus slightly longer, second segment length about 1.15–1.20 eye diameter. *Thorax:* Ochreous on legs more extensive. *Forewing:* Slightly broader than in *delliella,* length about 3.0–3.1 times width. Markings metallic blue, pattern similar to *delliella,* markings broader: first band, near base from costa to just above dorsum; second and third bands broad (width about one-half eye diameter), complete from costa to dorsum, only slightly curved outward toward middle, outward projecting spur in cell from third band, lacking or represented by a small isolated spot; fourth band complete or broken just below broad connecting spur to fifth band, latter complete or broken above connecting spur; submarginal dots reduced to about six, very small. Marginal band more extensive, broader and extending beyond tornus, and darker ochreous than on *delliella.* Fringe grayish, pale ochreous basally. *Hindwing:* Costal brush lacking. *Abdomen:* Genitalia as in Figure 85 (drawn from allotype, JAP prep. no. 351; one preparation examined); uncus rather broad, its length about 1.1 times width; basal process rather short, its length about 1.2 times uncus length, constricted near middle; valva with costal area drawn out into a projecting lobe.

FEMALE.—Length of forewing 9.8–10.0 mm. As described for male; antenna not dilated. Genitalia not examined.

TYPES.—Holotype female and allotype male: Mexico, 20 miles east of El Camaron, Oaxaca, August 7, 1956 (D. D. Linsdale); deposited in Califor-

nia Academy of Sciences. One paratype: Female, same data, in California Insect Survey.

Ethmia clarkei Powell, new species

FIGURE 86; PLATE 10*d*, MAP 32

A small shiny moth with white forewings having metallic blue spots and an ochreous terminal band; from an island off the coast of Quintana Roo.

MALE.—Length of forewing 8.0 mm. *Head:* Labial palpus rather short, not strongly curved; second segment slightly curved, length about 1.1 times eye diameter; third segment straight, about 0.7 as long as second; smooth scaled, white, second segment becoming dark brown apically. Antenna slightly dilated, width of shaft basally about 0.22 eye diameter; scaled dorsally, white near base, brown distally. Scaling of tongue, front, crown, and tufts of occipital margin white. *Thorax:* Pronotal scaling white; two wide metallic blue spots between tegulae, a second pair at sides of scutellum. Underside shining white; legs exteriorly ochreous at base, becoming dark brownish distally; metathoracic leg mostly white with dark segmental bands, tibial fringe rather reduced, grayish white. *Forewing:* Length about 3.3 times width; costa slightly curved from base to apex; termen not strongly angled back, slightly concave, tornal angle well developed, tornal fringe broad; wing rectangular in appearance. Ground color shining white; costa at base dark brown; remainder of wing checkered with isolated, metallic blue spots of varying sizes and shapes, more concentrated near base and in dorsal area, those of terminal area smaller; terminal margin with an ochreous band from just before apex to just above tornus. Fringe pale brownish, white at tornus. Underside pale brownish, paler toward dorsum; fringe whitish in apical and tornal areas; ochreous terminal band faintly reproduced. *Hindwing:* Broader than forewing; costal hair pencil from base, elongate, pale ochreous; costal margin excavate toward apex, latter narrow, termen slightly concave below apex, strongly angled back, tornal angle scarcely discernible. Fringe rather broad, about one-fourth membrane width. Ground color white, tinged with ochreous in costal area; apical area irregularly brownish. *Abdomen:* Dorsal scaling of second segment ochreous, of other segments brownish with paler caudal bands; of underside whitish; genital scaling ochreous. Genitalia as in Figure 86 (drawn from holotype, JAP prep. no. 1229; one preparation examined); very similar to *E. delliella,* differing by a slightly broader uncus, width 1.1 times length, and by slightly broader valvae with the distal notch broader.

FEMALE.—Length of forewing 8.1 mm. Essentially as described for male, differing as follows. Antenna not dilated, width of shaft basally about 0.15 eye diameter (eye about as large as in male). Forewing markings reduced, metallic blue spots smaller, ochreous terminal band smaller and paler. Hindwing costal area simple. Abdomen less distinctly marked, ochreous of second tergite reduced, less well defined; genital scaling pale tan. Genitalia not examined.

TYPES.—Holotype male and allotype female: Mexico, Quintana Roo, Isla de Mujeres (near Puerto Juarez), March 29, 1960 (J. F. G. Clarke; Bredin Expedition); deposited in U.S. National Museum.

Ethmia subsimilis Walsingham

FIGURE 87; PLATE 10*e-f*; MAP 33

Ethmia subsimilis Walsingham, 1897:89.—Busck, 1934:166, figures [biology].

A rather small Antillean moth having whitish gray forewings marked with numerous bluish gray spots.

MALE.—Length of forewing 7.5–8.4 mm. *Head:* Labial palpus rather short, strongly upcurved, not reaching base of antenna; second segment curved, length 1.0 eye diameter; third segment slightly curved, 0.80–0.85 as long as second; smooth scaled, whitish, with intermixed brownish, which forms a spot at apex of second segment. Antenna only slightly dilated, width of shaft near base about 0.20 eye diameter; densely scaled above, white at base, becoming shining gray distally, scape with a dark spot above. Scaling of front and crown appressed, occipital tufts only slightly spreading, white, an ill-defined gray band or pair of spots on front. *Thorax:* Pronotal scaling white, tinged with pale gray, base of collar and large paired spots between tegulae and at sides of scutellum steel gray. Underside shining white including legs; prothoracic tibia and tarsi mostly, mesothoracic and metathoracic tibiae and tarsi spotted exteriorly with dark brown reflecting steel blue; hind tibial fringe

elongate, conspicuous, white. *Forewing:* Moderately broad, length 3.1–3.2 times width; costa curve slightly flattened beyond middle, apex blunt, termen only slightly angled back, tornal angle well developed, fringe broad, giving truncate appearance. Ground color pale whitish gray, becoming dull gray with age, the whitish scaling apparently easily lost. Markings shining steel blue, sharply contrasting on freshly emerged specimens, becoming dull steel gray and ill-defined with age, as follows: about five small, distinct spots near base, at base of costa, in cell and two in dorsal area; numerous separate or more or less coalesced spots tending to form two parallel, outwardly angled, transverse bands at times becoming obsolete toward costa; about six darker and more distinct spots parallel to but preceding margin. A row of bronzy scales at base of fringe; latter gray. Underside brown; whitish blotches along costa and at dorsum. *Hindwing:* Slightly broader than forewing; costal hair pencil well developed, partially enclosed in a costal fold, pale whitish ochreous; costa slightly excavate toward apex, latter acute, termen strongly angled back, broadly curved to dorsum, tornal angle scarcely discernible. Ground color whitish, becoming pale brownish or dark brown toward apex. Fringe white. Underside whitish, brownish along costal and apical areas. *Abdomen:* Dorsal scaling brownish, segments with pale caudal margins; underside paler; genital scaling shining whitish tan. Genitalia as in Figure 87 (drawn from plesiotype, Sierra Maestra, Cuba, AB Slide September 27, 1931; four preparations examined); very similar to *E. delliella,* differing by a slightly narrower gnathos and slightly deeper notch on distal margin of valva.

FEMALE.—Length of forewing 7.7–9.7 mm. Essentially as described for male, samples available too limited to define sexual dichromatism. Antenna not dilated, width of shaft basally about 0.75 that of male. Costal brush of hindwing lacking. Wing markings variable as in male; one specimen with a conspicuous angulate bar from dorsum well before tornus toward apex, ending in cell (this marking usually narrower and less distinct). Hindwing not darker than male. Genitalia very similar to *E. delliella,* sterigmal plate somewhat simpler, without rugosity subtending the ostium (two preparations examined).

TYPE DATA.—West Indies, Jamaica, VII–17 (Cockerell); type male in British Museum. A specimen of *E. abraxasella* with the same data bears additional information: "Institute of Jamaica, Kingston, 1891."

GEOGRAPHICAL DISTRIBUTION.—Jamaica and Cuba (Sierra Maestra; Portland Parish; Santiago).

FLIGHT PERIOD.—January and February (Cuba); April, July, September (Jamaica).

FOOD PLANT.—A specimen from Santiago is labeled "Feeding on leaves of Cabo-Hacha," a plant reported by Busck (1934) and Bruner, et al. (1945) to be *Trichilia hirta* L. (Meliaceae).

REMARKS.—Specimens from Cuba differ in appearance from Jamaican ones, but the small numbers of both available limit conclusions. The variation in forewing pattern exhibited by reared and nonreared Cuban examples is greater than that among nonreared Cuban and Jamaican material. Male genitalia from Jamaica show a slightly broader posterior lobe of the valva and slightly smaller spines of the posterior part of the gnathos. Examination of additional material will be necessary to define species or subspecies in the entities here referred to as *subsimilis* and *E. kirbyi.*

Ethmia kirbyi (Moeschler)

PLATE 10*g-h*; MAP 33

Psecadia kirbyi Moeschler, 1890:341.—Walsingham, 1892:528, 546.

Ethmia kirbyi.—Walsingham, 1897:91.—Wolcott, 1923:204.—Forbes, 1930:133.

A moderately small Antillean *Ethmia,* having whitish forewings with broad costal and dorsal gray-brown markings.

MALE.—Length of forewing 8.1–8.4 mm. *Head:* Labial palpus strongly upcurved, slightly exceeding antennal base; second segment curved, length 1.1–1.2 times eye diameter; third segment slightly bent, 0.7 as long as second; smooth scaled, white, a brown spot at apex of second segment. Antenna only slightly dilated, width of shaft near base 0.20 eye diameter, densely scaled dorsally, white basally, becoming pale brownish distally. Scaling of front, crown, and tufts of occipital margin appressed, white. *Thorax:* Dorsal scaling white; broad, black, faintly metallic, paired spots at bases of tegulae,

between tegulae and at sides of scutellum. Underside white; prothoracic leg mostly, metathoracic tibia and tarsi spotted with dark brown; hind tarsi spotted with pale brown, tibial fringe moderately large, white. *Forewing:* Length about 3.2 times width; costa curve slightly flattened beyond middle; apex blunt, termen not strongly angled back, tornal angle well developed, fringe broad, giving truncate appearance to wing. Ground color white; gray-brown markings as follows: three or four small roundish spots near base, the two central ones tinged with metallic bluish; a broad, more or less complete blotch on middle half of costa extending into cell, and an opposing one on dorsum, both variably interrupted by spots of ground color, and separated by a median longitudinal streak of ground color which is upcurved to costa at basal one-fourth and before apex; terminal area with some scattered brownish gray marks and a submarginal row of about six roundish spots tinged with metallic blue. A narrow terminal band of golden ochreous. Fringe gray-brown with a basal row of white scales adjoining the ochreous terminal band. Underside pale brownish; costa whitish at middle and toward apex. *Hindwing:* About as broad as forewing; costal hair pencil narrow, pale whitish ochreous, arising from, but not enclosed in, a thin, subcostal pinch fold; costa slightly excavate toward apex, termen moderately strongly angled back, tornal angle discernible. Ground color white, becoming brownish toward apex. Fringe narrow, white. Underside white, indistinctly brownish along costa. *Abdomen:* Dorsal scaling pale brownish; distal segments with whitish caudal bands; underside and genital scaling shining whitish. Genitalia very similar to *E. delliella,* virtually indistinguishable from *E. subsimilis* (Figure 87) (two preparations examined).

FEMALE.—Not studied. In the original description, Moeschler mentions that the golden terminal band is lacking from a female, but it is present, darker than in male, on a recently collected female at U.S. National Museum.

TYPE DATA.—Porto Rico; types in Moeschler collection.

GEOGRAPHICAL DISTRIBUTION.—Haiti (Port au Prince) and Puerto Rico (Coamo Springs; Peñon Collao, Salinas; Mayaguea).

FLIGHT PERIOD.—February (Haiti), April, August (Puerto Rico).

FOOD PLANT.—Unknown.

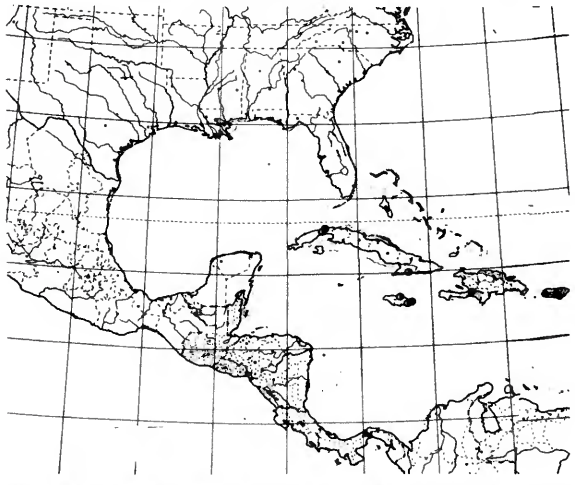
Ethmia bittenella (Busck)

FIGURES 88, 209; PLATE 10*i*; MAP 34

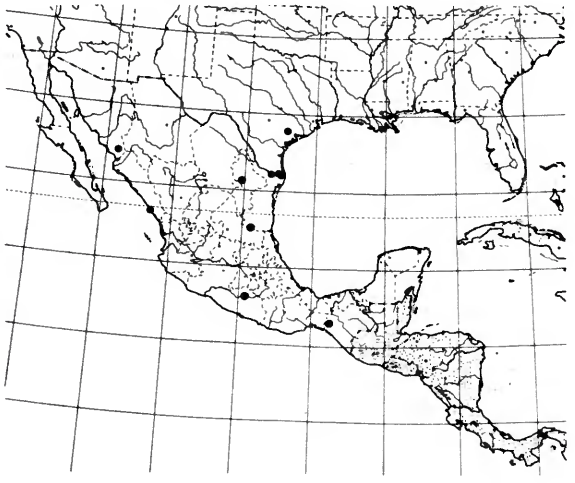
Tamarrha bittenella Busck, 1906b:730.—Barnes and Busck, 1920, pls. 26, 36.

Ethmia bittenella.—Meyrick, 1914:28.—Heinrich, 1921:819 [biology].—McDunnough, 1939:83.

A moderately small moth in Texas and Mexico, having a white forewing, with a dark costa, scat-



MAP 33.—Geographical distribution of members of the Kirbyi group of *Ethmia.*
● *E. kirbyi* (Moeschler) ◑ *E. subsimilis* Walsingham



MAP 34.—Geographical distribution of *Ethmia bittenella* (Busck).

tered black dots, and an ochreous marginal band.

MALE.—Length of forewing 7.4–9.2 mm. *Head:* Labial palpus upcurved, short, not reaching base of antenna; second segment length 1.0 eye diameter; third segment about 0.8 as long as second; smooth scaled, white, some scattered brownish scaling exteriorly, especially on second segment distally. Antenna slightly dilated, width of shaft basally 0.20 eye diameter. Scaling of front and crown smooth, and of occipital margin tufts, white. *Thorax:* Pronotal scaling white; paired large spots, black, reflecting metallic blue, between tegulae and on scutellum. Underside whitish; legs bright ochreous basally, tibiae and tarsi banded with dark brown; hind tibial fringe whitish. *Forewing:* Length about 3.3–3.4 times width; costa slightly curved from base to apex, latter blunt, termen moderately strongly angled back, slightly concave; tornus evident, its fringe broad, wing rather truncate in appearance. Ground color white, markings blackish brown, those longitudinally through middle of wing reflecting metallic blue, as follows: costa from base nearly to apex, broadly along middle area, paler than other markings; a round spot in dorsal area near base, followed at basal one-fourth on dorsum by oblique bar, a spot in cell above latter; a roundish spot on dorsum at one-third followed by an elongate blotch along dorsum, a U- or V-shaped mark just above latter, its apex toward base, reaching just into cell, followed by an indistinct spot just beyond its distal, open end; a larger roundish spot at tornus; about six somewhat variable spots in terminal area, at outer, lower edge of costal brownish and end of cell; at times two or three elongate blotches in cell adjoining costal brown; an irregular submarginal streak preceding a distinct, dark ochreous marginal band, from before apex nearly to tornus, becoming brown at latter. Fringe brown with a distinct, white basal band. Underside yellow-brown clouded with brownish; markings of upper side showing through, marginal ochreous not reproduced. *Hindwing:* About as broad as forewing; costa dorsally with thick ochreous hair pencil from base to end of cell; costa not folded, excavate toward apex, latter narrow, termen strongly angled back, tornal angle evident. Whitish basally, becoming pale brownish on apical half; costal area under hair pencil brown. Fringe white. Underside similar, brownish more restricted. *Abdomen:* Dorsal scaling brownish, second segment pale ochreous; segments laterally and ventrally whitish, leaving a thin, brown line down middle of venter; genital scaling whitish ochreous above, darker ochreous below. Genitalia as in Figure 88 (drawn from cotype, JAP prep. no. 1538; three preparations examined); uncus short; basal processes short; valva large in relation to tegumen, with apical notch small; vesica with small spurs.

FEMALE.—Length of forewing 9.0–9.6 mm. Essentially as described for male, evidently consistently larger and more heavily marked. Antenna not dilated. Hindwing costal area simple. Forewing markings as on male but all larger relative to size of wing; spot beyond the V-shaped one conspicuous, at times almost coalescing with the broadened V; elongate blotches in cell adjoining costal brown well developed. Terminal ochreous band darker, deep burnished gold. Abdomen color, including ochreous second segment, same as in male. Genitalia as in Figure 209 (drawn from plesiotype, Culiacan, Sinaloa, JAP prep. no. 2731; two preparations examined); sterigma plate deep, hoodlike, surrounding ostium, posteriorly with fine spines; ductus unsclerotized, with five or six loose coils; signum as in *E. delliella.*

TYPE DATA.—Brownsville, Texas (Barber), "June"; the type female in U.S. National Museum bears the additional data "29–5–04" and "in copula."

GEOGRAPHICAL DISTRIBUTION.—Southern Texas (Victoria) to southern and central Mexico (Chiapas; Rio Balsas, Guerrero) and thence northward along the west coast to Sinaloa (Mazatlan, Culiacan) and Sonora (Alamos).

FLIGHT PERIOD.—February, March, May, June, and November (Texas); late June to August (Sonora and Sinaloa).

FOOD PLANT.—Heinrich (1921) reported that two pupae were collected in galleries in stems of *Pseudabutilon* (=*Wissadula*) *lozani* (Rose) (Malvaceae) at Brownsville. In view of known food plant and pupation site preferences in the genus, this record may represent a pupation site only. A specimen in the U.S. National Museum from Victoria, Texas, is labeled "larva from Anachua, IV–2–08, pupa IV–7–08"; specimens of *E. delliella* and *E. semiombra* are similarly labeled, "Anacua" or "Anagua," and these records are believed to refer

to *Ehretia anacua* (=*elliptica* de Candollé) (Boraginaceae).

REMARKS.—A female of *E. bittenella* labeled "Vulkan Colima" in the Bavarian States Museum is somewhat darker, with the spots slightly broader, than extreme specimens from Texas.

The Mulleri Group

Eye small, index not comparable with other species owing to extraordinary head shape, crown produced in a large knob, front compressed, shorter than normal. Labial palpus moderately short, smooth scaled. Antenna of male not dilated. Forewing narrow; pattern white with longitudinal spots. Hindwing of male with double costal brush and pinch fold. Abdomen I-II terga with specialized scaling. Uncus hoodlike; gnathos dentate anteriorly and posteriorly; basal processes membranous narrow; valva with distal notch; fulturamanica simple; vesica armed. Female unknown.

A single species in Mexico which has strongest phenetic similarity with the Cypraeella group.

Ethmia mulleri Busck

FIGURE 89; PLATES 2*a*, 4*d*, 10*j*

Ethmia mulleri Busck, 1910a:212; 1914c:55,56. — Meyrick, 1914:30.

Ethmia mülleri (error) Busck, 1912:84.—Walsingham, 1912: 146, pl. 5, fig. 10.

A Mexican species, superficially similar to *E. proximella* but having fewer spots on a narrower forewing and hindwing costal fold over one brush and a second, exposed, enlarged brush; the crown is produced, with huge lateral tufts.

MALE.—Length of forewing 9.7–10.4 mm. *Head:* Labial palpus thin, porrect; basal segment curved, second segment nearly straight, length 1.1–1.2 times diameter of the small eye (eye diameter 0.7–0.9 that of comparable sized *Ethmia* species); third segment straight, short, about 0.5 the length of second; smooth scaled, ochreous basally, becoming dark brownish apically. Antenna not dilated, width of shaft basally about 0.15 eye diameter; scaling pale grayish. Scaling of proboscis ochreous of front roughened silvery white; crown produced into a conspicuous knob, scaling rough, shining white, with enlarged, dense, lateral tufts above antennae caplike over scapes, dark gray-brown. *Thorax:* Pronotal scaling white; scutellum with lateral black spots. Underside pale ochreous; prothoracic leg ochreous basally, becoming dark brown, tibia with a broad brushlike fringe directed mesad; mesothoracic leg ochreous, becoming pale brownish; metathoracic leg whitish ochreous, tibial fringe rather sparse. *Forewing:* Narrow, length 4.1–4.3 times width; costa very slightly curved, straight beyond middle, termen rather strongly angled back, to curve into dorsal margin at about middle, resulting in narrowed aspect of distal half of wing. Ground color white; costal area above cell gray-brown, tapered, ending before apex. Seven black spots (possibly reflecting blue on fresh examples): one at base; a pair above and below lower fold at basal one-fourth; a pair at about middle, one in cell adjoining costal gray-brown and one just basad and below fold; a pair just beyond end of cell, parallel to preceding pair. Six conspicuous black dots along terminal margin. Fringe white. Underside pale brownish; irregularly blotched with whitish beyond end of cell; costa with a conspicuous fringe directed toward middle of wing. *Hindwing:* Broader than forewing; costa with a large dense, dark ochreous scale brush extending to end of cell, subtended by a second brush enclosed in fold over costal half of cell; costa excavate toward apex, termen strongly angled back, tornus not discernible, dorsum concave before anal angle. Ground color pale brownish, darker under costal brush. Fringe whitish. Underside similar, distal area broadly dark gray-brown. *Abdomen:* Dorsal scaling of first two segments pale ochreous, of succeeding segments and underside tan; genital scaling ochreous-tan. Genitalia as in Figure 89 (drawn from plesiotopotype, JAP prep. no. 1096; two preparations examined); uncus notched as in Albitogata and Cypraeella groups; posterior gnathos with dense, fine spines; anterior gnathos with lateral lobes, weakly dentate on sides; basal processes short; valva modified, unlike any other member of the genus.

FEMALE.—Unknown.

TYPE DATA.—Tehuacan, Puebla, Mexico, July, September (R. Müller); type male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality.

FLIGHT PERIOD.—May, July, August, September.

FOOD PLANT.—Unknown.

REMARKS.—*Ethmia mulleri* exhibits some characters which are unique among New World members of the genus: the porrect labial palpus, bulging crown with lateral tufts, and narrowed forewing in distal half. It will be interesting to find whether the female shares some of these features. Even if none of these prove to be exclusive male traits, inclusion of the species in *Ethmia* is warranted according to present concepts, by the typical uncus, gnathos, and basic valva shapes.

The Cypraeella Group

Eye index 0.9–1.0. Maxillary palpus small to large, three or four segments, distal one reduced or elongated. Labial palpus moderately short to extremely elongate, II segment index 1.0–1.9; smooth scaled. Antenna of male not dilated to moderately dilated, index 0.19–0.25. Forewing moderately broad; pattern usually dorsal blotch, markings metallic. Hindwing of male with costal area unmodified or with hair pencil enclosed in pinch fold (rarely costal fold). Abdomen usually with genital scaling ochreous and scaling of I-II terga specialized. Uncus hoodlike; gnathos dentate posteriorly, usually not developed anteriorly; basal processes membranous, narrow, sometimes weakly ridged; valva with distal notch or simple; fulturamanica usually strongly armed; vesica usually simple. Papillae anales heavily sclerotized, setate; posterior apophyses not elongate; anterior apophyses narrow, usually short, sterigma ornate with lateral lobes or simple; antrum usually enlarged with sclerotized band; ductus bursae membranous or partly sclerotized with 5–8 tight or loose coils; signum a dentate bar or short or long dentate keel.

This is a somewhat diverse assemblage of 20 nocturnal yet brightly colored species. The group is widespread in the Neotropical Region, and includes three fairly distinct subgroups according to features of male genitalia, but overall phenetic similarity values indicate no strong clustering within the array. Genitalic similarities to species in the Oriental Region suggest this group may be a component of a pantropical group, perhaps with New World derivatives.

Ethmia proximella Busck

FIGURE 90; PLATE 11*a*

Ethmia proximella Busck, 1912:84.—Walsingham, 1915:423.

A moderately small Mexican *Ethmia,* resembling *E. bittenella,* differing by a reduction of the black markings on the dorsal half of the forewing, and by the presence of a costal fold on the hindwing of the male.

MALE.—Length of forewing 8.0–9.0 mm. *Head:* Labial palpus moderately elongate and strongly upcurved, reaching base of antenna; second segment length slightly more than 1.1 times eye diameter, moderately curved; third segment short, about 0.55–0.70 as long as second, slightly bent; smooth scaled, whitish, second segment exteriorly with scattered brownish or mostly brown at least apically. Antenna scarcely dilated, width of shaft basally about 0.16–0.17 eye diameter; scaled dorsally, white at base, becoming pale brownish distally. Scaling of front and crown smooth, white, at times with scattered pale brownish scales; occipital tufts dense, rather appressed, white. *Thorax:* Pronotal scaling white; paired blackish spots under tegulae and on scutellum. Underside white; legs pale ochreous at base, prothoracic and mesothoracic legs mostly dark brown exteriorly, banded with white; hind tibial fringe short, pale whitish ochreous. *Forewing:* Moderately narrow, length 3.4–3.5 times width; costa evenly curved from base to apex, latter blunt, termen not strongly angled back, tornal angle well developed, its fringe broad. Ground color white; costa from base nearly to apex, broadly dark gray-brown, broadest at distal half of cell, where it adjoins a double black spot or interrupted longitudinal bar in cell. Similar black markings, reflecting metallic blue-green on fresh specimens as follows: two roundish spots in dorsal area, one at basal one-fourth, second at one-third; a third spot, slightly larger, just beyond, in cell; an outwardly oblique row of three spots from middorsum to lower edge of cell before end; two spots at lower, outer end of cell, just preceding, below, and parallel to the oblique row of three; some ill-defined mottling and spots in terminal and tornal area preceding a more or less complete, narrow, dark submarginal band. A marginal band of dark to bright ochreous from apex to tornus. Fringe pale brownish, whitish basally. Underside

pale brownish, markings of upper side showing through, marginal ochreous not reproduced; a row of elongated, tan scales following retinaculum; a streak of unscaled, dark brown along upper edge of cell, from basal one-third to R_1. *Hindwing:* Slightly broader than forewing; costal hair pencil thin, pale whitish ochreous, enclosed, almost completely concealed in tightly appressed costal fold; costal margin appearing straight to apex, latter narrow, tornus strongly angled back to dorsum, tornal angle not evident. Ground color white, pale ochreous-brownish toward margins. Fringe white. Underside similar, costal fold area brownish. *Abdomen:* Dorsal scaling shining, pale tan, becoming whitish distally; second segment pale ochreous medially. Underside whitish; genital scaling whitish, pale ochreous below. Genitalia as in Figure 90 (drawn from plesiotype, Tehuacan, JAP prep. no. 1503; two preparations examined); uncus divided through entire length; posterior gnathos a dense bunch of flat setae; basal processes broad; valva with apical notch, similar to *E. bittenella.*

FEMALE.—Length of forewing 8.3–9.2 mm. Essentially as described for male; wing markings apparently not consistently darker than male as in the case of *E. bittenella.* Antenna not dilated, width of shaft basally about 0.9 that of male. Hindwing costa simple. Hindwing slightly darker than on male. Genital scaling darker ochreous. Genitalia not examined.

TYPE DATA.—Tehuacan, Puebla, Mexico (R. Müller); type male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Mexico, Guerrero (Rio Balsas), and Puebla.

FLIGHT PERIOD.—June to September; all records from Tehuacan.

FOOD PLANT.—Unknown.

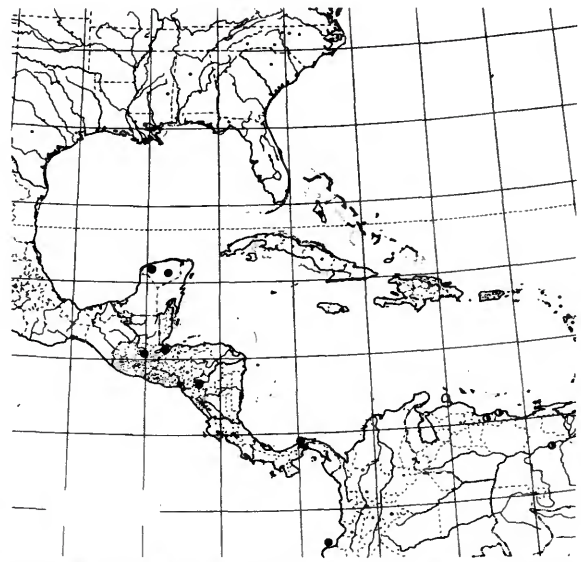
Ethmia festiva Busck

FIGURES 91, 210, 211; PLATE 11*b*; MAP 35

Ethmia festiva Busck, 1914b:33.—Showalter, 1929:72, pl. 15, fig. 15.
Ethmia xantholitha Meyrick, 1928a:519.—Clarke, 1955a:327; 1965:433 [synonymy].

A widespread Neotropical species having white forewings marked with black stripes and bright ochreous dorsal and terminal patches.

MALE.—Length of forewing 8.3 to 8.9 mm. *Head:*



MAP 35.—Geographical distribution of members of the Cypraeella group of *Ethmia.*
● *E. festiva* Busck ◑ *E. cypraeella* (Zeller)

Labial palpus strongly curved, elongate, reaching antenna base; second segment strongly curved, length 1.25–1.35 times eye diameter; third segment slightly curved, 0.67–0.75 as long as second; smooth scaled, white, tinged with brownish near base to mostly brownish exteriorly. Antenna dilated, width of shaft near base about 0.22–0.24 eye diameter; dorsal scaling white basally, becoming brownish distally. Scaling of front appressed, brown at base or entirely brown; of crown appressed, white; tufts of occipital margin compact, suberect, white. *Thorax:* Dorsal scaling white, shining dark brown, reflecting bluish, at base and under collar, a narrow band of the same color across scutellum. Underside shining white; legs ochreous; metathoracic tibial brush dense, elongate, whitish. *Forewing:* Broad, length about 2.9–3.1 times width; costa evenly curved from base to apex, latter broadly curved, termen only slightly angled back, fringe moderately broad; wing rather oval in appearance. Ground color white; distinct lines, brownish black, reflecting bluish, as follows: costa at base; three narrow, transverse bands, first near base from costa to dorsum, second at basal one-fourth from just below costa to just above dorsum, angled slightly outward at lower fold, third at about middle of wing, angling outward on costal

half, sending a longitudinal spur outward above Cu fold which nearly connects to a fourth transverse band from lower, outer angle of cell to dorsum; a large, square, bright ochreous patch between last two bands from above Cu fold to just above dorsum; costa pale ochreous from basal one-fifth; apical and terminal area with a broad, triangular, bright ochreous patch; terminal area between latter and cell with a small circle of blackish, sending five radiating arms, two toward costa, one each toward midtermen, tornus, and lower outer angle of cell. Fringe white with a distal ochreous band. Underside pale ochreous, indistinctly clouded with pale brownish; whitish on dorsal margin. *Hindwing:* About as broad as forewing; costal area simple; costa very slightly excavate toward apex, termen moderately strongly angled back, tornal angle scarcely discernible. Ground color whitish becoming brownish apically. Fringe shining white with pale brown, basal band. Underside whitish, indistinctly clouded with pale brownish on costal and apical areas. *Abdomen:* Dorsal scaling pale brownish, segments with pale caudal bands; underside and genital scaling ochreous. Genitalia as in Figure 91 (drawn from plesiotype, Cayuga, Guatemala, JAP prep. no. 1494; four preparations examined); uncus deeply notched, basal processes moderately broad, somewhat angulate in cross section, distal notch of valva broad, round, simple; vesica with a small spur.

FEMALE.—Length of forewing 9.6–10.0 mm. Essentially as described for male. Antenna not dilated, width of shaft basally about 0.8 that of male. Forewing colors tending to be brighter and more contrasting. Hindwing brownish darker and more extensive. Genitalia as in Figures 210, 211 (drawn from plesiotype, Condega, Nicaragua, JAP prep. no. 2727; five preparations examined); sterigmal plate with spiculate, depressed lateral lobes, sometimes each with a convexity near ventral margin; ductus with an ill-defined sclerotized patch; signum a narrow, multidentate fold without lateral flanges. Specimens from Mexico less elaborate, with only a single lobe on each side of the sterigma.

TYPE DATA.—Panama, Porto Bello, May (A. Busck); male type in U.S. National Museum (*festiva*). Colombia, Gorgona Island, 200 feet, July, October, at light; type in British Museum (*xantholitha*).

GEOGRAPHICAL DISTRIBUTION.—Southeastern Mexico (Temescal, Oaxaca; Chichen Itza, Yucatan) and Guatamala (Chelel; Cayuga) to northern Colombia.

FLIGHT PERIOD.—Late March to May (Yucatan, Panama), July (Oaxaca and Nicaragua), July and October (Colombia).

FOOD PLANT.—Unknown.

REMARKS.—It is possible that there are two species involved. Meyrick's *E. xantholitha,* described from Colombia, is similar to typical *festiva* from Panama, differing slightly from Mexican specimens of *E. festiva* in color and in form of the valva. The northern *festiva* have mostly whitish hindwings, while those from Nicaragua southward have the hindwing mostly brown, even in the male, and in Panama and Colombia the markings are somewhat stronger and more contrasting. The valva of Yucatan and Guatamala *festiva* is somewhat broader than in *xantholitha,* while the depth of the cleft is greater in both Colombia and Guatamala specimens than in those from Mexico. The genitalia are generally more heavily sclerotized in Nicaragua, resulting in marked differences in appearance of the gnathos and basal processes (although their shapes are constant) between the two areas. For the present it seems best to regard the fragmentary sample available as representing clinal variation and to treat *xantholitha* as a synonym. Variation in female genitalia may also be clinal, since Yucatan examples are less ornate and complex (sterigma having shallower lobes with smaller spiculae; ductus with few scobinate patches) than those from Nicaragua, but more southerly examples have not been studied.

Ethmia cypraeella (Zeller)

FIGURE 92; PLATE 11c; MAP 35

Psecadia cypraeella Zeller, 1863:149, pl. 2, fig. 9.
Ethmia cypraeella.—Meyrick, 1914:27.—Amsel, 1956:293; 1957, pls. 64, 107.

A rather small moth resembling *E. festiva,* with white forewings marked by thin black lines which define outer dorsal and terminal spots of pale ochreous.

MALE.—Length of forewing 8.0 mm. *Head:* Labial palpus lacking from single male examined (of female, elongate, strongly curved; second segment

curved, length about 1.2 times eye diameter; third segment slightly curved, nearly 0.75 as long as second; smooth scaled, creamy white, second segment tinged with brownish exteriorly). Antenna slightly dilated, width of shaft basally about 0.20 eye diameter; scaled dorsally, whitish. Scaling of front and crown smooth, whitish. *Thorax:* Pronotal scaling whitish; tegula at base and under collar shining metallic blue; a large metallic blue spot in middle of scutellum. Underside shining white; legs whitish tan, tinged with ochreous at bases and on tarsi; metathoracic tibial fringe short, white. *Forewing:* Moderately broad, length about 3.1 times width; costa evenly curved from base to apex, latter blunt, termen not strongly angled back, tornal angle well developed; fringe moderately broad. Ground color white; pattern similar to *E. festiva* but reduced. Three narrow, black, transverse, outwardly curved bands: near base, at basal one-third, and at middle of wing, the latter two connected along costa, the last connected in cell by a short longitudinal line to an opposing, curved line from terminal area, through end of cell and vertically to dorsum well before tornus, the two opposing curved lines defining between them a square, bright ochreous patch from just above Cu fold to just above dorsum; a fourth blackish band from costa beyond cell curving outward in terminal area, nearly connecting to an apical patch of bright ochreous which is indistinctly defined inwardly by blackish and becomes narrowed and brownish toward tornus; two smaller, irregular blackish spots in terminal area above and below distal portion of inwardly curved band, preceding outer costal band. Fringe white with a brownish basal band which defines apical ochreous patch outwardly. Underside whitish, indistinctly clouded with pale brownish, the pattern of upperside showing through. *Hindwing:* Slightly broader than forewing; costal area simple; costa slightly excavate before apex, latter narrow, termen strongly angled back, broadly curved to dorsum. Ground color white, pale brownish apically. Underside whitish, indistinctly clouded with pale brownish. *Abdomen:* Dorsal scaling pale brownish, second segment tinged with ochreous brown, distal segments with pale caudal bands; laterally and underside whitish; genital scaling pale ochreous. Genitalia as in Figure 92 (drawn from plesiotype, Maracay, Aragua, Venezuela, JAP prep. no. 1213; one preparation examined); similar to *E. festiva*, differing by slightly broader basal processes (exaggerated in the figure owing to orientation on the slides) and a narrower distal notch in the valva.

FEMALE.—Length of forewing 7.9–9.0 mm. Essentially as described for male. Antenna not dilated, width of shaft basally about 0.16 eye diameter. Abdomen not as distinctly marked with ochreous. Genitalia not examined.

TYPE DATA.—Venezuela; type male "in Dir. Kadens" collection, location unknown.

GEOGRAPHICAL DISTRIBUTION.—Northern Venezuela (Maracay; Caracas; Portachuela Pass, Aragua National Park, 3,600 feet; C.[iudad], Bolivar).

FLIGHT PERIOD.—April to July.

FOOD PLANT.—Unknown.

Ethmia abraxasella (Walker)

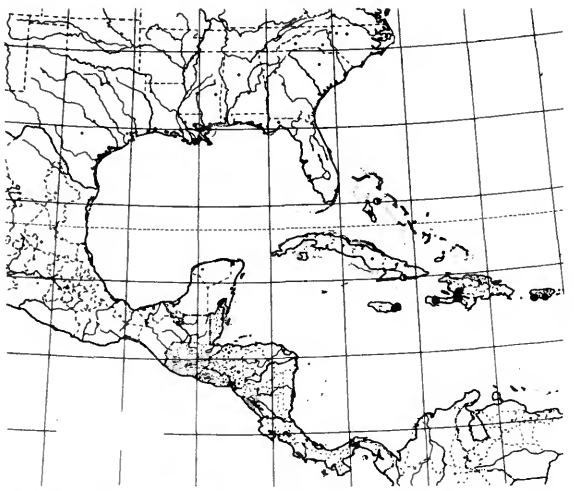
Psecadia abraxasella Walker, 1864b:1016.—Walsingham, 1892: 528 [synonymy].
Ethmia abraxasella.—Walsingham, 1897:90.—Meyrick, 1914:27. —Wolcott, 1923:203.—Forbes, 1930:134.—Busck, 1934:167.
Psecadia aureoapicella Moeschler, 1890:341.
Ethmia abraxella [error] Meyrick, 1914:27.

A moderately small Antillean species having white forewings marked by metallic bluish spots and a spot of ochreous on the cubital fold near the middle of the wing. The nominate race, which has more extensive forewing markings, is widespread in the Greater Antilles.

Ethmia abraxasella abraxasella (Walker), new status

FIGURE 93; PLATE 11*d*; MAP 36

MALE.—Length of forewing 7.4–8.0 mm. *Head:* Labial palpus moderately strongly curved and elongate; second segment length about 1.3 times eye diameter, curved; third segment very slightly curved, about 0.67 as long as second; smooth scaled, white, second segment dark brown on basal half, third segment brownish basally. Antenna slightly dilated, width of shaft near base about 0.21 eye diameter; scaled dorsally on basal half, whitish, scape with a dark spot on upper side. Scaling of front smooth, of crown somewhat roughened, tufts of occipital margin not appressed, white. *Thorax:* Dorsal scaling white, base of tegula and two pairs



MAP 36.—Geographical distribution of *Ethmia abraxasella* (Walker).
● *E. a. abraxasella* ◑ *E. a. clarissa* Busck

of large spots, between tegulae and at sides of scutellum, dark metallic greenish. Underside white; prothoracic leg dark brown exteriorly, middle legs and hindlegs paler with ochreous spots on trochanters and base of femora, hind tibia brownish ochreous below. *Forewing:* Broad, length 2.7–2.9 times width; costal curve strong on basal half, flattened toward apex, latter blunt, termen not strongly angled back, tornal angle well developed, fringe rather broad, the wing truncate in appearance. Ground color white; costa brownish gray from base to just before apex, this color produced at about middle as a broad triangulate spot reaching costal part of cell; a broad dorsal blotch of the same color beyond middle, extending into cell, to or nearly to costal blotch. Dark roundish spots usually reflecting metallic bluish, as follows: three near base, on costa, in cell and below Cu fold; two at basal one-third, in cell and below lower fold, latter one elongated toward dorsum; a larger one at about middle of wing on and below Cu fold enclosing a bright ochreous, transversely elongated mark; one at end of cell; about six, variable in development, in terminal area, arranged as an angled band from below outer one-fifth of costa toward termen above tornus. Terminal margin dark, at times reflecting bluish, enclosing a small ochreous spot at apex. Fringe whitish, with brownish distal band. Underside brown; costa distally with two whitish patches. *Hindwing:* About as broad as forewing; costal area simple; costa excavate toward apex, latter blunt, termen strongly angled back, broadly curved to dorsum. Ground color white, becoming brownish apically. Fringe white, tinged with brown at apex. Underside white, irregularly clouded with brownish on costal and apical areas. *Abdomen:* Dorsal scaling brownish, segments with slightly paler caudal bands; underside whitish; genital scaling pale brownish above, white below. Genitalia as in Figure 93 (drawn from plesiotype, Porto Rico, JAP prep. no. 1339; three preparations examined); uncus deeply cleft; gnathos with posterior spines and broad anterior flange, somewhat wrinkled, not dentate; basal processes moderately broad; valva with distal notch broad, the saccular portion blunt apically and shorter than costal.

FEMALE.—Length of forewing 8.3–8.8 mm. Essentially as described for male; insufficient samples available to show consistent differences in color pattern. Antenna not dilated, width of shaft basally slightly over 0.8 that of male. Genital scaling bright ochreous on sides. Genitalia essentially as in less ornate examples of *E. festiva* (Figure 210) (one preparation examined).

TYPE DATA.—Santo Domingo; type female in British Museum (*abraxasella*). Puerto Rico; location of type unknown (*aureoapicella*).

GEOGRAPHICAL DISTRIBUTION.—Jamaica (Kingston; Hardwar Gap, Portland Parish); Haiti (Port au Prince; Manville; Petionville; Camp Perrin); Dominican Republic; and Puerto Rico (Ensenada; Santa Rita; Guanica; Coamo Springs).

FLIGHT PERIOD.—February, May to July, October.

FOOD PLANT.—Unknown.

REMARKS.—Two specimens in the British Museum ("Felder Coll.," Rothschild 1913–86") are of the *abraxasella* s. str. phenotype, and one bears the data "Cuba Gundl," which presumably was the basis for Walsingham's (1897) report of *abraxasella* in Cuba. All other Cuban material examined has been of the *clarissa* phenotype. If *abraxasella* s. str. does occur in Cuba, a subspecific concept of *E. abraxasella clarissa* may be in error, but the two are very similar in structure.

The Jamaican record is represented by three specimens, two in the British Museum (Kingston, July 15, 17, 1891, Cockerell) which are somewhat darker in appearance, having the brownish gray

more extensive, and one from Portland Parish (Hardwar Gap, VII–9–66, H. F. Howden), which is typical in appearance, without additional brownish gray.

Ethmia abraxasella clarissa Busck, new status

PLATE 11*e*; MAP 36

Ethmia clarissa Busck, 1914c:56; 1934:167, pl. 34, fig. 1.
Ethmia abraxasella.—Walsingham (not Walker, 1864b), 1897: 90 [in part].

A race in Cuba which has the forewing markings restricted, so that the spots are mostly separated, without the transverse brownish gray blotches which connect the metallic blue spots in *a. abraxasella.*

MALE.—Length of forewing 7.1–8.0 mm. Similar to nominate subspecies, differing as follows. *Head:* Labial palpus tending to be shorter, length of second segment 1.2–1.3 times eye diameter. *Forewing:* Slightly narrower, length about 3.0–3.2 times width. Ground color white; brownish gray costal and dorsal blotches of *abraxasella* reduced to some indistinct scaling along costa; roundish markings dark brown, reflecting dark metallic greenish, through middle of wing similar to pattern of *abraxasella:* two near base, above and below Cu fold; three at basal one-fourth, above cell, below Cu fold, and in cell, the last located distad of the other two; three elongated ones forming a rough costal triangle at about middle (replacing brownish gray costal blotch of *abraxasella*); two below and adjoining lower fold on outer third of cell, the basal one having on its outer side a small bright ochreous spot (about half as large as in typical *abraxasella*); two on dorsum, before middle and before tornus; one in cell just before distal end; several irregular shaped and partially coalesced spots in terminal area from outer edge of cell to termen, leaving three spots of ground color, on costa before apex, on margin below apex and at tornus; a trace of a second yellow dot, often lacking, just before apex. Fringe grayish brown, interrupted by white spot below apex, with a basal row of white scales. *Abdomen:* Slightly darker above, pale brownish gray, including genital scaling. Genitalia not distinguishable from *a. abraxasella* (three preparations of *clarissa* examined).

FEMALE.—Length of forewing 7.6–9.1 mm. Generally as described for male and nominate subspecies; forewing markings larger than on male, giving a darker appearance; ochreous spots both somewhat larger than on male. Ochreous genital spots of *a. abraxasella* reduced to traces. Genitalia not examined, probably as in *E. festiva* and *abraxasella* s. str.

TYPE DATA.—Cuba (W. Schaus); type male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Cuba (Santiago) and Bahama Islands (Nassau).

FLIGHT PERIOD.—June, October, December (Cuba), July (Bahama Islands).

FOOD PLANT.—Unknown.

Ethmia scythropa Walsingham [11]

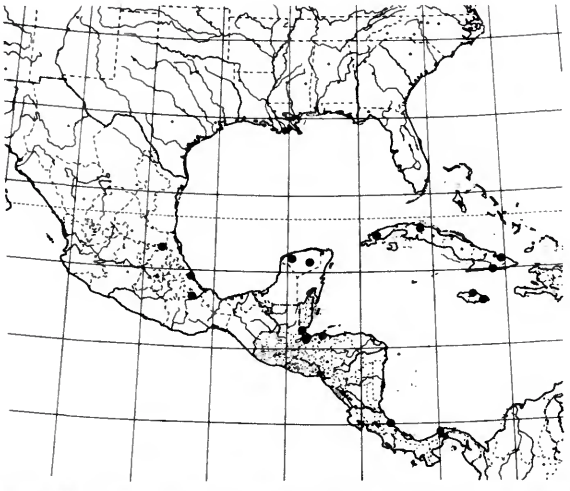
FIGURES 10, 25, 26, 94; PLATES 3*c*, 11*f*; MAP 37

Ethmia scythropa Walsingham, 1912:148, pl. 5, fig. 13.—Busck, 1934:168, pl. 35, fig. 1.

A large moth, widespread in central America and the Greater Antilles, which has erect, white head scaling, enormous hair tufts under the tegulae of the male and whitish forewings heavily mottled with olivaceous gray, including the entire costal area, and with a bluish dorsal blotch.

MALE.—Length of forewing 9.4–12.5 mm. *Head:* Labial palpus greatly elongate, only slightly curved; second segment length 1.9–2.1 times eye diameter, slightly curved; third segment about 0.6 as long as second (about 1.2 eye diameter), nearly straight, tapering to hair-fine apex; smooth scaled, white, tinged with grayish on basal half. Antenna, scape greatly elongate, flagellum slightly dilated, width of shaft basally 0.21 eye diameter; dorsal scaling dark gray, scape with scattered whitish. Scaling of tongue and front smooth, pale grayish, of vertex, crown, and occipital margin and elongate, erect, anteriorly directed, white tuft, on fresh individuals exceeding crown by about eye diameter. *Thorax:* Dark gray, tegulae with metallic bluish and scat-

[11] I have not seen the types of the following species: *E. nivosella* (Walker) and its alleged synonym, *adustella* Zeller. However, on the basis of Walsingham's (1906) discussion, it seems likely that the species later described by him as *scythropa* (and so treated in this work) should be called *nivosella* Walker, while Zeller's series consisted of both species, and judicious selection of a lectotype could make the name *adustella* available for the species here treated as *nivosella.*



MAP 37.—Geographical distribution of *Ethmia scythropa* Walsingham.

tered translucent white scales basally, enlarged distally as a dense tuft of elongate paler scales which converge over scutellum, enclosing dense tufts of wavy hair which can be teased out into enormous fluffy masses. Underside pale grayish, legs pale brownish, hind tarsi with ochreous, hind tibial fringe dense, rather short, pale whitish ochreous. *Forewing:* Length 3.0–3.3 times width; costa evenly curved from base to apex, latter blunt, termen not strongly angled back, very slightly concave, tornal angle well developed, fringe narrow. Ground color olivaceous gray, reflecting metallic olivaceous; basal area and a large dorsal blotch from just beyond middle nearly to tornus, extending to top of cell, dark gray-purple, reflecting metallic purplish, containing scattered translucent white scales, which in the dorsal blotch tend to form a W- or M-shaped line; a broad dorsal area of white extending to lower fold between the purplish blotches and isolated from them by margins of ground color, at times clouded with ground color, some scattered whitish scaling in cell; a second white area at tornus, adjoining dorsal blotch, tapering and extending nearly to apex. Underside pale brown, terminal area pale yellowish. *Hindwing:* Slightly broader than forewing. Costal hair pencil dense, elongate, reaching to end of cell, dark ochreous; enclosed except at base in a tight pinch-fold between Sc and R; costa with a pale fringe from base to apex, excavate toward the narrow apex, termen strongly angled back, tornal angle not discernible. Ground color shining whitish, becoming pale brownish apically. Underside color similar. *Abdomen:* Scaling brown, first segment paler; genital scaling bright ochreous. Genitalia as in Figure 94 (drawn from plesiotype, Chichen Itza, Yucatan, JAP prep. no. 1460; seven preparations examined); uncus notched a short distance; gnathos with broad, dentate posterior portion, anterior portion without armature; basal processes thin, valva broadly, shallowly emarginate distally; fultura plate with curved, broad spurs, vesica with a thin spinelike cornutus.

FEMALE.—Length of forewing 8.3–12.5 mm. Essentially as described for male. Labial palpus shorter, second segment 1.5–1.7 times eye diameter. Antenna slightly dilated, about equal in width to antenna of male (0.21 eye diameter). Tegulae normal, without enlarged hair tufts. Hindwing with costal area simple. Genitalia very similar to *E. festiva*; sterigma with spiculate, round cup-like lateral lobes; ductus with an irregular sclerotized sleeve basally, without scobinate patches; signum a narrow, dentate fold.

TYPE DATA.—Banana River, Costa Rica, March 1907 (W. Schaus); unique male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Widespread in Neotropical areas; from eastern Mexico (San Luis Potosi; Veracruz; Oaxaca; Yucatan), British Honduras, and Guatamala to Costa Rica, and in Cuba and Jamaica.

FLIGHT PERIOD.—Evidently multivoltine; taken in nearly every month; December to March in Cuba and Jamaica, December to June and September in Yucatan, and March to May and September to October in Guatamala.

FOOD PLANT.—Unknown.

REMARKS.—This and the following species occur as distinct entities in Cuba and Jamaica, although they apparently have not been taken flying together. *E. nivosella* ranges eastward to Porto Rico, but *E. scythropa* has not been collected there. I have seen no specimens from Dominican Republic and only two from Haiti, both worn males in the U.S. National Museum. One has genital characters somewhat intermediate between *scythropa* and *nivosella*. A Busck slide with what I assume to be the genitalia preparation from the second speci-

men shows identical characters. The specimen is labeled "Haiti, *Dognin* coll." and neither the moth nor the slide bears the characteristic date label Busck normally used to associate pinned specimens and slides. However, both specimen and slide are determined "Ethmia near or = scythropa Wlsm." in Busck's handwriting. Although very worn, the specimens resemble *scythropa* in having the ground color uninterrupted costad of the dorsal blotch. Additional material from Dominican Republic or Haiti will be necessary to define the status of populations there.

Busck (1934) also stated that *E. scythropa* was represented in the U.S. National Museum by a large series from Costa Rica, but these were not located during this study. The only specimens I have seen from any place south of Honduras are a very worn female from the Canal Zone and the type from Costa Rica, which differs slightly in appearance by having the white areas, although as large, less conspicuous and contrasting than material from more northern areas. Specimens from Cuba and Jamaica tend to have the white areas less extensively invaded by ground color than those from the mainland.

Ethmia nivosella (Walker)[12]

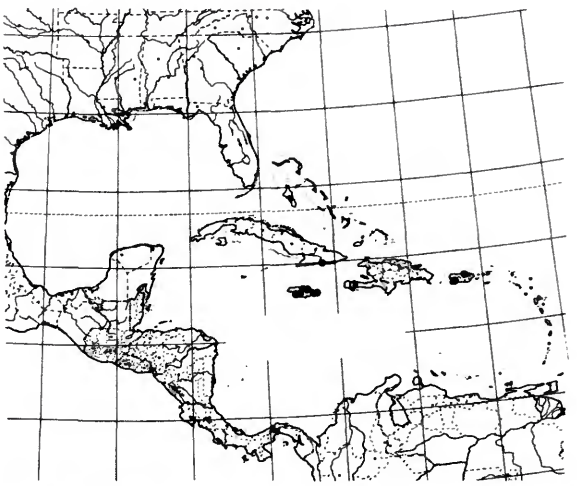
FIGURE 95; PLATES 2*b*, 11*g*; MAP 38

Tamarrha nivosella Walker, 1864a:817.—Walsingham, 1897: 144 [Synonymy].
Psecadia nivosella.—Walsingham, 1892:528, 546.
Ethmia nivosella.—Meyrick, 1914:28.—Forbes, 1930:134.—Busck, 1934:167, pls. 34, 36.
Psecadia adustella Zeller, 1877:240.—Moeschler, 1890:343.—Walsingham, 1892:528, 546.
Ethmia adustella.—Wolcott, 1923:203.
Tamarrha niveosella (error), Busck, 1906b:728.
Tamarrha nievosella (error), Busck, 1906b:729.

A West Indian species which resembles the larger *E. scythropa,* differing by expansion of white on the costal area of the forewing connecting the submedian and terminal white areas.

MALE.—Length of forewing 8.3–10.0 mm. ***Head:*** Labial palpus moderately elongate, not much curved; second segment length about 1.5 times eye diameter, slightly curved; third segment about 0.6 as long as second (about 0.9 eye diameter); smooth

[12] See footnote 11.



MAP 38.—Geographical distribution of *Ethmia nivosella* (Walker).
● typical morphotype
◑ atypical morphotype on Hispaniola

scaled, white, second segment pale brownish exteriorly. Antenna only slightly dilated, width of shaft basally about 0.19 eye diameter; dorsal scaling dark gray. Scaling of tongue and front smooth, pale brownish, of crown and occipital margin as in *scythropa,* an elongate, erect, white tuft. ***Thorax:*** Dorsal scaling purplish gray with scattered translucent white scales; tegulae heavily scaled, bulging, extending to but not over scutellum, which is similarly densely scaled, enclosing dense tufts of wavy hair which can be teased out into fluffy masses. Underside whitish, legs pale brownish to whitish, hind tibial brush white, rather reduced. *Forewing:* Broad, length about 3.0 times width; costa slightly curved from base to apex, latter blunt, termen scarcely angled back, nearly vertical. Pattern similar to *scythropa,* white more extensive, forming the predominate ground; basal area and broad dorsal blotch purplish bronzy, reflecting metallic purplish, the blotch extending to about middle of cell, its scattered white scales usually forming an M-shaped zigzag line; gray areas not as strongly olivaceous as on *scythropa:* on costa before middle and broadly bordering purplish basal area and dorsal blotch, not extending from latter into costal area beyond cell, at apex; resulting white area contiguous from dorsum before middle through to costa above end of cell and into terminal area to tornus. Underside pale brown, irregu-

larly clouded by whitish on dorsal and terminal areas. *Hindwing:* About as broad as forewing; costa with elongate hair pencil, enclosed in tight, subcostal pinch-fold; costa free of the fold, with fringe, slightly excavate toward apex, latter rather blunt, termen broadly curved to dorsum. Ground color whitish becoming pale brownish distally. *Abdomen:* Dorsal scaling brown, tinged with ochreous basally; underside whitish; genital scaling ochreous. Genitalia as in Figure 95 (drawn from plesiotype, Portland Parish, Jamaica, JAP prep. no. 1235; six preparations examined); uncus shallowly notched; gnathos similar to *E. scythropa;* basal processes broad, becoming subcapitate, extended laterad apically; valva deeply notched, the saccular portion produced into a triangulate flange apically; fultura plate elongate, with a few very small spurs.

FEMALE.—Length of forewing 8.7–10.5 mm. Essentially as described for male. Labial palpus as long as on male (shorter in *scythropa*). Antenna shaft about as wide as on male. Tegulae normal, not covering large hair tufts. Hindwing costal area simple. Genitalia similar to *E. festiva* and *E. scythropa,* very weakly sclerotized; lateral lobes of sterigma thin, shallow, ductus without differentiated sclerotized areas; signum smaller, with fewer teeth than in related species.

TYPE DATA.—Jamaica (Grosse), Domingo (Tweedie); types in British Museum (*nivosella*). One ♂, 3 ♀, from Puerto Rico in Staudinger collection, location unknown (*adustella*).

GEOGRAPHICAL DISTRIBUTION.—West Indies, from Jamaica and eastern Cuba, "Bahamas," and Puerto Rico. As discussed in connection with the preceding species, I have not seen specimens of typical *nivosella* from Haiti or Dominican Republic. The species was reported from Trinidad by Walsingham (1897) and by Forbes (1930) (probably quoting Walsingham), based on specimens I have not examined.

FLIGHT PERIOD.—January to March (Jamaica), July (Jamaica, Porto Rico), October (Cuba).

FOOD PLANT.—Unknown.

REMARKS.—Busck (1906b) stated that this species seems to have the remarkable ability of raising the scales of the head when alive, since in "a series of perfect specimens" some exhibited a tufted head while others had "the scales of the head perfectly smoothly appressed." He also mentioned that in two specimens one side of the head was tufted, the other smooth, "proving that it is a changeable character, probably in control of the individual and subject to the mental condition of the insect." Later, however, the same author (Busck, 1934) gives the curious erect scaling of this and *E. scythropa* as a diagnostic feature which "at once separates them from all other species of the genus with normal smooth head." The latter statement seems more tenable; all specimens I have examined have the scaling of the crown erect except where rubbed off.

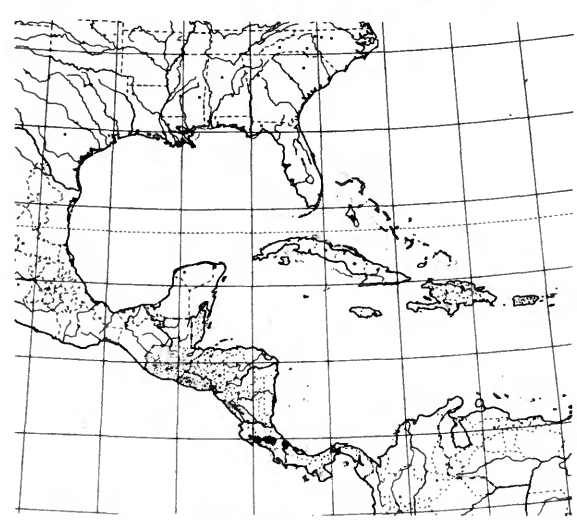
Ethmia terpnota Walsingham

FIGURES 96, 212, 213; PLATE 11*h*; MAP 39

Ethmia terpnota Walsingham, 1912:147, pl. 5, fig. 11.

A large Central American species having a large coppery dorsal blotch on the forewing, and the costa broadly gray-brown.

MALE.—Length of forewing 11.8–12.4 mm. *Head:* Labial palpus rather short, strongly upcurved; second segment moderately curved, length about 1.1 times eye diameter; third segment moderately curved, about 0.6 as long as second; smooth-scaled, brown with occasional white scales. Antenna only slightly dilated, width of shaft basally about 0.20–0.21 eye diameter; dorsal scaling dark brown with occasional white scales, scape white below. Scaling



MAP 39.—Geographical distribution of *Ethmia terpnota* Walsingham.

of proboscis and front appressed, brown with scattered white scales, reflecting metallic blue at upper front, becoming roughened, somewhat spreading, white on crown. *Thorax:* Dorsal scaling white, base of tegula and lateral spots on scutellum dark metallic blue. Underside pale brownish; legs dark brown marked with white; metathoracic leg gray-brown, tibial fringe sparse, grayish. *Forewing:* Length 3.0–3.1 times width; costa strongly bowed toward middle, apex blunt, termen only slightly angled back, nearly straight. Ground color white; a large quadrate dorsal blotch from well before middle nearly to tornus, extending upward to middle of cell, metallic purplish coppery, containing translucent white scales forming an irregular sinuate line; costal area gray-brown from base nearly to apex, broadened in outer half of cell, contiguous with dorsal blotch; three paler gray spots in terminal area; several dark metallic blue spots on basal one-fourth, those on costal half ill-defined and blending with costal gray, a single distinct one in dorsal area, an ill-defined marginal bar of same color at apex. Fringe dark gray, white at tornus. Underside pale brown, dorsal area pale yellowish, tornal area whitish. *Hindwing:* About as broad as forewing; costa with elongate, whitish ochreous hair pencil tightly enclosed in subcostal pinch-fold; costa nearly straight, apex narrow, termen broadly curved to dorsum. Ground color white, becoming pale brownish at apical margins. Fringe white. Underside whitish, costal and apical areas brownish. *Abdomen:* Scaling brown, slightly paler ventrally; genital scaling bright ochreous. Genitalia as in Figure 96 (drawn from plesiotype, Puntarenas, Costa Rica, JAP prep. no. 1493; three preparations examined); uncus elongate, deeply notched, gnathos with posterior teeth divided into lateral groups, anteriorly broadened, somewhat crenulate, not dentate; basal processes elongate, thin; sacculus with a finger-like projection, rounded or attenuate apically; fultura plate elongate, narrow, without spurs.

FEMALE.—Length of forewing 13.6–13.8 mm. Essentially as described for male; antenna nearly equally thick; forewing markings at times slightly heavier. Hindwing without subcostal fold and brush. Genitalia (Figures 212, 213, drawn from plesiotypes, Tuis and Juan Vinas, Costa Rica, JAP prep. nos. 2267, 2797; two preparations examined); similar to *E. festiva,* lateral lobes of sterigma deep, bowl-like, densely covered with fine spines inside; ductus with a narrow sclerotized sleeve basally, followed by a long, curved, stiff, unsclerotized portion, then a tight spiral of about six loops; signum a broadly flanged, dentate fold with a single row of large teeth.

TYPE DATA.—Costa Rica, Volcan de Irazu, 6,000–7,000 feet (H. Rogers); type male in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from Costa Rica (Juan Vinas; Puntarenas, Monteverde; San Jose; Sixola River; Tuis).

FLIGHT PERIOD.—March, October to November.

FOOD PLANT.—Unknown.

Ethmia iridella Powell, new species

FIGURE 97; PLATE 11*i*

A Mexican species resembling *E. terpnota* but having the forewing costa only narrowly gray, the area above the dorsal blotch white.

MALE.—Length of forewing 12.3 mm. *Head:* Labial palpus moderately elongate, rather strongly curved, reaching base of antenna; second segment length about 1.25 times eye diameter, curved; third segment about 0.5 the length of second, slightly curved; smooth scaled, dark brown, third segment white beyond base. Antenna only slightly dilated, width of shaft basally about 0.20 eye diameter; dorsal scaling gray, scape white below. Scaling of proboscis and front smooth, dark gray-brown with scattered whitish scales, of crown appressed, somewhat roughened, white (holotype irregularly yellowish, presumably discolored). *Thorax:* Dorsal scaling white; base of tegula, two large spots on collar between tegulae and scutellum dark metallic blue. Underside whitish; legs pale ochreous, prothoracic and mesothoracic tibiae and tarsi dark brown; hind tibial fringe well developed, white. *Forewing:* Length about 3.3 times width; costa rather strongly curved toward middle, apex blunt, termen slightly concave. Ground color white; a broad dorsal blotch from before middle to about end of cell, extending upward into cell, metallic purplish copper, containing translucent white scales which form a zigzag line; costa narrowly gray nearly to the end of cell. Dark gray-brown spots, reflecting metallic blue, as follows: several in costal area

above Cu fold near base, the outer most at one-fifth, extending below Cu, preceded in dorsal area by a single indistinct spot; an irregular mark adjoining inner side of dorsal blotch below Cu; a spot in cell above dorsal blotch, one just beyond dorsal blotch at end of cell; several more or less coalesced spots in apical area. Fringe gray, white at tornus. Underside pale brownish, broadly clouded with yellowish white in middle and dorsal area, yellow beyond cell, costa ochreous distally. *Hindwing:* About as broad as forewing; an elongate, whitish hair pencil, tightly enclosed in subcostal pinch-fold; costa nearly straight, termen broadly curved to dorsum. Ground color white, faintly grayish along costa, tinged with pale ochreous at apex. Underside similar, the colors darker and more extensive. *Abdomen:* Scaling colors not recorded. Genitalia as in Figure 97 (drawn from holotype, JAP prep. no. 1101; one preparation examined); uncus elongate, very shallowly notched; gnathos as in *scythropa* and *nivosella;* basal processes elongate, thin; valva broad distally, with a round notch, sacculus attenuate distally.

FEMALE.—Unknown.

TYPE.—Holotype male: Mexico, Puebla, Tehuacan, June 21, 1941 (C. C. Hoffmann); unique, deposited in American Museum of Natural History.

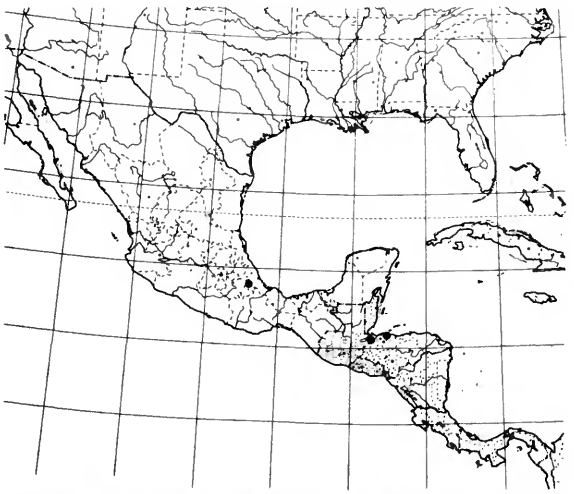
Ethmia perpulchra Walsingham

FIGURES 98, 214; PLATE 11*j*; MAP 40

Ethmia perpulchra Walsingham, 1912:146, pl. 5, fig. 14.

A moderately large Central American moth having white forewings with a reddish coppery dorsal blotch and golden ochreous termen.

MALE.—Length of forewing 8.2–10.0 mm. *Head:* Labial palpus short, rather strongly curved; second segment length 0.9–1.0 eye diameter; third segment 0.80–0.85 as long as second, slightly curved; smooth scaled, mostly whitish, second segment brownish exteriorly. Antenna slightly dilated, width of shaft basally 0.21 eye diameter; dorsal scaling white. Scaling of tongue mostly brownish, of front smooth, dark brown reflecting metallic blue, of crown roughened, white. *Thorax:* Dorsal scaling white; paired, conspicuous dark metallic blue spots at bases of tegulae, between tegulae and on scutellum. Underside white; legs ochreous, tibiae and tarsi marked with brown; hind tibial fringe rather



MAP 40.—Geographical distribution of *Ethmia perpulchra* Walsingham.

sparse, white. *Forewing:* Length 3.1–3.2 times width; costa gently curved from base to apex, latter blunt, termen moderately strongly angled back, tornal angle a broad curve. Ground color white; a quadrate, well-defined dorsal blotch from before middle to end of cell, extending upward well into cell, shining metallic reddish coppery, enclosing some white scaling which forms an irregular sinuate line; termen broadly shining golden ochreous. Ground more or less evenly checkered by distinct squarish dark metallic blue spots, becoming black and more coalesced toward costa. Underside pale brownish, whitish on dorsal area, becoming pale ochreous towards tornus. *Hindwing:* Slightly broader than forewing; costal hair pencil elongate, pale gray, tightly enclosed in subcostal fold; costa nearly straight, apex narrow, termen broadly curved to dorsum. Ground color shining translucent white, becoming pale brownish apically. Fringe white. Underside similar, costal area brownish. *Abdomen:* Dorsal scaling dark brown; underside white; genital scaling bright ochreous. Genitalia as in Figure 98 (drawn from plesiotype, Cayuga, Guatamala, JAP prep. no. 1138; four preparations examined); uncus rather broad, not notched; gnathos broad and heavily dentate posteriorly, not developed anteriorly; basal processes moderately broad and sclerotized; valva broad, with costa developed into strong apical hook (as in

Elutella complex); fultura plate with heavy, irregular armature.

FEMALE.—Length of forewing 10.4 to 11.7 mm. Essentially as described for male; antenna not dilated, width of shaft basally about 0.8 that of male; hindwing costal area simple. Genitalia as in Figure 214 (drawn from plesiotype, Lancetilla, Honduras, JAP prep. no. 2160; one preparation examined); papillae anales heavily sclerotized, anterior apophyses short, sterigma broad with elongate, pointed lateral lobes, ductus lightly sclerotized basally with a dentate band; signum narrow, dentate.

TYPE DATA.—Mexico, Orizaba, Veracruz (W. Schaus); type female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Veracruz to Guatamala (Cayuga) and Honduras (Lancetilla, Tela).

FLIGHT PERIOD.—February to May.

FOOD PLANT.—Unknown.

Ethmia elutella Busck

FIGURES 99, 217–219; PLATE 12*a*; MAP 41

Ethmia elutella Busck, 1914b:35; 1914c:57.
Ethmia submissa.—Amsel, 1956 [not Busck, 1914c]:293.

A small Central American moth, which has the costal half of the forewing clouded with grayish, the dorsal area with a large purplish blotch which is concolorous with the termen.

MALE.—Length of forewing 6.3–7.7 mm. *Head:* Labial palpus elongate, strongly upcurved, exceeding base of antenna; second segment about 1.3 times eye diameter, strongly curved; third segment nearly straight, about 0.6 as long as second; smooth scaled, pale grayish exteriorly, apex and interiorly white. Antenna with shaft basally moderately dilated, about 0.23 eye diameter; dorsal scaling pale brownish. Scaling of front appressed, brownish, of crown white, only slightly upraised. *Thorax:* Scaling of collar, tegula, and dorsum laterally white, median area with large coalesced metallic blue spots. Underside including legs shining sordid whitish, hind tibial brush well developed. *Forewing:* Length about 3.0–3.2 times width; costa slightly, evenly arched from base to apex; termen straight, moderately angled back, tornal angle well developed; dorsum slightly convex. Ground color white, mostly obscured by grayish clouding or ill-defined blotches basally and through costal half except along costa on distal one-third; a large, median dorsal blotch of bronzy purplish bearing two ill-defined, bluish white, zigzag lines; terminal area of same bronzy-purplish, basal scale row of fringe slightly more coppery colored; fringe paler distally and at tornus, continuous with white tornal area. Underside, Sc with a broad, pale ochreous fringe directed toward middle of wing; ground color pale grayish, blotched with whitish along

MAP 41.—Geographical distribution of members of the Elutella complex of *Ethmia*.
● *E. elutella* Busck ◑ *E. janzeni* Powell ▲ *E. submissa* Busck

dorsum and termen. *Hindwing:* About as broad as forewing; costal hair pencil, arising from a subcostal pinch-fold near base, composed of about 40 dark gray hairlike scales, reaching to beyond middle of wing; costa slightly excavate on distal one-third; apex acute; termen strongly angled back, tornal angle nearly obsolete. Ground color pale gray except under costal hair pencil, pale ochreous; fringe and underside white. *Abdomen:* Brownish gray dorsally except second and third terga mostly clothed with narrower, ochreous scales; scaling laterally and ventrally mostly whitish except near base, dark gray-brown, genital scaling whitish. Genitalia as in Figure 99 (drawn from plesiotype, Barro Colorado Island, Canal Zone, JAP prep. no. 1511; seven preparations examined); uncus evenly broad to apex, gnathos thick, dentate, without lateral flanges, basal processes slightly enlarged distally; valva with variable development of apical and subapical terminal spines, fultura plate with two spines laterad of a simple, elongate, curving plate.

FEMALE.—Length of forewing 7.3–8.3 mm. Essentially as described for male. Eye only slightly smaller than in male; diameter of antennal shaft basally about 0.75 that of male. Coloration generally somewhat darker than male; forewing markings darker, the gray clouding contrasting more strongly with ground color; dorsal and terminal blotches a darker purple with the zigzag lines rather distinct; hindwing costal area simple, ground color a uniform dark gray. Abdomen with dorsal ochreous scaling reduced to second segment. Genitalia similar to *E. submissa,* sterigma a narrow band fused with anterior margin of VII sternite, ostium subtended by a variable, bowl-shaped or assymetrically bilobed plate, ventrally with a dentate patch as in Figures 217–219 (drawn from plesiotypes, Barro Colorado Island, Panama, and Trinidad, JAP prep. nos., 2388, 2390, and 2235; four preparations examined); ductus unsclerotized with about seven loops; signum a deep fold terminating in the dentate ridge into bursa.

TYPE DATA.—Porto Bello, Panama, March (A. Busck); holotype female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION. — Panama (Barro Colorado Island) to Venezuela (Rancho Grande, Aragua) and Trinidad. A single record in Chile (Tolhuaca) not shown on map.

FLIGHT PERIOD.—February, March, May.

FOOD PLANT.—Unknown.

REMARKS.—This species and the following two comprise a closely knit allopatric triad. The three are separable on genitalia configuration and other minor differences. *E. elutella* apparently was described from a unique female, although the original description does not specify this. The females of this species have darker hindwings than the males; thus the dark hindwing of *elutella* and white hindwing of *submissa* mentioned by Busck (1914b) is not a diagnostic difference for the males.

Specimens from Venezuela are larger than both Panama and Trinidad on the average but do not otherwise differ in appearance. The shape of the fultura armature is variable but is basically similar throughout, consisting of a central, elongate twisted plate with three curved spines from its base. The sclerotized plate subtending the ostium is apparently geographically variable, from a bilobed sac in Panama to a broader, bowl shape in Venezuela and Trinidad (Figures 217–219).

A single female from Chile (Tolhuaca, I–9–62, R. L. Usinger) does not differ from more northern material appreciably in external features and is referred to *E. elutella* provisionally. The genital characters are similar except the Chilean example lacks most of the sclerotization of the sterigma.

Ethmia janzeni Powell, new species

FIGURES 100, 101, 220; PLATE 12*b*; MAP 41

A Mexican species closely related to *E. elutella* but differing by having a generally paler color, an ochreous rather than gray hindwing costal hair pencil, and differences in genital form.

MALE.—Length of forewing 7.3–8.3 mm. *Head:* Labial palpus, antenna, and scaling as described for *E. elutella;* scaling of front paler. *Thorax:* As described for *elutella*; prothoracic tibia blue-gray exteriorly, coxa tinged with ochreous at base. *Forewing:* Length about 3.2 times width. Pattern and color similar to *elutella*; the gray clouding restricted to more or less well-defined blotches, leaving a more extensive contrasting white ground; dorsal and terminal blotches a slightly darker purplish (as in female of *elutella*). *Hindwing:* Costal hair pencil as in *elutella* except ochreous on a whitish ground. Ground color white near base,

becoming pale grayish toward margins. *Abdomen:* Scale coloring as in *elutella.* Genitalia as in Figures 100, 101 (drawn from plesiotypes, El Salvador, JAP prep. no. 2008, and Mazatlan, JAP prep. no. 1634; five preparations examined); gnathos broadened into rounded lateral flanges anteriorly, basal processes narrow in basal half, distinctly dilated toward apex; ventral plate of fultura larger than in *elutella,* more complex, variable with about four basal and dorsal spines.

FEMALE.—Length of forewing 7.8–8.5 mm. Essentially as described for male and for female of *E. elutella.* Coloration only slightly darker than male, white ground color and whitish of hindwing considerably more extensive than on *elutella.* Genitalia similar to *elutella* but base of ductus with a more weakly sclerotized shallow bowl, bearing a slightly more heavily sclerotized dentate patch (Figure 220, drawn from paratopotype, JAP prep. no. 2779; two preparations examined).

TYPES.—Holotype male and allotype female: Mexico, Temescal, Oaxaca, December 12 and 21, 1963 (D. H. Janzen); deposited in California Academy of Sciences, on indefinite loan from the California Insect Survey. Seventy-four paratypes: 33♂, 39♀, same data, November 15 to December 21, 1963; 2♀, April 17 1964. Deposited in American Museum of Natural History, British Museum, California Academy of Sciences, California Insect Survey, and U.S. National Museum.

REMARKS.—The type locality is in extreme northeastern Oaxaca, near the Temescal Dam on the Rio Tonto.

Two additional Mexican specimens have been studied but not designated as paratypes. The California Insect Survey collection has 1♀, 1♂, from Sinaloa (12 mi S Mazatlan, December 17, 1963, C. A. Toschi and M. J. Tauber) that are somewhat worn and are larger (forewing length 8.7 mm) than the average from Oaxaca but otherwise are not superficially distinguishable from typical *E. janzeni.* The male genitalia, however, differ in development of the fultura plate (Figure 101). Although this character appears to be constant at Temescal, it may be that populational differences of this type are characteristic; and study of additional material may reveal that *E. janzeni* represents a northern portion of a mosaic of variation, which is continuous with *E. elutella.*

The only specimens available from the intervening area between *elutella* in Panama and *janzeni* are a series from El Salvador (5♂, 10♀, Cojutepeque, II–9–65; 1♂, 3♀, 13 km N San Salvador, II–4–65, S. S. and W. D. Duckworth, in USNM; and 1♀, San Salvador, Salvador, 600 m, II–28–60, B. Bechyne, deposited in the Bavarian States Museum, Munich. These specimens are superficially indistinguishable from *E. janzeni,* and do not differ appreciably in fultura development from typical specimens.

Ethmia submissa Busck

FIGURES 102, 221; PLATE 12c; MAP 41

Ethmia submissa Busck, 1914c:57; 1934:167.

A Caribbean species similar in forewing pattern to *E. elutella* but with reduced gray clouding and the dorsal and terminal patches dark purple rather than the bronzy or coppery purplish of *E. elutella* and *E. janzeni.*

MALE.—Length of forewing 7.0–8.6 mm. *Head:* Labial palpus moderately elongate, not exceeding base of antenna; second segment curved, length about 1.25 times eye diameter, third segment short, less than 0.5 the length of second; smooth scaled, white, second segment with scattered gray exteriorly. Antenna with basal portion of shaft slightly dilated, width about 0.2 eye diameter; dorsal scaling dark gray. Scaling of front and crown white, front at times lightly tinged with brownish. *Thorax:* Collar and tegula white, notum steel blue gray, white at margins. Underside sordid whitish, prothoracic and mesothoracic tibiae and tarsi marked with steel gray exteriorly; hind tibial brush rather short, white. *Forewing:* Length about 3.2 times width; costa slightly, evenly curved from base to apex; termen moderately strongly angled back; tornal angle a broad curve to dorsum. Pattern similar to *E. elutella,* the white ground color more extensive, the gray clouding restricted to a series of more or less well-defined spots on costal half except on a broad white area along distal one-third of costa; two or three gray spots in dorsal half near base; dorsal blotch deep metallic purple, containing some bluish white scaling not well defined as a zigzag line; terminal blotch restricted to a deep gray subterminal band tinged with purplish and a broad metallic purple scale row at base of fringe

extending to tornus. Fringe lighter gray, white below tornus. Underside mostly pale brownish or ochreous brown, including the broad subcostal fringe. *Hindwing:* Subcostal pinch fold lined (on dorsal surface of wing) with non-overlapping, black scales, each of which is about 0.6 mm in length; otherwise similar to *E. janzeni;* costal hair pencil dark ochreous. Ground color white, becoming pale brownish toward margins; fringe and underside white, specialized subcostal scaling of upper side visible. *Abdomen:* Dorsal scaling pale brownish, second and third terga not distinctly ochreous (as they are in *elutella* and *janzeni*); scaling of underside and genitalia cream-white. Genitalia as in Figure 102 (drawn from plesiotype, Puerto Rico, JAP prep. no. 1254; two preparations examined); similar to *E. janzeni,* saccular angle of valva somewhat more produced, the two spines of fultura (present in *elutella* and *janzeni*) lacking.

FEMALE.—Length of forewing 8.0–8.7 mm. Essentially as described for male; eye only slightly smaller; basal area of antenna not dilated, diameter of shaft about 0.75 that of male. Hindwing costal area simple; not appreciably darker than male (as in *elutella*). Genitalia as in Figure 221 (drawn from plesiotypes, Jamaica, JAP prep. nos. 2383, 2733; two preparations examined); similar to *E. elulella,* plate subtending ostium asymmetrical, extending further into base of ductus, its dentate patch as in *elutella.*

TYPE DATA.—"Cuba; E. A. Schwarz and W. Schaus"; holotype female in U.S. National Museum. The species was described from four females; the type and another female, collected by Schaus, bear additional handwritten data which may read "Tanamo" and one other word. One specimen, collected by Schwarz, is labeled "Caymas."

GEOGRAPHICAL DISTRIBUTION. — Cuba (Santiago; Baracoa); Jamaica (Kingston; Portland Parish; Port Antonio); Puerto Rico ("Lares").

FLIGHT PERIOD.—Evidently multivoltine, February and March (Jamaica), April, May, July (Puerto Rico), November, December (Cuba).

FOOD PLANT.—Unknown.

REMARKS.—This and the two preceding closely related species have all been taken at lights.

Ethmia fritillella Powell, new species

FIGURE 104; PLATE 12*d*

A moderately large *Ethmia* in southern Brazil, having brown forewings checkered with shining white.

MALE.—Length of forewing 11.0 mm. *Head:* Labial palpus moderately strongly upcurved, not quite reaching base of antenna; length of second segment 0.87 eye diameter, of third 0.7 eye diameter; smooth scaled, white, blotched apically on second segment and most of third segment distally, blackish. Antenna not dilated, width of shaft near base 0.18 eye diameter; scape scaling white, marked with shining deep blue dorsally; of shaft white at base, becoming dark brown after first few segments. Scaling of tongue and lower front white, a broad, transverse, median band of deep steel blue between eyes, crown, and occipital tufts white. *Thorax:* Dorsal scaling white, marked with deep steel blue: base of tegula, a pair of spots between tegulae, a large blotch across the width of notum before scutellum. Underside white, tinged with brownish; trochanters bright ochreous exteriorly; tibiae and tarsi dark brownish, reflecting bluish exteriorly. *Forewing:* Moderately narrow, length 3.5 times width; costa gently, evenly curved; termen strongly angled back, fringe broad around tornus, giving a concave appearance to dorsum. Ground color brown, reflecting shining purplish, extensively marked with shining white: basal half more or less uniformly checkered with eight large spots; distal half with three small spots at and beyond end of cell, surrounded by four large blotches at upper corner of cell below costa, on tornus, on costa just below apex and a subterminal one above tornus. Fringe white tinged with brown below apex, preceded by a blue-black terminal line. Underside brown; margins white. *Hindwing:* Slightly broader than forewing; subscostal area with a narrow pinch-fold from near base to about end of cell, enclosing a thin, white hair pencil; costa slightly concave before apex, latter blunt, termen broadly curved to dorsum. Ground color white at base, pale brownish beyond, becoming dark brown in apical area; fringe white. Underside similar, darker, mottled with white in apical area. *Abdomen:* Dorsal scaling dark brown except second segment with modified, short, ochreous scaling; ventral whitish, genital dark ochreous. Genitalia as in Figure 104 (drawn from holotype, JAP prep. no. 1942; one preparation examined); similar to *E. elutella,* basal processes shorter, valva apex more

strongly curved, fultura plate elongate, with two apical spurs.

FEMALE.—Unknown.

TYPE.—Holotype male, Brazil, Nova Teutonia, Santa Catharina, 300–500 m (27°11′ S, 52°23′ W), August 1963 (F. Plaumann); unique, in U.S. National Museum.

REMARKS.—As indicated below, this may be the male of *cupreonivella,* which is known only from a single female.

Ethmia epilygella Powell, new species

FIGURES 44, 103; PLATE 12*e*

A Brazilian species closely related to the preceding one, with white forewings heavily blotched with shining bronzy brown.

MALE.—Length of forewing 10.0–10.3 mm. *Head:* Labial palpus moderately elongate, reaching base of antenna; second segment not strongly curved, length 1.15–1.20 eye diameter; third segment nearly straight, 0.75 as long as second; scaling dark brown, reflecting bluish, irregularly blotched with white, more so ventrally and interiorly. Antenna slightly dilated, width of shaft near base 0.21–0.22 eye diameter; scape white, deep metallic blue posteriorly, dorsal scaling of shaft limited to a few segments, white, becoming brown. Scaling of tongue, front and crown white, a dark steel bluish, transverse bar between eyes. *Thorax:* Dorsal scaling white, marked with dark steel blue: base of tegula, two pairs of large spots on notum, posterior pair perhaps joined. Underside whitish intermixed with brownish; legs marked with dark brown, reflecting bluish, bright ochreous basally to base of femora. *Forewing:* Length 3.3 times width; costa very slightly curved, termen slightly convex, not strongly angled back. Ground color white, about half to more than half suffused with shining bronzy brown; most contiguous in basal half along costal area, and dorsal area except a bar on dorsal margin at base, a spot at about middle and one at tornus; white otherwise restricted to a series of connected blotches along Cu fold, followed beyond cell by a large blotch covering most of terminal area; in extreme cases, the white spots in part separated, especially those in outer half of wing. Fringe whitish, brownish below apex. Underside brown, the white spots of upper side showing through. *Hindwing:* Slightly broader than forewing; subcostal area with a narrow pinch fold nearly to end of cell, enclosing a whitish hair pencil; apex acute, termen broadly curved to dorsum. Ground color whitish, becoming pale brownish in distal half. Fringe white. Underside similar, darker. *Abdomen:* Dorsal scaling brown, except second segment with short ochreous scaling; ventral and genital scaling whitish, genital tinged with pale ochreous. Genitalia as in Figure 103 (drawn from paratype, JAP prep. no. 1940; one preparation examined); similar to *E. fritillella,* uncus notched, gnathos with dual anterior dentate development; basal processes more elongate; valva with deeper apical notch and elongate sacculus apex; fultura plate smaller, with irregular dentation.

FEMALE.—Length of forewing about 9.6 mm. A single damaged specimen examined. Generally similar to male but more extensive white scaling than any male in the small sample available. Labial palpus slightly shorter, third segment 0.68 as long as second. Antenna not dilated, width of shaft basally 0.16 eye diameter. Hindwing costal area simple. Genitalia not examined.

TYPES.—Holotype male and allotype female: Brazil, Nova Teutonia, Santa Catharina (27°11′ S, 52°23′ W), August 1963 (F. Plaumann); deposited in U.S. National Museum. Two male paratypes: one same data, one same data except September, 1963; in California Insect Survey and U.S. National Museum.

REMARKS.—It is possible that one of the two preceding species is *E. cupreonivella,* the type of which I have not seen. Except for the larger size, the description of *cupreonivella* matches the type of *fritillella* fairly well, but Walsingham's figure indicates sufficient difference in superficial appearance to warrant provisional separate treatment of the three until genital features of *cupreonivella* are known.

Ethmia cupreonivella (Walsingham)

Psecadia cupreonivella Walsingham, 1880:77
Ethmia cupreonivella.—Meyrick, 1914:28.

A Brazilian species similar to *E. fritillella;* known only from the female type, which I have not examined. The following is based on the original description.

MALE.—Unknown.

FEMALE.—Length of forewing 13.2 mm. *Head:* Labial palpus slender, second segment purplish above, third segment more than half the length of second, purplish, extreme tip white, scaling of tongue and head white. Antenna pale grayish brown, scape slightly thickened dark purplish. *Thorax:* Dorsum and patagia white. Femora of forelegs orange-ochreous beneath, tibiae and tarsi grayish brown beneath, white above. Mid and hind legs with base only of femora orange-ochreous, tibiae and tarsi spotted with purplish brown. *Forewing;* Glossy cupreous violet with large shining snow-white spots and blotches: six spots on the basal half and middle of wing (three upon and three below the cell) well defined and separate, others along costa and apical third of wing contiguous to anal angle more or less blended and irregular; a white spot on the middle of base blended with another at base of dorsal margin; above it, on costa and beyond on median vein, shades of dark glossy blue, which are also on lower half of apical margin above anal angle. Costa, except extreme base, white. Fringe white, tinged around apex with grayish brown at tips. *Hindwing:* Pale grayish brown, rather whitish, not quite transparent towards base. *Abdomen:* Grayish brown, whitish beneath; anal tuft orange-ochreous. Genitalia not examined.

TYPE DATA.—Brazil, Rio do Espirito Santo; unique female in British Museum.

REMARKS.—If the size given by Walsingham (expanse 28 mm) is correct, I doubt that *fritillella,* which is superficially very similar, is the male of this species. I have not located the type locality. There is a Rio do Espirito Santo in Bahia, but it seems more likely that the source of a specimen described in 1880 would have been the mouth of some river on the coast of the state of Espirito Santo. In either case the site is likely to be a considerable distance from the interior of Santa Catharina, the type locality for *fritillella* and *epilygella.*

THE CHALCODORA COMPLEX

This complex has the southernmost distribution of New World *Ethmia,* and as a consequence is the most poorly represented in the material available for study. *Ethmia chalcodora* Meyrick, 1912, from Argentina was the first species of this group to have been described. It has been taken subsequently in Paraguay but is known only from females. *E. ungulatella* Busck, described in 1914 from Panama, has been found to range northward to Mexico and is the only species of the complex which has been taken at more than one locality subsequent to the original description. Two additional South American species were described by Meyrick in 1930 and 1931 on the basis of unique specimens. In accumulating material for the present study, none of the described South American species have turned up other than in Meyrick's material, while two undescribed species are represented by a short series, with single males from Bolivia, Brazil and Argentina. In addition, three females from Venezuela and Brazil are referable to two more species, both probably distinct from any previously known form. Thus, most of the species are each known only from a single collection.

It is evident that the preliminary state of knowledge covering New World *Ethmia* is the most pronounced in this complex. Further collecting in South America will probably reveal the Chalcodora complex to be a large and diversified assemblage of species.

Ethmia notomurinella Powell, new species

FIGURES 105, 224, 225; PLATE 12*f*

An Argentine species related to *E. chalcodora* but with the dorsal and terminal forewing markings gray.

MALE.—Length of forewing 8.1 mm. *Head:* Labial palpus moderately elongate; second segment curved, length about equal to eye diameter, third segment slightly curved, length 0.75 that of second; smooth scaled, white with a few grayish scales exteriorly. Antenna dilated, width of shaft basally about 0.25 eye diameter; dorsal scaling whitish basally, becoming gray distally. Scaling of front white, a few scales tipped with grayish, remainder of head scaling white. *Thorax:* Collar and tegulae white except dark gray at base; dorsal scaling (damaged) apparently white laterally, dark gray medially and on scutellar area. Underside white, coxae tinged with ochreous; prothoracic and mesothoracic tibiae and tarsi gray (these two legs lacking on one side of holotype). *Forewing:* Length about 3.2 times

width; costa slightly curved from base to apex, a little more strongly so near base; termen moderately strongly angled back, tornal angle broadly curved to dorsum. Ground color white; dark, steel gray basal spots as in *chalcodora* on basal one-third, in cell, and dorsad of cell, distally obscured by mouse gray suffusion as follows: costa narrowly at base, broadly towards middle, beyond middle extending into cell and continuous to area of dorsal blotch (slightly darker, steel gray on fold), white ground interrupting gray costa before terminal area; termen gray, preceded by several ill-defined spots in terminal area. Fringe gray except white at tornus. Underside brownish gray, whitish along dorsal margin; Sc with a rather broad fringe directed into cell. *Hindwing:* Costal area with a subcostal pinch-fold, enclosing a pale ochreous hair pencil; costal margin slightly concave before apex; termen evenly curved to dorsum. Ground color white, pale ochreous basally, brownish at distal margins; fringe white. Underside whitish tinged with pale brownish, costal and apical areas brown. *Abdomen:* Dorsal scaling brownish except basal two terga golden-ochreous. Underside and genital scaling cream-white. Genitalia as in Figure 105 (drawn from holotype, JAP prep. no. 1822; one preparation examined); valva deeply notched apically; fultura plates well developed, elongate; basal processes short.

FEMALE.—Length of forewing 8.1–8.4 mm. Essentially as described for male; eye smaller, diameter about 0.9 that of male, labial palpus and antenna shaft basally about as large as in male. Hindwing costal area simple, basal ochreous scaling lacking. Abdomen with ochreous lateroventral genital tufts arising from sclerotized ridges on VII sternite flanking sterigma. Genitalia (Figures 224, 225, drawn from paratopotype, JAP prep. no. 2264; one preparation examined); anterior apophyses short, thin; sterigma without lateral lobes; signum an elongate, transverse, dentate fold, as in *E. delliella* and *bittenella.*

TYPE.—Holotype male and allotype female: Argentina, Rio Seco, Cordoba, August 29, 1962 (P. Koehler); deposited in Bavarian States Museum, Munich. Two female paratypes: same data, in Bavarian States Museum and California Insect Survey collections.

REMARKS.—This species is superficially similar to *E. chalcodora* and *E. chalcogramma,* while the valva and secondary sexual features of the male, together with the female genitalia, suggest that *E. notomurinella* may represent, with *E. bittenella,* a link between the Kirbyi and Cypraeella groups. The scale-bearing, curving ridges of the seventh sternite in the female are unique. Among New World species, only *phylacis* possesses what appears to be homologous structures.

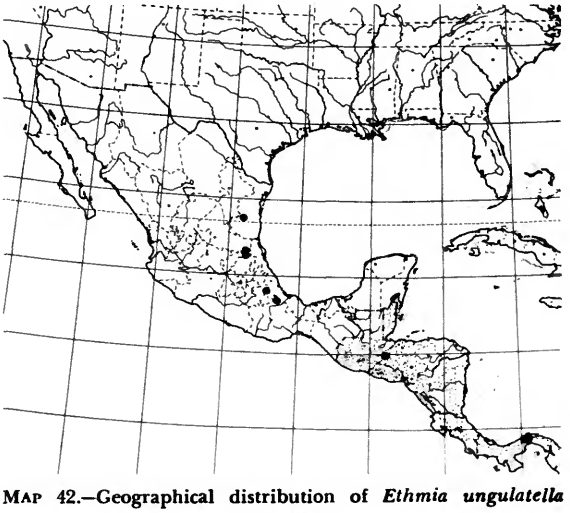
Ethmia ungulatella Busck

FIGURES 106, 215, 216; PLATE 12*g*; MAP 42

Ethmia ungulatella Busck, 1914b:34; 1914c:57.—Walsingham, 1915:424.

A moderately large Central American *Ethmia* having the whitish forewing conspicuously marked with single dorsal and terminal blotches of bronzy-purplish.

MALE.—Length of forewing 8.4–9.8 mm. *Head:* Labial palpus moderately elongate; second segment rather strongly curved, length 1.15 times eye diameter; third segment nearly straight, length about 0.7 times that of second; smooth scaled, second segment mostly dark gray, whitish basally, third segment white except extreme base gray. Antenna dilated, width of basal half of shaft about 0.25 eye diameter, dorsal scaling pale gray, scape dark gray above, white below. Scaling of tongue



MAP 42.—Geographical distribution of *Ethmia ungulatella* Busck.

white, front dark gray, crown white. *Thorax:* Dorsal scaling white except tegula at base steel gray and pronotum with two pairs of large, steel gray spots which almost join medially. Underside cream white, trochanters and coxae bright ochreous exteriorly, tibiae and tarsi brownish exteriorly; hind tibial brush well developed, pale gray-brown. *Forewing:* Length 3.0–3.1 times width; costa evenly, gently curved from base to apex, termen rather strongly angled back, tornus a broad curve. Ground color white; with steel blue-gray spots: at base, just beyond base in cell, two in dorsal area near base, the outer one larger; a series of spots in cell continuing outward, becoming pale gray in terminal area beyond cell, costa narrowly concolorous; a large squarish dorsal blotch from before middle nearly to tornus, metallic purplish copper or bronze colored, enclosing an ill-defined bluish white, transverse zigzag line; a longitudinal pale gray-brown band in cell adjacent to dorsal blotch; terminal area narrowly coppery, enclosing a similar zigzag line. Fringe white basally, brown distally. Underside brown, irregularly cream-whitish dorsad and between veins in apical area; subcostal fringe poorly developed. *Hindwing:* Slightly narrower than forewing, owing to an appressed costal fold which encloses a dense brush of cream-whitish hairs and is lined with short (about 0.6–0.7 mm), cigar-shaped, dark brown scales; costal margin nearly straight, apex rather blunt, termen broadly curved to dorsum. Ground color dorsad of fold gray, darker toward distal margins; fringe paler. Underside whitish, irregularly blotched with brownish on costal and terminal areas. *Abdomen:* Dorsal scaling dark brown, except second tergite bright orange-ochreous; genital scaling slightly paler ochreous; underside whitish with a broad, dark median band. Genitalia as in Figure 106 (drawn from cotype, JAP prep. no. 1251; five preparations examined); basal processes rather evenly broadened; valva not notched, anterior margin only moderately concave; fultura plate small, simple.

FEMALE.—Length of forewing 9.5–10.4 mm. Essentially as described for male; antenna not dilated, width of shaft at base about 0.8, at basal one-third about 0.6 that of male. Dark markings of thorax and base of forewing tending to more strongly reflect metallic green. Hindwing costal area simple. Second segment of abdomen with only a trace of ochreous. Genitalia as in Figures 215, 216 (drawn from plesiotype, JAP prep. no. 2015; two preparations examined, both Mexico); sterigma with deep, lateral lobes; ductus with an irregular, scobinate patch near base; signum broad, with an elongate fold without a dentate margin.

TYPE DATA—Panama, "Cabima and Alhajuela"; May. The holotype female, from Cabima, and cotype male, labeled Alhajuelo, April 1911 (August Busck) are in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION. — From Panama northward through central America (Chejel, Guatemala) and eastern Mexico (Oaxaca; Vera Cruz; Tamaulipas; San Luis Potosi).

FLIGHT PERIOD.—Possibly multivoltine; April, May (Panama), July, August (Mexico).

FOOD PLANT.—Unknown.

Ethmia cypraspis Meyrick

PLATE 12*h*

Ethmia cypraspis Meyrick, 1930:263, pl. I, fig. 31.—Clarke, 1955a:110.

A moderately large Brazilian moth with a forewing pattern similar to *E. ungulatella.* Males were included in the type series but were not differentiated in the original description. During the present study, only two females (not of the type series but determined by Meyrick) have been available, and the following description is based on these.

MALE.—Not examined.

FEMALE.—Length of forewing 9.4–9.8 mm. *Head:* Labial palpus moderately elongate, reaching nearly to base of antenna; second segment moderately curved, length 1.1 times eye diameter; third segment nearly straight, length about 0.7 that of second; smooth scaled, second segment mostly brownish laterally, white below and interiorly; third segment white. *Thorax:* Collar white, tegula white except at extreme base, dark gray; pronotal scaling white laterally, dark metallic gray medially. Underside whitish, coxae ochreous, prothoracic and mesothoracic tibiae brownish exteriorly. *Forewing:* Length 3.1 times width; costa slightly, evenly curved from base to apex, termen scarcely angled back, tornal angle well developed. Ground color white, with brownish gray markings: about eight more or less evenly spaced spots on basal one-third, two near dorsum more well defined; a series of pale

gray, ill-defined blotches through central area of wing and on costal half; a large, semicircular, bronzy blotch on middle one third of dorsal margin, extending to lower edge of cell, containing an ill-defined, bluish white, zigzag line; terminal area concolorous reddish coppery or bronzy, with a transverse, bluish white zigzag line preceding termen. Fringe paler, brownish. Underside pale brownish becoming whitish toward margins. *Hindwing:* Slightly broader than forewing; costa moderately excavate before apex; termen broadly curved to dorsum. White, becoming pale brownish at distal margins; fringe white. Underside white, costal area and veins pale brownish. *Abdomen:* Dorsal scaling brown, second segment very lightly tinged with ochreous; genital scaling pale ochreous. Underside whitish. Genitalia not examined.

TYPE DATA.—Brazil, Taperinha; 17 specimens (♂,♀); types in Vienna Museum.

GEOGRAPHICAL DISTRIBUTION.—Amazon region of Brazil (Taperinha and Santarem, Para).

FLIGHT PERIOD.—July to September.

FOOD PLANT.—Unknown.

REMARKS.—Meyrick stated that this species is nearest *chalcodora,* but it appears to me that ***E. cypraspis*** is more closely allied to ***E. ungulatella.***

Three additional females from Venezuela and southern Brazil have been examined and are provisionally referred to *cypraspis* until a comparison of males can be made. Two from Venezuela have forewing markings closely matching the female from Santarem, Brazil, except that the dorsal and terminal blotches are slightly more purplish rather than reddish coppery. They bear the data "Los Venados, Caracas" and "Caracas" (USNM). The former is a specimen from the Vogl material which formed the basis of Amsel's "Microlepidoptera Venezolana" (1956) and bears what I take to be a manuscript name of Busck, written by Amsel in 1954. Perhaps the name is a product of correspondence with Busck in the early stages of work on the Vogl material, although J. F. G. Clarke is cited as the determination authority for the other three species of *Ethmia* that Amsal did report.

The third female is somewhat different in appearance and may represent another undescribed species. The pattern is similar to *cypraspis,* but the gray markings are a little more restricted, at least beyond the dorsal blotch, and the terminal area tends toward a golden coppery. The specimen bears the data: Rio de Janeiro, Brazil, October 10, 1919, Cornell U. Expedition.

Ethmia chalcodora Meyrick

PLATE 12*i*

Ethmia chalcodora Meyrick, 1912:718; 1914:28.—Clarke, 1955a:81; 1965:422.

A southern South American species superficially similar to *E. bittenella* owing to elongate black markings through the white forewing ground color. The dorsal blotch is leaden blue, the apex coppery. The following description is based on a single specimen from Paraguay determined by J. F. G. Clarke after comparison with the type.

MALE.—Unknown.

FEMALE.—Length of forewing 9.6 mm. *Head:* Labial palpus only moderately elongate, second segment moderately curved, about equal to eye diameter (head and eyes damaged); third segment slightly curved, about 0.7 the length of the second; smooth scaled, white, irregularly blotched with brown exteriorly. Antenna not dilated, width of basal area of shaft about 0.17 eye diameter; dorsal scaling dark gray, scape white. Scaling of head mostly lacking, apparently entirely white. *Thorax:* Collar white, tegula white, steel-blue at base; dorsum white with two pairs of broad steel-blue lateral spots, separated by a thin white longitudinal line. Underside shining whitish, legs tinged with ochreous exteriorly, prothoracic and mesothoracic tibiae brownish. *Forewing:* Length 3.2 times width; costa slightly curved from base to apex, a little more strongly so near base; termen only slightly angled back, tornal angle distinct. Ground color white, markings dark brown, reflecting metallic steel-blue: about eight irregular spots on basal one-third, a large spot in cell at distal end, subtending a gray streak along costa which is paler than other markings; a large dorsal blotch from before middle nearly to tornus, extending to lower edge of cell and containing a coppery streak in its upper half; a series of partially fused spots in terminal area connected to the dark termen by a second copper colored area. Fringe paler gray, separated from the concolorous costal area by ground color only in outer one fourth. Underside mostly dark brownish, streaks of white along veins in terminal area.

Hindwing: Costa rather excavate before apex, latter acute, termen broadly curved to dorsum. White, brown at apex; underside white, costa and apical areas brown. *Abdomen:* Dorsum brown with a white median longitudinal streak; second segment and genital scaling ochreous. Underside white basally becoming ochreous distally. Genitalia figured by Clarke (1965); sterigma similar to that of *E. elutella;* signum elongate as in *E. delliella* and *E. notomurinella.*

TYPE DATA.—Argentina, La Plata; two specimens (♀ ♀); location of type unknown according to Clarke (1955a), who later designated a lectotype at the British Museum (Clarke, 1965).

GEOGRAPHICAL DISTRIBUTION.—Known only from northern Argentina and Paraguay.

FLIGHT PERIOD.—One specimen collected in October in Paraguay.

FOOD PLANT.—Unknown.

REMARKS.—In addition, two males in rather poor condition from western Brazil (Isla Cauropot, Rio San Francisco, XII–3–1907; Haseman) have been examined which are superficially very similar to *chalcodora* and may represent that species. The forewing pattern differs only by lacking the coppery streaks of the dorsal blotch and termen. Fresh examples might reveal presence of some coppery scaling in the Brazilian moths; moreover, males of *chalcodora* may not be as conspicuously marked with bluish and coppery as are the females. Owing to the poor condition of the present specimens, it seems best to provisionally refer them to *chalcodora,* pending study of more material, particularly from intervening geographical areas. The genital characters shown by these males are most similar to *E. elutella* among described species. The Brazil male has a broader spined portion of the gnathos, slightly narrower basal processes, and a similar aedeagus armature. The valva bears a flaplike preapical extension of the saccular margin, which is not developed in other members of the complex except in *elutella* where it is much shorter than on the Brazilian *chalcodora.*

Ethmia cellicoma Meyrick

Ethmia cellicoma Meyrick, 1931a:89.—Clarke, 1955a:79.

A member of the Chalcodora complex described from Paraguay, for which material has not been available in the present study. The following description is based on the original description.

MALE.—Length of forewing about 8.4 mm. (expanse 18 mm.). *Head:* Labial palpi lacking. Scaling whitish. *Thorax:* Whitish, dorsum tinged gray, a small black spot within the base of each tegula. *Forewing:* Somewhat elongate, costa gently arched, termen rather oblique. Ground color whitish gray, costal edge whitish toward middle; about 14 small blackish or gray spots arranged in a longitudinal median band from basal part of costal area to middle of termen; an irregular deep coppery blotch on dorsum beyond middle, reaching fold; a coppery apical blotch preceded on costa by a gray blotch. Fringe whitish (damaged). Underside with fringe of long, whitish hairs projecting obliquely downward from beneath in median area of wing. *Hindwing:* White, apex suffused pale gray; fringe white. *Abdomen:* Light gray; two apical segments (genital scaling) white. Genitalia not examined.

FEMALE.—Unknown.

TYPE DATA.—Paraguay, Chaco, February; the unique type stated to be in the Vienna Museum.

REMARKS.—From the description, it seems as though *E. cellicoma* is a member of the Chalcodora complex but quite distinct from any other described species.

Ethmia chalcogramma Powell, new species

FIGURE 107; PLATE 12*j*

A Bolivian species superficially quite similar to *E. notomurinella* but with a longitudinal coppery streak through the distal portion of the forewing.

MALE.—Length of forewing 9.0 mm. *Head:* Labial palpus moderately elongate; second segment slightly curved, length about 1.1 times eye diameter; third segment nearly straight, length about 0.7 that of second; smooth scaled, white, a few scale tips and base of third segment brown exteriorly. Antenna slightly dilated, width of shaft basally about 0.2 eye diameter; dorsal scaling white basally becoming dark gray distally, scape shining gray above reflecting metallic green, white below. Scaling of front white, lightly tinged with brownish, remainder of head scaling white. *Thorax:* Collar white, brownish basally; tegula white basally with a large spot of blackish, reflecting metallic green; scaling of notum white interrupted by two large

spots, concolorous and nearly contiguous with those of tegulae, separated by a thin median longitudinal line, tapering posteriorly, scutellar area concolorous blackish green. Underside shining white, coxae marked with bright ochreous, prothoracic and mesothoracic tibiae and tarsi marked with grayish brown exteriorly (metathoracic legs lacking from holotype). *Forewing:* Length about 3.2 times width; costa curved near base, very slightly curved beyond; termen slightly angled back, somewhat convex; tornal angle distinct. Ground color white, largely replaced by gray-brown markings; an elongate coppery spot in subcostal area at base and another streak of copper through middle of cell from about middle of wing nearly to termen; pattern superficially like *E. notomurinella* but only two spots as in *bittenella,* at base and basal one-fourth in cell, blackish reflecting metallic greenish; remainder of markings gray-brown; costa narrowly margined, the margin broadened at about middle to include most of midcell to terminal area except irregular spots of white at about end of cell above and below; terminal area white except termen narrowly gray-brown; fringe white beyond. Underside mostly pale brown; Sc with a moderately well developed fringe directed mesad. *Hindwing:* A closed subcostal pinch-fold present, no brush evident from it (not dissected); costal margin only slightly sloped off toward apex; termen broadly curved to dorsum. Ground color white, becoming brownish at distal margins; fringe white. Underside white, subcostal fold ochreous with pale grayish brown overscaling; distal one-third irregularly brownish. *Abdomen:* Scale coloring not recorded. Genitalia as in Figure 107 (drawn from holotype, JAP prep. no. 1652; one preparation examined); gnathos short with fine teeth, basal processes short, valva elongate, shallowly emarginate and dentate distally, fultura large, ornate.

FEMALE.—Unknown.

TYPES.—Holotype male: Bolivia, Boyuibe, November 5, 1959 (P. Koehler); unique, deposited in Bavarian States Museum, Munich.

REMARKS.—Described from a single specimen in poor condition, this species will probably be found to be nearest *chalcodora* among described *Ethmia* when males of the latter species are known.

Ethmia phylacops Powell, new species

FIGURES 108, 222, 223; PLATE 13*a*

A Mexican species having the forewing pattern of the Elutella-Ungulatella series but with colors similar to *E. phylacis,* the dorsal blotch reddish bronze and the termen golden and a single black dot in the dorsal area before the dorsal blotch.

MALE.—Length of forewing 9.9 mm. *Head:* Labial palpi lacking from holotype. Antennae (mostly lacking) slightly dilated, width of shaft about 0.22 eye diameter; dorsal scaling pale grayish, of scape whitish. Scaling of front brownish, of crown white. *Thorax:* Scaling of scape and collar whitish, of pronotum largely blackish owing to three pairs of large, fused spots. Underside whitish, prothoracic and mesothoracic legs pale brownish, tinged with ochreous; hind leg mostly whitish. *Forewing:* Broad, length about 2.9 times width; costa nearly straight toward middle, strongly curved beyond; termen strongly angled back. Ground color white, costal half from base to end of cell heavily clouded with pale grayish brown, followed by two separated spots of the same color in terminal area; a slightly darker spot at base and another, larger, conspicuous one in white dorsal area at one-fourth; a large blotch on dorsum from before middle to before tornus, reddish or purplish copper colored, containing a rather distinct, transverse, bluish white zigzag line; apical area concolorous reddish coppery, blending to golden ochreous at apex, the subtending termen yellow. Fringe yellowish white. Underside pale brownish, becoming ochreous brown in terminal area; subcosta with a rather broad, whitish fringe extending to upper margin of cell. *Hindwing:* Slightly broader than forewing; subcostal area with closed, bulky pinch-fold extending to termination of Sc at costa; containing an elongate, whitish hair pencil; costal margin bowed outward at apex of fold; termen moderately strongly angled back, tornal angle evident. Ground color white, becoming pale ochreous at apical margin; cubital and anal tufts pale ochreous. Underside whitish, costal area pale brownish, terminal margin pale ochreous. *Abdomen:* Dorsal scaling of first segment of shaggy, elongate, pale ochreous hair scales; of second segment smooth, dark ochreous; remainder gray-brown. Underside brown, broadly whitish laterally and on last two segments. Genital scaling pale ochreous.

Genitalia as in Figure 108 (drawn from holotype, JAP prep. no. 1828; one preparation examined), apparently most similar to *E. chalcogramma,* basal processes narrow, elongate; fultura armature less well developed than in related species.

FEMALE.—Length of forewing 8.3 mm. *Head:* Eye diameter about 0.9 that of male; labial palpus moderately elongate, not strongly upcurved, second segment only slightly curved, length about equal to eye diameter; third segment straight, length about 0.8 that of second; smooth scaled, whitish. Antenna not dilated, width of shaft basally about 0.8 that of male. General appearance and coloration essentially as described for male (allotype grease-stained). Hindwing costal area simple. Abdomen apparently without the shaggy scaling of first tergum. Genitalia as in Figures 222, 223 (allotype, JAP prep. no. 2393; two preparations examined); anterior apophyses thin; sterigma without lateral lobes; ductus basally sclerotized through a broad, double circle followed by about five membranous loops; signum a moderately elongate, narrow, strongly dentate fold.

TYPES.—Holotype male and allotype female: Mexico, Chichen Itza, Yucatan, February 28 and April 6, 1956 (E. C. Welling); deposited in California Academy of Sciences.

REMARKS.—According to genital characters this species is most similar to *E. chalcogramma,* described above from Bolivia. The specimens of *E. phylacops* were for some years mixed with a series of *E. phylacis* from the same locality owing to the close superficial similarity of the two.

In addition to the above, I have examined two specimens from Cuba in the Moravia Museum, Brno, which probably represent a race of *phylacops:* Prov. Habana, Guajayabon, 1 ♀, VI–66 (F. Gregor); Prov. Pinar del Rio, Los Jazmines, 200 m, 1 ♀, VI–16/17–66 (F. Gregor). These specimens differ from the Mexican examples in having the forewing nearly white, with the typical pattern washed out and only faintly indicated. The female genital characters do not differ between the Cuban and mainland populations, and these features place *E. phylacops* as markedly distinct from all known *Ethmia.*

The Exornata Group

Eye index 1.0. Maxillary palpus very small, three segments, the apical one tiny. Labial palpus moderately short to moderately elongate, II segment index 1.0–1.3; smooth scaled. Antenna of male not dilated to moderately dilated, index 0.18–0.25. Forewing broad; pattern dorsal blotch, metallic colors. Hindwing of male unmodified. Abdomen with genital scaling ochreous. Uncus sclerotized, narrow; gnathos dentate posteriorly, rarely anteriorly; basal processes narrow, ridged; valva with distal notch; fultura and vesica simple. Papillae anales sclerotized basally, setate; posterior apophyses not elongate; anterior apophyses narrow, short; sterigma simple or ornate with lateral lobes; antrum sclerotized, with or without inner spurs; ductus bursae membranous, four to eight tight or loose coils; signum a dentate keel.

Four species of brightly colored, nocturnal moths make up the group, which is widespread in the Caribbean region. Although phenetic assessments indicate relationship to the Cypraeella group, the uncus and highly modified antrum suggest affinities to the Hagenella group.

Ethmia exornata (Zeller)

FIGURES 109, 227, 228; PLATE 13*b*; MAP 43

Psecadia exornata Zeller, 1877:238 [in part], pl. 3, fig. 73.—Walsingham, 1892:528 [in part].
Ethmia exornata.—Walsingham, 1897:90 [in part]; 1912:147.—Meyrick, 1914:27.—Busck, 1934:168, pl. 35, fig. 3.
Ethmia exornatella [error].—Busck, 1906b:729.

A rather large South and Central American member of the genus having the forewings ornamented with a large dorsal blotch of bronzy purplish, a golden ochreous termen, and conspicuous metallic blue-green dots at the base, two of which are on the dorsal half.

MALE.—Length of forewing 9.7 to 11.8 mm. *Head:* Labial palpus elongate, exceeding base of antenna; second segment curved, length 1.1–1.3 times eye diameter; third segment slightly curved, length 0.70–0.85 that of second (both variable independently, third segment 0.88–1.04 eye diameter); smooth scaled, white, second segment tinged with dark brownish exteriorly on basal half. Antenna slightly dilated, width of shaft basally about 0.20 eye diameter; dorsal scaling present only basally, whitish; scape steel blue-gray above, white below. Scaling of tongue dark metallic gray, remainder of head white. *Thorax:* Dorsal scaling

MAP 43.—Geographical distribution of *Ethmia exornata* (Zeller).

white with dark gray markings, reflecting bluish green: base of collar narrowly, base of tegula broadly, two anterior pronotal spots adjoining bases of tegulae, a large spot on scutellum sometimes split longitudinally by white. Underside shining white, prothoracic leg, mesothoracic and metathoracic trochanters dark brown exteriorly, tarsi ochreous and brownish. *Forewing:* Broad to moderately broad, length 2.8 to 3.1 times width; costa gently curved from base to apex, slightly flattened toward middle, curved abruptly just before apex; termen rather strongly angled back, straight, tornal angle distinct. Ground color white; several dark brown spots near base on costal half, strongly reflecting blue-green, at times partially fusing; two concolorous, distinct spots in subtending dorsal area; costa beyond to end of cell narrowly or broadly gray, or white; a large dorsal blotch, purplish copper or bronze colored, from before middle nearly to tornus, extending through cell, fusing with costal gray when latter present (otherwise separated from costa by white above cell); bluish white scaling in dorsal blotch forming a more or less distinct transverse zigzag line; termen broadly golden ochreous, preceded by some variable gray spotting, often forming three well-defined spots in white subterminal area; some bluish white scaling in apical area tending to form a marginal line of spots. Underside dark brown, dorsal area whitish, termen ochreous. *Hindwing:* As broad as forewing; costal area simple; costa gently angled to apex from before middle or excavate in apical one-third only, apex acute, termen broadly curved to dorsum. Ground color whitish becoming brownish toward distal margins or entirely brownish; apical area ochreous. Underside correspondingly variable; entirely brownish or whitish except costal area brownish; apical and terminal margins pale ochreous. *Abdomen:* Dorsal scaling shining brownish or bronzy, segmental bands paler; whitish laterally, brown ventrally; genital scaling pale ochreous laterally to whitish dorsally. Genitalia as in Figure 109 (drawn from plesiotype, Venezuela, JAP prep. no. 1245; seven preparations examined); uncus with lateral "arms" basally, gnathos and basal processes variable (at times larger than in Figure 109), valva apex pointed, broadly notched at distal end of sacculus; vesica with a triangular sclerotized plate.

FEMALE.—Length of forewing 10.0 to 12.4 mm. As described for male, eye slightly smaller, labial palpus as elongate; antenna nearly the same width as male. Forewing pattern tending to be somewhat brighter and more distinct than male. Genitalia as in Figures 227, 228 (drawn from plesiotypes, Nicaragua, JAP prep. no. 2269, and Brazil, JAP prep. no. 2551; two preparations examined); sterigma a simple ring with anterior enlargement around ostium weakly attached to posterior margin of VII sternite which bears weakly sclerotized lateral ridges, an elongate sclerotized sleeve on base of ductus which is without enlarged antrum, signum a narrow fold with numerous fine teeth in a single row.

TYPE DATA.—Peru, Chanchamajo; described from two males, location of types unknown.

GEOGRAPHICAL DISTRIBUTION.—Widespread in northern South America and Central America, from Brazil (Rio de Janiero) through Central America to the west coast of Mexico (Sinaloa). As discussed below, however, more than a single species may be involved.

FLIGHT PERIOD.—Taken at various times of year in different parts of the wide range; January (Peru), February (Trinidad), May and December (Brazil), June and November (Venezuela), June-July (Guatemala), August (Ecuador; Mexico), September (Nicaragua).

FOOD PLANT.—Unknown.

REMARKS.—The fragmentary sample available for study, 22 specimens representing 15 collections from eight countries, limits conclusions on the assemblage. The broad range of variation in both wing pattern and genitalia, some of which are correlated, suggests that two species are involved. The narrower forewing (length 3.1 times width) as shown by three male specimens from Venezuela is accompanied by absence of the costal gray which joins the dorsal blotch, and by genitalia with less ornate gnathos and shorter basal processes. Males from other areas (Brazil, Peru, Guatemala, Mexico) have a broader forewing (2.8–2.9 times width), usually with well-developed gray along the costa. In addition the individuals with broader forewings share genital characters which differ, particularly the elongate basal processes.

E. exornata as originally described has the costal area white, but the figure given by Zeller shows a wing length:width ratio of about 3.0, so it cannot now be stated for certain that the Venezuelan narrow-winged form represents typical *exornata*. Females from Brazil are mostly of the white costal area phenotype, but are broad winged; males are variable in costa color and are narrow winged (3.1). A single male from Peru appears to have an intermediate condition with regard to costal gray but has a relatively broad (2.9) forewing.

The variation in labial palpus length is also unusually great in this case, but the variation is not correlated with the above differences. The relatively largest and smallest second segment occur on specimens from the most northern areas.

It seems best to retain the assemblage under the name until more material can be examined and compared with the type of *E. exornata*. All of the above specimens share the two blue spots in the dorsal area basally, as described by Zeller, which will serve, with the genital characters (variation notwithstanding), to separate *exornata* from the other members of the species group.

One aditional male from the Dognin collection at the U.S. National Museum has been examined; it probably represents another species and is not included in the above description and discussion. This specimen is the largest studied of this complex (forewing 12.4 mm); it is worn and bears only the fragmentary data "Equateur, c. de Labonnefon." The forewing, which is rather broad (length just under 3.0 times width), has the dorsal area basally too rubbed to enable recognizing the spot pattern; the costal area is gray. The genitalia differ as shown in Figure 110 (JAP prep. no. 1233). I prefer not to name the species on the basis of a single specimen in this condition.

Ethmia phylacis Walsingham

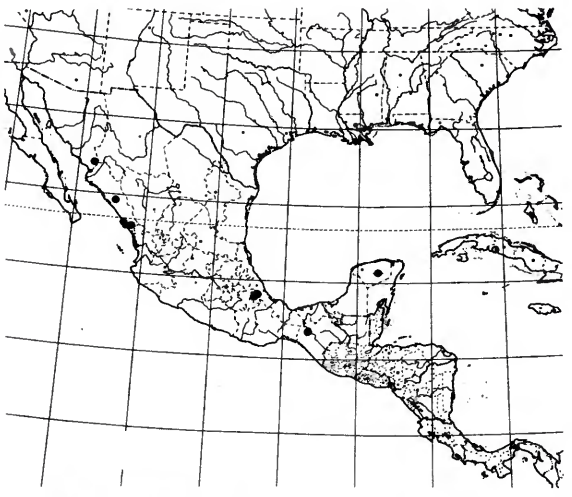
Ethmia phylacis Walsingham, 1912:147, pl. 5, fig. 12.—Meyrick, 1914:28.

A moderately large *Ethmia* similar to *E. exornata* but distinguishable by having a single or no dot in the dorsal area near the base of the forewing. The typical subspecies, with one basal dot, occurs in Mexico.

Ethmia phylacis phylacis Walsingham, new status

FIGURES 27, 111, 226; PLATE 13*c*; MAP 44.

MALE.—Length of forewing 8.7 to 10.0 mm. *Head:* Labial palpus moderately elongate, exceeding base of antenna; second segment curved, length about 1.2 times eye diameter; third segment nearly straight, about 0.62–0.75 as long as second; smooth scaled, white, first and basal half of second segment slightly to mostly dark brown exteriorly. Antenna dilated near base, width about 0.25 eye diameter; dorsal scaling sparse, dark brown; scape shining metallic green above, white below. Scaling of tongue dark brown, of remainder of head white. *Thorax:* Dorsal scaling white, base of collar narrowly, tegula broadly, and scutellum dark metallic green or brown reflecting greenish. Underside shining white, legs blotched with dark brown exteriorly, tarsi tinged with ochreous ventrally. *Forewing:* Broad, length 2.7–2.8 times width



MAP 44.—Geographical distribution of *Ethmia phylacis* Walsingham.
● *E. p. phylacis* ◑ *E. p. ornata* Busck

costa apparently (owing to fringe) straight toward middle, slightly concave before apex, termen not strongly angled back, tornal angle distinct. Ground color white, costal area on basal one-fifth densely spotted dark gray brown, blending to metallic green, a single small spot of the same color in dorsal half below outer edge of costal spotting; costa gray to beyond middle, subtended by irregular grayish into distal area of cell; a large, median dorsal blotch of shining bronzy purple extending through cell nearly to costa, fusing with and at times partially broken in cell by costal grayish; considerable bluish white scaling through dorsal blotch, in part forming a more or less distinct zigzag line; apical area concolorous bronzy-purple, largely infused with bluish-white; termen golden ochreous from tornus to above middle, blending with apical purplish. Fringe concolorous with subtending areas, paler; white at tornus. Underside dark brown to beyond end of cell, becoming bright ochreous beyond. *Hindwing*: About as broad as forewing; costal area simple; costa rather deeply excavate before the acute apex, termen broadly curved to dorsum. Ground color whitish basally, becoming brownish before margins, ochreous at distal margins including fringe. Underside whitish, costal area dark brownish, termen and apex bright ochreous. *Abdomen:* Dorsal scaling dark gray-brown, underside whitish with a median, longitudinal dark band; genital scaling pale ochreous. Genitalia as in Figure 111 (drawn from plesiotype, Yucatan, JAP prep. no. 1087; five preparations examined); uncus simple, without lateral extensions, basal processes with variable, broad lateral flanges; valva deeply notched at apex of sacculus.

FEMALE.—Length of forewing 9.7 to 12.0 mm. As described for male, eye slightly smaller, palpus as elongate, antenna not dilated basally, width of shaft about 0.8 that of male. Genitalia similar to *E. exornata* but with sterigma a broad ring with shallow, lateral depressed lobes fused with posterior margin of VII sternite which bears strongly developed lateral ridges, ostium subtended by a short sclerotized sleeve, antrum enlarged sclerotized, with many inwardly directed spurs; ductus membranous with about six loops, signum a narrow crease with numerous inwardly directed teeth (Figure 226, drawn from plesiotype, Sinaloa, JAP prep. no. 2782; three preparations examined).

TYPE DATA.—"Mexico: Durango: Presidio (A. Forrer)." According to Selander and Vaurie (1962), this locality is erroneously ascribed to Durango and should read Presidio de Mazatlan, Sinaloa, referring to an area a few kilometers east of the present Mazatlan. The species has not subsequently turned up at localities in the high interior of Mexico, but it has been taken along the coast in Sinaloa.

GEOGRAPHICAL DISTRIBUTION.—Mexico, southern Sonora and Sinaloa on the west coast to Veracruz and Yucatan on the east coast.

FLIGHT PERIOD.—April-May (Yucatan), June (Chiapas), July (Veracruz), July-August (Sonora, Sinaloa).

FOOD PLANT.—Unknown.

Ethmia phylacis ornata Busck, new status

MAP 44

Psecadia exornata Zeller, 1877:238 [in part].—Walsingham, 1892:528 [in part].
Ethmia exornata.—Walsingham, 1897:90 [in part].
Ethmia ornata Busck, 1934:168, pl. 35, fig. 2.

This is a Cuban form which may be provisionally regarded as a subspecies pending study of additional material. The two examples mentioned by Zeller were not seen during this study, and I have examined only a few specimens other than Busck's type. *E. ornata* evidently is distinguishable from

phylacis only by the lack of a spot on the basal part of the dorsal area of the forewing. Male genitalia characters shown by *phylacis* in Mexico are somewhat variable (gnathos; basal processes) and the type of *ornata* falls within this range of variation. The female genitalia do not differ from the mainland race (two preparations examined).

Busck differentiated *ornata* from *exornata* as Zeller had done, but chose to ignore *phylacis,* possibly because specimens of the latter were not available for study.

TYPE DATA.—Cuba; unique type in U.S. National Museum. The specimen bears an additional, handwritten label which I was unable to decipher and possibly has been partially cut away.

GEOGRAPHICAL DISTRIBUTION.—Cuba (Cienfuegos).

FLIGHT PERIOD.—August (based on one record).

FOOD PLANT.—Unknown.

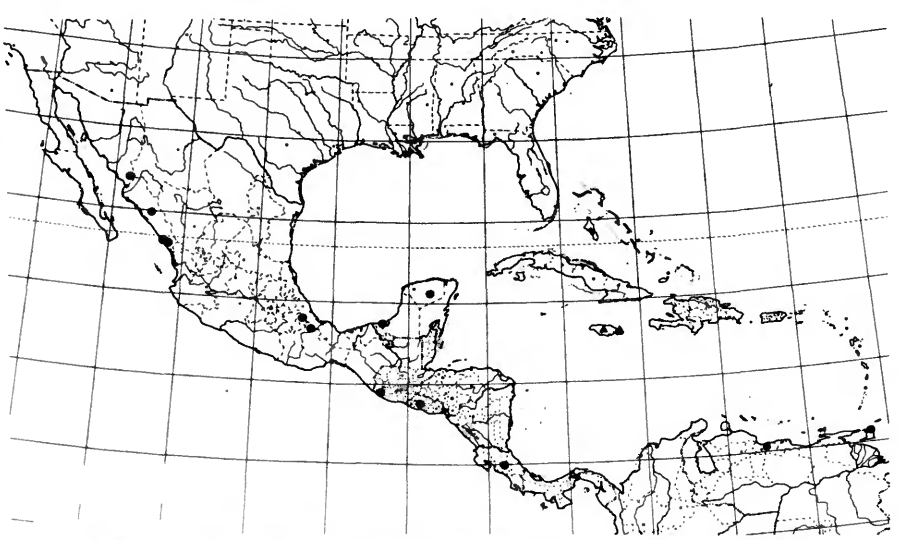
Ethmia mnesicosma Meyrick

FIGURE 112; PLATE 13*d*; MAP 45

Ethmia mnesicosma Meyrick, 1924:119.—Clark, 1955a:208; 1965:429.

A Central American species resembling *E. exornata* but with the basal blue spotting of the forewing costal area extended over the dorsal area as well.

MALE.—Length of forewing 7.0 to 8.8 mm. *Head:* Labial palpus moderately elongate, scarcely reaching base of antenna, usually not strongly curved; second segment slightly curved, length 1.0, or slightly greater, eye diameter; third segment straight, length 0.65–0.68 that of second; smooth scaled, white, second segment brown exteriorly. Antenna very slightly dilated, width of shaft basally about 0.18–0.20 eye diameter; dorsal scaling present on basal one-third, shining dark gray; scape white below. Scaling of tongue and front mostly dark gray, remainder of head white. *Thorax:* Scaling of collar and tegula white, latter shining gray-blue at base, of pronotum white, scutellar area steel-gray with intermixed whitish. Underside shining white, prothoracic and mesothoracic legs exteriorly and metathoracic tarsi dark grayish. *Forewing:* Broad, length about 2.7–2.8 times width; costa slightly curved, apparently straightened beyond middle, more strongly curved just before apex; termen moderately strongly angled back, straight, tornal angle distinct. Ground color white; basally heavily spotted with shining gray- or silver-blue on both costal and dorsal areas; costal area pale grayish to about end of cell; a large dorsal blotch of reddish bronze from before middle nearly to termen, extending into cell, nearly completely fused to costal grayish; apical area reddish bronze, becoming golden ochreous towards tornus; some scattered pale grayish marking in subterminal white band beyond dorsal blotch; apical area and dorsal blotch with scattered bluish white scaling some-



MAP 45.—Geographical distribution of members of the Exornata group of *Ethmia*.
● *E. mnesicosma* Meyrick ▲ *E. gelidella* (Walker)

times forming a zigzag line in latter. Underside brown, dorsal edge whitish, especially at tornus, termen ochreous. *Hindwing:* Width about equal to forewing; costal area simple, costa only slightly excavate towards tornus; apex acute, termen broadly curved to dorsum. Ground color whitish at base, becoming brown towards margins, fringe paler, very slightly tinged with ochreous. Underside white, brownish along costal area. *Abdomen:* Dorsal scaling brown, ventral white; genital scale tufts large, ochreous. Genitalia as in Figure 112 (drawn from plesiotype, Sonora, JAP prep. no. 1777; five preparations examined); similar to *E. phylacis,* anterior margin of valva nearly entire, sacculus not separated by a deep notch.

FEMALE.—Length of forewing 8.4 to 10.7 mm. Essentially as described for male, generally a little larger, markings often somewhat more distinct. Antenna not dilated, width of shaft near base about 0.8 that of male. Hindwing more extensively brown with apical area more distinctly ochreous. Genital scaling reduced. Genitalia very similar to *E. phylacis* (Figure 226) posterior margin of VII sternite more heavily sclerotized, with inner spurs more numerous, ductus membranous with only four loops. Signum a thin, deep fold with a row of flat teeth projecting into bursa. Four preparations examined.

TYPE DATA.—Costa Rica, San Jose; two females in British Museum, one selected as lectotype by Clarke (1965).

GEOGRAPHICAL DISTRIBUTION.—Mexico, on both east coast (Chichen Itza, Yucatan; Temescal, Oaxaca) and west coast (Alamos, Sonora; Villa Union, Sinaloa) to northern Venezuela and Trinidad; and in southern Brazil (Nova Teutonia, Santa Catharina) according to one record (not shown on Map 45).

FLIGHT PERIOD.—February (Trinidad), May (San Salvador; Yucatan), June-July (Veracruz), July-August (Sinoloa; Sonora), November (Venezuela), December (Oaxaca).

FOOD PLANT.—Unknown.

REMARKS.—Provided the fragmentary sample represents a single species there appears to be a tendency in *E. mnesicosma* towards smaller individuals in northern parts of the range. The forewing length of females in Venezuela ranges 10.1 to 10.9 mm, in Costa Rica 10.5 to 10.7 mm, in Salvador 9.8 mm, and in Mexico 8.4 to 10.7 mm. Males are not available from Central America. Individuals from Trinidad average smaller, about the same as in Mexico. Females from nothern regions show coalescence of the blue dorsal spots at the base and a generally greater development of the gray spotting of the forewing in comparison to the typical specimens. Otherwise, however, the small and large forms are quite similar.

Ethmia gelidella (Walker)

FIGURE 113, 114; PLATE 13e; MAP 45

Tamarrha gelidella Walker, 1864a:817.—Busck, 1906b:728.
Psecadia gelidella.—Walsingham, 1892:528.
Ethmia gelidella.—Walsingham, 1897:91.—Meyrick, 1914:28.

A Jamaican species allied to *E. phylacis,* having the dark bluish dorsal blotch of the forewing fused with a dark band through cell from base to the ochreous apex.

MALE.—Length of forewing 8.3 to 8.7 mm. *Head:* Labial palpus moderately elongate; second segment slightly curved, length 1.1 times eye diameter; third segment nearly straight, length about 0.75 that of second; smooth scaled, white, second segment and base of third grayish exteriorly. Antenna slightly dilated, width of shaft basally about 0.20 eye diameter; dorsal scaling restricted to a few basal segments, dark gray. Scaling of front grayish, remainder of head white. *Thorax:* Collar scaling white, tegula dark gray except apex white, pronotum white. Underside white; tarsi tinged with ochreous, prothoracic trochanter and tibia brownish gray. *Forewing:* Broad, length about 2.9 to 3.0 times width; costa evenly curved from base to apex, latter and termen broadly curved, nearly oval. Ground color white; dark basally on costal half, blue-gray in cell, gray-brown at costa above it, extending outward as a broad longitudinal band through cell, angling towards apex from end of cell, blending to golden ochreous in apical area; a broad dorsal blotch of purplish or bronzy gray from before middle to just before tornus, blending with gray-brown of cell; scattered bluish white scales at base, in dorsal blotch and at apex, sometimes forming zigzag lines; distinctly defined unspotted white areas remain as follows: basal one-third of dorsal area, costal area from about middle nearly to apex, tornal area to mid termen. Underside dark brown, outer margins whitish ochreous. *Hindwing:* Slightly broader than forewing; costal area

simple; costa slightly excavate towards apex, latter acute, termen broadly curved to anal area. Ground color whitish becoming brownish gray distally, margins and fringe pale ochreous. Underside similar, brownish mostly confined to costal area. *Abdomen:* Dorsal scaling dark gray, whitish laterally and ventrally; genital scaling ochreous. Genitalia as in Figure 113 (drawn from plesiotype, Portland Parish, Jamaica, JAP prep. no. 1175; two preparations examined); similar to *E. phylacis,* differing by the smaller basal processes; valva with a deep notch at end of sacculus (Figure 114, drawn from JAP prep. no. 1458).

FEMALE.—Length of forewing 9.0 to 9.7 mm. As described for male, differing superficially only by antenna size, width of shaft basally about 0.8 that of male, and by reduced ochreous genital scaling. Genitalia similar to *E. exornata,* with the sclerotized sleeve of the ductus smaller, no enlarged antrum with spurs as in *phylacis* and *mnesicosma,* signum a small, narrow fold with sparse teeth (two preparations examined).

TYPE DATA.—Jamaica; from Grosse collection; unique type female in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from Jamaica (Kingston; Troy; Portland Parish).

FLIGHT PERIOD.—March, May, July.

FOOD PLANT.—Unknown.

REMARKS.—Busck (1906b) stated that *gelidella* "is evidently the species" subsequently described by Zeller as *exornata.* However, it is probable that Busck had not seen true *gelidella* and was confusing Walker's description with Cuban material of the race Busck later described as *ornata.*

The Notatella Group

Eye index 0.9–1.0. Maxillary palpus moderately large, four segments, the distal one largest. Labial palpus moderately long, II segment index 1.1–1.7; smooth scaled. Antenna of male with scape modified, elongate; shaft not dilated to moderately dilated, index 0.15–0.25. Forewing broad to moderately broad; pattern transverse metallic marks. Hindwing usually with Sc pinch-fold, costal brush absent to well developed. Thorax of male with or without posterior brushes. Abdomen with genital scaling red or ocherous. Uncus hoodlike; gnathos dentate, elongate posteriorly; basal processes narrow, sclerotized, usually strongly or weakly ridged; valva with sacculus armed, at times a distal notch; fultura-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses elongate or short; anterior apophyses broad; sterigma ornate, with or without lateral lobes; antrum undifferentiated or enlarged, unsclerotized; ductus bursae membranous, 2–10 tight coils; signum a weak scobinate patch or dentate keel.

A diverse assemblage of seven species which show highly developed male primary and secondary characteristics unlike anything described in the Old World. The group is restricted to western Mexico and the Caribbean region.

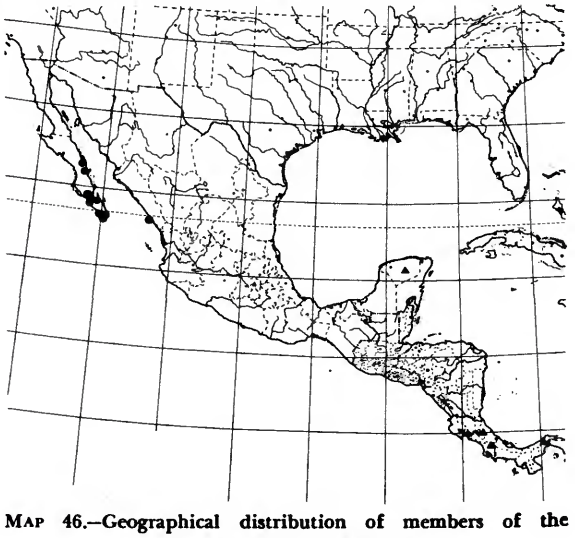
Ethmia phoenicura Meyrick

FIGURES 11, 28, 29, 115, 229–231; PLATES 3*b*, 13*f*; MAP 46

Ethmia phoenicura Meyrick, 1932:346.—Powell, 1959:146, fig. 2.

A Baja California species with white forewings marked by distinct blue-black bands and with bright red genital scaling.

MALE.—Length of forewing 7.0 to 11.2 mm. *Head:* Labial palpus rather strongly curved, exceeding base of antenna; second segment length 1.1–1.3 times eye diameter; third segment 0.60–0.65 the length of second; smooth scaled, white, basal half of second segment dark brown exteriorly. Antenna dilated, width of shaft basally about 0.25 eye diameter; scape elongate, about 0.8 eye diam-



MAP 46.—Geographical distribution of members of the Notatella group of *Ethmia.*
● *E. phoenicura* Meyrick ▲ *E. wellingi* Powell

eter; dorsal scaling of scape white, of shaft dark gray. Scaling of tongue, front and crown, appressed, white. *Thorax:* Scaling of collar metallic greenish blue, tegula white, pronotum white with scutellar area blackish reflecting greenish blue. Underside white and blackish, legs black, margined and banded with white; metathoracic tibial fringe sparse. *Forewing:* Length 3.1–3.3 times width; costa evenly, gently curved from base to apex; termen moderately strongly angled back, very slightly concave. Ground color shining white; markings blackish brown, reflecting greenish blue as follows: costa narrowly from base to apex; two transverse bands (about 0.6–0.7 eye diameter in width) near base and at basal one-fourth; an incomplete transverse band at about middle of wing, of three separate spots, a triangular one on costa, a squarish one just below and distad in cell, an elongate one from lower edge of cell nearly to dorsum; a second incomplete band at about apical one-fourth, of a transverse bar from costa to end of cell, a separate subcrescent at end of cell, a short bar at tornus; a subapical spot on costa followed by a dot in apical area; a subterminal line continued from costa to tornus. Fringe white. Underside dark brown, a white spot just beyond retinaculum; fringe white. *Hindwing:* About as broad as forewing; a closed, unscaled pinch fold between Sc and R which contains an elongate, dense brush of 40–50 cream-white scales extending nearly the length of Sc; costal margin thus nearly straight to subapical concavity, termen strongly angled back, broadly curved to dorsum. Ground color brown, anal area paler, fringe whitish. Underside similar, paler. *Abdomen:* Dorsal scaling dark brown; ventrally dark brown with segmental white bands; genital scaling pale to bright red. Genitalia as in Figure 115 (drawn from plesiotype San Venancio, Baja California, JAP prep. no. 347; four preparations examined); uncus hoodlike, gnathos elongate, narrow, sclerotized projection on inner face of valva somewhat variable in shape.

FEMALE.—Length of forewing 8.0 to 13.2 mm. Essentially as described for male. Antenna not dilated, width of shaft basally about 0.8 that of male; hindwing subcostal area lacking pinch-fold and brush, with upraised whitish scaling, ground color usually paler than in male, whitish becoming brownish towards distal margins. Genital scaling reduced but bright red as in male. Genitalia as in Figures 229–231 (drawn from plesiotype Todos Santos, JAP prep. no. 2010; three preparations examined); posterior apophyses extremely elongate and pre-IX membrane correspondingly extensible, VIII segment entirely heavily sclerotized with anterior apophyses very broad and sterigma not differentiated, ostium surrounded by a protruded area, subtended by a heavily sclerotized, corrugated plate on VII segment, encased in a deep fold of the intersegmental membrane, ductus entirely membranous, signum an elongate, narrow fold with imbricate appearing texture and serrate inner margin.

TYPE DATA.—Mexico; Lower California, "Las Parras"; October (W. M. Mann); unique type female in British Museum; figured by Clarke (1965), who gives the type locality as "Los Parros." I have been unable to locate the place under either spelling.

GEOGRAPHICAL DISTRIBUTION.—Mexico: the southern one-third of the Baja California peninsula, and Sinaloa. The mainland record is based on a single female in poor condition labeled "Venadio Sinaloa" in the U.S. National Museum.

FLIGHT PERIOD.—Late August to early January.

FOOD PLANT.—Unknown.

REMARKS.—This species exhibits the greatest range in size of known New World *Ethmia,* but the markings are quite consistent. J. A. Chemsak found the adults in large numbers on foliage and flowers of *Celosia floribunda* Gray (Anacardiaceae) during the daytime, although this moth and related species are believed to be nocturnal, on the basis of light attraction records.

Ethmia zebrata Powell

FIGURES 117, 234; PLATE 13*g*

Ethmia zebrata Powell, 1959:149, fig. 3.

A Mexican species similar to *E. phoenicura,* with the dark markings forming complete transverse stripes on the white forewing and with the same red genital scaling.

MALE.—Length of forewing 9.5 to 9.7 mm. *Head:* Labial palpus elongate, strongly curved, exceeding base of antenna; second segment length nearly 1.5 times eye diameter; third segment about 0.7 the length of second (1.05 times eye diameter); smooth scaled, white except extreme base of second segment dark brown exteriorly. Antenna modified,

scape greatly elongated, length about 1.3–1.4 times eye diameter, gradually enlarged to middle, tapered apically, scaling white basally, brown apically, a scale tuft on enlargement, giving a notched appearance beyond; shaft dilated, width about 0.25 eye diameter, dorsal scaling dark gray. Scaling of front and crown white. *Thorax:* Dorsal scaling white, collar, extreme base of tegula and scutellum broadly dark brown, reflecting metallic blue. Underside mostly white; tibiae and tarsi black with white bands. *Forewing:* Length about 3.0 times width; costa slightly, nearly evenly curved from base to apex; termen moderately strongly angled back, very slightly concave. Ground color white, markings blackish brown reflecting deep metallic blue, as follows: costa narrowly from base to apex; three transverse bands from costa to dorsum, first near base, second at basal one-fourth, curved outward towards middle (these about 0.6–0.7 eye diameter in width, similar to *E. phoenicura,* broader than on *chemsaki*), third band slightly narrower, at about middle of wing, with a broad spur projecting distad in cell; markings in terminal one-third comparable to *E. phoenicura,* more elongate, forming an almost closed pentagon with spurs projecting towards costa before apex, termen below apex, and above tornus; a separate marginal spot at tornus; a line along terminal margin from costa to tornus. Fringe white. Underside dark brown with a white spot beyond retinaculum. *Hindwing:* About as broad as forewing; Sc and R forming an almost closed pinch-fold containing an elongate brush of whitish tan scales, extending about one-half the wing; costa only slightly concave before apex; termen moderately strongly angled back, broadly curved to dorsum. Ground color dark brown, anal area paler; fringe whitish. Underside similar, paler. *Abdomen:* Dorsal scaling whitish brown, ventral dark brown with pale segmental bands; genital scaling pale to bright red. Genitalia as in Figure 117 (drawn from holotype, JAP prep. no. 348; two preparations examined); uncus very broad, hoodlike, gnathos a broad flap under uncus; basal processes large, rather heavily sclerotized, inner, posterior margin of sacculus produced into a small upcurved projection.

FEMALE.—Length of forewing 9.0 to 10.5 mm. Superficially as described for male. Antennal scape elongate as in male but without the median enlargement and scale tuft; shaft not dilated, width about 0.8 that of male. Hindwing costal area simple; ground color paler, anal one-third generally whitish. Genitalia similar to *E. phoenicura* (Figure 234, drawn from paratype, JAP prep. no. 2018; one preparation examined); posterior apophyses and VIII-IX intersegmental membrane elongate as in *phoenicura,* VIII heavily sclerotized with anterior apophyses broad but very short, sterigmal area protruding, ostium flanked by lobes with many small spurs, antrum with sclerotized curled plate, signum a very long, narrow, serrate fold.

TYPE DATA.—Mexico, 34 miles south of Atlixco, Puebla, June 27, 1957 (J. A. Chemsak); holotype male in California Academy of Sciences.

GEOGRAPHICAL DISTRIBUTION.—Mexico, Puebla (Atlixco and Tehuacan).

FLIGHT PERIOD.—June, July.

FOOD PLANT.—Unknown.

REMARKS.—The hindwing modifications and color relate this species to *E. phoenicura,* but the specialization of the antenna scape in the male and features of both male and female genitalia easily distinguish *zebrata.*

Ethmia chemsaki Powell

FIGURES 116, 232, 233; PLATE 13*h*

Ethmia chemsaki Powell, 1959:148, fig. 4.

Another red-tailed species from Puebla, Mexico, simliar to *E. zebrata* but having narrower black bands on the white forewing and lacking modification of the hindwing in the male.

MALE.—Length of forewing 8.0 to 8.4 mm. *Head:* Labial palpus greatly elongate, well exceeding base of antenna; second segment rather strongly curved, length about 1.7 times eye diameter; third segment nearly 0.7 the length of second (about 1.15 eye diameter); smooth scaled, white. Antenna slightly modified, scape moderately elongate, length nearly equal to eye diameter, not much enlarged; shaft slightly dilated, width about 0.20 eye diameter; dorsal scaling dark gray, scape white. Scaling of front and crown white. *Thorax:* Dorsal scaling white, collar deep metallic blue, scutellar area narrowly dark, reflecting blue. Underside mostly white; tibiae and tarsi pale gray-brown, broadly banded with white. *Forewing:* Broad, length about 2.9 times width; costa gently curved, nearly

straight; termen rather strongly angled back, nearly straight. Ground color white, markings black, faintly reflecting metallic blue, similar to *E. zebrata* but reduced, the lines narrow (only about 0.3–0.4 eye diameter); three bands from costa to just above dorsum, first near base, second at basal one-fourth, third at about middle of wing with a spur projecting outward in cell; a fourth, broken band at about end of cell, consisting of a line to end of cell, a crescent at lower outer angle of cell and a short bar on dorsum before tornus; a subapical crescent extending from costa to nearly upper end of crescent at end of cell; a line along terminal margin from above apex nearly to tornus. Fringe white. Underside pale brownish, white areas beyond retinaculum, along costa narrowly and on dorsal area. *Hindwing:* About as broad as forewing; subcostal areal simple; costa shallowly concave on distal one-half. Ground color white, becoming brown toward apical margin; fringe white. Underside similar, costal and apical areas narrowly brown. *Abdomen:* Dorsal scaling brown, becoming white at lateral and posterior margins of segments; ventrally mostly white, each segment brown only basally; genital scaling pale red, with a conspicuous white tuft above uncus. Genitalia as in Figure 116 (drawn from paratype, JAP prep. no. 321; one preparation examined); uncus very broad, hoodlike, gnathos narrow, attenuate extending nearly the length of uncus; inner, posterior margin of sacculus produced into a strongly sclerotized projection.

FEMALE.—Length of forewing about 9.0 to 9.2 mm. Essentially as described for male. Antennal scape elongate as in male; shaft scarcely smaller, width basally 0.9 that of male. Hindwing and abdomen slightly more whitish than male. Genitalia as in Figures 232, 233 (drawn from paratype, JAP prep. no. 2275; two preparations examined); similar to preceding species but posterior apophyses and VIII-IX intersegmental membrane shorter, VIII heavily sclerotized with anterior apophyses broad and short, sterigmal area elongate, with heavily sclerotized lateral margins, its median portion not differentiated or protruding, ostium enclosed in deep fold between VII-VIII, antrum enlarged, lightly sclerotized but without inner plate, signum a small scobinate patch near juncture of ductus.

TYPE DATA.—Mexico, 34 miles south of Atlixco, Puebla, June 27, 1957 (J. A. Chemsak); holotype male in California Academy of Sciences.

GEOGRAPHICAL DISTRIBUTION.—Known only from the type locality and from Cãnas, Guanacasta Province, Costa Rica.

FLIGHT PERIOD.—June.

FOOD PLANT.—Unknown.

REMARKS.—This and the preceding two species form a distinct subgroup which is most similar to the Notatella complex according to coloration and genital characters. Members of the present complex differ by lacking the thoracic scale brush and peculiar aedeagus of males of *notatella* and allies.

THE NOTATELLA COMPLEX

A group of closely related forms, characterized by shining white forewings with deep metallic blue markings, that occurs through the islands of the Caribbean but has remained too poorly collected to permit firm conclusions on specific relationships. Members of the complex are unique in several respects, notably the possession in the male of well developed lateral, metathoracic brushes, which are directed caudad. The anterior abdominal segments are in some cases modified to form lateral receptables for the brushes. The males also differ superficially from the Phoenicura complex—to which they are related by forewing color and genital characters—by usually ochreous rather than red genital scaling.

Ethmia notatella was described from Santo Domingo in 1863 by Walker. A second name, *xanthorrhoa,* was proposed by Zeller in 1877 on the basis of specimens from Puerto Rico, and it was reported from Curaçao by Snellen in 1887. The later name was synonymized by Walsingham (1892) and subsequent reports have treated the assemblage as *notatella.* The species has been recorded in the literature on a number of occasions, but I have been unable to obtain males for study from most areas.

Another species, *E. hiramella* in Cuba, was described by Busck in 1914. It differs from *notatella* in details of forewing pattern and genitalia.

A third species, originally described as *Hyponomeuta paucellus* by Walker and also from Santo Domingo, was placed as congeneric with *notatella* by Walsingham (1892). *E. paucella* is of the same general size and appearance as the preceding mem-

bers of the complex but has fewer spots on the forewing. It was described from two males according to Walker, but the paratype forwarded to me from the British Museum is a female, and it appears that the male has not been described. A single male received from the Yale University collection has a forewing pattern identical to the *paucella* female. The specimen, which was collected in Haiti, does not appear to be conspecific on superficial bases, particularly owing to the peculiarly enlarged labial palpus and the ochreous hindwing. However, the genital characters indicate a definite relationship to the Notatella group, and I am considering it to be the male of *paucella*.

Provided these interpretations are correct, the group is composed of two allopatric species, *hiramella*, in Cuba, and the widespread *notatella*, which is sympatric with a third species, *paucella*, in Hispaniola. Whether any of the island populations of *notatella* should be considered specifically or subspecifically distinct will have to be ascertained with accumulation of more material. Those from more northern areas (Florida Keys and the Bahamas) seem to differ slightly in forewing pattern, having the spots somewhat smaller and separated, but the species in general is rather variable and specimens in series are not available. Males of *notatella* from only three localities—Tavernier, Florida; Nassau, Bahamas; and Constanza, Dominican Republic—have been examined during the present investigation.

A fourth species, *E. wellingi*, the largest of the New World Ethmiidae, is described below from Yucatan and Costa Rica. It differs from Carribean members of the complex by lack of abdominal modifications for reception of the thoracic brush and in Costa Rica by red rather than ochreous genital scaling.

Ethmia notatella (Walker)

FIGURES 118, 235–237; PLATES 4*e*, 13*i*; MAP 47

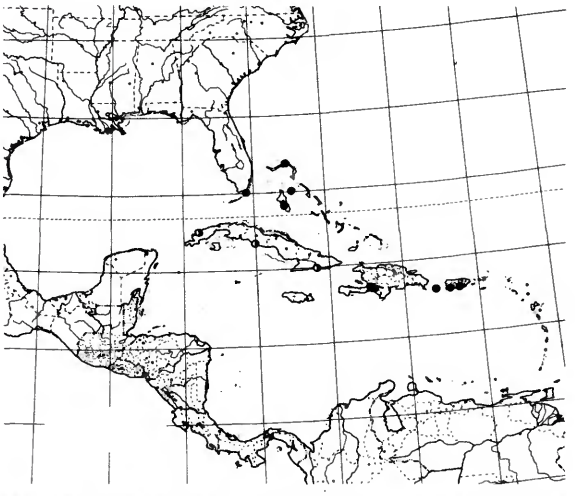
Psecadia notatella Walker, 1863:536.—Butler, 1882:108.—Walsingham, 1892:526, 546.

Ethmia notatella.—Walsingham, 1897:90.—Busck, 1914c:56.—Wolcott, 1923:203.—Forbes, 1930:133.

Psecadia xanthorrhoa Zeller, 1877:234, pl. 3, fig. 71.—Butler, 1882:108.—Snellen, 1887:65.—Moeschler, 1890:341.—Walsingham, 1892:528 [synonymy].

Ethmia xanthorrhoa.—Busck, 1914c:56, 57; 1934:166.

Ethmia sp.—Kimball, 1965:286.



MAP 47.—Geographical distribution of members of the Notatella complex of *Ethmia*.
● *E. notatella* (Walker) ◑ *E. hiramella* Busck

A rather large *Ethmia* having white forewings marked by diagonal rows of blue-black spots; widespread through the Caribbean area.

MALE.—Length of forewing 10.4 to 12.0 mm. *Head:* Labial palpus elongate, exceeding base of antenna; second segment length about 1.2 times eye diameter; third segment nearly straight, length about 0.7 that of second; smooth scaled, white, broadly banded with black on basal half of second and third segments exteriorly. Antenna modified, scape elongate, about 1.4–1.5 times eye diameter, swollen towards middle, tapered beyond with a dark scale tuft forming a notchlike depression dorsally; not dilated, width of shaft basally only about 0.15 eye diameter; dorsal scaling complete, white, scape with black blotches basally and apically, entirely white below. Scaling of tongue, front and crown white. *Thorax:* Dorsal scaling white, paired blue-black spots at bases of tegulae, on collar near middle, and larger ones on pronotum adjoining tegulae and at sides of scutellum. Underside white, trochanters tinged with ochreous, tibiae and tarsi banded with deep blue-black, Metathorax laterally with an elongate hair pencil (about as long as hind tibia), of about 40–60 ochreous hair-scales, extending along side of basal abdominal segment. *Forewing:* Length 3.0 to 3.3 times width; costa very gently curved from base to apex, apparently slightly straightened toward middle; termen rather strongly angled back. Ground

color white or cream-white, markings black, reflecting metallic blue-green as follows: extreme base and costa basally, a rather large spot in cell near base, preceded by a smaller one below it and basad in dorsal area and followed by another in costal area; three poorly defined diagonal rows nearly parallel to termen, of distinct or partially coalesced spots, first at basal one-third, of three spots, one in cell and two in dorsal area, second row at middle, of an irregular streak through cell and a spot in dorsal area, third row from terminal area to dorsum just before tornus, sometimes complete, sometimes as two well-defined, separated spots; two spots or areas of indistinct dusting in costal area above cell; three small spots in apical area; a row of dots at base of fringe from before apex nearly to tornus. Fringe white with a black spot just below apex. Underside brown, costa with basal one-third blue-black, sending a broad white fringe to cell, costa beyond and terminal fringe white, the subapical black spot reproduced. *Hindwing:* Broader than forewing; a weak, closed pinch-fold between Sc and R, without enclosed specialized scaling, costa as a result nearly straight to apex, latter acute, termen strongly angled back and broadly curved to dorsum. Ground color white, becoming brown at apex; fringe white. Underside similar, costal area pale brownish. *Abdomen:* Basal two segments modified laterally to form a pouch-like receptacle which closes over the thoracic brushes; dorsal scaling pale gray, ventral and lateral, white; genital scaling including large dorsolateral brushes of ninth segment, ochreous. Genitalia as in Figure 118 (drawn from plesiotype, Nassau, JAP prep. no. 1467; two preparations examined); tegumen with anterior lobes bearing elongate scale tufts (not shown in figure); uncus hoodlike, gnathos elongate, narrow, valva greatly modified with a membranous pouch at distal end and sacculus with heavily sclerotized inner, posterior portion sending a straight spur to end of valva; aedeagus modified, distal half crooked.

FEMALE.—Length of forewing 10.3 to 13.4 mm. Essentially as described for male; eye smaller, labial palpus as large; antennal scape smaller, length about two thirds that of male, without the pronounced enlargement of male. Forewing variable, length 3.0 to 3.5 times width; costal fringe of underside lacking; pattern variable, as in male. Hindwing subcostal area simple. Thoracic lateral brushes present but greatly reduced, not extending along abdomen; latter not modified. Genitalia as in Figures 235–237 (drawn from plesiotype, Florida, JAP prep. no. 2166; two preparations examined); posterior apophyses moderately elongate, VII segment heavily sclerotized on ventral half, anterior apophyses rudimentary, sterigma an elaborate, ridged structure with large lateral depressed lobes which meet behind base of ductus, subtended by weakly sclerotized lateral lobes apparently derivative of the VII-VIII intersegmental membrane, ductus rugose but otherwise without sclerotization, signum a deep fold with large inner teeth.

TYPE DATA.—Santo Domingo; from Hearse collection; described from a single specimen, sex not given, deposited in the British Museum (*notatella*); "Portorico," 1 male, 1 female in Staudinger collection, presumably in Berlin Museum (*xanthorrhoa*).

GEOGRAPHICAL DISTRIBUTION.—Florida Keys, the Bahama Islands, Hispaniola, Puerto Rico, and the Lesser Antilles; the latter based on Snellen's (1887) record of the species in Curaçao. I have not seen specimens from areas south of Puerto Rico.

FLIGHT PERIOD.—March (Bahamas); April-May (Haiti, Mona Island); June-July (Puerto Rico); April, August-September (Florida Keys).

FOOD PLANT.—Unknown.

Ethmia hiramella Busck

FIGURES 121, 122, 239–241; PLATES 3*a*, 13*j*, 14*a*; MAP 47

Ethmia hiramella Busck, 1914c:56; 1934:166.

A rather large *Ethmia* from Cuba, resembling *E. notatella* but with the forewing markings reduced to separate spots.

MALE.—Length of forewing 11.9–12.0 mm. *Head:* Labial palpus elongate, exceeding base of antenna; second segment strongly curved, length about 1.2 times eye diameter; third segment slightly curved, length about 0.7 that of second; smooth scaled, white, basal half of each segment black exteriorly. Antenna modified, scape elongate, length about 1.5 times eye diameter, greatly enlarged toward middle, scaling giving a somewhat notched appearance beyond; shaft scarcely dilated, width basally about 0.20 eye diameter; dorsal scaling dark gray, scape white with dorsal black spots at base and from before middle to apex. Scaling of tongue and

front white, posterior tufts tinged with pale ochreous. *Thorax:* Dorsal scaling white, marked with deep blue-black: base of collar narrowly, base of tegula, two pairs of large spots on notum adjoining bases of tegulae and at sides of scutellum. Underside whitish; legs blotched exteriorly and tarsi banded with blackish; metathoracic tibial fringe dense, rather short, white. A large brush of ochreous hair scales from below hindwing extending along base of abdomen, about as long as hind femur. *Forewing:* Rather narrow, length about 3.3–3.4 times width; costa rather strongly curved before middle, apparently slightly concave beyond owing to fringe; termen straight, rather strongly angled back, tornal angle not distinct. Ground color white or pale cream-white, markings brownish black reflecting metallic greenish blue, pattern similar to *E. notatella,* the spots all separated, distinct: base of costa and at base in cell, two spots just beyond base in cell and in subcostal area, followed by three more in subcostal area before middle, the three transverse diagonal rows hardly defined (wing has a more evenly spotted appearance than in *notatella*), first row of four spots, one in subcostal area at distal two-thirds, one at upper margin of cell at about middle, two diagonally nearer base in dorsal area, second row of three large spots at end of cell, in cell and in dorsal area just before middle, third row of two large spots, beyond and below lower distal corner of cell; two small spots in apical area; a submarginal row of ten dots from before apex nearly to tornus. Fringe white with a black dot below apex. Underside brown, costal fringe not developed as in *E. notatella,* scarcely discernible from the rather elaborate retinaculum. Fringe white with partially reproduced upperside submarginal dots. *Hindwing:* Slightly broader than forewing; a tightly closed pinch-fold between Sc and R on basal one-third, containing a short cream-white hair pencil; costal margin nearly straight, apex acute, termen strongly angled back, broadly curved to dorsum. Ground color semitranslucent white basally, becoming opaque ochreous on distal half, brownish at apex. Fringe white. Underside similar, costal and apical areas pale brown. *Abdomen:* Second segment modified laterally to form pouchlike folds as receptacle for thoracic scale brushes. Dorsal scaling pale brownish becoming pale ochreous at segment VIII, venter white becoming ochreous at VIII; genital scaling including immense, paired dorsolateral tufts of VIII and of tegumen basally (Figure 122) ochreous. Genitalia as in Figure 121 (drawn from plesiotype, Sanitago, Cuba, JAP prep. no. 1623; three preparations examined); tegumen developed anteriorly into elongate lobes bearing huge hair tufts (which are not shown in Figure 121), uncus and gnathos similar to *E. notatella,* valva relatively smaller, with the apical membranous pouch and heavily sclerotized sacculus bearing a distal two pronged structure, aldeagus not as crooked as in *E. notatella.*

FEMALE.—Length of forewing 12.0 mm. Essentially as described for male, eye and labial palpus size not differing from male. Antennal scape length about equal to eye diameter, not enlarged toward middle; shaft about as broad as in male. Hindwing subcostal area simple, costal margin concave before apex. Abdomen without specialization of first two segments laterally; scaling brown dorsally, broadly white laterally and ventrally; segments VIII and IX bright ochreous, a pair of peglike lateral evaginations on sternite IV and a single median one on VII (Figure 241); VII heavily sclerotized ventrally with broad, rounded, lateral emarginations. Genitalia similar to *E. notatella* with ventral portion of sterigma not ridged, lateral lobes broader and deeper (Figures 239, 240, drawn from plesiotype, Prov. Pinar del Rio, JAP prep. no. 2819; one preparation examined).

TYPE DATA.—Santiago Cuba; W. Schaus collector; holotype male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from Cuba.

FLIGHT PERIOD.—April, June, October.

FOOD PLANT.—Unknown.

Ethmia paucella (Walker)

FIGURE 119; PLATES 2*c*, 14*b*

Hyponomeuta paucellus Walker, 1863:530.
Psecadia paucella.—Walsingham, 1892:527,546.
Ethmia paucella.—Walsingham, 1897:90.—Busck, 1914c:55.

A little known species of the Notatella group from Hispaniola, somewhat resembling *hiramella* but with smaller spots. The following description is based on a single male and a paratype female. As discussed above, study of additional material will

have to show whether the male, which has broader, yellow hindwings and peculiarly enlarged palpi, is conspecific with the paratype female.

MALE.—Length of forewing 12.4 mm. *Head:* Eye large, diameter about 1.25 times that of other *Ethmia* of comparable size. (Front also modified, concave; and eye index =1.0.) Labial palpus modified into an elongate, clublike shape, reflexed from head (Plate 2*c*); first segment greatly elongated, strongly curved, about 0.9 eye diameter; second segment curved away from head (opposite to first), enlarged into a dorsoventrally flattened hoodlike structure about 1.33 times eye diameter (one palpus; the other considerably shorter, possibly broken or teratologically malformed, lacking third segment); third segment greatly reduced, only about 0.13 eye diameter, mostly concealed by scaling of second; dorsal scaling of second segment appressed, tan, ventral concavity (away from head) filled by upright scales about 0.23 mm in length, white, margined laterally by tan scales about one-half as long; third segment with the tan scales only. Antenna not strongly modified, length of scape about 0.8 eye diameter (about as long as in other members of Notatella group, which have smaller eyes), not much swollen toward middle; shaft little dilated beyond first segment, width about 0.15 eye diameter; dorsal scaling tan. Tongue heavily clothed with shaggy, tan scaling; front concave between eyes, scaling appressed, tan, becoming white at occipital tufts (crown denuded). *Thorax:* Dorsal scaling pale grayish white, dark steel blue spots laterally and at midcollar, midtegula and laterally on scutellar area. Underside pale tan. Prothoracic tibia broadened, margined with white interiorly; prothoracic and mesothoracic tarsi banded with dark brown; metathoracic tibial brush large, extending around inner side to venter, pale ochreous. An elongate, pale ochreous hair brush from below hindwing extending alongside of abdomen to segment II. Dorsal metathoracic tufts also enlarged. *Forewing:* Length about 3.0 times width; costa evenly, gently curved from base to apex, apparently slightly concave beyond middle owing to fringe; termen rather strongly angled back, tornal angle not distinct. Ground color uniform pale grayish white; markings more or less evenly spaced, similar sized (about 0.6 mm), roundish spots of black reflecting metallic blue: one at base, divided by ground color at R; one in costal area at basal one-fourth; three parallel, diagonal rows of three spots each, first row a spot in costal area just before middle, one in cell and one in dorsal area successively nearer base, second row spots in costal area at two-thirds, in cell beyond middle and in dorsal area at middle, third row spots in apical area, at outer edge of cell and above dorsal margin before tornus; one more spot just below and distad of the one at end of cell. A row of blackish dots around termen from before apex nearly to tornus, preceded just below apex by a short streak of the same color. Underside pale ochreous becoming pale brownish toward apex; subcosta with a short fringe; an unscaled area following retinaculum, with subcostal spot of upperside evident. *Hindwing:* About 1.2 times broader than forewing, (cubital and anal areas noticeably broader than in other *Ethmia*; subcostal area with a very slight pinch-fold; costal margin, evenly curved from base to apex, no concavity before apex, termen strongly angled back, tornal angle slightly developed. Ground color pale ochreous except costal area entirely clothed from upper margin of cell to costal margin with bright ochreous, roughened scaling. Underside unicolorous whitish ochreous. *Abdomen:* Basal segments not conspicuously modified for reception of the thoracic tufts as in other members of Notatella group. Scaling entirely pale ochreous, concolorous with hindwing; large dorsal hair brushes of segment VIII lying against tegumen, and large tufts of valvae dark ochreous. Genitalia as in Figure 119 (drawn from plesiotype, Haiti, JAP prep. no. 1613; one preparation examined); intermediate in appearance between *notatella* and *phoenicura;* tegumen not extended anteriorly as in *hiramella;* valva not heavily spined as in latter and *wellingi.*

FEMALE.—Length of forewing 10.9 mm. *Head:* Eye smaller, diameter about 0.8 that of male. Labial palpus normal in form, elongate, exceeding base of antenna; second segment upcurved, length about 1.25 times eye diameter; third segment short, length about 0.6 that of second; smooth scaled, whitish, both distal segments blackish exteriorly except apically. Antenna not modified, scape length about three-fourths eye diameter, without enlargement; shaft not dilated, similar in size to male. Scaling of tongue moderate, whitish, of front

and crown pale tan. *Thorax:* Dorsal scaling of pronotum as in male; metathoracic hair tufts reduced. Underside whitish, tibiae and tarsi banded with black. *Forewing:* Shape and upperside color pattern as in male. Underside whitish at base, becoming pale brownish beyond middle. *Hindwing:* Slightly narrower than forewing (width about 0.7 that of male). Costal area simple. Ground color white; apex dark; fringe white. Underside similar. *Abdomen:* Dorsal scaling dark brown; lateral and ventral white; genital bright ochreous. Genitalia not examined.

TYPE DATA.—Santo Domingo; lectotype female in British Museum, labeled "St. Dom. 55.1" and "Type ♀," probably by Durrant.

GEOGRAPHICAL DISTRIBUTION.—Dominican Republic and Haiti (Bourdon).

FLIGHT PERIOD.—June (a single record).

FOOD PLANT.—Unknown.

Ethmia wellingi Powell, new species

FIGURES 120, 238; PLATE 14*c*; MAP 46

A large central American *Ethmia* having the white forewings broadly marked with black which faintly reflects metallic greenish; the genital tuft is bright ochreous or red.

MALE.—Length of forewing 13.4 to 15.9 mm. *Head:* Labial palpus greatly elongate, well exceeding base of antenna; second segment strongly curved, length about 1.3 times eye diameter; third segment slightly curved, length about 0.70–0.75 that of second; smooth scaled, white, basal half of apical two segments black. Antenna modified, scape elongate, about 1.3 times eye diameter, moderately enlarged distally; shaft scarcely dilated, width basally less than 0.20 eye diameter. Scaling of tongue dark basally, whitish beyond; of front and crown, appressed, white. *Thorax:* Dorsal scaling white, marked with black, reflecting metallic greenish blue: base of tegula, most of collar, pronotum broadly adjoining collar, a pair of spots which sometimes join medially on scutellar area. Underside whitish tinged with brown anteriorly; legs mostly brown, tibiae and tarsi banded with white; prothoracic and mesothoracic legs reflecting metallic bluish on fresh examples; mesocoxae and metacoxae and trochanters blotched with bright ochreous. A large, dull ochreous hair brush from below hindwing extending alongside of abdomen to segment III. *Forewing:* Length 3.0–3.3 times width; costa evenly, gently curved from base to apex; termen not strongly angled back, slightly concave, tornal angle well developed. Ground color white, markings distinctly defined, dark brownish black reflecting greenish blue, as follows: costal half of wing from base to end of cell except an irregular spot at basal one-fourth and a smaller one in cell below it, lower edge of costal dark area sending two lobes into dorsal area, an inwardly, slightly oblique, one at basal one-fourth and a short, broad one at about middle, the latter preceded slightly and subtended by a round spot in dorsal area, sometimes joined to it; outer margin of costal dark area sinuate, with an outwardly projecting spur at end of cell; terminal area with an irregular, diagonal band from below apex to dorsum just before tornus, reaching termen just below apex, there expanding as a blotch in the otherwise white fringe. A submarginal row of black dots at base of fringe, from before apex nearly to tornus. Underside pale brownish; costa basally with an inwardly directed, darker fringe, obscuring retinaculum. Fringe as on upperside. *Hindwing:* Slightly broader than forewing; Sc and R with a broad, tightly closed pinch-fold between them extending to middle of wing containing a thin, ochreous hair pencil and a tightly compacted row of specialized scales, which are broad, brittle, translucent (recalling fish scales); costal margin as a result nearly straight, apex blunt, termen moderately strongly angled back, tornal angle obscured. Ground color whitish, becoming pale brownish on distal half; fringe white. Underside similar, costal area including fold brownish. *Abdomen:* Basal segments not modified for reception of thoracic brushes. Dorsal scaling dark gray, ventral mostly whitish except apical two or three segments dark gray. Genital scaling entirely bright ocherous or tufts of segment VIII and valvae red and tufts lying over tegumen ochreous; tufts laterally on tegumen white. Genitalia as in Figures 120 (drawn from paratype, Costa Rica, JAP prep. no. 1389; three preparations examined); tegumen with moderately enlarged lateral lobes bearing tufts of very long hair scales (not shown in figure), uncus hoodlike, gnathos elongate-narrow, valva greatly modified with a large apical membranous lobe subtended by

a blade-shaped and a scythe-shaped sclerotized structure, sacculus with a free, outward extending, flat projection on inner, posterior margin; aedeagus greatly modified, with crooked distal half.

FEMALE.—Length of forewing 12.7 to 16.4 mm. Essentially as described for male; eye and palpus size as in male. Antennal scape shorter, about equal to eye diameter, less enlarged. Thoracic hair brushes smaller, white. Hindwing costal area simple. Genital scaling reduced, bright ochreous or bright red. Genitalia as in Figure 238 (drawn from plesiotypes, Puntarenas, Costa Rica and Yucatan, JAP prep. nos. 2544, 2787; three preparations examined); similar to *E. notatella,* sterigma fused with VII sternite, forming deeply recessed, partially sclerotized lateral lobes which are pinched inward; subtending lobes of *E. notatella* lacking; ductus with two loose coils.

TYPES.—Holotype female and allotype male: Mexico, Chichen Itza, Yucatan, May 17, 1955 and April 14, 1956 (E. C. Welling); deposited in the California Academy of Sciences. Thirty-four paratypes, as follows: *Mexico:* Chichen Itza, Yucatan, 1 ♀, IV–3–54, 3 ♀, V–(5–23)–54, 2 ♀, V–14, 16–55, 1 ♂, 4 ♀, V–(20–28)–55, 4 ♀, II–(4–29)–56, 2 ♀, III–5, 16–56, 4 ♀, IV–(7–9)–56 (E. C. Welling); *Costa Rica:* Puntarenas, Monteverde, 4,600 feet; 1 ♀, II–18–60, 1 ♂, 3 ♀, III–2, 3–60, 1 ♂, 1 ♀, I–14, 29–61, 2 ♀, XI–14, 24–61, 1 ♀, VII–5–61, 2 ♀, II–23, 27–62 (C. W. Palmer); Turrialba, 1 ♀, III–(13–17)–65 (S. S. and W. D. Duckworth). Deposited in American Museum of Natural History, British Museum, California Insect Survey, Carnegie Museum, U.S. National Museum, and collection of E. C. Welling, Merida, Yucatan. Two additional specimens have been examined subsequent to writing the description: *Costa Rica:* 6 km S San Vita, Puntarenas, 1 ♀, III–13/18–67, 1 ♀, IV–27/V–4–67 (D. F. Veirs).

REMARKS.—The specimens from Costa Rica are generally larger (forewing length of females 14.4 to 16.4 mm.) than those from Mexico (forewing of female 12.7 to 14.6 mm) and exhibit other differences, the most conspicuous of which is the bright red genital scaling. In the series from the type locality the caudal tuft is bright ochreous or orange-ochreous. Individuals from Costa Rica show a tendency toward somewhat more extensive markings on the forewing, particularly a slight broadening of the large costal blotch and its outer spur into the dorsal area.

Section II

ADULT.—Eye large (index 1.1–1.2). Male with uncus reduced, membranous, or absent; gnathos rudimentary or lacking; valva with differentiated "distal seta-bunch," and usually with modified scale-like setae that are often bifid apically. Female with posterior apophyses usually elongate; anterior apophyses narrow-elongate.

MATURE LARVA.—Head capsule rounded, with epicranial lobes strongly bulging; strongly sclerotized (uniformly dark); adfrontal sutures reaching only about 0.5–0.6 to cervical triangle. Secondary setae in SV group: 2–10 on abdominal segments 1, 2, 7, 8; none on segment 9; 18–22 on abdominal and anal prolegs, on a distinct pinaculum. Crotchets arranged in a circle.

PUPA.—Robust, cylindrical, with rugose, densely sclerotized integument. Appendages extended to middle of abdominal segment VI or beyond. Segment VI stationary (?), segment VII movable by lateral condyles. Anchoring by grasp of larval head capsule or cocoon in abdominal segments VI–VII intersegmental closure. Setae lacking.

COCOON.—Loose, frail, nonresistant to desiccation.

The Baliostola Group

Eye index 1.1 Maxillary palpus moderately large, 4-segmented, lengths about 1:1:1:2. Labial palpus elongate, II segment index 1.5–1.6; smooth scaled. Antenna of male moderately dilated, index 0.23–0.28. Forewing broad to moderately broad; pattern longitudinal streaks. Hindwing of male with costal brush and Sc–R pinch-fold. Abdomen with ochreous genital scaling. Uncus short, hoodlike; gnathos absent; basal processes membranous, narrow; without costal plume; fultura-manica simple; vesica simple or armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma ornate; antrum enlarged with sclerotized band; ductus bursae sclerotized basally, four tight coils; signum a dentate keel.

Two large Central American and Antillean species which occupy a somewhat intermediate position between the two sections of the genus.

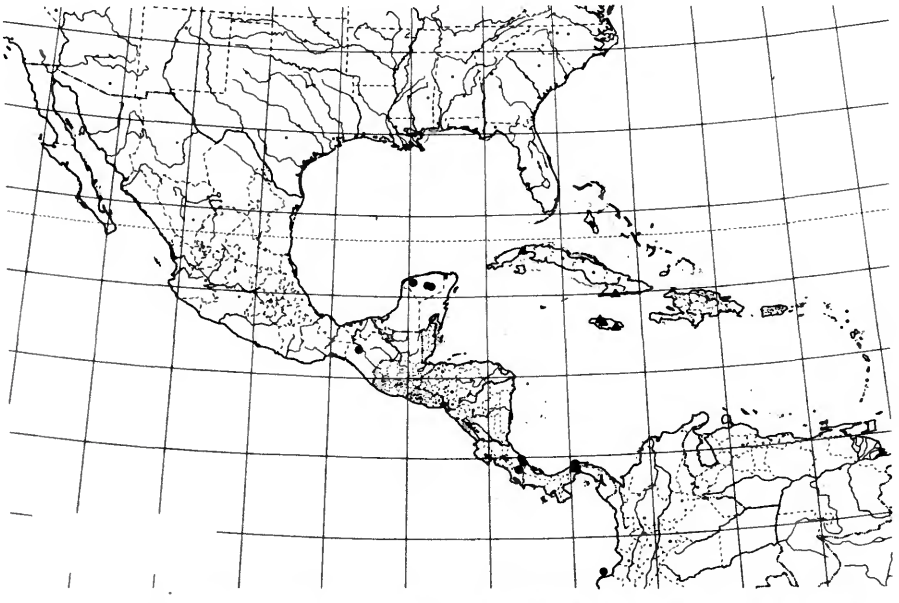
Ethmia baliostola Walsingham

FIGURES 30, 31, 138, 257, 258; PLATE 16*a*; MAP 48

Ethmia baliostola Walsingham, 1912:144.—Meyrick, 1924: 119.—Busck, 1934:165.
Ethmia baliostoma [error] Busck, 1914c:54.

A rather large, broad-winged, central American *Ethmia* having white forewings heavily mottled with dark brownish and a double whitish costal brush on the hindwing.

MALE.—Length of forewing 10.7 to 13.8 mm. *Head:* Labial palpus greatly elongate, strongly curved, extending to back of crown; second segment length 1.43–1.50 times eye diameter; third segment moderately curved, length 0.83–0.88 that of second (about 1.25–1.30 eye diameter); smooth scaled, white, second segment with basal, median, and preapical blackish rings, third segment with broad black bands before and beyond middle. Antenna dilated, width of shaft at basal one-third 0.21–0.25 eye diameter; dorsal scaling sparse, gray, scape white with some blackish scaling dorsally. Scaling of tongue, front and crown whitish with some intermixed grayish, occipital tufts black at middorsum, white laterally. *Thorax:* Dorsal scaling grayish, collar and tegula unspotted, pronotum with paired blackish spots adjoining collar, under tegulae near middle, at apices of tegulae, and at sides of scutellum, a single spot at middorsum preceding scetellum. Underside whitish, prothoracic leg mostly blackish exteriorly, mesothoracic and metathoracic legs marked with paler gray; hind tibial fringe elongate, dense, whitish ochreous. *Forewing:* Broad, length about 2.8–2.9 times width; costa gently, nearly evenly curved from base to apex, termen rather strongly angled back, straight, tornal angle distinct. Ground color white, largely replaced by grayish and dark brown (probably blackish when fresh) irregular and indistinct markings, forming elongated spots and streaks, which are at times somewhat distinct; the most conspicuous mark usually an irregular streak from a spot at end of cell to termen below apex; at times the dorsal area before middle somewhat less marked, but not showing the two distinct, small spots, as in *confusella* at least the outer one, usually both, obscured by brownish mottling; a row of about ten blackish dots around margin from before costa to tornus. Fringe whitish except just below apex interrupted by the longitudinal streak through terminal area. Underside pale brownish, dorsal area and fringe whitish; subcostal area and R near base with specialized, erect scaling. *Hindwing:* Slightly narrower than forewing; base of costa



MAP 48.—Geographical distribution of members of the Baliostola group of *Ethmia*.
● *E. baliostola* Walsingham ▲ *E. cubensis* Busck

with a double, thin, elongate, ochreous-white hairbrush which is divided at base, the anterior portion free, arising on the outside (ventral side of wing) of a short costal fold, posterior portion enclosed in a small pinch-fold between C and Sc; costal margin as a result nearly straight, slightly convex beyond middle, apex acute, termen straight, tornal angle recognizable. Ground color pearly white, becoming brown at the margins; fringe whitish. Underside similar, irregularly brownish. *Abdomen:* Dorsal scaling brown, ventral whitish, genital bright to dark ochreous. Genitalia as in Figure 138 (drawn from plesiotype, Gorgona Island, Colombia, JAP prep. no. 1199; seven preparations examined); uncus short, not well defined, hoodlike, bearing an elongate, dense, persistent scale brush; gnathos rudimentary, not heavily sclerotized, cucullar area of valva drawn out apically into a membranous lobe with a dense scale "plume" exteriorly, distal end of sacculus with a dense row of flat spines subequal in length followed by a triangular projection bare or hairy to outer margin; vesica with a weakly sclerotized longitudinal band.

FEMALE.—Length of forewing 11.3 to 14.1 mm. Essentially as described for male; eye smaller but labial palpus equally elongate (second segment length over 1.6 times eye diameter); antenna not dilated, width of shaft 0.80–0.85 that of male. Underside of forewing without specialized scaling on subcostal area and R; hindwing costal area simple. Genitalia as in Figures 257, 258 (drawn from plesiotype, Yucatan, JAP prep. no. 2550; two preparations examined); anterior and posterior apophyses long, sterigma rather simple, a narrow plate protruding ventrally, ductus with a long, strongly sclerotized, flat antrum subtended by a lightly sclerotized, recurved-flaplike accessory sac, signum a double-flanged, shallow fold with a single row of teeth.

TYPE DATA.—Costa Rica, Banana River, March 1906 (W. Schaus); unique male type in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Northwestern South America (Colombia coast) to southern Mexico (Chiapas; Yucatan).

FLIGHT PERIOD.—At least two generations; March-April (Costa Rica), May-July and September-October (Panama, Mexico), November (Colombia).

FOOD PLANT.—Unknown.

REMARKS.—The South American record is represented by two males from Gorgona Island, Colombia, which are superficially distinguishable by more extensive, darker wing markings. The genital characters, however, are identical to those shown in other parts of the range.

Ethmia cubensis Busck

FIGURE 139, PLATE 16*b*; MAP 48

Ethmia cubensis Busck, 1934:164, pl. 23, fig. 2; pl. 26, fig. 3.

A moderately large Antillean *Ethmia* related to *E. baliostola,* with similar, less distinctly marked, gray-streaked forewings and the same kind of double hair pencil of the hindwing.

MALE.—Length of forewing 9.8 to 11.0 mm. *Head:* Labial palpus greatly elongate, well exceeding base of antenna; second segment length 1.35–1.45 times eye diameter; third segment slightly curved, length about 0.75–0.85 that of second (1.1–1.2 times eye diameter); smooth scaled, second segment whitish gray, with broad blackish exteriorly becoming narrow bands at middle and before apex interiorly, third segment blackish except narrow basal, median and apical white bands. Antenna dilated, width of shaft basally 0.21–0.24 eye diameter; dorsal scaling gray, scape white below. Scaling of tongue, front and crown interspersed whitish and grayish, becoming darker at back of crown, particularly medially. *Thorax:* Dorsal scaling pale grayish, collar dark basally, dark brownish markings outlined with whitish as follows (all markings probably blackish when fresh, all specimens examined collected more than 40 years ago): at base of tegula, two pairs of spots on pronotum, adjoining tegulae anteriorly and at tips, three spots at sides of and anterior to scutellar area. Underside white; prothoracic and mesothoracic legs spotted with brown or blackish. *Forewing:* Moderately broad, length 3.1–3.2 times width; costa evenly, gently curved from base to apex; termen rather strongly angled back, tornal angled scarcely evident. Ground color pale grayish, heavily mottled with darker, especially longitudinal streaks, the most conspicuous of which are a basal streak in cell on fold, a dark shade in outer half of cell (at times subtended by a rather distinct bar in dorsal area adjoining outer third of cell) an ill-defined spot at end of cell which is usually the darkest

mark of the wing, and a streak through terminal area below apex; two pale areas, more whitish than the general ground color, beyond basal and median dark shades; a row of eight or nine blackish dots around margin from before apex to tornus. Underside pale brownish; Sc and Cu with roughened, pale ochreous fringes basally. *Hindwing:* Slightly broader than forewing; base of costa with double, elongate, pale yellowish white hair brush which is divided at base, the anterior half free, basad, originating on outer side of a short costal fold (ventral surface of wing), posterior half enclosed in a pinch-fold between costa and Sc; costal margin as a result nearly straight. Ground color white, distal margin and apical area narrowly brown. Underside similar, costal area slightly brownish. *Abdomen:* Dorsal scaling brown, lateral and ventral white, genital pale ochreous. Genitalia as in Figure 139 (drawn from plesiotype, Mandeville, Jamaica, JAP prep. no. 1510; seven preparations examined); similar to *baliostola,* differing principally by the shape of the cucullus, and by possessing two large, flat spines at the end of the sacculus and a hooklike cornutus in the vesica.

FEMALE.—Not examined. Busck (1934) figured the signum, which does not differ from that of *baliostola.*

TYPE DATA.—Cuba, Sierra Maestra, Comaquey (W. Schaus, O. Querci, and J. Acuna). Holotype male in U.S. National Museum bears the additional information "Apr. 28, 1930," and "1000 ft." and indicates Querci as the sole collector.

GEOGRAPHICAL DISTRIBUTION.—Cuba and Jamaica.

FLIGHT PERIOD.—Evidently multivoltine; records from Jamaica for April, May, July, and December.

FOOD PLANT.—Unknown.

REMARKS.—Superfically, *E. cubensis* most closely resembles the Caribbean *E. confusella* (Walker) and *E. catapeltica* Meyrick in Central America, but in structural characters the present species relates to *baliostola.* In addition, the dark mark at the end of the cell serves, along with the two distinct dots borne by *E. confusella* in the dorsal area basally, to distinguish that species from the present one. *E. cubensis* differs superficially from *E. catapeltica* by the divided pale hindwing costal brush in which the enclosed portion is white in the latter species and in *E. flavicaudata,* while the outer surface of the fold bears a blackish fringe.

The Confusella Group

Eye index 1.1–1.2. Maxillary palpus moderately large, four segments, lengths about 4:4:3:7. Labial palpus elongate, II segment index 1.1–1.8; smooth scaled. Antenna of male not dilated to dilated, index 0.18–0.30. Forewing moderately broad; pattern longitudinal gray or black streaks. Hindwing of male unmodified or with hair pencil enclosed in costal fold. Abdomen scaling undifferentiated or wholly ochreous or genital scaling weakly ochreous. Uncus membranous; gnathos absent; basal processes narrow, membranous, rarely ridged; valva with dense setation on inner side and cucullus "plume" bearing scalelike setae that are bifid apically; fultura-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma simple; antrum enlarged, usually with sclerotized band; ductus bursae membranous, straight or six to nine tight coils; signum a dentate bar or lacking.

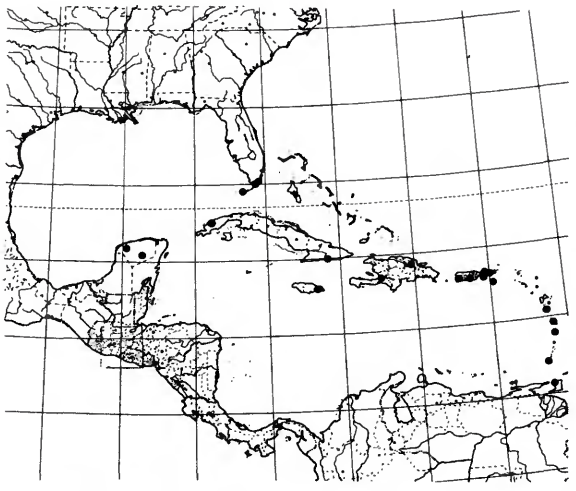
A fairly closely knit group of eight nocturnal species distributed primarily in the Caribbean region for which phenetic assessment indicated only weak justification for retention separate from the Longimaculella group. However, the densely haired valva, a cohensive feature of the Confusella group, was not used as a character in the phenetic clustering. *Ethmia farrella* is a marginal member, with varying relationships indicated by clustering techniques. These superficially similar gray moths have no Old World relatives.

Ethmia confusella (Walker)

FIGURES 32, 33, 123, 244, 245, 286, 291, 293, 294; PLATES 2*d*, 14*d-e;* MAP 49

Hyponomeuta confusellus Walker, 1863:531.
Psecadia confusella.—Walsingham, 1892:527, 546 [synonymy].
Ethmia confusella.—Walsingham, 1897:89 [synonymy].—Dyar, 1902:205.—Grossbeck, 1917:143.—Wolcott, 1923:203.—Forbes, 1930:134.—Busck, 1934:163, pls. 33, 36.—McDunnough, 1939:83.—Kimball, 1965:286.
Cryptolechia strigosella Walker, 1864a:710.
Psecadia strigosella.—Walsingham, 1892:527 [synonymy].
Psecadia ingricella Moeschler, 1890:343, 354, fig. 19.—Walsingham, 1892:527, 546.
Ethmia ingricella.—Walsingham, 1897:89 [synonymy].
Psecadia (Cryptolechia) strigosa [error] Cockerell, 1891:33.

A widespread Caribbean species having gray forewings marked by blackish longitudinal streaks and



MAP 49.—Geographical distribution of *Ethmia confusella* (Walker).

two distinct spots in the dorsal area toward the base.

MALE.—Length of forewing 8.0 to 10.7 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding base of antenna; second segment length 1.25 to 1.5 times eye diameter; third segment 0.9 to 1.0 the length of second; smooth scaled, whitish, second and third segments with median and subapical black bands. Antenna dilated, width of shaft basally about 0.25 eye diameter; dorsal scaling grayish, scape whitish with a dorsal blackish spot or mostly dark. Scaling of tongue, front, and crown white or grayish, a black spot at mid-dorsum of occipital tufts. *Thorax:* Dorsal scaling whitish or pale gray; bases of tegulae blackish and seven blackish spots on pronotum, three pairs laterally, near collar, adjoining tegulae apices, and at sides of scutellum, and a single median one preceding scutellum. Underside white, protibiae and mesotibiae and tarsi marked with blackish. *Forewing*: Length 3.2 to 3.5 times width; costa gently curved, appearing slightly flattened beyond middle; termen strongly angled back, straight or very slightly concave, tornal area a broad curve. Ground color whitish, usually mostly dusted by pale grayish; markings blackish or dark gray-brown, as elongated longitudinal spots, more or less uniformly placed over costal half, at times tending to form a somewhat more conspicuous line through end of cell and termen; dorsal area below cell to tornus unmarked except two spots on basal one third, the inner one closer to cell; a row of darker dots around termen subtending fringe. Fringe whitish, interrupted by the dark line just below apex. Underside uniform pale brown. *Hindwing:* Costal area with an external fringe and a fold containing a thick, elongate, white hair pencil; costal margin slightly convex beyond middle; apex acute, termen strongly angled back, broadly curved to dorsum. Ground color white, semitranslucent, brownish at apex; fringe white. Underside similar, costal area pale brownish. *Abdomen:* Dorsal scaling pale brownish gray, lateral and ventral scaling white, genital whitish slightly tinged with ochreous. Genitalia as in Figure 123 (drawn from plesiotype, Jamaica, JAP prep. no. 1195; 14 preparations examined); uncus lightly sclerotized, valva broad with dense, elongate setation on inner face, apex of valva with a bunch of about 4–6 short spurs, vesica with an ornate cornutus bearing many small spines.

FEMALE.—Length of forewing 9.0 to 10.8 mm. Essentially as described for male; eye relatively smaller; labial palpus segments as long. Hindwing costal area simple. Genitalia (Figures 244, 245, drawn from plesiotype, Florida, JAP prep. no. 2553; two preparations examined); anterior and posterior apophyses elongate, thin; sterigma a narrow, single plate, antrum with sclerotized sleeve and lateral pouch; ductus membranous, with about 11 coils; signum a narrow, shallow fold with short inner teeth.

TYPE DATA.—Santo Domingo, Tweedie collection, described from two males in the British Museum, the paratype bearing the additional data "55.1" (*confusellus*); Santo Domingo, Tweedie collection, unique type in British Museum (*strigosella*); Puerto Rico, types in Moeschler collection (*ingricella*).

GEOGRAPHICAL DISTRIBUTION.—Florida Keys and Bahama Islands, through the Greater Antilles to the Yucatan Peninsula, and through the Lesser Antilles to Trinidad. An old record for Bogota, Colombia (Walsingham, 1892) is represented in the material examined only by a male and female which lack abdomens.

FLIGHT PERIOD.—Probably multivoltine; July and December (Jamaica), April and June (Puerto Rico), July and October (Virgin Islands), March, May, and August (Dominica); most other records are for June and July.

FOOD PLANT.—*Bourreria ovata* (Boraginaceae) in Florida. Specimens were reared from larvae collected by D. H. Habeck at Plantation Key in May 1969. The U.S. National Museum has larvae which are indistinguishable from a larva preserved by Habeck, collected on *Bourreria* at Coral Gables.

REMARKS.—The typical form, with more or less uniformly streaked, gray forewings, occurs from Hispaniola southward. Specimens from the Florida Keys and eastern Cuba (Santiago) differ by having a more extensive whitish ground color with more contrasting black markings. Those from western Cuba (Pinar del Rio) and Jamaica are generally smaller (♂♂ forewing length 8.0–8.8 mm) and have less well-defined markings than the typical form. Those from Jamaica have the hindwing costal brush reduced. In a series from Chichen Itza, Yucatan (the type locality of *E. confusellastra,* described below), the individuals are small (forewing 8.7–9.9 mm) and pale. The ground whitish although not as immaculate as on Florida examples, is more extensive, with the major markings reduced and paler. The Mexican specimens thus more closely resemble *confusellastra* than Caribbean *confusella* in forewing pattern.

The species is superficially quite similar to *E. catapeltica* of Central America and the Caribbean species, *E. cubensis,* but can usually be recognized by the two distinct spots in the dorsal area of the forewing basally.

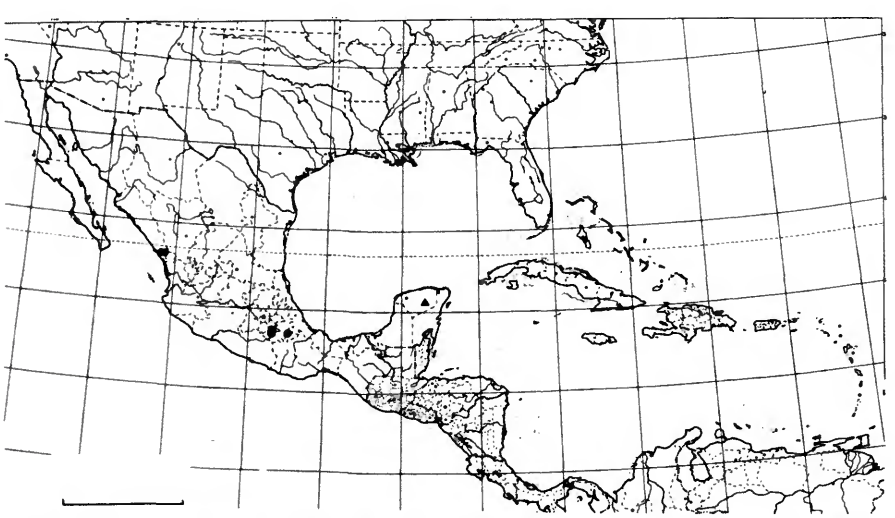
Ethmia striatella Busck

FIGURES 124, 246, 247; PLATE 14*f*; MAP 50

Ethmia striatella Busck, 1913b:141.—Powell, 1959:136.

A Mexican species with gray-streaked forewings and bright ochreous abdomen.

MALE.—Length of forewing 10.4 to about 11.0 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding base of antenna; second segment length 1.4 to 1.5 times eye diameter; third segment 0.9 to 1.0 the length of second, distinctly curved; smooth scaled, white, second and third segments with subbasal and subapical broad, black bands. Antenna not dilated, width of shaft basally about 0.18 eye diameter; dorsal scaling sparse, gray. Scaling of tongue and front whitish, becoming gray at crown, occipital tufts black at middorsum. *Thorax:* Dorsal scaling pale gray; collar and tegulae darker at extreme base; pronotum with seven blackish spots margined with whitish, lateral pairs adjoining tegulae at collar, under tegulae apices and at sides of scutellum, a single median one preceding scutellum. Underside white, prothoracic legs mostly dark brown exteriorly, mesothoracic legs spotted with brownish; hind tibial fringe rather dense, pale grayish ochreous. *Forewing:* Length 3.2 to 3.5 times width; costa gently curved, appearing flattened toward middle; termen strongly angled back, broadly curved to dorsum, tornal



MAP 50.—Geographical distribution of members of the Confusella group of *Ethmia.*
● *E. striatella* Busck ▲ *E. confusellastra* Powell

angle scarcely evident. Ground color whitish gray, more or less uniformly streaked with dark gray, longitudinal, ill-defined markings, dorsal area with a single ill-defined spot before middle; a row of blackish dots around termen from before apex to tornus. Fringe whitish. Underside dark brownish gray, cell near base and dorsal area pale whitish ochreous. *Hindwing:* About as broad as forewing; costal area with a fold containing an elongate pale ochreous hair pencil; costal margin nearly straight; apex rather blunt, termen not strongly angled back, broadly curved to dorsum. Ground color semitranslucent white near base, narrowly or rather broadly dark brownish in apical area; fringe whitish. Underside similar, costal area brownish. *Abdomen:* Dorsal scaling uniform ochreous; underside whitish ochreous. Genitalia as in Figure 124 (drawn from plesiotype, Matamoros, Puebla, JAP prep. no. 1118; one preparation examined); similar to *confusella,* valva narrower, cornutus less ornate.

FEMALE.—Length of forewing 9.7 to 10.1 mm. Essentially as described for male, coloration indistinguishable. Eye and labial palpus about the same size as in male. Antenna not appreciably smaller than in male. Hindwing costal area simple. Genitalia similar to *confusella,* distal portion of antrum with two well-defined sclerotized patches, signum with multiserial, large teeth (Figures 246, 247, drawn from plesiotype, 34 mi S Atlixco, Puebla, JAP prep. no. 2554; two preparations examined).

TYPE DATA.—Mexico; Tehuacan, Puebla, June (R. Müller); unique male type in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Thorn forest areas of central Mexico; Puebla and Sinaloa (foothills east of Villa Union).

FLIGHT PERIOD.—June and September (Puebla); late July (Sinaloa).

FOOD PLANT.—Unknown.

REMARKS.—This species has a nondescript forewing pattern resembling *confusella, cubensis,* and *flavicaudata,* but the entirely ochreous abdomen will at once separate *E. striatella.*

Ethmia duckworthi Powell, new species

FIGURE 127; PLATE 14*g*

A rather large *Ethmia* from Panama superficially resembling *E. baliostola* but having genital characters of the Confusella group.

MALE.—Length of forewing 11.9 to 12.6 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; length of second segment about 1.45 eye diameter; third segment slightly curved, length about 0.95 that of second; smooth scaled, white, second segment with basal, submedian and subapical black bands, third segment with slightly broader submedian and preapical black bands. Antenna dilated, width of shaft basally about 0.23 eye diameter; dorsal scaling whitish gray, becoming dark gray beyond basal one-third. Scaling of tongue, front, and crown whitish; occipital tufts broadly black at middorsum. *Thorax:* Dorsal scaling pale gray, pronotum with three lateral pairs of moderately large black spots, adjoining tegulae at collar, at tegulae apices and at sides of scutellum, a smaller, median spot preceding scutellum. Underside pale whitish gray, protibiae and mesotibiae and tarsi spotted exteriorly with black; hind tibial fringe dense, pale whitish ochreous. *Forewing:* Length 3.1–3.2 times width; costa gently curved, appearing flattened toward middle; termen moderately strongly angled back, straight, tornal angle distinct. Ground color whitish, more or less uniformly covered by irregular, mostly ill-defined, dark brownish gray longitudinal streaks and spots, dorsal area before middle and terminal area paler, the latter crossed just below apex by an elongate blotch (as in *E. baliostola* and *lichyi*); two dorsal spots as in *confusella,* the inner one nearly obsolete, joined to a dark area on Cu, the outer one distinct (as in *baliostola*); a row of distinct, black dots around terminal margin from well before apex to tornus. Fringe whitish, irregularly speckled with dark grayish. Underside dark brownish, dorsal area and a blotch around retinaculum pale. *Hindwing:* Slightly broader than forewing; costal area simple, a slight pinch-fold between Sc and R, without hair pencil; costal margin as a result convex at about end of cell, nearly straight to apex, termen moderately strongly angled back, broadly curved to dorsum. Ground color whitish basally, semitranslucent, becoming dark brown at apical area and along dorsal margin; fringe white. Underside more uniformly white, pale brownish along costal and apical margins. *Abdomen:* Dorsal scaling brownish gray, ventral whitish, genital ochreous. Genitalia as in Figure 127 (drawn from paratype, JAP prep. no. 1520; two preparations examined); similar to

E. striatella, basal processes broader, the flat spines at apex of valva, broad, curved, vesica with about three curved plates, the apical one with fine spines as in *confusella.*

FEMALE.—Length of forewing 12.7 to 13.4 mm. Essentially as described for male; eye and labial palpus as large as in male, antenna smaller. Forewing slightly broader, length about 2.9 to 3.1 times width. Coloration similar to male, dark markings slightly more extensive on both forewings and hindwings. Genitalia quite similar to *E. confusella* (Figure 244), with the signum teeth enlarged nearly as in *E. striatella* (Figure 246) (one preparation examined).

TYPES.—Holotype male and allotype female: Panama, Barro Colorado Island, May 1–9, 1964, and May 10–17, 1964 (W. D. and S. S. Duckworth); deposited in U.S. National Museum: Five paratypes, same locality: 2♂♂, 1♀, VII–24–63 (M. E. Irwin and D. Q. Cavagnaro), 1♀, V–(10–17)–64, 1♂, V–(24–28)–64 (W. D. and S. S. Duckworth). Deposited in collections of California Academy of Sciences, California Insect Survey, and U.S. National Museum.

REMARKS.—One additional female with the same data as the allotype is referred here provisionally on the basis of the elongate third segment of the labial palpus. The moth is appreciably smaller (forewing length 10.4 mm.) and differs further by a general darker grayish appearance which is particularly emphasized on the hindwing.

Ethmia sandra Powell, new species

FIGURES 126, 248; PLATES 3*d*, 14*i*

A moderately large Central American member of the Confusella group that resembles the eastern Nearctic *E. zelleriella* but has the abdomen entirely ochreous.

MALE.—Length of forewing 10.0 to 11.4 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding crown; second segment curved, length 1.4 times eye diameter; third nearly straight, about 0.87 as long as second; first segment white, second and third blackish dusted with white at middle and tip. Antenna not dilated, width of shaft basally about 0.16 eye diameter; dorsal scaling whitish to grayish. Scaling of tongue whitish, front and crown grayish, with a large blue-black, median spot posteriorly. *Thorax:* Dorsal scaling pale brownish gray; seven black spots, three pairs at sides of notum and scutellum and a small median spot preceding scutellum. Metathoracic brushes short, not obscuring the broadly scaled scutellum, both ochreous. Underside whitish, legs grayish, metathoracic tibiae and tarsi ochreous. *Forewing:* Length 3.4–3.5 times width; costa evenly curved, fringe short, giving an oval appearance to wing. Ground color uniform pale gray, at times an irregular, whitish clouding around markings, latter black, longitudinally elongate spots (about three times longer than wide): a broken spot at base of costa, five spots in cell, a roundish spot at end of cell, a curving row of about six spots parallel to termen, one spot on Cu fold beyond middle (the largest mark of the wing), and one spot in dorsal area at basal one-third. A row of about eleven dots around termen from costa well before apex to tornus. Fringe pale gray. Underside pale brown, a whitish spot through cell with some apparently specialized, pale ochreous scaling. *Hindwing:* Costa tightly folded over to end of cell, enclosing a thick white hair pencil, with a sparse ochreous, exterior fringe (ventral surface of wing); costa slightly convex beyond, apex narrow, round. Ground color semitranslucent whitish, becoming brown at margins beyond middle and in apical area; anal area tinged with ochreous, hair tuft of 2A unusually large, ochreous. Underside similar, costal area also tinged with ochreous. *Abdomen:* Scaling entirely ochreous, venter paler; first tergum with apparently specialized, short, brighter colored scales. Genitalia as in Figure 126 (drawn from paratopotype, JAP prep. no. 2177; three preparations examined); similar to *E. confusella,* differing primarily by a more elongate membranous uncus and by three evenly spaced, enlarged, flat spines of the distal, produced portion of the valva.

FEMALE.—Length of forewing 10.2 to 12.7 mm. Generally as described for male. Labial palpus ranging to more elongate, second segment 1.41–1.55 times eye diameter, third less variable, 0.80–0.93 as long as second; antenna not narrower than male. Forewing slightly broader, length 3.2 times width; markings usually somewhat larger than on male (evident when specimens viewed in series). Hindwing costal area simple; hair tuft of 2A enlarged, as in male. Abdomen scaled as in male except

genital scaling short. Genitalia similar to *confusella,* sterigma broader, mostly membranous, antrum with a defined plate (Figure 248, drawn from paratype, Turrialba, Costa Rica, JAP prep. no. 2361; two preparations examined); signum as in *E. striatella.*

TYPES.—Holotype male and allotype female: El Salvador, 13 km north of San Salvador, February 4, 1965 (W. D. and S. S. Duckworth); deposited in U.S. National Museum. Fifty-seven paratypes, as follows: El Salvador, same data as holotype, 12♂♂, 30♀♀; Cojutepeque, 5♂♂, 6♀♀, II–9–65 (S. S. and W. D. Duckworth); Costa Rica, Turrialba, 2♂♂, 2♀♀, III–1/6–65 (S. S. and W. D. Duckworth). Deposited in California Insect Survey and U.S. National Museum.

REMARKS.—Although no host plant information is available, oviposition by this species evidently occurs into flowers. All female specimens possess considerable pollen on the abdomen (Plate 3*d*), a phenomenon not observed in any other ethmiid. Samples from the moths were examined by R. W. Thorp, University of California, Davis, and confirmed as nucleate pollen grains, although no taxonomic designation could be made.

Ethmia confusellastra Powell, new species

FIGURES 125, 252; PLATE 14*h;* MAP 50

This species, which occurs in the Yucatan Peninsula and Cuba, resembles a small, pale *E. confusella,* but, in addition to genital characteristics, it differs in lacking a hindwing costal fold and hair pencil.

MALE.—Length of forewing 7.4 to 7.7 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; second segment length 1.3 to 1.5 times eye diameter; third segment slightly curved, length 0.85–0.90 that of second; smooth scaled, white, second and third segments with subbasal and subapical black bands, those of third broader. Antenna slightly dilated, width of shaft basally 0.21–0.23 eye diameter; dorsal scaling whitish gray. Scaling of tongue, front, and crown whitish gray, occipital tufts black at middorsum. *Thorax:* Dorsal scaling pale gray with some blackish spots (not distinguishable on material examined, perhaps seven, as on *E. confusella*). Underside white, protibiae and mesotibiae and tarsi spotted with blackish exteriorly. *Forewing:* Length 3.1 to 3.3. times width; costa gently curved, apparently slightly flattened beyond middle; termen moderately strongly angled back, straight, tornal angle a broad curve. Ground color white, generally somewhat infused with pale grayish (less so than in *E. confusella*); markings brownish gray, ill-defined, as elongated spots and streaks more or less evenly distributed; dorsal area below cell with a single pale gray spot at basal one-fourth and two darker spurs protruding from markings near base and in outer part of cell; a row of nine or ten blackish spots at base of fringe from before apex to tornus. Fringe white with a small brownish spot just below apex. Underside brownish gray, dorsal area and a spot beyond retinaculum whitish. *Hindwing:* About as broad as forewing; costal area simple, without fold or hair pencil; costal margin with a narrow, white fringe, slightly convex beyond middle. Ground color white, semitranslucent, becoming brownish at distal margins; fringe white. Underside similar, costal and distal areas indistinctly mottled with pale brownish gray. *Abdomen:* First two segments dorsally with small scales, giving a smooth appearance, tinged with dark ochreous, paler than the brownish gray scaling of the remaining segments; underside white; genital scaling dull ochreous. Genitalia as in Figure 125 (drawn from paratopotype, JAP prep. no. 1077; two preparations examined); similar to *E. confusella,* differing by the narrower valva and biordinate elongate flat spurs at the apex of the valva.

FEMALE.—Length of forewing 7.0 to 7.4 mm. As described for male; eye a little smaller, labial palpus as elongate. Antenna not dilated, width of shaft basally about 0.8 that of male. Genitalia similar to *confusella,* sterigma differing slightly, with a median, sclerotized streak, antrum unsclerotized (Figure 252, drawn from paratype, JAP prep. no. 2281; one preparation examined); signum as in *striatella.*

TYPES.—Holotype male and allotype female: Mexico, Chichen Itza, February 25, 1956, and May 9, 1955 (E. C. Welling); deposited in California Academy of Sciences. Five paratypes: Same data except 2♂♂, V–9–55, 3♀♀, III–16–56, V–8–56, V–26–55; deposited in collections of California Insect Survey and U.S. National Museum.

REMARKS.—Three additional males and one female from Cuba in the British Museum and the

U.S. National Museum have been examined but are not designated as paratypes. The specimens differ by having a more elongate, more strongly curved second segment of the labial palpus (1.5 times eye diameter) and a slightly narrower forewing (length about 3.3 times width). In addition, the forewings are somewhat darker in the Cuban examples. The genitalia, however, are indistinguishable from the Mexican material, and the male possesses no costal fold or hair pencil on the hindwing, a feature which serves to separate *confusellastra* from all other members of the Longimaculella-Baliostola-Confusella groups.

Ethmia julia Powell, new species

PLATE 15*b*; MAP 51

Ethmia [*?paucella* (Walker)]; Kimball [not Walker, 1863] 1965:286.

A small, gray Caribbean moth that looks like a pale edition of *E. linda* with an additional spot in the costal area beyond the middle. Subsequent to writing the following description on the basis of two females from Puerto Rico, I received examples which appear to be conspecific, from the Florida Keys, upon which the male is characterized.

MALE.—Length of forewing 5.6–5.7 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding base of antenna; length of second segment 1.1 times eye diameter; third segment curved, 1.1 as long as second (1.25 times eye diameter). Antenna slightly dilated, width of shaft basally about 0.22 eye diameter. General coloration as described for female, ground color of forewing at times less broadly tinged with grayish. *Hindwing:* Costa narrowly folded to about middle, enclosing a thick, dark gray hair pencil. Ground color slightly paler than in female, whitish near base, becoming brownish distally. *Abdomen:* Genitalia virtually indistinguishable from *E. humilis* (Figure 128; one preparation of *julia* examined).

FEMALE.—Length of forewing 5.8–6.4 mm. *Head:* Labial palpus greatly elongate, strongly curved, well exceeding crown; second segment length 1.2 times eye diameter (eye smaller than in male); third segment strongly curved, 1.3 times length of second (over 1.5 times eye diameter); smooth scaled, white, a broad, dark brown subapical band on third segment. Antenna not dilated, width of shaft about 0.9 that of male; dorsal scaling whitish. Scaling of tongue, front, and crown white, occipital tuft with a small brown spot at middorsum. *Thorax:* White, notum with two pairs of dark brown spots, adjoining apices of tegulae and at sides of scutellum,

MAP 51.—Geographical distribution of members of the Confusella and Joviella groups of *Ethmia*, superficially similar, allopatric species which form a circum-Caribbean ring.
▲ *E. linda* Busck ◑ *E. julia* Powell
● *E. joviella* Walsingham ◒ *E. humilis* Powell

the latter pair nearly fused. Underside white, fore and midtibiae and tarsi marked exteriorly with brown. *Forewing:* Length 3.0–3.1 times width; costa very gently curved, almost straight towards middle, apex rather blunt, termen not strongly angled back. Ground color white, tinged with pale brownish gray in costal area, more broadly so towards end of cell and less conspicuously so over remainder of wing, or evenly over whole wing. Markings round, blackish dots, more or less uniform in size (about 0.6 eye diameter) and spacing; pattern as in *E. linda,* with an additional spot just above cell beyond middle: one spot at base of costa, continued along extreme costal edge to another spot at basal one-fourth, a row of three dots, upwardly oblique from dorsal area at basal one-fifth, toward midcosta, the first below Cu, followed by two in cell; a second, almost parallel row of four spots from dorsal area at basal one-third to costa before apex, the first just above dorsal margin, second adjoining Cu before end of cell, third adjoining end of cell, fourth before apex; a single spot, largest of the wing, in tornal area, and a large, somewhat elongate one just below and beyond subapical one; a row of dots around terminal margin to above tornus. Each dot accented by a border of white. Fringe white with a brownish tinge below apex. Underside pale brown, a whitish area in cell beyond retinaculum. *Hindwing:* Costal area simple, costa slightly convex before apex, latter rather blunt, termen only moderately strongly angled back. Ground color translucent white, becoming brownish distally; fringe white becoming brownish toward apex. Underside irregularly blotched with brownish. *Abdomen:* Dorsal scaling pale ochreous-gray, ventral white. Genitalia indistinguishable from that of *E. humilis* (Figure 249).

TYPES.—Holotype female: Puerto Rico, Isabela Substation, April 24, 1930 (Cornell University Lot. 795, Sub 41). One paratype female: Rio Piedras, Puerto Rico, September 21, 1930 (no further data). Both deposited in Cornell University collection. Additional specimens subsequently examined, from Florida: Monroe County: Key Largo, 1♂, X–7–65, 1♀, VI–28–66, 2♂, 3♀, VII–12 to VIII–18–67, 1♀, "11/2/67" (Mrs. S. Kemp); Tavernier, 1♀, IX–14–55 (J. N. Todd); Plantation Key, 1♀, IV–8–66 (C. P. Kimball collection); not designated as paratypes. The present species resembles *E. linda* and *joviella* but bears additional forewing spots and has paler hindwings. In addition, the greatly elongated third segment of the labial palpus serves to distinguish *E. julia* from any related species I have seen.

REMARKS.—The holotype bears a label in Busck's handwriting stating that the species could not be matched in Meyrick's collection in 1932. The paratype has labels in Forbes' hand indicating that the specimen was compared with the type of *E. joviella* and it differed by the above mentioned features and that the British Museum has a specimen of the present species from the Bahamas determined as *E. joviella.*

Ethmia humilis Powell, new species

FIGURES 128, 249; PLATE 15*c-d*; MAP 51

A small, nondescript tan moth in Jamaica.

MALE.—Length of forewing 5.4 mm. *Head:* Labial palpus greatly elongate, strongly curved, exceeding crown; second segment length 1.25 eye diameter; third segment curved, as long as second; smooth scaled, whitish or pale tan. Antenna slightly dilated, width near base 0.19 eye diameter; dorsal scaling sparse, tan. Scaling of tongue, front, and crown whitish, tinged with tan. *Thorax:* Dorsal scaling concolorous with head; underside whitish; protarsi and mesotarsi indistinctly mottled with brown. *Forewing:* Length 3.2 times width; costa nearly straight along middle one-third; apex blunt, termen only moderately angled back. Ground color tan with some scarcely discernible slightly darker spots which in part indicate the pattern shown by *E. julia*: two or three above Cu fold before middle, one in dorsal area at basal one-fourth, one at end of cell and one just below and beyond; a row of darker, more distinct dots around terminal margin, fringe tan. Underside brownish gray, darker than upperside. *Hindwing:* Narrower than forewing, costa with a tightly appressed fold to end of cell, slightly convex beyond; apex acute, termen moderately strongly angled back. Ground color whitish, slightly tinged with brownish distally; fringe white. Underside similar, costal area brownish. *Abdomen:* Dorsal scaling pale grayish tan, ventral and genital whitish. Genitalia as in Figure 128 (drawn from holotype, JAP. prep. no. 1312; one preparation examined); uncus lacking, basal processes very re-

duced; valva with broad setose apical flap bearing short "plume," and distally with three curved, strong, large setae, valva emarginate below; vesica with a series of flat spinelike cornuti.

FEMALE.—Length of forewing 6.3 to 6.7 mm. As described for male; labial palpus slightly more elongate than in male, second segment 1.3–1.4 times eye diameter, third 1.0–1.1 as long as second, antenna not dilated, width of shaft about 0.15 eye diameter. Forewing markings ranging to more distinct than male in the limited sample available. Hindwing costal area simple. Genitalia as in Figure 249 (drawn from paratype, JAP prep. no. 2556; one preparation examined); sterigma simple, subtended by a short, sclerotized sleeve and a membranous antrum, signum lacking.

TYPES.—Holotype male: Jamaica, Constant Spring, St. Andrew Parish, July 21–22, 1962 (T. Farr, O. and R. Flint), deposited in U.S. National Museum. Allotype female: Same locality, December 27, 1904 (Walsingham), deposited in British Museum. Three paratypes: 1 ♀, same data as allotype; 2 ♀, Runaway Bay, Jamaica, II–24–1905 (Walsingham), deposited in collections of British Museum and California Insect Survey.

REMARKS.—One of the paratypes bears the manuscript name *"Psecadia humilis* Wlsm.," which I have retained since specimens so identified may have gotten into other collections.

Ethmia farrella Powell, new species

FIGURES 129, 250, 251; PLATE 15*a*

A small Caribbean moth resembling *E. confusella,* but darker and with a single basal spot in the dorsal area of the narrow forewing.

MALE.—Length of forewing 6.7 mm. *Head:* Labial palpus greatly elongate, strongly curved, well exceeding crown; second segment length 1.0–1.2 times eye diameter; third segment curved, length 1.1 that of second; smooth scaled, white, second segment with broad subbasal and narrower preapical dark bands exteriorly, third with some ill-defined dusky scaling basally and a narrow preapical dark band. Antenna slightly dilated, width of shaft about 0.20 eye diameter; dorsal scaling gray. Remainder of head scaling mostly lacking from holotype, whitish. *Thorax:* Dorsal scaling gray (damaged), tegulae paler, paired dark spots adjoining apices of tegulae and at sides of scutellum. Underside whitish, prothoracic and mesothoracic tibiae and tarsi marked with dark brown exteriorly. *Forewing:* Moderately narrow, length 3.5–3.6 times width; apex rather blunt, termen strongly angled back. Ground color whitish, heavily, nearly uniformly, streaked with longitudinal dark gray blotches, the most well defined of which are a single oblong spot in dorsal area at one-fourth (at times obliterated), a smudge toward end of cell, a smaller mark at end of cell, subtended by a similar spot above tornus, and followed by a streak through terminal area; a row of ill-defined dots around terminal margin, nearly coalesced. Fringe whitish. Underside brown, paler towards dorsum. *Hindwing:* Slightly narrower than forewing; costa with a narrow, tightly appressed fold, bearing exteriorly a whitish fringe and enclosing an elongate, thin, white hair pencil; apex acute, termen very strongly angled back, the wing shape sublanceolate. Ground color semitranslucent white, tinged with brownish distally; fringe white. Underside similar, the brownish restricted to costal area. *Abdomen:* Scaling gray, paler ventrally. Genitalia as in Figure 129 (drawn from holotype, JAP prep. no. 1313; two preparations examined); uncus elongate, membranous, basal processes short; valva with elongate apical "plume" setate along entire length, subtended by a setate lobe at end of costa, distal margin with five elongate, spinelike setae and an asymmetrically bifid process; vesica with ill-defined, elongate cornuti.

FEMALE.—A single damaged specimen examined, which is presumed to represent this species, may be characterized as follows. Forewing length 6.5 mm; palpi lacking; antenna not dilated, width of shaft near base 0.17 eye diameter; forewing pattern evidently as in male; hindwing costal area simple. Genitalia similar to *confusella;* sterigma broadly sclerotized with VIII sternite, ostium subtended by a short sclerotized sleeve and an enlarged, membranous antrum, signum with a row of flat, blunt teeth (Figures 250, 251, drawn from plesiotype, Jamaica, JAP prep. no. 2155; one preparation examined).

TYPES.—Holotype male: Jamaica, near Farmouth, Trelawny Parish, July 28, 1962 (T. Farr, O. and R. Flint); deposited in U.S. National Museum. Two paratypes: male, Florida, Key Largo,

Monroe County, VI–7–67 (Mrs. S. Kemp), in collection of C. P. Kimball, Barnstable, Massachusetts; female (not designated as allotype), Jamaica, Hardwar Gap, Portland Parish, July 9, 1965 (H. F. Howden), deposited in California Insect Survey.

REMARKS.—Two additional specimens from Key Largo (♂,♀,IX–5–67) were received after the above description was written and are not designated as paratypic. The female is larger (forewing 7.4 mm), with a slightly more elongate labial palpus.

The Longimaculella Group

Eye index 1.0–1.1. Maxillary palpus moderately large, 4-segmented, lengths about 1:1:1:2. Labial palpus usually elongate, II segment index 1.3–1.9; smooth scaled. Antenna of male moderately dilated, index 0.20–0.28. Forewing moderately broad; pattern longitudinal blackish streaks or costal-dorsal. Hindwing of male with costal brush and costal or (rarely) pinch-fold. Abdomen entirely ochreous or anal scaling ochreous. Uncus membranous; gnathos absent; basal processes membranous, narrow; valva with or without cucullus "plume" and modified scalelike setae that are bifid apically; fultura-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma simple; antrum enlarged with sclerotized band; ductus bursae sclerotized basally or membranous, 3–12 tight coils; signum a notched keel.

A rather homogeneous array of 13 nocturnal, primarily Neotropical species that show the widest geographical range of any New World group. Features of the genitalia in both sexes indicate no relationship to Old World components of the genus.

Ethmia coronata Walsingham

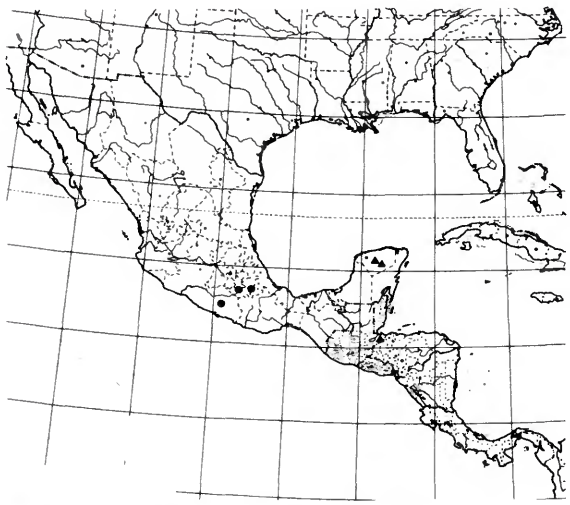
FIGURE 130, PLATE 15*e*; MAP 52

Ethmia coronata Walsingham, 1912:145, pl. 5, fig. 6.—Busck, 1914c:54.

Ethmia abdominella Busck, 1912:85; 1914c:54.—Powell, 1959: 145 [new synonymy].

A large *Ethmia* in central Mexico with ochreous abdomen and the forewing dark gray on costal half, pale gray on dorsal half.

MALE.—Length of forewing 12.7 to 13.7 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; second segment length 1.6 times eye diameter; third segment slightly curved, length 0.88 that of second (1.4 times eye diameter); smooth scaled, whitish gray with black submedian and subapical bands on second and third segments. Antenna slightly dilated, width of shaft basally 0.21–0.24 eye diameter; dorsal scaling dark gray, scape whitish at base. Scaling of tongue whitish, front whitish becoming pale gray at crown, occipital tufts black at middorsum. *Thorax:* Dorsal scaling pale gray; tegula narrowly black at base and seven rather large, black spots on pronotum, narrowly edged with white: paired spots adjoining collar and tegula, under apices of tegulae, at sides of scutellum and a single spot preceding scutellar area at middorsum. Metathoracic scutellum scaled, ochreous. Underside white, prothoracic and mesothoracic legs spotted with brownish black, metalegs with pale brownish. *Forewing:* Length about 3.3 times width; costa evenly, gently curved from base to apex, termen strongly angled back, tornal angle scarcely evident. Ground color dark gray on costal half, pale gray, narrowly edged with white on dorsal, the dividing line distinct, irregular, extending below Cu as two broad spurs before middle and a narrow one beyond cell, extended above Cu as an outwardly angled, jagged spur at end of cell and angled in terminal area to midtermen; area just above line darkest, nearly black, becoming paler toward costa; poorly defined pale blotches along costa at one-third, two-thirds and at apex; dorsal area before middle with two distinct black spots narrowly edged with white, the inner one slightly elongate, nearly adjoining the first dark spur from costal half; terminal margin with a row of blackish dots from costa to tornus. Fringe pale grayish, interrupted below apex by a blackish gray streak from terminal area. Underside dark brownish gray, dorsal area and a blotch beyond retinaculum whitish ochreous. *Hindwing:* About as broad as forewing; costal area with a broad, closed pinch-fold between C and Sc containing a thick, elongate brush of whitish ochreous hair scales; costal margin as a result nearly straight; apex acute, termen very strongly angled back, tornal angle not evident. Ground color white, semitranslucent, reflecting purplish, becoming brownish in apical area. Fringe whitish except basally. Underside similar,



MAP 52.—Geographical distribution of members of the Longimaculella group of *Ethmia*.
● *E. coronata* Walsingham ▲ *E. nigritaenia* Powell

costal area brownish. *Abdomen:* Scaling entirely ochreous, slightly paler ventrally. Genitalia as in Figure 130 (drawn from plesiotype, Tehuacan, Puebla, JAP prep. no. 1130; two preparations examined); uncus slightly sclerotized, greatly elongate, valva with apical process sparsely setate, distal end of saccular area with a narrow, bare, flat projection, vesica without definite sclerotization.

FEMALE.—Not examined in detail. There is only one known specimen: length of forewing 16.0 mm; labial palpus more elongate than in male, second segment 2.0, third 1.5 times eye diameter. Generally as described for male in external features; hindwing unmodified. Genitalia not examined.

TYPE DATA.—Mexico, Chilpancingo, Guerrero, June (H. H. Smith), unique male in British Museum (*coronata*); Tehuacan, Puebla, October 10 (R. Muller), holotype male in U.S. National Museum (*abdominella*).

GEOGRAPHICAL DISTRIBUTION.—South-central Mexico.

FLIGHT PERIOD.—June, September, October.

FOOD PLANT.—Unknown.

REMARKS.—Through the efforts of Mr. Tremewan of the British Museum (Natural History), I have been able to examine photographs of the type male and accompanying genitalia slide of Walsingham's *E. coronata,* which was described from a unique specimen. The identity of the species as that of the same moth to which Busck applied the name *abdominella* was evident. The figure in the *Biologia* of this quite distinctive, rather dark gray *Ethmia* with a bright ochreous abdomen, is misleading.

Busck's name *abdominella* is the only one among the 90-odd names proposed by previous workers which I have discovered to be a new synonym; ironically it was published within one month of *coronata.* The section of the *Biologia* containing the original description bears the date May 1912, while Volume 14, Number 2 of the *Proceedings of the Entomological Society of Washington,* carrying *abdominella,* is dated June 19, 1912.

Ethmia nigritaenia Powell, new species

FIGURES 131, 253; PLATE 15*f*; MAP 52

A moderately large *Ethmia* in northern Central America that has gray forewings bearing a conspicuous longitudinal, median black streak from base to apex.

MALE.—Length of forewing 10.4 to 13.0 mm. *Head:* Labial palpus elongate, strongly curved, exceeding base of antenna; second segment length 1.3 to 1.5 times eye diameter; third segment slightly curved, length 0.83–0.90 that of second (1.1 to 1.4 times eye diameter); smooth scaled, white, second segment mostly blackish exteriorly on basal half, with a narrow subapical ring, third segment with basal spot and broad submedian and subapical black rings. Antenna dilated, width of shaft basally 0.24–0.26 eye diameter; dorsal scaling pale gray, scape whitish. Scaling of tongue, front, and crown shining white; occipital tufts dark brown at middorsum. *Thorax:* Dorsal scaling whitish gray, pronotum with seven small black spots: lateral pairs adjoining tegulae at collar, under apices of tegulae, at sides of scutellum, a single median spot preceding scutellum. Underside white, prolegs and mesolegs heavily marked with dark brown; hind tibial fringe dense, whitish. *Forewing:* Moderately broad, length 3.1 to 3.2 times width; costa gently curved, appearing flattened towards apex (owing to fringe); termen moderately strongly angled back, straight; tornal angle distinct. Ground color whitish gray, clouded with pale brownish gray except at terminal margin; a more or less well defined

median blackish streak from base to apex, filling most of cell near base, narrowed at about middle of cell, sending a short, ill-defined spur into dorsal area and broadened towards end of cell where it is interrupted by a well-defined white spur from dorsal area, thence broad again in terminal area and narrowed at margin, crossing fringe; an ill-defined brownish spot in dorsal area at one-fourth, at times a few similar spots in costal and dorsal areas at and beyond end of cell; a row of blackish dots around terminal margin from before apex to tornus. Fringe whitish, interrupted by dark streak below apex. Underside brownish, paler along dorsal area to end of cell and in cell beyond retinaculum. *Hindwing:* Slightly broader than forewing; a broad costal fold to end of cell, enclosing a thick brush of elongate hair scales from base; costal margin nearly straight, slightly convex at end of cell; termen strongly angled back, broadly curved to dorsum. Ground color white, semitranslucent, becoming pale brownish at distal margins. Underside similar, area of costal fold brownish. *Abdomen:* Dorsal scaling brown, ventral whitish, genital pale ochreous. Genitalia as in Figure 131 (drawn from paratopotype, JAP prep. no. 1513; four preparations examined); uncus elongate, moderately well sclerotized; valva apex produced into an elongate "plume"; apex of saccular area produced as a broad extension.

FEMALE.—Length of forewing 12.4 to 14.0 mm. Essentially as described for male, except larger and darker; labial palpus more elongate, second segment length about 1.7 times eye diameter (eye as large as in male), third segment about 0.8 as long as second (about 1.4 times eye diameter). Forewing markings as in male, the whole pattern at times darker. Hindwing costal area simple; ground color darker than male, distal one third mostly dark brown. Abdomen coloration similar to male, darker. Genitalia as in Figure 253 (drawn from paratopotype, JAP prep. no. 2557; two preparations examined); posterior apophyses elongate, thin; sterigma simple, bowl-shaped, lightly sclerotized, subtended by a heavily sclerotized sleeve and a ventrally membranous, dorsally sclerotized antrum; ductus membranous with about four tight coils; signum an inwardly directed ridge with rounded emargination, flanged on one side.

TYPES.—Holotype male and allotype female: Mexico, Chichen Itza, Yucatan, February 14 and January 18, 1956 (E. C. Welling), deposited in collections of the California Academy of Sciences. One hundred thirteen paratypes, as follows: *Mexico:* Chichen Itza, Yucatan, 5♂, 1♀, II–(11–15)–56, 1♂, III–17–56, 1♂, IV–6–56, 1♀, VI–18–55, 1♂, VII–9–54, 1♂, VII–24–55, 1♂, X–14–55 (E. C. Welling), 1♂, IX–15–52 (J. and D. Pallister); Merida, Yucatan, 55♂, 41♀, VII–29/30–64 (P. J. Spangler); Pisté, Yucatan, 1♀, VI–8–59 (M. and P. Vaurie); "Port. Guatulca" (state unknown), 1♂, XII–3–37 (Zaca Exped.). *Guatemala:* Cayuga, 1♀, VIII (Schaus and Barnes); "Guatemala", 1♂ (no date given) (W. Schaus). *British Honduras:* Orange Walk, 1♀, VIII–47 (no further data). Deposited in collections of American Museum of Natural History, British Museum, California Insect Survey, Carnegie Museum, and U.S. National Museum.

Ethmia subnigritaenia Powell, new species

FIGURE 132

A Mexican species resembling *nigritaenia* but with the median, longitudinal black band of the forewing less distinct, irregular, and narrow at base. The description is based on specimens in poor condition.

MALE.—Length of forewing 11.4 to 12.3 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding base of antenna; second segment length 1.5–1.6 times eye diameter; third segment 0.85 the length of second, slightly curved; smooth scaled, white, second segment broadly blackish basally and with a narrow subapical band, third segment with submedian and subapical black bands. Antenna slightly dilated, width of shaft basally about 0.22 eye diameter; dorsal scaling grayish. Scaling of tongue, front, and crown whitish gray; occipital tufts brownish black at middorsum. *Thorax:* Dorsal scaling gray with scattered whitish flecks, pronotum margined laterally with blackish (the first two pairs of spots of related species enlarged and coalesced), small blackish spots at sides of and preceding scutellum at middorsum. Scaling of metathoracic scutellum ochreous. Underside white, prothoracic and mesothoracic legs marked exteriorly with blackish brown. *Forewing:* Moderately narrow, length about 3.5 times width; costa gently,

evenly curved from base to apex; termen very steeply angled back (adding to narrow appearance), tornal angle scarcely evident. Ground color whitish gray, infused with dark grayish clouding, slightly less so on dorsal and terminal areas; a median longitudinal black band from base to apex, somewhat indistinct and irregular, narrow at base, nearly confined to Cu fold, broadened in outer half of cell and sending a spur into dorsal area, narrowed again and broken at end of cell, then continued to termen; some short, thin, blackish longitudinal streaks in costal and dorsal areas beyond middle; a partial row of obscure spots around margin subtending fringe. Fringe whitish, broken just below apex by the dark terminal streak. Underside brownish, dorsal area and cell paler. *Hindwing:* Slightly broader than forewing; a broad costal fold, enclosing a dense brush of elongate, whitish ochreous hair scales from base; costal margin nearly straight; termen strongly angled back, broadly curved to dorsum. Ground color whitish, semitranslucent, becoming pale brownish in apical area. Fringe white. Underside similar, costal fold area ochreous-brown. *Abdomen:* Dorsal scaling pale ochreous, ventral whitish, genital ochreous. Genitalia as in Figure 132 (drawn from paratype, Tehuacan, JAP prep. no. 1124; two preparations examined); similar to *E. nigritaenia,* apex of valva short, not drawn out into a narrow "plume."

FEMALE.—Unknown.

TYPES.—Holotype male: "Mexico, R. Muller, 4665"; the genitalia slide bears the additional data in Busck's handwriting "Mexico City"; deposited in U.S. National Museum. Two male paratypes: Mexico, Tehuacan, Puebla, V–21–41 (C. C. Hoffmann); deposited in collections of American Museum of Natural History and California Insect Survey.

Ethmia catapeltica Meyrick

FIGURES 133, 134, 242, 243; PLATE 15g; MAP 53

Ethmia catapeltica Meyrick, 1924:119.—Clarke, 1955a:76; 1965:422.

Ethmia flavicaudata.—Busck [not Walsingham, 1912], 1934:165 [in part?].

A widespread species in Central America and northern South America which is superficially similar to *E. flavicaudata;* differing usually by slightly more extensive white ground color of the forewing and by a smaller, dark, costal hair fringe on the hindwing.

MAP 53.—Geographical distribution of *Ethmia catapeltica* Meyrick.

MALE.—Length of forewing 8.6 to 13.0 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; second segment length 1.2–1.4 eye diameter; third segment slightly curved, length 0.85–1.0 that of second (1.0–1.4 times eye diameter); smooth scaled, white, second segment broadly black basally, narrow subapically, third segment with submedian and preapical black bands. Antenna slightly dilated, width of shaft basally 0.20–0.22 eye diameter; dorsal scaling whitish to about one-fourth, becoming gray beyond. Scaling of tongue,

front, and crown white, lightly tinged with gray, occipital tufts black at middorsum. *Thorax:* Dorsal scaling pale grayish white, four rather large, black spots laterally adjoining apices of tegulae and at sides of scutellum. Underside white, prothoracic and mesothoracic legs spotted with black exteriorly. *Forewing:* Length 3.1–3.4 times width; costa gently curved from base to apex, flattened or very slightly concave at about middle; termen moderately strongly angled back, straight, tornal angle distinct. Ground color whitish, markings dark brownish gray, variable from an almost complete replacement of ground color to a rather distinct pattern resembling *E. lichyi,* the gray reduced to more or less well defined blotches above Cu and two distinct spots on an otherwise unmarked dorsal area; most individuals intermediate, with an ill-defined pattern showing two outwardly oblique bars from costa before middle, one before apex and a streak through end of cell into dorsal area (on heavily marked specimens this pattern remains discernible, slightly darker than remainder of markings); a row of about nine distinct, blackish dots around termen subtending fringe; latter white with a light brownish spot below apex. Underside brown, dorsal area and a blotch beyond retinaculum paler. *Hindwing:* About as broad as forewing; a tightly appressed costal fold to beyond cell, bearing a sparse blackish fringe exteriorly (ventral surface of wing) and enclosing a thin, white hair pencil from base; costal margin nearly straight, apex acute, termen strongly angled back, broadly curved to dorsum. Ground color semitranslucent white, pale brownish at margins. Fringe white. Underside similar, costal fold area pale brownish and ochreous. *Abdomen:* Dorsal scaling pale brownish, ventral whitish, genital pale ochreous. Genitalia as in Figures 133 and 134 (drawn from plesiotypes, Guatemala and Colombia, JAP preps. nos. 1202 and 1319; nine preparations examined); characters variable, apparently independently; uncus membranous, basal processes narrow to somewhat broadened, outer margin of valva at times with a small, pointed ridge, saccular margin angulate or rounded; vesica with an elongate, spurred cornutus (Figure 133, drawn from plesiotype, Costa Rica, JAP prep. no. 2232).

FEMALE.—All females examined are from Barro Colorado Island, Panama. Length of forewing 9.0 to 10.7 mm. Essentially as described for male. Females available represent the more distinctly marked forms; eye and labial palpus size within range shown in male. Antenna scarcely smaller than in male, shaft basally about 0.2 eye diameter. Genitalia as in Figures 242, 243 (drawn from plesiotype, Panama, JAP prep. no. 2558; two preparations examined); similar to *nigritaenia,* sterigma narrower, antrum sclerotized, ductus with about 12 coils, signum with a narrow inner ridge, deeply or scarcely notched.

TYPE DATA.—Costa Rica, San Jose; unique male in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Southern Mexico (Cordoba, Veracruz) to Boliva.

FLIGHT PERIOD.—Probably multivoltine; April, May, October, and December at Barro Colorado Island, Panama; February, March and October in Costa Rica; July in Mexico.

FOOD PLANT.—Unknown.

REMARKS.—The variation in various features suggests that more than a single species may be involved in material I have assigned to *E. catapeltica.* However, I have been unable to correlate any differences satisfactorily. The more elongate, narrow wing, more elongate third segment of the labial palpus, and various differences in male genitalia, particularly the armature of the vesica, which is not much variable in most *Ethmia,* all seem to vary independently.

The variation is in part geographically related. The specimens available from Guatemala and Costa Rica average larger (forewing length 10.8 to 13.0 mm) and have a narrower forewing (length 3.35–3.4 times width) than those from Panama, the only other area from which a series is available. Panama specimens are generally slightly smaller (forewing 9.0 to 11.7 mm) and have a slightly broader forewing (length 3.1 to 3.35 times width). In addition, northern specimens show a tendency for the more obscured forewing pattern, but the extreme in this regard is a dark male from Alhajuelo, Panama. All material from Colombia and Bolivia is of the more distinctly marked form, indistinguishable from some of the series from Barro Colorado Island.

The genital characters as shown in Figure 134 are present on South American specimens, but the full ranges of variation in form of the basal proc-

esses, valvae, and vesica armature are shown in Panama material. Thus it seems best to provisionally retain the assemblage under the single name.

Although related with the Longimaculella group according to the genitalia, *E. catapeltica* superficially most resembles *E. flavicaudata,* from which it may be distinguished by a smaller black costal fringe of the hindwing, which is borne on the exterior of the costal fold, and by paler ochreous genital scaling. Both species also are superficially similar to the Antillean *E. cubensis,* which does not possess the dark costal fringe of the hindwing. Distinctly marked forms of *E. catapeltica* bear a similar forewing pattern to the larger and sympatric *E. lichyi,* which also possesses dark hindwing costal hairs.

Ethmia howdeni Powell, new species

FIGURE 135; PLATE 15*h*

A Mexican and Central American species somewhat resembling *E. longimaculella,* but with pale gray forewing, with more extensive markings, and with a black costal hair fringe on the hindwing.

MALE.—Length of forewing 8.6–11.4 mm. *Head:* Labial palpus moderately elongate or elongate, reaching or exceeding base of antenna; second segment length 1.15–1.50 times eye diameter, third segment slightly curved, length 1.0–1.1 times that of second; smooth scaled, whitish, second segment irregularly blotched on basal half and narrowly banded apically with blackish, third segment with broad submedian band and distal half, except extreme tip, black. Antenna dilated, width of shaft basally about 0.25 eye diameter; dorsal scaling whitish gray to apex; scape with a black spot apically. Scaling of tongue, front and crown whitish gray, occipital tufts at middorusm broadly blackish, reflecting bluish. *Thorax:* Dorsal scaling whitish gray, two lateral pairs of blackish spots adjoining tegulae apices and at sides of scutellum. Underside white, procoxae and mesocoxae and trochanters blotched with grayish, tarsi marked with black; hind tibial fringe pale ochreous. *Forewing:* Length 3.0–3.3 times width; costa gently, evenly curved from base to apex; termen rather strongly angled back, slightly concave, tornal angle distinct. Ground color whitish, irregularly and indistinctly blotched with pale gray to almost entirely pale grayish; markings black, mostly somewhat ill-defined, as follows: costal area basally, a series of short streaks in subcostal area, cell, and terminal area, at times forming a continuous streak from outer part of cell to termen below apex (as in *E. l. coranella*), the line usually broken or not evident, its basal or apical half indistinct; dorsal area unmarked except for three roundish spots, usually the most distinct markings of the wing, first at basal one-third, just above dorsum, second at about middle, more or less connected to markings in distal half of cell, third beyond outer, lower corner of cell; a row of black dots subtending fringe from well before apex to tornus. Fringe white with a brownish spot just below apex, sometimes nearly obsolete. Underside brown. *Hindwing:* About as broad as forewing; costal area with a broad, tightly appressed fold, bearing on its outer surface (ventral surface of wing) a dense row of black scales, and enclosing an elongate brush of white hair scales, from base; costal margin nearly straight, apex acute, termen broadly curved to dorsum. Ground color semitranslucent whitish basally, becoming pale brownish in apical area and along hind margin. Fringe whitish. Underside paler, costal area irregularly brownish. *Abdomen:* Dorsal scaling pale brownish gray, ventral whitish, genital pale ochreous. Genitalia scarcely distinguishable from *E. longimaculella;* basal processes with a ventral ridge; vesica with an elongate, spurred cornutus (Figure 135, drawn from holotype, JAP prep. no. 1737; three preparations examined).

FEMALE.—Length of forewing 9.8 mm. Essentially as described for male; eye and labial palpus size within range shown by male. Antenna not as dilated, width of shaft basally about 0.2 eye diameter. Hindwing, costal area simple; color darker than in male. Genitalia not examined.

TYPES.—Holotype male: Mexico, 21 miles east of Villa Union, Sinaloa (7.3 road miles east of Concordia, about 300 feet elevation), July 25, 1964, at black and white lights (J. A. Chemsak, J. Powell, and H. F. Howden); deposited in California Academy of Sciences. Allotype female: El Salvador, San Salvador, October 25, 1959 (B. Bechyné); deposited in Bavarian States Museum, Munich. Three paratypes: 1♂, same data as holotype; 2♂♂, same data as allotype except November 2, 1959; deposited in collections of Bavarian States Museum and California Insect Survey.

REMARKS.—The genital characters and general facies indicate a close relationship to *E. longimaculella,* with which *E. howdeni* is allopatric. However, the elongate labial palpus, especially the much larger third segment, and the hindwing costal scaling are features which relate the present species to *E. catapeltica.* The two localities from which the new species is described indicate a wider geographical range of stability than is shown by *l. longimaculella* and *l. coranella* in the Nearctic Region.

I take pleasure in naming the species for Henry F. Howden, coleopterist with the Entomology Research Institute, Ottawa, Canada, whose experience and cooperation greatly increased the efficiency of our collecting in Durango and Sinaloa during 1964.

Ethmia longimaculella (Chambers)

Hyponomeuta longimaculella Chambers, 1872:43.
Ethmia longimaculella.—Dyar, 1902:207; 1904b:178 [biology].—Barnes and Busck, 1920, pls. 27, 36.—Braun, 1921b:12 [biology].—Forbes, 1923:246.—McDunnough, 1939:83.—Clench, 1957:44 [synonymy].
Psecadia walsinghamella Beutenmuller, 1889:9.
Ethmia walsinghamella.—Dyar, 1902:207 [synonymy].
Ethmia zelleriella.—Engel [not Chambers, 1878], 1908:127.

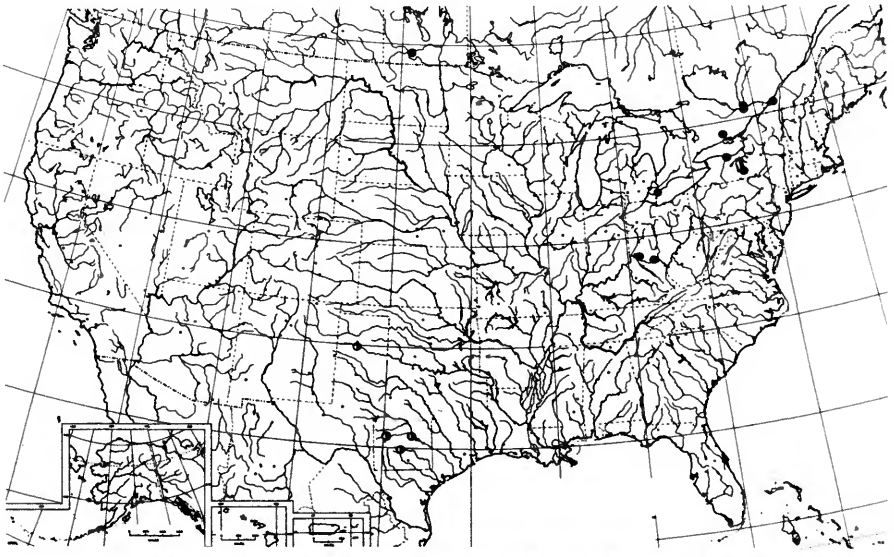
A Nearctic species having the white forewings marked by evenly distributed black spots and lines.

Ethmia longimaculella longimaculella (Chambers), *new status*

FIGURES 136, 256, 287; PLATE 15*i*; MAP 54

This subspecies, which occurs in the northern Appalachian region, has white forewings marked with black dots and short longitudinal lines.

MALE.—Length of forewing 10.5 to 11.2 mm. *Head:* Labial palpus moderately elongate, scarcely reaching base of antenna; second segment length 1.1–1.3 times eye diameter; third segment 0.73–0.90 as long as second; smooth scaled, white, second segment with a broad brownish black band exteriorly, third with narrow basal and apical dark bands. Antenna slightly dilated, width of shaft basally 0.21–0.23 eye diameter; dorsal scaling basally, including scape, silvery white, gray distally. Scaling of tongue, front, and crown shining white, occipital tufts brownish black at middorsum. *Thorax:* Dorsal scaling shining white, brownish black on tegulae at base and collar adjoining tegulae and at middorsum, notum with two pairs of rather large, lateral, blackish spots adjoining tegulae apices and at sides of scutellum. Underside shining white, prothoracic and mesothoracic legs broadly blotched with dark brown exteriorly. *Forewing:* Length about 3.3–3.4 times width; costa evenly curved from base to apex, termen rather strongly angled back, straight, tornal angle distinct. Ground



MAP 54.—Geographical distribution of *Ethmia longimaculella* (Chambers).
● *E. l. longimaculella* ◑ *E. l. coranella* Dyar

color white, markings black, mostly as longitudinal streaks, as follows: costal area at base, a series of oblong spots in subcostal area; two longitudinal lines in cell, the basal one nearer costa, followed by a large dot at end of cell and a third line in terminal area, ending well before fringe; another large dot in terminal area below end of cell; dorsal area with three spots adjoining Cu, the first inwardly oblique, the third often indistinct, and a large dot below and between the first two; some scattered dark scaling between the spots, a row of dots around termen from costa well before apex to tornus. Fringe white, usually with a tinge of brownish below apex. Underside nearly uniform brown; fringes, including costal, whitish. *Hindwing:* Slightly narrower than forewing; costa with a narrow fold to end of cell, enclosing a thin brush of white hair-scales; costal margin nearly straight, apex blunt, termen a broad curve to dorsum. Ground color whitish basally becoming pale brownish. Fringe white. Underside pale brownish except fringe white. *Abdomen:* Scaling pale brownish, slightly paler ventrally; genital scaling whitish, lightly tinged with pale ochreous or tan. Genitalia as in Figure 136 (drawn from plesiotype, "Canada," JAP prep. no. 1541; two preparations examined); similar to *E. catapeltica,* saccular margin of valva slightly more angulate, vesica with faint, sclerotized cornutus.

FEMALE.—Length of forewing 9.0 to 10.0 mm (reared). Essentially as described for male. Labial palpus slightly shorter, second segment 1.1 times eye diameter. Antenna not dilated, width of shaft near base 0.19 eye diameter. Hindwing costal area simple. Genitalia similar to *E. plaumanni* (Figures 254, 255), sclerotized sleeve at base of ductus bursae shorter (Figure 256, drawn from plesiotype, Ohio, JAP prep. no. 2056; one preparation examined).

TYPE DATA.—Kentucky, June 4 (V. T. Chambers), lectotype male, by present designation, "Kentucky, Chambers, Type 1403," in Museum of Comparative Zoology, Harvard (*longimaculella*); West Virginia (W. Beutenmüller), type female in U.S. National Museum (*walsinghamella*).

GEOGRAPHICAL DISTRIBUTION.—Southern Canada (Stockton, Manitoba; Ottawa, Montreal) to eastern Kentucky.

FLIGHT PERIOD.—Evidently normally late May to early July, but there is a single record for March in Pennsylvania (Clench, 1957) and there are three specimens, possibly reared, from Ontario, labeled August, September, and December.

FOOD PLANT.—*Lithospermum officinale* (Ottawa, J. Fletcher) and *L. latifolium* (Ohio). The latter according to Braun (1921b), who found large numbers of larvae July 10 and reared the adults the following May. Miss Braun (in litt.) also reared this species from *Onosmodium hispidissimum* in Ohio.

Ethmia longimaculella coranella Dyar, new status

FIGURE 137; PLATE 15*j*; MAP 54

Ethmia coranella Dyar, 1902:207.—Busck, 1915:84.—Barnes and Busck, 1920, pls. 27, 36.—McDunnough, 1939:83.

A Texas race which has slightly narrower forewings than *l. longimaculella,* with a black line from the middle of the wing to the apex.

MALE.—Length of forewing 8.8–10.7 mm. Essentially as described for nominate subspecies; labial palpus slightly shorter, second segment length 1.0–1.25 times eye diameter. *Forewing:* Slightly narrower, length about 3.5–3.6 times width; markings as in *l. longimaculella* except the outer bar in cell, dot at end of cell, and bar in terminal area, enlarged and fused as a streak from about middle of wing to termen just below apex, crossing marginal dot row and fringe. Remainder of markings slightly reduced, particularly the scattered scaling between definite spots. *Hindwing:* Paler than typical, pale brownish towards margins. Genitalia as in Figure 137 (drawn from plesiotype, Palo Duro Canyon, Randall County, Texas, JAP prep. no. 621; two preparations examined); similar to *l. longimaculella,* valva slightly narrower with a relatively deeper emargination following saccular area and a slightly shorter "plume" at apex.

FEMALE.—Unknown.

TYPE DATA.—Kerrville, Texas (Barnes), and Shovel Moutain,[13] Texas, June 16–23 (Barnes). Two males in U.S. National Museum from Kerrville, without further data, bear labels "Type 6624,

[13] I am informed by R. O. Kendall, veteran lepidopterist of San Antonio, Texas, that Shovel Mountain (1,508 feet elevation) is in the northeast corner of Blanco County. This is about 70 miles northeast of Kerrville and probably is the locality to which the Barnes material refers.

USNM"; I have designated and labeled one as a lectotype.

GEOGRAPHICAL DISTRIBUTION.—Central and northern Texas.

FLIGHT PERIOD.—May (Palo Duro Canyon, Randall County), June (Shovel Mountain), August (Kerrville).

FOOD PLANT.—Unknown.

REMARKS.—One of the original specimens from Kerrville has the line through the middle of the forewing broken at the end of the cell and again before the margin. The line is unbroken in 15 other specimens examined.

THE FLAVICAUDATA COMPLEX

A series of superficially similar Central American species having mottled gray forewings provide a problem for which no satisfactory solution is available. *Ethmia flavicaudata* was described by Walsingham in 1912 on the basis of three specimens from the state of Veracruz, Mexico. Unfortunately a female, from San Juan, was selected as the holotype, and two males, from Cordoba, were designated as paratypes. Subsequent authors (e.g., Busck, 1934) and workers arranging collections have accumulated a variety of superficially similar entities under the name, including specimens of *E. lichyi,* described below, and all material I have seen that is referable to *E. catapeltica* Meyrick, 1924. This latter species was proposed for a unique male, also deposited in the British Museum, and my determination of it is made from photographs of the type and its genitalia slide provided by Clarke (1965). It is more closely related to *longimaculella* (see above).

Inasmuch as no further material from Veracruz or other parts of Mexico has become available, and owing to the close superficial similarity of the various forms, I have assigned the name *flavicaudata* to the species represented by the male paratypes in the U.S. National Museum. Whether these are actually conspecific with the female type will not be definitely known until specimens in series are examined. Thus *E. flavicaudata* as presently conceived is known only from the area of the type locality. Genital characters of the types are quite distinct from *E. catapeltica* and more closely ally the species to three previously undescribed species, which are discussed below.

Ethmia flavicaudata Walsingham

FIGURE 141

Ethmia flavicaudata Walsingham, 1912:145, pl. 5, fig. 7.—Busck, 1934:165 [in part].

A species in southern Mexico having whitish forewings densely marked with brownish gray except along the dorsum; the hindwing bears a conspicuous, exposed, dark gray costal fringe.

MALE.—Length of forewing 10.5 mm. *Head:* Labial palpus elongate, exceeding base of antenna, second segment length about 1.4 times eye diameter; third segment nearly straight, length about 0.9 that of second; smooth scaled, whitish, second and third segments with blackish submedian and preapical bands. Antenna slightly dilated, width of shaft basally about 0.2 eye diameter, dorsal scaling gray, scape whitish. Scaling of front and crown whitish, occipital tufts blackish at middorsum. *Thorax:* Dorsal scaling gray, paired, lateral black spots adjacent to apices of tegulae and at sides of scutellum; possibly a singly median spot preceding scutellar area. Underside grayish white, legs blotched exteriorly with blackish. *Forewing:* Length about 3.1 times width; costa gently, nearly evenly curved from base to apex; termen moderately strongly angled back, straight, tornal angle distinct. Ground color whitish, mostly replaced by brownish black above Cu, the pattern more or less obscurely clouded; concentrated dark areas at base of costa and through outer half of cell into terminal area, sending a broad spur across Cu into dorsal area at about middle of wing, the darkest mark of the pattern; dorsal area pale whitish gray with a single spot in at basal one-third and a trace of another nearer base; terminal area whitish except for the broad blotch extending through end of cell and a row of large, black dots subtending fringe from before apex to tornus. Fringe whitish with an indistinct brownish gray blotch below apex. Underside brown, dorsal area and a blotch in cell paler. *Hindwing:* About as broad as forewing; costal area with a tightly appressed costal fold, bearing on its outer (ventral wing surface) dorsal side a thick fringe of black hair scales, and enclosing an elongate white hair pencil from base; costal margin nearly straight, slightly convex at end of cell; apex acute, termen very strongly curved back to anal area. Ground color semitranslucent whitish

at base, becoming brown in apical area and at margins. Fringe whitish. Underside similar, costal area also brownish. *Abdomen:* Dorsal scaling dark brown, ventral whitish; genital tuft broad, bright ochreous. Genitalia as in Figure 141 (drawn from paratype, Cordoba, Mexico, JAP prep. no. 1845; one preparation examined); uncus membranous, basal processes extremely elongate, narrow, apex of valva without extended "plume," distal end of saccular area with about eight flat, blunt spurs; vesica with an elongate, ill-defined plate, fultura ornately developed, armed with dentate processes.

FEMALE.—Not examined, known only from the holotype.

TYPE DATA.—Mexico, Veracruz, San Juan, 600 feet (W. Schaus); holotype female in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from Veracruz, Mexico.

FLIGHT PERIOD.—April, May, July.

FOOD PLANT.—Unknown.

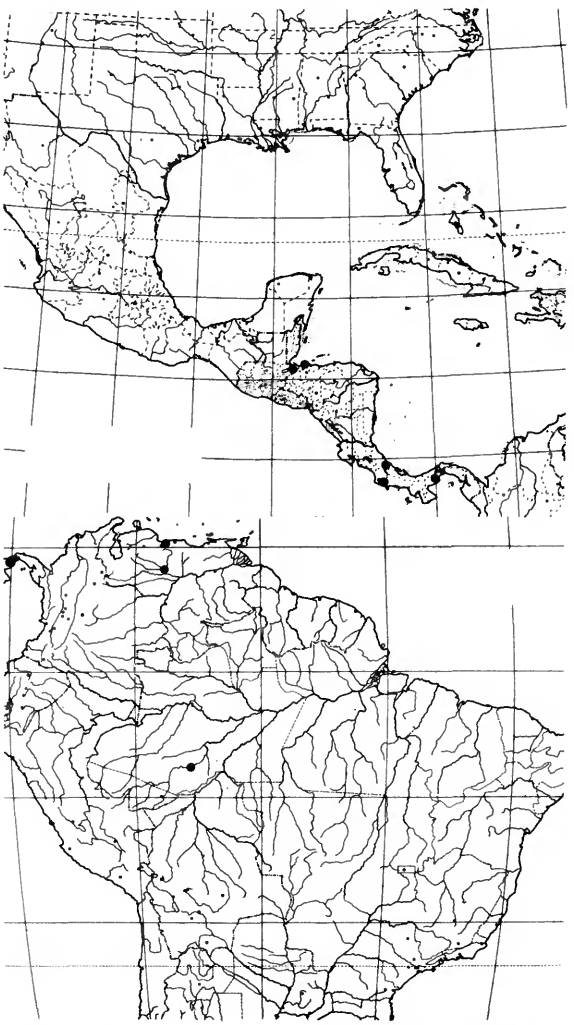
Ethmia lichyi Powell, new species

FIGURE 140; PLATES 2*e*, 4*b*, 16*c*; MAP 55

Ethmia flavicaudata.—Busck [not Walsingham, 1912], 1934:165 [in part?].

A Central and South American species which resembles a large *Ethmia baliostola*, having the same forewing pattern but with more extensive white ground color and with a dark rather than whitish exterior costal hair brush on the hindwing of the male.

MALE.—Length of forewing 13.7 to 17.1 mm. *Head:* Labial palpus greatly elongate, well exceeding base of antenna; second segment length 1.5 to 1.7 times eye diameter; third segment gently curved, length about 0.88 that of second (1.3–1.5 times eye diameter); smooth scaled, white, marked with blackish brown as follows: second segment on basal one-third (at times divided into two bands by ground color), a narrow subapical band, third segment with broad submedian and subapical bands, fusing interiorly. Antenna, shaft only slightly dilated, width near base 0.18–0.21 eye diameter; dorsal scaling whitish basally, becoming gray; scape white, blackish at apex dorsally. Scaling of tongue, front, and crown white, occipital tufts black at middorsum. *Thorax:* Dorsal scaling pale gray, pronotum with five blue-black spots on posterior half, one at middorsum preceding scutellar area, a pair lateral to it, and a pair at sides of scutellum; at times an ill-defined dark blotch adjoining collar at middorsum. Underside white; prothoracic leg mostly blackish exteriorly, mesoleg and metaleg indistinctly banded with blackish or gray; hind tibial fringe tinged with ochreous. *Forewing:* Length about 3.0 to 3.1 times width; costa gently, evenly curved from base to apex; termen rather strongly angled back, tornal angle nearly obsolete. Ground color white, clouded with very pale gray except narrowly adjoining markings; markings



MAP 55.—Geographical distribution of *Ethmia lichyi* Powell.

blackish brown, as follows: a series of elongated spots and streaks over costal half, the most conspicuous of which is an irregular broad streak from about middle of cell to termen just below apex, usually broken just before end of cell; dorsal area to beyond middle, pale gray, devoid of streaks, marked only by two small spots, the inner one at about basal one-fourth, smaller and sometimes obsolete; an irregular blotch of blackish brown just before tornus beneath streak through terminal area. A row of black dots around termen, subtending fringe, from before apex to tornus. Underside pale grayish brown except dorsal area whitish. *Hindwing:* Slightly broader than forewing; costa with a double hair brush, anterior part exposed, white at base becoming blackish distally, arising on outer surface of costal fold (ventral side of wing), posterior part an elongate white hair pencil enclosed in the pouchlike fold, between C and Sc; costal margin slightly convex beyond the blackish fringe; termen rather strongly angled back, broadly curved to dorsum. Ground color semitranslucent white, becoming brownish at apex; fringe white. Underside similar, costal area pale brownish *Abdomen:* First segment laterally with elongate ochreous white scaling partially concealing an area of specialized, appressed ochreous-white scaling which forms a pouchlike fold with velvet-like texture. Dorsal scaling brown, ventral white, anal bright ochreous. Genitalia as in Figure 140 (drawn from paratype, Venezuela, JAP prep. no. 1614; four preparations examined); similar to *E. calumniella,* differing by a slightly more angulate sacculus and more numerous and smaller flat spines of the apex of the valva.

FEMALE.—Unknown.[14]

TYPES.—Holotype male: Venezuela, Cuenca del Rio Borborata, "Carabobo," September 1, 1948 (R. Lichy), with the additional data "675 m. virgin forest"; deposited in collections of Cornell University. Fourteen paratype males: *Venezuela:* "La Union, R. Huacamayo, Carabaya," 1♂, November 1904 (G. Ockenden); Rancho Grande, Aragua, 1♂, XII–1–53 (F. Fernandez-Y.); "Las Quiguas, Esteban Valley," 1♂ (no further data). *Brazil:* "Hyutanaban, Rio Purus," 1♂, January 1922 (S. M. Klages). *Panama:* Campana, near Chica, 2♂, IV–(2–5)–65 (S. S. and W. D. Duckworth). *Costa Rica:* Golfito, 3♂, IV–(25–28)–65 (S. S. and W. D. Duckworth); "Sixola Riv.," 1♂; "Costa Rica" 1♂ (no further data). *Honduras:* Lancetilla, Tela, 2♂, IV–30, V–5–35 (M. Bates). *Guatemala:* Cayuga, 1♂ (Schaus and Barnes). Deposited in collections of British Museum, California Insect Survey, Carnegie Museum, Harvard (MCZ), U.S. National Museum, and University of Venezuela.

REMARKS.—The holotype bears an identification label written by Forbes in 1945 indicating the close superficial similarity of this species with *E. baliostola.*

Two specimens from Venezuela and Brazil have what I take to be a manuscript name accredited to "Wlsm.?" on a handwritten label added by a later worker. The Guatemalan specimen was identified on an accompanying slide as *"E. flavicaudata* Wlshm." by Busck in 1920 and probably was the basis for Busck's (1934) reference to genital characters of Walsingham's species.

An additional specimen (in the California Insect Survey) from Mexico (Cotaxtla Exp. Sta., Veracruz, VI–14–62, D. H. Janzen) may be referred here tentatively but it is not designated as a paratype. It is a smaller moth (forewing length 11.7 mm) with appreciably narrower forewings (length about 3.3 times width) having a slightly darker, pale gray ground color. The pattern of dark markings, relative size of labial palpus, and costal tuft of the hindwing are as in typical *E. lichyi.* In male genitalia the Mexican specimen differs in a few details, particularly in having narrower basal processes and fewer setae on the inner surface of the valvae basally. The second segment of the abdomen exhibits a somewhat reduced version of the peculiar pouchlike area of specialized, pale ochreous scaling which serves to separate *lichyi* from all other known *Ethmia.*

[14] Subsequent to writing the above description, I have seen a good series, including females, from near the type locality (Rancho Grande, Aragua, Venezuela, 1100 m, various dates in January 1966, and June 1967, S. S. and W. D. Duckworth). The female does not differ in general appearance from the male and in this sample is no larger. The labial palpus size is within the variation shown by the larger sample of males, with the length of second segment 1.67, of third 1.5, times eye diameter. The antenna, hindwing costal area, first segment of abdomen, and genital scaling are not modified as in the male. The female genitalia are similar to *E. plaumanni* (Figures 254, 255), differing by a shorter sclerotized plate in the antrum, which is enlarged about as in *E. plaumanni* (two preparations of *E. lichyi* examined).

Ethmia calumniella Powell, new species

FIGURE 142; PLATE 16*d*

A Brazilian species superficially resembling *E. catapeltica,* with the white forewing heavily marked with blackish except on the dorsal area.

MALE.—Length of forewing 11.4 mm. *Head:* Labial palpi lacking from holotype. Antenna scarcely dilated, width of shaft basally about 0.20 eye diameter; dorsal scaling dark gray, scape white. Scaling of tongue, front, and crown appressed, white; occipital tufts blue-black at middorsum. *Thorax:* Dorsal scaling whitish; ill-defined dark spots on tegula at base and on pronotum laterally near apices of tegulae and across scutellum. Underside whitish, prothoracic and mesothoracic legs spotted with blackish exteriorly. *Forewing:* Length about 3.4 times width; costa gently, nearly evenly curved from base to apex; termen strongly angled back, tornal angle not distinct. Ground color white, markings blackish brown, mostly not well defined, as follows: costal half more or less evenly blotched, the most conspicuous mark a diagonal band from costa at one-third to cell at about middle of wing, occupying most of distal end of cell, continued as three weakly joined blotches to termen below apex; dorsal area below Cu to tornus unmarked except for a single, small, faint brownish spot at basal one-third, preceded and followed by short extensions across the fold of blotches in cell; a subterminal row of dots not darker than other markings from before apex to tornus, disappearing in blotch below apex. Fringe whitish interrupted by brown at termination of central streak, below apex. Underside pale brownish, dorsal area paler. *Hindwing:* Slightly narrower than forewing; costal area modification as in *E. lichyi,* costal brush divided, partially outside costal fold, of blackish, short hairs, partially a thick tuft of whitish hair scales enclosed by fold; costal outline rather straight; apex acute, termen strongly angled back, tornal angle not evident. Ground color subhyaline whitish, dark brown at distal margin and along veins approaching terminal margin; fringe white. Underside similar; costal area pale grayish brown, membrane ochreous tinged. *Abdomen:* Second segment laterally without modification. Dorsal scaling white, becoming brownish caudad; underside white; genital scaling bright ochreous. Genitalia as in Figure 142 (drawn from holotype, JAP prep. no. 1606; one preparation examined); similar to *lichyi* and *plaumanni,* differing by having narrower basal processes and three broad, flat spines at the apex of the valva.

FEMALE.—Unknown.

TYPES.—Holotype male; Brazil, Santarem, Para, "Z. .6.27"; unique, deposited in the British Museum.

REMARKS.—The holotype bears an identification by Meyrick assigning the moth to *Ethmia catapeltica* Meyrick, which the present species closely resembles.

Ethmia omega Powell, new species

PLATE 16*e*

A species from southern Brazil that superficially resembles *E. nigritaenia* but structurally is close to *E. calumniella.*

MALE.—Length of forewing 11.6 to 11.7 mm. *Head:* Labial palpus elongate, strongly upcurved, well exceeding base of antenna; second segment strongly curved, length 1.40–1.45 times eye diameter; third segment slightly curved, about 0.85 as long as second; smooth scaled, white, both segments blotched basally and subapically with brownish black. Antenna slightly dilated, width of shaft near base 0.22 eye diameter; dorsal scaling whitish, becoming brownish beyond segment 8 or 9. Scaling of tongue and front white, becoming intermixed with grayish and brownish at crown. *Thorax:* Dorsal scaling whitish, intermixed with various shades of brown, no discernible pattern. Metathoracic brushes dense, not covering the scaled scutellum. Underside whitish with intermixed pale brown; tibiae and tarsi banded (prothoracic and mesothoracic with blackish brown, metathoracic with brown). *Forewing:* Length about 3.4 times width; rather oval in outline, costa evenly curved to apex, termen broadly curved to dorsum. Ground color whitish, heavily interspersed with brownish gray scales, appearing more or less uniform speckled gray to the unaided eye; markings blackish brown: some indistinct spots near base, a median longitudinal bar, indistinctly arising at costa at basal one-fourth, angled outwardly into cell, thence broadened along Cu fold to termen, beyond middle with three evenly spaced bumps along its costal side, which is darker than any other mark of the

wing; two linear spots in costal half, just beyond middle and at outer one-fourth; dorsal half with a spot in basal one-third, sometimes indistinct, a larger, distinct spot above tornus; termen narrowly blotched. Fringe whitish except at termination of median line, dark brownish. Underside brownish, pale at apex and along dorsum. *Hindwing:* Slightly narrower than forewing; costa folded to end of cell, bearing a dark gray fringe exteriorly (ventral surface of wing), enclosing a whitish hair pencil and clothed with short, specialized scales above the pencil. Ground color white, becoming brownish along costal and distal margins. Fringe white. Underside similar. *Abdomen:* Dorsal scaling gray, segments banded with whitish posteriorly; ventral and genital scaling whitish, latter tinged with pale ochreous. Genitalia similar to *E. calumniella* (Figure 142), differing by a slightly broader valva which bears a strong convexity on the costal margin before cucullus; three or four flat, distal spines (two preparations examined).

FEMALE.—A single damaged specimen examined. Length of forewing about 12.4 mm. Apparently as described for male. Labial palpus slightly longer; length of second segment about 1.55 times eye diameter; third about 0.88 as long as second. Antenna not dilated, width of shaft basally about 0.85 that of male. Hindwing costal area simple. Genitalia very similar to *E. plaumanni* (Figures 254, 255), ductus with only three spirals in the one preparation of *omega*.

TYPES.—Holotype male and allotype female: Brazil, Pelotas, Rio Grande do Sul, November 20, 1952 (C. M. de Biezanko); deposited in Museum of Comparative Zoology, Harvard. Three paratype posited in California Insect Survey and Museum of males: same data except November 4–11, 1953; de- Comparative Zoology.

REMARKS.—*Ethmia omega* may represent a southern race of *E. calumniella*. The present species differs primarily by having uniform gray forewing ground color, rather than the dorsal half whitish, and by having the black markings more reduced than in the pattern shown by *calumniella*.

Ethmia plaumanni Powell, new species

FIGURES 143, 254, 255; PLATE 16*f*

A Brazilian species with white forewings heavily marked with black except along the dorsum, in the manner of certain Palearctic species such as *sabiella* Felder and forms of *pusiella* Roem.

MALE.—Length of forewing 9.7 to 10.3 mm. *Head:* Eye unusually small, about 0.8 or 0.9 that of other species of similar overall size. (Head evidently entirely small as eye index =1.1.) Labial palpus elongate, exceeding base of antenna; second segment length 1.5 times eye diameter; third segment curved, length about 0.8 that of second (about 1.25 times eye diameter); smooth scaled, white, broad blue-black bands on second segment basally and third segment basally and subapically. Antenna not much dilated, width of shaft basally about 0.25 the unusually small eye diameter; dorsal scaling white basally, becoming gray. Scaling of tongue, front and crown white, occipital tufts white laterally, deep blue-black at middorsum. *Thorax:* Dorsal scaling white, base of tegula blackish, pronotum with three large blue-black spots, a pair laterally about middle and one spot covering scutellum. Underside white; prothoracic and mesothoracic legs spotted with black exteriorly; hind trochanters lightly tinged with ochreous, hind tibial fringe moderately dense. *Forewing:* Moderately narrow, length 3.2 to 3.6 times width; costa gently curved, straightened or appearing slightly concave just before middle; apex acute, termen strongly angled back, tornal angle scarcely evident. Ground color white, markings unicolorous blackish brown, nearly black, faintly reflecting steel bluish in spots: costal half rather uniformly blotched with distinct and indistinct longitudinal streaks, the most conspicuous a bar through outer half of cell into terminal area, preceded by a diagonal, less- distinct band from costa before middle, sending two broad spurs into dorsal area at about middle of cell and beyond end of cell; dorsal area otherwise unmarked except two spots in basal one-third, the outer one nearer dorsal margin; a row of about nine dots around termen, subtending fringe, from before apex to tornus. Fringe white except a small blotch of dark gray below apex. Underside dark gray brown, costa and dorsal area pale whitish ochreous; fringe as above. *Hindwing:* About as broad as forewing; costa with a fold to termination of Sc, enclosing an elongate, white hair pencil; costal outline nearly straight, apex acute, termen strongly angled back, tornal angle not evident. Ground color white, dark brown at distal margins; fringe

white. Underside white, costal area and distal margins dark brown. *Abdomen:* Dorsal scaling pale brown, ventral white, genital ochreous. Genitalia as in Figure 143 (drawn from holotype, JAP prep. no. 1317; two preparations examined); similar to *calumniella* and *lichyi,* the structures relatively small (about 85 percent that of *lichyi* relative to the respective forewing lengths), spines at distal end of valva in two bundles, a group of several elongate ones and another of small ones.

FEMALE.—Length of forewing 9.3 to 10.0 mm. Essentially as described for male; eye about as large as male; labial palpus second segment length slightly less than male. Antenna not dilated, width of shaft basally about 0.8 that of male. Hindwing costal area simple, concave before apex. Genitalia as in Figures 254, 255 (drawn from paratype, JAP prep. no. 2290; one preparation examined); sterigma simple, lightly scerotized, antrum with a flat plate curled anteriorly, ductus tightly coiled with about nine spirals, signum a concave notched keel without spines.

TYPES.—Holotype male and allotype female: Brazil, Nova Teutonia, Santa Catarina (27°11′, 52°23′), November 1961 and October 8, 1948 (F. Plaumann); deposited in U.S. National Museum. Three paratypes: same data, 1♂, 1♀, X–11–39, 1♀, X–21–48; deposited in collections of California Insect Survey and Carnegie Museum. A series (9♂, 4♀) subsequently examined, same data except VIII, X, 1963, not designated as paratypes, in U.S. National Museum.

Ethmia transversella Busck

FIGURE 144; PLATE 16*g*

Ethmia transversella Busck, 1914c:53.

A rather large moth with the forewings more or less uniformly clouded with indistinct gray streaks.

MALE.—Length of forewing about 14.0 to 15.6 mm. *Head:* Labial palpus moderately elongate, slightly exceeding base of antenna; second segment length about 1.4 times eye diameter; third segment about 0.85 the length of second (about 1.2 times eye diameter); smooth scaled, grayish white, second and third segments with broad basal and subapical black bands. Antenna scarcely dilated, width of shaft basally about 0.18 eye diameter; dorsal scaling dark gray. Scaling of tongue and front grayish, becoming brown at crown; occipital tufts black at middorsum. *Thorax:* Dorsal scaling gray; collar dark basally, paired blackish spots on notum adjoining base of tegula, at about end of tegulae and laterally on scutellum. Underside pale gray; legs mostly blackish to dark gray except white tibial and tarsal bands. *Forewing:* Length about 3.2–3.3 times width; costa gently, evenly curved from base to apex, termen strongly angled back, straight, giving a narrow appearance to wing. Ground color gray, more or less completely clouded with indistinct blackish brown; ill defined streaks at times evident as follows: base through basal half of cell, from just before midcosta angling into outer part of cell, thence angled toward apex, ending beyond end of cell, a third streak at apical one-third of costa, outwardly angled; a row of eight or nine subterminal black dots at base of fringe, from before apex to tornus. Underside dark gray, paler basally in cell and dorsal area. *Hindwing:* About as broad as forewing; an elongate, divided costal brush of hair scales, anterior portion sparse, blackish, external on costal fold, posterior part larger, whitish, enclosed by the fold to termination of Sc; costal margin nearly straight; termen very strongly angled back, broadly curved to dorsum. Ground color semihyaline whitish, brownish along costal area beyond middle and on terminal margin; fringe white. Underside similar. *Abdomen:* Dorsal scaling brownish gray, ventral shining gray, genital ochreous. Genitalia as in Figure 144 (drawn from plesiotype, Puntarenas, Costa Rica, JAP prep. No. 1324; two preparations examined); uncus rather well defined, lightly sclerotized; valva apex produced costad into short plume, three or four flat spines at apex of saccular area, vesica with a row of numerous short, flat spines.

FEMALE.—Unknown.

TYPE DATA.—Costa Rica, Juan Vinas (W. Schaus); holotype male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from Costa Rica (Juan Vinas; Puntarenas, Monteverde).

FLIGHT PERIOD.—January (a single record).

FOOD PLANT.—Unknown.

REMARKS.—The species evidently was described from a single male and the above description is based on the one other specimen I have seen.

Ethmia hieroglyphica Powell, new species

FIGURE 145; PLATE 16*h*

A Bolivian species having white forewings marked by large, black serpentine streaks.

MALE.—Length of forewing 13.0 mm. *Head:* Labial palpus moderately elongate, slightly exceeding base of antenna; second segment length about 1.5 times eye diameter; third segment very slightly curved, 0.85 the length of second (about 1.25 eye diameter); smooth scaled, white; second segment exteriorly with a broad area basally and a small spot subapically black, third segment with broad basal and subapical black bands. Antenna scarcely dilated, width of shaft basally about 0.18 eye diameter; dorsal scaling black, scape whitish below. Scaling of tongue dark gray, front and crown white, occipital tufts black at middorsum. *Thorax:* Dorsal scaling white; black markings as follows: base of tegula, a tinge at apex of tegula, pairs of spots laterally under tips of tegulae and at sides of scutellum. Underside whitish (legs lacking from holotype). *Forewing:* Length about 3.25 times width; costal curve slight, flattened along middle one-third; apex acute, termen strongly angled back, straight; tornal angle scarcely evident. Ground color white, markings black, mostly rather well defined, as follows: a broad bar from base to middle of cell, slightly serpentine, dipping into dorsal area at one-fourth, a small spot in dorsal area just beyond lower curvature of latter; a second serpentine bar from costa at about middle into outer end of cell, sending a short spur back toward base in dorsal area, thence through end of cell and turned downward toward tornus; another bar from costa before apex into terminal area, at its termination weakly joined to second; a row of indistinct dots around termen at base of fringe. Underside dark brown. *Hindwing:* About as broad as forewing; costal brush divided as in *E. transversella,* a few black hairs externally, the remainder whitish, enclosed in a fold between C and Sc; costal outline nearly straight, apex acute, termen rather strongly angled back, broadly curved to dorsum. Ground color subhyaline white, becoming pale brownish in apical area. Underside pale brownish, anal area subhyaline whitish. *Abdomen:* External features not examined; genitalia as in Figure 145 (drawn from holotype, AB slide, May 13, 1931; one slide examined); similar to *E. transversella,* basal processes narrowed on distal half; four or five flat spines at distal end of saccular area; vesica with fine spines.

FEMALE.—Unknown.

TYPE.—Holotype male: Bolivia, Incachaca Cochabamba (J. Steinbach), no further data; unique, deposited in U.S. National Museum.

The Conglobata Group

Eye index ± 1.0–1.1. Labial palpus moderately elongate, II index ± 1.4–1.5, smooth scaled. Antenna of male not dilated. Forewing broad, pattern longitudinal gray streaks. Hindwing of male with hair pencil enclosed in costal fold. Abdomen with genital scaling ochreous. Uncus and gnathos lacking; basal processes membraneous, narrow; fultura-manica and vesica simple. Female genitalia not examined.

A single South American species which superficially would appear to be a member of the Longimaculella group. All phenetic assessments failed to cluster *conglobata* within any grouping, indicating its relationship either to members of the Baliostola group or the Trifurcella group. Study of the female genitalia may dissolve the isolated status which this species appears to maintain.

Ethmia conglobata Meyrick

FIGURE 146; PLATE 16*i*

Ethmia conglobata Meyrick, 1912:717.—Clarke, 1955a:98; 1965:422.

A Colombian species having rather broad whitish forewings clouded with ill-defined brownish gray blotches and diffusion.

MALE.—Length of forewing 11.7 mm. *Head:* Labial palpus elongate, exceeding base of antenna; second segment length about 1.45 times eye diameter; third segment curved, length slightly greater than that of second; smooth scaled, white with broad brownish black bands basally and subapically on second and third segments. Antenna scarcely dilated, width of shaft basally about 0.19 eye diameter; dorsal scaling dark gray. Scaling of tongue brownish, front and crown whitish, occipital tufts blackish at middorsum. *Thorax:* Dorsal scaling whitish, collar and tegulae pale brownish basally; notum with two pairs of small, black

spots, adjoining tegulae apices and at sides of scutellum, possibly a fifth spot, preceding scutellar area at middorsum. Underside shining white, legs broadly blotched with brownish gray exteriorly. *Forewing:* Broad, length about 3.0 times width; costa moderately steeply angled to about middle, gently curved beyond, termen moderately strongly angled back, straight, tornal angle distinct. Ground color whitish, largely replaced by brownish gray clouding except in terminal area; several brownish blotches, darker than surrounding suffusion, the most well defined, an oblong spot on Cu fold before end of cell, dorsal area with slightly less infuscation, two spots on inner one-third, the outer one larger and closer to dorsum; a broad band parallel to termen with scarcely any infuscation; a row of distinct blackish marginal dots from well before apex nearly to tornus. Fringe white with a small, pale brown spot below apex. Underside brown. *Hindwing:* Slightly narrower than forewing; costal area on basal half with a tightly appressed fold to R, containing a thin pencil of cream-white hair scales; costal margin slightly convex; apex blunt, termen broadly curved to dorsum. Ground color whitish basally, becoming pale brownish on apical half; fringe white. Underside similar, costal area darker. *Abdomen:* Dorsal scaling pale brownish, ventral similar, genital pale ochreous. Genitalia as in Figure 146 (drawn from plesiotype, La Crumbre, Colombia, JAP prep. no. 1628; one preparation examined); not closely similar to any other described species; uncus lacking; tegumen a strongly sclerotized ring, valva exceptionally broad, with three prominent, flat spines on distal margin.

FEMALE.—Length of forewing 13.5 mm. Generally as described for male; eye about the same size; labial palpus larger, second segment length about 1.7 times eye diameter, third segment about 1.45 times eye diameter (as in male). Forewing slightly broader, length about 2.9 times width, markings similar, darker. Hindwing costal area simple, slightly concave to end of R; ground color rather uniform dark brown, not whitish basally. Abdomen darker brown than male, ochreous genital scaling reduced. Genitalia not examined.

TYPE DATA.—Colombia, San Antonio, 5,800 feet, November; lectotype male, designated by Clarke (1965), in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Known only from Colombia (La Crumbre, 6,600 feet).

FLIGHT PERIOD.—November; May (?) ("5–14").

FOOD PLANT.—Unknown.

The Cyanea Group

Eye index 0.9 (female). Labial palpus moderately short, II segment index 1.1–1.2 Antenna of male probably with scape modified (length in ♀, 0.9 of eye diameter), dilation of shaft unknown. Forewing broad; metallic blue without pattern. Hindwing of male with costal brush, status of folding unknown. Abdomen scaling undifferentiated. Uncus membranous; gnathos lacking; basal processes membranous, narrow; valva with cucullus "plume"; fultura-manica simple; status of vesica unknown. Papillae anales membranous, setate; posterior apophyses elongate; sterigma simple; antrum enlarged with sclerotized band; ductus bursae membranous, seven tight coils; signum a notched keel.

A single entirely metallic blue species in southern Mexico which appears to show closest relationships to the Longimaculella and Trifurcella groups.

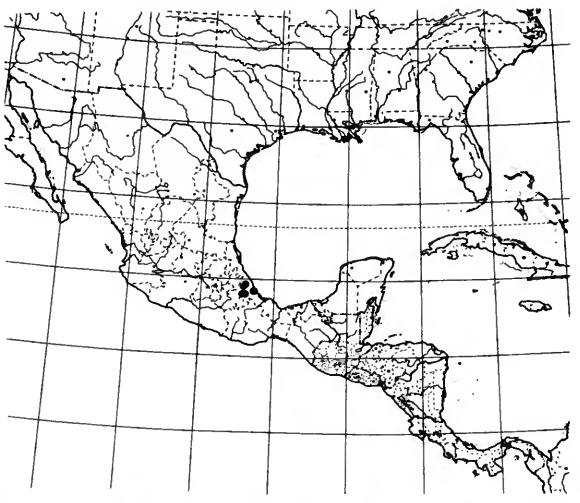
Ethmia cyanea Walsingham

FIGURES 45, 259; PLATE 16*j*; MAP 56

Ethmia cyanea Walsingham, 1912:144, pl. 5, fig. 4.

This is a distinctive dark metallic blue moth known only from Veracruz.

MALE.—Known only from the type in the British Museum, characterized in the original description by the following: Length of forewing not recorded (Walsingham cited the wing expanse as 21–23 mm, evidently in part an error, since a paratype female from Atoyac measured only 18 mm. Possibly the male is much larger than the female with a forewing length up to 10.5 mm.) *Head:* Labial palpus erect, third segment length only 0.5 that of second; shining purplish blue. Antenna flattened laterally, slightly serrate beneath; purplish blue. *Thorax:* Dark, shining greenish blue, legs dark green externally, purplish on their inner sides. *Forewing:* Unicolorous, dark, shining greenish blue; fringe purple. *Hindwing:* K. Sattler states (in litt.) that the costa bears a dorsal hair pencil. Color, including fringe dark purple. *Abdomen:* Deep blackish



MAP 56.—Geographical distribution of *Ethmia cyanea* Walsingham.

green. Genitalia somewhat like *E. similatella* (Figure 157). *E. cyanea* compared via a photograph of the holotype provided by K. Sattler.

FEMALE.—Length of forewing 8.0 to 9.0 mm. Essentially as described for male. Labial palpus moderately elongate, not strongly curved, just exceeding base of antenna; second segment length 1.2 to 1.3 eye diameter, third segment straight, 0.65–0.85 as long as second. Forewing broad, length 2.9–3.1 times width; dorsum somewhat concave, giving a broader appearance beyond middle than in most *Ethmia*. Coloration as described for male. Abdomen dark metallic blue. Genitalia as in Figure 259 (drawn from plesiotype, Cordoba, Veracruz, JAP prep. no. 2120; two preparations examined); sterigma narrow with a thin ring around ostium, ductus basally with a broad, heavily sclerotized band continued through first spiral, with about six membranous spirals, signum not differing from that of *nigritaenia*.

TYPE DATA.—Mexico, Veracruz, Atoyac, April (H. H. Smith), holotype male and paratype females in British Museum. Paratypes from Jalapa and Coatepec, Veracruz, in the U.S. National Museum and in the Los Angeles County Museum.

GEOGRAPHICAL DISTRIBUTION.—Northern Veracruz, Mexico; in addition to Walsingham's localities, the California Insect Survey collection has females from Cordoba and near Rinconada.

FLIGHT PERIOD.—April and June.

FOOD PLANT.—Unknown.

The Gigantea Group

Eye index 1.1. Labial palpus moderately elongate, II segment index 1.3–1.5, smooth scaled. Antenna of male slightly dilated, index 0.22. Forewing moderately broad; pattern costal-dorsal. Hindwing of male with hair pencil enclosed in costal fold. Abdomen with genital scaling ochreous. Uncus membranous; gnathos lacking; basal processes membranous, narrow; valva with cucullus "plume"; modified, scalelike setae not bifid apically; fultura-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma simple; antrum enlarged; ductus bursae membranous, five tight coils; signum a notched keel.

The largest New World species of *Ethmia* occurs in northern Central America and shows close relationship to no other species. Phenetic assessments consistently indicated an isolated position, near the Longimaculella and Trifurcella groups yet not clustering with *E. cyanea* which occupies a similar position.

Ethmia gigantea Busck

FIGURE 147; PLATE 17*a*

Ethmia gigantea Busck, 1914c:54.

A Mexican species with a brown and white forewing pattern similar to *E. marmorea;* having the greatest forewing length of the New World Ethmiidae.

MALE.—Length of forewing 14.6 to 17.4 mm. *Head:* Labial palpus elongate, exceeding base of antenna; second segment length 1.2 to 1.35 times eye diameter; third segment straight, slightly reflexed, length about 0.7 to 0.8 that of second (0.8 to 1.1 times eye diameter); smooth scaled, second segment white, broadly blackish basally and with a narrow subapical, black band exteriorly, third segment entirely blackish except white in a narrow median band exteriorly and extreme tip. Antenna slightly dilated, width of shaft basally about 0.2 eye diameter; dorsal scaling blackish. Scaling of tongue, front, and crown whitish, occipital tufts broadly blackish at midorsum. *Thorax:* Dorsal scaling whitish, bases of tegulae and adjoining areas of collar broadly dark brownish black, reflecting

steel blue, notum with a large, concolorous median blotch and two pairs of smaller, lateral spots of the same color adjoining apices of tegulae and at sides of scutellum. Underside whitish, legs mostly brownish exteriorly. *Forewing:* Length 3.1 to 3.3 times width; costa nearly straight beyond basal one-third, apex acute, termen strongly angled back, tornal angle nearly obsolete. Ground color dark brownish black, nearly unicolorous on costal half, at times with some indistinct paler blotches; dorsal area white, the dividing line sinuate, fairly distinct, along Cu fold, with broad spurs of dark in dorsal area near base and just before middle, thence angled upward to end of cell with an elongate dark spur or separate spot angled back above tornus; a distinct spot beyond basal spur near dorsum; terminal area white except just below apex. The dark costal area extended narrowly to fringe; a row of blackish dots subtending fringe, from before apex to tornus. Fringe white with a tinge of brown below apex. Underside brown, dorsal area white. *Hindwing:* Slightly broader than forewing; costal area with a narrow fold, ending before end of cell, tightly appressed, enclosing a thin, whitish hair pencil; costal margin convex beyond fold, apex acute, termen broadly curved to dorsum. Ground color whitish, semitraslucent basally, becoming pale brownish on apical half; fringe white; underside similar, costal area brownish. *Abdomen:* Dorsal scaling dark brown, ventral pale brownish, genital ochreous. Genitalia as in Figure 147 (drawn from topotype, JAP prep. no. 1102; two preparations examined); uncus membranous, short; valva broad, its apical "plume" short; vesica with some roughened sclerotization.

FEMALE.—Length of forewing 16.8 to about 17.5 mm. Essentially as described for male; eye slightly smaller, labial palpus and antennae about as large as in male. Hindwing costal area simple, ground color not darker than on male. Genitalia similar to *E. nigritaenia* (Figure 253) and *E. cyanea* (Figure 259), one preparation examined; sterigma simple, ringlike, antrum sclerotized, with a ventral fold, ductus with about three small and five large coils, signum elongate with a deep cleft on the inner ridge.

TYPE DATA.—Mexico, Zacualpan, August 1913 (R. Muller); type female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Mexico (Zacualpan, presumably in northwestern Veracruz) and Guatemala (Chichicastenango).

FLIGHT PERIOD.—April, June, August.

FOOD PLANT.—Unknown.

The Trifurcella Group

Eye index 1.0–1.2. Maxillary palpus moderately large, four segments varying in lengths, about 2:2:2:3. Labial palpus moderately elongate to elongate, II segment index 1.3–1.8; smooth scaled. Antenna of male slightly dilated to dilated, index 0.20–0.30. Forewing moderately broad; pattern costal-dorsal. Hindwing of male with hair pencil enclosed in costal fold. Abdomen usually with genital scaling ochreous, at times basal two terga with specialized scaling. Uncus and gnathos absent; basal processes membranous, narrow; valva with cucullus "plume" bearing scalelike setae that are bifid apically; valva usually with distal specialized seta-bunch; fultura-manica simple; vesica simple or armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma simple; antrum enlarged, usually with sclerotized band; ductus bursae membranous, at times sclerotized basally, 5–9 tight coils; signum a notched keel.

This is a somewhat loose assemblage of 17 superficially similar nocturnal species distributed primarily in semiarid parts of the southwestern Nearctic and northern Neotropical regions. Phenetic assessments indicate *E. semiombra,* the *playa-baja* complex, and *E. oterosella* do not cluster well with other members of the group. They are retained, as I believe they represent separate ex-group derivatives of this New World group, which has no relatives in the Old World fauna. *Ethmia oterosella,* the only Antillean representative, may well be excluded when the female genitalia have been studied.

Ethmia semiombra Dyar

Ethmia semiombra Dyar, 1902:206.—Busck, 1906b:728.—Barnes and Busck, 1920, pls. 27, 36.—McDunnough, 1939:83.

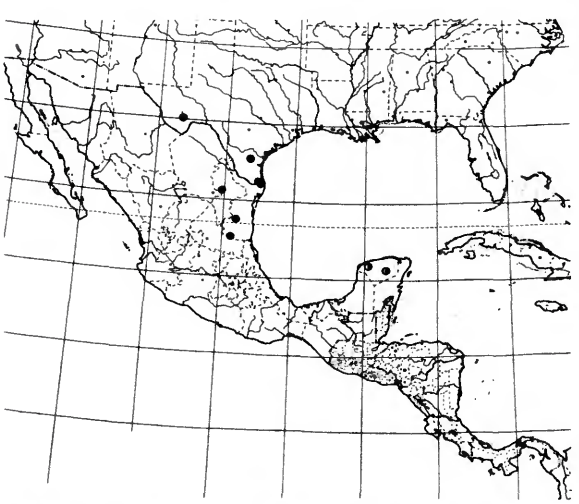
This species, which occurs in eastern Mexico and southern Texas, has the costal-dorsal forewing pattern of the Trifurcella group, with the costal brownish half variably replaced by whitish along the costa.

Ethmia semiombra semiombra Dyar, new status

FIGURES 148, 261, 291, 292; PLATES 17*b-c*, 20*g-h*; MAP 57

A Texan and Mexican race having the forewing with a whitish or grayish dorsal band and a dark blackish or brownish costal half which is indistinctly and irregularly replaced by whitish along the costa.

MALE.—Length of forewing 9.2–9.8 mm. *Head:* Labial palpus elongate, second segment length 1.4 to 1.5 times eye diameter; third segment slightly curved, 0.80–0.83 the length of the second; smooth scaled, whitish, second segment with basal half exteriorly and a narrow subapical band black; third segment with broader submedian and subapical bands. Antenna slightly dilated, width of shaft basally about 0.22 eye diameter; dorsal scaling brownish black. Scaling of tongue and front whitish, crown and occipital tufts tinged with grayish. *Thorax:* Dorsal scaling unicolorous whitish, tinged with grayish. Underside whitish, prothoracic and mesothoracic legs broadly blotched exteriorly with dark or pale brownish gray, hind legs blotched with pale brownish on darker individuals. *Forewing:* Moderately broad, length 3.1–3.2 times width; costa slightly more strongly curved than related species, appearing slightly concave before apex owing to fringe, termen very strongly angled back, tornal angle nearly obsolete. Ground color dark on costal half; whitish, lightly to heavily tinged with gray, on dorsal half; dividing line sinuate, on Cu fold at base, curving into dorsal area as shallow lobes at basal one-third and at about middle, thence upward to lower corner of cell and on to termen; dorsal area usually unmarked except for a small spot below and beyond lower corner of cell, at times a small spot at basal one-third; costal half darkest in cell, becoming slightly and indistinctly paler at costa, at times rather broadly whitish, a more distinct pale area before apex; a row of dark spots at margin, scarcely discernible except in preapical pale area. Fringe whitish tinged with grayish at apex and tornus, broadly dark below apex. Underside brown, a paler area in cell. *Hindwing:* Slightly narrower than forewing; costal area with a narrow fold, ending before termination of Sc, a large whitish hair pencil from base, mostly outside fold; apex rather blunt, termen broadly curved to dorsum. Ground color whitish basally, becoming pale brownish on apical half; fringe gray, paler at anal area. Underside similar, slightly paler. *Abdomen:* Dorsal and ventral scaling pale to dark gray brown, genital scaling slightly paler, not ochreous. Genitalia as in Figure 148 (drawn from plesiotype, Brownsville JAP prep. no. 1152; three preparations examined); uncus membranous, fultura extended as a ventrally sclerotized sheath around aedeagus; basal processes unusually heavily sclerotized, curved outward at middle, valva with a strong distal projection; vesica with a spiral, rasplike sclerotized cornutus.



MAP 57.—Geographical distribution of *Ethmia semiombra* Dyar.
● *E. s. semiombra* ◑ *E. s. nebulombra* Powell

FEMALE.—Length of forewing 11.0–11.7 mm. Essentially as described for male; eye relatively slightly smaller (absolute size about the same as in the smaller male); labial palpus as large or larger than in male, second segment length 1.6–1.7 times eye diameter; antenna as large as in male. Color generally darker, especially the hindwing; abdominal scaling darker, the genital scaling distinctly ochreous. Genitalia as in *E. s. nebulombra* (Figure 260); sterigma not differentiated from VIII sternite, antrum with light sclerotization on one side, signum an open fold with a broad emargination in the inner ridge, which is deeper than in *nebulombra* (Figure 261, drawn from plesiotype, Texas, JAP prep. no. 2562; one preparation examined).

TYPE DATA.—San Diego, Texas, June 12, 1895 (E. A. Schwarz); Brownsville, Texas, June 20, 1895 (C. H. Townsend); USNM type No. 6623. Two females in U.S. National Museum bear the above data and identical type numbers. The former bears an additional "Holotype" label and may be considered as such.

GEOGRAPHICAL DISTRIBUTION.—Southwestern Texas (Brewster County) and southern Texas to southern Tamaulipas, Mexico.

FLIGHT PERIOD.—Evidently multivoltine; February, May, June, and September (Texas), July (Tamaulipas).

FOOD PLANT—Probably *Ehretia elliptica* de Candolle (Boraginaceae); a series of specimens in the U.S. National Museum from Brownsville bear labels "on Ehretia sp.," "ex Anagua," and "on Anacua" (Reagan), presumably referring to *Gaza anacua,* now considered to be a synomym of *E. elliptica.* Additional specimens from the Reagan material were reared from "wild hackberry."

The 18 specimens from Tamaulipas, Mexico, are generally somewhat larger and appreciably darker than a smaller and older sample of flown individuals from Texas.

Ethmia semiombra nebulombra Powell, new subspecies

FIGURE 260; PLATE 17*d;* MAP 57

A race in Yucatan which differs from *s. semiombra* by a generally paler appearance, particularly due to a broad, pale costal area of the forewing.

MALE.—Length of forewing 10.5 to 11.0 mm. Generally similar to *s. semiombra,* differing as follows: *Head:* Labial palpus size slightly more variable in the sample available, third segment 0.75–0.83 the length of second. *Forewing:* Color pattern with dividing line between light and dark more produced into dorsal area, forming two dark squarish spurs, rather than broad, ill-defined ones; costal area irregularly whitish, at times restricting dark portion to an ill-defined, brown, broad, longitudinal band through middle of wing, blackish in cell as in *s. semiombra;* the dot in basal one-third in dorsal area present, at least a trace. *Hindwing:* Whitish, tinged with brownish distally. Genitalia very similar to *s. semiombra* (Figure 148); valva slightly broader distally, with less well developed distal production below the "plume."

FEMALE.—Length of forewing 10.4 to 11.8 mm. As described for nominotypic race; pale ground color generally darker than in male, tinged with gray to uniform gray, narrowly bordered with whitish adjoining dark markings. Hindwing much darker than in male, dark brownish on distal half. Genitalia as in Figure 260 (drawn from paratype, JAP prep. no. 2698; two preparations examined); essentially as in *E. s. semiombra,* inner ridge of signum evidently shallower with slightly larger teeth.

TYPES.—Holotype male and allotype female: Mexico, Merida, Yucatan, July 29–30, 1964 (P. J. Spangler); deposited in U.S. National Museum. Eleven paratypes, all Yucatan, as follows (Map 57): same data as holotype, 3♂, 3♀, Chichen Itza, 1♂, II–4–56, 1♀, III–11–56, 1♀, IV–8–56, 1♀, V–26–55, 1♀, IX–27–55 (E. C. Welling). Deposited in California Insect Survey and U.S. National Museum.

Ethmia albicostella (Beutenmüller)

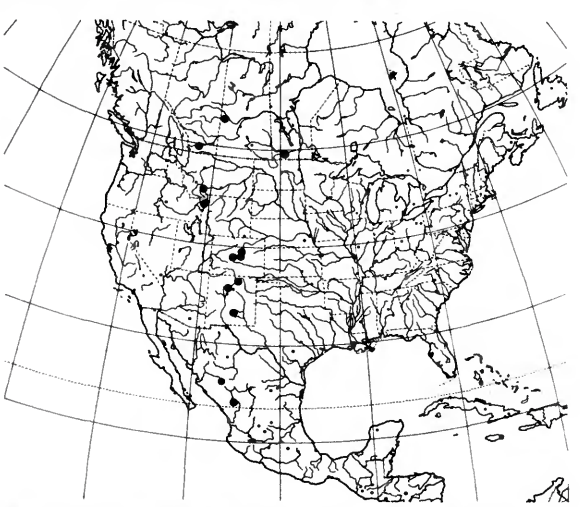
FIGURE 149; PLATE 17*e;* MAP 58

Anesychia mirusella.—Chambers, 1877 [not Chambers, 1874]: 121.

Pseudia albicostella Beutenmüller, 1889:9.

Ethmia mirusella.—Dyar, 1902 [not Chambers, 1874]:203 [in part].—Barnes and Busck, 1920 [not Chambers, 1874], pls. 27, 36.—McDunnough, 1939 [not Chambers, 1874]:83 [in part].

Ethmia mirella Meyrick, 1914:29 [in part].



MAP 58.—Geographical distribution of *Ethmia albicostella* (Beutenmüller).

A widespread species in the Rocky Mountains and Sierra Madre Occidental of Mexico having narrow forewings which are evenly divided by a straight, longitudinal line, brownish gray on costal, white on dorsal half.

MALE.—Length of forewing 11.2 to 13.2 mm. *Head:* Labial palpus moderately elongate, variable; second segment length 1.05 to 1.20 eye diameter; third segment slightly curved, length 0.4 to 0.8 that of second (0.45 to 1.0 eye diameter); scaling slightly shaggy, second segment blackish exteriorly, at times with a whitish median blotch and narrow apical ring, whitish interiorly, third segment black with narrow basal and postmedian white bands. Antenna not dilated, width of shaft basally less than 0.2 eye diameter; dorsal scaling dark gray. Scaling of tongue and front white, crown slightly to heavily tinged with grayish, occipital tufts black at middorsum. *Thorax:* Dorsal scaling grayish white, base of tegula and adjoining collar narrowly blackish, five black spots on notum: lateral pairs adjoining apices of tegulae and at sides of scutellum, a single larger one at middorsum preceding scutellar area. Underside whitish, legs broadly marked with pale gray exteriorly. *Forewing:* Narrow, length 3.5 to 3.8 times width; costa straight along middle one-third, apex acute, termen strongly angled back, tornal angle obscure. Ground color divided by a straight longitudinal line along Cu fold to end of cell, costal half dark to pale brownish gray, darkest at dividing line, blending to whitish at costa; dorsal area white, lightly tinged with grayish, marked by a single small, oblong, dark spot at basal one-fourth; dorsal white upcurved at end of cell as a distinct spur, at times defined outwardly by gray, at times white thence to termen, a small grayish spot just below and beyond the spur; terminal area with a heavy streak of gray from cell to termen or mostly white; a row of black dots around termen before fringe, well defined only on paler specimens. Fringe white or pale grayish, a brownish gray spot below apex. Underside pale brownish, dorsal area paler. *Hindwing:* About as broad as forewing; costal area with a narrow fold, ending before end of cell, containing a thin, whitish hair pencil; costal margin convex at end of cell, apex rather blunt, termen strongly angled back to dorsum, tornal angle not evident. Ground color pale brownish, slightly darker apically; fringe slightly paler. Underside similar. *Abdomen:* Scaling, dorsal and ventral, pale to rather dark gray-brown; genital scaling dull to bright ochreous. Genitalia as in Figure 149 (drawn from plesiotype, Florissant, Colorado, JAP prep. no. 918; five preparations examined); uncus membranous; valva with apex attenuate, without a well-developed "plume" at end of costa.

FEMALE.—Not examined in detail; the holotype was the only specimen available: length of forewing 10.5 mm; labial palpus more elongate than in male, second segment about 1.35, third 0.95 eye diameter; external characters essentially as in male; hindwing simple; abdomen, especially the venter, tinged with ocherous. Genitalia not examined.

TYPE DATA.—Colorado, "1♂," a female specimen which evidently is the type (cited by Dyar, 1902), in U.S. National Museum, bears the data "Col., 248, collection Beutenmüller, Psecadia albicostella Beut. Type," and "Type No. 435 U.S.N.M."

GEOGRAPHICAL DISTRIBUTION.—Southern Manitoba, Saskatchewan, and Montana (Bozeman) through the southern Rocky Mountain states at moderately high elevations (mostly 7,000–8,000 feet) and mountains of western Mexico at least to Durango (25 mi W. Durango, 8,100 feet).

FLIGHT PERIOD.—Mid-June to early August.

FOOD PLANT.—*Lithospermum,* in Wyoming (A. F. Braun, in litt.).

REMARKS.—The Mexican specimens (2♂, Mesa de Heracan, Chihuahua; 2♂, 25 mi W. Durango) are generally somewhat darker colored than Colorado and Manitoba individuals. In addition, it appears there may be a clinal change in labial palpus length from north to south. The ratios of eye diameter: second segment: third segment were 1.0:1.1:0.45 for the single Manitoba specimen measured; they ranged 1.0: 1.05–1.15 :0.75–0.88 for Florissant, Colorado, individuals; and 1.0:1.2 :0.95–1.05 in material from Chihuahua and Durango.

One additional male in the U.S. National Museum from Mexico, D.F. (Mexico City, June) that was examined is referred to *albicostella* tentatively, although it differs in several respects. The specimen is slightly larger (forewing length 13.8 mm) than any other examined but has an equally narrow forewing and labial palpus size about equal to that of other Mexican *albicostella.* The basic forewing pattern is the same; but the general coloration

is dull and less contrasting, and all minor marks of the forewing (dorsal area spot, spot below outer lower corner of cell, and marginal dots) are lacking. The darker areas are more brownish than gray, a feature which may in part be due to age of the specimen. In genital characteristics the Mexico City example differs only by having narrower basal processes and slightly more angulate distal and saccular margins in the valva.

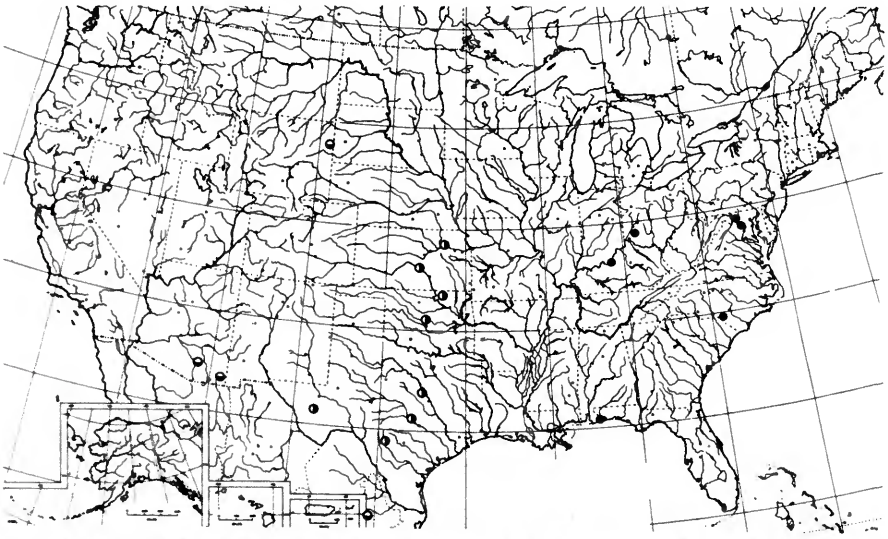
Ethmia mirusella (Chambers)

FIGURE 150; PLATE 17*f*; MAP 59

Anesychia mirusella Chambers, 1874:233.
Ethmia mirusella.—Dyar, 1902:203 [in part].—McDunnough, 1939:83 [in part].
Ethmia mirella Meyrick, 1914:29 [in part].

A rather small *Ethmia* in Oklahoma and adjacent states which resembles a faded *E. albicostella*.

MALE.—Length of forewing 7.8 to 9.2 mm. *Head:* Labial palpus moderately elongate, not strongly upcurved; second segment length 1.1 to 1.25 times eye diameter; third segment slightly curved, length 0.82 to 0.90 that of second (1.0–1.1 eye diameter); smooth scaled, white, second segment broadly brownish on basal half, with a small, indistinct, subapical spot exteriorly, third segment with dark submedian and subapical bands. Antenna not dilated, width of shaft basally less than 0.2 eye diameter; dorsal scaling brownish gray. Scaling of tongue, front, and crown silvery whitish, occipital tufts lightly tinged with brownish gray; extreme base of tegula dark brown, notum with five small, dark spots: two lateral pairs adjoining apices of tegulae and at sides of scutellar area, and a single median one preceding scutellar area. Underside whitish, prothoracic and mesothoracic legs mostly dark brownish gray exteriorly; hind tibial fringe rather dense and elongate, whitish. *Forewing*—Length 3.2 to 3.6 times width; costa nearly straight on middle one-third, apex acute, termen strongly angled back, tornal angle scarcely evident. Ground color white, pattern divided by a longitudinal, straight line along Cu fold, area costad in cell dark brown, shading to pale brownish and whitish toward costa, latter brown only at base, costal area beyond cell mostly white, dividing line slightly upcurved at end of cell, becoming indistinct beyond; dorsal area white with two small, brownish spots, basal one at one-third rather distinct, nearer dorsum, second one at about middle, sometimes absent or connected to dark area of cell at Cu; an indistinct spot at lower corner of cell; a row of dark marginal dots, usually distinct only below apex on termen. Fringe white with a brown spot below apex, at times indistinctly connected to



MAP 59.—Geographical distribution of members of the Trifurcella group of *Ethmia*.
● *E. trifurcella* (Chambers) ◑ *E. mirusella* (Chambers)
◒ populations of uncertain affinity

brown streak through cell. Underside dark brown, dorsal area and a small blotch in cell paler. *Hindwing:* Slightly narrower than forewing; costal area with a narrow fold containing a thin pencil of white hairscales; costal margin slightly convex at end of cell, apex blunt, termen broadly curved to dorsum. Ground color white, at times very lightly tinged with grayish brown towards distal margins. Fringe white. Underside whitish, lightly tinged with pale brownish. *Abdomen:* Dorsal scaling whitish tan, ventral white; genital concolorous. Gentalia as in Figure 150 (drawn from plesiotype, Jeff Davis County, Texas, JAP prep. no. 771; three preparations examined); uncus lacking, valva somewhat variable in width, sclerotized portion of apical plume at times broader than in Figure 150, distal seta bunch a dense row of about 15 heavy, spurlike setae; vesica with a lightly sclerotized, ill-defined cornutus.

FEMALE.—Length of forewing 8.0 to 9.0 mm. Essentially as described for male; eye about the same size; labial palpus slightly larger, length of second segment about 1.4 times eye diameter, third 0.75–0.83 as long as second (1.1–1.2 eye diameter). Hindwing, costal area simple, broadly convex; ground color slightly darker. Genitalia similar to *E. marmorea* and *E. hodgesella* (Figures 262–264) but less heavily sclerotized; antrum with only faint brownish sclerotization (one preparation examined).

TYPE DATA.—Texas, April and May; lectotype male, by present designation: "Chambers, Tex; Type 1423" in Museum of Comparative Zoology, Harvard. The material upon which the description is based is stated to have come from "Mr. Belfrage of Waco, Texas." According to Geiser (1948), Belfrage lived near Norse, Bosque County (about 40 miles northwest of Waco) from 1870 to 1879.

GEOGRAPHICAL DISTRIBUTION.—Kansas, Oklahoma to central and western Texas.

FLIGHT PERIOD.—Evidently double brooded; March, May to September.

FOOD PLANT.—Unknown.

REMARKS.—This and the following species need further study. Although the two seem distinct in the eastern United States, the precise relationships of populations on the western periphery of the geographical distribution of the complex are in need of clarification (see Map 59). Western morphotypes differ markedly in appearance from the typical form of *E. trifurcella,* but the genitalia do not differ from eastern specimens. The phenotype in Nueva Leon and Arizona resembles a paler, more strongly marked kind of *E. mirusella,* with a straight line separating the dark median and pale dorsal areas of the forewing and the brown restricted to the median area, with the costal area whitish, as in *E. trifurcella.* Specimens from Wyoming are intermediate between the dark and pale extremes of *E. trifurcella* and superficially resemble *E. albicostella.*

Ethmia trifurcella (Chambers)

FIGURE 151; PLATE 17*g*; MAP 59

Anesychia trifurcella Chambers, 1873:12.
Ethmia trifurcella.—Dyar, 1902:206.—McDunnough, 1939:83.—Kimball, 1965:286.

A widespread but poorly known Nearctic species superficially resembling *E. marmorea,* with a broader costal whitish area.

MALE.—Length of forewing 7.6 to 9.8 mm. *Head:* Labial palpus moderately elongate, slightly exceeding base of antenna; second segment length about 1.3 times eye diameter; third segment slightly curved, length 0.85–0.90 that of second (1.1 eye diameter); smooth scaled; white, second segment exteriorly with broad basal band and small subapical spot of brownish black; third segment with sub-basal and apical dark rings. Antenna scarcely dilated, width of shaft basally 0.18–0.20 eye diameter; dorsal scaling dark gray except extreme base of scape white. Scaling of tongue and front white, latter margined narrowly below eye dark gray reflecting metallic bluish, crown white, occipital tufts at middorsum narrowly to broadly dark, reflecting bluish. *Thorax:* Dorsal scaling white, base of tegula and adjoining collar dark brownish, dark brown spots at side of notum adjoining apices of tegulae and medially, one or a pair (originally described as a longitudinal stripe) preceding scutellar area. Underside white, prothoracic leg heavily blotched with brownish black, mesothoracic leg lightly so, hind tibial fringe sparse, pale ochreous. *Forewing:* Length about 3.3 times width; costa gently curved, flattened before middle and before apex, latter acute, termen strongly

angled back, broadly curved to dorsum. Color pattern divided longitudinally by a somewhat sinuate line along Cu fold, dorsal area white or pale gray and containing a single dark spot at about basal one-third; costal half dark brownish or blackish, darkest at Cu fold, becoming paler costad, costal area with scattered pale grayish scaling or mostly whitish above cell; dorsal area sending a narrow spur at end of cell obliquely towards apex, at times nearly isolating a second dark spot beyond and below cell; a row of dark dots around margin from before apex to tornus. Fringe white except brownish adjoining dark median streak of terminal area. Underside brown, paler on dorsal half. *Hindwing:* Narrower than forewing; costa with a narrow fold to about end of cell, containing a thin, whitish hair pencil; apex very acute, sublanceolate, termen strongly angled back, straight. Ground color pale brownish, slightly darker distally; fringe concolorous. Underside whitish. *Abdomen:* Dorsal scaling brownish gray, ventral and genital paler. Genitalia as in Figure 151 (drawn from plesiotype Jefferson County, Kentucky, JAP prep. no. 1177; three preparations examined); uncus membranous, basal processes and valva narrow, apical "plume" on a rather broad stem, distal seta bunch of about 16 elongate, heavy spurlike setae.

FEMALE.—Length of forewing 8.7 to 9.1 mm. Essentially as described for male. Antenna about as large as in male; general coloration, especially hindwing, darker. Hindwing costal area simple. Genitalia not examined, presumably as in *E. mirusella.*

TYPE DATA.—Kentucky, in July. Lectotype female, by present designation, "Chambers, Kentucky, 19, Type #1426," at Museum of Comparative Zoology, Harvard.

GEOGRAPHICAL DISTRIBUTION. — Incompletely known. Pennsylvania, Ohio, and Kentucky to North Carolina and northern Florida (Pensacola); and widespread westward, according to scattered records of an atypical phenotype from Nueva Leon, Arizona, and Wyoming.

FLIGHT PERIOD.—Probably bivoltine; April (Florida; Ohio, reared), May (Kentucky, reared), June (Nueva Leon and Florida) July (Kentucky, Wyoming, Pennsylvania and Maryland), September (North Carolina); all single locality records.

FOOD PLANT. — *Cynoglossum virginianum* L. (Boraginaceae), reared from larvae collected in July in Warren County, Ohio, and Jefferson County, Kentucky, by A. F. Braun, who kindly supplied the information. The larva forms a tubular shelter on the underside of the leaf and feeds upon the leaves.

REMARKS.—This species exhibits geographical variation, but insufficient material has been available to enable analysis of any population differences. The few specimens examined from Kentucky and southern Ohio are smaller (and are reared) and have more strongly contrasting white areas on the forewing.

Three specimens from North Carolina (Maxton) and Florida (Pensacola) are darker than those from Kentucky and Ohio, having the pale areas of the forewing gray and somewhat restricted.

As discussed above, the genital form characteristic of *E. trifurcella* is widespread westward according to scattered records from northern Nueva Leon, southeastern Arizona, and eastern Wyoming. It is not known whether these populations represent a geographical segregate of *E. trifurcella* or western components of a polytypic complex which also includes populations here referred to *E. mirusella.*

Ethmia marmorea (Walsingham)

FIGURES 152, 262, 263; PLATES 4*a*, 17*h*; MAP 60

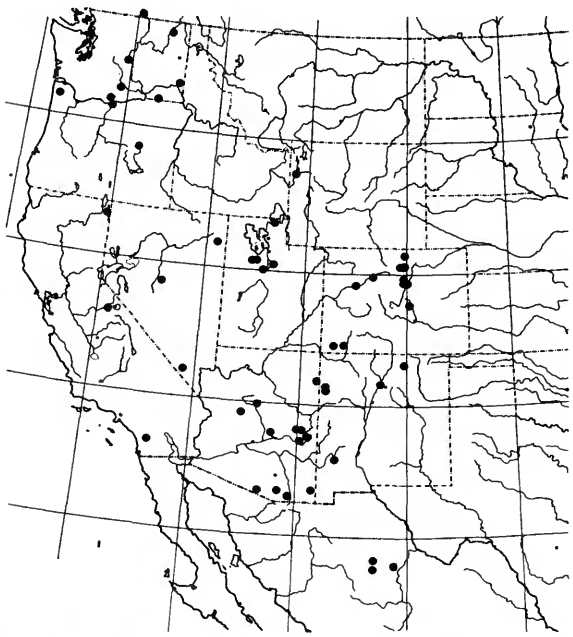
Psecadia marmorea Walsingham, 1888:149.

Ethmia marmorea.—Dyar, 1902:206.—Walsingham, 1912:146.—Barnes and Busck, 1920, pls. 27, 36.—McDunnough, 1927: 271; 1939:83.—Powell, 1959:145.

Ethmia semilugens.—Braun [not Zeller, 1872], 1925:197.

A widespread, variable Nearctic species with the forewings having a broad white dorsal margin, the remainder pale to dark brown, usually with one or more whitish blotches along the costa.

MALE.—Length of forewing 8.8–11.7 mm. *Head:* Labial palpus moderately elongate, variable, second segent length 1.35–1.50 eye diameter; third segment 0.70–0.96 as long as second (1.05–1.33 eye diameter); smooth scaled, white, second segment dark brown on basal half exteriorly, at times with a postmedian band; third segment with broad basal band and tip dark brown, or extreme tip white. Antenna slightly dilated width of shaft basally about 0.22 eye diameter, dosal scaling dark brown. Scaling of tongue, front, and crown silverywhite, occipital tufts dark brown at middorsum. *Thorax:* Dorsal scaling white, tegula basally and adjacent



MAP 60.—Geographical distribution of *Ethmia marmorea* (Walsingham).

collar dark brown, notum with five large blackish spots: one at middorsum, lateral pairs adjoining apices of tegulae and at sides of scutellum. Underside whitish, legs banded with dark brown exteriorly, metathoracic leg indistinctly so. *Forewing:* Length 3.25–3.50 times width; costa gently, evenly curved from base to apex, termen strongly angled back, straight, tornal angle evident. Pattern divided by a longitudinal line along Cu fold extended below fold as blunt, triangular spurs at basal one-fourth, middle, and in terminal area; dorsal area white, area costad of line dark brown, usually with one or more ill-defined whitish blotches along costa: an indistinct dusting at basal one-third, a larger blotch just beyond middle containing a dark dot, a more distinct white blotch always present preceding apex, containing one or more terminal dots; dorsal white area with a distinct dark spot between and below basal two dark spurs, a second spot just before tornus, at times connected to the third spur from dark in terminal area; a row of distinct blackish spots around termen from before apex to tornus. Fringe white at apex and broadly around termen, brownish between. Underside dark brown, white areas of upperside distinctly reproduced pale brownish. *Hindwing:* Slightly narrower than forewing; costa with a narrow fold to end of cell, containing a rather thick, whitish hair pencil, costal margin nearly straight, apex acute, termen strongly angled back, broadly curved to dorsum. Ground color whitish basally, becoming pale brownish on apical half; fringe paler. Underside mostly whitish except blotched with brownish along costal area. *Abdomen:* Dorsal scaling pale brownish gray, ventral whitish, genital pale ochreous. Genitalia as in Figure 152 (drawn from plesiotype, Santa Clara Canyon, Chihuahua, JAP prep. no. 774; eight preparations examined); uncus lacking, valva with apical "plume" thin, its setation restricted to apical end, distal seta-bunch of valva a curved row of heavily sclerotized, short, black, spurlike setae from exterior side apical margin.

FEMALE.—Length of forewing 8.4 to 10.7 mm. As described for male, variation in markings and palpus size within range shown in male. Antenna not dilated, width of shaft about 0.75 that of male. Hindwing costal area simple. Genitalia as in Figures 262, 263 (drawn from plesiotype, Chiricahua Mountains, Arizona, JAP prep. no. 2567; two preparations examined); similar to *semiombra*, with sterigma as a V-shaped emargination in VIII sternite, antrum not much enlarged, broadly sclerotized on its ventral side, signum ridge with a single, deep notch.

TYPE DATA.—Arizona; unique type male in British Museum.

GEOGRAPHICAL DISTRIBUTION.—Lower parts (mostly 5,000 to 7,500 feet elevation) of the Great Basin ranges and Rocky Mountains from southeastern British Columbia (Seton Lake) and eastern portions of the Pacific states to northern and central Colorado (Loveland) and central Chihuahua (15 mi E Cuauhtemoc).

FLIGHT PERIOD.—May to August; possibly univoltine.

FOOD PLANT.—Unknown.

REMARKS.—The wing color variation does not seem to be geographically restricted. In addition to Arizona, the typical form, with more distinct whitish costal blotches, has been taken in southern California, Utah, and Chihuahua. Dark individuals closely resemble *E. sphenisca* and *E. semilugens* in wing pattern, but the latter species is easily distinguished by the shorter labial palpus, simple

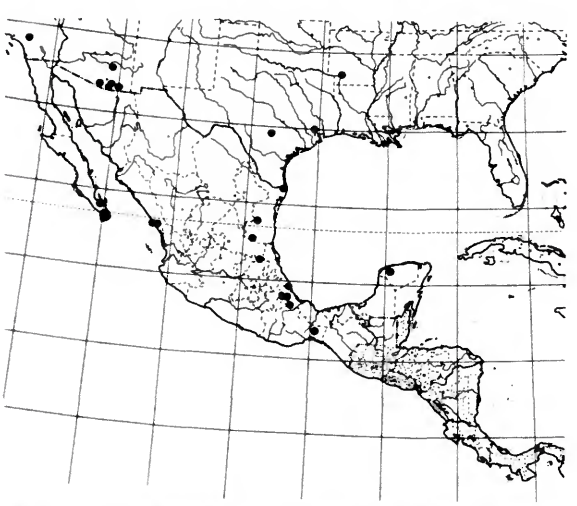
costal area of the hindwing, and abdomen coloration, which is entirely bright ochreous ventrally.

Ethmia hodgesella Powell, new species

FIGURES 153, 264; PLATE 17*i*; MAP 61

A widespread species in the southwestern United States and Mexico having the appearance of a small *E. marmorea*.

MALE.—Length of forewing 6.0–7.8 mm. *Head:* Labial palpus moderately elongate, slightly exceeding base of antenna; second segment length 1.1–1.3 times eye diameter; third segment 0.75–0.85 as long as second (0.94–1.1 eye diameter); smooth scaled, whitish, second segment dark brownish on basal half, third segment with subbasal and subapical dark rings. Antenna not appreciably dilated, width of shaft basally less than 0.2 eye diameter; dorsal scaling dark gray-brown. Scaling of tongue, front, and crown white, occipital tufts dark brown at middorsum. *Thorax:* Dorsal scaling white, at times tinged with pale gray, extreme base of tegula dark brownish, notum with a pair of lateral spots adjoining apices of tegulae and a transverse band preceding scutellum, dark gray-brown. Underside whitish, prothoracic and mesothoracic legs marked exteriorly with pale grayish brown. *Forewing:* Length 3.1 to 3.5 times width; costa gently curved, nearly straight; apex moderately blunt, termen strongly angled back, straight. Color pattern divided by a serpentine longitudinal line along Cu fold; dorsal area whitish, invaded by three prominent triangulate dark spurs from cell, first at basal one-third, second beyond middle, third reaching to tornus, a conspicuous round, dark spot between and below first two spurs; area costad of line mostly dark brownish gray, an ill-defined whitish blotch on costa beyond middle containing an ill-defined dark spot, at times some whitish along costa before middle; terminal area mostly whitish, at times crossed by a dark, median extension from cell; a row of blackish, rather large dots around margin from before apex nearly to tornus. Fringe white at apex and around tornus, broadly grayish along termen. Underside dark gray-brown, the white areas of upperside paler. *Hindwing:* Narrower than forewing, costa with a narrow fold from base to end of cell, containing a thin, white hair pencil; costal margin slightly convex at end of cell, apex rather blunt, termen not strongly angled back, broadly curved to dorsum. Ground color unicolorous pale gray; fringe paler. Underside similar, slightly mottled along costa. *Abdomen:* Dorsal scaling pale, silvery gray, first two segments lightly tinged with ochreous, ventral whitish, genital whitish ochreous. Genitalia as in Figure 153 (drawn from paratopotype, JAP prep. no. 1624; eight preparations examined); resembling *E. marmorea,* basal processes more elongate, valva broader, its apical "plume" with setae more restricted, distal seta-bunch a compact group of about a dozen elongate, thick setae (not extended onto posterior margin as in *marmorea*).



MAP 61.—Geographical distribution of *Ethmia hodgesella* Powell.

FEMALE.—Length of forewing 6.7 to 7.6 mm. Essentially as described for male; hindwing costal area simple, margin broadly convex. Genitalia (Figure 264, drawn from plesiotype, San Jose del Cabo, JAP prep. no. 2570; two preparations examined); similar to *E. marmorea,* sterigma simple, thin, ostium subtended by a short, sclerotized sleeve and sclerotized antrum, signum not differing from *marmorea* and related species.

TYPES.—Holotype male and allotype female: Arizona, Madera Canyon, 4880 feet, Santa Rita Mountains, August 3, 1959 (R. W. Hodges); deposited in Cornell University collection.

One hundred sixty-five paratypes (69♂, 96♀), as follows *California,* "Victoria" (near Loma Linda, Riverside County), 1♀, X–26–25 (E. Piazza).

Arizona, Oracle, Pinal County, 1 ♀, VI–28–24 (J. O. Martin); Santa Rita Exp. Range, Santa Rita Mountains, 1 ♀, VII–16–41 (A. B. Klots); Madera Canyon, Santa Rita Mountains, 9 ♂, 12 ♀, VII–5 to 12–59, 2 ♀, VII–22, 25–59, 22 ♂, 38 ♀, VIII–1 to 5–59, 8 ♂, 14 ♀, VIII–9 to 12–59 (all R. W. Hodges); Baboquivari Mountains, Pima County, 1 ♂, VII–15 to 31–23, 1 ♀ VIII–15 to 30–23, 2 ♂, VI–15 to 30–24, 1 ♂, VII–15 to 31–24) all O. C. Poling); Pena Blanca Canyon, Santa Cruz County, 12 ♂, 1 ♀, VIII–7 to 11–59 (R. W. Hodges); Huachuca Mountains, 1 ♂ (no further data.) *Arkansas,* Hope, Hempstead County, 1 ♀, VI–6–31, 1 ♀, IX–26–32 (no further data). *Texas,* San Antonio, Bexar County, 1 ♂, VIII–1–42 (E. S. Ross); Brownsville, 1 ♀, III–4–25 (E. Piazza), 1 ♂, IV–26–28 (F. H. Benjamin); "Tex", 1 ♀, (no further data). *Sinaloa,* Mazatlan Beach, 1 ♂, 1 ♀, VIII–14–60 (Arnaud, Ross, Rentz); 5 mi N Mazatlan, 1 ♂, VIII–5–64 (J. A. Chemsak and J. Powell); 28 mi E Villa Union, 1 ♂, VIII–4–64 (H. F. Howden). *San Luis Potosi,* 2 mi S Tamazunchale, 1 ♂, 2 ♀, VII–15–63 (Duckworth and Davis). *Tamaulipas,* El Salto Falls, 26 mi W Antiguo Morelos, 2 ♂, 2 ♀, VII–11 to 14–63 (Duckworth and Davis); 4 mi SW Ciudad Victoria, 1 ♀, VIII–5–63 (Duckworth and Davis). *Veracruz,* Puente Nacional, 1 ♂, 1 ♀, VI–21–62 (D. H. Janzen); 1,2 mi W Fortin de las Flores, 2 ♂, 6 ♀, VII–2–62 (D. H. Janzen); Cotaxtla Exp. Sta., 1 ♂, 2 ♀, VI–28–62, 3 ♀, VIII–2,6–62 (D. H. Janzen). *Oaxaca,* Temescal, 1 ♂, 3 ♀, VII–4–64 (D. H. Jansen). Deposited in American Museum of Natural History, British Museum, California Academy of Sciences, California Insect Survey, Canadian National Collection, Cornell University, and U.S. National Museum.

The following specimens from Baja California have more recently been examined and are not designated as paratypes. *Baja California* (Territorio Sur), 2 mi NW El Triunfo, 1 ♀, VIII–12–66 (J. Chemsak, J. Doyen, and J. Powell); 3.5 mi N San Pedro, 2 ♂, IX–7–67, at lights (J. A. Chemsak, A. E. Michelbacher); 5 mi S Miraflores, 1 ♂, VII–10–38 (Michelbacher and Ross); 1 mi SW Punta Palmilla, 1 ♂, 2 ♀, IX–13–67, at lights (Chemsak and Michelbacher); 6 mi N San Jose del Cabo, 9 ♂, 12 ♀, IX–10, 15–67, at lights (Chemsak and Michelbacher); 3 mi N San Jose del Cabo, 1 ♂, IX–11–67, at lights (Chemsak and Michelbacher).

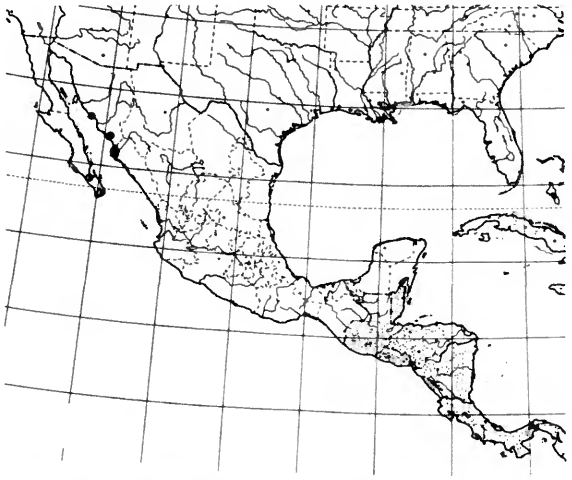
REMARKS.—Although *E. hodgesella* is one of the most widespread members of the genus in the New World, it shows very little variation. The distribution appears to be disjunct, extending along the two sides of the central cordillera of Mexico. However, it is noteworthy that all but one of the 16 Mexican records (representing seven separate American expeditions) are the result of work during the past decade and considerable extension of the known range of the species will not be surprising. In superficial appearance *E. hodgesella* is almost indistinguishable from typical *E. marmorea* except by size. The smallest specimen of the latter species examined measures 8.4 mm forewing length; the largest *hodgesella* 7.8 mm.

Ethmia playa Powell, new species

FIGURE 155; PLATE 18*a*; MAP 62

A small, dull-colored species along the west coast of northern Mexico, having brown forewings with a grayish or whitish dorsal band.

MALE.—Length of forewing 5.2–6.2 mm. *Head:* Labial palpus moderately elongate, exceeding base of antenna; second segment length about 1.2 times eye diameter; third segment 0.75 to 0.88 as long as second (0.96–1.0 eye diameter), slightly curved;



MAP 62.—Geographical distribution of members of the Trifurcella group of *Ethmia.*
● *E. playa* Powell ◑ *E. baja* Powell

smooth scaled, white, second segment mostly brown exteriorly except apex, third segment brown apically. Antenna slightly dilated, width of shaft basally about 0.24 eye diameter; dorsal scaling brown. Scaling of front pale brownish or mostly white, of crown and occipital tufts white, latter at times with a pale brownish median spot. *Thorax:* Dorsal scaling whitish tinged with pale brownish. Underside whitish, prothoracic and mesothoracic legs pale brownish exteriorly. *Forewing:* Length 3.0–3.2 times width; costa rather strongly curved, appearing (owing to fringe) flattened beyond middle; apex blunt, termen only moderately strongly angled back, straight or very slightly convex. Ground color divided by a longitudinal line along Cu fold, costal half grayish brown, darkest basally and near Cu; dorsal area whitish, usually tinged with grayish or tan; the line projected below cell at basal one-fourth and about middle, producing shallow, rounded spurs of dark into dorsal area, latter usually with a small spot between and below the spurs; whitish produced upward as a narrow spur at end of cell, thence sloped away to tornus; at times a light tinge of whitish on costa preceding apex. Fringe gray-brown, pale only at tornus. Underside brown, dorsal area paler, the dividing line of upperside visible. *Hindwing:* Slightly narrower than forewing; costa with a narrow fold to end of cell enclosing a sparse pencil of whitish ochreous hair scales; costal margin nearly straight, apex blunt, termen moderately strongly angled back, straight, tornal angle evident. Ground color gray, paler basally; fringe whitish ochreous. Underside slightly paler, somewhat mottled. *Abdomen:* Dorsal scaling dull ochreous on basal two or three segments, becoming gray brown distally, ventral whitish, genital whitish ochreous. Genitalia as in Figure 155 (drawn from paratype, San Carlos Bay, JAP prep. no. 800; four preparations examined); uncus rudimentary, basal processes and valvae rather narrow, apical spur bunch of valva consisting of a tight group of about six heavy setae, setation of apical process of costa restricted to apex.

FEMALE.—Length of forewing 5.4 to 6.5 mm. Essentially as described for male, eye and labial palpus as large as in male. Coloration as in male, including abdominal scaling. Hindwing costal area simple, convex beyond cell. Genitalia similar to *E. marmorea* and *E. hodgesella* (Figure 264) but antrum unsclerotized and both sleeve at base of ductus and signum somewhat smaller and less heavily sclerotized (three preparations examined).

TYPES.—Holotype male and allotype female: Mexico, Rio del Fuerte, 13 miles north of Los Mochis, Sinaloa, August 7, 1964 (J. A. Chemsak and J. Powell), deposited in the California Academy of Sciences. Two hundred paratypes (100♂, 100♀), all Mexico, as follows: same data as holotype, 91♂, 96♀; Navajoa, Sonora, 6♂, VII–14–63 (P. J. Spangler); San Carlos Bay (Northwest of Guaymas), Sonora, 1♂, 3♀, VIII–10–60 (P. H. Arnaud, E. S. Ross, D. C. Rentz). Numerous additional specimens in poor condition, from the same localities, not designated as paratypic. Paratypes deposited in American Museum of Natural History, British Museum, Canadian National Collection, California Academy of Sciences, California Insect Survey, and U.S. National Museum.

REMARKS.—Although it was not collected until recently, the species is abundant in the northern, desert-scrub portion of the Sinaloan thorn forest, flying at the beginning of the rain season. There is little variation in external features in the material examined.

Ethmia baja Powell, new species

FIGURES 154, 265; PLATE 18*b*; MAP 62

A moderately small moth in the Cape District of Baja California that resembles the smaller *E. playa* but with the costal dark portion of the forewing and the white dorsal portion more strongly contrasting.

MALE.—Length of forewing 5.7 to 7.2 mm. *Head:* Labial palpus moderately elongate, exceeding base of antenna; second segment moderately strongly curved, length 1.2–1.4 times eye diameter; third segment nearly straight, length 1.0–1.2 times eye diameter; smooth scaled, whitish, second segment with broad subbasal and narrow subapical dark bands, third with narrow subbasal and broader subapical dark bands, the narrow ones incomplete on inner side of palpus. Antenna dilated, width of shaft near base about 0.25 eye diameter. Coloration as described for *E. playa,* the pale areas of *baja* mostly white rather than whitish tinged with gray brown. *Forewing:* Length 3.2 to 3.3 times width; costal half darker than in *playa,* blackish

brown in cell adjoining pale dorsal area, fading to gray brown at costa; apical whitish spot usually present, not well defined; dorsal area white, sometimes tinged with pale gray-brown. Genitalia as in Figure 154 (drawn from paratype, San Jose del Cabo, JAP prep. no. 2350; two preparations examined); similar to *E. playa*, differing by darker, more elongate setation, by a less-produced peak on the distal margin of the valva, and by a more well developed cornutus in the vesica.

FEMALE.—Length of forewing 6.7 to 8.0 mm. As described for male; labial palpus more elongate, second segment 1.5 times eye diameter; antenna not dilated, width of shaft basally about 0.75 that of male. Genitalia (Figure 265, drawn from paratype, San Jose del Cabo, JAP prep. no. 2574; three preparations examined); similar to *E. marmorea*, base of ductus with more extensive sclerotization than in *playa*, antrum membranous, signum relatively large, not differing in shape from *marmorea* and related species.

TYPES.—Holotype male and allotype female: Mexico, 26 miles west of La Paz, Baja California (Territorio Sur), August 11 and 13, 1966, at lights (J. A. Chemsak, J. T. Doyen, J. Powell); deposited in California Academy of Sciences. Seventy paratypes, all Baja California, as follows: same data as holotype, 2♂; same data as allotype, 37♂, 3♀; 1 mi SW Punta Palmilla, 6♂, 1♀, IX–11–67, at lights (J. A. Chemsak and A. E. Michelbacher); 6 mi N San Jose del Cabo, 5♂, 1♀, IX–10–67, 12♂, 2♀, IX–15–67, at lights (Chemsak and Michelbacher); 3 mi N San Jose del Cabo, 1♂, IX–11–67 (Chemsak and Michelbacher).

REMARKS.—This species is closely related to *E. playa* but differs from that species by its larger size, more contrasting colors, slightly larger labial palpus, and minor genitalic features, particularly the valva shape and more well developed cornutus. *Ethmia baja* may represent a southern race of *E. playa*, but this will have to be shown through material originating from the gap in the allopatry of the two, perhaps northward along the peninsula or across some of the islands in the Gulf of California.

THE PENTHICA COMPLEX

Most members of the Trifurcella group are rather similar in appearance, having the forewing brown on the costal half, white on the dorsal area, with the pattern divided by a sinuate line. However, within this series, a small group in Mexico and Central America consists of species which are so similar in external appearance that reliable separation of them is not possible except by genital characters. Moreover, female genital features are variable (possibly geographically), the complex is represented by females from more localities than males, and I have not been able to associate the female with one of the male genital types, so satisfactory treatment of the complex has not been realized.

The first species, *E. penthica* Walsingham, 1912, was described on the basis of a single male from Oaxaca, Mexico, and no member of the complex has been collected from that region subsequently. The slide of the *penthica* type specimen, unfortunately, was mounted with the aedeagus in situ. However, I believe that I am correct in referring several collections from Puebla, Veracruz, and other central Mexican areas to *penthica*, using as the most distinguishing feature a heavy spurlike cornutus in the vesica. This species has slightly narrower forewings and more elongate labial palpi than the other three members of the complex.

The second species to be described, *E. similatella* Busck, 1920, from Guatemala, was distinguished by Busck by its larger size, less sinuate line dividing the colors of the forewing, and by a white patch at the apex of the forewing surrounding two of the terminal dots. Moths with male genital characters apparently identical to those of the type series have subsequently been taken in Costa Rica, Honduras, and western Mexico. In this material all of Busck's diagnostic features disappear. The Mexican specimens, in particular, reverse the comparison to *penthica;* most are smaller and all lack the white apical patch, which is nearly always present in *penthica*. There is a tendency for all these *similatella* to exhibit a less sinuate line, but this feature is better seen in series than in individual specimens.

A third species is here described as *E. cordia*, from Yucatan. This may prove to represent a race of *E. similatella* in eastern Mexico, since the genital characters are very similar to those of Busck's species. *E. cordia* is the only population in the complex with pale hindwings; all the others have dark brown hindwings in both sexes.

Fourth and fifth male genital types turned up in older material from Sonora and Nayarit on the west coast of Mexico. When we collected in that area in 1964 and 1965 considerable additional material was accumulated, but this revealed both *similatella* and *penthica* also present in the Sinaloan thorn forest and failed to clarify the status of the two new species. A few additional males of the Sonoran species described below as *E. scutula* were collected, but always along with *E. similatella*. The two are nearly indistinguishable superficially, and recognition of the female of *scutula* has not been possible.

The other of the two west coast species, previously known from a single battered specimen from Tepic, has subsequently been taken in Veracruz and proves to be a larger, darker moth which is superficially recognizable. The species is described below as *E. clava*; it is also quite distinctive in genital characters.

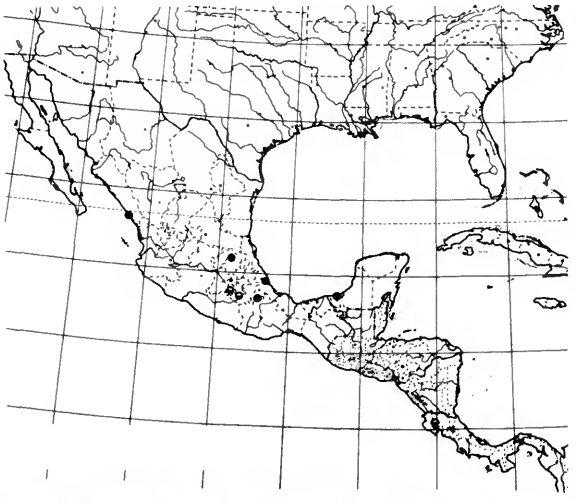
Only in the case of *E. similatella* was the female included in the type series, and the one topotypical genital preparation I have examined differs from all others in the complex which I have studied. Females associated by collection data for both *penthica* and *similatella* in Mexico suggest that structures associated with the ostium are geographically variable. Thus, I have not been able to draw species limits in female genitalia. Localities in Mexico and Costa Rica are represented only by females which do not closely match females from any area where males have been taken. One of these may represent *E. scutula* but cannot be assigned to species with certainty at present.

In the Mazatlan area, where three species have been collected, *E. penthica* has been taken only in late June, prior to the rainy season, while *E. similatella* was flying both then and in July and August, well into the rainy season, and *E. scutula* was encountered only in the latter period. *Ethmia scutula* can be distinguished from west coast *similatella* by a white spot at the apex of the forewing which encloses a single terminal dot; Sinaloan *similatella* have at most a trace of white near the apex, but as mentioned above this is a geographically variable character.

Ethmia penthica Walsingham

FIGURES 156, 266, 267; PLATE 18c; MAP 63

Ethmia penthica Walsingham, 1912:146.—Powell, 1959:145.



MAP 63.—Geographical distribution of *Ethmia penthica* Walsingham.
● typical populations
◒ populations of uncertain affinity (♀ only)

A species in southern Mexico with very elongate palpi and a strongly sinuate line dividing the costal brown and dorsal white areas of the forewing.

MALE.—Length of forewing 8.0 to 9.9 mm. *Head:* Labial palpus greatly elongate, well exceeding base of antenna; second segment length 1.45–1.60 times eye diameter, third slightly curved, 1.1–1.2 times eye diameter; scaling white with blackish brown bands, median and subapical on second segment, submedian and subapical on third. Antenna scarcely dilated, width of shaft near base 0.19 eye diameter; dorsal scaling dark brown with some scattered whitish near base. Scaling of tongue, front, and crown white; a large, median black spot at back of head. *Thorax:* Dorsal scaling white with five black or brownish spots: a large median one, a pair adjacent to tips of tegulae, and a pair at sides of scutellum which sometimes coalesce. Underside whitish, legs heavily marked with dark brown. *Forewing:* Length 3.2–3.4 times width; costa almost straight in middle; apex blunt, termen rather strongly angled back. Ground color divided by a sinuate line from base of Cu to termen above tornus, forming three broad, triangulate to nearly U-shaped projections of costal brown into the white, extending about halfway from Cu to dorsal margin, at basal one-fourth, middle of wing, and above tornus; dorsal white area extended beyond Cu between second and third brown projections

and in an irregular spur at end of cell; a blackish brown spot centrally placed in interspace between first two brown projections and another adjacent to the third, just above tornus, at times joined to third; dorsal white continued beyond tornus nearly to midtermen and reappearing at apex, interrupted by a narrow band of brown through termen. A row of about eight blackish spots around termen, two in apical white, one or two in terminal brown, about four in white above tornus. Fringe white at apex, broadly brown on termen, white at tornus. Underside dark brown. *Hindwing:* Slightly narrower than forewing; costa with a tight fold to end of cell, with an external brownish gray hair fringe and enclosing a whitish hair pencil; apex narrow, termen strongly curved to anal angle. Ground color dark brown, whitish inside fold. Fringe slightly paler, gray-brown. Underside dark brown. *Abdomen:* Dorsal scaling brown, basal segments paler; underside whitish brown; genital scaling ochreous, pale exteriorly. Genitalia as in Figure 156 (drawn from holotype, RWH slide no. 2324, and plesiotype, Tehuacan, JAP prep. no. 2370; six preparations examined); basal processes short, inconspicuous; valva moderately broad, costal "plume" originating well back from apex, costa evenly curved beyond, its apex round; vesica with a twisted plate and elongate, heavy spurlike cornutus.

FEMALE.—Length of forewing 8.0 to 9.4 mm. Essentially as described for male; labial palpus not more elongate; antenna not dilated, width of shaft basally 0.16 eye diameter; forewing ranging to broader, length 3.0–3.4 times width; hindwing costal area simple. Genitalia (Figure 266, drawn from plesiotype, Veracruz, JAP prep. no. 2736; four preparations examined) similar to *E. marmorea,* sterigma with a median, slightly flanged plate, ostium subtended by a short sclerotized band, antrum with ill-defined, variable sclerotization, ductus with about seven increasingly larger coils, signum not differing from *marmorea* and related species.

TYPE DATA.—Mexico, Oaxaca, Oaxaca (W. Schaus); unique male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Mexico: Sinaloa; Hidalgo, Veracruz, and Oaxaca to Campeche.

FLIGHT PERIOD.—Late June to August.

FOOD PLANT.—Unknown.

REMARKS.—The more elongate labial palpus and spurlike cornutus in the vesica will most easily distinguish *penthica.* The narrower forewing with the white (not tinged with gray) dorsal area more strongly contrasting with and more serpentinely invaded by the brown costal portion, the apical patch consistently enclosing two terminal dots, and the paler ochreous genital scaling are features by which the species can be superficially but less reliably segregated from other members of the complex.

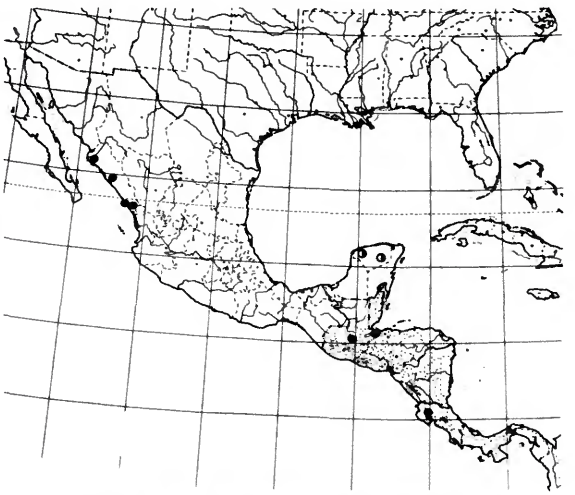
A series of 15 females from Costa Rica (4 km N Camas, Guanacasta Province, VII–12/19–65, D. Veirs) does not differ from Mexican material of *penthica* superficially, but the genitalia show the sterigmal area sufficiently different to indicate that another species may be involved (Figure 267, drawn from JAP prep. no. 2757; three preparations examined).

Ethmia similatella Busck

FIGURES 157. 269. 270: PLATE 18*e-f*; MAP 64

Ethmia similatella Busck, 1920:88.

A variable member of the penthica complex which has the dividing line between brown and white on the forewing less sinuate, so that the lobes of brown are less rounded and extend less broadly into the pale dorsal area.



MAP 64.—Geographical distribution of members of the Trifurcella group of *Ethmia.*
● *E. similatella* Busck ◑ *E. cordia* Powell

MALE.—Length of forewing 6.7–9.4 mm. *Head:* Labial, palpus elongate, exceeding base of antenna; length of second segment 1.3–1.4 times eye diameter, of third 1.0–1.15 times eye diameter. Antenna slightly dilated, width of shaft near base 0.19 eye diameter. General coloration as in *E. penthica,* with the pale areas usually tinged with grayish (usually somewhat less brownish than in *E. scutula*). *Forewing*: Moderately broad, length 2.9–3.1 times width. Color pattern similar to *E. penthica,* the longitudinal line dividing brown and whitish areas less sinuate so that the lobes of brown into white and the intervening white projections are less regularly U-shaped; outermost brown projection without an additional spot above tornus (present in *penthica*); white patch at apex present or absent. At times some ill-defined pale scaling in costal area near middle (similar to but less strongly developed than in *E. semiombra*). *Hindwing*: Modified with costal fold and hair pencil as in *E. penthica.* Ground color dark brown. *Abdomen:* Dorsal scaling dark brown, ventral paler, genital bright, deep ochreous (usually brighter than in *E. penthica*). Genitalia as in Figure 157 (drawn from plesiotype, Rio Temas, Guatamala, JAP prep. no. 1226; nine preparations examined); basal processes elongate, conspicuous; valva broad, costa evenly curved beyond "plume," drawn out into a narrow tip at apex of distal spur row; vesica with an ill-defined, twisted plate and a bunch of about 20 small spurs.

FEMALE.—Length of forewing 7.0 to 10.2 mm. Generally as described for male; eye slightly smaller, about 0.95 that of male; labial palpus variable, length of second segment 1.4–1.6 times eye diameter, of third, 1.10–1.35 eye diameter. Antena not dilated, width of shaft basally about 0.16 eye diameter. Forewing pattern at times more contrasting than in male, with greater tendency for pale scaling in costal area. Hindwing costal area simple; ground color dark brown, slightly darker than in male. Genitalia similar to *penthica,* differing by lack of the median plate of the sterigma and by more extensive sclerotization of the antrum and base of the ductus, which is greatly variable (Figures 269 and 270, drawn from paratype, Cayuga, Guatemala, and plesiotype, Sinaloa, JAP preps. 2169, 2355; six preparations examined).

TYPE DATA.—Guatemala, Cayuga (W. Schaus); type male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Western Mexico (Sinaloa) to Honduras, Guatemala, and Costa Rica.

FLIGHT PERIOD.—Probably multivoltine; records available for February, April, and August in Guatemala, July and August elsewhere.

FOOD PLANT.—Unknown.

REMARKS.—The type series has greater development of whitish on the forewing than in either Mexican or Costa Rican examples. Specimens from both latter areas are smaller (forewing length: ♂♂, 7.1–8.5 mm; ♀♀, 7.0–8.6 mm), with heavier grayish in the pale areas and lacking the apical white patch. Possibly some of these differences are seasonal, since all the topotypical examples which bear dates on the labels were collected in February and April, while those from Mexico and Costa Rica were taken in July and early August. Differences in female genitalia, primarily in the degree of sclerotization in the basal part of the ductus, occur among several populations. Most *Ethmia* have not shown intraspecific variation of this magnitude.

Ethmia cordia Powell, new species

FIGURES 158, 268; PLATE 18*d*; MAP 64

Another brown and white *marmorea*-like species, from eastern Mexico, with pale hindwings.

MALE.—Length of forewing 7.9 to 8.3 mm. *Head*: Labial palpus elongate, exceeding base of antenna; second segment length 1.25 to 1.40 times eye diameter; third segment 0.88–0.92 as long as second (1.15–1.25 eye diameter), nearly straight; scaling appressed, white banded with brown, each segment with submedian and subapical bands, not complete interiorly. Antenna scarcely dilated, width of shaft basally about 0.19 eye diameter; dorsal scaling brown. Scaling of tongue, front, and crown white, a pair of lateral spots below eyes and occipital tufts at middorsum dark brown. *Thorax:* Dorsal scaling white, extreme base of tegula dark; notum with five rather large blackish spots: one in middle, lateral pairs adjoining apices of tegulae and at sides of scutellum. Underside whitish, prothoracic and mesothoracic legs heavily marked with blackish exteriorly; hind tibial fringe short, pale ochreous. *Forewing:* Length about 3.0 times width; costa

curve appearing flattened on middle one-third; apex blunt, termen straight, moderately strongly angled back. Ground color divided by a sinuate, longitudinal line along Cu fold, dark brown above, white below to dorsum; dark ground of cell dipping below Cu as shallow lobes at basal one-fourth and middle, the white projected upward as a shallow triangulate lobe at end of cell; two dark spots in dorsal area, first near margin between dark lobes, second larger, beyond lower corner of cell; a white blotch on costa just before apex, costal half otherwise nearly unicolorous. A row of marginal, blackish dots, slightly darker than costal half of wing, from costa before apex to tornus, two in apical white blotch, three scarcely visible in dark terminal area, three or four in tornal area. Fringe concolorous with adjoining areas. Underside dark brown, the pattern of upperside faintly visible; dorsal area pale whitish ocherous. *Hindwing:* Slightly narrower than forewing; costa with a rather broad fold to end of cell, having on its exterior (ventral side of wing) a dark fringe and enclosing a whitish hair pencil. Ground color whitish basally becoming pale brownish distally. Fringe whitish. Underside whitish except costal fold area and apex brownish. *Abdomen*: Dorsal scaling pale brownish gray, ventral brownish basally becoming whitish distally, genital ochreous. Genitalia (Figure 158, drawn from paratotpotype, JAP prep. no. 1514; two preparations examined); similar to *E. similatella,* valva apex blunt, distal "plume" before end of costa with apical setation only, distal seta bunch an elongate, curved row of stout setae; vesica with an irregular platelike cornutus without a well-defined spur.

FEMALE.—Length of forewing 8.0 mm. Essentially as described for male; eye slightly smaller, labial palpus as large; antennal shaft narrower, about 0.8 that of male. Forewing very slightly broader, length 2.9–3.0 times width. Hindwing costal area simple; broader, ground color brown. Abdomen dorsum brown, genital ochreous reduced. Genitalia similar to less strongly sclerotized forms of *similatella,* sterigma with a small, median, pointed projection, antrum lightly sclerotized (Figure 268, drawn from paratopotype, JAP prep. no. 2070; one preparation examined).

TYPES.—Holotype male and allotype female: Mexico, Chichen Itza, Yucatan, May 27, 1955, and February 26, 1956 (E. C. Welling), deposited in California Academy of Sciences. Thirty-eight paratypes, all Yucatan, as follows: Chichen Itza, 2♂, V–5, 27–54, 1♂, VI–23–54, 3♂, V–19, 25–56 (E. Welling); Merida, 29♂, 3♀, VII–29/30–64 (P. J. Spangler); deposited in California Insect Survey, Carnegie Museum, and U.S. National Museum.

REMARKS.—This species is similar to *E. penthica* in color, but as discussed above, *cordia* may be a race of *similatella.* The pale hindwing will serve to distinguish the present species.

Ethmia scutula Powell, new species

FIGURE 159; PLATE 18*g*

A *penthica*-like species from the west coast of Mexico that has the dorsal pale area of the forewing clouded with brownish gray, the labial palpus only moderately elongate, and the antenna not dilated.

MALE.—Length of forewing 7.7 to 8.4 mm. *Head*: Labial palpus elongate, exceeding base of antenna; second segment length 1.20–1.35 times eye diameter; length of third 1.10–1.15 times eye diameter. Antenna not dilated, width of shaft near base 0.16–0.17 eye diameter. General coloration and pattern similar to *E. penthica* except the pale areas clouded with brownish gray. *Forewing*: Moderately broad, length 2.9–3.1 times width. Pattern as in *penthica* except tending to be less distinct in apical and tornal areas owing to infusion of brown in pale areas; the whitish dorsal area narrowly lacking its brownish cast adjacent to the dark markings and in apical patch. *Hindwing:* Modified with costal fold and hair pencil as in *E. penthica.* Ground color dark brown. *Abdomen:* Dorsal scaling dark brown, ventral paler, genital ochreous, about as pale as in *penthica.* Genitalia as in Figure 159 (drawn from paratype, Alamos, JAP prep. no. 1154; four preparations examined); basal processes elongate, conspicuous; valva narrow, with costal "plume" originating well subapicad and costa produced into a distinct apical peak beyond plume; vesica with a twisted, well-defined plate, without spurs or spines.

FEMALE.—Unknown.

TYPES.—Holotype male: Mexico, 6 miles south of Culiacan, Sinaloa, August 6, 1964, at black and white lights (J. A. Chemsak and J. Powell); deposited in California Academy of Sciences. Four

paratypes, all Mexico: 5 mi N Mazatlan, Sinaloa, 1♂, VII–24–64, 1♂, VIII–5–64 (J. A. Chemsak and J. Powell); Alamos, Sonora, 2♂, VII–25 to VIII–7–53 (F. S. Truxal); deposited in California Insect Survey, Los Angeles County Museum, and U.S. National Museum.

REMARKS.—This species may be distinguished from its sympatric close relatives by its shorter palpi and more heavily infuscated pale areas than in *penthica* and by possession of the apical white spot which is lacking or reduced to a trace in *similatella*. However, *scutula* is virtually indistinguishable superficially from some Central American *similatella*. The genital characters are quite distinctive, especially the produced apical area of the valva, and this may be seen on the whole specimen by brushing away some of the scaling.

Ethmia pala Powell, new species

FIGURES 160, 272; PLATE 18*h-i*

A small moth from the west coast of Mexico, resembling *hodgesella* but with restricted white markings, intermediate in pattern towards *penthica*.

MALE.—Length of forewing 6.7 to 7.3 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding base of antenna; second segment length 1.45–1.55 times eye diameter; third segment 0.75–0.80 as long as second (1.1–1.2 times eye diameter); smooth scaled, whitish, with basal half of second segment exteriorly, narrow subapical band and submedian, and subapical bands of third segment brownish black. Antenna slightly dilated, width of shaft basally about 0.20 eye diameter; dorsal scaling grayish brown, scape white basally. Scaling of tongue, front, and crown white, latter with a few intermixed brownish scales, a pair of small, lateral, brownish spots under eyes, at times some middorsal brownish in occipital tufts. *Thorax:* Dorsal scaling white, tegula basally and five rather large spots on notum dark brown: a median one and lateral pairs adjoining apices of tegulae and at sides of scutellum. Underside white, legs heavily marked with dark gray-brown exteriorly. *Forewing:* Length 3.0–3.1 times width; costa gently curved from base to apex, termen convex, moderately strongly angled back. Pattern divided by a line along Cu fold, strongly sinuate, as in *E. hodgesella,* with rounded lobes from dark costal half extended about halfway from Cu to dorsal margin, at basal one-fourth and beyond middle and nearly to margin at tornus, the intervening whitish lobes extended across Cu at middle and end of cell; a small, dark spot just beyond and below basal dark lobe; a white spot at end of cell, nearly detached from the subtending whitish lobe; apex rather broadly white, subtended by a narrow, dark band along termen; some scattered pale scaling in costal area; a row of blackish spots along termen, at midtermen beyond the white band blending with brownish gray fringe. Underside brown, a spot at base of cell and fringe at apex and tornus paler. *Hindwing:* Narrower than forewing; costa with a rather narrow, tightly appressed fold to beyond end of cell, with a thick grayish fringe above, exteriorly (ventral side of wing) and enclosing a white hair pencil from base; apex blunt, termen rather strongly angled back, tornal angle scarcely evident. Ground color uniform gray-brown; fringe paler. Underside grayish brown, somewhat mottled. *Abdomen:* Dorsal scaling pale grayish brown, tinged with ochreous basally, ventral and genital scaling paler, whitish gray (Not ochreous). Genitalia as in Figure 160 (drawn from paratype, Venadio, JAP prep. no. 802, two preparations examined); uncus lacking, anal sheath not sclerotized, basal processes short, valva attenuated apically, apical projection of costa elongate, narrow, with scarcely any setation; distal seta-bunch a dense, broad row of numerous heavily sclerotized spurlike setae; vesica with a poorly defined sclerotized band.

FEMALE.—Length of forewing 6.5 to 7.4 mm. Generally as described for male. Labial palpus relatively more elongate (second and third segments each 1.4–1.5 times eye diameter). Antenna scarcely narrower than male. Forewing slightly narrower, length 3.1–3.2 times width. Hindwing costal area simple. Abdominal scaling slightly darker, not tinged with ochreous. Genitalia as in Figure 272 (drawn from paratype, JAP prep. no. 2305; one preparation examined); sterigma a simple, three-sided hood; ductus with a weak sclerotization near base, tightly coiled; signum as in related species but with relatively smaller inner ridge and emargination.

TYPES.—Holotype male and allotype female: Mexico, 6 miles south of Culiacan, Sinaloa, August 6, 1964 (J. A. Chemsak and J. Powell), deposited in California Academy of Sciences. Six paratypes, all Mexico, as follows: same data as holotype, 2♂♂, 2♀♀; "Venadio, Sinaloa," 1 ♂, 1♀, B. P. Clark, donor (no further data); deposited in collections of California Insect Survey and U.S. National Museum.

REMARKS.—The unique male genitalia place *E. pala* apart from the remainder of the Trifurcella group.

Ethmia clava Powell, new species

FIGURES 162, 274; PLATE 18*j*

A brown and white moth resembling *E. similatella,* superficially differing by its larger size and relatively larger palpi, and by having the pale markings gray instead of white.

MALE.—Length of forewing 9.4–11.0 mm. External features generally as described for *E. similatella,* differing as follows: *Head:* Labial palpus somewhat more elongate, well exceeding base of antenna; second segment length 1.40 to 1.55 times eye diameter; third segment 1.1–1.2 times eye diameter; dark markings enlarged to all but narrow white bands, postmedian and apical on each segment. Antenna slightly dilated, width of shaft basally 0.21 eye diameter. Dark middorsal scaling of occipital tufts more extensive. *Forewing:* Length 3.3–3.5 times width; color pattern similar but darker, dorsal pale area gray, narrowly white adjacent to brown markings; costal area blackish brown, more extensive, the lobes into dorsal area reaching more than half way from Cu to dorsal margin, the pale area between them scarcely touching Cu; costal area with some indistinct gray blotches along costa and an apical spot; dorsal area with a brown spot just above dorsal margin preceding tornus, below pale spur at end of cell. *Hindwing:* Costal fold broad, with a large exterior brush, its hair scales blackish becoming whitish apically and enclosing a dense, elongate hair pencil, gray basally becoming ochreous apically. Ground color dark gray-brown. *Abdomen:* Darker brown than in *similatella;* genital tufts bright ochreous, relatively smaller. Genitalia as in Figure 162 (drawn from paratypes, Tepic, Cordoba, JAP prep. nos. 1091, 2093; two preparations examined); anal sheath moderately strongly sclerotized, valva broader than in related species, with a pointed projection along distal margin of saccullar area, "plume" subapical, broad, heavily sclerotized; distal seta-bunch a compact group of about eight spurlike setae; vesica without a well defined cornutus.

FEMALE.—Length of forewing 10.4 to 10.6 mm. Essentially as described for male; labial palpus relatively slightly shorter, second segment length 1.4–1.6, third 1.3 times eye diameter; antenna not dilated, width of shaft near base about 0.85 that of male. Hindwing costal area simple. Genital scaling bright ochreous, reduced from that of male. Genitalia (Figure 274, drawn from paratopotype, JAP prep. no. 2096; one preparation examined); similar to *E. marmorea,* sterigma a narrow ring, ostium subtended by a narrow, sclerotized sleeve and greatly enlarged, heavily sclerotized antrum, ductus with about six tight coils, signum with a slightly smaller emargination than in *penthica* and related species.

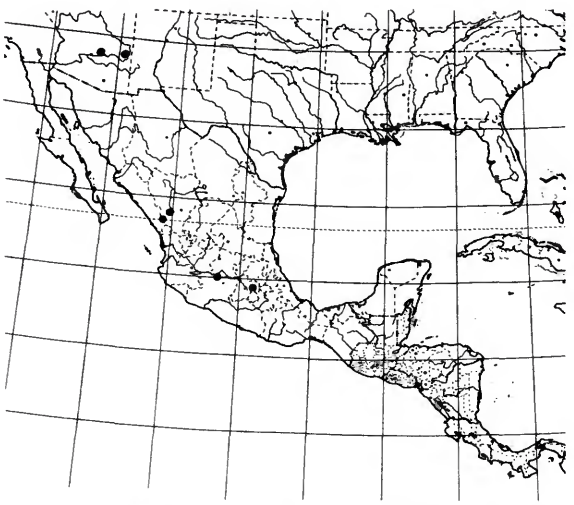
TYPES.—Holotype male and allotype female: Mexico, Cordoba, Veracruz, July 20, 1966 (J. S. Buckett and M. R. and R. C. Gardner); deposited in American Museum of Natural History and California Academy of Sciences. Twelve paratypes, all Mexico: same data as holotype, 9♂, 2♀, VI–29 to VII–25–66; Tepic, Nayarit, 1♂, IX–8–34 (C. C. Hoffmann); deposited in American Museum of Natural History, California Insect Survey, and U.S. National Museum.

Ethmia sphenisca Powell, new species

FIGURES 161, 275; PLATE 19*a*; MAP 65

A moderately large, black and white *Ethmia* superficially resembling *E. semilugens,* from the high mountains of Arizona and northwestern and central Mexico.

MALE.—Length of forewing 10.0–13.0 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; second segment length 1.30–1.35 times eye diameter; third segment 0.85–0.93 as long as second; smooth scaled, white, basal half of second segment black exteriorly, third segment with basal and apical black bands. Antenna only slightly dilated, width of shaft basally about 0.20 eye diam-



MAP 65.—Geographical distribution of *Ethmia sphenisca* Powell.

eter; dorsal scaling dark gray. Scaling of tongue dark gray, of front and crown white, a small spot below eye and occipital tuft at middorsum broadly dark blue-black. *Thorax:* Dorsal scaling white, marked with blue-black; on tegulae basally and adjoining lateral areas of collar, notum with a large median spot, at times contiguous with lateral spots adjoining apices of tegulae, a pair of spots at sides of scutellum. Underside whitish, prothoracic and mesothoracic legs mostly dark gray exteriorly, hind tibial fringe rather short, pale brownish. *Forewing:* Length 3.2 times width; costa gently curved from base to apex, termen strongly angled back. Ground color divided by a sinuate longitudinal line from base to termen, dorsal area below line narrowly white, sending a pointed projection to Cu fold at basal one-fourth and another beyond Cu at end of cell, each projection containing a conspicuous black spot; remainder of wing costad of longitudinal line brownish black or black, only slightly paler toward costa; a white spot on costa just before apex, containing a marginal black dot; two other marginal dots in white area at tornus, the remainder not discernible in dark ground. Fringe concolorous with adjoining wing areas. Underside dark brownish gray; the dorsal white areas of upperside visible. *Hindwing:* About as broad as forewing; costal area with a narrow fold from base to end of cell, containing a thin, white hair pencil, apex rather acute, termen strongly angled back, straight, tornal angle visible. Ground color whitish gray, slightly darker distally; fringe irregularly grayish. Underside paler, mottled grayish in apical and costal areas. *Abdomen:* Dorsal scaling gray-brown, basal two segments tinged with dark ochreous; underside paler, genital scaling bright ochreous. Genitalia as in Figure 161 (drawn from paratype, Mexico City, JAP prep. no. 805; five preparations examined); uncus absent, apical "plume" of valva densely setose throughout, apical seta-bunch borne on a flaplike extension, containing two elongate, recurved and three or four smaller, heavy setae, preceded by a broad projection at end of saccular margin.

FEMALE.—Length of forewing 10.5 to 11.9 mm. As described for male; eye slightly smaller (diameter about 0.9 that of male), labial palpus as large; antenna scarcely smaller. Hindwing costal area simple. Genitalia with sterigma a simple ring produced ventrad, subtended by a long, sclerotized sleeve and an enlarged, membranous antrum and four membranous coils in ductus; signum not differing from *E. marmorea* and related species (Figure 275, drawn from paratype, Michoacan, JAP prep. no. 2299; two preparations examined).

TYPES.—Holotype male and allotype female: Mexico, 10 miles west of El Salto, Durango, 9,000 feet elevation, June 6 and July 9, 1964 (H. F. Howden and J. E. H. Martin), deposited in Canadian National Collection. Eight paratypes, as follows: *Mexico:* same data as holotype, 1♂, VI–26–64; 8 mi W El Palmito, Sinaloa, 1♀, VIII–19–64 (J. A. Chemsak and J. Powell); 60 mi E Zamora, Michoacan, 1♀, VI–24–57 (J. A. Chemsak); Mexico City, D. F., 1♂, July 1918 (R. Muller). *Arizona:* White Mountains, Apache Indian Reservation, Greenlee County, 7,000 feet, 1♂, VI–15–30, 1925 (O. C. Poling); Tonto Creek Campground, near Kohls Ranch, Gila County, 1♂, 1♀, VI–27–29–56 (Martin, Comstock, Rees); Tonto Creek Fish Hatchery, 6,400 feet, Gila County, 1♂, VI–30–56 (Martin, Comstock, Rees). Deposited in California Insect Survey, Canadian National Collection, Los Angeles County Museum, and U.S. National Museum.

REMARKS.—This species is similar to darker forms of *E. marmorea,* but complete lack of whitish scaling along the costa will distinguish *E. sphenisca,* which is not closely related to the rest of the Trifurcella group according to genitalia characters.

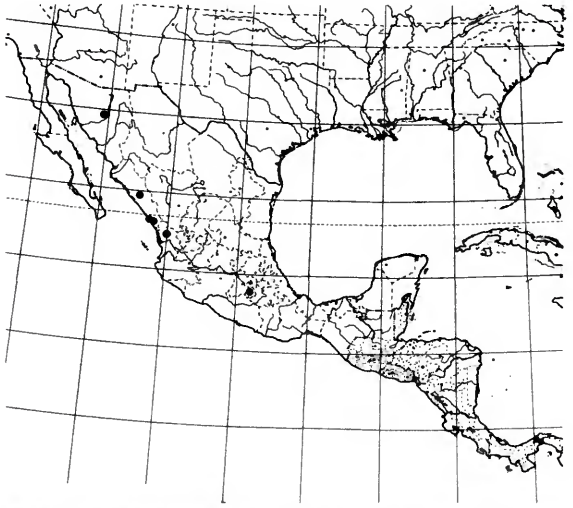
Ethmia heptastica Walsingham

FIGURES: 34, 35, 163, 273; PLATE 19*b*; MAP 66

Ethmia heptastica Walsingham, 1912:146, pl. 5, fig. 8.—Powell, 1959:145.

A dark brownish moth in southern Mexico with the general appearance of species in the penthica complex but with seven rather than five spots on the notum.

MALE.—Length of forewing 7.4 to 11.0 mm. *Head:* Labial palpus elongate, strongly curved, well exceeding base of antenna; second segment length 1.5–1.6 times eye diameter; third segment 0.75–0.82 as long as second (1.15–1.33 times eye diameter), smooth scaled, whitish, second segment with a broad median and narrow subapical blackish band, third segment with submedian and subapical black bands. Antenna slightly dilated, width of shaft about 0.20 eye diameter; dorsal scaling dark gray. Scaling of tongue, front, and crown whitish, small spot below eye and occipital tufts at middorsum blue-black. *Thorax:* Dorsal scaling whitish tinged with grayish; seven well-defined, subequal blue-black spots: a pair adjoining collar between tegulae, a pair adjoining tegulae apices, a median one between them, a pair at sides of scutellum. Underside whitish, legs marked with grayish brown exteriorly; hind tibial fringe rather elongate, pale brownish. *Forewing:* Moderately broad, length 2.9 to 3.3 times width; costa evenly, gently curved from base to apex; termen rather strongly angled back. Ground color divided by a longitudinal line along Cu fold, costal half dark brown, the line forming two irregular, squarish spurs of dark from cell into pale dorsal area at basal one-fourth and middle; a dark dot just beyond and below basal spur; dorsal area uniformly pale grayish brown except narrowly whitish adjoining dark costal half, extended as an irregular spur at end of cell, the dividing line becoming obscure beyond, some pale infusion extending along termen. Fringe brown. Underside brown. *Hindwing:* About as broad as forewing; costa narrowly folded on basal half, enclosing a thin, whitish or pale brownish hair pencil; apex rather acute, termen strongly angled back, straight, tornal angle evident. Ground color uniform dark brown, fringe scarcely paler; underside similar. *Abdomen:* Dorsal scaling dark brown, basal two terga tinged with dark ochreous; ventral scaling dull whitish, genital pale, dull ochreous. Genitalia as in Figure 163 (drawn from plesiotype, Venadio, Sinaloa, JAP prep. no. 799; four preparations examined); uncus lacking, basal processes elongate, setose, originating dorsad of the elongated fultura plates; apical "plume" of valva a broad membranous flap with sparse, broad, bified scalelike setae; distal seta-bunch a compact group of three broad, flat setae at the apex of a sclerotized projection; vesica with a lightly sclerotized, ill-defined cornutal plate.



MAP 66.—Geographical distribution of *Ethmia heptastica* Walsingham.

FEMALE.—Length of forewing 9.0–10.7 mm. Essentially as described for male; eye smaller, and as a result labial palpus relatively slightly longer; antenna scarcely narrower. Hindwing costal area simple. Genitalia as in Figure 273 (drawn from plesiotype, Mazatlan, JAP prep. no. 2788; four preparations examined); sterigma a broad, depressed plate, ostium rimmed anteriorly by a narrow, curved band, base of ductus with a weakly sclerotized band, antrum small, with a weakly sclerotized band, signum a broad, shallow fold with lateral flanges, its inner ridge notched as in *E. marmorea* and related species, yet serrate on either side of the notch as well.

TYPE DATA.—Mexico, Tonalapa, Guerrero, June (H. H. Smith); unique female type in British Museum. Tonalapa is a village 26 km south of Iguala, according to Selander and Vaurie (1962).

GEOGRAPHICAL DISTRIBUTION.—West coast of Mexico from Sonora ("30 E of Carbo") and Sinaloa

(Culiacan, Mazatlan) south to Cuernavaca and northern Guerrero.

FLIGHT PERIOD.—June, July, August.

FOOD PLANT.—Unknown.

REMARKS.—This species is similar in appearance to members of the *marmorea-penthica* series, but *heptastica* is distinguishable superficially by the seven, rather than five, thoracic spots. Both male and female genital characters place *heptastica* distinct from any of the other brown and white forewing species.

Inasmuch as Walsingham based the name on a unique female, which I have not seen, there can be room for doubt as to the identification. However, the material available is little variable, matching *heptastica* in the seven thoracic spots and the smoky suffusion on the pale dorsal area of the forewing; and examples from Sinaloa compare well in genital features with a male from Cuernavaca, Morelos, which is near the type locality.

Ethmia oterosella Busck

FIGURE 164; PLATE 19c

Ethmia oterosella Busck, 1934:165, pl. 36, fig. 4.

A small Cuban *Ethmia* superficially resembling *E. macelhosiella* in wing pattern and color.

MALE.—Length of forewing 6.7–7.8 mm. *Head:* Labial palpus moderately elongate, slightly exceeding base of antenna; second segment slightly longer than eye diameter, third segment straight, 0.85 as long as second; smooth scaled, whitish, indistinctly blotched with brownish exteriorly, white interiorly. Antenna not dilated, width of shaft near base about 0.16 eye diameter; dorsal scaling pale brown, occiptal tufts without a defined spot. *Thorax:* Dorsal scaling concolorous with head, no defined spots (all specimens available damaged at middorsum). Underside whitish, prothoracic leg marked with dark brown, mesothoracic and metathoracic legs with pale brownish. *Forewing:* Length 3.3–3.4 times width; costa slightly more strongly curved basally, apex rather acute, termen strongly angled back, tornal angle scarcely evident. Ground color divided by a line along Cu fold, dorsal half whitish, costal half blackish along Cu, blending to brown through cell and to whitish at costa; terminal area mostly whitish brown; two indistinct, flat spurs of pale brown extend beyond Cu in basal half, the dividing line thence angled towards apex to form a distinct, white spur at end of cell, beyond which the line becomes indistinct; some scattered black scales tend to form lines along the veins on costal half and beyond cell. Fringe whitish. Underside pale brownish. *Hindwing:* Slightly narrower than forewing, costa with a tightly appressed, narrow fold to end of cell, enclosing an elongate brush of yellowish white hair scales; apex acute, termen strongly angled back. Ground color whitish, becoming pale brownish distally. Fringe whitish. Underside white. *Abdomen:* Dorsal scaling grayish, ventral white, genital whitish. Genitalia as in Figure 164 (drawn from plesiotype, Santiago, JAP prep. no. 1609; one preparation examined); uncus lacking, basal processes large; valva narrow distally, lacking distal seta bunch, subapical "plume" large, setate on the broad distal half, subtended by a group of unsually elongate, fine setae on inner face of valva.

FEMALE.—Length of forewing 7.4–8.0 mm. Externally essentially as described for male, differing as follows (one specimen): eye slightly smaller, labial palpus second segment slightly longer, third segment shorter than in male. Hindwing costal area simple, ground color slightly darker, mostly pale brown. Genitalia not studied; signum figured by Busck (1934), serrate, similar to *E. heptastica,* but without a median notch.

TYPE DATA.—Estacion Experimental Agronomica, Santiago de las Vegas, Cuba; holotype female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Cuba (Santiago and Trinidad Mountains).

FLIGHT PERIOD.—June, July, October.

FOOD PLANT.—The type is labeled "leaf tier on bejuco de canasta" by Mr. Otero. This was reported by Busck (1934) to be *"Stenospermum hamilifolia"*; a misspelling of *Stegnospermum halimifolia* Benth. (Phytolaceae). Either this plant ("Bejuco de canasta Blanco") or *Trichostigma octandrum* (L.) (Phytolaccaceae ("Bejuco de canastas") appears to be a possible host if Busck's identification originated from an inference from the common name on the label (c.f. Roig y Mesa, 1953).

REMARKS.—The genital characters place this species as distinct from all other known *Ethmia* but most similar to members of the Trifurcella group.

The Prattiella Group

Eye index ±1.0. Labial palpus short, II segment 0.8 eye diameter; rough scaled. Antenna of male slightly dilated, index ±0.21. Forewing moderately broad; pattern transverse dot rows. Hindwing of male unmodified. Abdomen scaling undifferentiated. Uncus and gnathos absent; basal processes membranous, narrow; valva with cucullus "plume" with flat sclerotized nonbifid scales on distal margin; vesica-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma ornate, antrum enlarged with sclerotized band; ductus bursae sclerotized basally, six membranous coils beyond; signum a broad cone.

A single species of southern Texas and northern Mexico which shows close similarity to no other species.

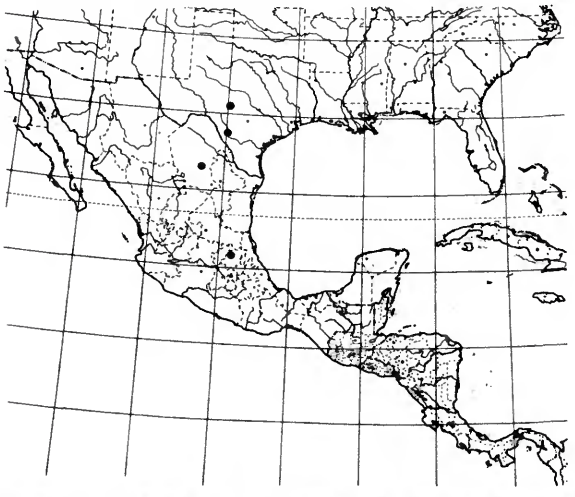
Ethmia prattiella Busck

FIGURES 165, 277–279; PLATE 19*d*; MAP 67

Ethmia prattiella Busck, 1915:85.—Barnes and Busck, 1920, pl. 26.—McDunnough, 1939:83.

A rarely collected species of Texas and eastern Mexico with white forewings marked by tiny black dots.

MALE.—Length of forewing 8.4 mm. *Head:* Labial palpus rather short, not much upcurved, not attaining base of antenna; second segment slightly curved, length about 0.8 eye diameter; third segment straight, as long as second; scaling white, roughened on second segment. Antenna slightly dilated, width of shaft basally slightly about 0.21 eye diameter; dorsal scaling whitish basally becoming pale brownish gray beyond. Scaling of tongue, front, and crown white, faintly tinged with brownish posteriorly. *Thorax:* Dorsal scaling white, pairs of small blackish spots on notum adjoining collar near tegulae and at sides of scutellum. Underside white, femora, tibiae, and tarsi mostly pale brownish gray exteriorly. *Forewing:* Length about 3.1 times width; costa gently curved from base to apex, latter acute, termen strongly angled back. Ground color white, markings of small black dots (about 0.4 eye diameter) as follows: a row of about five dots from base toward apex through costal half of cell (the fourth spot sometimes reduced to a trace), the basal two each subtended by a spot in cell at base and just beyond; a curving row of about six dots from dorsal area at basal one-fourth upward into cell to end of cell and thence toward tornus; a single spot in terminal area beyond cell; a row of about ten dots at margin, subtending fringe, from well before apex to tornus. At times one or more of the dots reduced or obsolete. Fringe entirely white. Underside pale brownish gray. *Hindwing:* As broad as forewing; costal area simple, without fold or hair pencil, nearly straight; apex narrow, termen strongly angled back. Ground color uniform pale brown; fringe white. Underside similar, with scattered whitish scaling. *Abdomen:* Scaling shining whitish gray; genital tuft white. Genitalia as in Figure 165 (drawn from plesiotype, Hidalgo, Mexico, JAP prep. no. 1629; one preparation examined); uncus lacking, basal processes elongate, slender; valva with short apical "plume" and a row of 12 heavily sclerotized, bladelike setae on distal margin; vesica with a row of toothlike cornuti.



MAP 67.—Geographical distribution of *Ethmia prattiella* Busck.

FEMALE.—Length of forewing 8.5 to 8.7 mm. As described for male, differing as follows: eye slightly smaller (about 0.9 that of male), labial palpus slightly smaller (second segment about 0.77–0.88 eye diameter), antenna not dilated, width of shaft basally about 0.15 eye diameter. Forewing slightly narrower, length about 3.3 to 3.5 times width. Genitalia as in Figures 277–279 (drawn from plesiotype, Coahuila, JAP prep. no. 2591; one prepara-

tion examined); sterigma complex, produced ventrally, contiguous with broad sclerotized area of ductus, signum with a single, narrow keel.

TYPE DATA.—"Zavalla Co., Tex; April" (F. C. Pratt); the unique female type in the U.S. National Museum bears the additional data: Nueces River, Zavalla [now Zavala] County, IV–26–10.

GEOGRAPHICAL DISTRIBUTION.—West-central Texas to eastern central Mexico. Only three specimens in addition to the type have been available for study: 1 ♂, Junction, Kimble County, Texas, IV–3–68 (A. Blanchard); 1 ♀, 3 mi S Gloria, Coahila, Mexico, VII–28–59 (E. E. Remington); 1 ♂, 10 mi S Jacala, Hidalgo, Mexico, I–6–41 (G. E. Bohart).

FLIGHT PERIOD.—January (central Mexico), April (Texas), and July (northern Mexico).

FOOD PLANT.—Unknown.

REMARKS.—This species bears a superficial resemblance to *E. apicipunctella,* but the male genitalia characters place *E. prattiella* well distinct from any known species, perhaps closest to the Trifurcella group.

The Joviella Group

Eye index ±1.2. Maxillary palpus moderately large, four segments, lengths about 3:3:3:5. Labial palpus moderately elongate, II segment index 1.4; smooth scaled. Antenna of male dilated, index 0.26–0.30. Forewing moderately broad; pattern transverse dots. Hindwing of male with hair pencil enclosed in Sc pinch-fold. Abdomen with specialized scaling on I-II terga. Uncus and gnathos absent; basal processes membranous, narrow; valva with cucullus "plume," setate apically; with modified scalelike setae that are bifid apically; with distal notch, fultura-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses elongate; sterigma simple; antrum enlarged; ductus bursae membranous, one loose coil; signum simple spurs.

Two small species in Central America and northern South America and the lesser Antilles. The pair shows no close similarity to other groups and phenetic assessments yielded varying indications of relationships among the Trifurcella, Confusella, and Punctessa groups.

Ethmia linda Busck

FIGURES 36, 37, 167, 280, 281; PLATE 19*e*; MAP 51

Ethmia linda Busck, 1914c:255.—Amsel, 1956:293, pl. 57.

A small, widespread Neotropical *Ethmia* having the white forewing marked by about ten black dots.

MALE.—Length of forewing 7.0–7.3 mm. *Head:* Labial palpus elongate, well exceeding base of antenna; second segment moderately curved, length 1.15–1.20 eye diameter; third segment slightly curved, 1.0–1.1 as long as second; smooth scaled, white, second segment exteriorly with ill-defined dark scaling on basal half and a distinct black preapical band, third with some blackish near apex. Antenna slightly dilated, width of shaft near base 0.21–0.24 eye diameter, dorsal scaling entirely white. Scaling of tongue, front, and crown white, a large, black middorsal spot on posterior half of head. *Thorax:* Dorsal scaling white, collar and tegulae dark basally, four black spots on notum, a large pair adjacent to tegulae distally and a smaller pair at sides of scutellum. Underside white, prothoracic and mesothoracic tibiae and tarsi marked with pale brown; hind tibial fringe rather sparse but elongate. *Forewing:* Length about 3.0 times width; costa evenly curved, apex blunt, termen moderately strongly angled back, tornal angle distinct. Ground color white, faintly tinged with grayish on costal half. Markings as distinct, black, round spots about 0.5 to 0.75 eye diameter, as follows: one in cell at base contiguous with a black shade on basal half of costa, a second spot just beyond base in subcostal area, a row of three dots upwardly oblique from dorsal area at basal one fifth towards midcosta, the first below Cu followed by two in cell, a second, almost parallel, row of four spots from dorsal area at basal one-third to costa before apex, the first just above dorsal margin, second adjoining Cu before end of cell, third adjoining end of cell and fourth before apex; a single spot in tornal area beyond end of cell and sometimes one just below and beyond the preapical area; a row of small, black dots around termen at base of fringe nearly confluent to form a line; fringe white. Underside dark brown with scattered white scales in subcostal and dorsal areas and a pale area of reduced scaling below Sc beyond retinaculum; fringe pale. *Hindwing:* About as broad as forewing; costal area with a broad pinch-fold from base to beyond end of cell, bearing a fringe of whitish hair scales externally while enclosing a thick brush of distally broadened white scales;

costal margin nearly straight, apex blunt, termen moderately strongly angled back. Ground color brown, usually dark at least distally; fringe whitish. Underside whitish, indistinctly brownish in costal area. *Abdomen:* Dorsal scaling of basal two segments dull ochreous, remainder shining grayish; underside whitish, genital scaling whitish, dorsolateral tufts ochreous. Genitalia as in Figure 167 (drawn from plesiotype, Guatemala, JAP prep. no. 1218; four preparations examined); uncus absent, basal processes enlarged, valva with a cucullus lobe preceded by a deep cleft, bearing the apical "plume," distal margin with a pair of broad, flat, bladelike setae, vesica with a lightly sclerotized, ill-defined apical plate.

FEMALE.—Length of forewing 7.0 to 7.3 mm. As described for male in external features, except as follows: eye slightly smaller, labial palpus as large as in male, antenna not dilated, width of shaft about 0.75 that of male. Hindwing costal area simple, ground color darker. Second tergite of abdomen only lightly tinged with ochreous scaling. Genitalia with sterigma simple, only lightly sclerotized, base of ductus with a short, sclerotized sleeve; ductus membranous with only one loop; signum variable, with one large and two or three smaller or only a single, flat inner tooth (Figures 280–281, drawn from plesiotype, Veracruz, JAP prep. no. 2592; three preparations examined).

TYPE DATA.—Caracas, Venezuela; type female in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Venezuela to southern Mexico (eastern Oaxaca, Veracruz, and Yucatan).

FLIGHT PERIOD.—March (Yucatan), July (Veracruz and Oaxaca), August and October (Guatemala), November (Venezuela).

FOOD PLANT.—Unknown.

Ethmia joviella Walsingham

FIGURE 168; PLATE 19*f*; MAP 51

Ethmia joviella Walsingham, 1897:90.

A small *Ethmia* resembling *E. linda,* differing by having fewer forewing spots; the unique type from Grenada was not studied during this study, but material from Dominica upon which the following description is based matches Walsingham's description.

MALE.—Length of forewing 6.0–6.7 mm. *Head:* Labial palpus greatly elongate, strongly curved, exceeding crown; second segment length 1.25 times eye diameter; third segment curved, slightly longer than second, 1.25–1.30 times eye diameter; white, dusted with brownish near base ventrally and near apex. Antenna dilated, width of shaft near base 0.26 eye diameter; dorsal scaling including scape brownish. Remainder of head scaling white. *Thorax:* Dorsal scaling white, collar brownish at base; metathoracic brushes short, ochreous. Underside dull whitish; prolegs and mesotarsi marked with dark gray. *Forewing:* Length 3.1–3.4 times width; costa rather strongly curved, termen convex, fringe short, outline oval in appearance. Ground color white, costal area broadly dusted with brownish gray. Markings black, pattern similar to *E. linda,* spots smaller (largest spots about 0.6 eye diameter): extreme costal edge in basal one-fourth; an indistinct spot at base of costa (described from Grenada as a large quadrate spot), followed by two similar spots in basal one-fourth of costal area and a more distinct spot above cell before middle of wing; three larger spots below Cu fold in basal half, the middle one closer to dorsal margin; a slightly larger spot above tornus. Fringe white. Underside brown. Fringe narrowly whitish. *Hindwing:* About as broad as forewing; subcostal area with a large pinch-fold to end of cell, enclosing a thick, whitish ochreous hair pencil; costa slightly concave beyond, apex narrow, blunt. Ground color gray-brown. Fringe whitish. Underside similar. *Abdomen:* Dorsal scaling brownish gray, basal two segments with short, ochreous scaling; ventral scaling whitish, genital tinged with pale ocherous. Genitalia as in Figure 168 (drawn from plesiotype, Dominica, JAP prep. no. 1933; one preparation examined); similar to *E. linda,* differing primarily by the shape of the cucullus.

FEMALE.—Length of forewing 5.8 to 6.4 mm. Essentially as described for male. Eye smaller but labial palpus also shorter, ratio similar to male. Antenna not dilated, width of shaft basally about 0.15 eye diameter. Hindwing costal area simple. Genitalia as in *E. linda* (Figures 280, 281), signum small, with a single inner tooth (one preparation examined).

TYPE DATA.—Grenada, Mount Gay Estate, 300

feet, leeward side, "1–5 X" (H. H. Smith); unique type in British Museum.

GEOGRAPHICAL DISTRIBUTION. — Dominica and Grenada.

FLIGHT PERIOD.—Evidently multivoltine; February, March, and July in Dominica.

FOOD PLANT.—Unknown.

REMARKS.—This species is closely related to *E. linda* of the mainland.

The Hammella Group

Eye index ±1.15. Labial palpus moderately elongate, II segment index 1.3–1.4; smooth scaled. Antenna of male moderately dilated; index 0.24. Forewing broad; pattern dorsal blotch. Hindwing of male unmodified. Abdomen scaling undifferentiated. Uncus membranous; gnathos lacking; basal processes membranous, narrow; valva with cucullus "plume"; with reduced bifid scalelike setae on and below plume; fultura-manica simple; vesica armed. Papillae anales membranous, setate; posterior apophyses not elongate; anterior apophyses rudimentary; sterigma simple; antrum weakly enlarged; ductus bursae membranous, three tight coils; signum simple spurs.

A single Central American species with extraordinarily broad wings which shows no close relationship to other groups.

Ethmia hammella Busck

FIGURES 166, 276; PLATE 19*g*; MAP 68

Ethmia hammella Busck, 1910b:53.—Walsingham, 1912:148, pl. 5, fig. 15.

An atypical appearing species with extraordinarily broad forewings which are pale yellowish blotched with blue.

MALE.—Length of forewing 8.0–10.5 mm. *Head:* Labial palpus elongate, moderately strongly upcurved, exceeding base of antenna; length of second segment 1.10–1.15 times eye diameter, third slightly shorter to slightly longer than second; white with some infuscation at extreme base. Antenna slightly dilated, width of shaft near base 0.20–0.21 eye diameter; smooth scaled, scape white, dorsal scaling of shaft whitish. Front and crown smooth scaled, cream-white, posterior margin of occipital tuft steel blue. *Thorax:* Dorsal scaling steel blue with a cream-white posterior fringe on tegula and around margin of scutellum. Underside shining white, prothoracic and mesothoracic legs exteriorly, except tarsi, spotted steel gray. *Forewing:* Broad, length about 2.6 to 2.9 times width; costa strongly arched from base to apex, more so than any other New World *Ethmia;* apex round, termen convex. Ground color pale yellowish white, indistinctly speckled and distinctly blotched with deep steel blue: costa

MAP 68.—Geographical distribution of *Ethmia hammella* Busck.

at base and a small spot just beyond; a large quadrate spot on dorsal half near base; a double spot, sometimes coalesced, in cell and subcostal area before middle of wing; a spot crossing Cu fold at about middle of wing; a small spot in cell just before end, sometimes reduced to a trace; a terminal band, broad near tornus, narrowed above, usually discernible from two spots which precede it. Fringe pale yellowish. Underside dark brownish gray, an unscaled area in cell basally; costa and fringe narrowly pale. *Hindwing:* Narrower than forewing. Costal area simple, margin with fringe and concavity before apex. Ground color pale brown, darker apically; costal area white; fringe whitish. Underside broadly brown on costal and terminal margins extending along veins into basal half which is translucent whitish. *Abdomen:* Dorsal scaling brownish gray; caudal margin of posterior segments, genital and ventral scaling whitish. Genitalia as in Figure 166 (drawn from plesiotype, Puntarenas, Costa Rica, JAP prep. no. 1636; two preparations examined); uncus membranous, well defined; gnathos poorly defined; basal processes broad, short; valva with a short preapical "plume" and bunch of about five large, flat setae distally; cornuti numerous, short setae aggregated into a curving spur-shaped group.

FEMALE.—Length of forewing 9.6 to 11.7 mm. Essentially as described for male; labial palpus appreciably longer, well exceeding base of antenna, length of second segment 1.2 to 1.4 eye diameter (eye slightly smaller than in male); third segment length 1.1 that of second. Forewing slightly narrower than in male, length 2.8 to 3.0 times width. Genitalia as in Figure 276 (drawn from plesiotype, Panama, JAP prep. no. 2801; one preparation examined); sterigma simple, surrounding ostium, ductus with basal sclerotized sleeve and poorly developed antrum, membranous beyond, short with about three coils in a tight spiral; signum similar to *E. linda,* with about five teeth.

TYPE DATA.—Tuis, Costa Rica, 2,400 feet. (W. Schaus); holotype female, No. 12884 in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION.—Costa Rica, Panama, and Gorgona Island, Colombia, so far as known.

FLIGHT PERIOD.—March, May, June, August, October, November.

FOOD PLANT.—Unknown.

REMARKS.—The specimens from Gorgona Island, off the coast of northern South America, are smaller (forewing length 8–9 mm) but otherwise are indistinguishable from Costa Rican material.

The Punctessa Group

Eye index 1.0–1.1. Labial palpus moderately short to moderately elongate, II segment index 1.0–1.2; smooth scaled. Antenna of male not or slightly dilated, index 0.18–0.21. Forewing moderately narrow; pattern obsolete or weakly costal-dorsal. Hindwing of male unmodified. Abdomen scaling not examined. Uncus membranous; gnathos absent; basal processes membranous, narrow; valva with cucullus "plume"; fultura-manica simple; vesica armed or simple. Papillae anales membranous, setate; posterior apophyses not elongate; sterigma simple; antrum undifferentiated; ductus bursae sclerotized basally, four loose coils distally; signum a broad cone.

Two closely related species in northern Mexico which have no close relatives in the known New World fauna but appear to represent a derivative of the Trifurcella group.

Ethmia punctessa Powell, new species

FIGURES 169, 282; PLATES 19*h-i*

A unique species in northeastern Mexico, with short palpi and white forewings which are marked by a single black dot at the end of the cell.

MALE.—Length of forewing 10.6 mm. *Head:* Labial palpus short, only weakly upcurved; second segment very slightly curved, length about 0.95 eye diameter; third straight, about 0.55 as long as second; scaling white. Antenna scarcely dilated, width of shaft near base 0.19 eye diameter; scape and basal segments white, dorsal scaling beyond brownish. Scaling of tongue and front white, crown pale brownish. *Thorax:* Collar white; dorsal scaling otherwise whitish interspersed with pale brownish. Lateral brushes of metanotum dense, elongate, whitish, nearly concealing scutellum. Underside scaling sordid whitish; prothoracic and mesothoracic legs brown exteriorly, hind legs pale brownish. *Forewing:* Moderately narrow, length 3.4–3.5 times width; costa nearly straight beyond base, apex narrow, termen strongly angled back. Ground

color white, a few scattered brownish scales; a small brownish black spot (8–10 scales) at end of cell; some dark brown scales at base of the white fringe. Underside pale brown; fringes white. *Hindwing:* About as broad as forewing; costal area simple; costa nearly straight, apex blunt. Ground color white basally, becoming pale brownish distally. Fringe white. Underside pale brown except fringe. *Abdomen* (not seen prior to dissection): Genitalia as in Figure 169 (drawn from holotype, RWH prep. no. 3234; one slide examined); uncus weakly sclerotized; valva with elongate subapical "plume," setate only distally, and with distal projection; aedeagus (mounted in situ) bears what appears to be two elongate, sclerotized extension flaps, between which the vesica extends with a dentate cornutus.

FEMALE.—The one specimen examined is presumed to represent this species on the basis of wing shape and labial palpus size. Length of forewing 10.2 mm. Generally as described for male, with more brownish scaling. Labial palpus short, second segment length 1.05 times eye diameter, third about 0.45 as long as second. Antenna not dilated. Forewing white with considerable brownish scaling, tending to form two broad, longitudinal streaks, along R fold and above Cu fold, leaving white streaks in costal area, along Cu fold and a median one through cell; latter emphasizing the small dot at end of cell; dark brown scales at base of fringe increased over that of male, forming suggestion of a row of dots. Hindwing more uniform white than in male. Genitalia as in Figure 282 (drawn from allotype, RWH prep. no. 3236; one slide examined); sterigmal plate simple, contiguous with VIII sternite; apophyses elongate, thin; ductus bursae with a short sclerotized sleeve and dorsal plate near base (antrum not defined), spiral portion ridged,[15] not sclerotized; signum round with a deep fold forming a pointed keel, without teeth.

TYPE.—Holotype male and allotype female: Mexico, three miles east of Galeana, Nueva Leon, 5,000 feet, August 7–9, 1963 (Duckworth and Davis); deposited in U.S. National Museum.

REMARKS.—This species and the following one, both collected only once, show no close relationships with any other known *Ethmia*. *E. punctessa* is perhaps most similar to *E. linda*, on the basis of genital features of both sexes, but the short labial palpus, narrower forewing, and simple hindwing in the male distinguish *E. punctessa* from *E. linda* and all other species which have the reduced uncus.

[15] Possibly an artifact of preparation technique.

Ethmia angustalatella Powell, new species

FIGURE 170; PLATE 19*j*

A unique species in northeastern Mexico with very narrow forewings which are grayish, mottled with whitish.

MALE.—Length of forewing 11.2 mm. *Head:* Labial palpus moderately short, upcurved, not quite reaching base of antenna; second segment length 1.2 times eye diameter; third segment straight, about 0.65 as long as second (0.77 eye diameter); scaling brownish black, with ill-defined white subbasal and apical bands on each segment. Antenna not dilated, width of shaft about 0.18 eye diameter; scape whitish, scaling of shaft almost complete, pale brownish. Scaling of tongue, front, and crown appressed, white, more or less uniformly interspersed with brownish; lateral occipital tufts white. *Thorax:* Dorsal and ventral scaling as on head; lateral hair brushes of metanotum sparse, scutellum densely scaled, ochreous. *Forewing:* Narrow, length about 3.9 times width; costa nearly straight from basal one-third nearly to apex; latter acute, termen strongly angled back, curving as far as end of cell. Ground color brownish gray, interspersed with white, which tends to form markings: several elongate dashes in apical area; a more distinct streak along Cu fold in basal half of cell, separated by a short dark streak from another white mark in outer half of cell terminating in an upturned, white spur at end of cell which is the most distinct mark of the wing. Fringe mostly whitish with pale brownish, a darker brown streak below apex. Underside brown, costa white, distal fringe as above. *Hindwing:* Slightly broader than forewing; subcostal area with a weak pinch-fold but no hair pencil; apex narrow, termen evenly curved to anal area. Ground color whitish basally, becoming pale brownish in distal half. Fringe white. Underside mostly brown, clouded with white in apical area. *Abdomen* (not seen prior to dissection): Genitalia as in Figure 170 (drawn from holotype, RWH prep. no. 3235; one slide examined); uncus membranous; valva without produced "plume" of

costa, valva distally strongly produced into a broad hook, its outer surface with four strong, flat spines, aedeagus (mounted in situ) bearing flaplike extensions or partially sclerotized vesica, which contains dentate apical process and spurred cornutus.

FEMALE.—Unknown.

TYPE.—Holotype male: Mexico, three miles east of Galeana, Nueva Leon, 5,000 feet, August 7–9, 1963 (Duckworth and Davis); unique, deposited in U.S. National Museum.

Pseudethmia Clarke

Pseudethmia Clarke, 1950:163.

TYPE.—*Pseudethmia protuberans* Clarke, 1950; monobasic (North America).

Moderately small moth, forewing length 8–10 mm. *Head:* Front produced into a strongly protuberant, rounded cone, covered with short, compact, differentiated scaling. Maxillary palpus small, 4-segmented, the segments globose, II and IV slightly longer. Labial palpus short, blunt, segment III very short; smooth scaled. Antenna of male not broader than in female. *Forewing:* Moderately narrow, length 3.6–3.7 times width; apex blunt, termen moderately strongly angled back, tornal angle scarcely visible. Vein Cu_2 from well before end of cell, not curved. *Hindwing:* Costal area not modified in male. Moderately broad, apex blunt, termen moderately strongly angled back. Vein M_2 equidistant between M_1 and M_3+Cu_1, latter short-stalked, *Male genitalia*: Uncus and gnathos absent; basal processes well developed, sclerotized; valva weakly divided below costa, without accessory lobe, with differentiated distal seta-bunch; sacculus not developed. *Female genitalia:* Apophyses extremely elongate; sterigma simple; antrum not developed; ductus bursae membranous, not coiled; signum of keel-shaped crease.

Pseudethmia contains a single species, in the low desert of California.

Pseudethmia protuberans Clarke

FIGURES 38, 39, 171, 283, 284; PLATES 2*f*, 20*a*

Pseudethmia protuberans Clarke, 1950:163, fig. 3.

A desert species of California having pale gray forewings with ill-defined, longitudinal blackish streaks.

MALE.—Length of forewing 8.4–9.9 mm. *Head:* Labial palpus moderately short, little upcurved, second segment length 0.63–0.68 eye diameter, slightly curved; third segment about 0.25 as long as second; whitish, second segment with a few brownish scales outwardly towards tip. Antenna not dilated, width of shaft near base 0.15 eye diameter; scaling whitish dorsally, dusted with brownish ventrally. Protuberant front clothed with modified, small, tightly appressed, pale brownish ochreous and white scales; scaling of crown white with some brown intermixed at middle posteriorly. *Thorax:* Dorsal scaling whitish with scattered brownish, tending to form a median, longitudinal line; lateral brushes of metanotum short, not reaching the fully scaled scutellum. Underside dirty whitish and pale gray-brown, legs without spotting. Hind tibia without fringe. *Forewing:* Moderately narrow, length 3.6–3.7 times width; costa nearly straight, termen moderately strongly angled back, tornal angle scarcely evident. Ground color whitish, markings variable in intensity, as dark brownish black streaks between the veins, the most conspicuous of which runs through the cell, broadening on its distal half. Fringe white. Underside dirty whitish with intermixed pale brown. *Hindwing:* Aoout as broad as forewing; costa nearly straight, apex rounded, narrow, termen strongly angled back, tornal angle not evident. Ground color white tinged with pale brownish towards apex and at base of the otherwise white fringe. Underside whitish, more or less evenly tinged with pale brownish. *Abdomen:* Dorsal scaling of small, tightly appressed, pale ochreous to whitish scales; underside whitish. Genitalia as in Figure 171 (drawn from plesiotype, Twenty-Nine Palms, JAP prep. no. 1644; three preparations examined); basal processes broad, heavily sclerotized, reaching posterior margin of tegumen; valva with a small, setate, membranous cucullus and elongate, distal, sclerotized projection, distal seta-bunch on exterior side, of 12–14 broad, flat, curved setae; vesica without cornuti.

FEMALE.—Length of forewing about 8.0 mm. External structural features as in male. The single specimen available is too worn to be used in discerning any color differences from male. Genitalia is in Figures 283, 284 (drawn from plesiotype, near Essex, JAP prep. no. 2331; one preparation examined); sterigma simple, base of ductus with a

short, sclerotized sleeve, antrum not differentiated, signum a short fold produced into an inner keel, notched or slightly serrate at its apex.

TYPE DATA.—Dixieland, Imperial County, California, March 1–15, 1922 (O. C. Poling); holotype male in U.S. National Museum.

GEOGRAPHICAL DISTRIBUTION. — Lower elevation deserts of southeastern California and doubtless northeastern Baja California.

FLIGHT PERIOD.—Mid-February (Imperial Valley at sea level) to early April (edge of the Mojave Desert at 2,000 feet).

REMARKS.—Among the material available for study there were more than 50 males, nearly all taken at light. The single female, which confirmed the protuberant front as a bisexual and generic character, was taken net sweeping at night by P. A. Opler, nine miles northwest of Essex, San Bernardino County.

Systematic List of New World Ethmiidae

(Synonyms in *italics*)

Pyramidobela Braun, 1923

Idioptila Meyrick, 1927

1. quinquecristata (Braun, 1921), Western United States
2. angelarum Keifer, 1936, California
3. agyrtodes (Meyrick, 1927), Texas-Chihuahua
4. tetraphyta Meyrick, 1931, Hidalgo
5. ochrolepra Powell, 1973, Chiapas
6. epibryas Meyrick, 1931, Brazil
7. compulsa Meyrick, 1931, Chile

Ethmia Hübner, 1819

Psecadia Hübner, 1825
Anesychia Hübner, 1825
Disthymnia Hübner, 1825
Melanoleuca Stephens, 1829
Aedia Duponchel, 1836
Chalybe Duponchel, 1836
Azinis Walker, 1863
Tamarrha Walker, 1864
Ceratophysetis Meyrick, 1887
Theoxenia Walsingham, 1887
Babaiaxa Busck, 1902
Wiltshireia Amsel, 1949

SECTION I

1. The Albitogata Group

1. umbrimarginella Busck, 1907, Arizona, New Mexico
2. lassenella Busck, 1908, Southwestern United States
3. coquillettella Busck, 1907, British Columbia, California
4. monachella Busck, 1910, Colorado
5. scylla Powell, 1973, California
6. brevistriga Clarke, 1950
   b. brevistriga Clarke, 1950, California
   b. aridicola Powell, 1973, California
7. albitogata Walsingham, 1907, California
8. plagiobothrae Powell, 1973, California
9. minuta Powell, 1973, California
10. tricula Powell, 1973, California

2. The Charybdis Group

11. charybdis Powell, 1973, California

3. The Semilugens Group

12. albistrigella (Walsingham, 1880)
    a. albistrigella (Walsingham, 1880), Western United States
    chrysurella (Dietz, 1905)
    a. icariella Powell, 1973, California
13. nadia Clarke, 1950, California
14. orestella Powell, 1973, Colorado
15. semilugens (Zeller, 1872), Southwestern United States
    multipunctella (Chambers, 1874)
    semiopaca (Grote, 1881)
    plumbeella (Beutenmüller, 1889)
16. epileuca Powell, 1959, Arizona, California
17. apicipunctella (Chambers, 1875), Southwestern United States, Northern Mexico
    zavalla Busck, 1915
18. arctostaphylella (Walsingham, 1880), Oregon to Baja California, Arizona
    obscurella (Beutenmüller, 1888)
    mediella Busck, 1913
19. mansita Busck, 1914, Puebla
20. discostrgella (Chambers, 1877)
    d. discostrigella (Chambers, 1877), Western United States
    d. subcaerulea (Walsingham, 1881), California
21. semitenebrella Dyar, 1902, Southwestern United States

4. The Papiella Group

22. papiella Powell, 1973, Sonora, Sinaloa
23. volcanella Powell, 1973, Oaxaca, Guatemala

5. The Macelhosiella Group

24. macelhosiella Busck, 1907, Eastern United States
25. gerancila Barnes and Busck, 1920, California
26. timberlakei Powell, 1973, California
27. macneilli Powell, 1973, California, Arizona

6. The Piperella Group

28. piperella Powell, 1973, Jamaica

7. The Bipunctella Group

29. bipunctella (Fabricius, 1775), Europe; introduced in Northeastern United States

echiella (Denis and Schiffermuller, 1775)
hochenwartiella (Rossi, 1790)
griseicostella Wiltshire, 1947
30. monticola (Walsingham, 1880)
m. monticola (Walsingham, 1880), Northwestern United States
m. emmeli Powell, 1973, Colorado, Arizona
m. fuscipedella (Walsingham, 1888), Eastern North America
31. caliginosella Busck, 1904, Colorado

8. The Hagenella Group

32. hagenella (Chambers, 1878)
h. hagenella (Chambers, 1878), Texas
h. josephinella Dyar, 1902, New Mexico, Western Texas
33. mimihagenella Powell, 1973, Arizona to Western Texas
34. burnsella Powell, 1973, Northwestern Texas
35. zelleriella (Chambers, 1878), Southeastern Canada, Texas
texanella (Chambers, 1880)

9. The Kirbyi Group

36. delliella (Fernald, 1891), Texas, Eastern and Western Mexico
37. davisella Powell, 1973, Eastern Mexico
38. linsdalei Powell, 1973, Oaxaca
39. clarkei Powell, 1973, Quintana Roo
40. subsimilis Walsingham, 1897, Cuba, Jamaica
41. kirbyi (Moeschler, 1890), Haiti, Puerto Rico
42. bittenella (Busck, 1910), Texas, Eastern and Western Mexico

10. The Mulleri Group

43. mulleri Busck, 1910, Puebla

11. The Cypraeella Group

44. proximella Busck, 1912, Puebla
45. festiva Busck, 1914, Mexico to Colombia
xantholitha Meyrick, 1928
46. cypraeella (Zeller, 1863), Venezuela
47. abraxasella (Walker, 1864)
a. abraxasella (Walker, 1864), Jamaica, Puerto Rico
aureoapicella (Moeschler, 1890)
abraxella Meyrick, 1914
a. clarissa Busck, 1914, Cuba
48. scythropa Walsingham, 1912, Cuba, Mexico to Costa Rica
49. nivosella (Walker, 1864), Greater Antilles
adustella (Zeller, 1877)
50. terpnota Walsingham, 1912, Costa Rica
51. iridella Powell, 1973, Puebla
52. perpulchra Walsingham, 1912, Veracruz, Honduras
53. elutella Busck, 1914, Trinidad, Venezuela, Panama
54. janzeni Powell, 1973, Mexico, El Salvador
55. submissa Busck, 1914, Greater Antilles
56. fritillella Powell, 1973, Brazil
57. epilygella Powell, 1973, Brazil
58. cupreonivella (Walsingham, 1880), Brazil
59. notomurinella Powell, 1973, Argentina
60. ungulatella Busck, 1914, Mexico to Panama
61. cypraspis Meyrick, 1930, Brazil
62. chalcodora Meyrick, 1912, Argentina, Paraguay
63. cellicoma Meyrick, 1931, Paraguay
64. chalcogramma Powell, 1973, Bolivia
65. phylacops Powell, 1973, Yucatan

12. The Exornata Group

66. exornata (Zeller, 1877), Mexico, Northern South America
67. phylacis Walsingham, 1912
p. phylacis Walsingham, 1912, Eastern and Western Mexico
p. ornata Busck, 1934, Cuba
68. mnesicosma Meyrick, 1924, Mexico, Northern South America
69. gelidella (Walker, 1864), Jamaica

13. The Notatella Group

70. phoenicura Meyrick, 1932, Baja California
71. zebrata Powell, 1959, Puebla
72. chemsaki Powell, 1959, Puebla, Costa Rica
73. notatella (Walker, 1863), Florida Keys, Antilles
xanthorrhoa (Zeller, 1877)
74. hiramella Busck, 1914, Cuba
75. paucella (Walker, 1863), Haiti
76. wellingi Powell, 1973, Yucatan, Costa Rica

SECTION II

14. The Balsiostola Group

77. baliostola Walsingham, 1912, Mexico, Northern South America
78. cubensis Busck, 1934, Cuba, Jamaica

15. The Confusella Group

79. confusella (Walker, 1863), Florida Keys, West Indies, Yucatan
strigosella (Walker, 1864)
ingricella (Moeschler, 1890)
80. striatella Busck, 1913, Eastern and Western Mexico
81. duckworthi Powell, 1973, Panama
82. sandra Powell, 1973, El Salvador
83. confusellastra Powell, 1973, Yucatan, Cuba
84. julia Powell, 1973, Florida Keys, Puerto Rico
85. humilis Powell, 1973, Jamaica
86. farrella Powell, 1973, Florida Keys, Jamaica

16. The Longimaculella Group

87. coronata Walsingham, 1912, Guerrero, Puebla
abdominella Busck, 1912, new synonymy
88. nigritaenia Powell, 1973, Yucatan, British Honduras
89. subnigritaenia Powell, 1973, Mexico, Distrito Federal, Puebla
90. catapeltica Meyrick, 1924, Guatemala to Bolivia
91. howdeni Powell, 1973, Sinaloa, El Salvador

92. longimaculella (Chambers, 1872)
    l. longimaculella (Chambers, 1872), Southern Canada to Kentucky
    walsinghamella Beutenmüller, 1889
    l. coranella Dyar, 1902, Texas
93. flavicaudata Walsingham, 1912, Veracruz
94. lichyi Powell, 1973, Guatemala to Brazil
95. calumniella Powell, 1973, Brazil
96. omega Powell, 1973, Brazil
97. plaumanni Powell, 1973, Brazil
98. transversella Busck, 1914, Costa Rica
99. hieroglyphica Powell, 1973, Bolivia

17. The Conglobata Group

100. conglobata Meyrick, 1912, Colombia

18. The Cyanea Group

101. cyanea Walsingham, 1912, Veracruz

19. The Gigantea Group

102. gigantea Busck, 1914, Veracruz, Guatemala

20. The Trifurcella Group

103. semiombra Dyar, 1902
    s. semiombra Dyar, 1902, Texas to Tamaulipas
    s. nebulombra Powell, 1973, Yucatan
104. albicostella (Beutenmüller, 1889), Manitoba to Durango
105. miruscella (Chambers, 1874), Kansas to Texas
    mirella Meyrick, 1914
106. trifurcella (Chambers, 1873), Eastern United States, Arizona, Wyoming
107. marmorea (Walsingham, 1888), British Columbia to Chihuahua
108. hodgesella Powell, 1973, California to Veracruz
109. playa Powell, 1973, Sonora, Sinaloa
110. baja Powell, 1973, Baja California
111. penthica Walsingham, 1912, Hidalgo to Campeche, Sinaloa
112. similatella Busck, 1920, Western Mexico to Costa Rica
113. cordia Powell, 1973, Morelos, Yucatan
114. scutula Powell, 1973, Sonora, Sinaloa
115. pala Powell, 1973, Sinaloa
116. clava Powell, 1973, Nayarit, Veracruz
117. sphenisca Powell, 1973, Arizona to Mexico, Distrito Federal
118. heptastica Walsingham, 1912, Sonora to Guerrero
119. oterosella Busck, 1934, Cuba

21. The Prattiella Group

120. prattiella Busck, 1915, Texas to Hidalgo

22. The Joviella Group

121. linda Busck, 1914, Southeastern Mexico to Venezuela
122. joviella Walsingham, 1897, Dominica, Grenada

23. The Hammella Group

123. hammella Busck, 1910, Costa Rica to Colombia

24. The Punctessa Group

124. punctessa Powell, 1973, Nueva Leon
125. angustalatella Powell, 1973, Nueva Leon

Pseudethmia Clarke, 1950

1. protuberans Clarke, 1950, California

Summary

The family Ethmiidae is a group of small- to moderate-sized moths which is worldwide in distribution. There are about 250 described species, of which 133 comprise the New World fauna, including 49 described as new in this study.

There has been no previous classification of the American ethmiids, and the present arrangement treats three genera, *Pyramidobela* (7 species), *Ethmia* (125 species), and *Pseudethmia* (1 species). The classification is based primarily on morphological features of the adults and is the result of an attempt to combine a traditional taxonomic approach with results of a numerical assessment of phenetic similarities. On the basis of phenetic clustering and supportive, albeit preliminary, evidence from larval characters and pupal habits and morphology, *Ethmia* is divided into two sections: Section I, with 13 species groups, is characterized by possession of a well-developed uncus and gnathos in the male genitalia. Its components are closely related to Palearctic species groups. Section II, characterized by reduction or absence of uncus and gnathos, is a New World derivative of considerable diversity (11 species groups) which makes up about 40 percent of the fauna. *Pseudethmia,* although distinct in many respects, shares several features of *Ethmia*'s Section II. *Pyramidobela* is a closely-knit group which is of more distant and uncertain relationships.

The systematic position of the ethmiids cannot be adequately known until a taxonomic framework for world Gelechioidea, particularly Oecophoridae, is available. Aspects of larval, pupal, and adult morphology all indicate that ethmiids are more closely related to oecophorids than to any other group. It is probable that when more is known about tropical Oecophoridae, the ethmiids will best be treated as a subfamily or tribe, with *Pyramidobela*

and *Ethmia* possibly showing affinities to different oecophorid taxa.

Knowledge of the biology of Ethmiidae is summarized, based on literature for the world fauna. Some information is available on the biologies of about 40 Holarctic species and about 10 species representing the three major sectors of the tropics and Australia. Only three of these are members of Section II of *Ethmia*. The habits of *Pseudethmia* and *Pyramidobela* are poorly known; two North American species of *Pyramidobela* have been partially studied. Most of the detailed information on *Ethmia* originates from an investigation of 14 Californian species which is published elsewhere (Powell, 1971). Although that sample represents only four species groups in Section I, remarkable differences are shown.

A generalized life cycle is as follows: the eggs are deposited singly, usually at the feeding site, hatch in about 10 days, and the larvae feed on either leaves or flowers, often without a shelter. Growth requires 30–50 days, and at maturity larvae wander in search of pupation sites, often appropriating holes or boring into soft woody substrates for cocoon construction. The pupa is the diapause stage for most Holarctic species.

On a world basis ethmiids in general are dependent on the large plant family Boraginaceae. In North America the closely related family Hydrophyllaceae assumes this role for about half the ethmiid fauna. In temperate zones mainly herbaceous plants are used, while in the tropics the scattered records indicate that woody borages are the principal hosts. In the Palearctic a pattern is emerging wherein indiscriminate use of Boraginaceae obtains. In North America the same may be true for boreal species groups, but few records are available. Members of western species groups, which generally occupy more xeric areas with more strict seasonal demands, are each specific to one plant genus.

Most temperate zone species and those dwelling in scrub thorn forest areas of the northern Neotropical Region are univoltine or bivoltine, with obligate diapause through the dry season and winter. Records, while too fragmentary to permit detailed analysis, suggest that many other Neotropical species are multivoltine, with flight records at various times through the year.

Divergent strategies in life cycle pattern and behavior have been developed, enabling speciation in western Nearctic areas which feature a prolonged dry season. A few species have adopted woody, evergreen host plants in Hydrophyllaceae and Rosaceae, maintaining nocturnal habits and facultatively multivoltine patterns which are characteristic of species in more mesic temperate areas. However, as most western Boraginaceae and Hydrophyllaceae are annuals or herbaceous perennials with short growing seasons in spring, divergence from the common pattern was necessary to exploit this habitat. Species groups have evolved in two ways: (1) by diurnal behavior and early spring flight, followed by larval preference for developing seed of annual hosts, and an obligate, prolonged pupal diapause; or (2) by late fall or winter flight, with adults resistant to desiccation (having nonfunctional mouthparts), followed by egg diapause in winter, early spring foliage-feeding, and pupal diapause in summer.

The geographical distribution of American ethmiids is analyzed. There are four major centers of distribution, each with a high proportion of endemism (percent given following species): southwestern Nearctic, 46 species (98 percent); Neotropical Mexico and Central America, 57 species (77 percent); West Indies, 21 species (76 percent); and a probably largely unworked center in temperate South America, 17 species (82 percent). Analysis of distributions at the species group level indicates six major patterns: (1) Holarctic Boreal Range; (2) Western Nearctic Austral Range; (3) Eastern Nearctic Range; (4) Nearctic Austral-Neotropical Scrub Forest Range; (5) Central America-Antillean Range; and (6) Neotropical Extensive Range. Although only 25 species are known from South America, and many more are to be expected, there are no endemic species groups there. All South American ethmiids are members of Neotropical Extensive groups.

Most ethmiids occupy areas of seasonal drought, with high species density in seasonal communities such as sclerophyllous chaparral zones of California and deciduous tropical forests and microphyllous forests (thorn forests) in Mexico. In this way Ethmiidae and the closely related family Stenomidae are in general geographically nearly mutually exclusive, with stenomids scarce in areas of ethmiid

diversity and ethmiids virtually absent from the great centers of stenomid distribution, particularly the tropical wet lowlands of central and northern South America.

Possible phylogenetic relationships are briefly considered. The New World ethmiid fauna consists of three separate elements: (1) *Pyramidobela,* which may be of separate origin; (2) *Ethmia,* Section I, the American fauna of which exhibits affinities separately to Temperate and Tropical Old World elements of the genus; and (3) *Ethmia,* Section II and *Pseudethmia,* which appear to be a New World derivative line from the tropical series of Section I.

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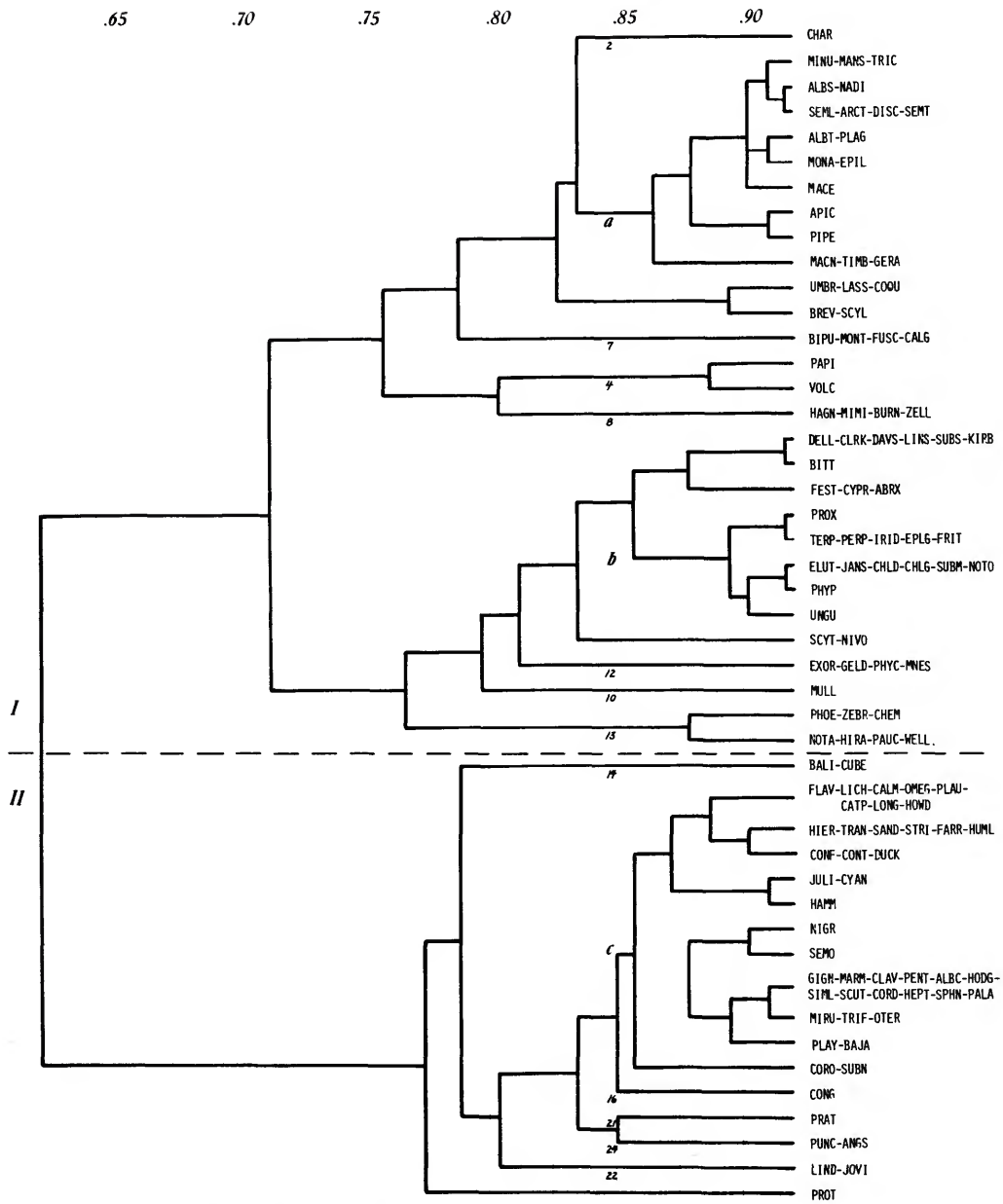


FIGURE 1.—Diagram of phenetic similarity among 123 species of *Ethmia* and *Pseudethmia*, with magnitude of correlation coefficient indicated at top. Correlations between any two joining stems can be found by reading the value corresponding to the vertical line connecting the stems. Species, designated by four-letter abbreviations (see Table 2), are given at the tips of the stems to right, which terminate at the .92 correlation level. The broken, horizontal line superimposed on the phenogram corresponds to the division of *Ethmia* into Sections I and II in the text (note that *Pseudethmia protuberans* shows greater similarity to Section II than I does to II in the characters selected for this analysis). The numbers along an imaginary vertical line through the .85 correlation level correspond to the species groups so numbered in the text. The three areas of greatest discrepancy between the phenogram and the proposed classification are indicated by the following letters: *a*, species group 1 is split at the .85 correlation level, while 1, 3, 5, and 6 are combined; *b*, group 11 is split and 9 and 11 are mixed; and *c*, groups 15, 16, 18, 19, 20, and 23 are combined.

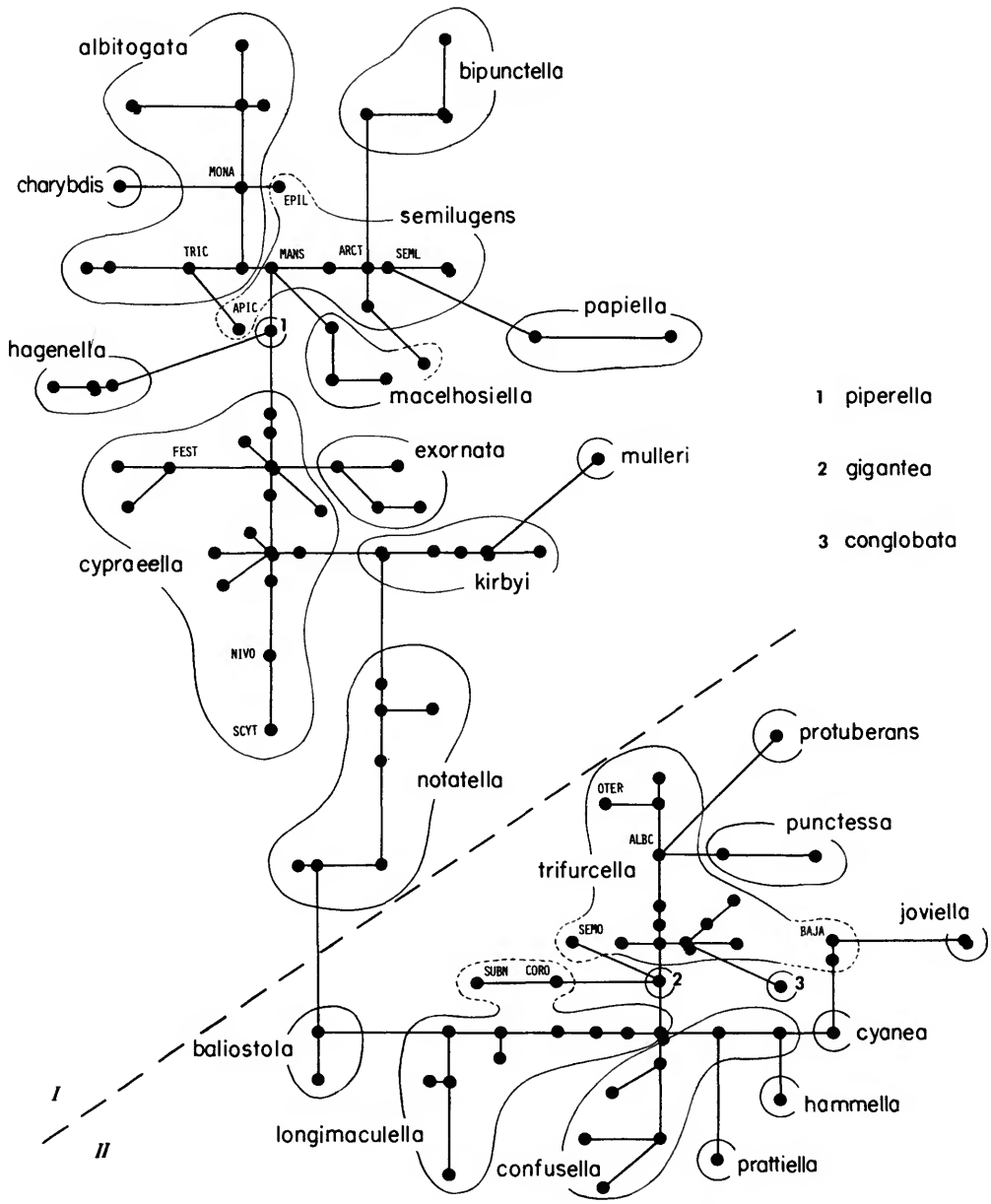


FIGURE 2.—Minimally connected network (Primnet) of phenetic similarity among 123 species of *Ethmia* and *Pseudethmia*. Each point, representing one species, is joined to its nearest neighbor by a straight line, the length of which is a measure of the similarity. Distances between points not connected by lines are artifacts of the two-dimensional portayal and have no meaning in terms of similarity. Curvilinear figures are superimposed on the Primnet corresponding to the clusters proposed as species groups in the present classification (as named in lowercase lettering). Areas of discrepancy between the species groups and phenetic similarities, indicated by broken lines, result from weighting features such as biological characteristics which were not employed as characters in the phenetic assessment. Some key individual species which occupy "hub" and peripheral positions are designated by four-letter abbreviations (see Table 2). The broken diagonal line drawn across the Primnet corresponds to the division of *Ethmia* into Sections I and II (note that *Pseudethmia protuberans* links to Section II; its distinctness could have been extended by inclusion of more characters).

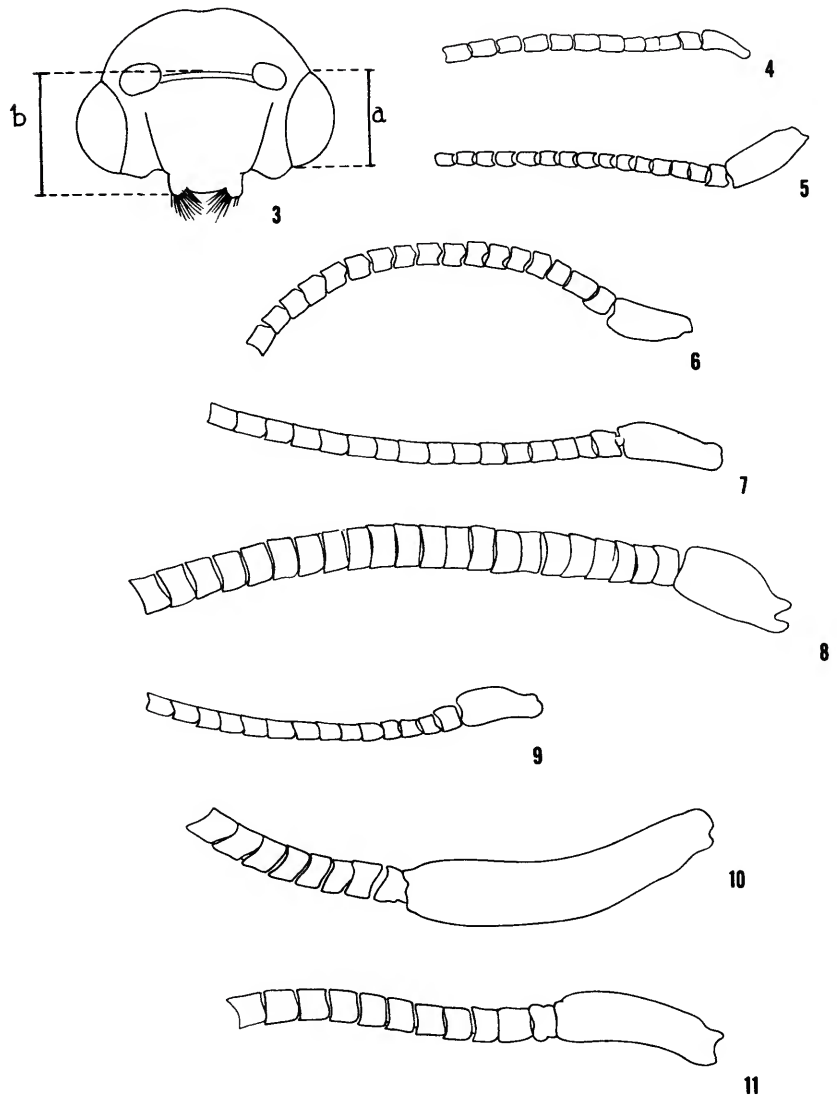
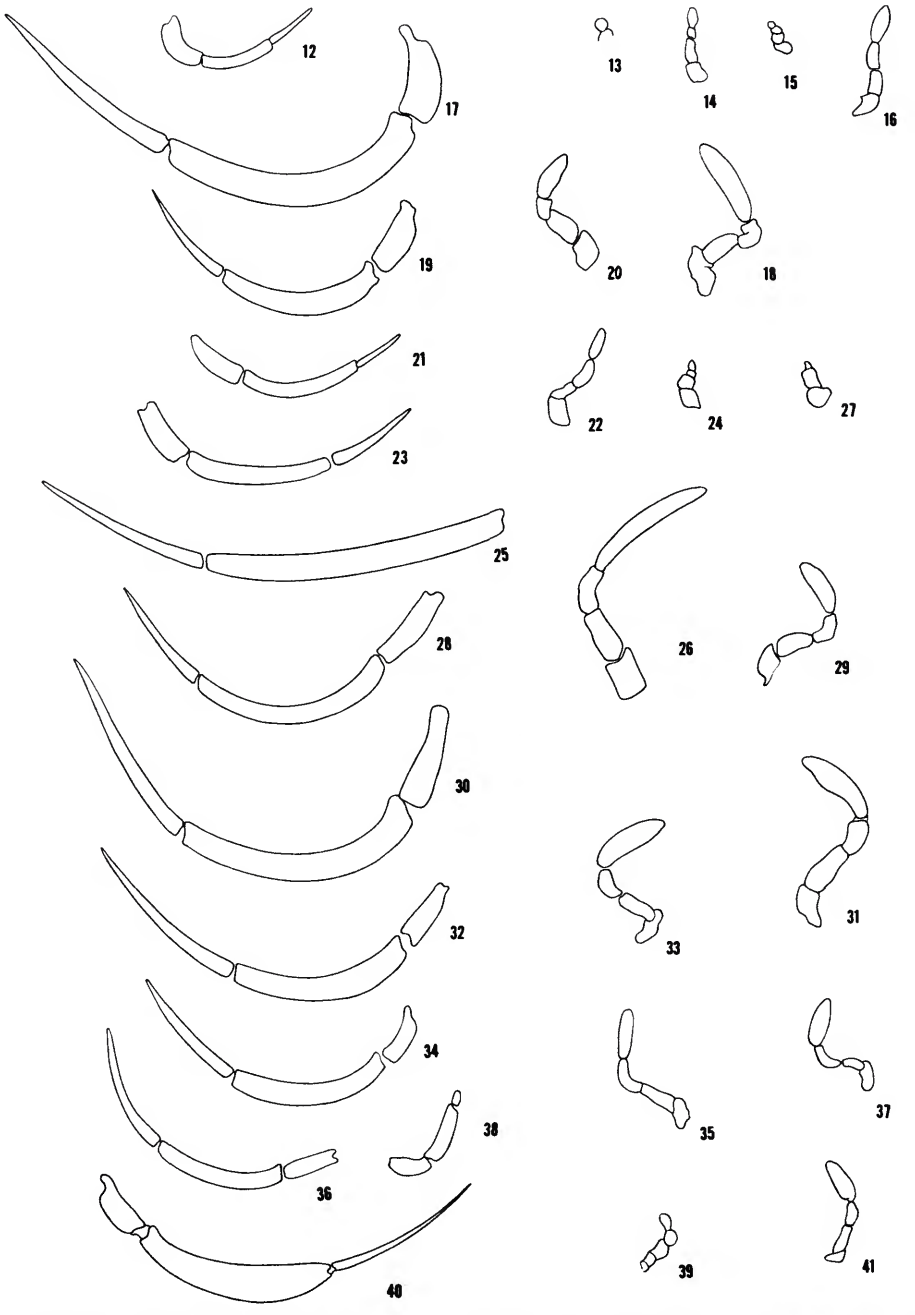
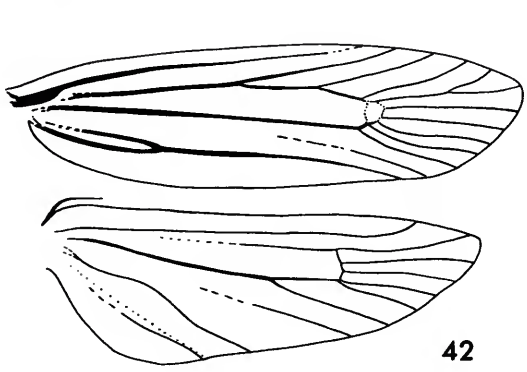


FIGURE 3–11.—Head structures of *Ethmia*: 3, frontal aspect of head of *E. coquillettella* Busck: *a*, vertical eye diameter; *b*, frontal height; 4–11, basal segments of antennae; 4, *E. albitogata* Walsingham ♂; 5, *E. timberlakei* Powell, ♂; 6, *E. nadia* Clarke ♂; 7, *E. nadia*, ♀, 8, *E. arctostaphylella* (Walsingham), ♂; 9, *E. arctostaphylella*, ♀; 10, *E. scythropa* Walsingham, ♂; 11, *E. phoenicura* Meyrick, ♂.



FIGURES 12–41.—Palpi of ethmiid moths; 12, labial; 13, maxillary, *Ethmia coquillettella* Busck; 14, maxillary, *E. nadia* Clarke; 15, maxillary, *E. timberlakei* Powell; 16, maxillary, *E. discostrigella* (Chambers); 17, labial; 18, maxillary, *E. arctostaphylella* (Walsingham); 19, labial; 20, maxillary, *E. monticola fuscipedella* (Walsingham); 21 labial; 22, maxillary, *E. mimihagenella* Powell; 23, labial; 24, maxillary, *E. delliella* (Fernald); 25, apical two segments of labial; 26 maxillary, *E. scythropa* Walsingham; 27, maxillary, *E. phylacis* Walsingham; 28, labial; 29, maxillary, *E. phoenicura* Meyrick; 30, labial; 31 maxillary, *E. baliostola* Walsingham; 32, labial; 33, maxillary, *E. confusella* (Walker); 34, labial; 35, maxillary, *E. heptastica* Walsingham; 36, labial; 37, maxillary. *E. linda* Busck; 38, labial; 39, maxillary, *Pseudethmia protuberans* Clarke 40, labial; 41, maxillary, *Pyramidobela angelarum* Keifer.



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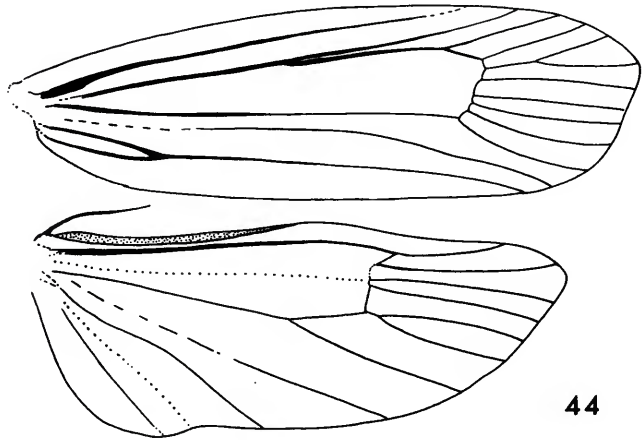

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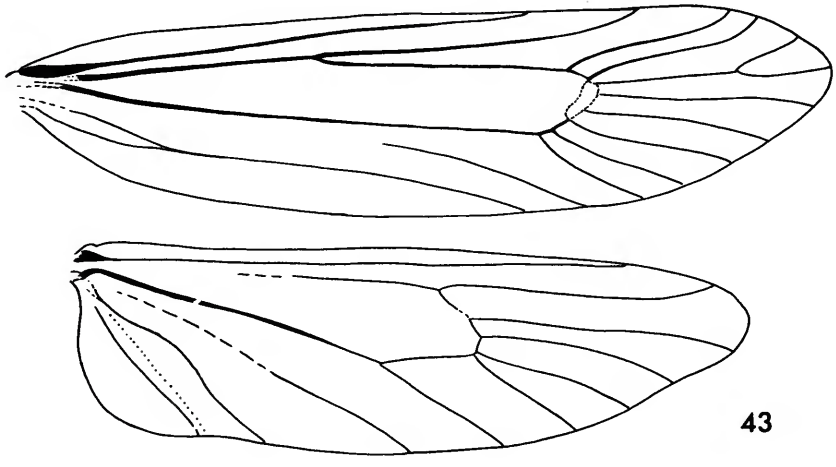

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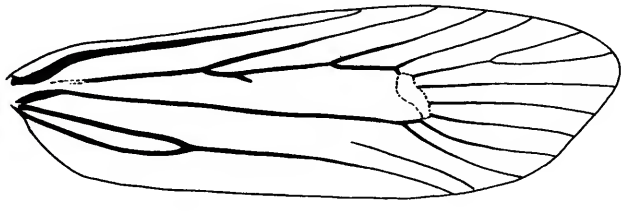

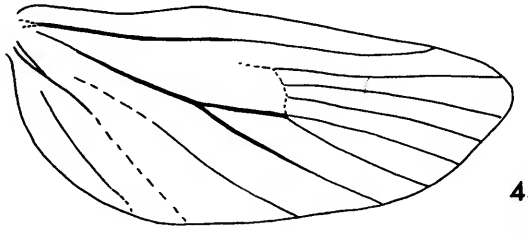

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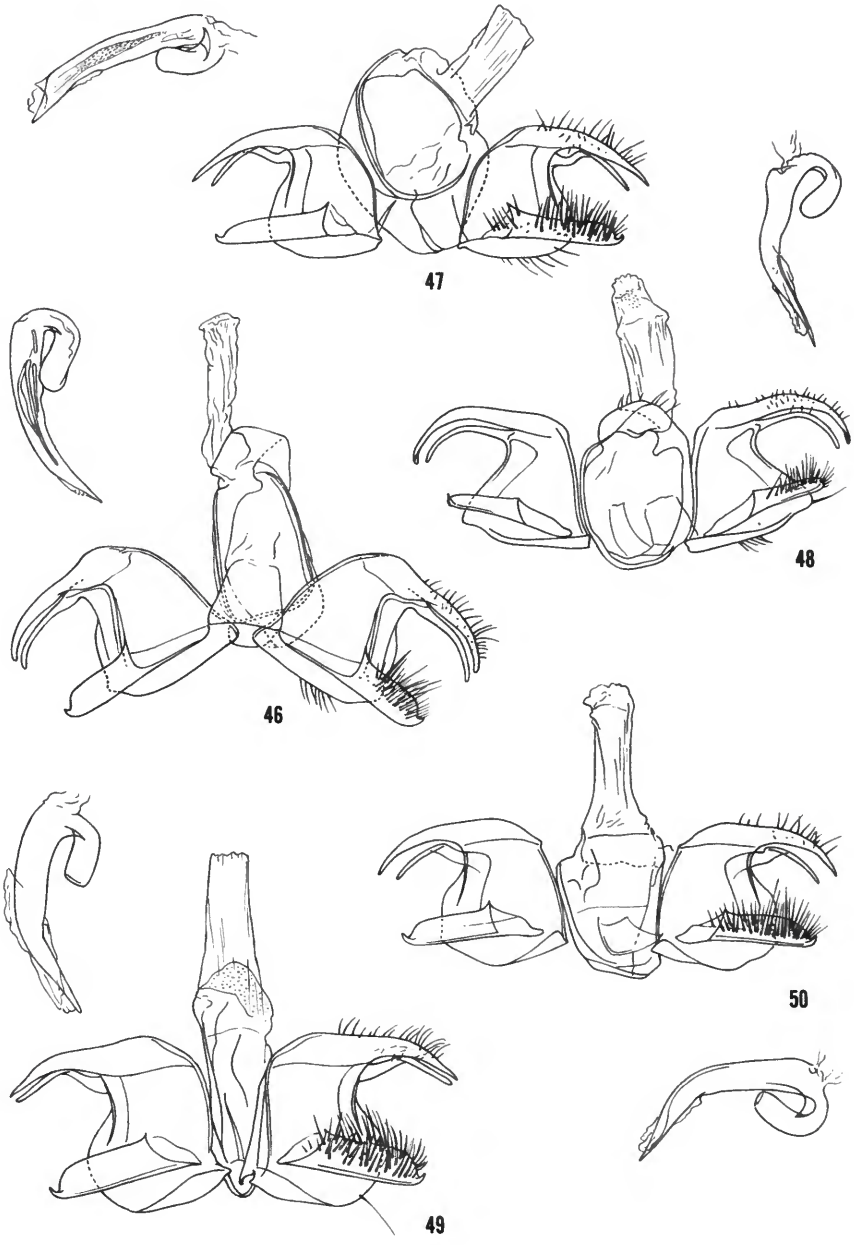
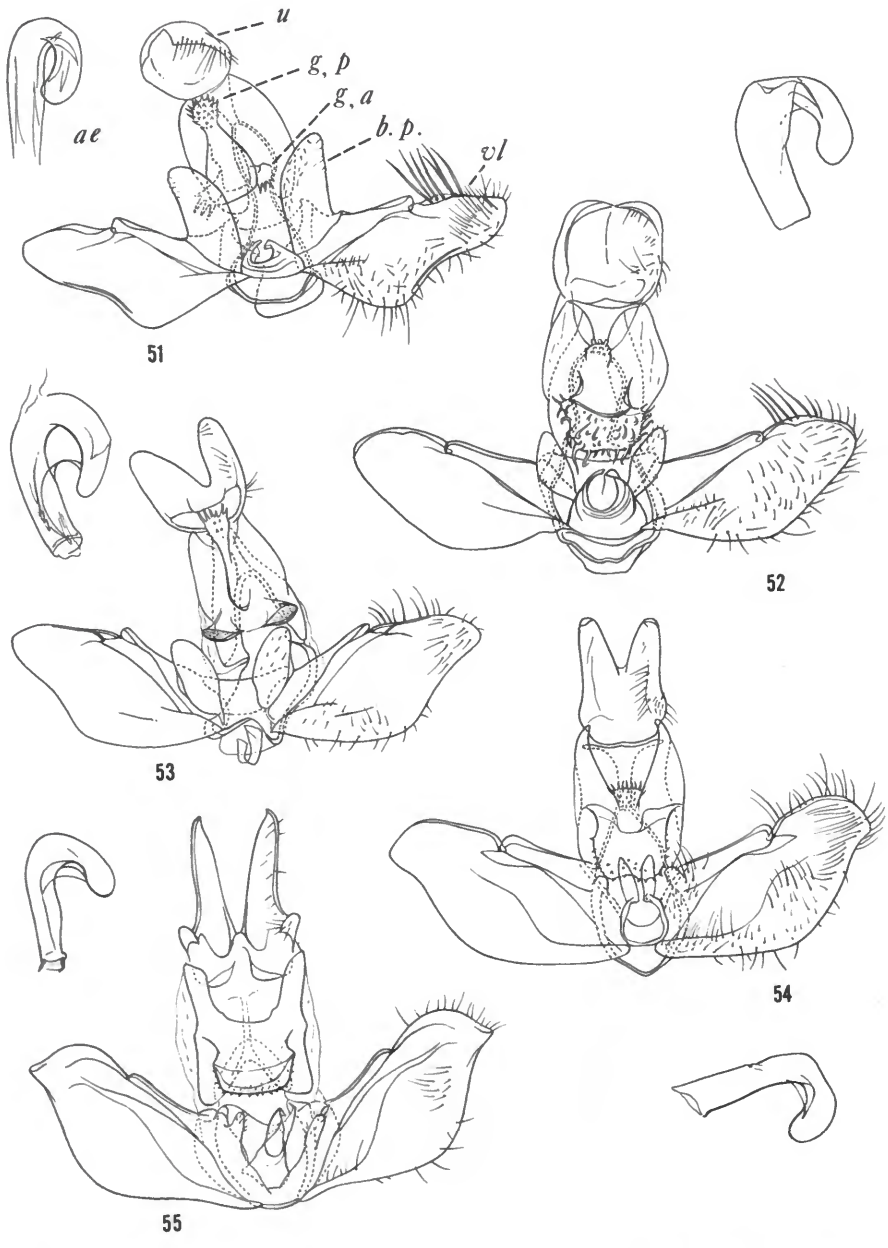
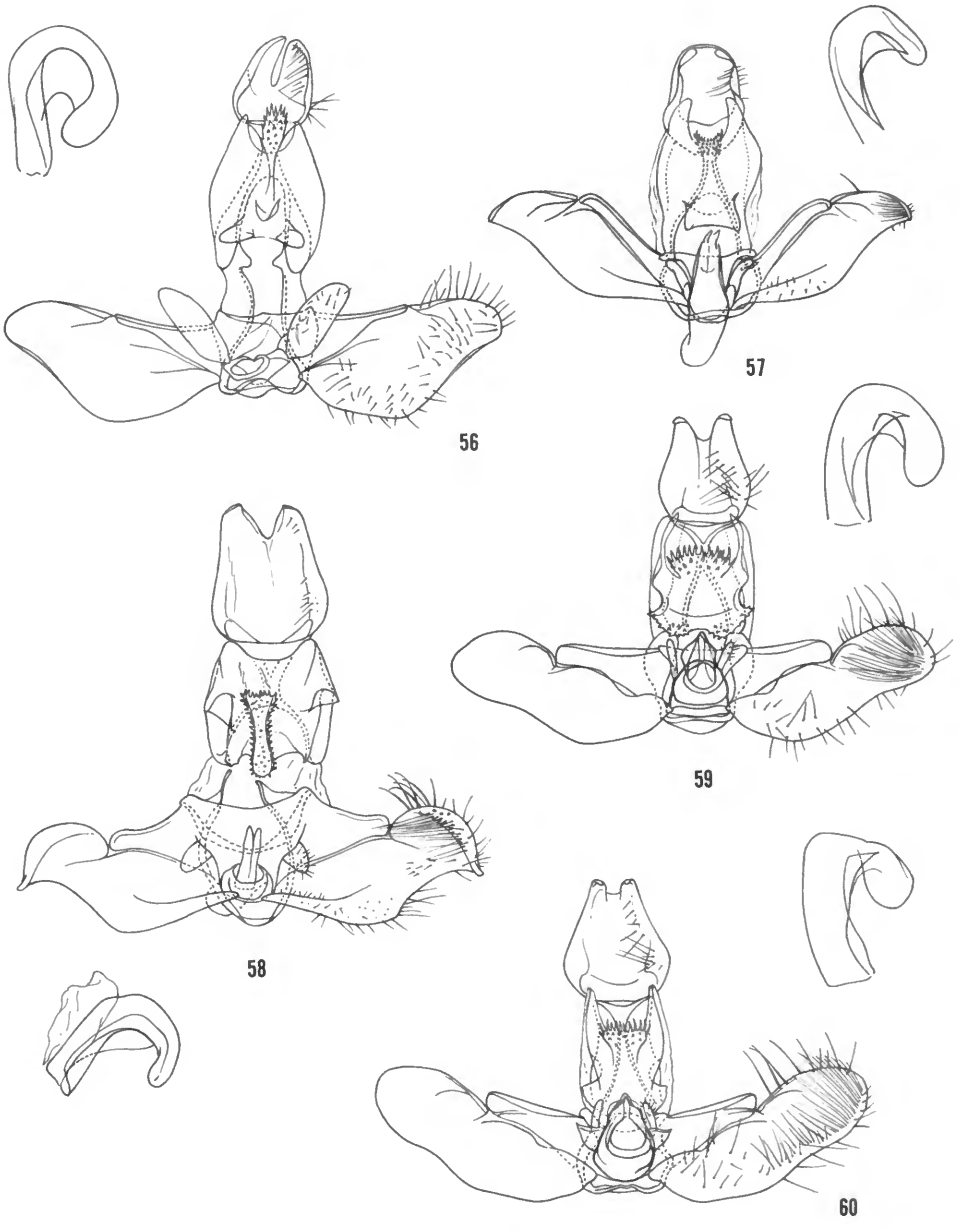
FIGURES 42–45.—Wing venation of *Ethmia* species: 42 *E. coquillettella* Busck; 43, *E. charybdis* Powell; 44, *E. epilygella* Powell; 45, *E. cyanea* Walsingham.



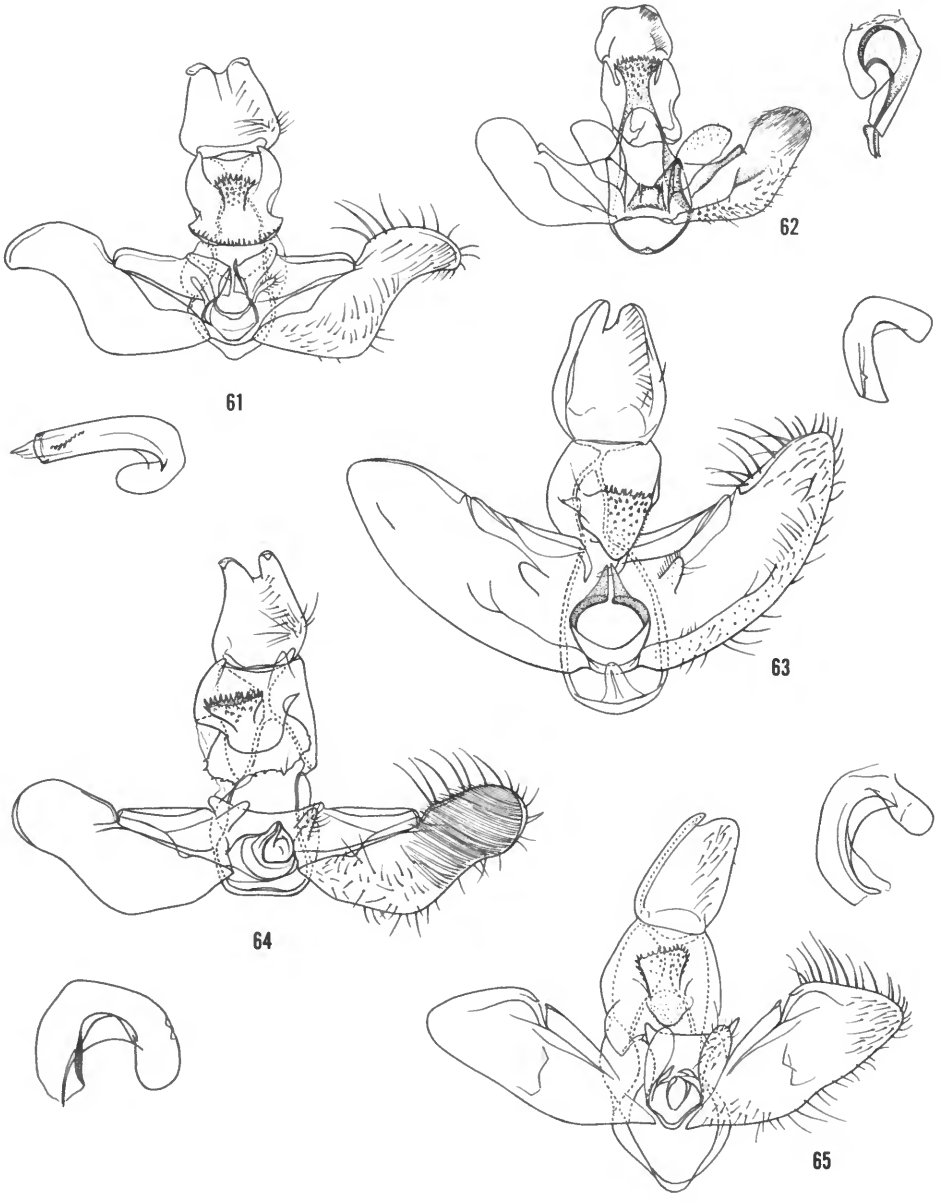
FIGURES 46–50.—Male genitalia of *Pyramidobela,* ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 46, *P. angelarum* Keifer; 47, *P. quinquecristata* (Braun); 48, *P. agyrtodes* (Meyrick); 49, *P. tetraphyta* Meyrick; 50, *P. ochrolepra* Powell.



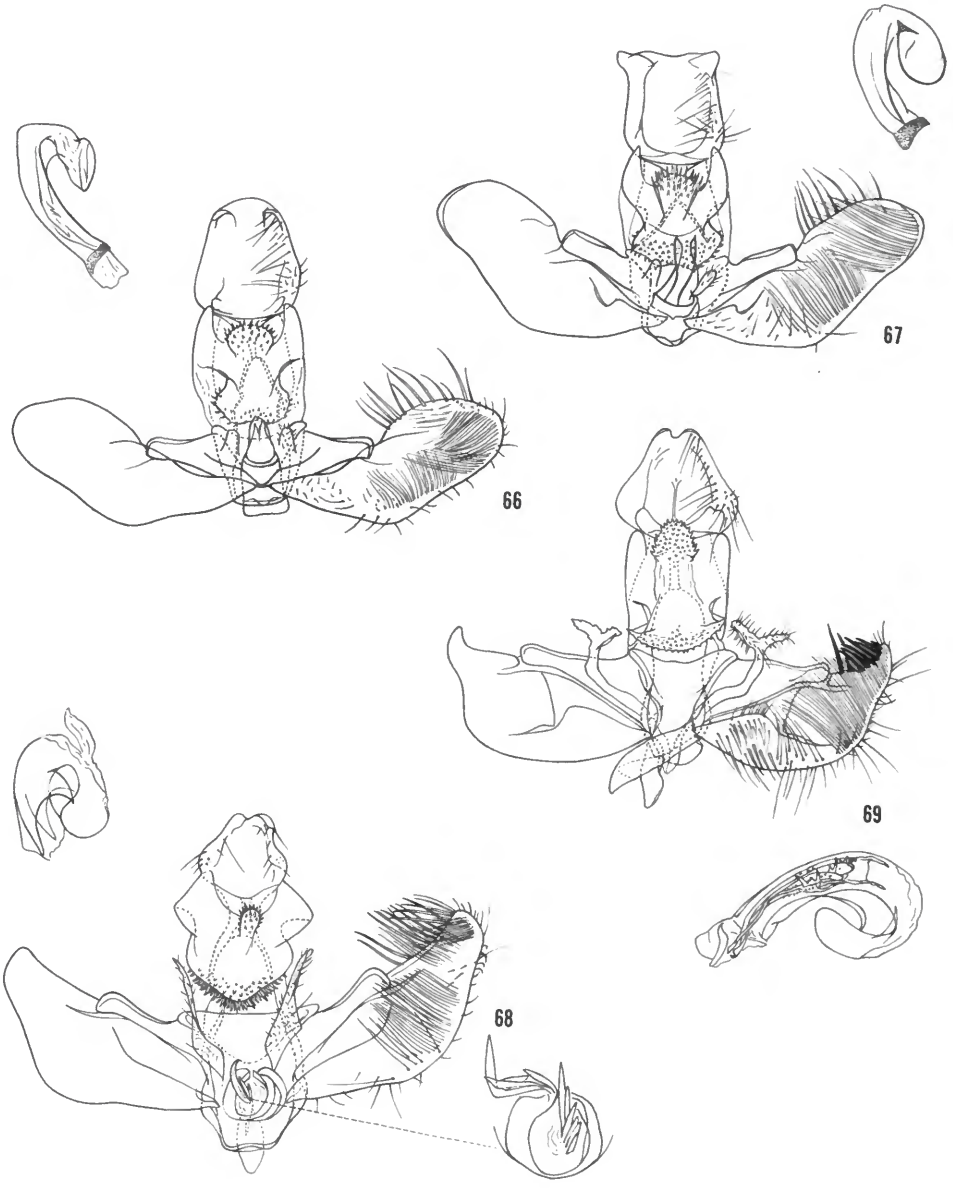
FIGURES 51–55.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 51, *E. coquillettella* Busck (*u*, uncus; *g*, *a*, anterior gnathos; *g*, *p*, posterior gnathos; *vl*, valva; *b. p.*, basal process; *ae*, aedeagus); 52, *E. scylla* Powell; 53, *E. brevistriga* Clarke; 54, *E. albitogata* Walsingham; 55, *E. plagiobothrae* Powell.



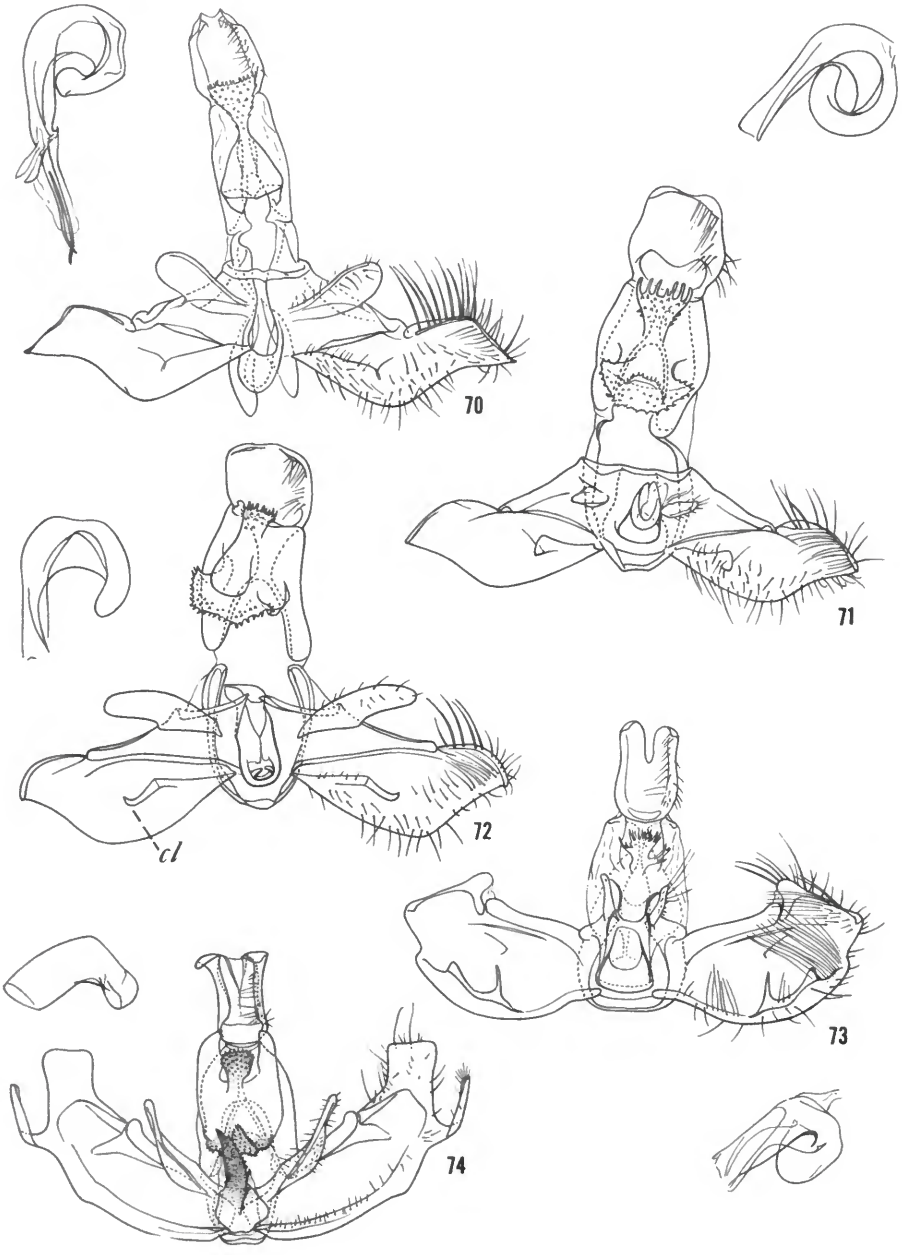
FIGURES 56–60.—Male genitalia of *Ethmia*, ventral aspect with valvae reflexed, aedeagus separated and shown in lateral aspect; 56, *E. minuta* Powell; 57, *E. tricula* Powell; 58, *E. charybdis* Powell; 59, *E. albistrigella* (Walsingham); 60, *E. nadia* Clarke.



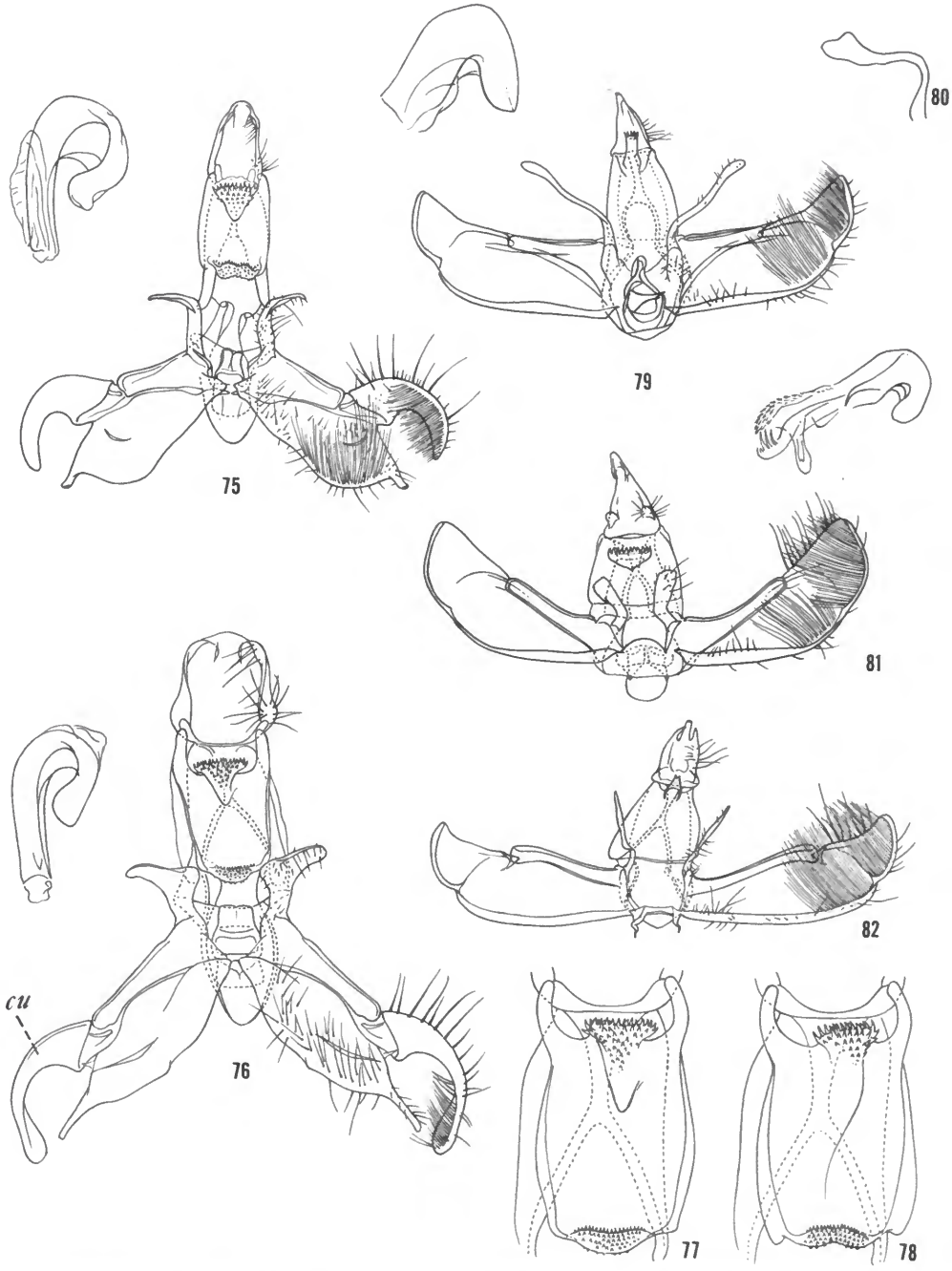
FIGURES 61–65.—Male genitalia of *Ethmia*, ventral aspect with valvae reflexed, aedeagus separated and shown in lateral aspect: 61, *E. semilugens* (Zeller); 62, *E. epileuca* Powell; 63, *E. apicipunctella* (Chambers); 64, *E. arctostaphylella* (Walsingham); 65, *E. mansita* Busck.



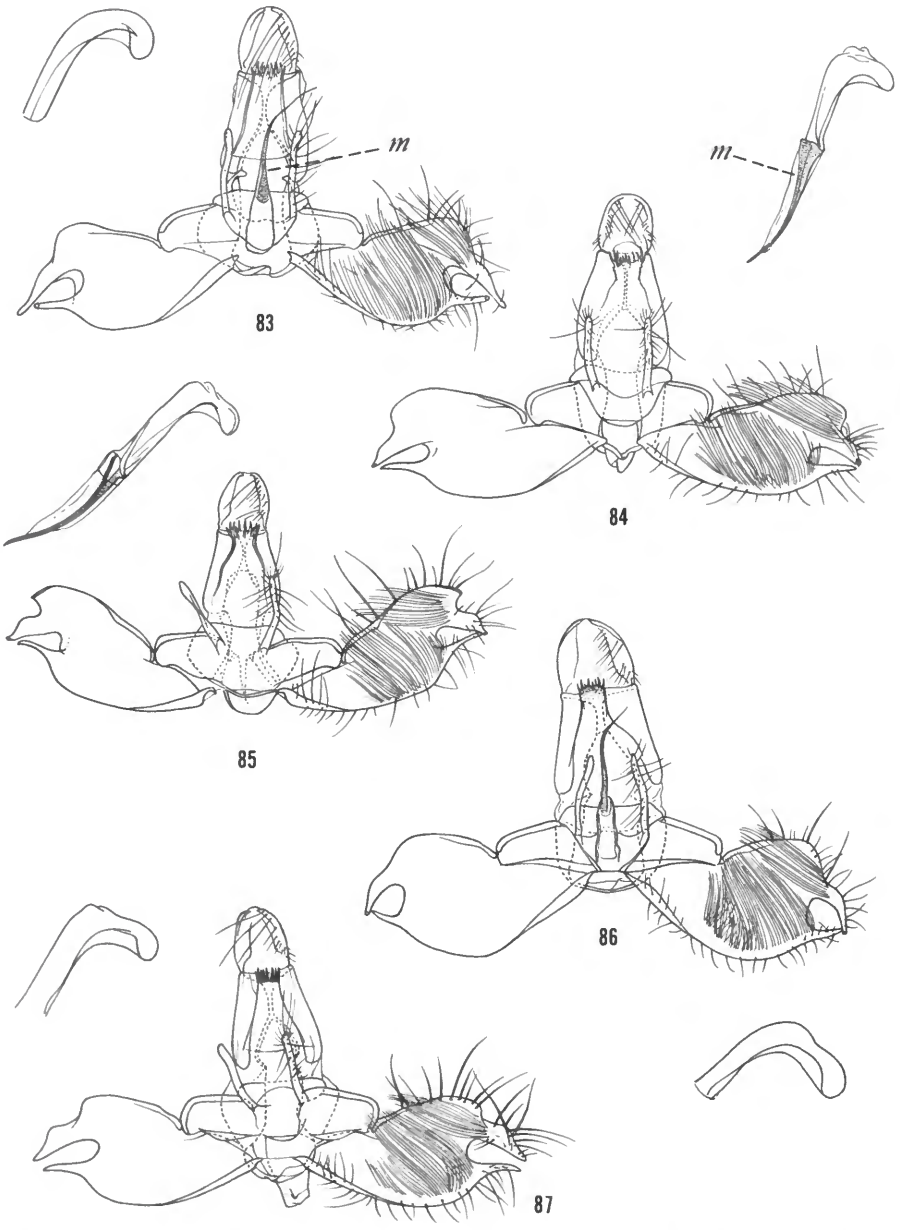
FIGURES 66–69.—Male genitalia of *Ethmia*, ventral aspect with valvae reflexed, aedeagus separated and shown in lateral aspect: 66, *E. discostrigella* (Chambers); 67, *E. semitenebrella* Dyar; 68, *E. papiella* Powell; 69, *E. volcanella* Powell.



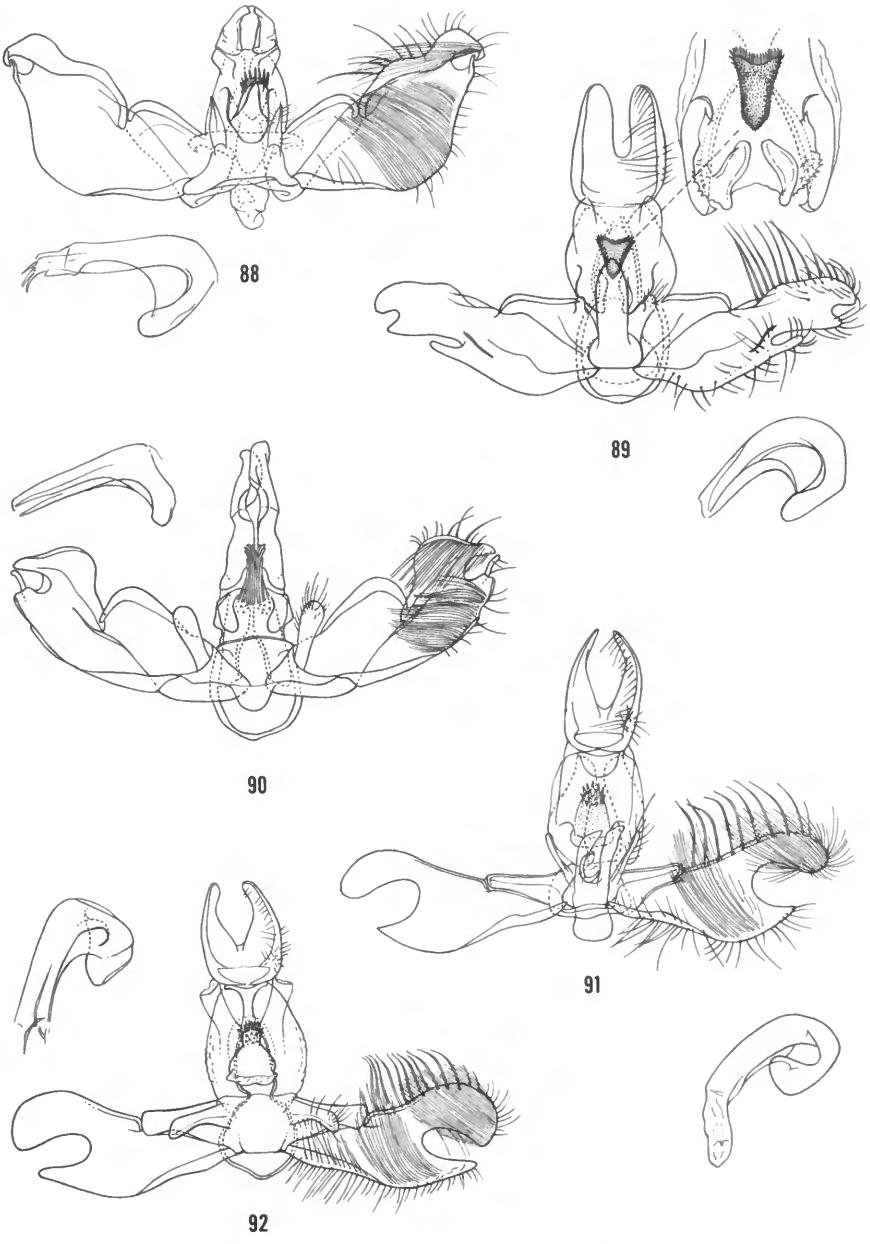
FIGURES 70–74.—Male genitalia of *Ethmia*, ventral aspect with valvae reflexed, aedeagus separated and shown in lateral aspect: 70, *E. macelhosiella* Busck; 71, *E. geranella* Barnes and Busck; 72, *E. macneilli* Powell (*cl*, "clasper"); 73, *E. piperella* Powell; 74, *E. aurifluella* (Hübner).



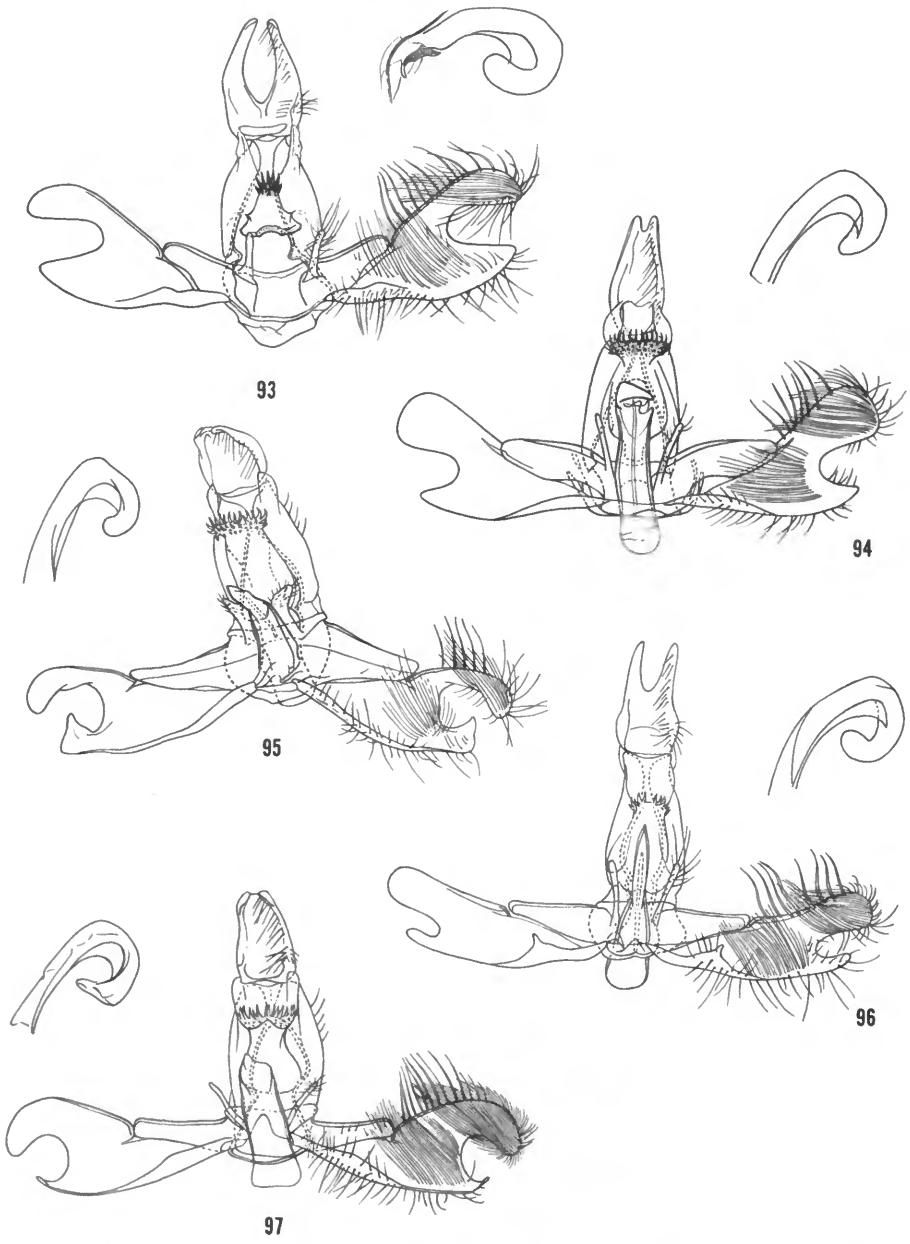
FIGURES 75–82.—Male genitalia of *Ethmia*, ventral aspect with valvae reflexed, aedeagus separated and shown in lateral aspect: 75, *E. bipunctella* (Fabricius); 76, *E. monticola* (Walsingham) (*cu*, cucullus); 77, *E. monticola*, gnathos enlarged; 78, *E. caliginosella* Busck, gnathos; 79, *E. hagenella* (Chambers); 80, *E. h. josephinella* Dyar, basal process; 81, *E. burnsella* Powell; 82, *E. zelleriella* (Chambers), aedeagus lacking.



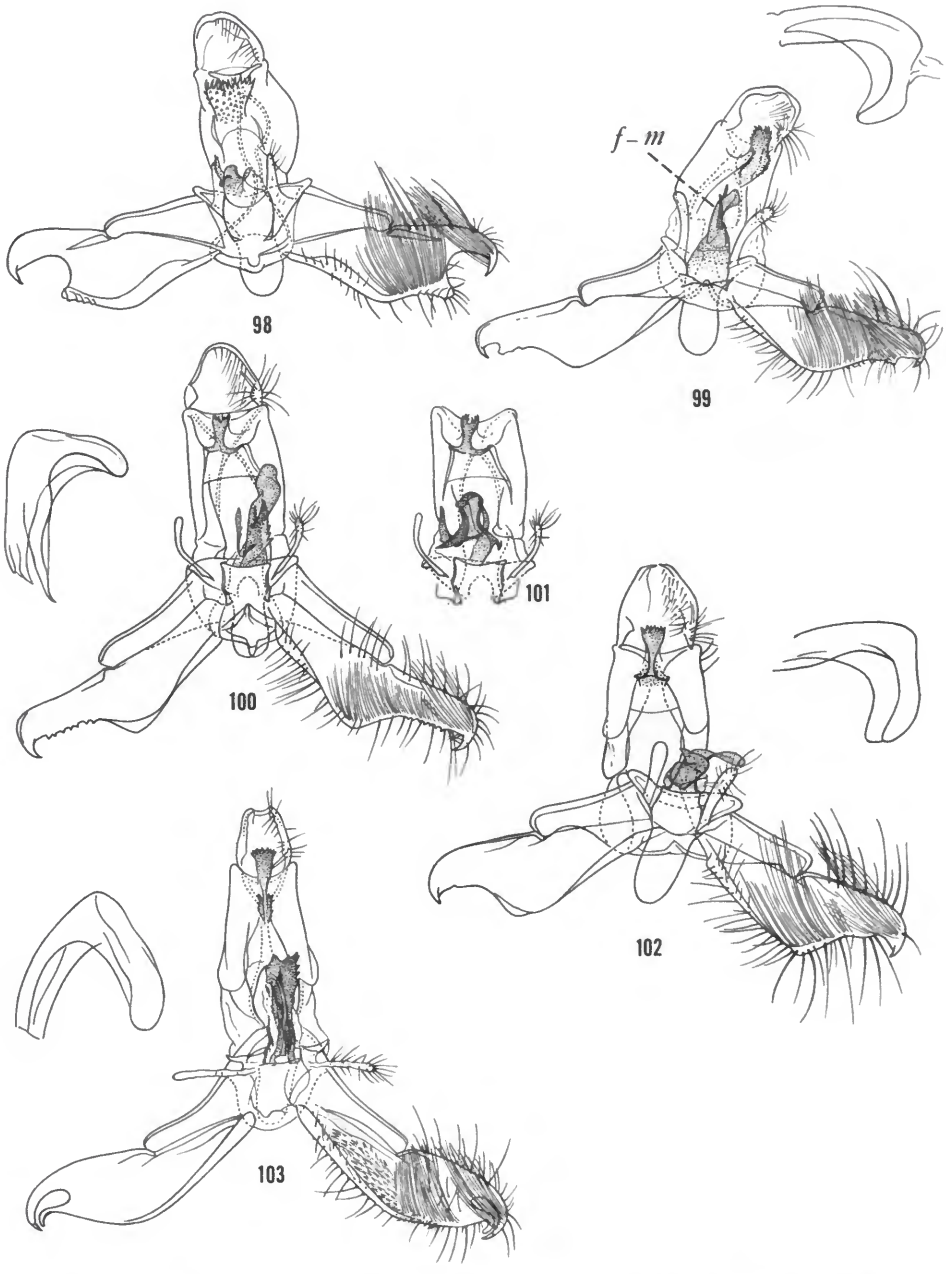
FIGURES 83–87.—Male genitalia of *Ethmia*, ventral aspect with valvae reflexed, aedeagus separated and shown in lateral aspect: 83, *E. detliella* (Fernald) (*m*, manica); 84, *E. davisella* Powell; 85, *E. linsdalei* Powell; 86, *E. clarkei* Powell; 87, *E. subsimilis* Walsingham.



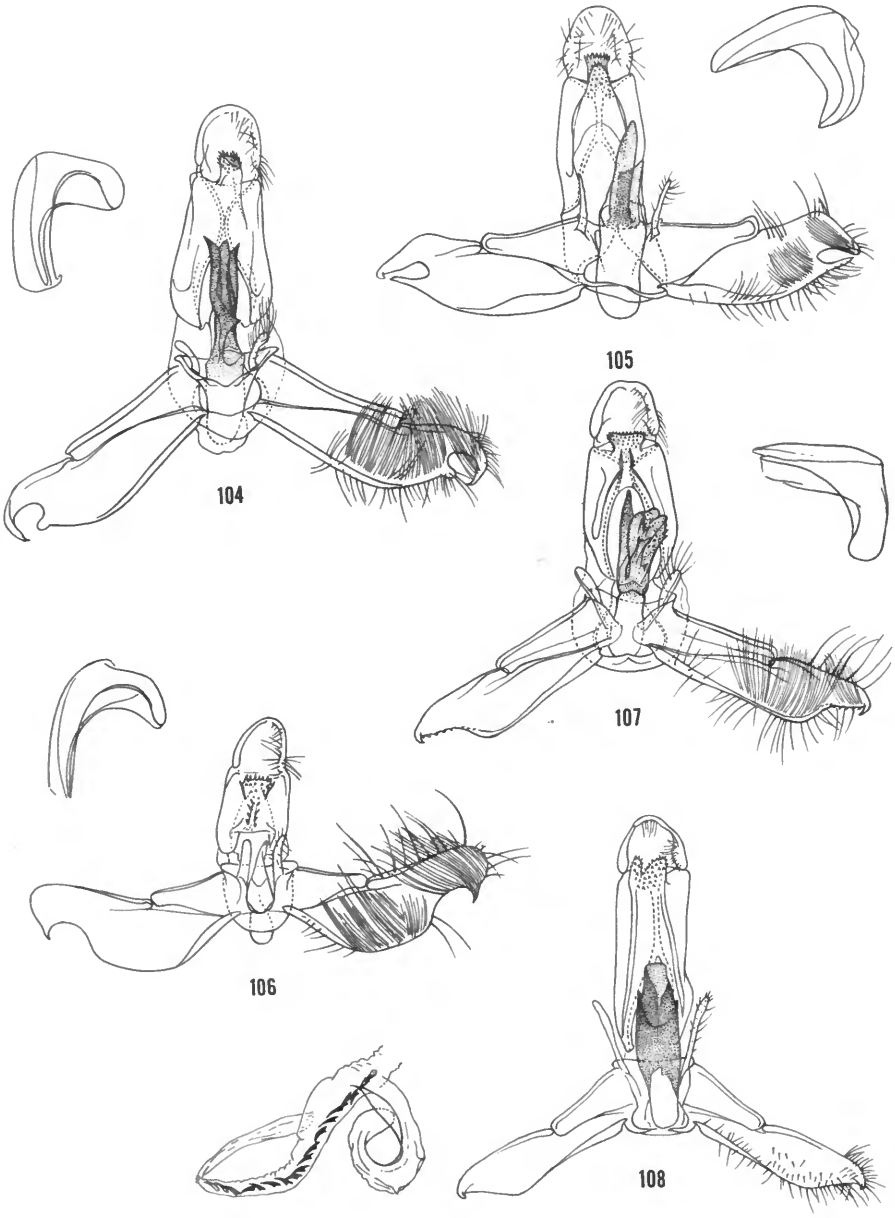
FIGURES 88–92.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 88, *E. bittenella* (Busck); 89, *E. mulleri* Busck; 90, *E. proximella* Busck; 91, *E. festiva* Busck; 92, *E. cypraeella* (Zeller).



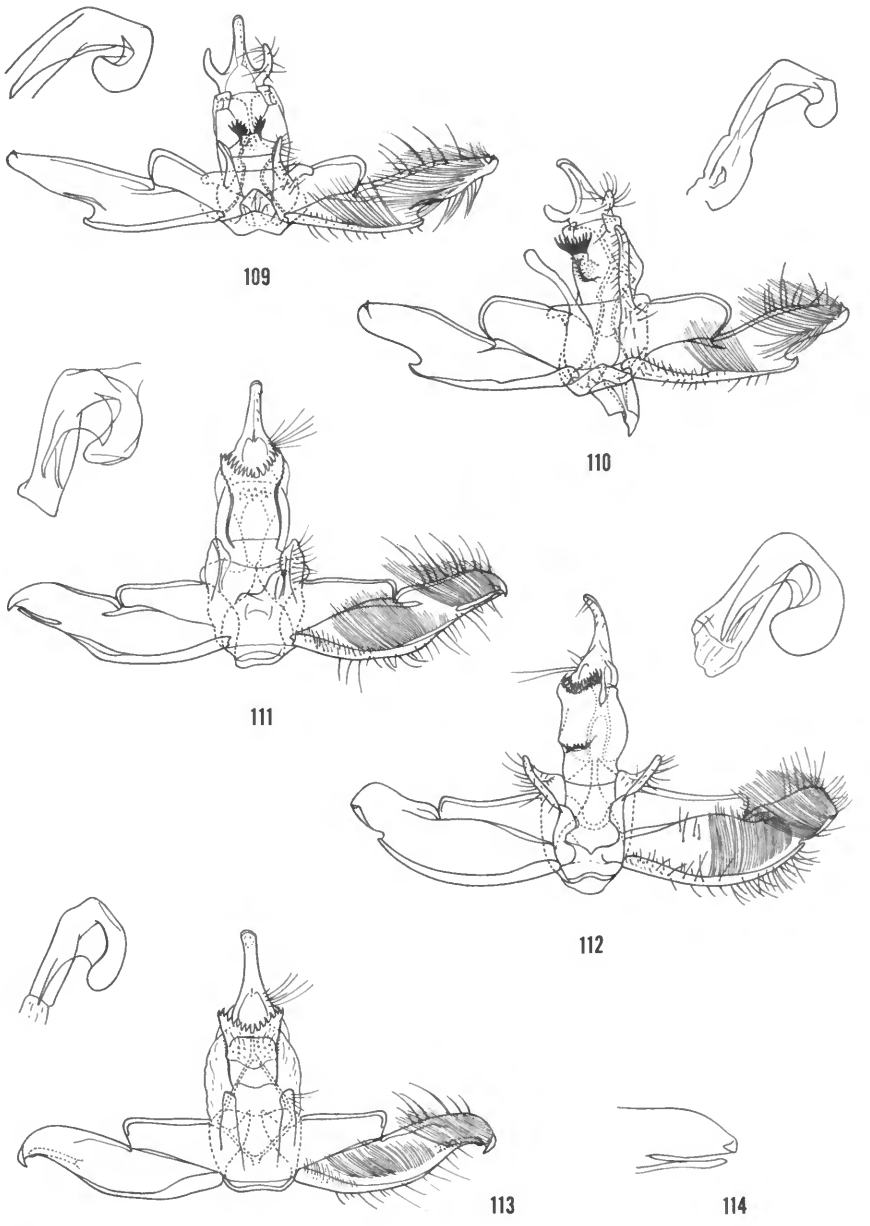
FIGURES 93–97.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 93, *E. abraxasella* (Walker); 94, *E. scythropa* Walsingham; 95, *E. nivosella* (Walker); 96, *E. terpnota* Walsingham; 97, *E. iridella* Powell.



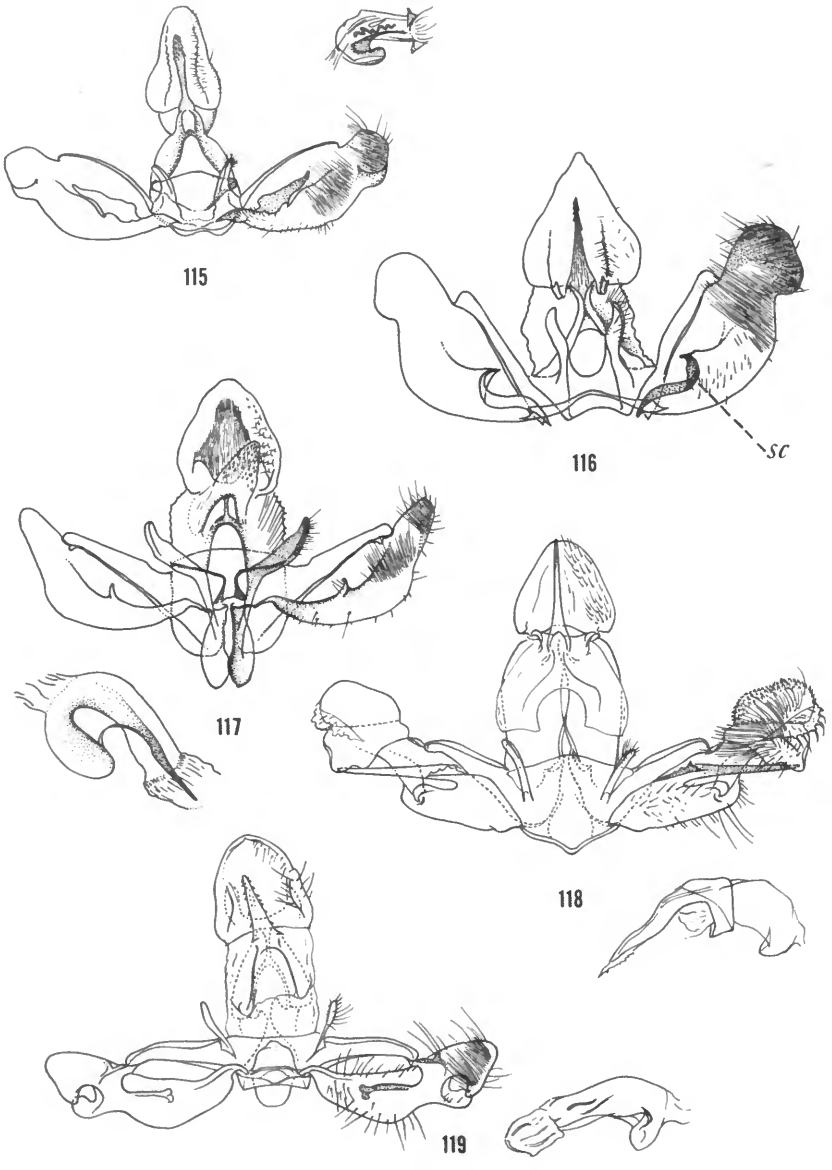
FIGURES 98–103.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 98, *E. perpulchra* Walsingham; 99, *E. elutella* Busck (*f-m*, fultura-manica); 100, *E. janzeni* Powell; 101, *E. janzeni*, (atypical manica); 102, *E. submissa* Busck; 103, *E. epilygella* Powell.



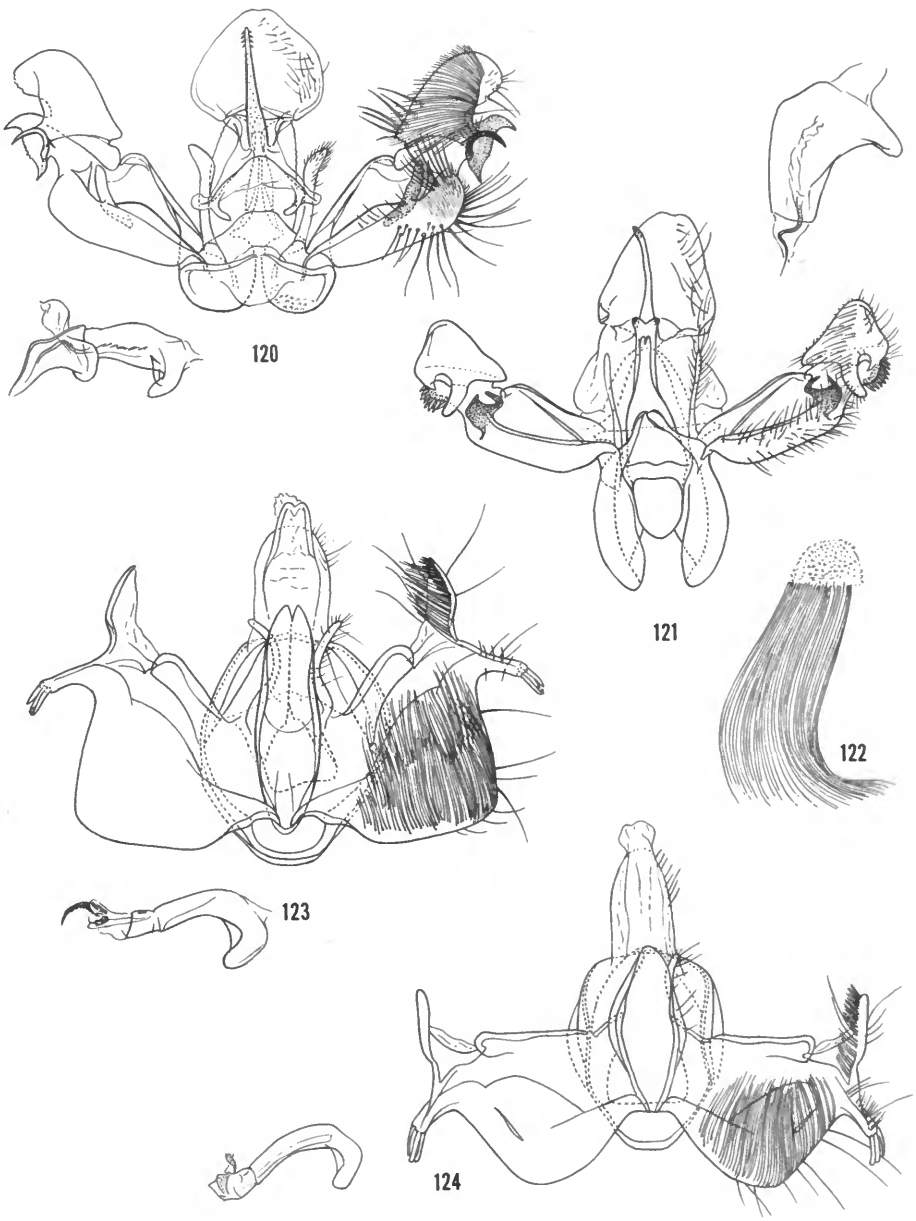
FIGURES 104–108.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 104, *E. fritillella* Powell; 105, *E. notomurinella* Powell; 106, *E. ungulatella* Busck; 107, *E. chalcogramma* Powell; 108, *E. phylacops* Powell.



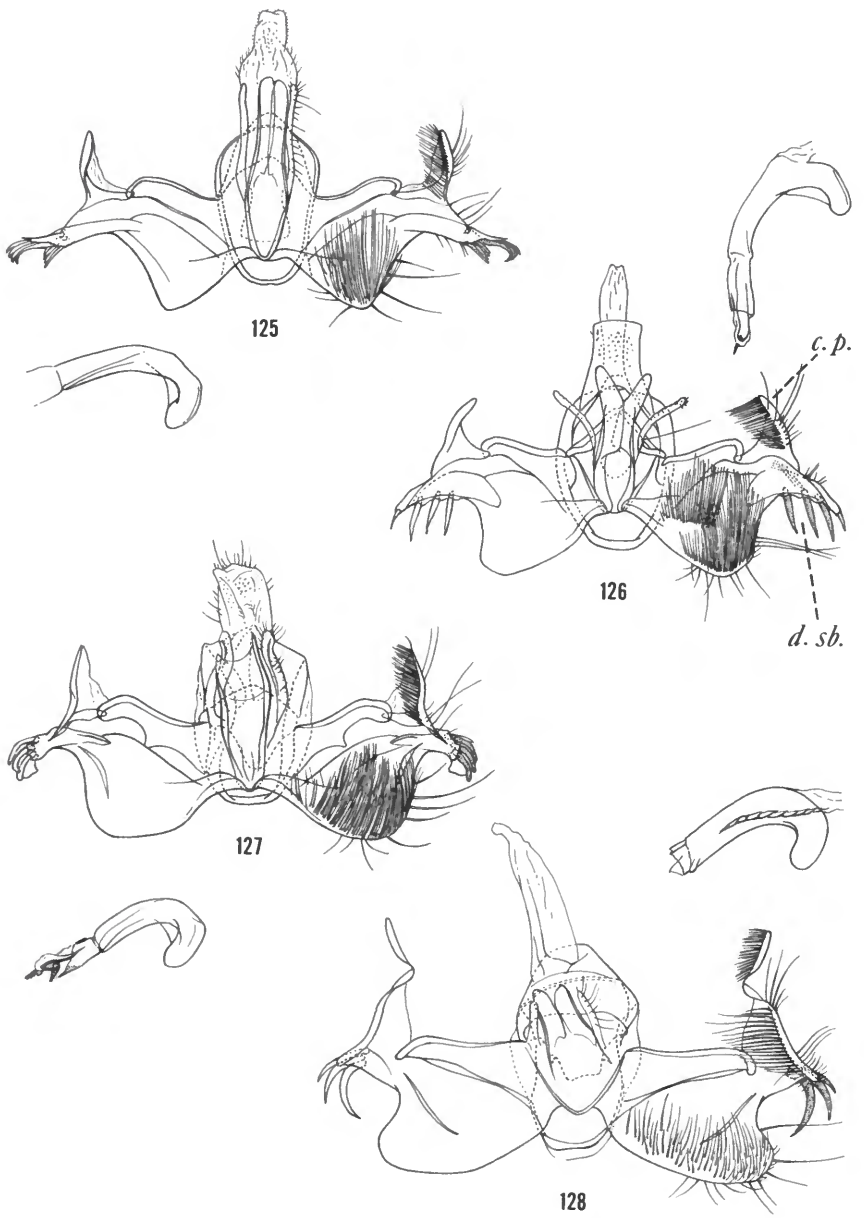
FIGURES 109–114.—Male genitalia of *Ethmia,* ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 109, *E. exornata* (Zeller); 110, undescribed species near *exornata;* 111, *E. phylacis* Walsingham; 112, *E. mnesicosma* Meyrick; 113, *E. gelidella* (Walker); 114, *E. gelidella,* outline of flattened valva.



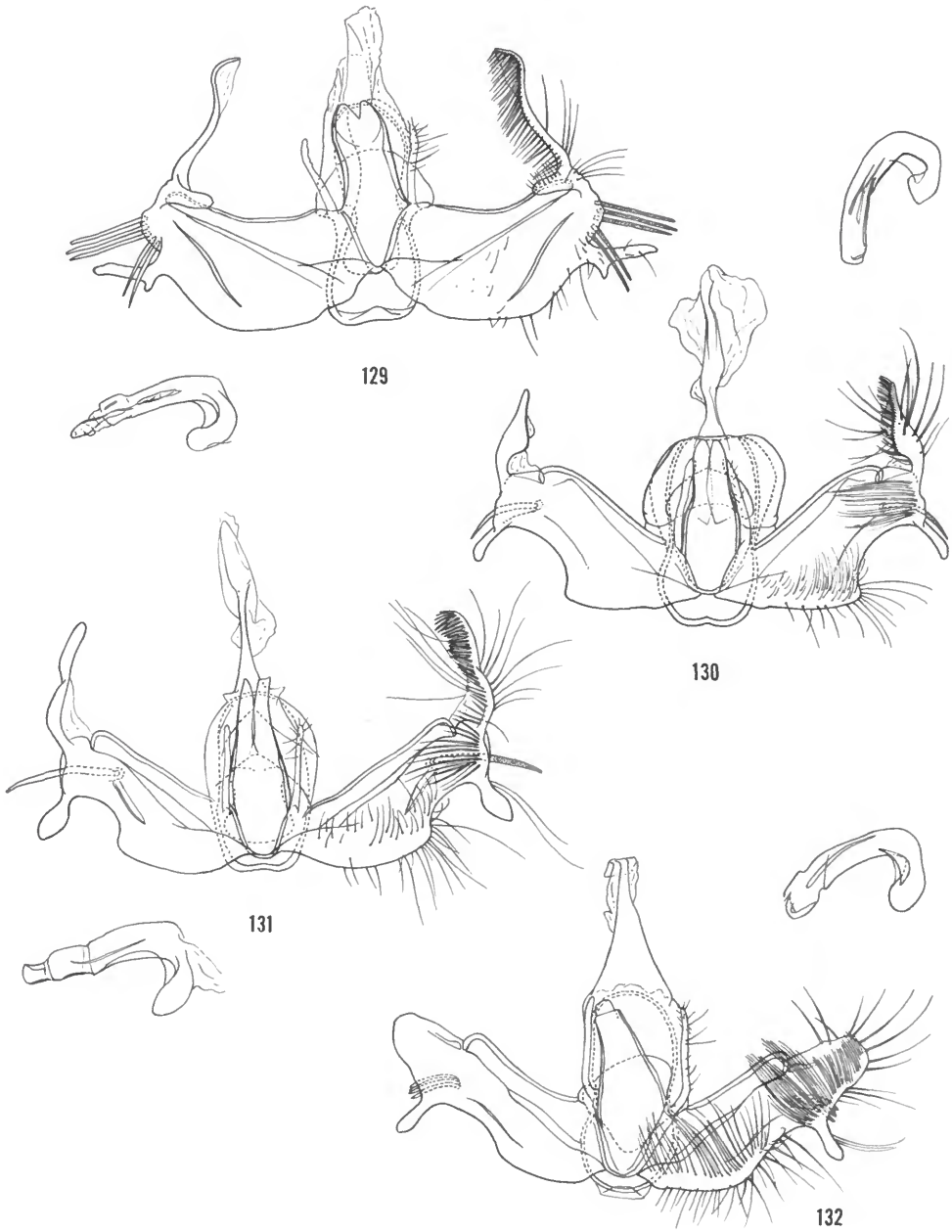
FIGURES 115–119.—Male genitalia of *Ethmia,* ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect; 115, *E. phoenicura* Meyrick; 116, *E. chemsaki* Powell, aedeagus lacking (*sc,* sacculus); 117, *E. zebrata* Powell; 118, *E. notatella* (Walker); 119, *E. paucella* (Walker).



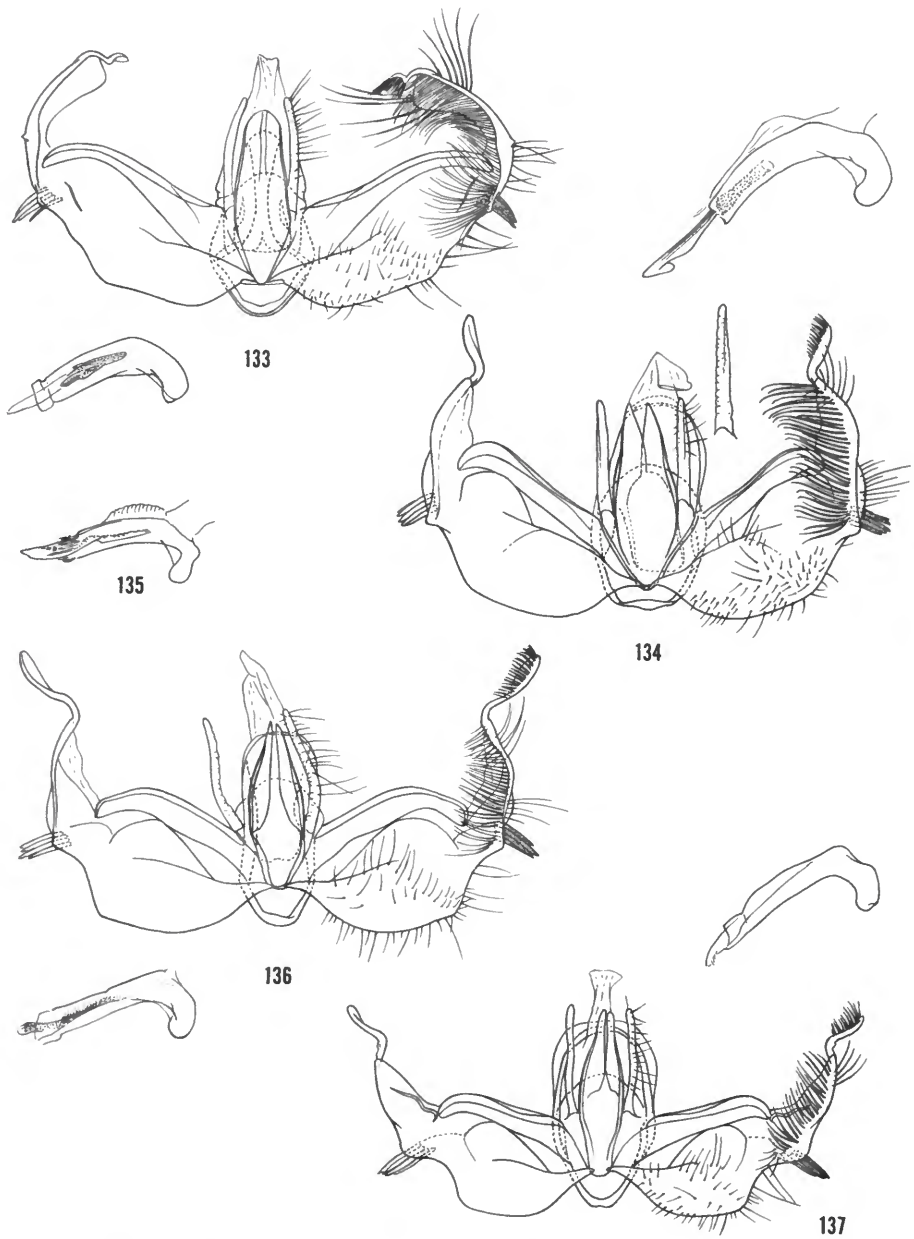
FIGURES 120–124.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 120, *E. wellingi* Powell; 121, *E. hiramella* Busck; 122, *E. hiramella*, lateral scale brush; 123, *E. confusella* (Walker); 124, *E. striatella* Busck.



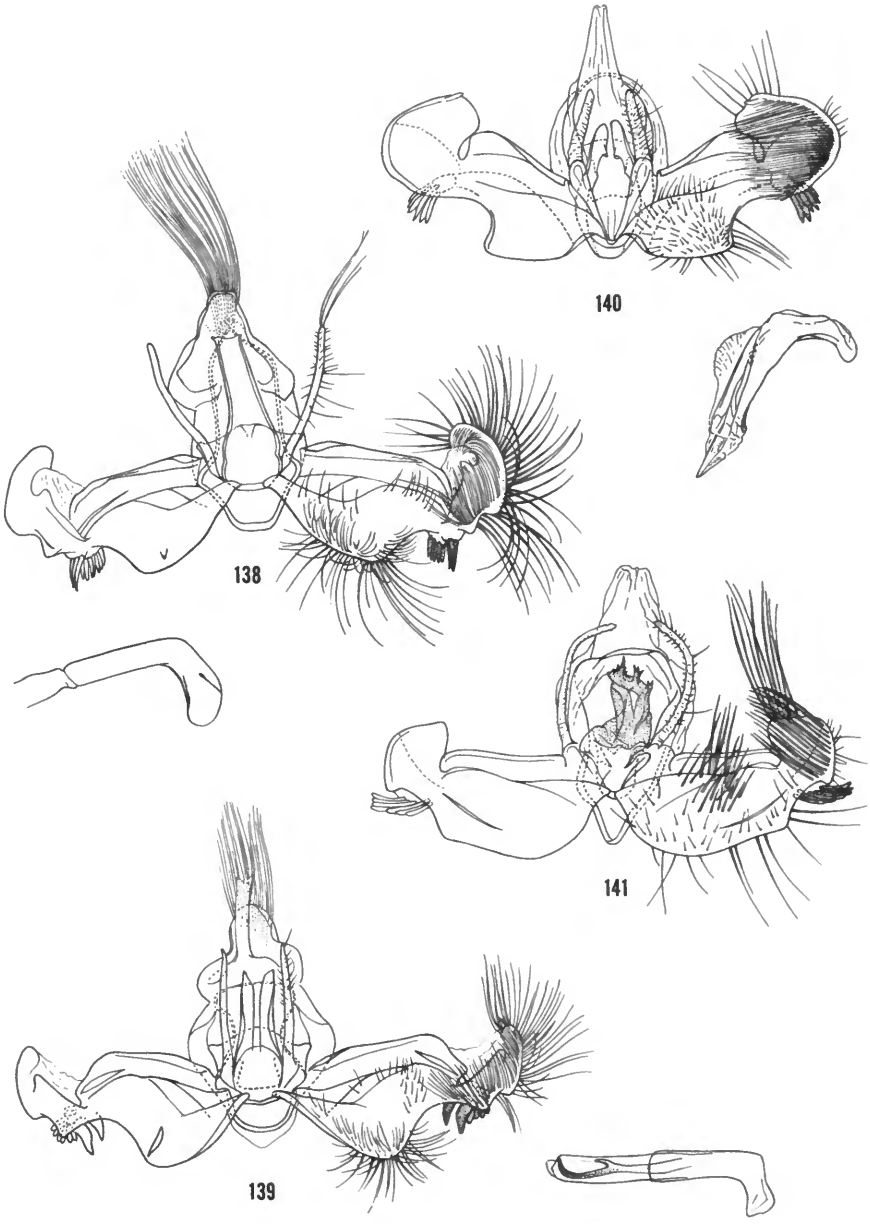
FIGURES 125–128.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 125, *E. confusellastra* Powell; 126, *E. sandra* Powell (*c.p.*, costal "plume"; *d. sb.*, distal "seta-bunch"); 127, *E. duckworthi* Powell; 128, *E. humilis* Powell.



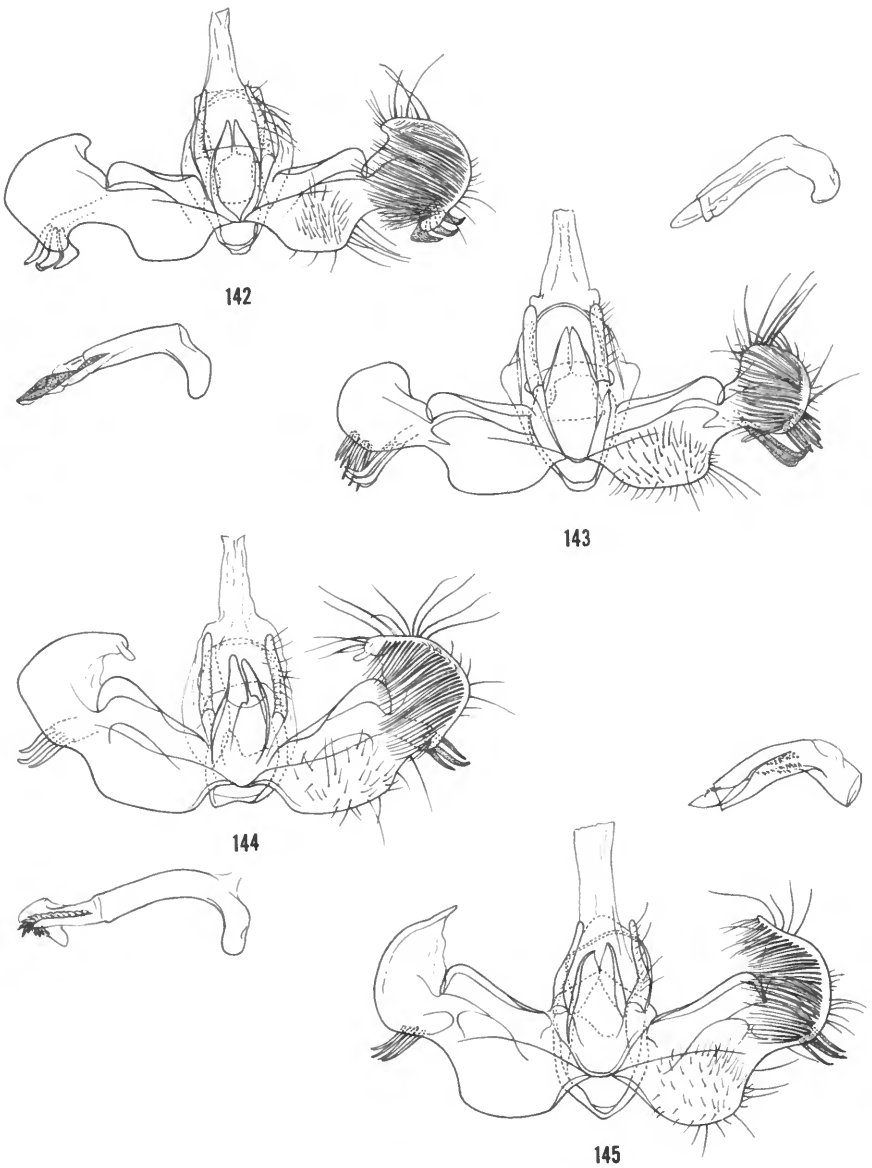
FIGURES 129–132.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 129, *E. farrella* Powell; 130, *E. coronata* Walsingham; 131, *E. nigritaenia* Powell; 132, *E. submigritaenia* Powell.



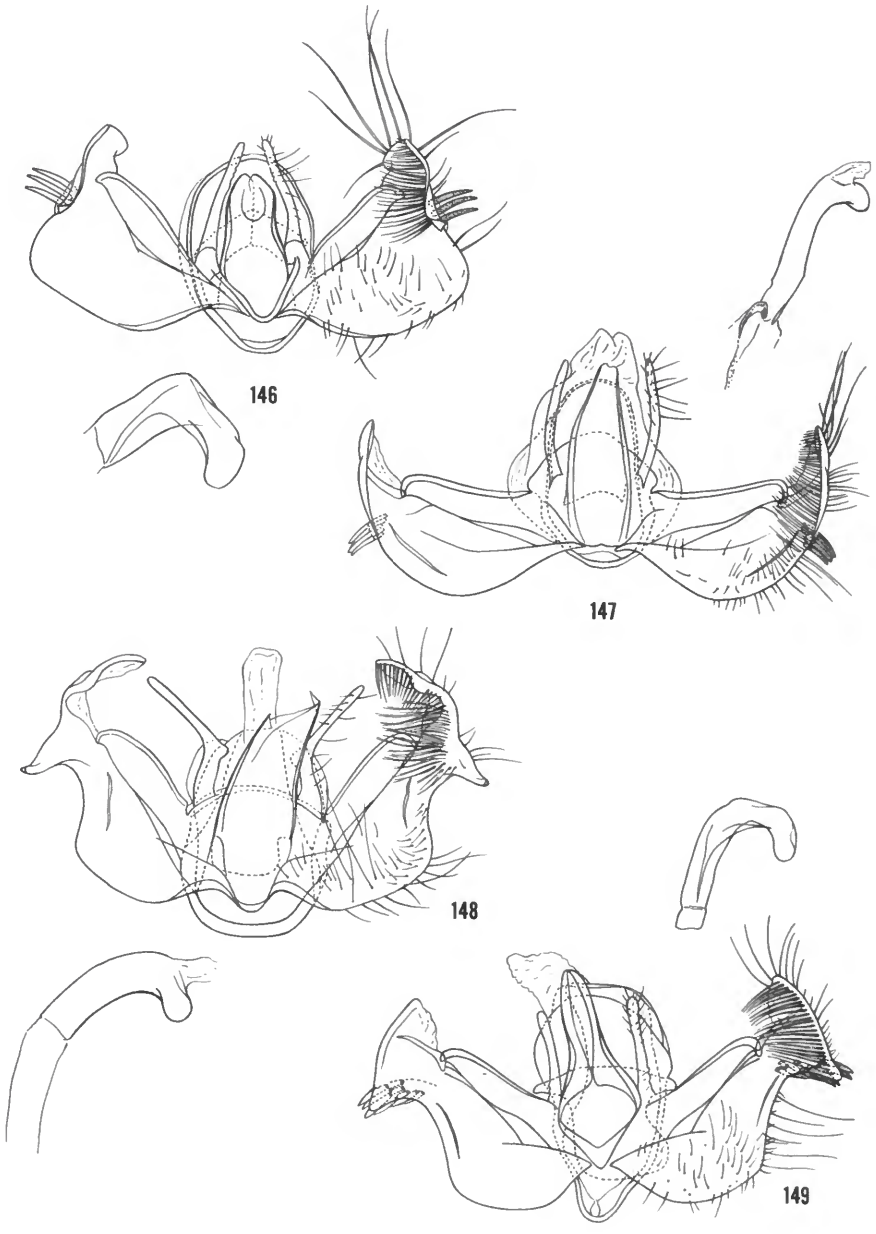
FIGURES 133–137.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 133, *E. catapeltica* Meyrick (Guatemala; aedeagus, Costa Rica); 134, *E. catapeltica* (Colombia); 135, *E. howdeni* Powell, aedeagus; 136, *E. l. longimaculella* (Chambers); 137, *E. l. coranella* Dyar.



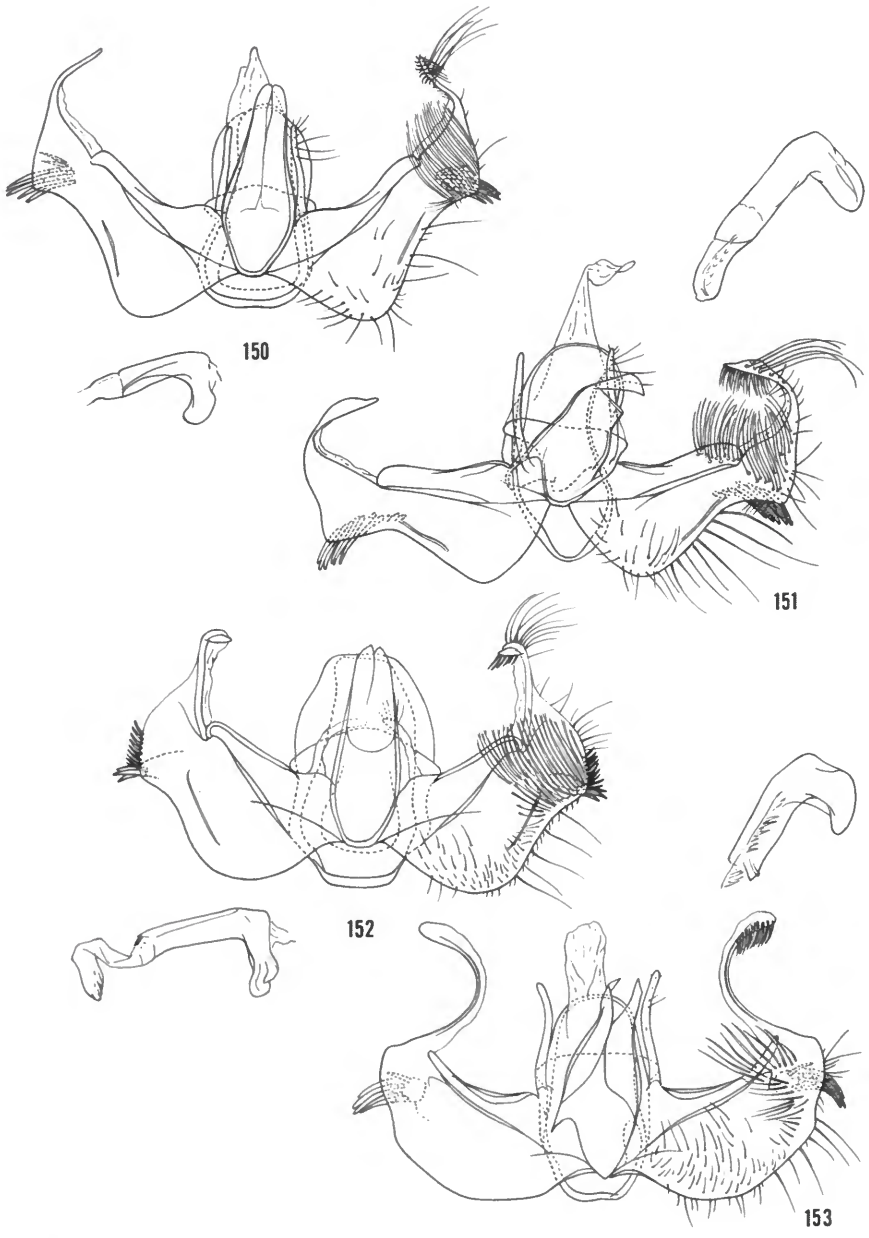
FIGURES 138–141.—Male genitalia of *Ethmia,* ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 138, *E. baliostola* Walsingham; 139, *E. cubensis* Busck; 140, *E. lichyi* Powell; 141, *E. flavicaudata* Walsingham (aedeagus not shown).



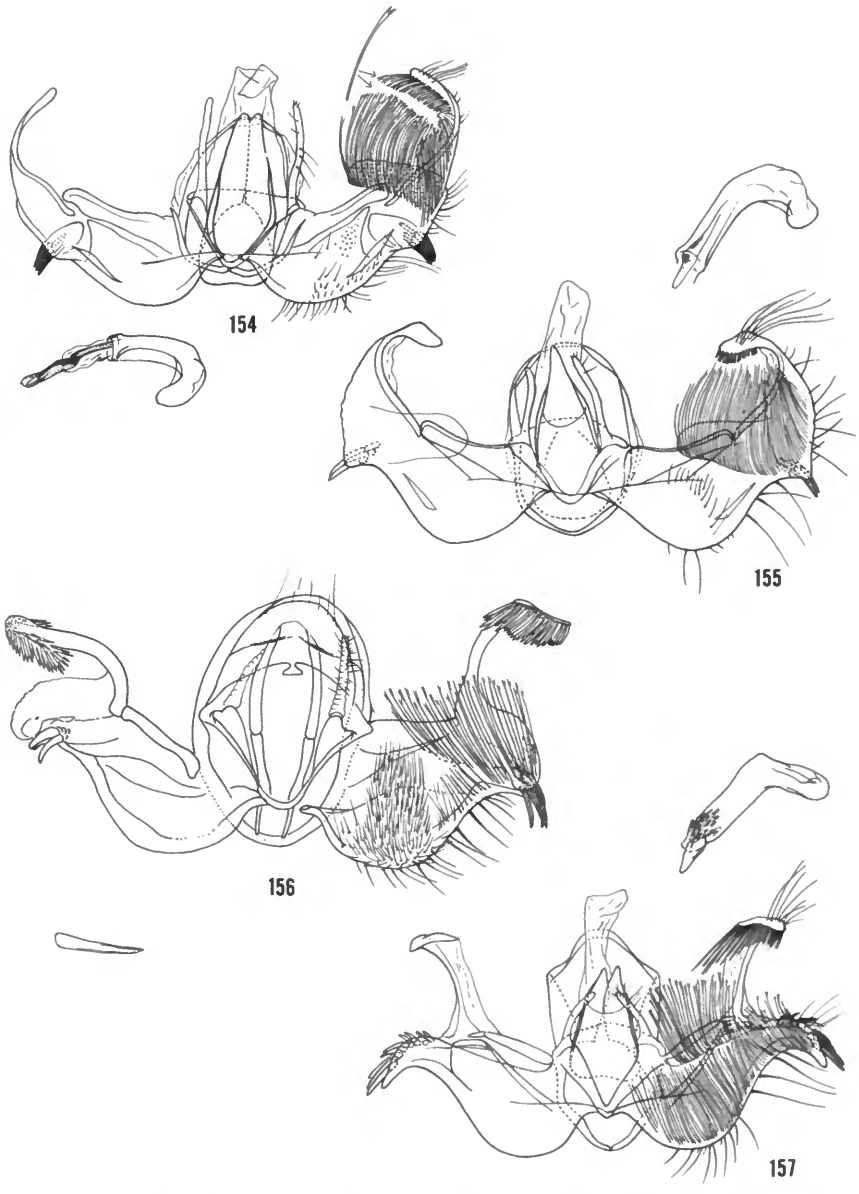
FIGURES 142–145.—Male genitalia of *Ethmia,* ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 142, *E. calumniella* Powell; 143, *E. plaumanni* Powell; 144, *E. transversella* Busck; 145, *E. hieroglyphica* Powell.



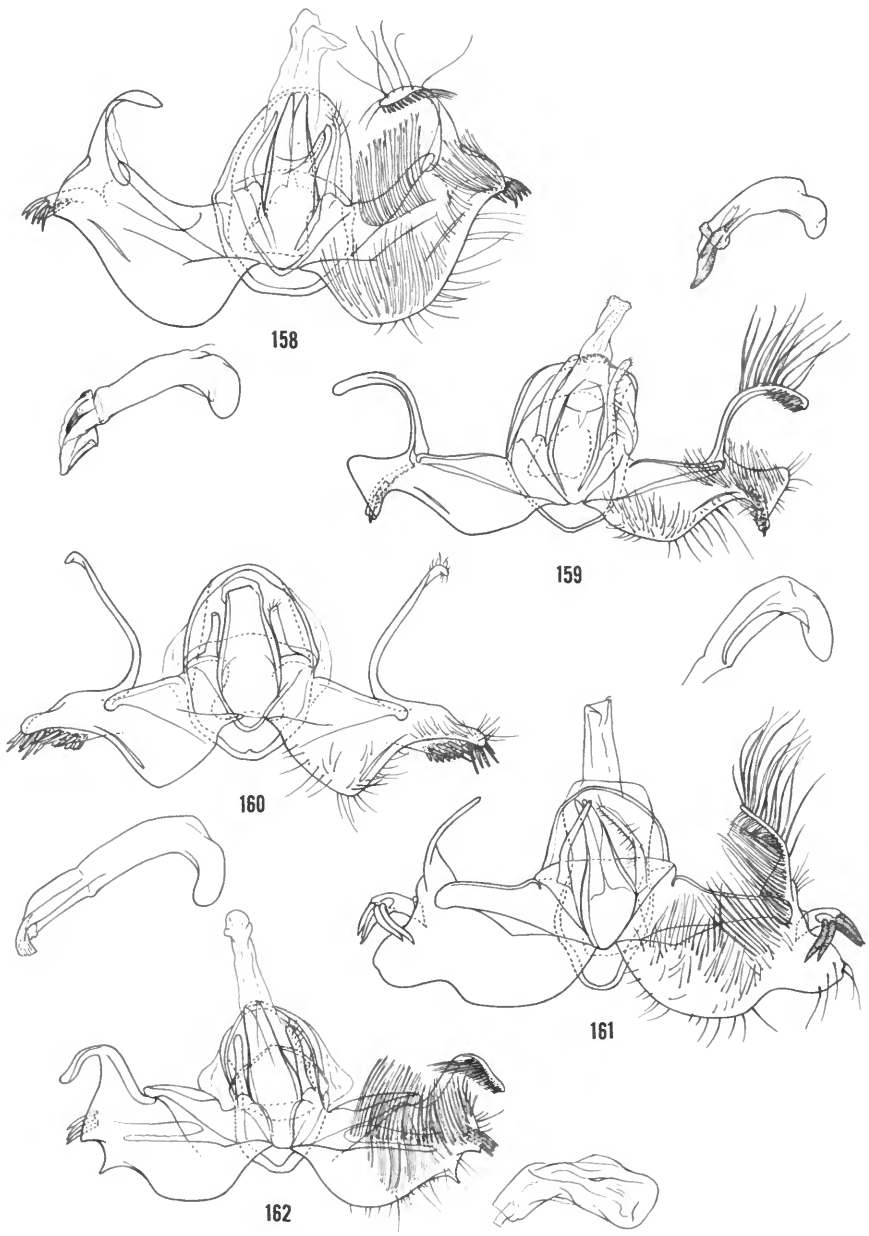
FIGURES 146–149.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 146, *E. conglobata* Meyrick; 147, *E. gigantea* Busck; 148, *E. semiombra* Dyar; 149, *E. albicostella* (Beutenmüller).



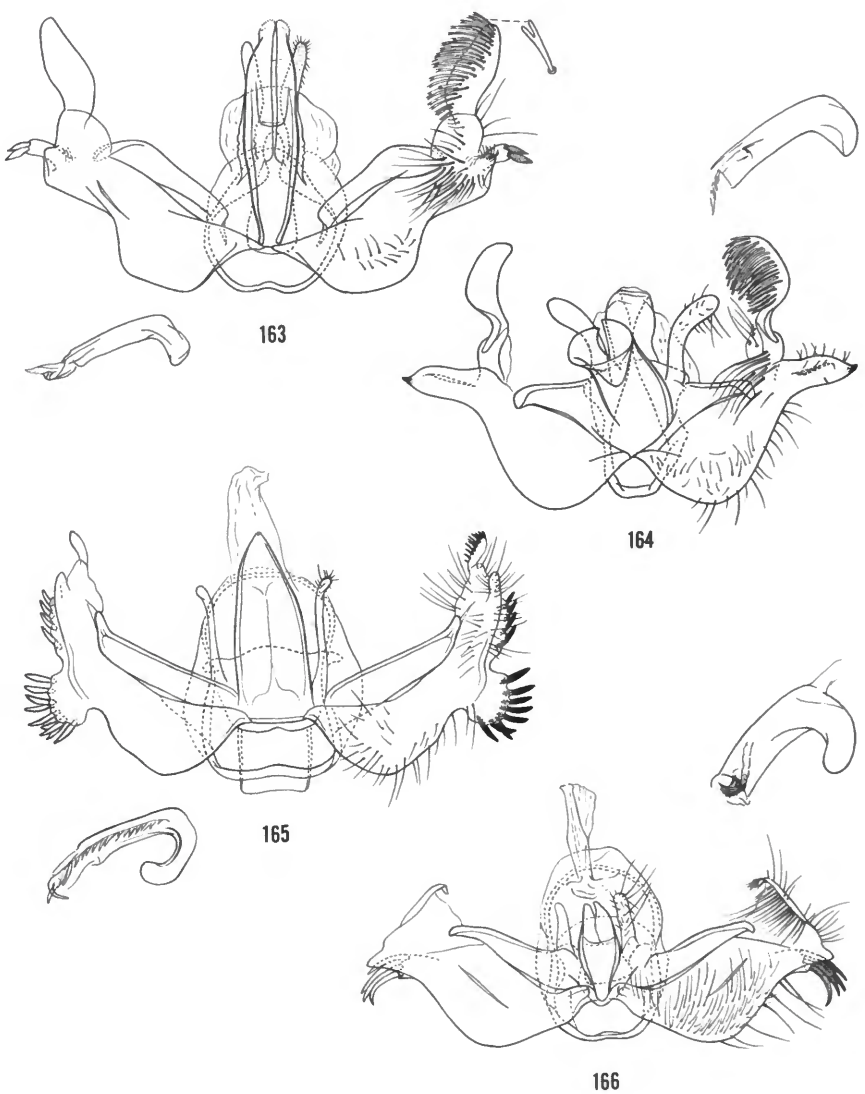
FIGURES 150–153.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 150, *E. mirusella* (Chambers); 151, *E. trifurcella* (Chambers); 152, *E. marmorea* (Walsingham); 153, *E. hodgesella* Powell.



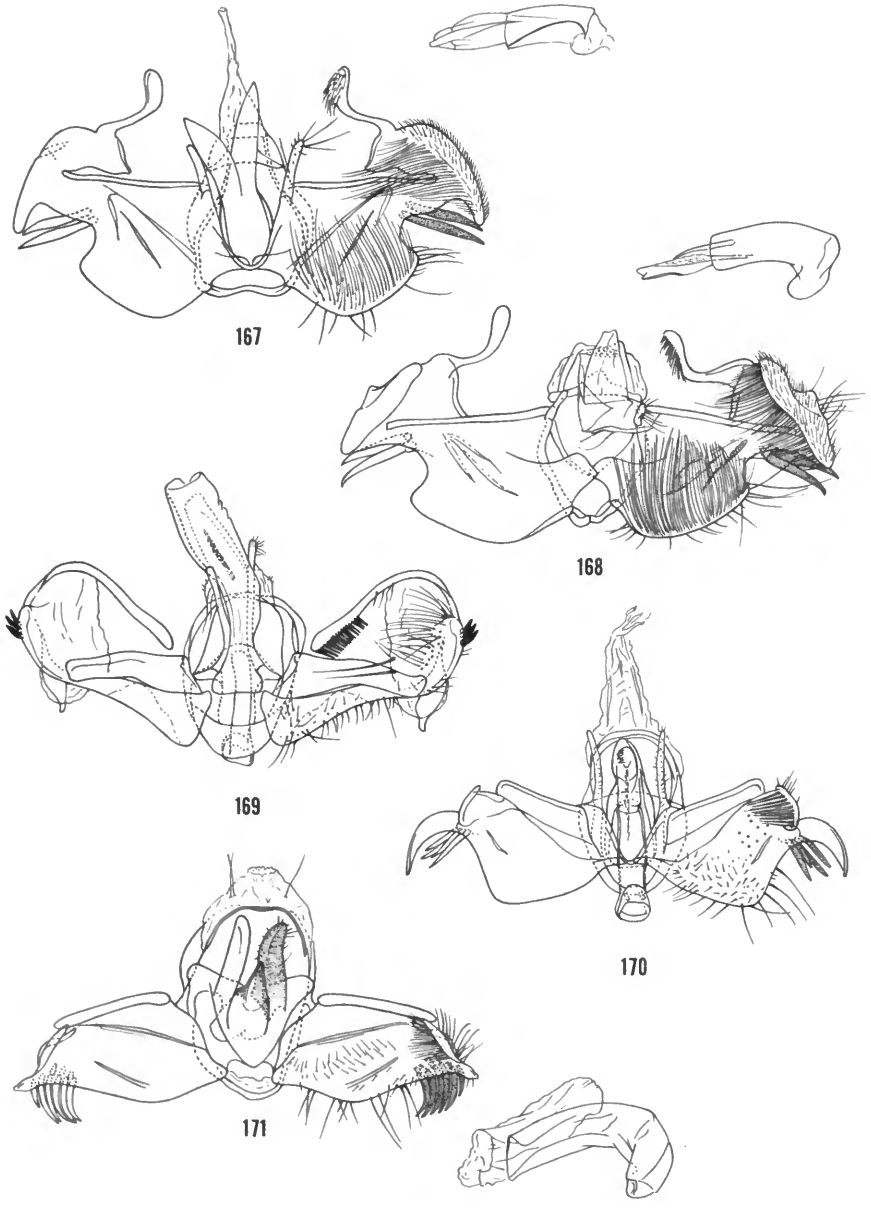
FIGURES 154–157.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 154, *E. baja* Powell; 155, *E. playa* Powell; 156, *E. penthica* Walsingham (aedeagus not shown, cornutus in vesica shown in ventral aspect); 157, *E. similatella* Busck.



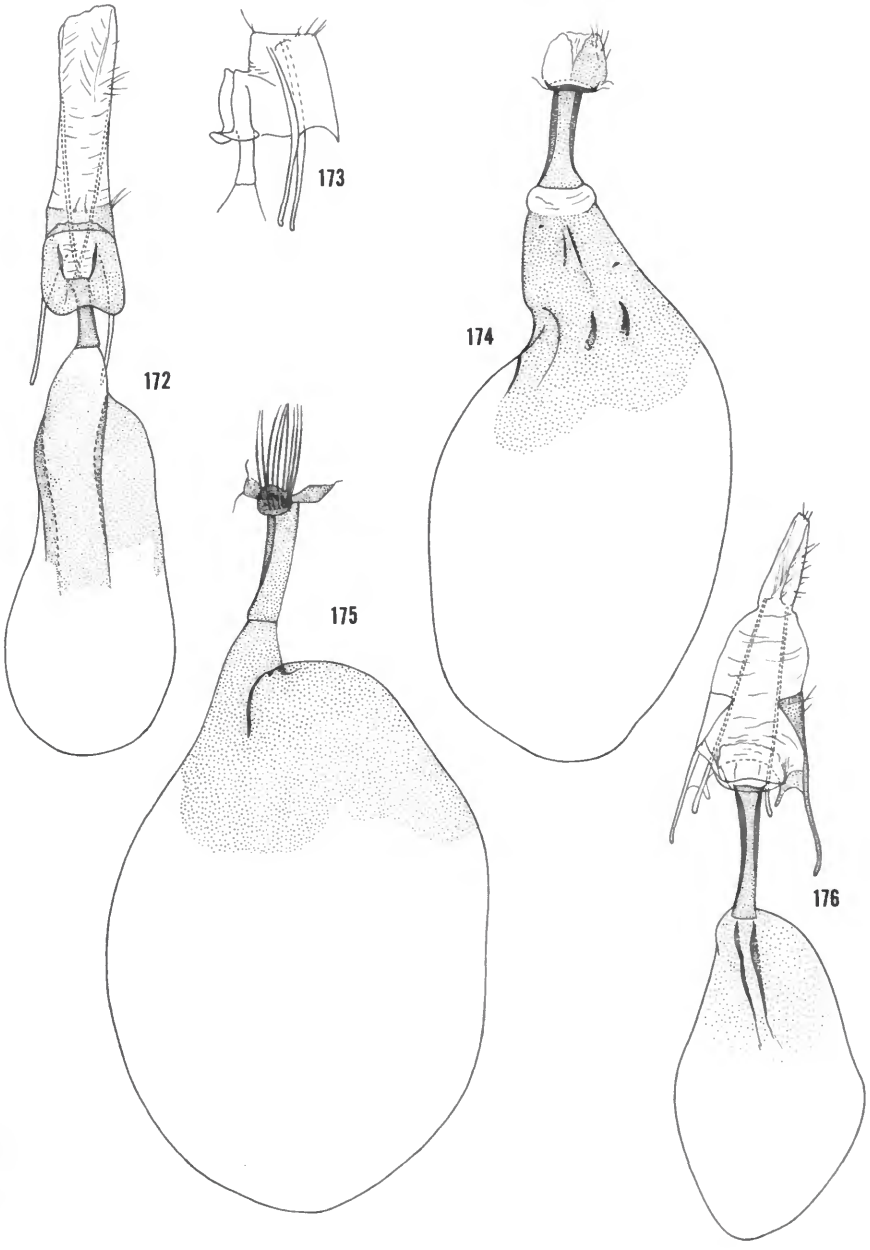
FIGURES 158–162.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 158. *E. cordia* Powell; 159, *E. scutula* Powell; 160, *E. pala* Powell; 161, *E. sphenisca* Powell; 162, *E. clava* Powell.



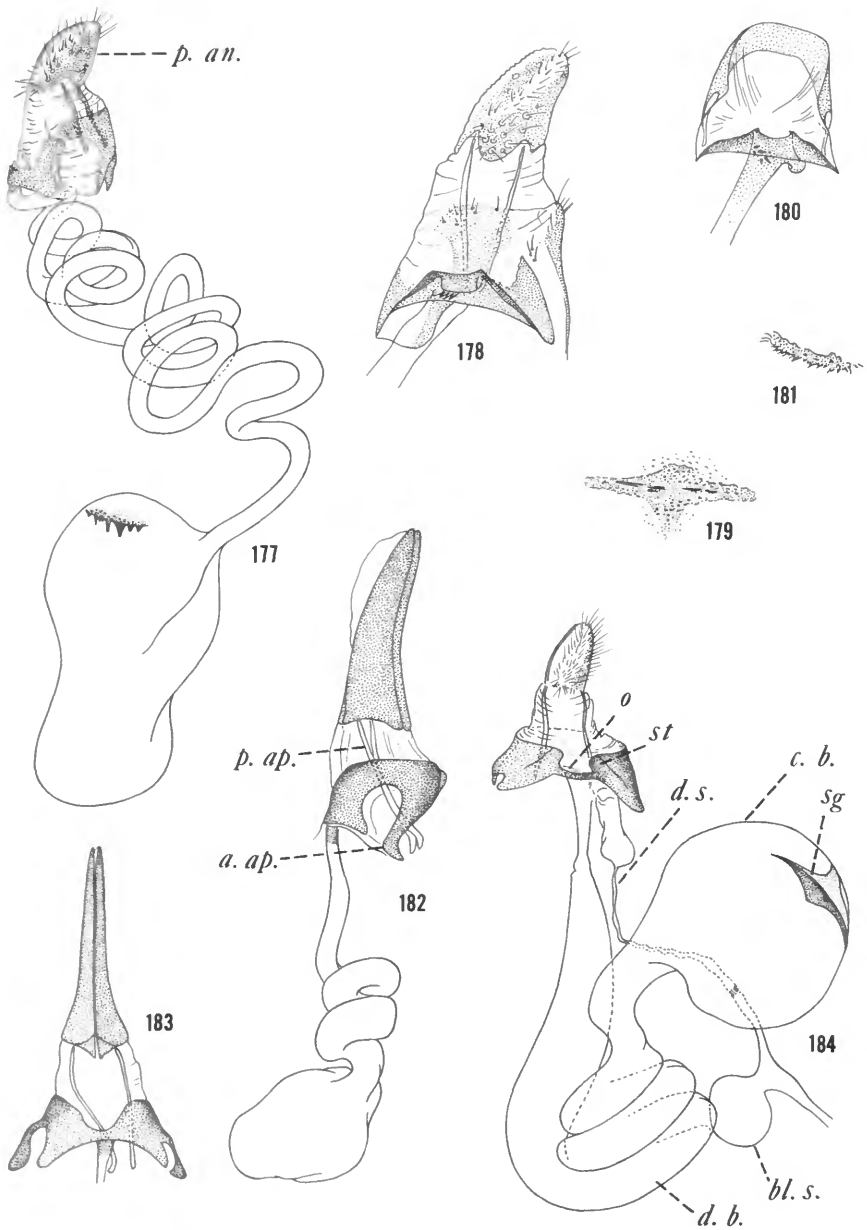
FIGURES 163–166.—Male genitalia of *Ethmia*, ventral aspect, valvae reflexed, aedeagus separated and shown in lateral aspect: 163, *E. heptastica* Walsingham; 164, *E. oterosella* Busck; 165, *E. prattiella* Busck; 166, *E. hammella* Busck.



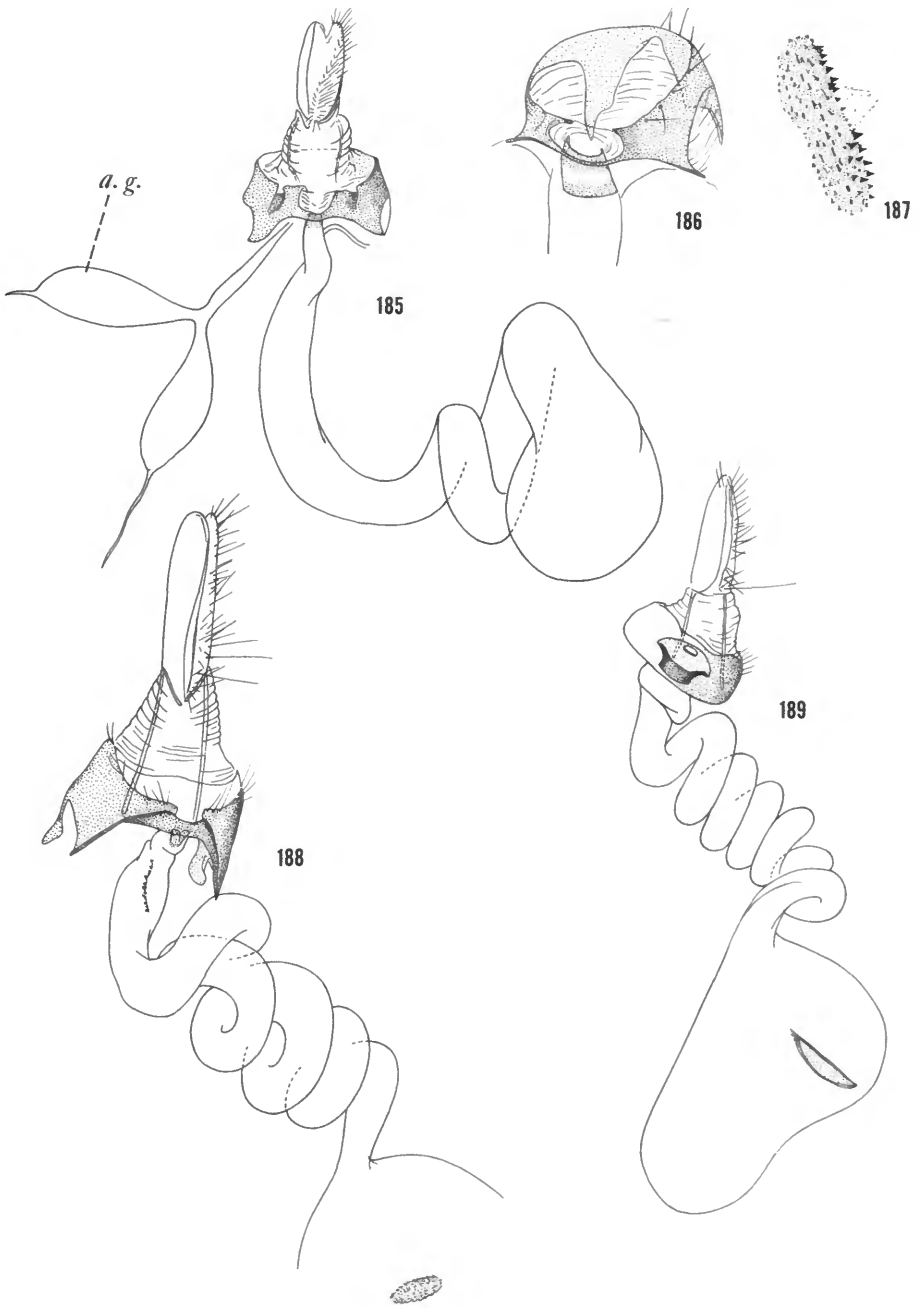
FIGURES 167–171.—Male genitalia of *Ethmia* and *Pseudethmia,* ventral aspect, valvae reflexed: 167, *E. linda* Busck, aedeagus separated, shown in lateral aspect; 168, *E. joviella* Walsingham, aedeagus separated, shown in lateral aspect; 169, *E. punctessa* Powell, aedeagus in situ; 170, *E. angustalatella* Powell, aedeagus in situ; 171, *P. protuberans* Clarke, aedeagus separated and shown in lateral aspect.



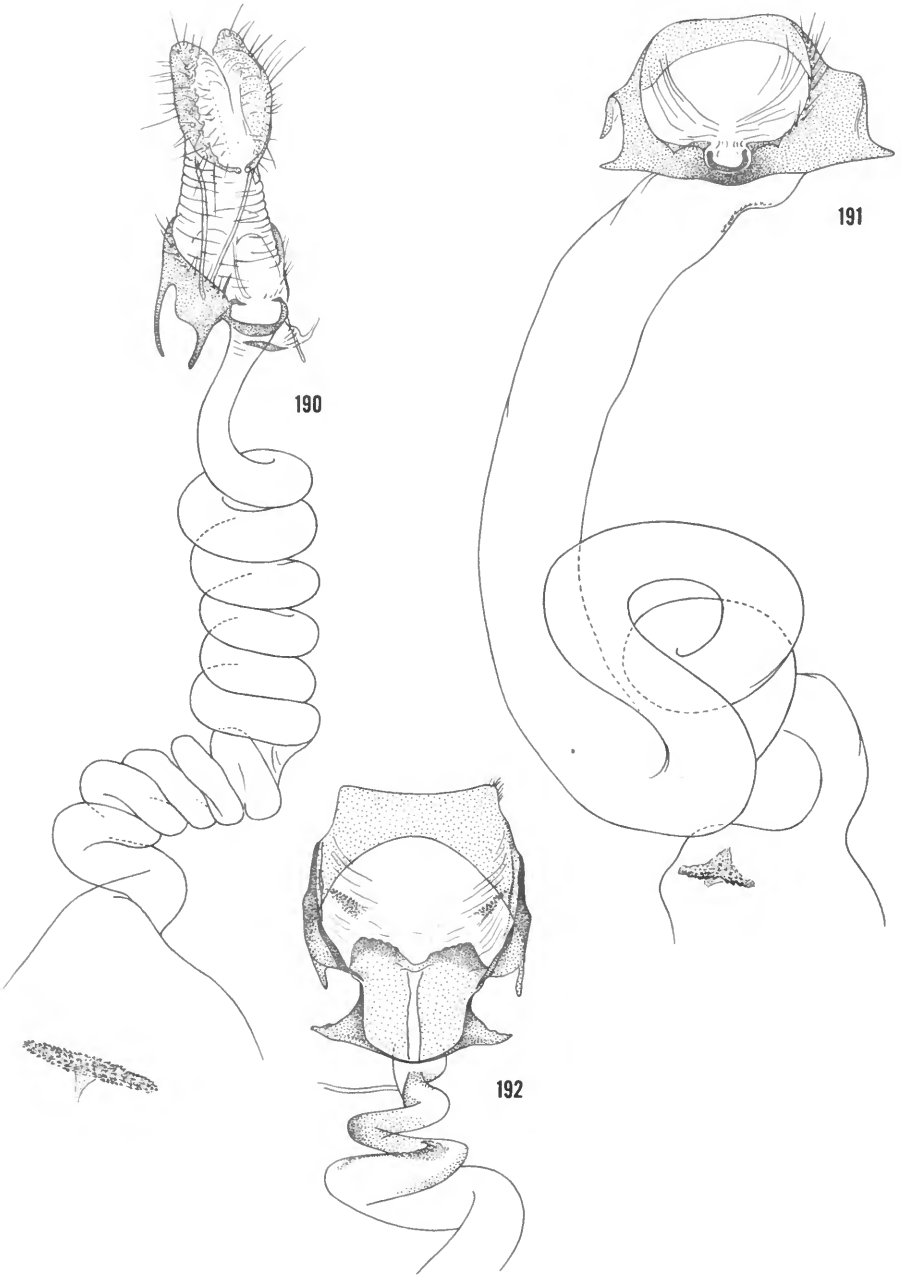
FIGURES 172–176.—Female genitalia of *Pyramidobela,* ventral aspect: 172, *P. angelarum* Keifer; 173, *P. angelarum,* lateral aspect of sterigma; 174, *P. quinquecristata* (Braun), sterigma and ductus bursae; 175, *P. tetraphyta* Meyrick, sterigma and ductus bursae; 176, *P. agyrtodes* (Meyrick).



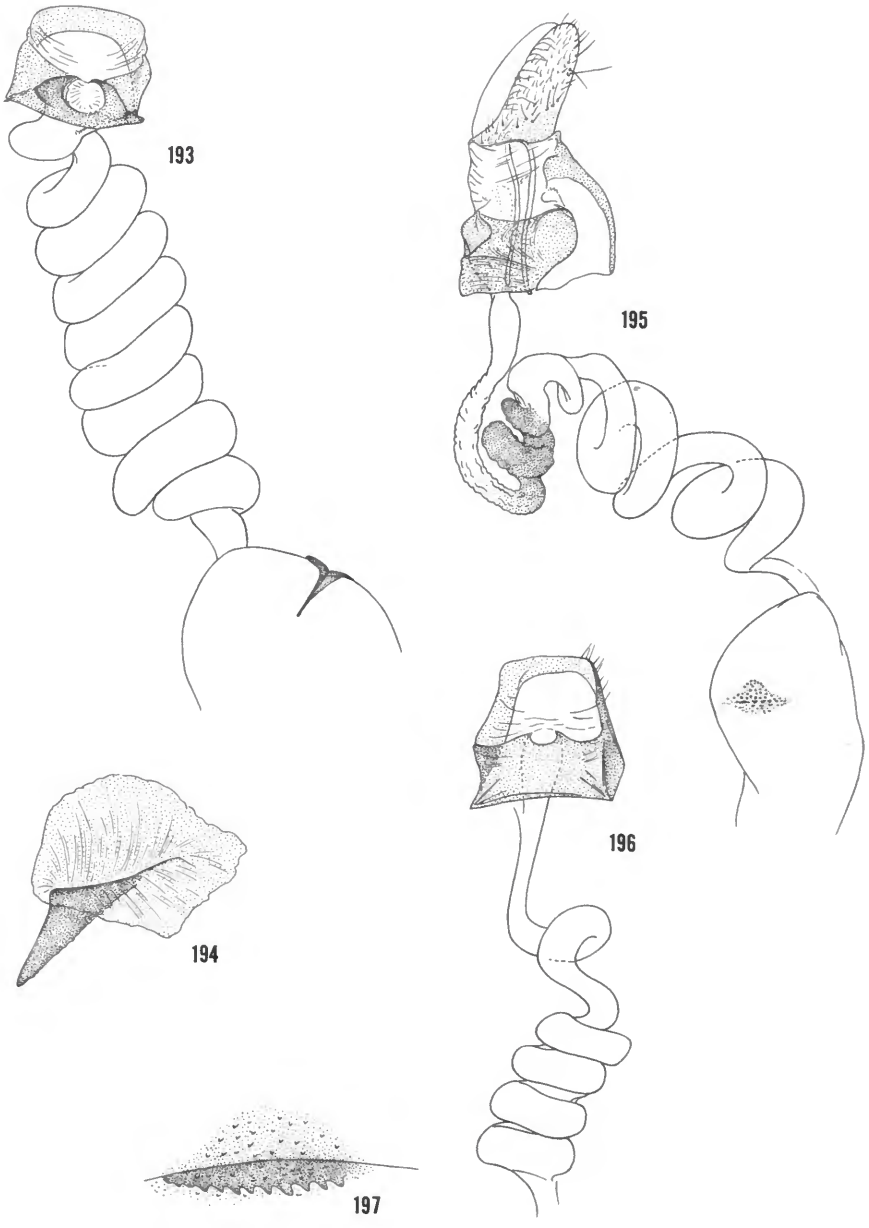
FIGURES 177–184.—Female genital structures of *Ethmia:* 177, *E. coquillettella* Busck, ventral aspect (*p. an.*, papillae anales) ; 178, *E. coquillettella*, segments VIII-X (2×) ; 179, *E. coquillettella*, signum, outer aspect (same enlargement as Figure 178); 180, *E. brevistriga* Clarke, signum and segment VIII; 181, *E. brevistriga*, signum, outer aspect, (1×); 182, *E. minuta* Powell, lateral aspect (*a. ap.*, anterior apophyses; *p. ap.*, posterior apophyses); 183, *E. minuta*, ventral aspect of segments VIII-X; 184, *E albitogata* Walsingham, ventral aspect (*st*, sterigma; *o*, ostium; *d. s.*, ductus seminalis; *bl. s.*, bulla seminalis; *d. b.*, ductus bursae; *c. b.*, corpus bursae; *sg*, signum).



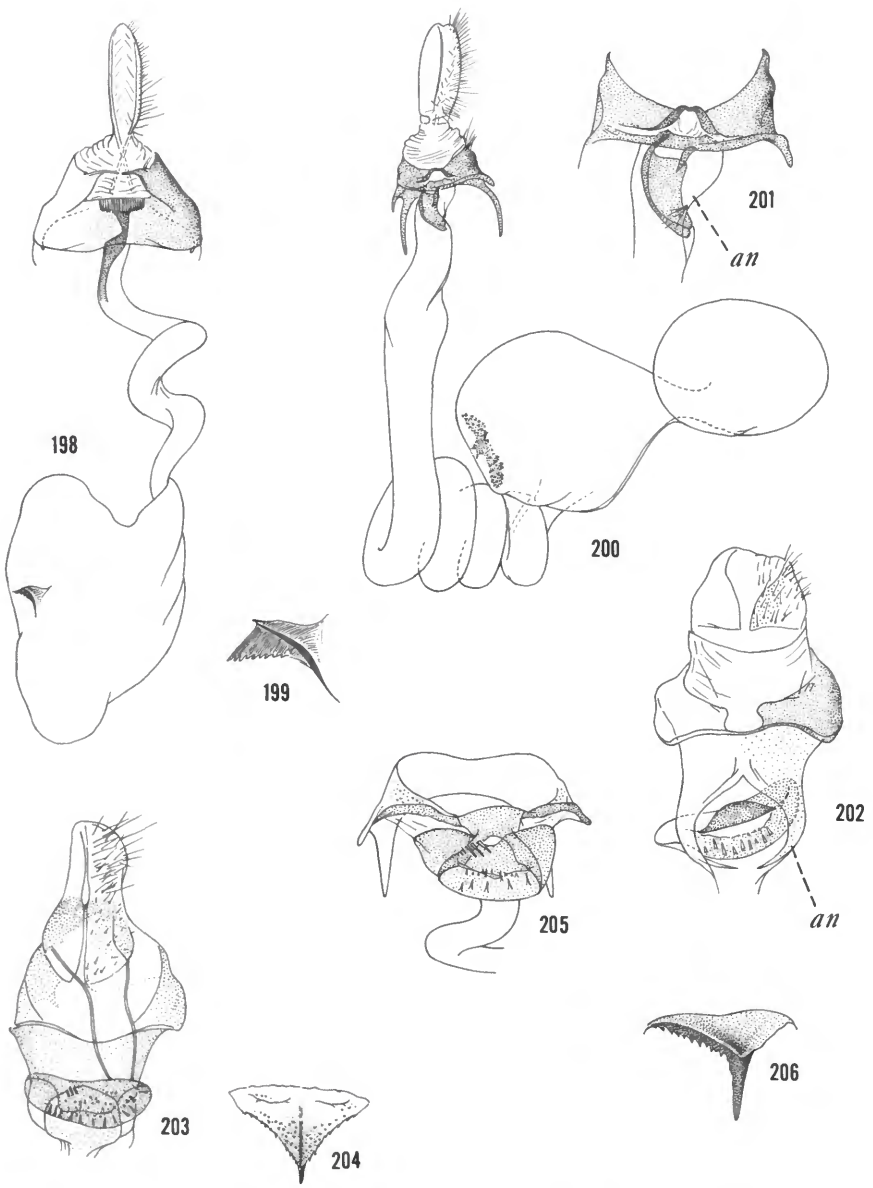
FIGURES 185–189.—Female genitalia of *Ethmia*, ventral aspect: 185, *E. plagiobothrae* Powell (a.g., accessory glands); 186, *E. albistrigella* (Walsingham), sterigma and VIII segment; 187, *E. albistrigella*, signum, inner aspect (3×); 188, *E. discostrigella* (Chambers); 189, *E. apicipunctella* (Chambers).



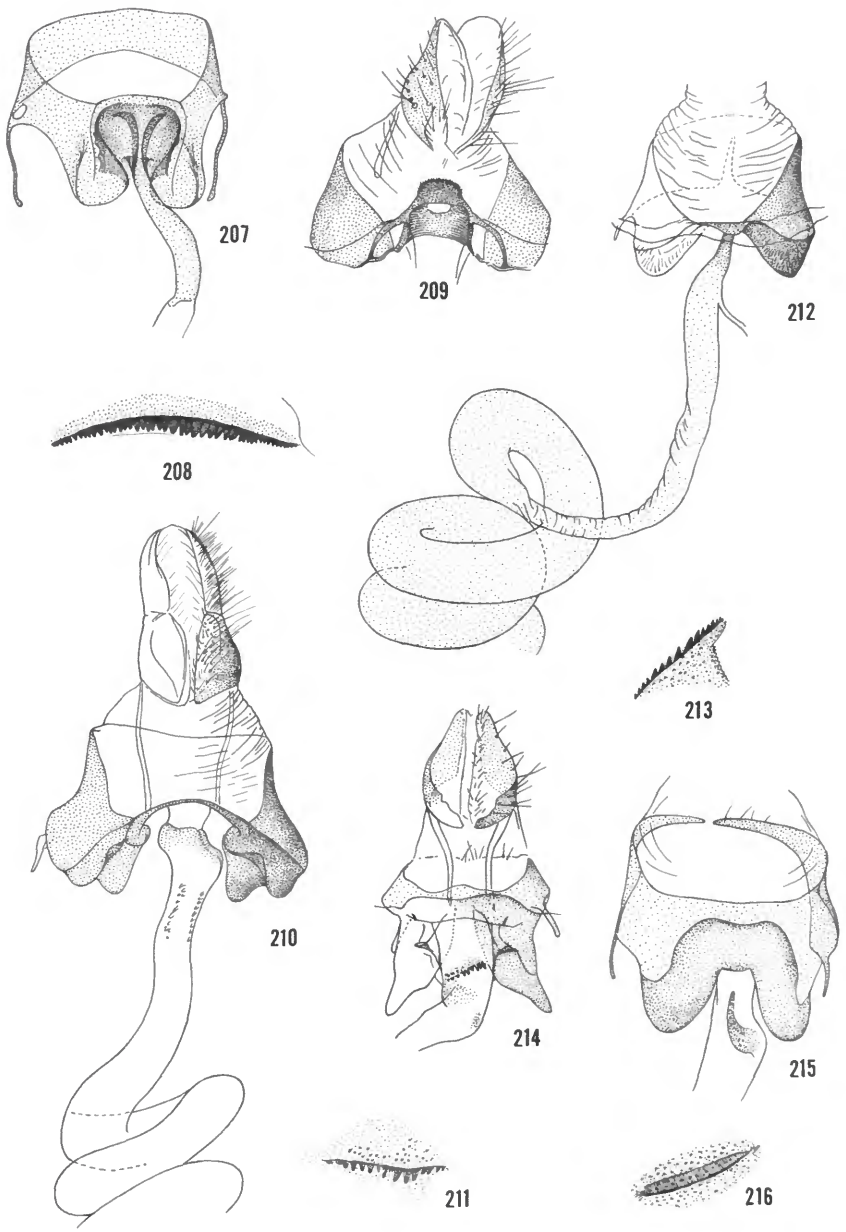
FIGURES 190–192.—Female genitalia of *Ethmia*, ventral aspect: 190, *E. arctostaphylella* (Walsingham); 191, *E. semitenebrella* Dyar, VIII segment and ductus bursae; 192, *E. volcanella* Powell, VIII segment and base of ductus.



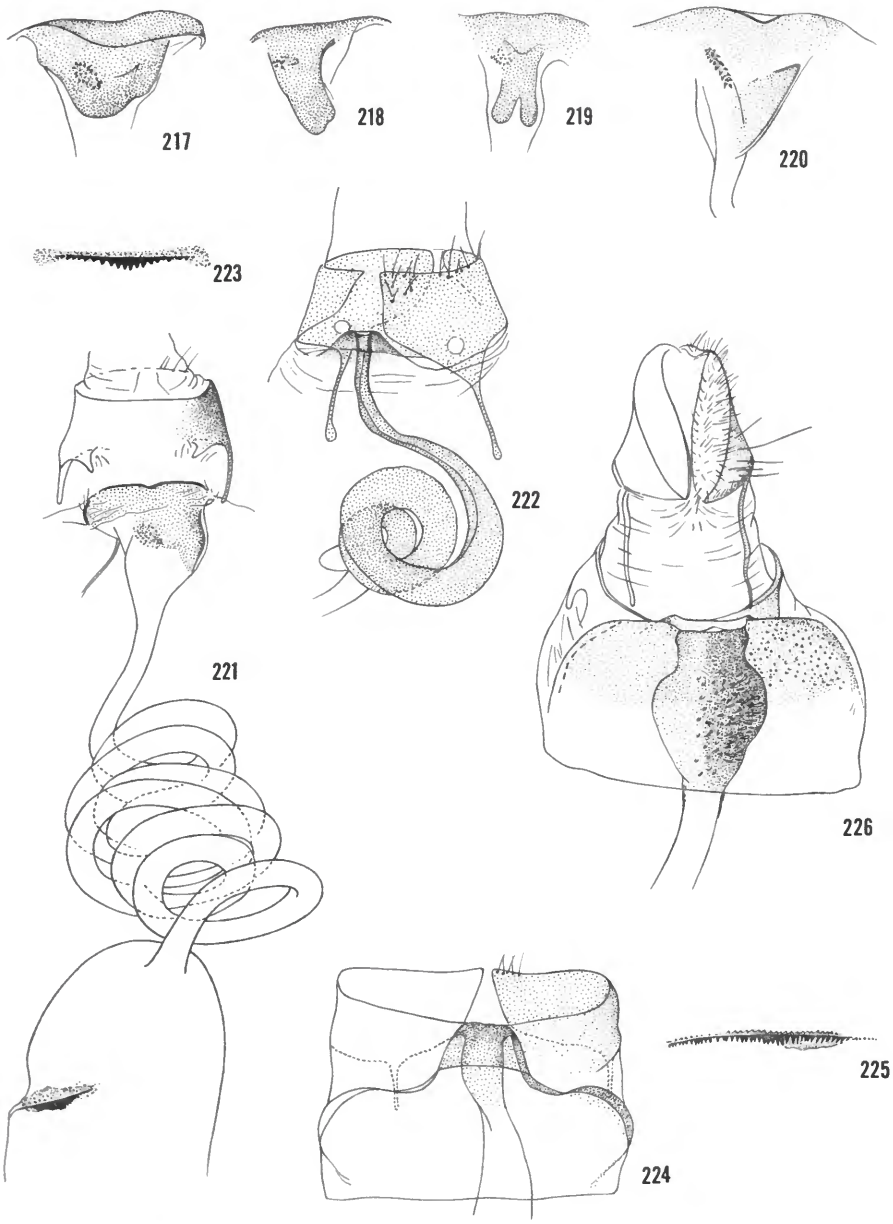
FIGURES 193–197.—Female genitalia of *Ethmia*: 193, *E. papiella* Powell, VII segment and ductus bursae, ventral aspect; 194, *E. papiella*, signum, outer aspect (3×); 195, *E. macelhosiella* Busck, ventrolateral aspect; 196, *E. timberlakei* Powell, VIII segment and ductus bursae, ventral aspect; 197, *E. timberlakei*, signum, inner aspect (3×).



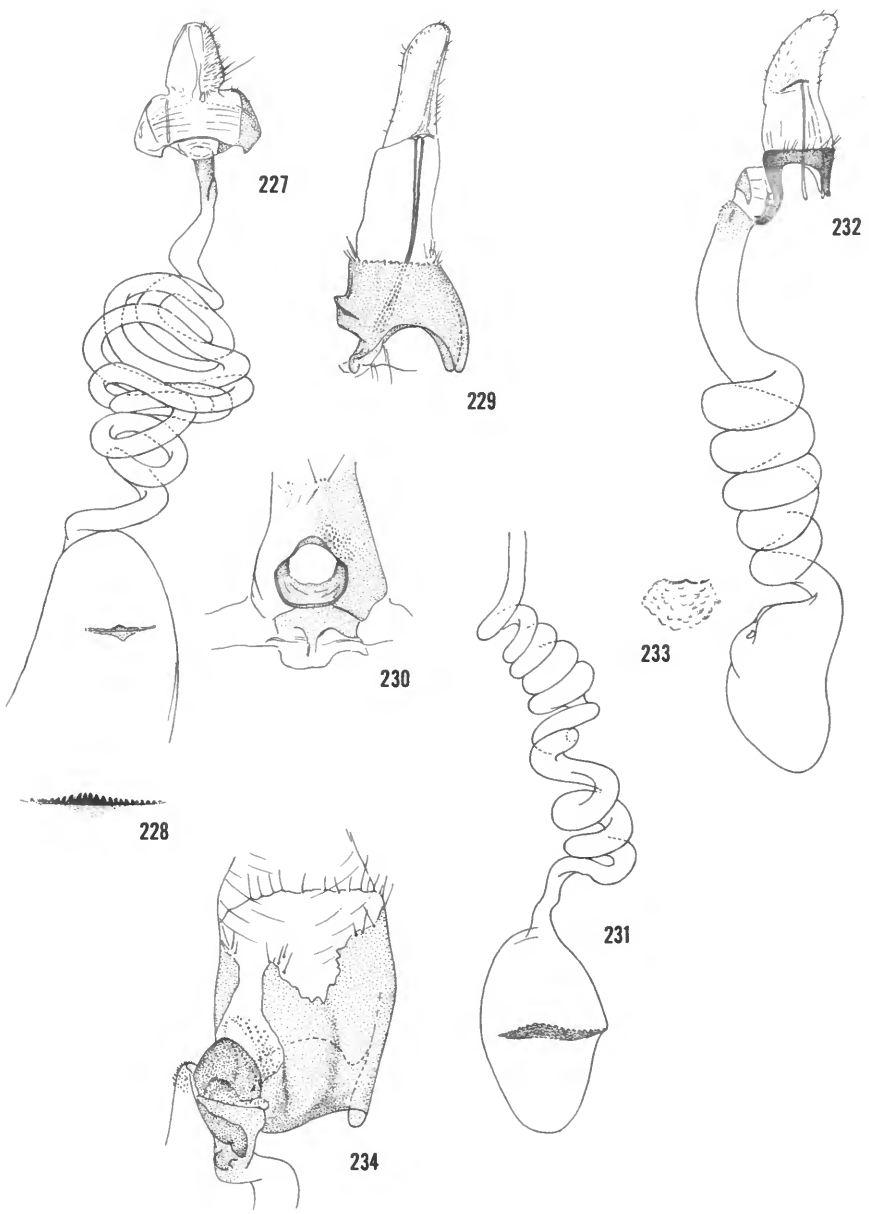
FIGURES 198–206.—Female genital structures of *Ethmia*, ventral aspect except signa: 198, *E. piperella* Powell; 199, *E. piperella*, signum, inner aspect (3×); 200, *E. monticola fuscipedella* (Walsingham); 201, *E. m. fuscipedella*, sterigma (2×) (*an*, antrum); 202, *E. hagenella josephinella* Dyar, antrum and segments VIII-X (*an*, antrum); 203, *E. mimihagenella* Powell, antrum and segments VIII-X; 204, *E. mimihagenella*, signum, inner aspect (1×); 205, *E. zelleriella* (Chambers), sterigma and segment VIII; 206, *E. burnsella* Powell, signum, inner aspect (1×).



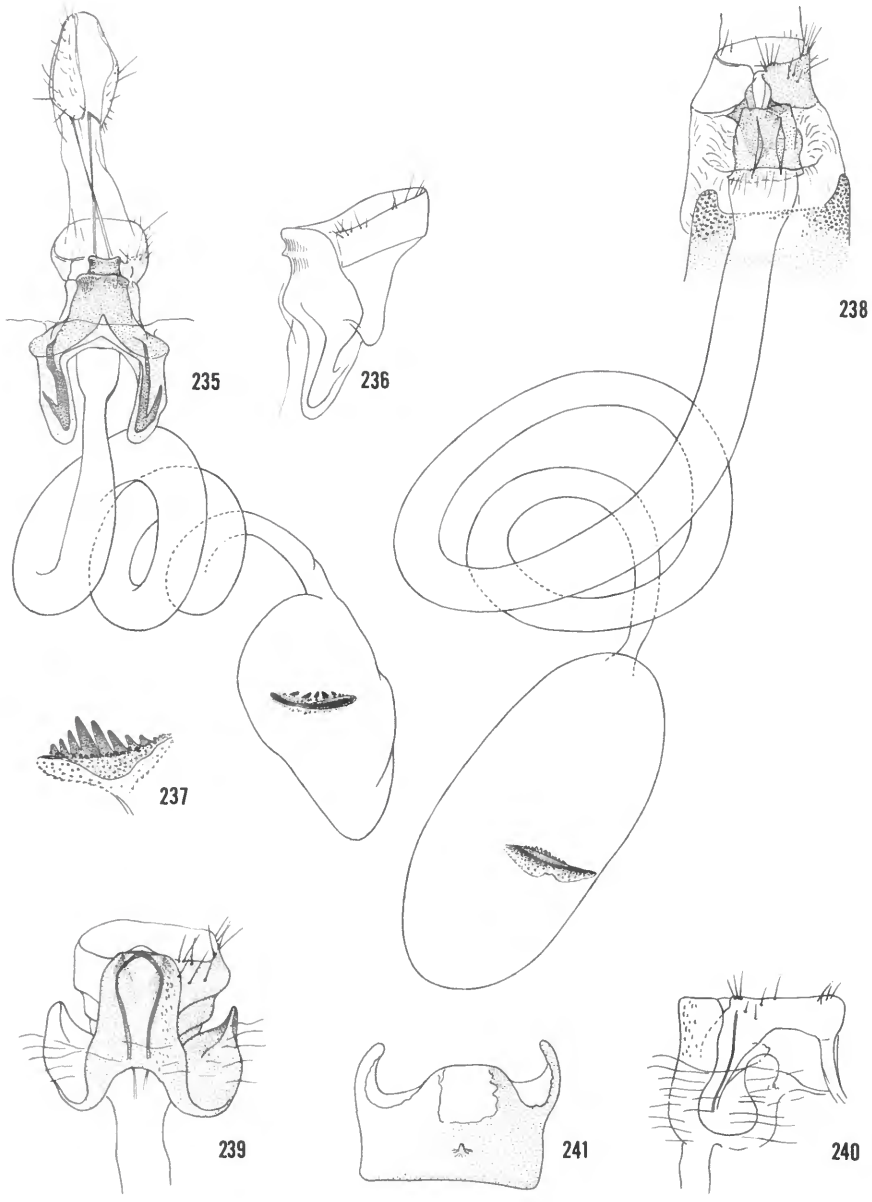
FIGURES 207–216.—Female genital structures of *Ethmia*, ventral aspect, signa inner aspect: 207, *E. delliella* (Fernald), sterigma, segment VIII, and base of ductus bursae; 208, *E. delliella*, signum (7×); 209, *E. bittenella* (Busck), sterigma and segments VIII-X; 210, *E. festiva* Busck, sterigma, segments VIII-X, and base of ductus; 211, *E. festiva*, signum (1×); 212, *E. terpnota* Walsingham, segment VIII and basal half of ductus bursae; 213, *E. terpnota*, signum (1×); 214, *E. perpulchra* Walsingham, sterigma, antrum, and segments VIII-X; 215, *E. ungulatella* Busck, sterigma and segment VIII; 216, *E. ungulatella*, signum (1×).



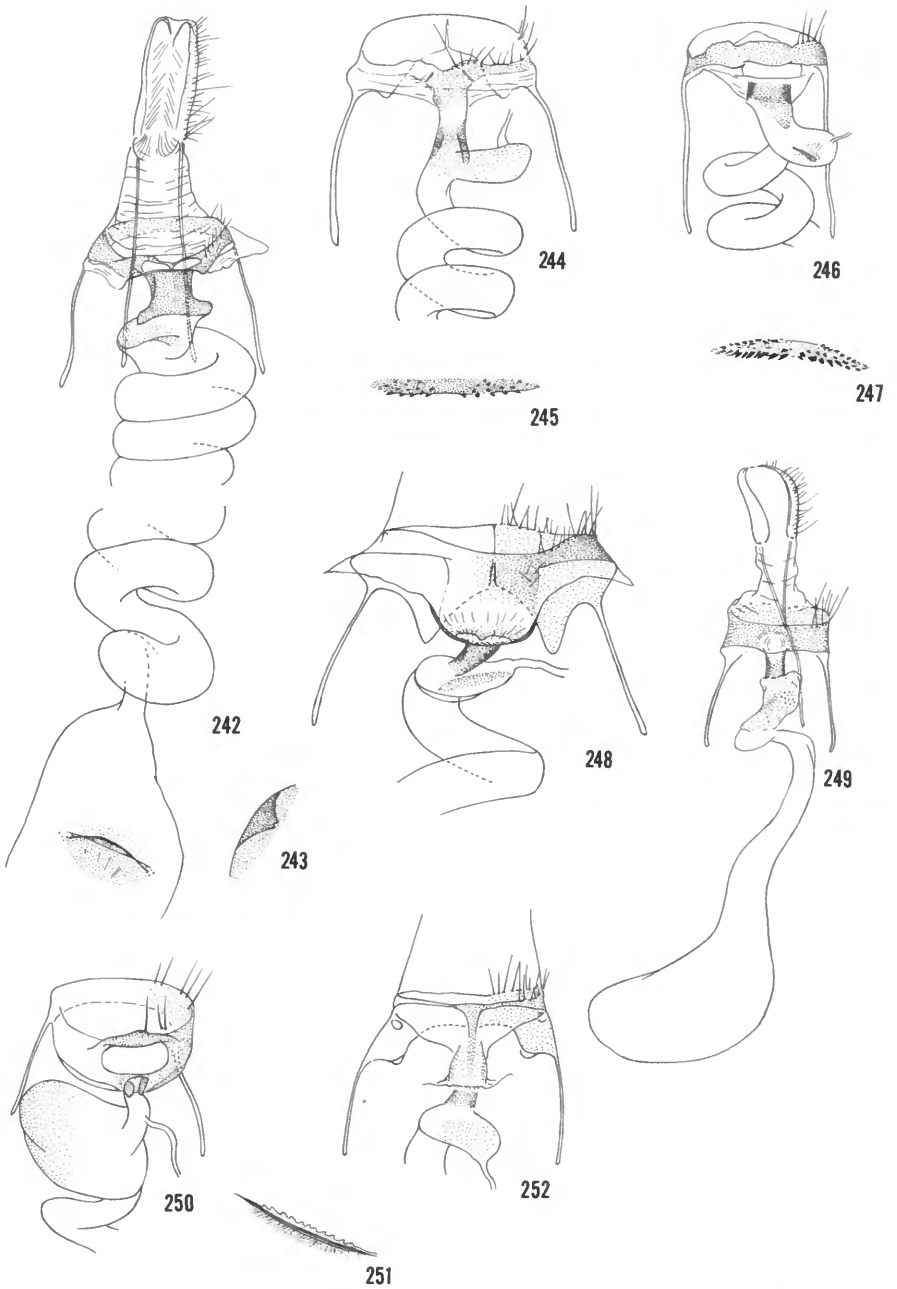
FIGURES 217–226.—Female genital structures of *Ethmia*, ventral aspect, signa inner aspect: 217–219, *E. elutella* Busck, antrum plate variants; 220, *E. janzeni* Powell, antrum; 221, *E. submissa* Busck, segment VIII, sterigma and ductus bursae; 222, *E. phylacops* Powell, segment VIII, sterigma, and basal portion of ductus bursae; 223, *E. phylacops*, signum (1×); 224, *E. notomurinella* Powell, segment VIII and sterigma with scale ridges fused to VII sternite; 225, *E. notomurinella*, signum (1×); 226, *E. phylacis* Walsingham, antrum and segments VII-X.



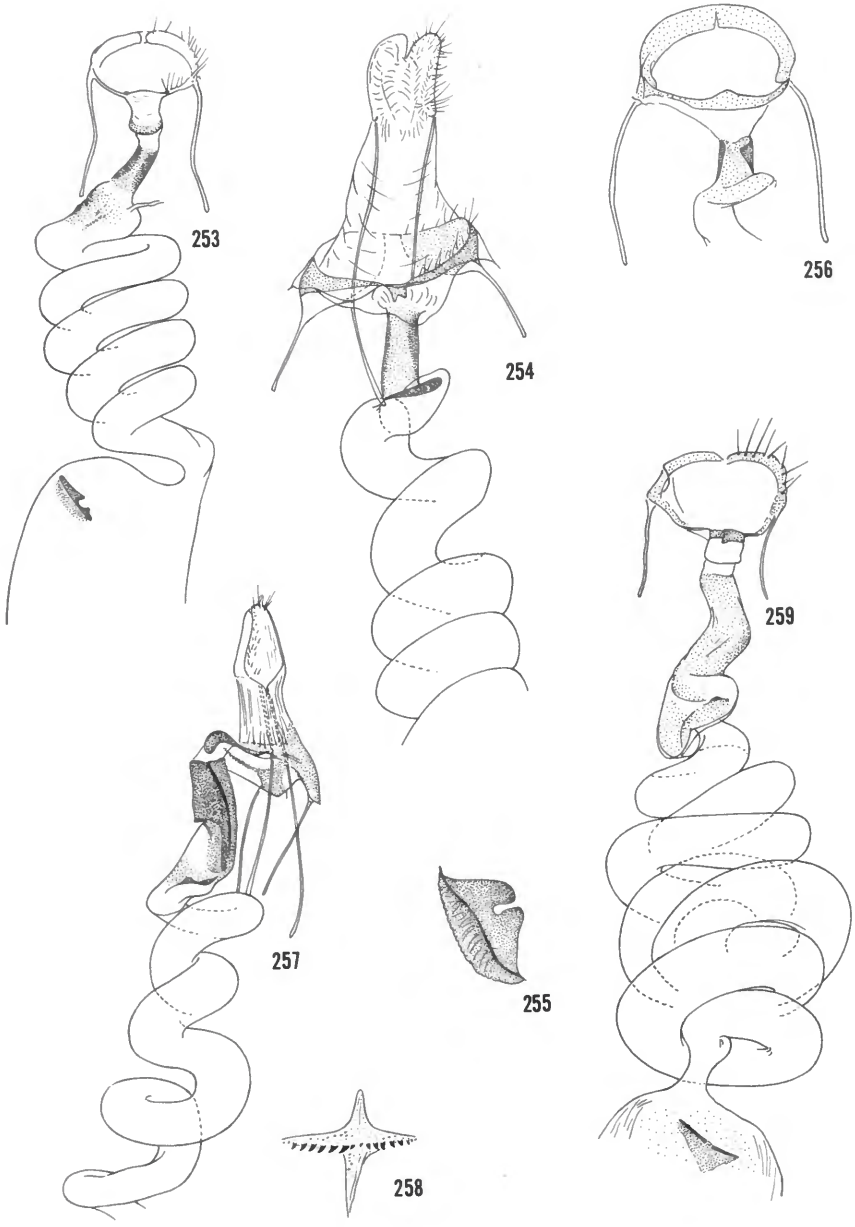
FIGURES 227–234.—Female genital structures of *Ethmia:* 227, *E. exornata* (Zeller), ventral aspect; 228, *E. exornata*, signum, inner aspect (2×); 229, *E. phoenicura* Meyrick, VIII-X segments, lateral aspect; 230, *E. phoenicura*, sterigma, ventral aspect (2×); 231, *E. phoenicura*, ductus bursae (1×); 232, *E. chemsaki* Powell, lateral aspect; 233, *E. chemsaki*, signum, outer aspect (3×); 234, *E. zebrata* Powell, sterigma and VIII segment, ventrolateral aspect.



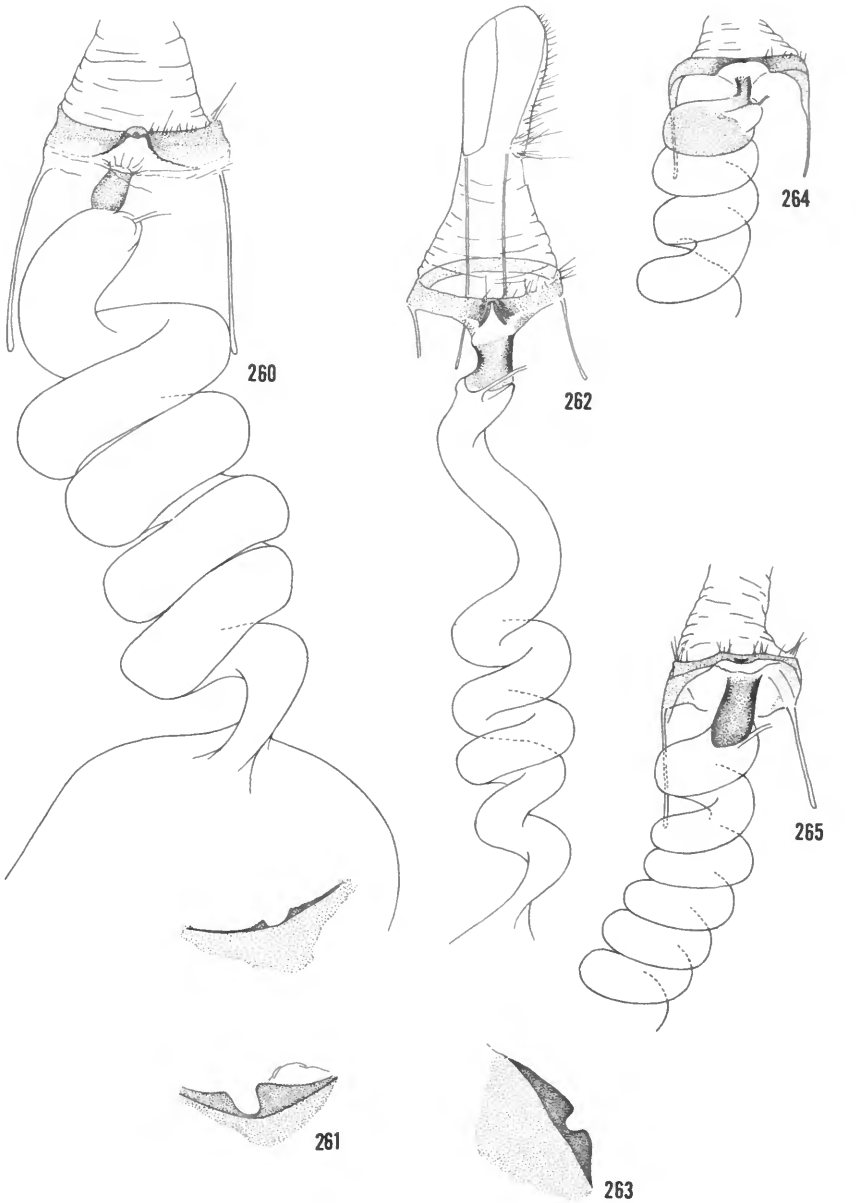
FIGURES 235–241.—Female genital structures of *Ethmia:* 235, *E. notatella* (Walker), ventral aspect; 236, *E. notatella,* sterigma, lateral aspect; 237, *E. notatella,* signum, outer lateral aspect (2×); 238, *E. wellingi* Powell, VII-VIII segments and ductus bursae, ventral aspect; 239, *E. hiramella* Busck, sterigma, ventral aspect; 240, *E. hiramella,* sterigma and VIII segment, lateral aspect; 241, *E. hiramella,* VII segment venter.



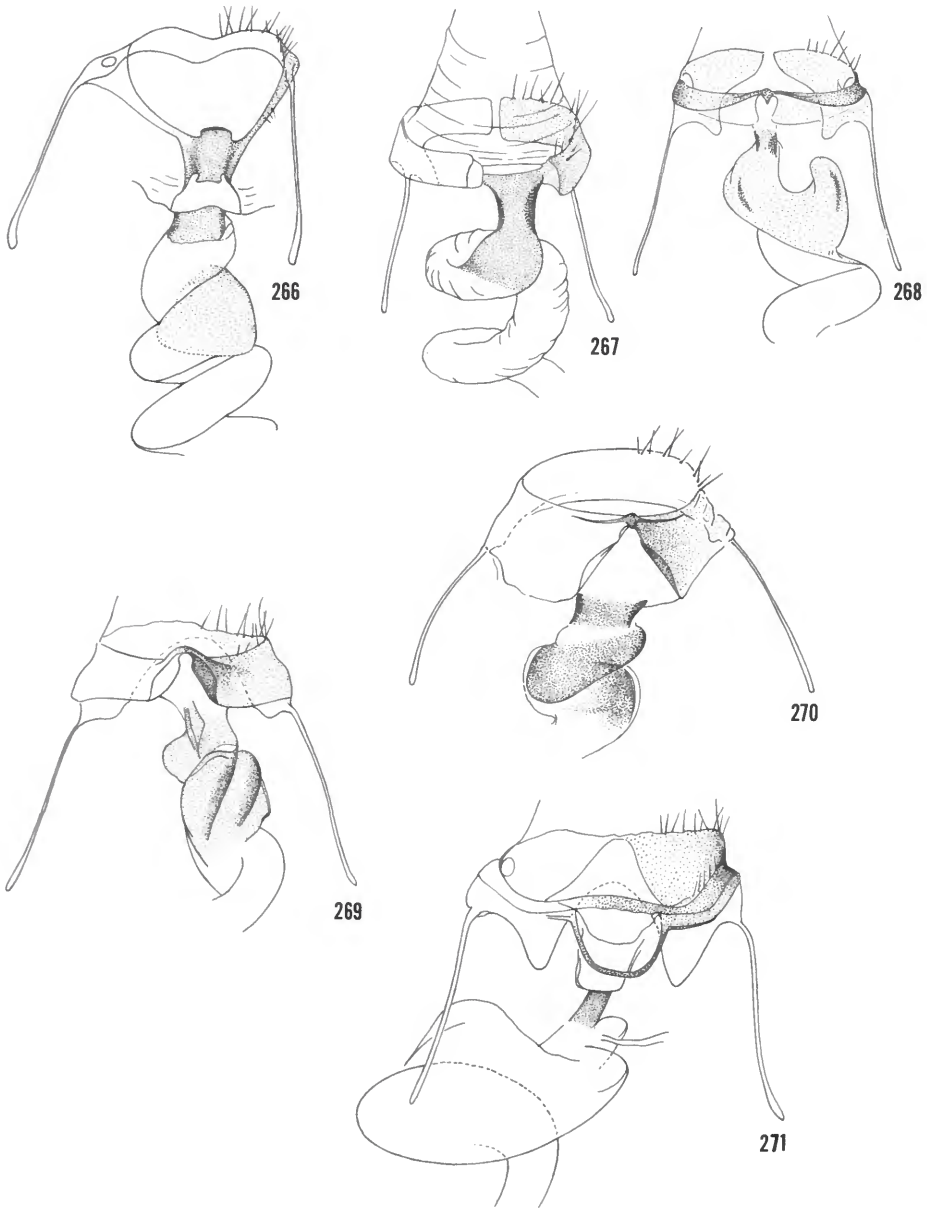
FIGURES 242–252.—Female genital structures of *Ethmia*, ventral aspect except signa: 242, *E. catapeltica* Meyrick; 243, *E. catapeltica*, signum inner aspect (1×); 244, *E. confusella* (Walker), VIII segment, sterigma, and basal part of ductus bursae; 245, *E. confusella*, signum, inner aspect (3×); 246, *E. striatella* Busck, VIII segment, sterigma, and basal part of ductus bursae; 247, *E. striatella*, signum, inner aspect (3×); 248, *E. sandra* Powell, VIII segment, sterigma, and antrum; 249, *E. humilis* Powell; 250, *E. farrella* Powell, VIII segment, sterigma, and antrum; 251, *E. farrella*, signum, inner aspect (3×); 252, *E. confusellastra* Powell, VIII segment, sterigma, and antrum.



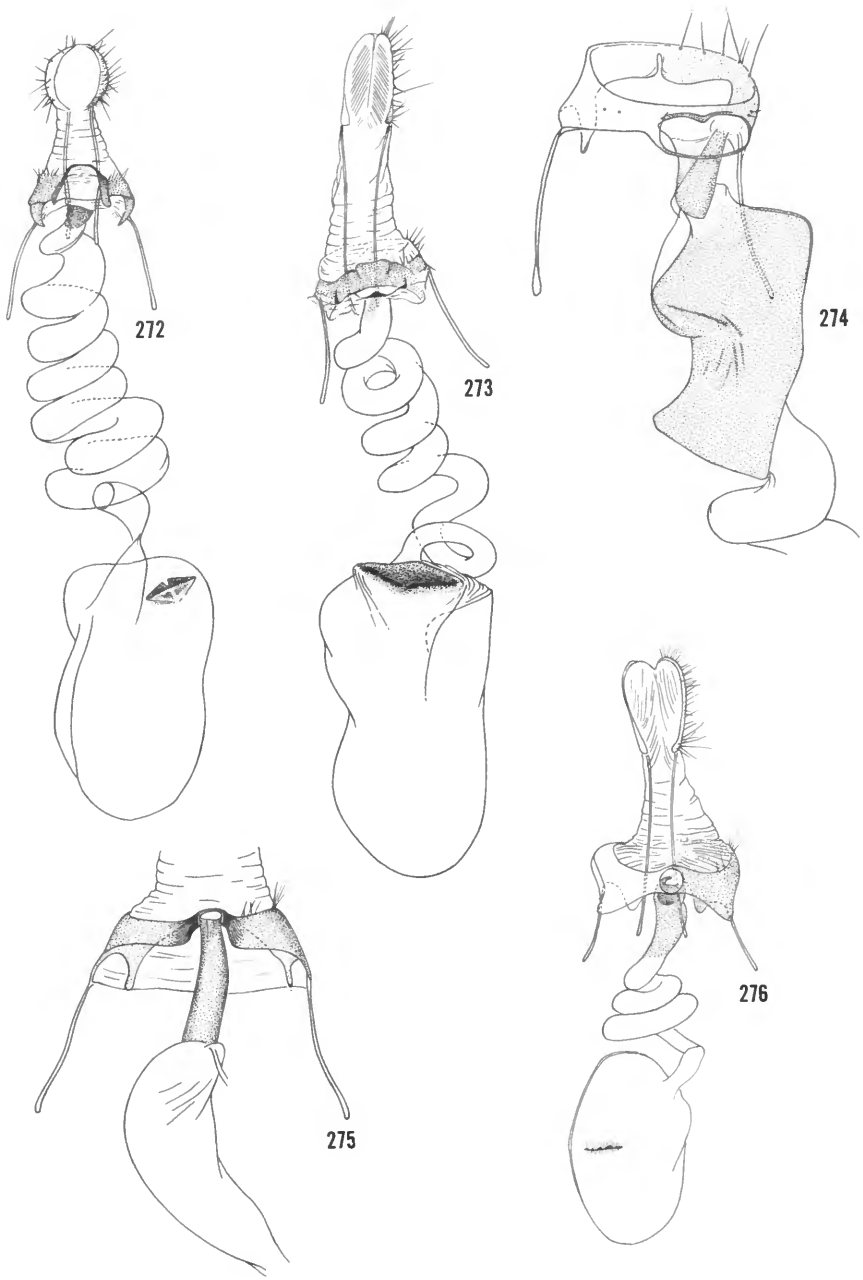
FIGURES 253–259.—Female genital structures of *Ethmia:* 253, *E. nigritaenia* Powell, ventral aspect; 254, *E. plaumanni* Powell, ventral aspect, corpus bursae removed; 255, *E. plaumanni,* signum, inner lateral aspect (2×); 256, *E. longimaculella* (Chambers), VIII segment, sterigma, and antrum, ventral aspect; 257, *E. baliostola* Walsingham, ventrolateral aspect, corpus bursae removed; 258, *E. baliostola,* signum, inner aspect (2×); 259, *E. cyanea* Walsingham, VIII segment and ductus bursae, ventral aspect.



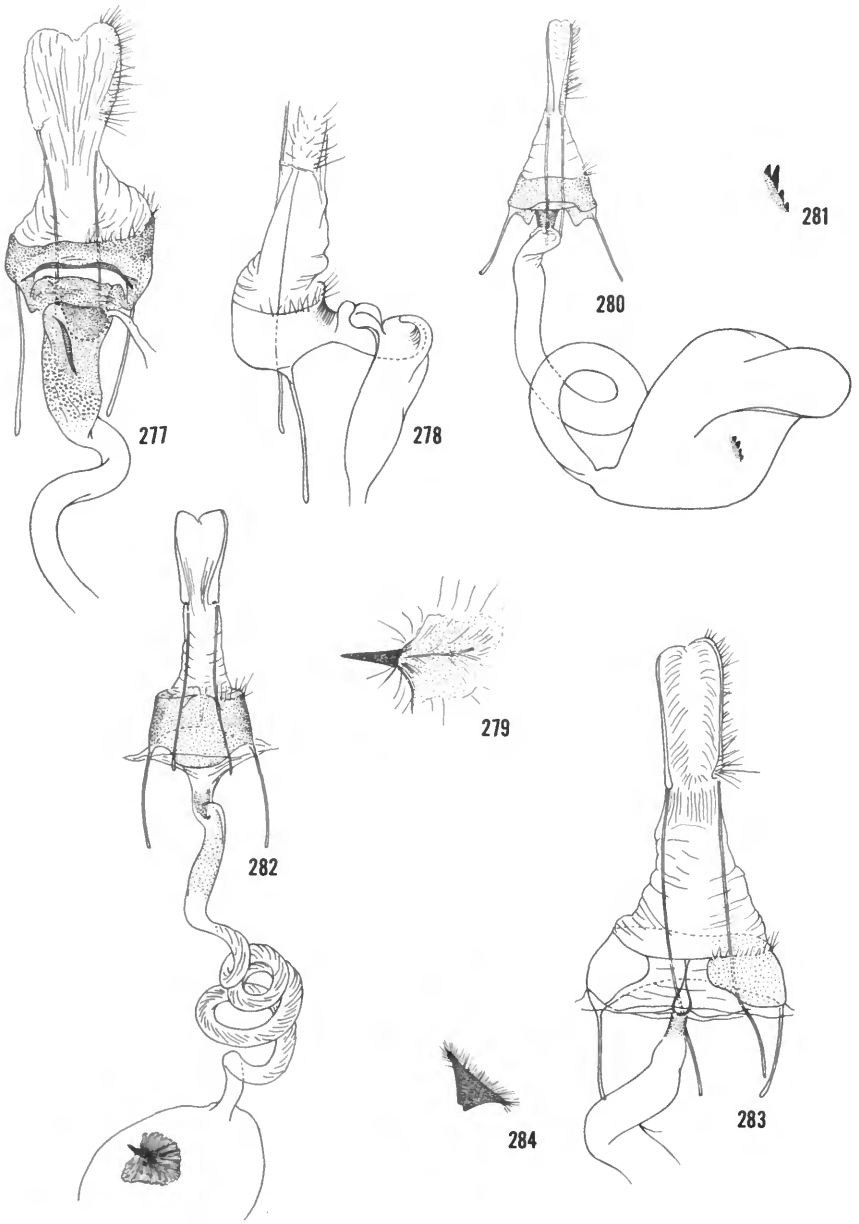
FIGURES 260–265.—Female genital structures of *Ethmia,* ventral aspect except signa: 260, *E. semiombra nebulombra* Powell, VIII segment and ductus bursae; 261, *E. s. semiombra* Dyar, signum, inner aspect (1×); 262, *E. marmorea* (Walsingham), corpus bursae removed; 263, *E. marmorea,* signum, inner lateral aspect (3×); 264, *E. hodgesella* Powell, VIII segment, sterigma, and basal part of ductus bursae; 265, *E. baja* Powell, VIII segment, sterigma, and basal part of ductus bursae.



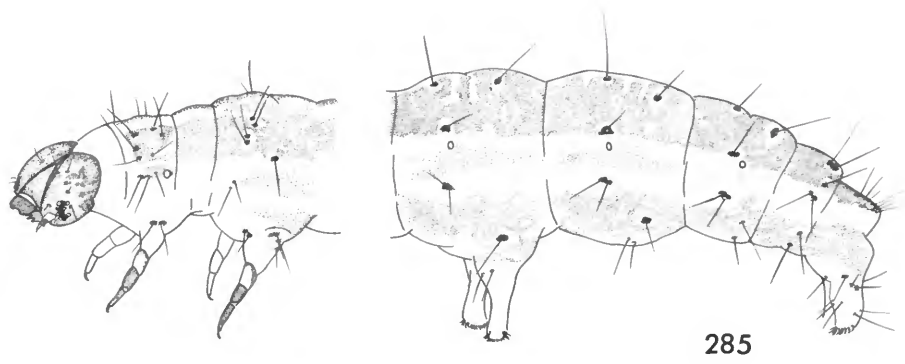
FIGURES 266–271.—Female genital structures of *Ethmia*, VIII segment, sterigma, and antrum, ventral aspect: 266, *E. penthica* Walsingham (Veracruz); 267, *E. penthica* (atypical, Costa Rica); 268, *E. cordia* Powell; 269, *E. similatella* Busck (Guatemala); 270, *E. similatella* (Sinaloa); 271, undescribed species.



FIGURES 272–276.—Female genital structures of *Ethmia*, ventral aspect: 272, *E. pala* Powell; 273, *E. heptastica* Walsingham; 274, *E. clava* Powell, VIII segment, sterigma, and antrum; 275, *E. sphenisca* Powell, VIII segment, sterigma, and basal part of ductus bursae; 276, *E. hammella* Busck.



FIGURES 277–284.—Female genital structures of *Ethmia* and *Pseudethmia:* 277, *E. prattiella* Busck, sterigma and VIII-X segments, ventral aspect; 278, *E. prattiella,* same, lateral aspect; 279, *E. prattiella,* signum, outer aspect (3×); 280, *E. linda* Busck, ventral aspect; 281, *E. linda,* signum inner aspect (2×); 282, *E. punctessa* Powell, ventral aspect; 283, *P. protuberans* Clarke, VIII-X segments and base of ductus bursae, ventral aspect; 284, *P. protuberans,* signum, inner lateral aspect (2×).



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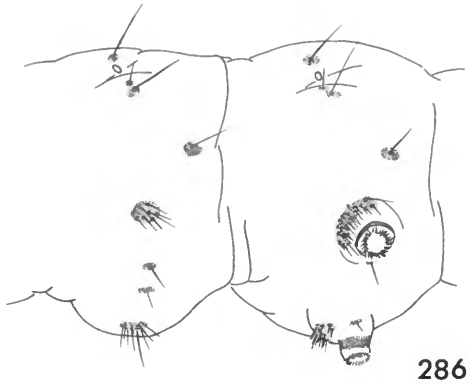

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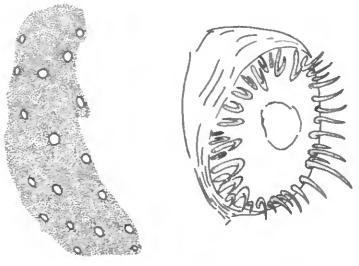

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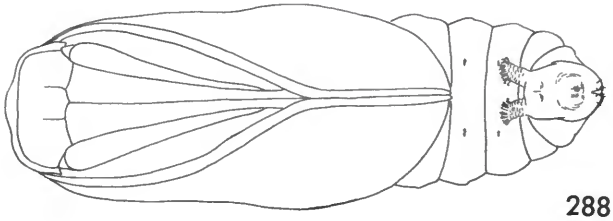

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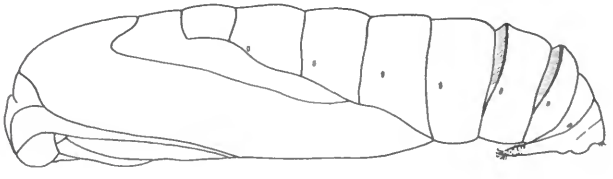

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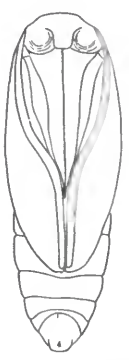
FIGURES 285–289.—Immature stages of *Ethmia:* 285, last instar larva of *E. charybdis* (thoracic segments 1, 2, abdominal VI-X), same data as holotype; 286, abdominal segments II-III of last instar larva of *E. confusella* (lateroventral aspect), Plantation Key, Fla., V–28–69 (D. H. Habeck); 287, last instar larva of *E. longimaculella,* crotchet and setal arrangement on abdominal proleg, Ottawa, Canada (J. Fletcher); 288, pupa of *E. semilugens* (ventral aspect), Darwin Wash, Calif., V–14–69 (Rude and Powell, 69E79); 289, same pupa (lateral aspect).



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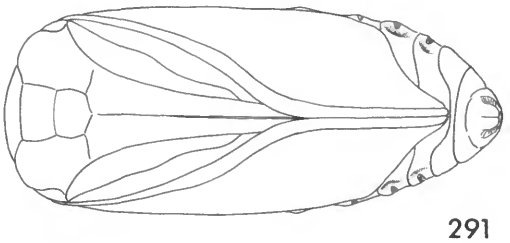

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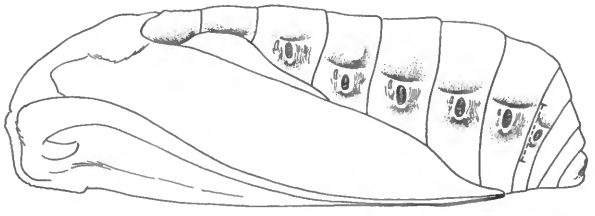

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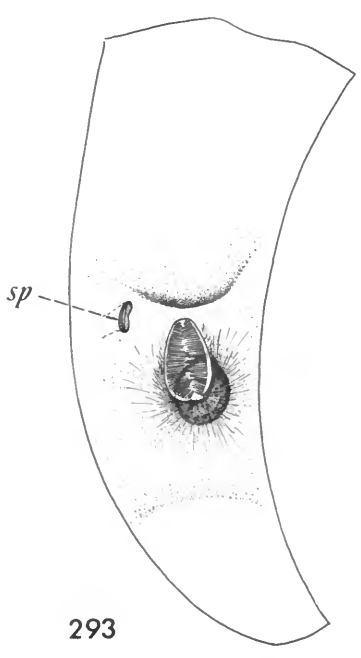

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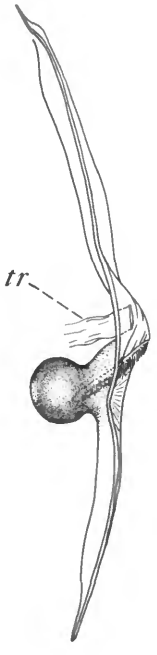

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FIGURES 290–294.—Pupae of *Ethmia:* 290, *E. scylla* (ventral aspect), Del Puerto Cyn., Calif. IV–27–69 (J. Powell, 69D90); 291, *E. confusella* (ventral aspect), Plantation Key, Fla., V–28–69 (D. H. Habeck); 292, *E. semiombra* (lateral aspect), Brownsville, Texas, V–14–41 (broken line along VI-VII segmental junction indicates area of condylic grasp, see Plate 20*g-h*); 293, *E. confusella,* same data as Figure 291, VI abdominal segment (lateral aspect, anterior margin to left, dorsum at top) showing spiracle (*sp*) and "spiracular pit"; 294, same structure (anterior aspect, inner side to left) showing trachea (*tr*) and bulbous interior portion of spiracular pit.

PLATES 1–22

PLATE I.—Heads of ethmiid moths: *a, Pyramidobela quinquecristata,* 13 mi S Ravendale, Calif., VI–5–70, r.f. ***Penstemon deustus*** (P. A. Opler); *b. Ethmia coquillettella,* Del Puerto Cyn., Stanislaus Co., Calif., III–19–69 (J. Powell); *c. E. albitogata,* Arroyo Mocho, Alameda Co., Calif., II–24–68 (J. Powell); *d, E. scylla,* same data as holotype; *e, E. charybdis,* holotype (arrow indicates position of minute labial palpus hidden in vestiture); *f, E. monticola,* 6 mi W Cedarville, Calif., VII–4–62 (J. S. Buckett).

PLATE 2.—Heads of ethmiid moths: *a*, *Ethmia mulleri*, Tehuacan, Pbla., Mex., V–21–41 (C. C. Hoffmann) (arrow indicates denuded, enlarged crown); *b*. *E. nivosella*, Green Hills, Portland Parish, Jamaica, III–11–66 (W. D. and S. S. Duckworth); *c*, *E. paucella* ♂, Bourdon, Haiti, VI–24–56 (J. G. Coutsis) (arrow indicates minute third segment of labial palpus, hidden in scaling of second segment); *d*, *E. confusella*, Grand Etang, Grenada, VIII–4–63 (O. Flint); *e*, *E. lichyi*, paratype, Lancetilla, Honduras; *f*, *Pseudethmia protuberans*, Thousand Palms, Calif., II–24–55 (D. F. Hardwick) (arrow indicates protuberant front).

PLATE 3.—*a, b,* Frontal aspect showing modified antennal scape: *a, Ethmia hiramella* ♂, San Vicente, Cuba IV–22–66 (F. Gregor) (arrow at distal end of scape); *b, E. phoenicura* ♂, San Jose del Cabo, Baja Calif., Mex., IX–15–67 (J. A. Chemsak) (arrow at broadest part of scape); *c,* lateral aspect showing modified scape and tegula, *E. scythropa* ♂, Chichen Itza, Yucatan Mex., VI–7–55 (E. Welling) (arrow at distal end of scape); *d,* dorsal aspect of abdomen covered with pollen, *E. sandra,* paratype 13 km N San Salvador; *e,* lateral aspect of abdomen showing modified ovipositor (arrow), *E. minuta,* paratype San Diego.

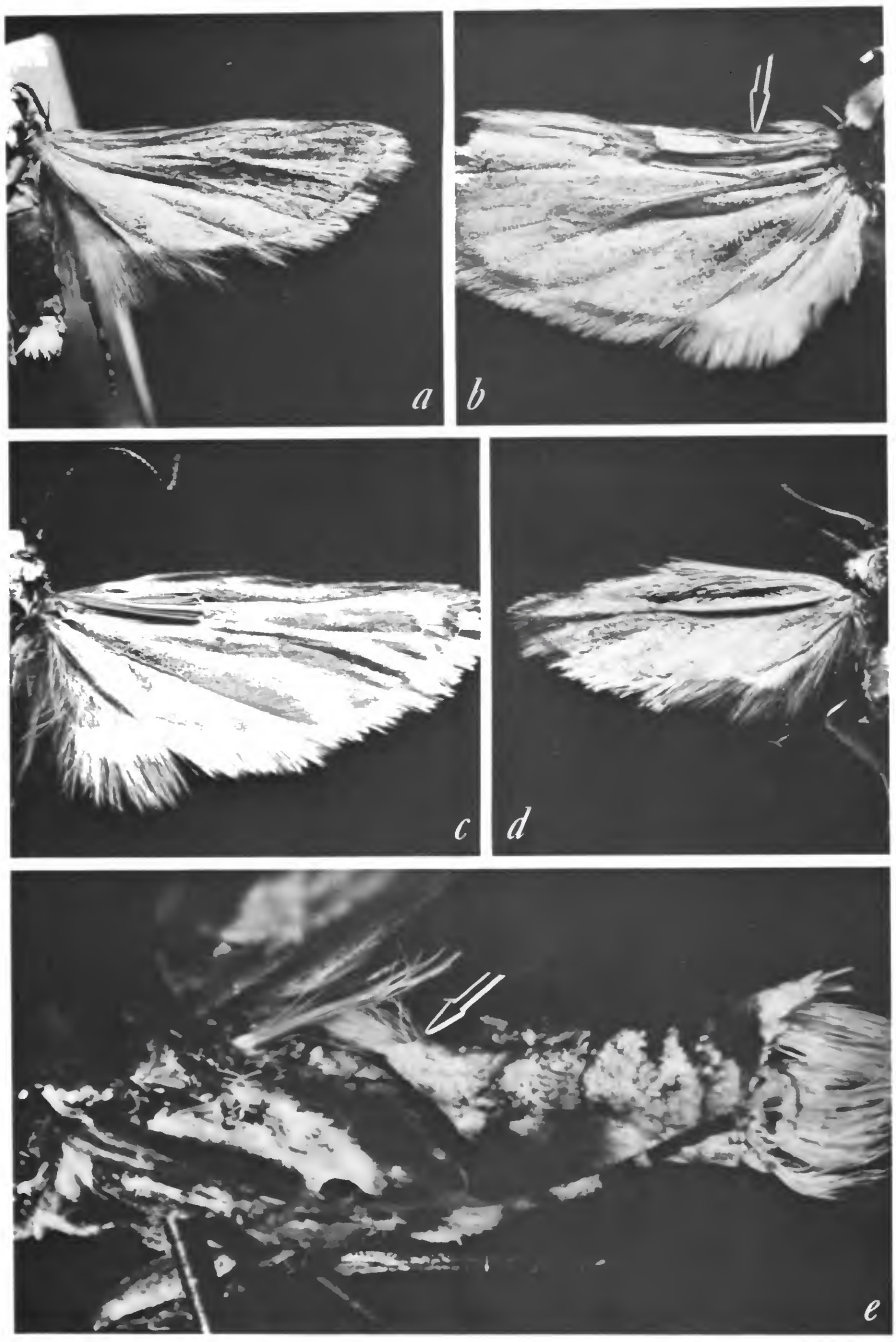

PLATE 4.—*a-d*, ♂ Hindwing modifications: *a*, *Ethmia marmorea*, Santa Clara Cyn; Chih, Mex., IX–1–56 (D. D. Linsdale) (narrow fold); *b*, *E. lichyi*, paratype Honduras (broad fold with external fringe (arrow) and fold distally partially cut away); *c*, *E. semitenebrella*, Pine Valley, San Diego Co., Calif., IV–17–50 (E. C. Johnston) (brush without fold); *d*, *E. mulleri*, Tehuacan, Mex., V-21–41 (C. C. Hoffmann) (external brush subtended by fold enclosing a second brush); *e*, lateral aspect showing metathoracic brush (arrow), *E. notatella*, ♂, Key Largo, Fla., IV–7–67 (S. Kemp).

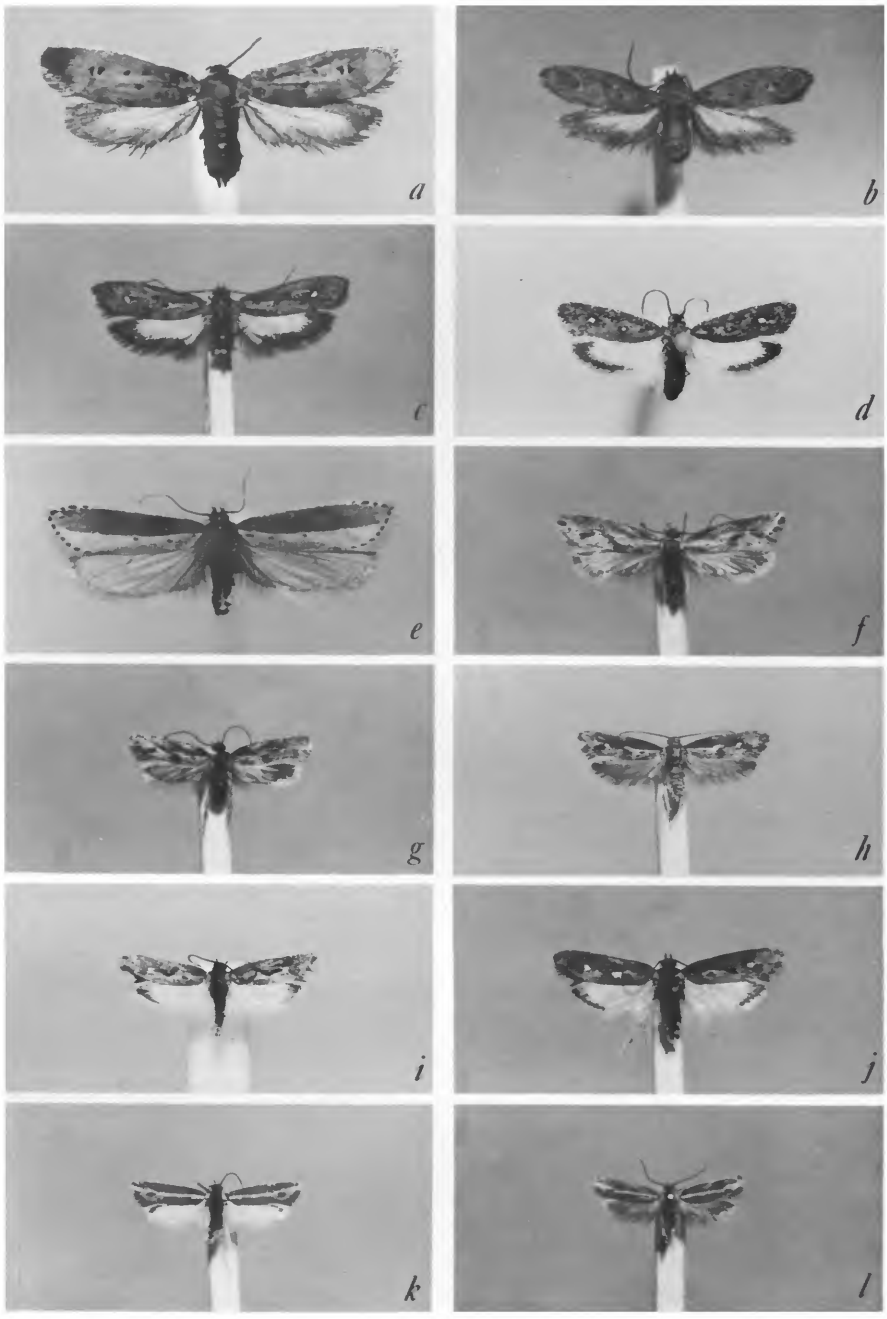

PLATE 5.—*a, Ethmia umbrimarginella* ♀, Nogales, Ariz., II–14–59 (E. H. Davidson); *b, E. lassenella* ♂, Globe, Ariz., III–7–37 (Parker); *c, E. coquillettella* ♂, Pinyon Flat, Calif., IV–13–63 (J. Powell); *d, E. coquillettella* ♀, Del Puerto Cyn., Calif., II–13–67 (C. D. MacNeill); *e, E. monachella* ♂, holotype; *f, E. scylla* ♀, allotype; *g, E. b. brevistriga* ♂, San Francisco, Calif., IV–7–61 (J. Powell); *h, E. b. aridicola* ♀, allotype; *i, E. albitogata* ♂, San Bruno Mts., Calif., II–7–64 (J. Powell); *j, E. plagiobothrae* ♂, holotype; *k, E. minuta* ♂, holotype; *l, E. minuta* ♀, allotype.

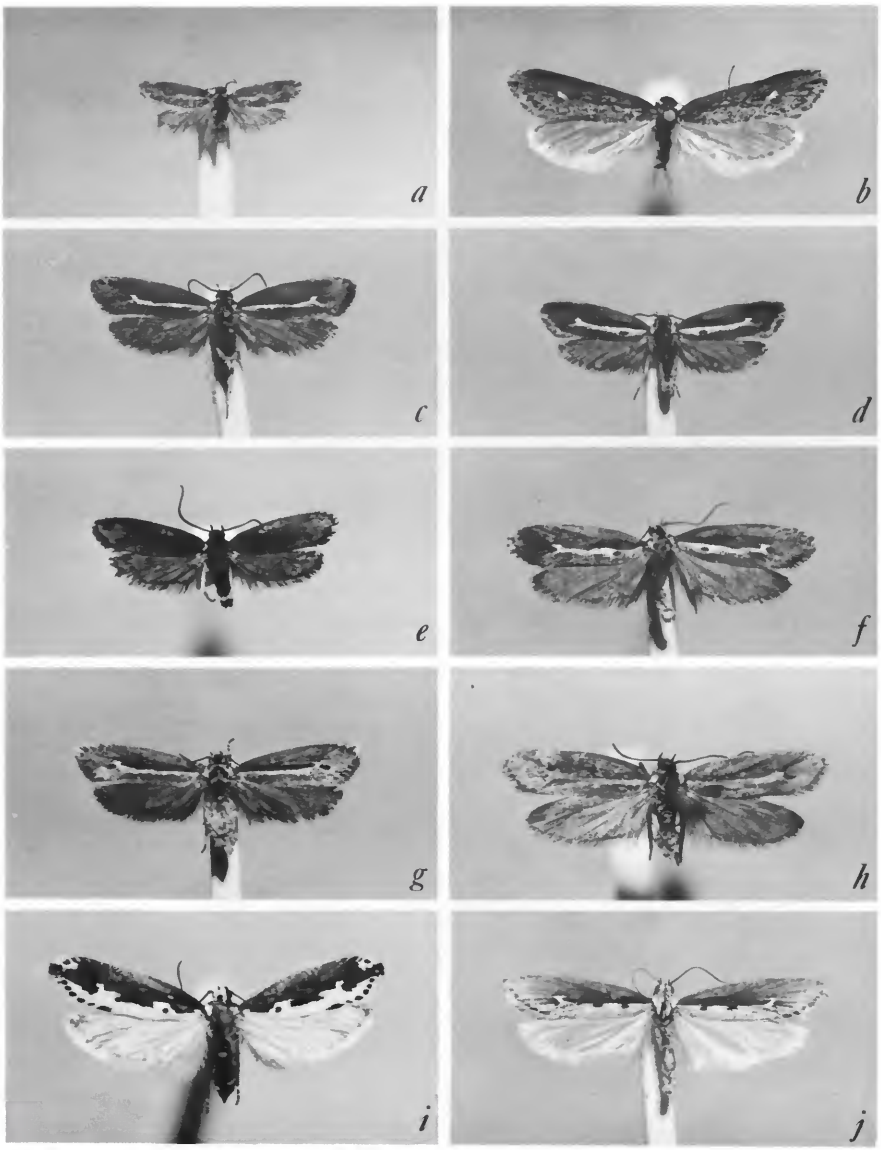

PLATE 6.—*a, Ethmia tricula* ♂, holotype; *b, E. charybdis* ♂, holotype; *c, d, E. a. albistrigella* ♂♂, Chipmunk Flat, near Sonora Pass, Calif., IV–25–62 (J. Powell); *e, E. a. icariella* ♂, holotype; *f, E. nadia* ♂, 5 mi E McCloud, Calif., VIII–7–57 (J. Powell); *g, E. nadia* ♀, Riverside, Calif., V–13–62, r. f. *Phacelia ramosissma* (J. Powell); *h, E. orestella* ♀, holotype; *i, E. semilugens* ♀, Gila Nat. Mon., N.M., VII–4–64 (D. R. Davis); *j, E. epileuca* ♂, same data as holotype.

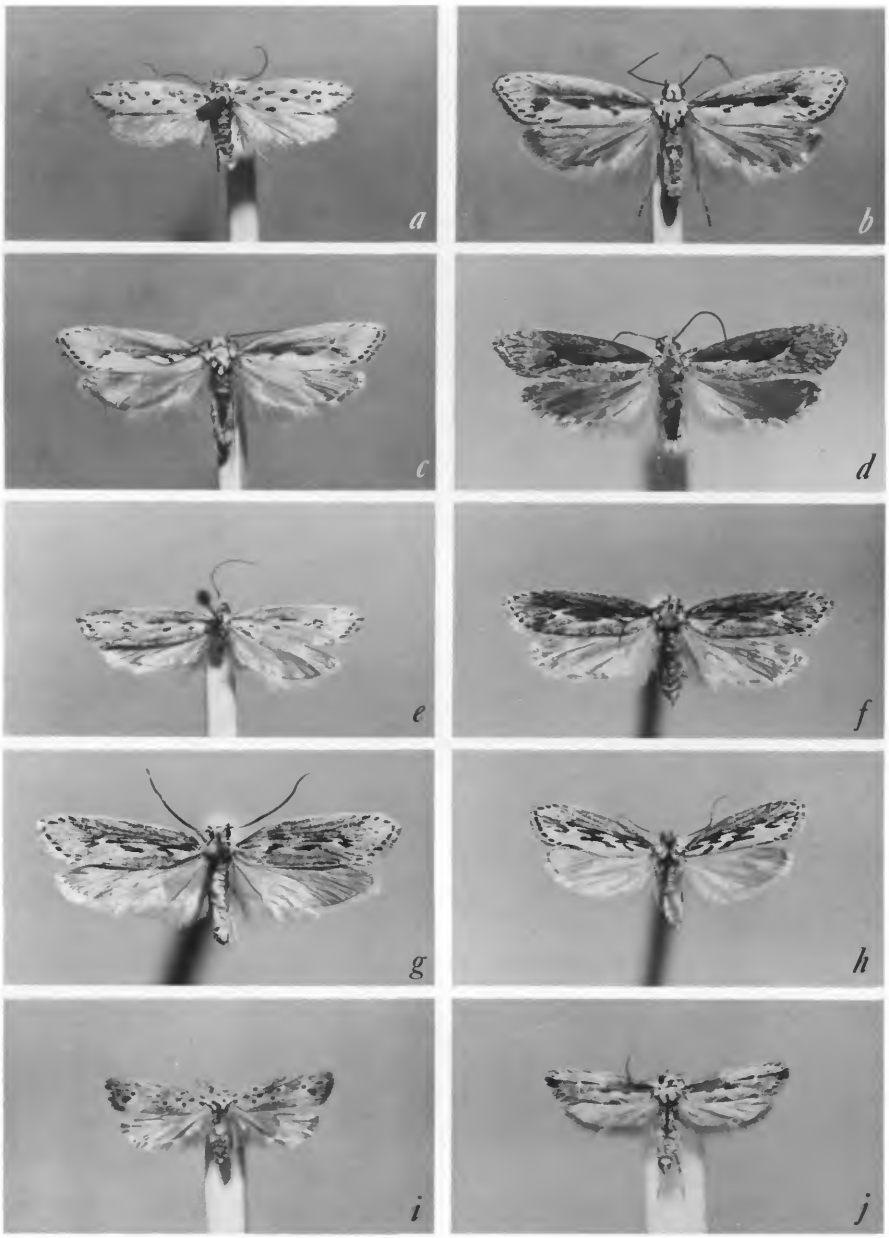

PLATE 7.—*a, Ethmia apicipunctella* ♀, Paradise, Ariz., Aug. 1-7; *b–d, E. arctostaphylella* ♂♂: *b,* Alpine Lake, Calif., V–28–60, r. f. *Eriodictyon californicum* (J. Powell); *c,* Pinnacles, Calif., VIII–24–62 (J. Powell) (summer form, *mediella*); *d,* Nacimiento Summit, Calif., IV–2–59 (D. J. Burdick) (spring form, *obscurella*); *e, E. mansita* ♂, Tehuacan, Mex., IX–18 (R. Müller); *f, E. d. discostrigella* ♀, Kyle Cyn., Charleston Mts., Nev., VI–10–59 (J. M. and S. N Burns); *g, E. d. subcaerulea* ♂, Lytle Cr., Calif., IV–14–65 (R. Langston); *h, E. semitenebrella* ♀, 4 mi. W Portal, Ariz., VIII–3–64 (D. R. Davis); *i, E. piperella* ♀, paratype; *j, E. papiella* ♂, holotype.

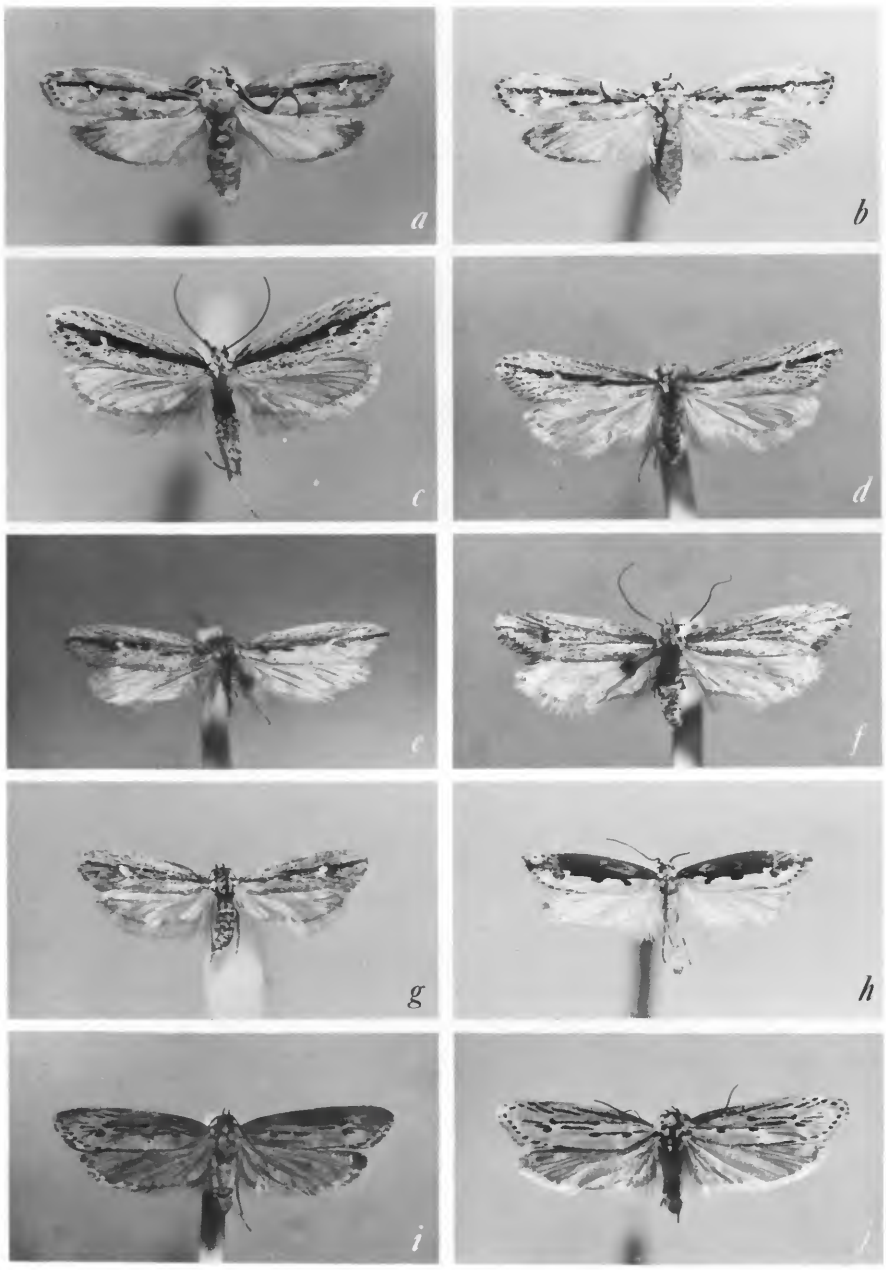

PLATE 8.—*a, Ethmica volcanella* ♂, Pte. Tlacotepec, Oax., Mex. VI–8–66 (Flint and Ortiz); *b, E. volcanella* ♀, allotype; *c, E. macelhosiella* ♂, Plummer's I., Md. X–8–64 (J. F. G. Clarke); *d, E. macneilli* ♂, holotype; *e, E. geranella* ♂, same data as holotype; *f, E. geranella* ♀, Ivanpah Mts., Calif. X–5–40 (J. A. Comstock); *g, E. timberlakei* ♀, allotype; *h, E. bipunctella* ♂, Ottawa, Ont., VIII–2–65 (H. F. Howden); *i,j, E. m. monticola* ♂ ♂: *i,* 6 mi W Cedarville, Calif. VII–4–62 (J. S. Buckett); *j,* 23 mi NE Logan, Utah, VI–20–63 (C. A. Toschi).

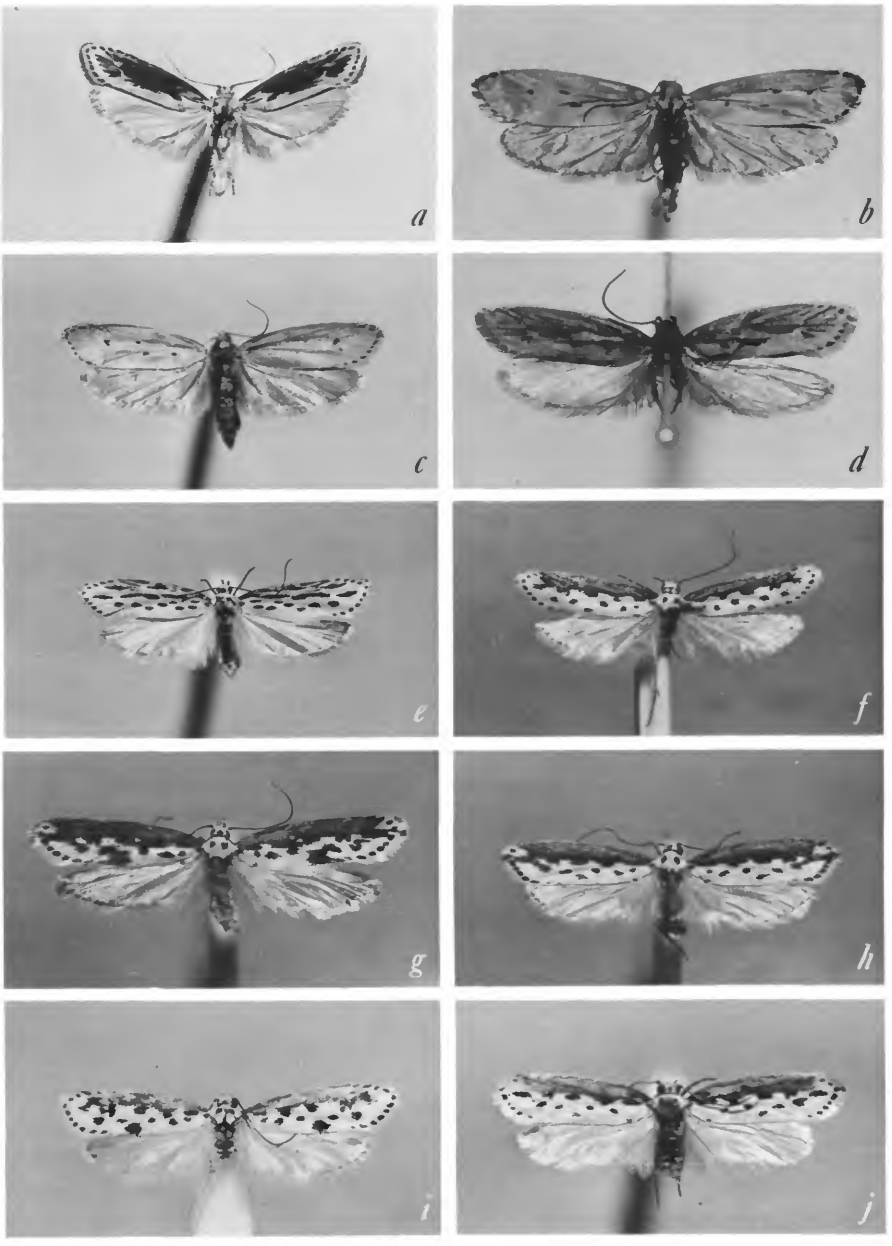

PLATE 9.—*a, Ethmia monticola emmeli* ♂, same data as holotype; *b, c, E. m. fuscipedella*: *b,* ♂, Ruidoso, N.M., VII–29–62 (E. and I. Munroe); *c,* ♀, 11 mi W Walcott, N. Dak., V–26–61 (J. R. Powers); *d, E. caliginosella* ♂, Colo. (Bruce); *e, E. zelleriella* ♀, Turkey Run State Park, Ind., V–18–51; *f, E. h. hagenella* ♂, Uvalde, Tex., III–10–23; *g, E. h. josephinella* ♀, Davis Mts., Tex., IV–30–59 (J. M. and S. N. Burns); *h, E. mimihagenella* ♀, same data as holotype; *i, E. hagenella* complex ♂, 25 mi W Hidalgo del Parral, Chih., Mex., VII–15–64 (Chemsak and Powell); *j, E. burnsella* ♀, same data as holotype.

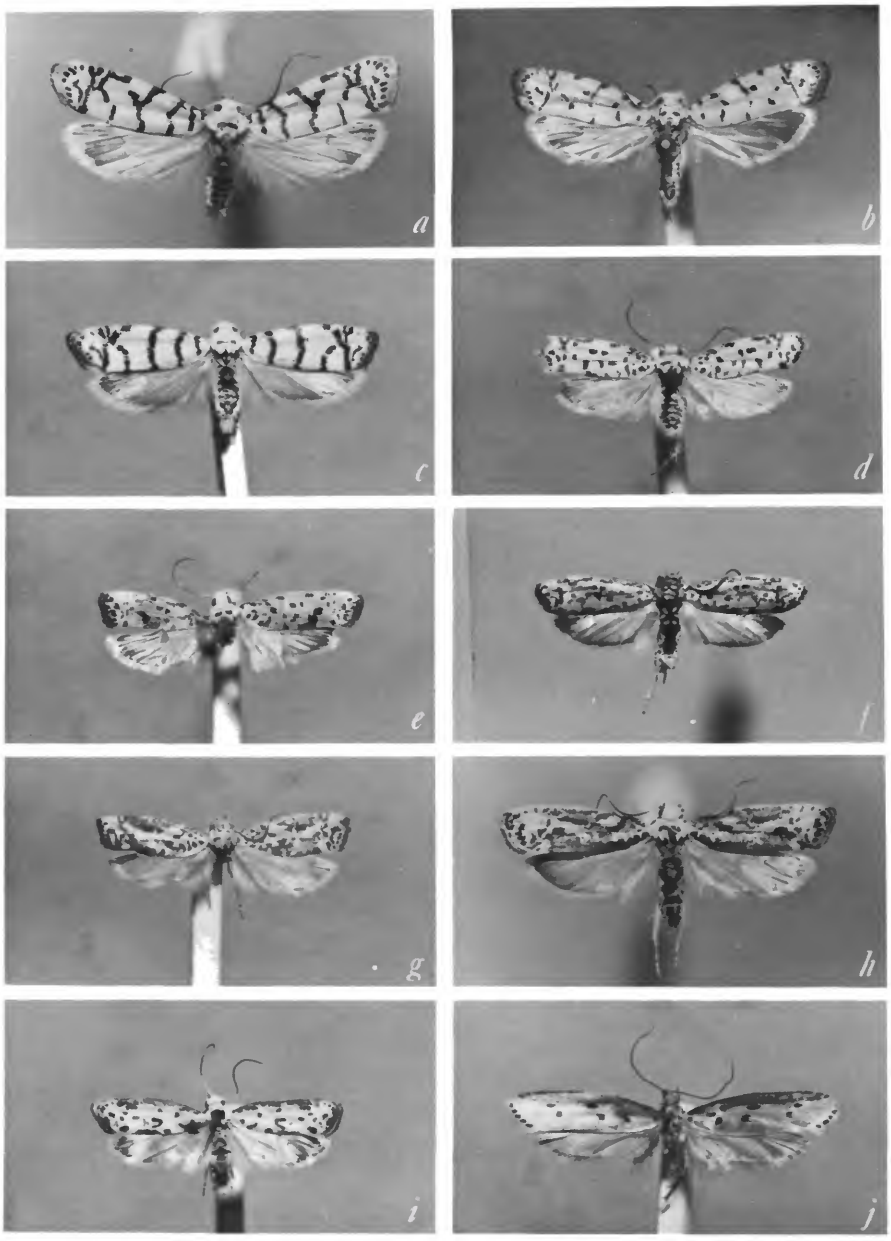

PLATE 10.—*a*, *Ethmia delliella* ♀, Monterrey, N. L., Mex., VIII–10–63 (Davis and Duckworth); *b*, *E. davisella* ♀, paratype 6 mi S Victoria, Mex.; *c*, *E. linsdalei* ♀, holotype; *d*. *E. clarkei* ♀, allotype; *e*, *E. subsimilis* ♂; Sierra Maestra, Cuba, II–21–1930 (Querci); *f*, *E. subsimilis* ♀, Hardwar Gap, Jamaica, VII–9–66 (H. F. Howden); *g*, *E. kirbyi* ♂, Coamo Spr., P. R., IV–7–30; *h*, *E. kirbyi* ♀, Constanza, Dom. Rep., VI–2–69 (Flint and Gomez); *i*, *E. bittenella* ♂, San Benito, Tex., May 8–15; *j*, *E. mulleri* ♂, Tehuacan, Mex., IX–1937 (C. C. Hoffmann).

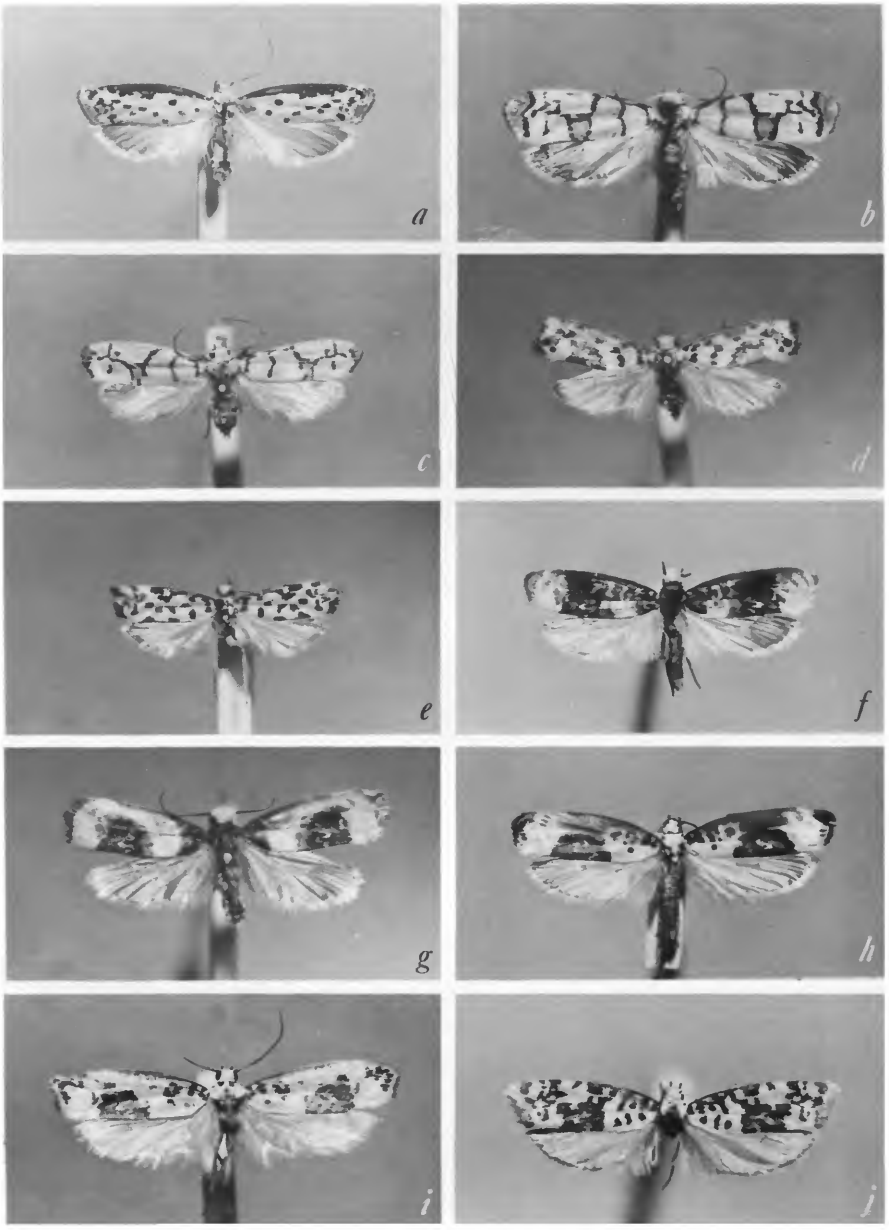

PLATE 11.—*a, Ethmia proximella* ♂, Tehuacan, Mex., VI–1913 (C. C. Hoffmann); *b, E. festiva* ♀, Chichen Itza, Yucatan, Mex., V–1–56 (E. Welling); *c, E. cypraeella* ♀, Aragua Nat. Park, Venez., V–31–49 (Cary and Cadbury); *d, E. a. abraxasella* ♀, Santa Rita, P. R., VII–30–1913 (E. G. Smyth); *e, E. a. clarissa* ♂, Santiago, Cuba, X–1902 (W. Schaus); *f, E. scythropa* ♀, Cayuga, Guat. (Schaus and Barnes); *g, E. nivosella* ♀, Santa Rita, P. R., VII–30–1913 (Smyth); *h, E. terpnota* ♀, Tuis, C. R. (W. Schaus); *i, E. iridella* ♂, holotype; *j, E. perpulchra* ♂, Cayuga, Guat. (W. Schaus).

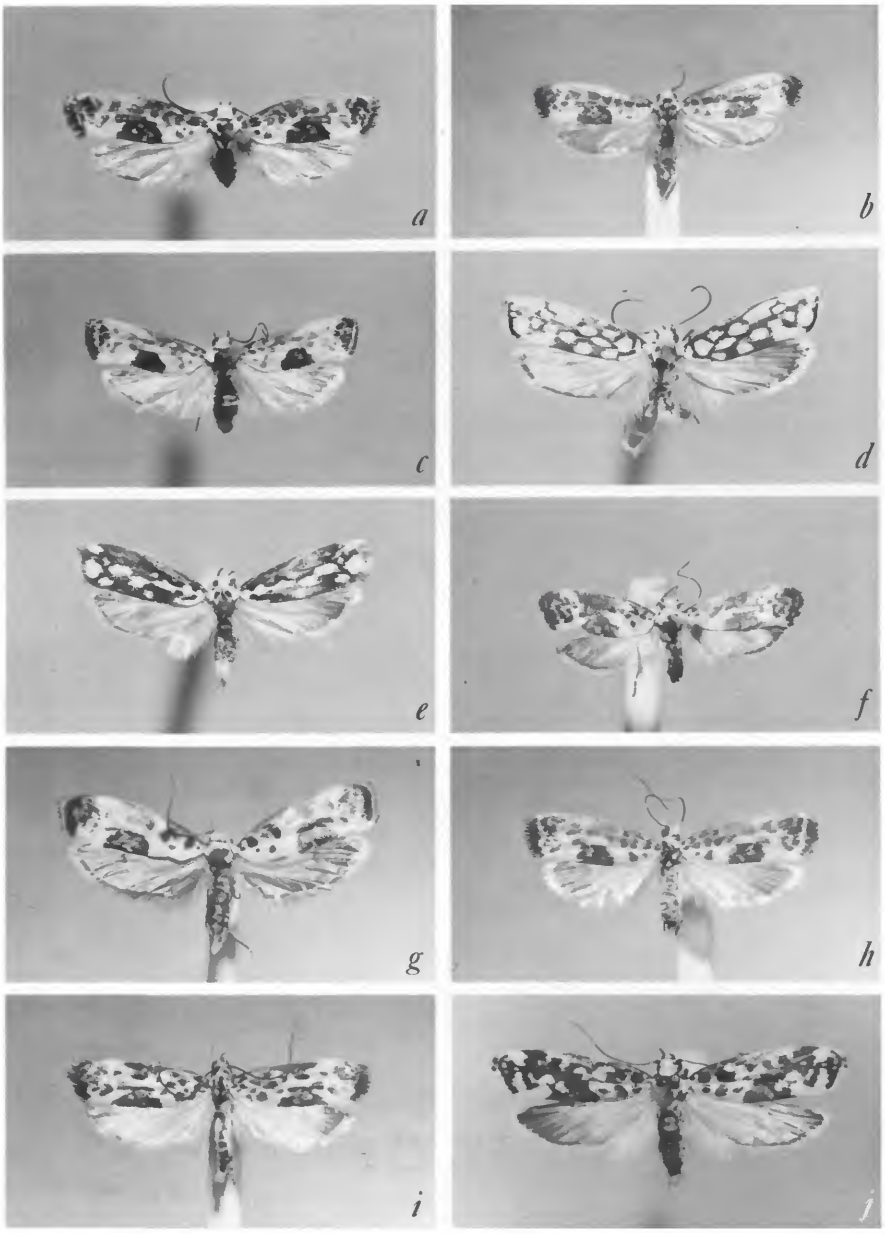

PLATE 12.—*a, Ethmia elutella* ♀, Rancho Grande, Ar., Venez. I–16–66 (S. S. and W. D. Duckworth); *b, E. janzeni* ♀, allotype; *c, E. submissa* ♀, Kingston, Jamaica, III–12–66 (S. S. and W. D. Duckworth); *d, E. fritillella* ♂, holotype; *e, E. epilygella* ♂, holotype; *f, E. notomurinella* ♀, allotype; *g, E. ungulatella* ♀, 6 mi S Victoria, Tamps., Mex. VIII–6–63 (Davis and Duckworth); *h, E. cypraspis* ♀, Santarem, Para, Brazil; *i, E. chalcodora* ♀, Villerrica, Paraguay, X–1934 (F. Schade); *j, E. chalcogramma* ♀, Nova Teutonia, Brazil, IX–1963 (F. Plaumann).

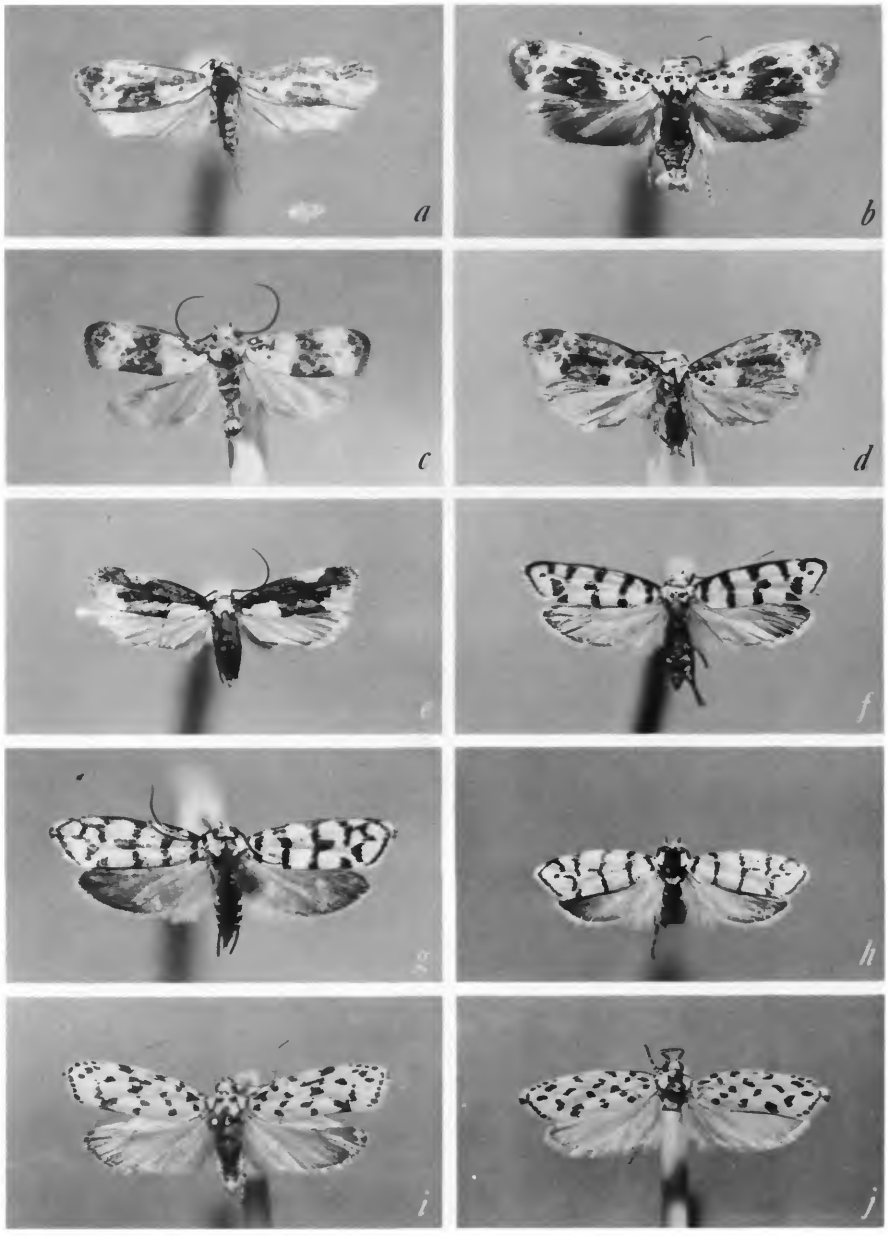

PLATE 13.—*a, Ethmia phylacops* ♂, holotype; *b, E. exornata* ♂, Rio de Janeiro, Brazil, XII–15–68 (J. A. Chemsak); *c, E. p. phylacis* ♂, Orizaba, Veracruz, Mex.; *d, E. mnesicosma* ♀, Cordoba, Veracruz, VII–30–66 (Buckett and Gardner); *e, E. gelidella* ♀, Green Hills, Jamaica III–11–66 (S. S. and W. D. Duckworth); *f, E. phoenicura* ♀, near Loreto, Baja Calif., Mex., XII–14–58 (H.B. Leech); g, *E. zebrata* ♀, paratype; *h, E. chemsaki* ♂, paratype; *i, E. notatella* ♀, Tavernier, Fla., IX–1955 (J. N. Todd); *j. E. hiramella* ♂, cotype, Santiago, Cuba.

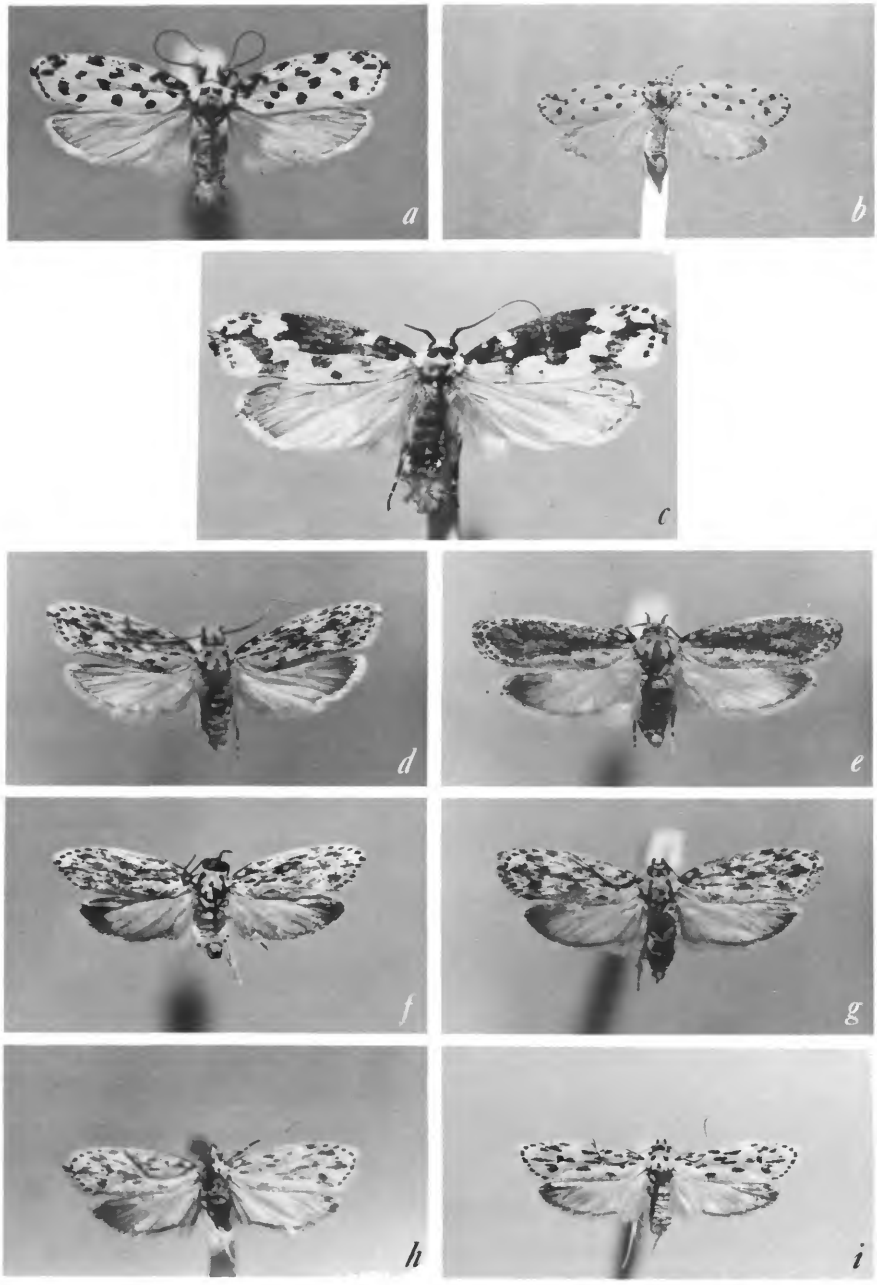

PLATE 14.—*a, Ethmia hiramella* ♂, San Vicente, Cuba, IV–22–66 (F. Gregor); *b, E. paucella* ♀, paratype St. Domingo; *c, E. wellingi* ♂, paratype Puntarenas, C. R.; *d, e, E. confusella* ♂ ♂, Dominica: *d,* (typical), V–1965 (D. R. Davis); *e* (variant), V–11–64 (O. Flint); *f, E. striatella* ♂, 27 mi E Villa Union, Sin., Mex., VII–26–64 (J. Powell); *g, E. duckworthi* ♀, allotype; *h, E. confusellastra* ♀, allotype; *i, E. sandra* ♀, allotype.

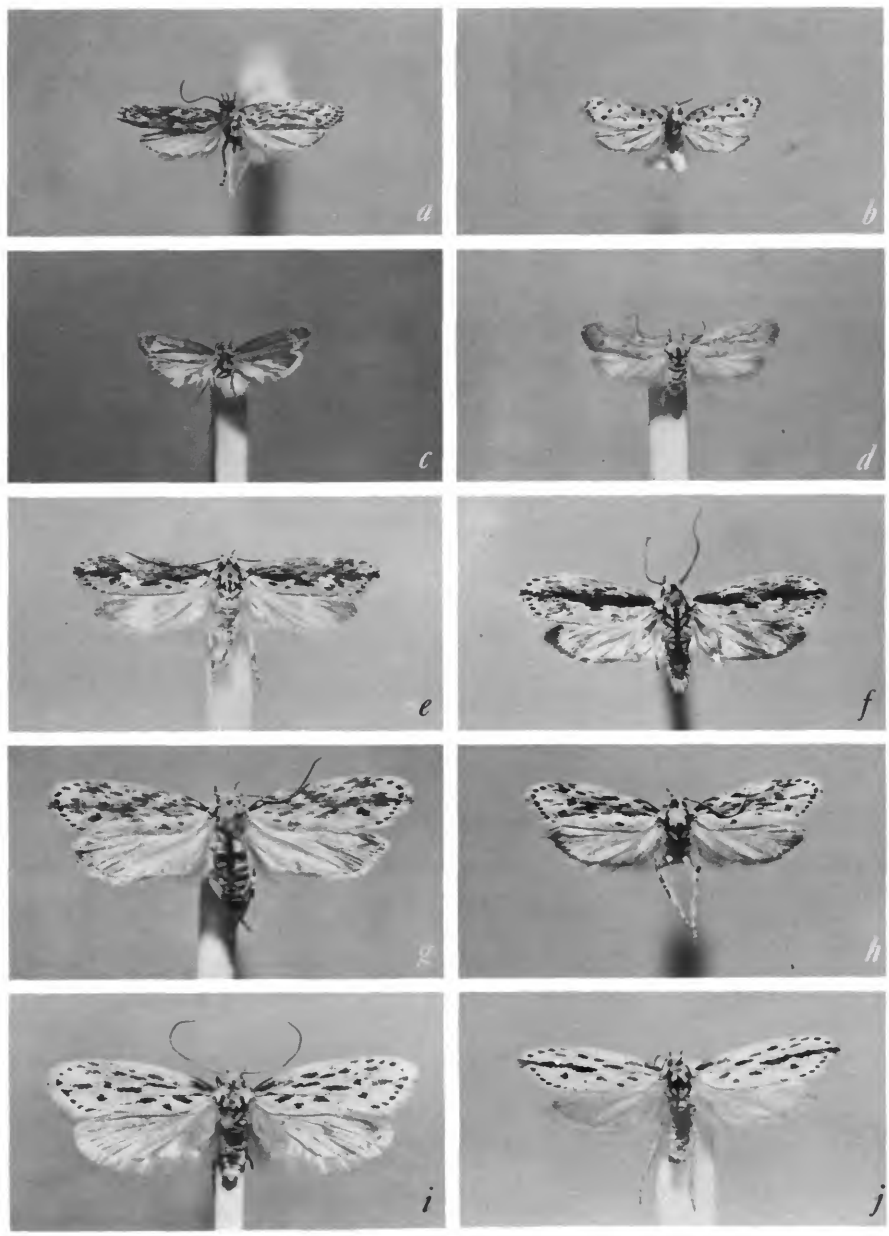

PLATE 15.—*a, Ethmia farrella* ♂, paratype Key Largo, Fla.; *b, E. julia* ♂, Key Largo, Fla., X–7–65 (S. Kemp); *c, E. humilis* ♂, holotype; *d, E. humilis* ♀, allotype; *e, E. coronata* ♂, 34 mi S Atlixco, Pbla., Mex., VI–27–57 (J. A. Chemsak); *f, E. nigritaenia* ♀, paratype Merida, Yucatan; *g, E. catapeltica* ♀, Barro Colorado I., Panama, V–1–64 (S. S. and W. D. Duckworth); *h, E. howdeni* ♂, holotype; *i, E. l. longimaculella* ♀, Ottawa, Ont., IX–1–06 (C. H. Young); *j. E. l. coranella* ♂, Palo Duro Cyn., Randall Co., Tex., V–6–59 (J. M. and S. N. Burns).

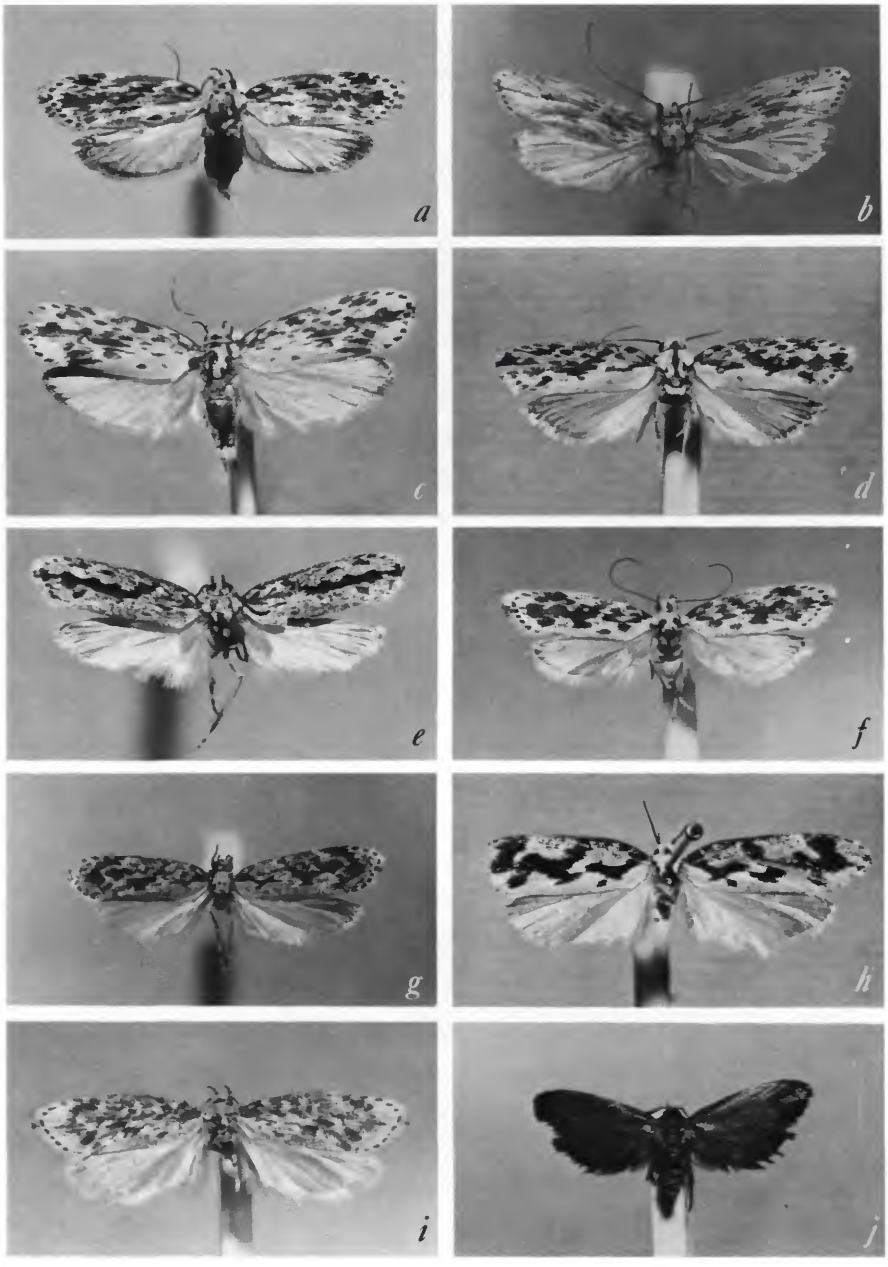

PLATE 16.—*a, Ethmia baliostola* ♀, Chichen Itza, Yucatan, Mex., V-28-56 (E. Welling); *b, E. cubensis* ♂, holotype; *c, E. lichyi* ♂, holotype; *d, E. calumniella* ♂, holotype; *e, E. omega* ♂, paratype; *f, E. plaumanni* ♂, holotype; *g, E. transversella* ♂, holotype; *h, E. hieroglyphica* ♂, holotype; *i, E. conglobata* ♂, La Crumbre, Colombia (Parish); *j. E. cyanea* ♀, 6 mi SE Rinconada, Veracruz, Mex., VI-21-62 (D. H. Janzen.)

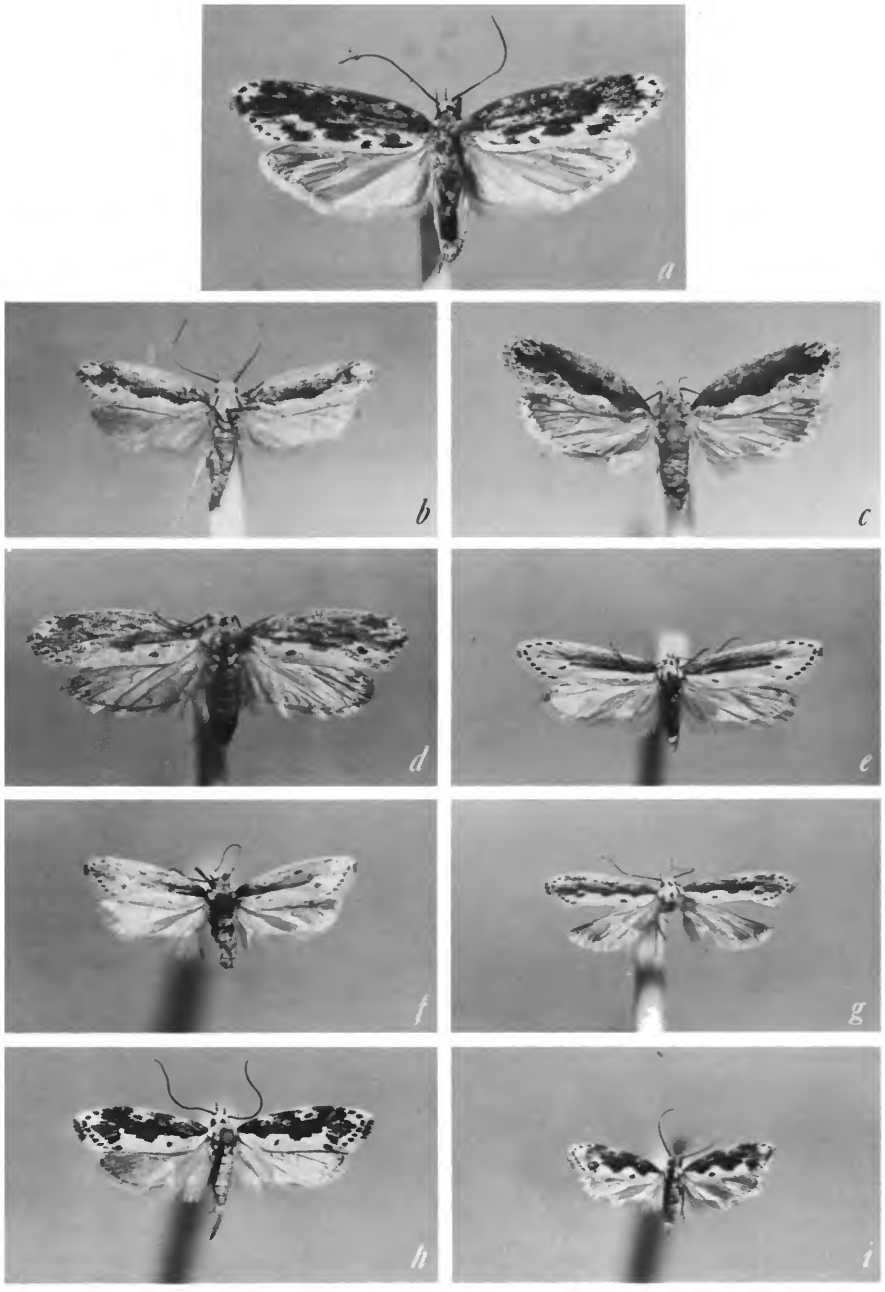

PLATE 17.—*a, Ethmia gigantea* ♂, Zacualpam, Mex. (C. C. Hoffmann); *b, E. s. semiombra* ♂, Brownsville, Tex., II-22-1926 (E. Piazza); *c, E. s. semiombra* ♀, 4 mi SW Victoria, Tamps., Mex., VII-10-63 (Davis and Duckworth); *d, E. s. nebulombra* ♀, paratype Chichen Itza, Yucatan; *e, E. albicostella* ♂, Florissant, Colo., VII-16-60 (T. C. Emmel); *f, E. mirusella* ♂, Oklahoma City, Okla., VIII-27-55 (D. R. Davis); *g, E. trifurcella* ♂, Cedar Cr., Jefferson Co., Ky., V-7-41 (A. F. Braun); *h, E. marmorea* ♀, 5 mi W Portal, Ariz., VII-9-56 (Cazier and Ordway); *i, E. hodgesella* ♀, paratype Pena Blanca Cyn., Ariz.

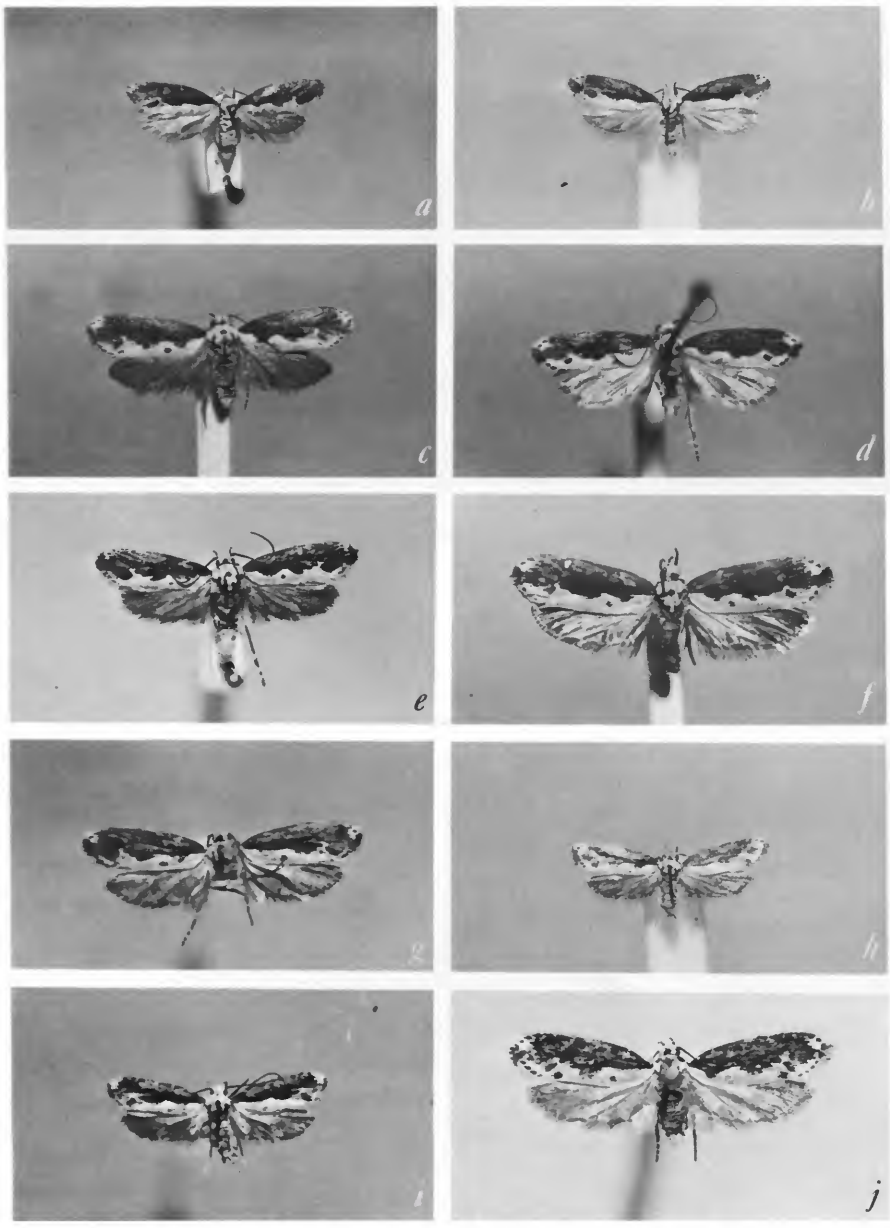

PLATE 18.—*a, Ethmia playa* ♂, paratype Los Mochis, Mex.; *b,, E. baja* ♂, paratype; *c, E. penthica* ♀, Cotaxtla, Veracruz, Mex., VII–30–62 (D. H. Janzen); *d, E. cordia* ♂, paratype Chichen Itza, Mex.; *e, E. similatella* ♂, 21 mi E Villa Union, Sin., Mex., VII–25–64 (Chemsak and Powell); *f, E. similatella* ♀, Cayuga, Guat. (Schaus and Barnes); *g, E. scutula* ♂, holotype; *h, E. pala* ♀ allotype; *i, E. pala* ♂, holotype; *j, E. clava* ♀, allotype.

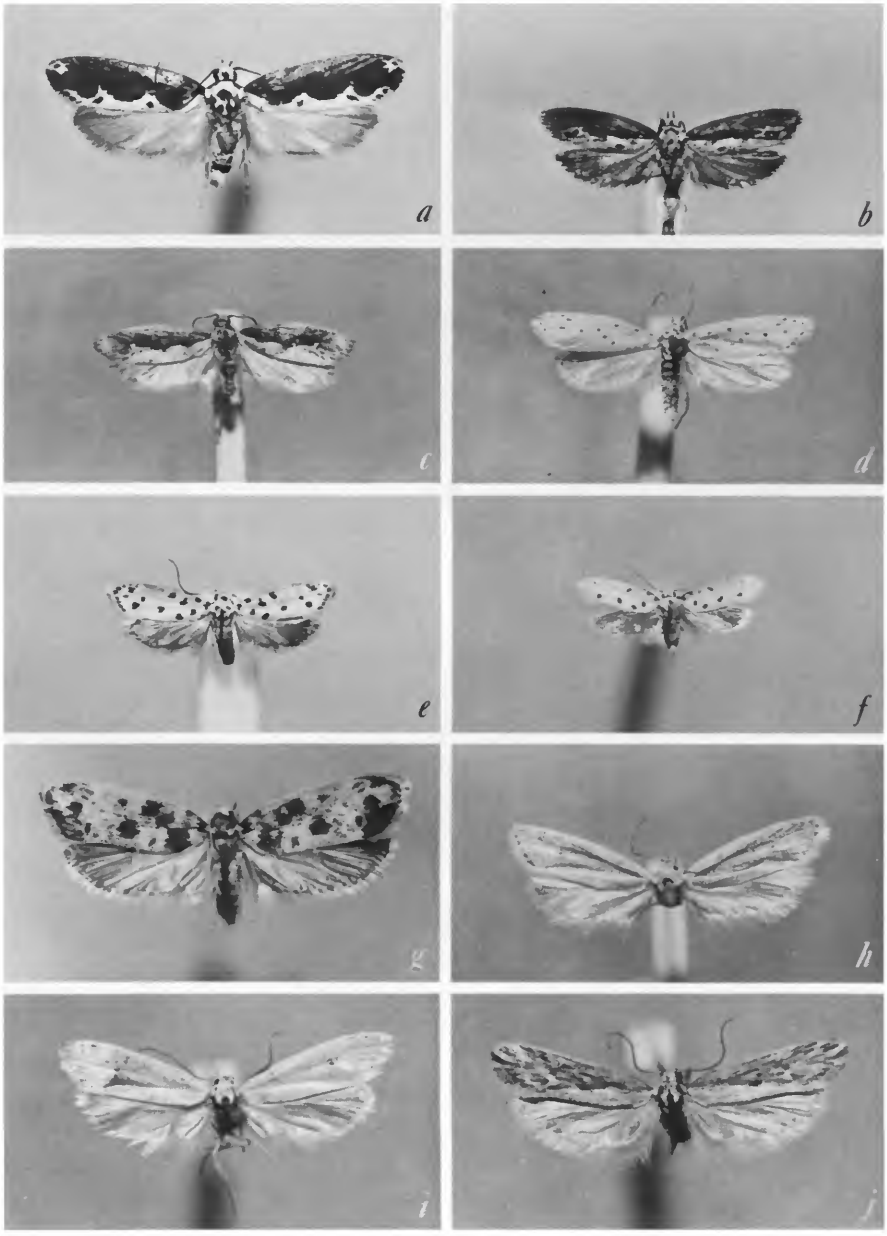

PLATE 19.—*a*, *Ethmia sphenisca* ♂, paratype El Palmito, Mex.; *b*, *E. heptastica* ♂, 5 mi N Mazatlan, Mex., VII–28–64 (Chemsak and Powell); *c*, *E. oterosella* ♂, Trinidad Mts., Cuba, VII–11–39 (C. T. Parsons); *d*, *E. prattiella* ♀, Gloria, Coah., Mex., VII–28–59 (E. E. Remington); *e*, *E. linda* ♀, Cordoba, Veracruz, Mex., VII–20–66 (Buckett and Gardner); *f*, *E. joviella* ♀, W. Cabrits, Dominica, III–3–64 (D. Bray); *g*, *E. hammella* ♀, holotype; *h*, *E. punctessa* ♀, allotype; *i*, *E. punctessa* ♂, holotype; *j*, *E. angustalatella* ♂, holotype.

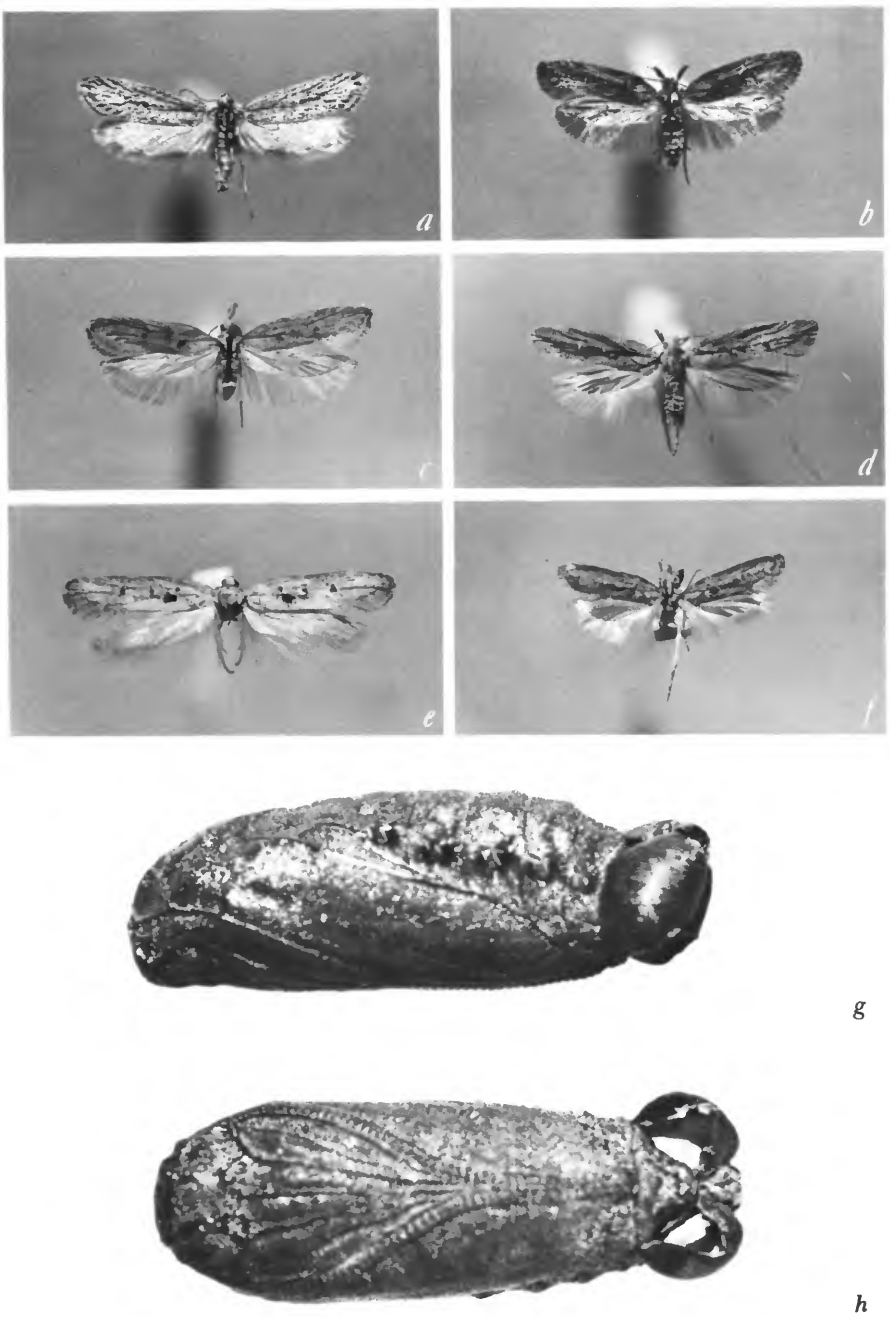

PLATE 20.—*a, Pseudethmia protuberans* ♂, 8 mi NW Essex, Calif., IV–1–70 (Dietz and Powell); *b, Pyramidobela quinquecristata* ♀, 13 mi S Ravendale, Calif., VI–5–70, r. f. *Penstemon deustus* (P.A. Opler); *c, P. agyrtodes* ♀, Alpine, Tex., IV–1–1926 (Poling); *d, P. angelarum* ♀, paratype Santa Paula, Calif.; *e, P. tetraphyta* ♀, same data as holotype; *f, P. ochrolepra* ♂, holotype; *g, h,* pupa of *Ethmia semiombra,* Brownsville, Tex., showing condylic grasp of exuvium head capsule: *g,* (lateral), *h* (ventral).

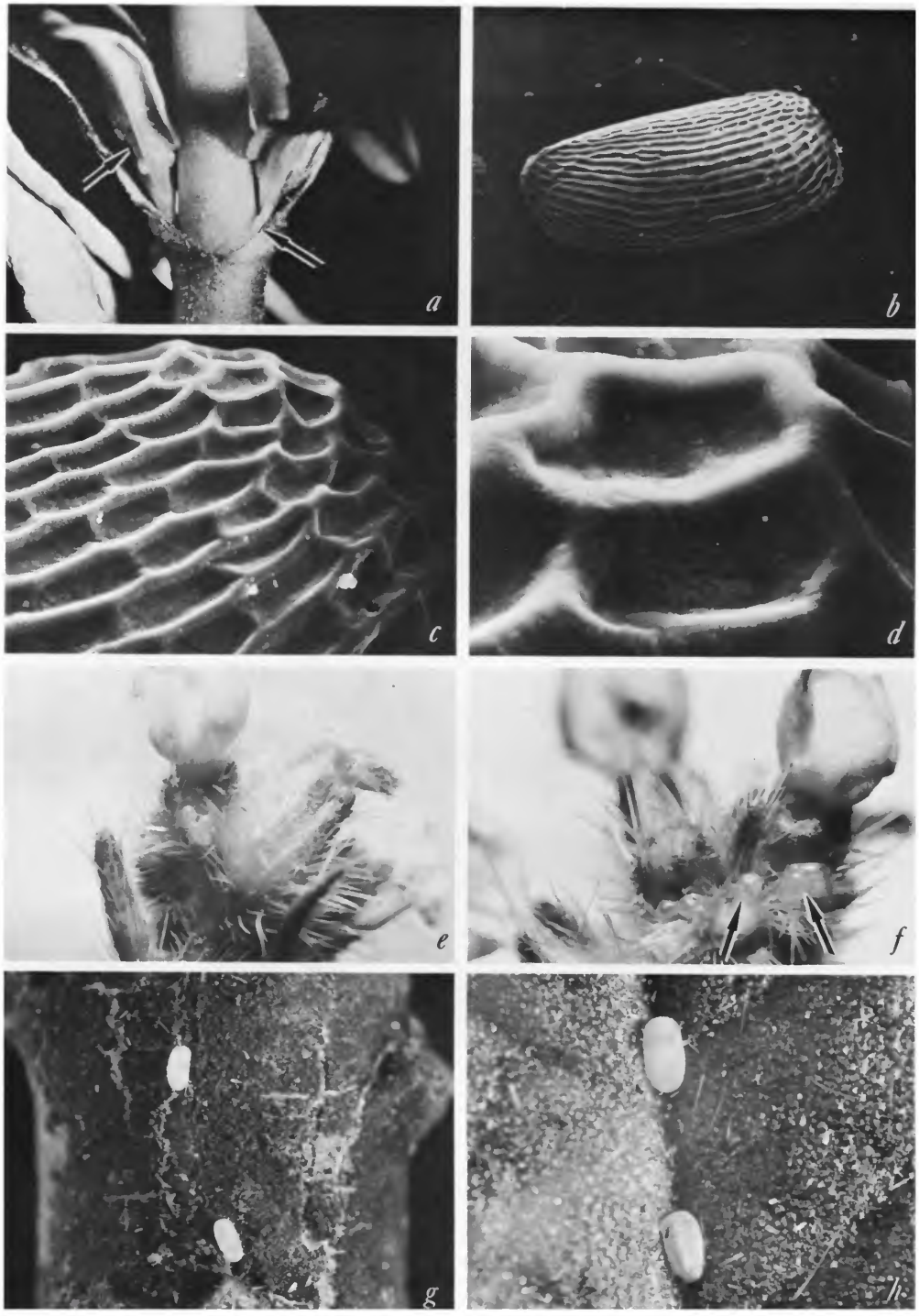

PLATE 21.—Eggs of *Ethmia*, approximate magnification indicated in parentheses (×): *a*, *E. scylla* in leaf axils *Collinsia heterophylla* (4.6 ×); b–d, scanning electron micrographs *E. scylla*: *b*, (70 ×), *c*, (350 ×), *d*, (1400 ×); *e*, *f*, *E. minuta* in floral buds *Crypantha intermedia*; *e*, (8.0 ×), *f* (14.5 ×); *g*, *h*, *E. arctostaphylella* on *Eriodictyon californicum*: *g*, on sooty mould-encrusted lower stem (8.0 ×); *h*, on leaf midrib (14.5 ×). (See Powell, 1971.)

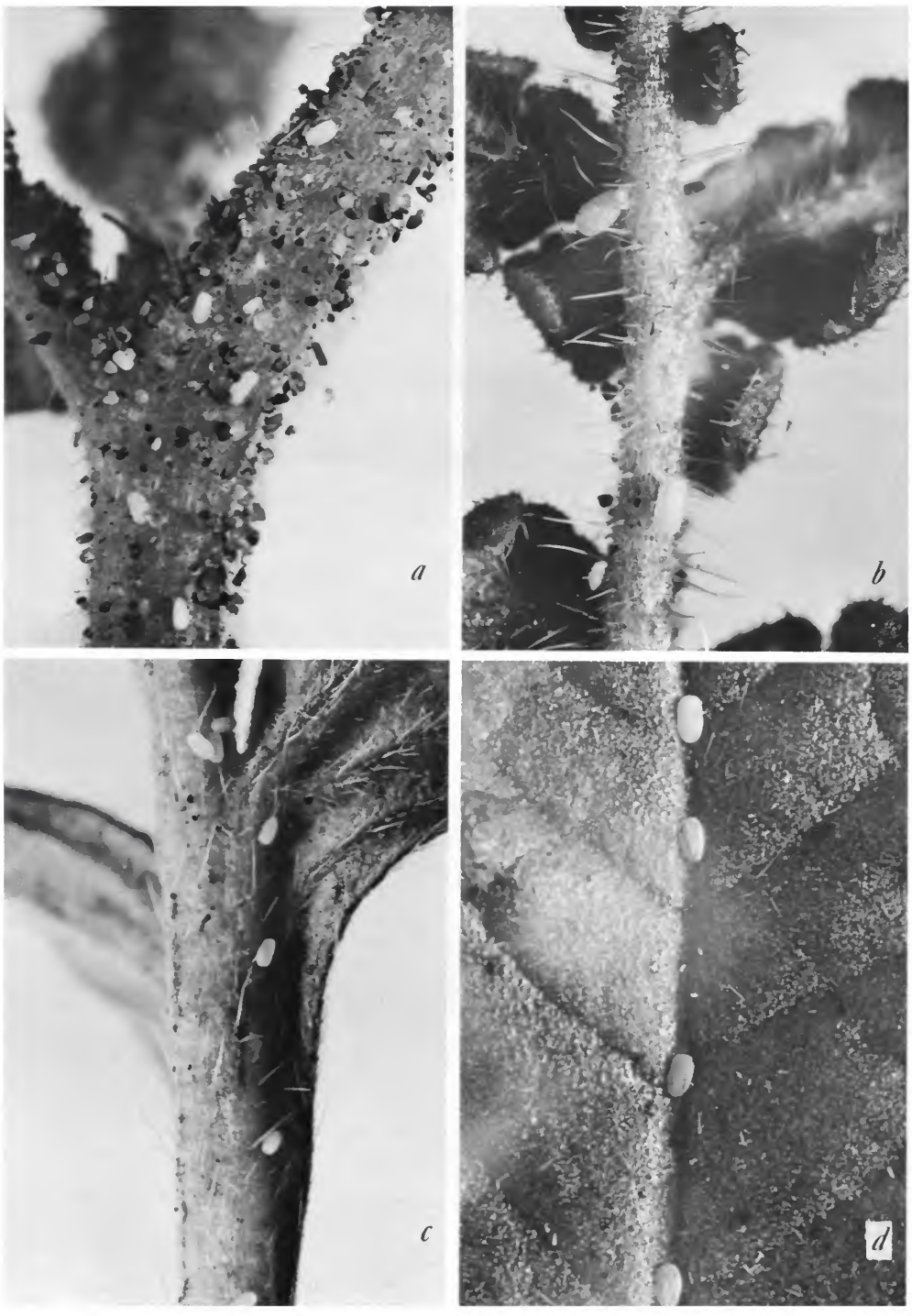

PLATE 22.—Eggs of *Ethmia*, approximate magnification indicated in parentheses (×): *a*, *b*, *E. brevistriga* on *Phacelia distans*: *a*, on sand-encrusted lower stem (8.0 ×); *b*, on compound leaf underside (14.5 ×); *c*, *E. plagiobothrae* on leaf underside, *Phacelia californica*, an unnatural host (8.5 ×); *d*, *E. arctostphylella* on upper side leaf midrib, *Eriodictyon californicum* (8.5 ×). (See Powell, 1971.)

General Index

(New names and references to principal accounts in **boldface**; synonyms in *italics*)

Index to Plant Names

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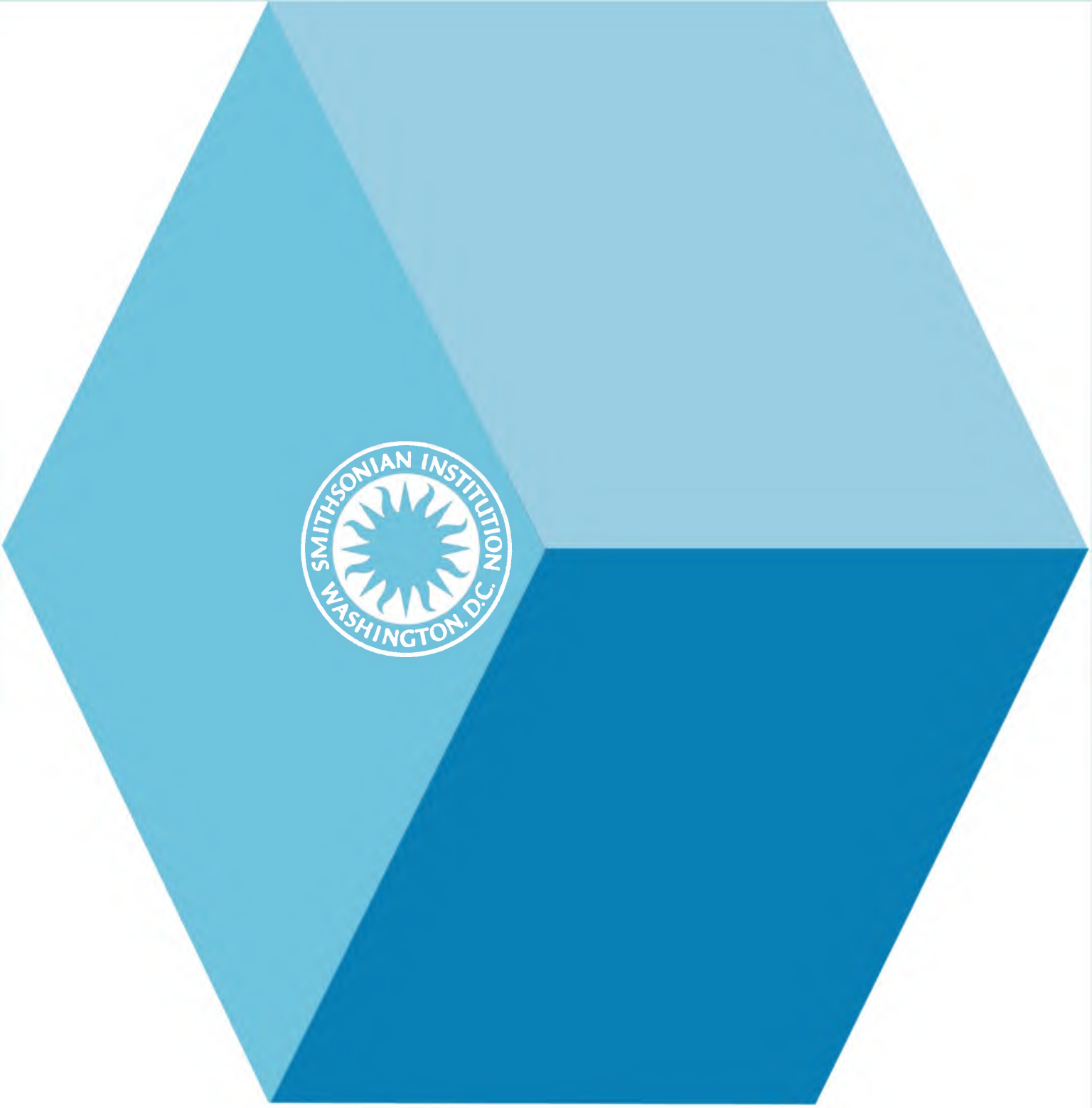
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